ASSAM
DON BOSCO UNIVERSITY

REGULATIONS AND SYLLABUS 2022 - 2023

SCHOOL OF TECHNOLOGY
SCHOOL OF COMMERCE
AND MANAGEMENT





DON BOSCO
Celebrating 100 Years in North East



ASSAM DON BOSCO UNIVERSITY

REGULATIONS AND SYLLABUS

2022-2023

School of Technology

School of Commerce and Management

ASSAM DON BOSCO UNIVERSITY

Tapesia Gardens, Sonapur, 782402 | Azara, Guwahati 781017 | Kharguli Campus, Guwahati 781004

NOTE

This handbook contains important information to help guide and inform you during your programme of study. We recommend that you keep this handbook for the duration of your studies in the University so that you can refer to it as needed. Please note that the onus of ignorance of the regulations and information contained in this handbook will be on the student and will not be ground for any consideration. You are also required to keep abreast of the amendments and additions to the regulations and syllabus that will be officially notified from time to time.

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REGULATIONS

ASSAM DON BOSCO UNIVERSITY REGULATIONS

GRADUATE DEGREE PROGRAMMES

The following are the regulations of the Assam Don Bosco University concerning the Graduate Programmes leading to the award of the Bachelor's Degree in various disciplines made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar

1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.

1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

2.1 The normal duration of the Graduate Programme shall be as per the table given below:

Programme	Number of Semesters	Number of Years
Bachelor of Technology (BTECH)	8	4
Bachelor of Computer Applications (BCA)	6	3
Bachelor of Business Administration (BBA)	6	3
Bachelor of Commerce (BCOM) Honours	6	3
Bachelor of Arts (BA) Honours	6	3
Bachelor of Science (BSc) Honours	6	3

2.2 However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.

2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme.

3.0 Course Structure

3.1 The University follows Outcome Based Education with Choice Based Credit System (CBCS) for all the Graduate Degree Programmes. One credit is equivalent to 15 hours of lecture/tutorial or 30 hours of practical. The courses offered for the Graduate Degree Programmes are divided into two baskets – Core Courses and Elective Courses.

3.2 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the said Degree Programme.

3.2.1 A student shall be required to take all the core courses offered for a particular programme.

3.2.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.2.3 For UGC programmes, core courses include Discipline Specific Core Courses, Ability Enhancement Compulsory Courses and Skill Enhancement Courses. For AICTE programmes, core courses include Professional Core Courses (DC), Engineering Science Courses (IC), Basic Science Courses (IC), Humanities and Social Science Courses (IC), Mandatory Courses (IC), Project Work, Seminar and Internship in Industry.

3.3 Elective Courses: These are courses in the curriculum which give the student opportunities for specialization and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.3.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.

3.3.2 For UGC programmes, elective courses include Discipline Specific Elective Courses and Generic Elective Courses. For AICTE programmes, elective courses include Professional Elective Courses and Open Elective Courses.

3.3.3 It shall be the prerogative of the department not to offer an elective course which has less than 5 students opting for it.

3.4 The schema of categorization of courses is given below:

Core Courses	
Discipline Specific Core (DC) or Professional Core (PC)	Core courses which are offered by the department conducting the programme
Elective Courses	
Discipline Specific Elective (DE) or Professional Elective (PE)	Elective courses which are specific to the programme of study
Generic Elective (GE) or Open Elective (OE)	Elective courses which are offered by departments of the University from departments other than the parent department

3.5 In order to qualify for a Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.6 In addition to the prescribed credit requirement, a student shall have to complete Institutional mandatory courses with Pass grade, as prescribed by the competent academic authority, from time to time, which shall be recorded in the Grade sheet but not taken into account for computing the SGPA and the CGPA.

3.7 **Audit Courses:** Students who secure a CGPA of at least 8 at the end of the 4th semester may opt to take one audit course per semester from any Department from the 5th semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.

3.8 The medium of instruction shall be English and examinations and project reports shall be in English.

3.9 The course structure and syllabi of the Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBS). The SBS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.10 The curriculum may include industry training and /or fieldwork for a specified time. This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged by respective departments, even during semester breaks as approved by the School Board of Studies.

3.11 In addition, students may also opt for additional elective courses in consultation with their mentors (Cf. 3.12). Elective courses may also be chosen from SWAYAM/NPTEL. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the grade sheet, but not taken into account for computing SGPA and CGPA.

3.12 Faculty Advisor/Mentor: A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) shall be assigned for groups of students. Generally the faculty advisor/mentor shall be assigned by the concerned department, in consultation with the Director of the School concerned. (For the first year students of the BTECH programme, the Director of the School of Technology may assign the faculty advisor/ mentor from departments belonging to other Schools teaching at the SOT). Faculty advisors/ mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 Admission

4.1 All admissions to the Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

4.2 Eligibility Criteria:

4.2.1 To be considered for admission to a Graduate Degree Programme a candidate should have passed the Higher Secondary examination of a recognized Board of Higher Secondary Education or an equivalent examination of any University / Board securing grades/marks as specified in the table below.

4.2.2 A candidate must also obtain qualifying marks required by the University in entrance tests/personal interview as the case may be. These marks shall be valid only for the academic year for which the test is held.

4.2.3 Admission will be on the basis of performance of the candidate at the qualifying examination, entrance test and/or personal interview.

Programme	Grade /Marks requirement from qualifying examinations	Entrance Examinations / Personal Interview
BTECH	Passed the qualifying examination with Physics/ Mathematics /Chemistry/ Computer Science/Electronics/Information Technology/ Biology/Informatics Practices/ Biotechnology/Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/Entrepreneurship with 45% in the aggregate of all subjects and 45% in the aggregate of any of the three	National Entrance Test such as JEE / State level entrance examination such as CEE or the ADBU Entrance Examination for Engineers
BBA, BCA, BCOM, BA Honours	Passed the qualifying examination in any stream with aggregate marks specified by appropriate academic body	Satisfactory performance in the Personal Interview
BSc Honours	Passed the qualifying examination in the science stream with aggregate of Physics, Chemistry and Mathematics specified by appropriate academic body	Satisfactory performance in the Personal Interview

4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.

4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.

4.4.1 The attendance of such students shall be computed from the date of admission.

4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.

4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.

4.6 BTECH Lateral Entry into Programmes

4.6.1 Polytechnic diploma holders in any branch of Engineering and Technology and B.Sc. Degree holders having Physics, Chemistry and Mathematics shall be eligible for admission to degree courses in Engineering and Technology in the third semester BTECH Programme against vacancies and/or seats in addition to the sanctioned intake in the first year.

4.6.2 Such diploma holders should have been bonafide students of polytechnics duly approved by the government and should have pursued an AICTE approved three-year diploma curriculum in an appropriate branch of Technology.

4.6.3 Only diploma holders who have secured a minimum of 45% in the aggregate in the relevant discipline and B.Sc. students who have secured a minimum of 45% marks in the aggregate shall be eligible for consideration for admission. The students belonging to B.Sc. Stream, would have to clear the subjects: Engineering Graphics/Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects.

4.6.4 Such admissions shall be on the basis of merit in the ADBU entrance test and a personal interview.

4.7 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

4.8 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

4.9 BTECH Honours

A student of BTech can obtain Honours by completing additional 18-20 credits in emerging areas of the same discipline of study. Departmental Board of Studies shall finalize the emerging areas of study. Students eligible for Honours programme shall have a CGPA of 6.5 till 2nd Semester. In case of lateral entry students, they should have 1st class in their qualifying examination. Students will be permitted to enroll for Honours in 3rd or 4th semester which may continue till 8th semester until they complete 18-20 credits. In any semester, they will be advised to take not more than 6 credits of courses.

Students may be allowed to opt from SWAYAM/NPTEL courses. Teaching and evaluation of the courses will be as per university norm followed for any other courses.

For the students, who opted for Honours but could not earn the minimum 18 credits till 8th semester examination, all the

courses completed shall be printed in the Transcript to recognize the additional effort of the students. The opportunity of additional chance may be given to the willing students whose deficiency is marginal (at the most 6 credits).

4.10 BTECH Minor Engineering

A student of BTech can obtain Minor by completing additional 18-20 credits in emerging areas of another discipline of study. Departmental Board of Studies shall finalize the emerging areas of study. Students eligible for Honours programme shall have a CGPA of 6.5 till 2nd Semester. In case of lateral entry students, they should have 1st class in their qualifying examination. Students will be permitted to enroll for Minor in 3rd or 4th semester which may continue till 8th semester until they complete 18-20 credits. In any semester, they will be advised to take not more than 6 credits of courses.

Students may be allowed to opt from SWAYAM/NPTEL courses. Teaching and evaluation of the courses will be as per university norm followed for any other courses.

For the students, who opted for Minor but could not earn the minimum 18 credits till 8th semester examination, all the courses completed shall be printed in the Transcript to recognize the additional effort of the students. The opportunity of additional chance may be given to the willing students whose deficiency is marginal (at the most 6 credits).

5.0 University Registration

5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.

6.0 Attendance

6.1. To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of the inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	**Bonus percentage available in the current semester**
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

6.4 If the sum of the credits of the courses for which a student is unable to appear at the end- semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 10.5 of these Regulations.

6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

6.6 Leave

6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the Office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.

6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.

6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the

programme for that particular semester because of long absence.

6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1 Three types of courses are offered in the Graduate programmes:

- **Graded courses**: For the majority of the courses, students shall be assessed and given grades.
- **Pass/Non-Pass courses**: There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses**: A third category of courses are audit courses. These are optional. However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
90 ≤ x ≤ 100	O	Outstanding	10
80 ≤ x < 90	E	Excellent	9
70 ≤ x < 80	A+	Very Good	8
60 ≤ x < 70	A	Good	7
50 ≤ x < 60	B	Average	6
40 ≤ x < 50	C	Below Average	5
x < 40	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non- passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

7.2.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

7.2.2 A letter grade 'F', 'NP' or 'X' in any course implies failure in that course.

7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.

7.3 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

7.3.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^{n} GP_i \text{ x } NC_i}{\sum_{i=1}^{n} NC_i}$$

Where GP_i = Grade points earned in the ith course
NC_i = Number of credits for the ith course
n = the number of courses in the semester

7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPAs obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^{n} SGP_i \text{ x } NSC_i}{\sum_{i=1}^{n} NSC_i}$$

Where SGP_i = Semester Grade point of the ith semester
NSC_i = Number of credits for the ith semester
n = the number of semesters completed

7.3.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

7.4 Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.

7.5 There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the 'P' and 'NP' grades. Non-credit courses such as Service Learning, Constitution of India, Essence of Indian Traditional Knowledge etc. belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.

7.6 In the case of an audit course, the letters "AU" shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1 A student's performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2 Theory Courses: Theory courses shall have two components of evaluation – in- semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1 The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School at the beginning of each semester.

8.3 Lab Courses: Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

Component	Weightage
Attendance	10
Assessment of Tasks Assigned	30
End-semester test / viva voce	60

8.3.1 The modalities of the conduct of evaluation under the heading "Assessment of tasks assigned", its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

8.3.2 The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the experiment
- Actual conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4 End-Semester examinations

8.4.1 End-semester examinations for the theory courses, generally of three hours' duration, shall be conducted by the University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3 A student shall not obtain a pass grade for a course without appearing for the end- semester examination in that course.

8.5 Industry Training/Internship Programme

8.5.1 Departments may require students to undergo industry training/internship programmes.

8.5.2 Departments are to notify the students at the beginning of their programmes about the details of industry training/internship.

8.5.3 After the Industry Training/Internship programme, the student shall furnish a certificate from the organisation where he/she underwent the programme as proof of successful completion.

8.5.4 The student shall submit a training/internship report to the department in a format to be laid down by the concerned department. He/she shall also give a seminar to present the learning outcomes of the programme in the presence of the faculty members and students of the department. The student shall be evaluated on the basis of the report, the seminar and interaction during the seminar and grades shall be assigned. These grades shall be given a weightage of two credits in the subsequent semester.

8.6 The Major Project

8.6.1 Students of the BTECH programme and BCA programme shall undertake a Major Project during the

course of their graduate studies. The BTECH major project work is normally conducted in two phases during the seventh and eighth semesters of the programme and is to be done individually or in groups within the campus. A department may substitute this with two independent projects in the seventh and eighth semesters with prior permission from the statutory authority. The BCA major project work is conducted during the sixth semester of the programme, and is to be done individually or in groups within the campus.

8.6.2 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Head of the Department, Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convenor. The DPEC shall co-ordinate the conduct and assessment of the project.

8.6.3 The DPEC shall notify the schedule and modalities for the following stages in the implementation of the project.

- Submission of the topic of the project.
- Notification for assignment of project supervisors.
- Submission of the synopsis.
- Schedule and modality for the submission of weekly activity reports.
- Schedule for the seminar presentation of synopsis.
- Schedule for Progress Seminars, submission of progress reports and viva voce examination.
- Date for the submission of the project report and a brief summary.
- Dates for the external evaluation of the project.

In the case of the BTECH project, some of these activities may be performed during semester VII (Phase I) and others during Semester VIII (Phase II) as shall be notified by the DPEC.

8.6.4 The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.

8.6.5 The Convenor of the DPEC shall submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the external examination. The Controller of Examinations shall appoint the external examiner(s) from this panel. The project supervisor shall be the internal examiner.

8.6.6 Each student shall submit to the DPEC three bound, typed copies of the project report, and prepared according to the prescribed format, after the pre-submission seminar, by the due date. The student shall also submit three copies of a brief summary of the project that shall be forwarded to the concerned examiners.

8.6.7 The DPEC shall make the arrangements necessary to conduct the external evaluation in consultation with the examiner(s) appointed by the University, during the dates notified.

8.6.8 Phase I of the project shall be evaluated through in-semester assessment only. The modality and components of the assessment and their weightages shall be determined by the School and the same shall be notified at the beginning of each semester.

8.6.9 Phase II of the project shall be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment shall be done by the DPEC and the project supervisor and the end-semester assessment shall be done by the external examiner(s) and the project supervisor, assisted by the DPEC. The modality and components of the in-semester assessment and their weightages shall be determined by the school and the same shall be notified at the beginning of each semester.

8.6.10 The DPEC shall forward the in-semester assessment marks to the Controller of Examinations by the date specified by the Examination Department.

8.6.11 The end-semester assessment shall have the following components:

- Project implementation: 40 marks
- Seminar presentation: 20 marks
- Viva voce examination: 20 marks
- Project documentation: 20 marks

8.6.12 Independent projects as envisaged in clause 8.6.1 shall be evaluated in the same manner as Phase II of the major project.

8.6.13 Those who obtain an 'F' grade for the major project shall be required to re-enrol for it in the subsequent semesters.

8.7 Minor and Mini Projects

8.7.1 Students may be assigned minor and mini projects by the department from the fourth semester onwards to ensure that their learning becomes a hands-on experience. These projects shall be executed by the students individually or in groups under the guidance of faculty members appointed by the department.

8.7.1.1 BCOM students shall undertake a Project (phase 1 & 2) spread across 5th and 6th semesters.

8.7.2 The mode of evaluation of these projects shall follow the pattern of evaluation of Lab Courses (vide clause 8.3) and the modalities for the conduct of evaluation, its components and the weightages attached to these components shall be published by the department concerned at the beginning of each semester.

8.7.3 The students may be required to submit project reports in the format specified. The evaluation of the Minor and Mini Projects shall take into consideration these project reports.

8.8 The evaluation of performance in non-credit courses shall be done by the authorities conducting them and they shall communicate the grades to the Director of the concerned School who shall forward them to the Controller of Examinations.

8.9 The Director of the concerned School shall forward the marks obtained in the in- semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.9.1 All evaluated work in a course except the end semester answer scripts shall be returned to the students promptly.

8.10 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that

8.10.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

8.10.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.

8.10.3 He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.11 Registration for end-semester Examinations

8.11.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

8.11.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end- semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.10.

8.11.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

8.11.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/ her in the last semester in which the said course was attended by him/her shall be retained.

8.11.5 Similarly, in case of an 'NP' grade in non-credit courses the student shall have to re-register for it in the appropriate semester of the next academic session.

8.11.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.11.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.12 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.13 Declaration of Results: The University shall declare the results of a semester and make available to the students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.14 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of these Regulations.

8.15 Re-examining of answer scripts

8.15.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.15.2 Re-examining of scripts may be of two different categories – scrutiny and re- evaluation.

8.15.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the grade sheet issued in respect of the course

under scrutiny.

8.15.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.15.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re- evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.15.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.15.7 Without prejudice to any of the clauses of section 8.15, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.16 Repeat Examination: The University shall conduct repeat examination for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

8.17 Improvement Examination

8.16.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for a programme.

8.16.2 A student who has taken migration from the University shall not be eligible to appear for Improvement Examination.

8.16.3 A student may not choose more than the number of courses specified below for improvement examinations.

Programme	Number of Courses for Improvement Examinations		
	Autumn Semester	Spring Semester	Total
BTECH	6	6	12
BCA	4	4	8
BCOM	4	4	8
BBA	4	4	8
BA	4	4	8
BSc	4	4	8

8.16.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.16.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.17 Special Examination

8.17.1 The University shall conduct Special Examinations to benefit the following categories of students:

8.17.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

8.17.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.

8.17.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

8.17.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 10.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of the inner family circle (restricted to only father, mother, siblings).

8.17.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end- semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial

Programme.

8.17.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Change of Branch (only for BTECH)

9.1 Normally a student admitted to a particular branch of the BTECH programme shall continue studying in that branch till completion. However, in special cases the university may permit a student to change from one branch of studies to another after the first two semesters.

9.2 Students shall be allowed a change in branch subject to the limitation that the strength of a branch should not fall below the existing strength by more than ten percent and should not go above the sanctioned strength by more than ten percent.

9.3 Only those students shall be eligible for consideration of a change of branch, who have completed all the credits required in the first two semesters of their studies, in their first attempt.

9.4 Applications for a change of branch must be made by intending eligible students in the prescribed form. The Office of the Registrar shall call for applications at the beginning of the third semester and the completed forms must be submitted by the last date specified in the notification.

9.5 Students may enlist up to two choices of branch, in order of preference, to which they wish to change over. It shall not be permissible to alter the choice after the application has been submitted.

9.6 Change of branch shall be made strictly in order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, the following shall be considered in the given order: the SGPA of the second semester, the SGPA of the first semester, grades obtained by the applicants in the courses of the second semester in an order to be determined by the Office of the Registrar.

9.7 A committee consisting of the Director and heads of departments of the concerned School, chaired by the Registrar shall examine the applications and consider them on the basis of the criteria laid out above.

9.8 The details of branch changes effected shall be notified to the students by the Registrar, within 7 days of the submission of applications.

9.9 All changes of branch shall be final and binding on the applicants. No student shall be permitted, under any circumstance, to refuse the change of branch offered.

9.10 All changes of branch made in accordance with the above rules shall be effective from the third semester of the applicants concerned. No change of branch shall be permitted after this.

10.0 Enrolment (for semesters other than the first)

10.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.

10.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.

10.3 Only those students shall be permitted to enrol who have

- cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
- paid all required University, Departmental and Hostel fees for the current semester, and
- not been debarred from enrolling on any specific ground.

10.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.

10.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

11.0 Eligibility for the Award of the Graduate Degree

11.1 A student shall be declared to be eligible for the award of the Graduate Degree for which he/she has enrolled if he/she has

11.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the mandatory graded courses and grade 'P' in all mandatory non-graded courses;

11.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, Field Work, Internship Programme, etc. (if any);

11.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;

11.1.4 owes no dues to the University, School, Department, Hostels; and

11.1.5 has no disciplinary action pending against him/her.

11.2 The award of the Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

12.0 Termination from the Programme

12.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.

12.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

ASSAM DON BOSCO UNIVERSITY REGULATIONS

POST GRADUATE DEGREE PROGRAMMES

SCIENCE AND TECHNOLOGY

The following are the regulations of the Assam Don Bosco University concerning the Post- Graduate Programmes leading to the award of the Master's Degree in the disciplines of Science and Technology made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar

1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.

1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

2.1 The normal duration of the Post Graduate Programme shall be as per the table given below:

Programme	Number of Semesters	Number of Years
Master of Technology (MTECH)	4	2
Master of Computer Applications (MCA)	4	2
Master of Science (MSc)	4	2

2.2 However, students who do not fulfill some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.

2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme

3.0 Course Structure

3.1 The University follows Outcome Based Education with Choice Based Credit System (CBCS) for all the Post Graduate Degree Programmes. One credit is equivalent to 15 hours of lecture/tutorial or 30 hours of practical. The courses offered for the Post Graduate Degree Programmes are divided into two baskets – Core Courses and Elective Courses.

3.2 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the said Post Graduate Degree Programme.

3.2.1 A student shall be required to take all the core courses offered for a particular programme.

3.2.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.3. Elective Courses: These are courses in the curriculum which give the student opportunities for specialization and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.3.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.

3.3.2 It shall be the prerogative of the department not to offer an elective course which has less than 5 students opting for it.

The schema of categorisation of courses into baskets is as given below:

Core Courses	
Departmental Core (DC)	Core courses which are offered by the department conducting th programme
School Core (SC)	Core courses which are offered by a department other than the departme conducting the programme, from within the same School

Institutional Core (IC)	Core courses which are offered by departments of the University fro Schools other than the parent School
Elective Courses	
Departmental Elective (DE)	Elective courses which are offered by the department conducting th programme
School Elective (SE)	Elective courses which are offered by a department other than th department conducting the programme, from within the same School
Institutional Elective (IE)	Elective courses which are offered by departments of the University fro Schools others than the parent School

***UGC Equivalent Courses**- Core Paper (DC), Ability Enhancement Compulsory Course (IC/SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)
***AICTE Equivalent Courses** - Basic Science Course (IC), Engineering Science Course(IC), Open Elective Course (IC), Humanities and Social Science Courses (IC),Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Post Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.7 In addition to the prescribed credit requirement, a student shall have to complete Institutional mandatory courses with Pass grade, as prescribed by the competent academic authority, from time to time, which shall be recorded in the Grade sheet but not taken into account for computing the SGPA and the CGPA.

3.8 **Audit Course:** Students who secure a CGPA of at least 8 at the end of the first may opt to take one audit course per semester from any Department from the second semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.

3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the grade sheet, but not taken into account for computing SGPA and CGPA.

3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.

3.11 The medium of instruction shall be English and examinations and project reports shall be in English.

3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.13 The curriculum may include industry training and /or fieldwork for a specified time. This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged during convenient semester breaks as shall be determined by the School Board of Studies.

3.14 **Faculty Advisor/Mentor:** A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) to shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 Admission

4.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

4.2 Eligibility Criteria

4.2.1 To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor's Degree (or equivalent) programme of a recognised university securing grades/marks as specified in the table below.

4.2.2 Admission will be on the basis of the performance of the candidate at the graduate level, the Post Graduate Entrance Test conducted by the university and/or a personal interview. Candidates for MTECH who have a valid

GATE score may be exempted from the entrance test.

Programme	Grade /Marks requirement from qualifying examinations	Entrance Examinations / Personal Interview
MTECH	Completed a Bachelor's Degree programme in the appropriate stream of technology from a recognised university successfully with a minimum CGPA of 6.5 (or equivalent). The Academic Council may establish other eligibility criteria for M Tech in a particular discipline.	Post Graduate Entrance Test of Assam Don Bosco University
MCA	Completed a Bachelor's Degree programme in any stream of a recognised university successfully with a minimum of 50 % marks in the aggregate. In addition, the candidate must have passed Mathematics or equivalent at the higher secondary level or above.	Post Graduate Entrance Test of Assam Don Bosco University
MSc	Completed a Bachelor's Degree programme in Science of a recognised university successfully with a minimum aggregate, specified by the competent academic body.	Satisfactory performance in the Personal Interview

4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.

4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.

4.4.1 The attendance of such students shall be computed from the date of admission.

4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.

4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.

4.6 Candidates may be required to furnish a certificate of good conduct from the institution last attended.

4.7 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

4.8 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

5.0 University Registration

5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.

6.0 Attendance

6.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	Bonus percentage available in the current semester
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if, on the strength of this bonus attendance

percentage, they obtain 65% attendance for that course.

6.4 If the sum of the credits of the courses for which a student is unable to appear at the end- semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 9.5 of these Regulations.

6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

6.6 Leave

6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.

6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.

6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.

6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1 Three types of courses are offered in the Post Graduate programmes:

- **Graded courses:** For the majority of the courses, students shall be assessed and given grades.
- **Pass/No-Pass courses**: There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses**: A third category of courses are audit courses. These are optional.

However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
$90 \leq x \leq 100$	O	Outstanding	10
$80 \leq x < 90$	E	Excellent	9
$70 \leq x < 80$	A+	Very Good	8
$60 \leq x < 70$	A	Good	7
$50 \leq x < 60$	B	Average	6
$40 \leq x < 50$	C	Below Average	5
$x < 40$	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non- passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

7.2.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

7.2.2 A letter grade 'F', 'NP' or 'X' in any course implies failure in that course.

7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.

7.3 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

7.3.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the

SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^{n} GP_i \text{ x } NC_i}{\sum_{i=1}^{n} NC_i}$$

Where GP_i = Grade points earned in the i^{th}course
NC_i = Number of credits for the i^{th}course
n = the number of courses in the semester

7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPAs obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^{n} SGP_i \text{ x } NSC_i}{\sum_{i=1}^{n} NSC_i}$$

Where SGP_i = Semester Grade point of the ith semester
NSC_i = Number of credits for the ith semester
n = the number of semesters completed

7.3.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

7.4 Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.

7.5 There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the 'P' and 'NP' grades. Non-credit courses such as Extra Academic Programmes belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.

7.6 In the case of an audit course, the letters "AU" shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1 A student's performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2 Theory Courses: Theory courses shall have two components of evaluation – in- semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1 The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School/Department at the beginning of each semester.

8.3 Lab Courses: Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

Component	**Weightage**
Assessment of Tasks Assigned	40
End-semester test / Viva voce	60

8.3.1 The modalities of the conduct of evaluation under the heading "Assessment of tasks assigned", its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

8.3.2 The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the program/experiment
- Coding, freedom from logical and syntactical errors, and accuracy of the result obtained / conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4 End-Semester examinations

8.4.1 End-semester examinations for the theory courses, generally of three hours' duration, shall be conducted by the

University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3 A student shall not obtain a pass grade for a course without appearing for the end- semester examination in that course.

8.5 Research Seminar

8.5.1 During the course of the Post Graduate programme students may be required to conduct research seminars on a regular basis. The purpose of these research seminars is to encourage the students to conduct literature survey on the recent trends and developments in a chosen area of the discipline.

8.5.2 The literature survey conducted in preparation for these seminars may lead the students to the development of a project model to be executed during the final semesters of the programme.

8.5.3 The Research Seminars shall be evaluated on the basis of a presentation, a report and a viva voce examination.

8.6 The Major Project / Research Project / Dissertation

8.6.1 Students of the Post Graduate Programme shall undertake a Major Project / Research Project / Dissertation during the course of their Post Graduate studies. The Major Project / Research Project / Dissertation (to be referred to as Major Project henceforth) is normally conducted in two phases during the last two semesters of the programme.

8.6.2 The Major Project may be a software project, a research oriented project or research work which leads to a dissertation, as may be relevant to the discipline in which the work is undertaken. If it is a research oriented work, it should expose the students to the current state of research in a chosen area of the discipline and lead to new developments in the area.

8.6.3 The Major Project is to be undertaken individually in the campus or outside as may be specified by the department.

8.6.4 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Director of the School (Chairperson), Head of the Department (Vice Chairperson), Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convenor. The DPEC shall co-ordinate the conduct and assessment of the project.

8.6.4.1 The DPEC will notify the schedule and modalities for the following stages in the implementation of the project.

- Submission of the topic of the project.
- Notification for assignment of project supervisors.
- Submission of the synopsis
- Schedule for the seminar presentation of synopsis.
- Schedule for Progress Seminars, submission of progress reports and viva voce examination.
- Date for the submission of the project report and a brief summary.
- Dates for the end semester evaluation of the project.

8.6.5 The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.

8.6.6 The project supervisor may be from outside the department or university. Such a supervisor should be approved by the DPEC and jointly supervise a project with a faculty member of the department.

8.6.7 The minimum qualification of a project supervisor shall be laid down by the DPEC in consultation with the Director of the School and authorities of the University.

8.6.8 The Chairperson of the DPEC will submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the end semester examination. The Controller of Examinations will appoint the external examiner(s) from this panel.

8.6.9 Each student shall submit to the DPEC four bound, printed copies of the project report, prepared according to the prescribed format made available, by the due date. The student will submit also three copies of a brief summary of the project that will be forwarded to the concerned examiners.

8.6.10 The DPEC will make the arrangements necessary to conduct the end semester evaluation in consultation with the examiners appointed by the University, during the dates notified.

8.6.11 The project will be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment will be done by the DPEC and the project supervisor. The end-semester assessment will be done by the external examiner(s), the project supervisor and a member of the DPEC appointed by it for the purpose. The weightages attached to their respective evaluations shall be 60:20:20.

8.6.12 The DPEC will forward the in-semester assessment marks to the Controller of Examinations by the date

specified by the Examination Department.

8.6.13 Given below are the suggested components of Internal assessment and respective marks assigned:

- Synopsis: 15 marks
- Seminar presentation of the synopsis: 15 marks
- Project implementation: 40 marks
- Pre-submission presentation: 15 marks
- Pre-submission viva voce: 15 marks

8.6.14 Given below are the suggested components of External assessment and respective marks assigned:

- Project implementation: 40 marks
- Seminar presentation: 25 marks
- Viva voce examination: 20 marks
- Project documentation: 15 marks

8.6.15 Publication of papers and registering of patents are encouraged during the Post Graduate programme. Papers published or patents obtained may be awarded extra weightage during the evaluation of the project.

8.6.16 Those who obtain an 'F' grade for the major project will be required to re-enrol for it in the subsequent semester and pay the prescribed fees.

8.7 The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.8 All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly.

8.9 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that

8.9.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

8.9.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.

8.9.3 He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.10 Registration for end-semester Examinations

8.10.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

8.10.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end- semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.9.

8.10.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

8.10.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/ her in the last semester in which the said course was attended by him/her shall be retained.

8.10.5 Similarly, in case of an 'NP' grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.

8.10.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.10.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.11 **Conduct of Examinations**: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.12 Declaration of Results: The University shall declare the results of a semester and make available to students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.13 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of

these Regulations.

8.14 Re-examining of answer scripts

8.14.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.14.2 Re-examining of scripts may be of two different categories – scrutiny and re- evaluation.

8.14.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the gradesheet issued in respect of the course under scrutiny.

8.14.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.14.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re- evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.14.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.14.7 Without prejudice to any of the clauses of section 8.14, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.15 Repeat Examination: The University shall conduct repeat examination for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

8.16 Improvement Examination

8.16.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for a programme.

8.16.2 A student who has taken migration from the University shall not be eligible to appear for Improvement Examination.

8.16.3 A student may not choose more than the number of courses specified in the table below for improvement examinations.

Programme	**Number of Courses for Improvement Examinations**		
	Autumn Semester	Spring Semester	Total
MCA	3	3	6
MSc	3	3	6
MTECH	2	2	4

8.16.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.16.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.17 Special Examination

8.17.1 The University shall conduct Special Examinations to benefit the following categories of students:

8.17.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

8.17.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.

8.17.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of

the Spring Semester.

8.17.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 9.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

8.17.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end- semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

8.17.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Enrolment (for semesters other than the first)

9.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.

9.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.

9.3 Only those students shall be permitted to enrol who have

- cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
- paid all required University, Departmental and Hostel fees for the current semester, and
- not been debarred from enrolling on any specific ground.

9.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.

9.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

10.0 Eligibility for the Award of the Post Graduate Degree

10.1 A student shall be declared to be eligible for the award of the Post Graduate Degree for which he/she has enrolled if he/she has

10.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the mandatory graded courses and grade 'P' in all mandatory non-graded courses.

10.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, field work, internship programme, etc. (if any);

10.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;

10.1.4 owes no dues to the University, School, Department, Hostels; and

10.1.5 has no disciplinary action pending against him/her.

10.2 The award of the Post Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

11.0 Termination from the Programme

11.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.

11.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

ASSAM DON BOSCO UNIVERSITY REGULATIONS

POST GRADUATE DEGREE PROGRAMMES

HUMANITIES AND SOCIAL SCIENCES & COMMERCE AND MANAGEMENT

The following are the regulations of the Assam Don Bosco University concerning the Post- Graduate Programmes leading to the award of the Master's Degree in the disciplines of Humanities and Social Sciences & Commerce and Management made subject to the provisions of its Statutes and Ordinances:
The Master's Degree Programmes of Assam Don Bosco University consist of theory and practicum components, taught and learned through a combination of lectures, field work/field visit and research projects.

1.0 Academic Calendar

1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.

1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

2.1 The normal duration of the Post Graduate Programme in the disciplines of Humanities and Social Sciences & Commerce and Management shall be 4 semesters (2 years).

2.2 However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.

2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme

3.0 Course Structure

3.1 The choice based credit system shall be followed for the Masters Degree Programmes. Credits are allotted to the various courses depending on the number of hours of lecture/practicum/Field work assigned to them using the following general pattern:

3.1.1 Lecture: One hour per cycle/week is assigned 1 credit.

3.1.2 Practicum/fieldwork: Two hours per cycle/week is assigned 1 credit.

3.2 The courses are divided into two baskets – core courses and elective courses. (Core courses will include "Core Courses" and "Ability Enhancement Courses" mentioned in CBCS guidelines. Elective Courses will include "Discipline Specific Electives", "Generic Electives", optional "Dissertation or Project", and "Skill Enhancement Courses")

3.3 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the programme.

3.3.1 A student shall be required to take all the core courses offered for a particular programme.

3.3.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.4 Elective Courses: These are courses in the curriculum which give the student opportunities for specialisation and which cater to his/her interests and career goals. These courses may selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.4.1 The number of credits which may be acquired through elective courses shall be prescribed by the Board of studies pertaining to the programme.

3.5 These categories of courses may further be subdivided into departmental, school or institutional, depending on the department which offers the course. The schema of categorisation of courses into baskets is as given below:

***Core Courses**	
Departmental Core (DC)	Core courses which are offered by the department which conducts the programme
School Core (SC)	Core courses which are offered by a department other than the department which conducts the programme, from within the same School

Institutional Core (IC)	Core courses which are offered by departments of the University from Schools other than the parent School
***Elective Courses**	
Departmental Elective (DE)	Elective courses which are offered by the department which conducts the programme
School Elective (SE)	Elective courses which are offered by a department other than the department which conducts the programme, from within the same School
Institutional Elective (IE)	Elective courses which are offered by departments of the University from Schools others than the parent School

***UGC Equivalent Courses** - Core Paper (DC), Ability Enhancement Compulsory Course (IC/ SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

***AICTE Equivalent Courses** - Basic Science Course (IC), Engineering Science Course(IC), Open Elective Course (IC), Humanities and Social Science Courses (IC), Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Master's Degree, a student is required to complete the credit requirement as prescribed in the curriculum.

3.7 In addition to the prescribed credit requirement, a student shall have to complete the requirements of Extra Academic Programmes (EAP) as may be prescribed by the Department. Students shall be awarded P/NP grades for the EAP, which shall be recorded in the Gradesheet, but not taken into account for computing the SGPA and the CGPA.

3.8 Students who secure a CGPA of at least 7.5 at the end of the 2nd semester may opt to take one audit course per semester from any Department from the 3rd semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% percentage is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.

3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the gradesheet, but not taken into account for computing SGPA and CGPA.

3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.

3.11 The medium of instruction shall be English and examinations and project reports shall be in English.

3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.13 The curriculum may include fieldwork / institutional visits / internship for a specified time.These are to be satisfactorily completed before a student is declared eligible for the degree.There shall be credit allocation for such activities. These activities may be arranged during the semester or during convenient semester breaks as shall be determined by the School Board of Studies.

3.14 Faculty Advisor/Mentor: A faculty advisor/mentor shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

PROGRAMME SPECIFIC CURRICULAR ASPECTS

4.0 MASTER OF SOCIAL WORK (MSW)

4.1 Area of Concentration: The third and fourth semesters shall have courses from a chosen Area of Concentration (AoC) from among those offered by the department. The AoC is to be opted for at the end of the second semester and will be confirmed by the department depending on the availability of seats and the aptitude and ability of the student. An AoC will be offered by the department only if a minimum of ten students opt for it. The fieldwork and research project of the third and fourth semesters will be based on the AoC.

4.2 Concurrent and Continuous Fieldwork

Fieldwork shall be an essential part of the course structure in all the semesters of the programme. The field work practice in the first semester shall consist of orientation visits, sessions for skills training and placement. In the first year, the focus of the field work shall be the community and in the second year the focus shall be based on the specialisation chosen by the students. In the first semester,, students shall be placed in communities, NGOs,service organizations and government agencies working with communities, and in those settings where they can be exposed to the community and community issues. The students get a close feel of the community and community settings, understand the dynamics and issues in the community and become aware of the sensitivities of people while working with them. They also get a firsthand experience of the programmes and projects implemented in the communities by NGOs and government agencies and the impact that these have on the community. They shall also interact with the personnel from organisations and the community members to understand the tension between tradition and change that the communities in the region are likely to experience, and how it is handled. They shall, with the help of the organisation and the field work supervisor, identify an issue and work on it following the principles of community organization. The students are expected to be creative and innovative in assisting the agency and community in whatever way possible.

The field work practice in the second semester will consist of lab sessions for skills training and placement. The focus will be on the practice of social case work and Group works. The students shall be placed in NGOs, and government service organizations and government agencies working with individuals and families, and in those settings where they can be exposed to issues related to individuals and groups.

4.2.1 Normally a student shall spend fifteen hours over two days per week in field work. However, keeping in mind the peculiar situation of transport and communications in the region and the expenses involved, the field work practice may be arranged in other convenient ways as the institution deems fit.

4.2.2 The student is required to submit the report on the field work and the field work diary to the field work supervisor, before the commencement of classes on the first day of class following the field work days. The supervisor shall conduct regular field work conferences

4.2.3 A student is expected to have 100 percent attendance in field work. Any shortage shall be compensated by him/her.

4.2.4 At the end of the semester the student shall submit a summary report of the field work for the semester and a viva voce examination shall be conducted.

4.2.5 The field work practice in the Third and Fourth Semesters shall focus upon the Area of Concentration chosen by the students. The students shall be placed in the field for twenty five days of consecutive field work. The field work settings shall be communities, NGOs, service organizations, hospitals, clinics and governmental agencies. Those students who are specializing in Community Development will either be placed in an urban or rural community setting that is identified by the Department. Students who are specializing in Medical and Psychiatric Social Work will be exposed to either a Medical or a Psychiatric setting.

4.3 Rural Camp

Students shall organise and participate in a rural camp during the first / second semester. The duration of the rural camp shall generally be ten days excluding days of travel.

4.3.1 The objectives of the rural camp are:

- To apply the acquired skills of group work and community organisation in communities.
- To understand and assess the problems faced by the rural population.
- To involve oneself positively in the communities to help to remove some of these problems.

4.3.2 At the end of the camp each student shall submit a written report to the department in a specified format. Performance at the Rural Camp shall be considered for the evaluation of the Field Work during the second semester.

4.3.3 The Rural Camp shall be credited along with the fieldwork of the semester along with which it can be conveniently coupled.

4.4 Study Tour

During the programme the students shall undertake a study tour along with the assigned faculty members to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be on visiting and interacting with as many NGOs/ state/national/international organisations involved in developmental work as possible. A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

4.5 Block Placement

After the examinations at the end of the fourth semester, the students shall be placed with an NGO or Agency for a period of not less than one month for practical experience and application of their skills. While the Block Fieldwork is not credited, it is mandatory for the completion of the MSW programme. The student shall contact an agency of his/her choice and get the choice of agency approved by the department. Students shall endeavour to choose an agency that is

primarily in tune with their AoC and which has credentials in the concerned field. At the end of every week the student shall send a brief report to the supervisor and at the end of the Block Field Work period a summary report shall be submitted. The summary report shall contain a short description of the Agency, the social service skills applied in his/her work and the student's learning outcomes. The report shall be submitted in a format prescribed by the department and shall be submitted together with a certificate from the agency confirming his/her field work, in a prescribed format.

4.6 Research Project Work

Every student shall undertake a research project work which has bearing on his/her AoC and present a written thesis on the research work under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

4.7 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

5.0 MASTER OF SCIENCE (MSC) PSYCHOLOGY

5.1 Field Work

Students shall take part in field work during the first three semesters in mental health agencies, medical institutions, educational institutions etc., under the supervision of professional counsellors and psychologists, where the student of psychological counselling can get a first-hand experience of the application of the learning derived from the classroom. The field work shall be credited and shall be evaluated using norms laid down by the department.

5.2 Study Tour

During the programme the students shall undertake a study tour, along with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/international organisations involved in psychological counselling. A report of the learning outcomes shall be submitted to the department at the end of the tour followed by a presentation. The Study Tour shall be a Pass/No Pass course.

5.3 Summer Internship

Students are required to undergo a summer internship of two weeks' during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in class room courses to the "real world" of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship enriches the students' academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

5.4 Supervised Internship

Each student shall perform a supervised internship for a period of 90 days (spread across semester three and four with 45days in each semester) in two organizations which offers counselling help to clients. The supervised internship is a credited course and the report for each internship shall be submitted by the students at the end of each semester followed by a presentation on the same. It shall be the prerogative of the department to propose the number of institutions where a student is expected to perform supervised internship. Supervision shall be provided for by the university in collaboration with the organisation where the student performs the internship. Evaluation of the internship shall be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

5.5 Research Project Work

A research project shall be undertaken during the course of the third and the fourth semesters. The topic of the research shall be so chosen that it will be possible for the student to pursue and complete the research work in the institution/hospital where the student is placed for the supervised internship. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/ Institute at the beginning of the

semester.

5.6 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A Group assignment shall be accompanied by a common presentation.

6.0 MASTER OF ARTS (MA) EDUCATION

6.1 Specialisations

The Master's Degree Programme in Education offers a number of specialisations, of which a student shall be required to choose a specialization after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

6.2 Educational Seminar

During the course of the programme, students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics which may be suggested by the department. Students shall be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions students shall be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They shall also consider alternative pedagogic strategies, teaching techniques and technologies. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

6.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

6.4 Research Project Work

Every student shall undertake a research project work which has bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the third and fourth semesters. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

6.5 School Visits

The students of the Masters Programme in Education shall be engaged in regular school visits with the purpose of understanding and evaluating the process of teaching, learning and evaluation as well as the exigencies of administration of the school.

6.6 Internship

During the final semester of the programme, a student is required to undergo an internship for a period of one month. The internship provides an opportunity for students to experience the ground reality and connect it with the theoretical and methodological perspectives the student has studied and interiorized. During the internship the student will be monitored and guided by his/her supervisor and faculty members. The student will be required to maintain a journal and at the end of the period of internship, submit a written report and to make a presentation of his/her experiences and learnings at the internship. The student will be required also to submit a report from the head of the institution regarding his/her performance there.

The evaluation of the student shall be based on the level of his/her engagement during the internship in addition to his/her ability to communicate this engagement in the journal, the report and the presentation. The journal and the report are to be submitted within a month of the completion of the internship. The department shall specify the criteria for evaluating the journal, the report and the presentation.

6.7 Journaling

During the 1st semester, students shall maintain a reflective journal, to develop within them a reflection that can be described as an inner dialogue, using visible thinking routine (Harvard), as a critical structure for guiding their journal writing. Journaling has to be done six days a week. At the end, the student will be awarded grade/marks after assessing their learning.

7.0 MASTER OF ARTS (MA) MASS COMMUNICATION

7.1 Specialisations

The Master's Degree Programme in Mass Communication offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

7.2 Media House Visits

During the course of the programme, students shall be required to visit a variety of Media Houses in small groups constituted by the department. The purpose of these Media House Visits shall be to gain exposure to the best practices among the day-to- day activities of the media house. A report of the visit is to be submitted in the format specified within two days of the visit. The Media House visit shall be a graded course and grades shall be awarded on the basis of the written reports of the media house visits.

7.3 Research Project Work

Every student shall undertake a research project work which has a bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the course of two semesters as shall be laid down in the course structure of the programme. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

7.4 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

7.5 Internship

All students shall undergo an internship involving media related activities of four weeks' duration. The purpose of the internship is to give the students an opportunity to have a hands-on field experience to effectively put into practice the theoretical and practical learning from the programme in an area of interest. Students may undergo their internship in a media house of their choice. The student shall be required to discuss the choice of media house with the department and obtain its consent. Before going for the internship, a Letter of Consent from the concerned media house, in the prescribed format, shall be submitted by the student to the Department. After returning from the internship each student shall have to submit a detailed report in a prescribed format. Each student shall also make a presentation of the internship experience and learning in the Department and submit a certificate of successful completion of the internship from the designated authority of the concerned media house. The schedule of the conduct, report submission and evaluation of the internship shall be as notified by the Department. The components of evaluation of the Internship and their weightages shall be as notified by the department at the beginning of the semester.

7.6 Final Project

As a Final Project the students are required to create a Social Awareness and Community Development oriented multi-media project which shall culminate in a Media Event. The purpose of the final project is to showcase all the skills that the students have acquired during the course of the programme as well as demonstrate their Media and Event Management, and Media Entrepreneurship abilities and at the same time use these skills for the service and upliftment of the community. The Final Project shall essentially be a group project and the number of groups shall be specified by the department. The groups shall perform their activities under the guidance of faculty members who shall be assigned to guide each group. The last dates for the submission of the project proposal and the conduct of the event shall be notified by the Department well in advance. The components of evaluation of the Final Project and their weightages shall be as notified by the department at the beginning of the semester.

8.0 MASTER OF ARTS (MA) ENGLISH

8.1 Specialisations

The Master's Degree Programme in English offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

8.2 Educational Seminar

During the course of the programme, students are expected to present a series of seminars related to English literature. They may also deal with other relevant topics which may be suggested by the department. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

8.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

8.4 Dissertation

Students will be required to write a dissertation in the 4th semester.

9.0 MASTER OF COMMERCE (MCOM)

9.1 Specialisations

The Master's Degree Programme in Commerce offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

9.2 Project Work/Dissertation

The Master's Degree Programme in Commerce will require students to do Project work in the 3rd and 4th semesters. The mode and components of evaluation of the project work and the weightages attached to them shall be published by the department at the beginning of the semester.

9.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

10.0 Admission

10.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

10.2 Eligibility Criteria

10.2.1. To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor's Degree (or equivalent) programme of a recognised university securing 50% of the grades/marks.

10.2.2. Admission will be on the basis of the academic records of the candidate, and taking into consideration his/her performance in any or all of the following:

- Written test
- Group Discussion
- Personal Interview

10.3 Candidates whose results for the qualifying examination are not yet declared may be provisionally admitted provided she/he submits proof of fulfilment of the eligibility criteria by 31 October of the year of provisional admission.

10.4 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

10.5 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

11.0 University Registration

11.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director.

12.0 Attendance

12.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

12.2 Deficiency in attendance up to 10% may be condoned by the Director in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

12.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle, may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	**Bonus percentage available in the current semester**
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

12.4 If the sum of the credits of the courses for which a student is unable to appear at the end- semester examinations

exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 13.5 of these Regulations.

12.5 The School may decide to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

12.6 Leave

12.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the Office of the Director of the School on prescribed forms, through the Head of the Department, stating fully the reasons for the leave requested along with supporting documents.

12.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must inform the office of the Director promptly.

12.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director to the Registrar with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director.

12.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.

12.6.5 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing of the leave.

13.0 Grading System

13.1 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
90 ≤ x ≤ 100	O	Outstanding	10
80 ≤ x < 90	E	Excellent	9
70 ≤ x < 80	A+	Very Good	8
60 ≤ x < 70	A	Good	7
50 ≤ x < 60	B	Average	6
40 ≤ x < 50	C	Below Average	5
x < 40	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non- passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

13.1.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

13.1.2 A letter grade 'F', 'NP' or 'X' in any course implies a failure in that course.

13.1.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.

13.2 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

13.2.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^{n} GP_i \text{ x } NC_i}{\sum_{i=1}^{n} NC_i}$$

Where GP_i = Grade points earned in the i^{th}course
NC_i = Number of credits for the i^{th}course
n = the number of courses in the semester

13.2.2 The Cumulative Grade Point Average (CGPA): From the SGPAs obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^{n} SGP_i \text{ x } NSC_i}{\sum_{i=1}^{n} NSC_i}$$

Where SGP_i = Semester Grade point of the ith semester
NSC_i = Number of credits for the ith semester
n = the number of semesters completed

13.2.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

13.3 Both the SGPA and CGPA will be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values will be used.

13.4 There are academic and non-academic requirements for the programme where a student will be awarded the 'P' and 'NP' grades. All non-credit courses (such as Study Tour and Extra Academic Activities) belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.

14.0 Assessment of Performance

14.1 A student's performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, projects, research work, concurrent and block field work performance and end-semester examinations.

14.2 Theory Courses: Theory courses will have two components of evaluation – in-semester assessment of 40% weightage and an end-semester examination having 60% weightage.

14.2.1 The modalities of conduct of in-semester evaluation, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

14.3 Practicum/Field Work/Lab: These courses shall be evaluated on the basis of attendance, performance of tasks assigned and an end semester test/viva voce examination. The weightage assigned to these components of the evaluation is given in the following table:

Component	Weightage
Attendance	10
Performance of tasks assigned	30
end-semester test / viva voce examination	60

14.4 End-Semester examinations

14.4.1 End-semester examinations, generally of three hours' duration, shall be conducted by the University for the theory courses. However, the Director of the Institute shall make the arrangements necessary for holding the examinations.

14.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

14.4.3 A student shall not obtain a pass grade for a course without appearing for the end- semester examination in that course.

14.5The evaluation of performance in Co-curricular Activities will be done by the authorities conducting them and they will communicate the grades to the Director who will forward them to the Controller of Examinations of the University.

14.6 The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

14.7 All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly. They should be collected back after the students have examined them, and preserved for a period of one semester.

14.8 Eligibility for appearing in the end-semester examinations: A student will be permitted to appear for the end-semester examinations, provided that

14.8.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

14.8.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 9 of these regulations.

14.8.3 He/she has paid the prescribed fees or any other dues of the university, institute and department within the date specified.

14.9 Registration for end-semester Examinations

14.9.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

14.9.2 Students who have registered with the University and those who have applied for such registration may apply to appear for the end-semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 14.8.

14.9.3 All eligible candidates shall be issued an admit card for the relevant examination and for the specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

14.9.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum

period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.

14.9.5 Similarly, in case of an 'NP' grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.

14.9.6 When a student re-registers for the end semester examination of a course, in accordance with clause 14.9.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

14.10 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

14.11 Declaration of Results: The University shall declare the results of a semester and make available to the students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

14.11.1 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 6 of these Regulations.

14.12 Re-examining of answer scripts

14.12.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

14.12.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

14.12.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the grade sheet issued in respect of the course under scrutiny.

14.12.4 e-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

14.12.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just- concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re- evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the Institute.

14.12.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

14.12.7 Without prejudice to any of the clauses of section 14.12, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

14.12 Repeat Examination: The University shall conduct repeat examination for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

14.14 Improvement Examination

14.14.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for the programme.

14.14.2 A student may choose no more than six courses (three in the Autumn semester and three in the Spring semester) for improvement examinations.

14.14.3 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

14.14.4 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

14.15 Special Examination

14.15.1 The University shall conduct Special Examinations to benefit the following categories of students:

14.15.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

14.15.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.

14.15.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

14.15.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 15.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

14.15.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end- semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

14.15.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

15.0 Enrolment (for semesters other than the first)

15.1 Every student is required to enrol for the programme through the designated officer at the commencement of each semester on the days fixed for such enrolment and notified in the Academic Calendar.

15.2 Students who do not enrol on the days announced for the purpose may be permitted late enrolment up to the notified day in the Academic Calendar on payment of a late fee.

15.3 Only those students will be permitted to enrol who have

15.3.1 cleared all University, Institute, Department, Hostel and Library dues and fines (if any) of the previous semester,

15.3.2 paid all required University, Institute, Department and Hostel fees for the current semester, and

15.3.3 not been debarred from enrolling on any specific ground.

15.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.

15.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

16.0 Eligibility for the Award of Degree

16.1 A student shall be declared to be eligible for the award of the degree if he/she has

16.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the graded courses and grade 'P' in all the non-graded courses.

16.1.2 satisfactorily completed all the non-credit requirements for the degree (if any);

16.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;

16.1.4 owes no dues to the University, Institute, Department, Hostels; and

16.1.5 has no disciplinary action pending against him/her.

16.2 The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

17.0 Termination from the Programme

17.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.

17.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

SCHEME OF IN-SEMESTER ASSESSMENT

GRADUATE DEGREE PROGRAMMES

Theory Courses

For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

Component	Weightage	Remarks
Class Test (Two Class tests of one and a half hour duration)	20	Average of the two marks shall be considered
Assignment (Individual and Group)	10	Group assignments for two courses and individual assignments for the remaining courses
Non-formal evaluation	5	Based on response and interaction in class, quizzes, open book tests, etc.
Attendance	5	For norms regarding attendance cfr. clause 6 of the Regulations for Undergraduate Programmes

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

Attendance

Marks for attendance will be given according to the following scheme:

	Marks Allotted	
Attendance Percent (x)	Theory	Lab
75 <= x < 80	2	4
80 <= x < 90	3	6
90 <= x < 95	4	8
95 <= x 100	5	10

EVALUATION OF LABORATORY COURSES, DRAWING AND WORKSHOP

All Laboratory courses are evaluated on the basis of attendance, performance of tasks assigned and end semester test/viva voce examination. The distribution of marks within these components will be specified by individual departments along the lines of the break-up given below:

Component	Weightage
Attendance	10
assessment of tasks assigned	30
End Semester Test and/or Viva-Voce Examination	60
Total	100

In-Semester Evaluation of Minor and Mini Projects

The guidelines for the conduct and evaluation of Minor and Mini Projects shall be laid down by the Department. The components of evaluation and allotment of marks may be as follows:

In Semester Evaluation	Marks	End Semester Evaluation (weightage 40)	Marks
Synopsis	10	Project Implementation	16
Seminar presentation of synopsis (Analysis and Design)	15	Seminar Presentation	8
Progress Seminar (Implementation)	15	Viva Voce Examination	16
Project Documentation	10		
Attendance	10		
Total	60		40

In-Semester Evaluation of BTECH Major Project Phase I and Phase II

The in-semester evaluation of Major Project Phase I and Phase II shall have 60% weightage. The modality and conduct of the in-semester evaluation of the Major Project Phase I, and their weightages shall be declared by the DPEC of each department at the beginning of the semester. The following aspects are to be assessed, among others:
Synopsis presentation Progress seminars Progress reports Weekly activity reports

In-Semester BCOM Project Evaluation

The scheme of in-semester evaluation and the modalities along with the weightages will be specified by the department at the beginning of the semester.

SCHEME OF IN-SEMESTER EVALUATION

POST GRADUATE DEGREE PROGRAMMES

MCA, MSW, MSC (Psychology), MA English, MA Education, MCOM

Theory Courses

The different components of the scheme of in-semester for the theory courses are given in the table below:

Component	Weightage
Class Test (Two class tests of equal weightage)	20
Assignments, Group Presentations/Seminar	10
Non-formal evaluation	5
Attendance	5
Total	**40**

Non-formal Evaluation

Non-formal evaluation may be done using a combination of quizzes, unannounced tests, open book tests, library work reports, class room interaction and participation, etc. The scheme of non- formal evaluation shall be announced by every teacher in the beginning of the semester.

Attendance

Marks for attendance will be given according to the following scheme:

Attendance Percent (x)	Marks Allotted
75 <= x < 80	2
80 <= x < 90	3
90 <= x < 95	4
95 <= x 100	5

NB: There shall be no re-test for in-semester Assessment under any circumstance. The original marks of all the in-semester Assessment components shall be retained for all further repeat examinations.

MCA Minor Project

The guidelines for the conduct and evaluation of the MCA Minor Project shall be laid down by the Department. The components of evaluation and allotment of marks will be as follows:

In Semester Evaluation	Marks	End Semester Evaluation (Weightage 40)	Marks
Synopsis	10	Project Implementation	16
Seminar presentation of synopsis (Analysis and Design)	15	Seminar Presentation	8
Progress Seminar (Implementation)	15	Viva Voce Examination	16
Project Documentation	10		
Attendance	10		
Total	60		40

In-Semester Evaluation of MCA Major Project

The in-semester evaluation of the MCA Major Project shall have 60% weightage. The Internal Evaluation of the Major project will be done through two seminar sessions:

Synopsis	:	20
Seminar Presentation of Synopsis (Analysis and Design)	:	30
Progress Seminar (Implementation)	:	30
Project Documentation	:	20

External Evaluation of all Major projects will follow the guidelines laid down in the Regulations.

MSW, MSc Psychology Field Work

The components of evaluation and their weightages for the concurrent/continuous fieldwork are as follows:

Component	Weightage
Field Work Diary	10
Agency Evaluation	15
Faculty Evaluation	20
Attendance	5
Viva Voce Examination	50
Total	100

Practicum

Field Report	:	15
Presentation	:	15
Administration of tests	:	10
Faculty Evaluation	:	10
Viva Voce Examination	:	50

MSW, MSc Psychology Research Project

Phase I

Literature Survey Presentation	:	40
Synopsis Presentation	:	60

Phase II

Examination of Thesis	:	50
Presentation and Viva Voce Exam	:	50

MTECH, MSC (Physics, Chemistry, Mathematics, Biochemistry, Biotechnology, Microbiology, Botany, Zoology)

Theory Courses

For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

Component	Weightage	Remarks
Class Test (Two Class tests of one and a half hour duration)	20	Average of the two marks shall be considered
Assignments	15	Written Assignments/Seminar on course Topics/ Technical Paper Review
Non-formal evaluation	5	Based on response and interaction in class, quizzes, open book tests, etc.
Total	40	

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

In-Semester Evaluation of Project (Phase I) / Research Project (Phase I) / Dissertation (Phase I)

The in-semester evaluation of Project Phase I / Research Project (Phase I) / Dissertation (Phase I) shall have 60% weightage. It shall be evaluated in the following seminar sessions having equal weightage:

Seminar 1: Presentation of the synopsis

Synopsis	:	30%
Seminar presentation of the synopsis	:	50%
Viva voce examination	:	20%

Seminar 2: Progress Seminar

Progress report	:	30%
Progress seminar	:	50%
Viva voce Examination	:	20%

In-Semester Evaluation of Project (Phase II) / Research Project (Phase II) / Dissertation (Phase II)

The in-semester evaluation of Project Phase II / Research Project (Phase II) / Dissertation (Phase II) shall have 60% weightage. The in-semester evaluation will be done through two seminar sessions having equal weightage. Each seminar will be evaluated using the following components.

Progress Report	:	30
Progress Seminar	:	50
Viva Voce Examination	:	20

External Evaluation of the project / Research Project / Dissertation shall follow the guidelines laid down in the Regulations.

RULES, PROCEDURES AND BEHAVIOURAL GUIDELINES

1. Dress Code and Identity Card

1.1 The dress code of the University consists of shirt / top (of the prescribed colour and material), trousers (of the prescribed colour and material), shoes (black) and socks (dark grey), a belt (black/dark brown, if required) and a tie (blue, with diagonal stripes). Students are required to come to the University following this dress code. The tie will be required to be worn only on formal occasions. An apron (of the prescribed colour) is to be worn in the Chemistry Lab and during Workshop Practice. During winter, students may wear only a blazer and/or a sweater (full sleeve or sleeveless) of the prescribed colour and material.

1.2 The Student Identity Card is to be brought to the University every day and is to be produced whenever asked for. Entry to the University campus shall be only on production of the Identity Card. The Identity Card is also the Library Card.

1.3 All students should wear the ID card around the neck from entry in the morning to exit in the evening.

2. Morning Assembly

2.1 The morning assembly is a daily programme in the university on all class days during which all members, i.e., students, faculty, staff and management meet together. The assembly starts at the prescribed time. During the assembly, important announcements are made and a thought or insight is shared. The assembly is concluded with an invocation to God to bless the activities of the day. Note that any announcement made at the morning assembly is considered as being equivalent to notifying the same in the notice boards. All students should reach the assembly venue before prescribed time. Immediately after assembly all should proceed to the classroom to start class. Any change in procedures will be notified by the concerned School at the beginning of the Semester.

2.2 One of the following prayers may be used to conclude the Morning Assembly:

The Our Father
Our Father, who art in heaven,
Hallowed be thy name, Thy kingdom come, Thy will be done on earth as it is in heaven.
Give us this day, our daily bread
And forgive us our trespasses
As we forgive those who trespass against us. And lead us not into temptation,
But deliver us from all evil, Amen.

Or

Prayer for Peace
Lord, make me an instrument of your peace,
where there is hatred, let me sow love;
where there is injury, pardon;
where there is doubt, faith;
where there is despair, hope;
where there is darkness, light;
where there is sadness, joy;
O Divine Master, grant that I may not so much seek to be consoled as to console;
to be understood as to understand;
to be loved as to love.
For it is in giving that we receive;
it is in pardoning that we are pardoned;
and it is in dying that we are born to eternal life. Amen

3. Punctuality in Attending Classes

3.1 All are expected to be at their respective assembly venues five minutes before assembly time.

3.2 Normally no student shall leave the University before all the classes are over. In case of an emergency, a student may leave with proper written permission from the HOD of the concerned department.

3.3 While all students are encouraged to have their lunch in the University Canteens, students are permitted to take lunch outside the University.

4. Make-up Classes, Leave of Absence and Earned Attendance

4.1 If any student misses any laboratory class due to illness or other grievous problems, he/she is required to meet the concerned teacher for completing the experiments as soon as possible. Such make-up attendance will be taken into consideration at the end of the semester if attendance is less than 75%. At most two make-up attendances may thus be earned by any student.

4.2 Any student who is required to be engaged in a University activity or a pre-planned training and placement activity during class hours, may apply for the grant of an 'earned attendance' from the concerned HODs in the prescribed form available at the Reception. Such applications must be forwarded by the Activity In-Charge. For club related activities, Faculty Advisor of the concerned club will be the Activity In- Charge. In all other cases, Faculty In-Charge or Assistant Faculty In-Charge of Student Affairs will be the Activity In-Charge. Filled up forms shall be submitted preferably before or in case of emergency, immediately after the activity for which earned attendance is to granted.

4.3 Any student going to participate in any activity or competition outside the University must apply to the Faculty In-Charge of student Affairs using the prescribed form which must be forwarded by the Assistant Faculty In-Charge of Student Affairs in consultation with respective Club Advisers. On return, these students must report back to the Assistant Faculty In-Charge of Student Affairs for recording the outcome.

4.4 Any student who is not able to attend classes due to medical or other grievous reasons are required to apply for leave in the prescribed form along with valid medical certificates and other requisite documents, to the Faculty In-charge, students' affairs within seven days of joining back. Such applications must be signed by a parent of the student and forwarded by the mentor of the concerned student and the HOD of the concerned department. Only these students will be considered for condonement of deficiency in attendance.

5. Discipline

5.1 Personal, academic and professional integrity, honesty and discipline, a sense of responsibility and a high degree of maturity is expected of all students inside and outside the campus. Integrity calls for being honest in examinations and assignments, avoiding plagiarism and misrepresentation of facts.

5.2 Indulging in acts of violence, riotous or disorderly behaviour directed towards fellow students, faculty members or other employees of the institution/hostel in the campus or outside is considered to be a serious breach of discipline and will attract penalty.

5.3 Respect for Common Facilities: Care and respect for common facilities and utilities are an essential component of social responsibility. Any willful damage to University property must be made good by the persons concerned. Further, maintaining cleanliness of the classrooms and the entire campus is everyone's responsibility.

5.4 Substance Abuse: Chewing of tobacco, betel nut and the likes, smoking and the use of other addictive substances and alcoholic drinks are strictly prohibited. These should not be brought into or used within the campus of the University. Violation of this norm will lead to stern action.

5.5 Use of Cell Phones: Cell phones may be used in the University lawns, canteens andother open areas. However, the use of cell phones in classrooms and labs are strictly prohibited except when used for teaching/learning purposes with the explicit permission of the teacher concerned. The cell phone of anyone found violating this rule shall be confiscated and his/ her SIM card shall be taken away and retained in the University office for 7 days. If a person violates the norm for a second time, his/her mobile will be confiscated and retained in the University office till the end of the semester.

5.6 Use of Internet: The entire campus is wi-fi enabled and the students may use the Internet freely for educational purposes. Students may also use the Computing Centre for browsing the Net. However, the use of Internet to access unauthorized and objectionable websites is strictly prohibited.

5.7 All cases of indiscipline will be brought before the Students' Disciplinary Committee and the decisions made by the Committee for dealing with such cases shall be final.

6. Class Tests and Examinations

6.1 The conduct of examinations will be governed by the norms of the University.

6.2 The Student Identity Card shall be the Admit Card for the class tests

6.3 During class tests, all students are expected to enter the venue of the class test 15 minutes before the scheduled time of commencement. However, no one will be permitted into the examination hall after 15 minutes of the commencement of the class test and No one will be allowed to leave the examination hall until an hour has elapsed from the commencement of the class test.

6.4 No one is to leave the hall during examination for any purpose, except in case of an emergency.

6.5 Malpractices during class tests and examinations will not be tolerated and will attract stern action.

7. Ragging

Ragging and eve-teasing are activities which violate the dignity of a person and they will be met with zero tolerance. Anti-ragging norms have been given to each student at the time of admission and all students and parents have signed the anti-ragging affidavit. Any case of ragging and eve-teasing must be reported to the anti-ragging squad. All cases of violation of anti-ragging norms will be taken up by the anti-ragging Committee and punished according to the norms.

8. Grievance Redressal

The University has constituted a Grievance Redressal Cell to redress any genuine grievance students may have. Any student having a genuine grievance may make a representation to the Grievance Redressal Cell through his/her mentor. The representation should be accompanied by all relevant documents in support of the genuineness of the grievance.

9. School Association

9.1 The School Association is an association of the representatives of the various stake holders of the School – students, staff, faculty and management. It is the responsibility of the School Association to take charge of organizing most of the co-curricular activities such as the annual festivals, quizzes, debates, competitions and social events.

9.2 A male and a female student are elected by the students of each class as "class representatives" to represent them in the School Association. Class representatives are expected to be outstanding students who are academically competent and having qualities of leadership.

10. Participation in University Activities

10.1 In order to provide opportunities for the holistic development of the human person, a large number of co-curricular and extra-curricular activities are designed and implemented under the banner of the University Association and student clubs. Some of the most important activities are D'VERVE & BOSCOSIADE (intra- University sports and cultural festival during University Week), PRAJYUKTTAM (the inter-University technical festival). All students are expected to take part actively in such activities to showcase their talents, to develop leadership qualities and to gain the experience of working in groups.

10.2 **Training and Placement Activities:** The training and Placement Cell of DBCET has been incorporated with the objective of minimizing the gap between industry and academia and giving the students training and exposure so that they can capitalize on every opportunity for placement. It is the prime responsibility of the cell to look after all matters concerning 'Training to enhance employability' and 'guiding students for placement'. In the first two semesters, students are trained for communication skills development under the department of Humanities and Social Sciences, and personal development programmes under the department of campus ministry. From the third semester onwards, in every semester, students are given systematic training in aptitude tests, communication skills, group discussion, etc. They are also made to undergo mock HR and Technical Interviews. These activities of the training and placement cell find a place in the curriculum as Extra Academic Programmes (EAP) and all students are required to get a P grade for these activities by taking an active part in these activities regularly.

Other departments of the University offer customised services in training and placement of their students.

11. Free Time

Some hours without class may be available for some students during the day. Students are expected to use such 'free time' for visiting the library, meeting teachers and mentors, self- study, carrying out lab or project related activities, etc.

12. Faculty Performance Feedback

In order to improve the teaching and learning process in the University, students will be required to give feedback about the performance of their teachers from time-to-time. All students are expected to participate in the online feedback sessions concerning their teachers with sincerity and responsibility.

13. Mentoring

All students are assigned mentors from among the faculty members for their guidance. Directors of Schools in collaboration with the Heads of Departments will take care of assigning mentors. Mentors shall help the students to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them. Although students should meet their mentors on a regular basis to get timely help, specific days have been set aside in the calendar for meeting mentors to ensure proper documentation of achievements, activities, shortcomings and problems faced by the students. Every student must meet the mentor during these days.

14. Interaction Meet with Parents

The University organises interaction meetings with parents once a year in which the parents are invited to interact with teachers and management to appraise themselves about the performance of their ward and also to offer their suggestions for the betterment of the institution. It is the responsibility of the students too to invite their parents to come and participate in the event and make the event meaningful.

SCHOOL OF TECHNOLOGY

SCHOOL OF TECHNOLOGY
2022-2023
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BACHELOR OF TECHNOLOGY (BTECH) - COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE

SEMESTER I						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	588
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	581
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	85
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	592
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	164
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	244
	Mandatory Course/IC	BTUH0001	Universal Human Values I: Student Induction Program	0-0-0	NC	604
Total Credits					**18**	
SEMESTER II						
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	579
	Basic Science Course/IC	MAIN0013	Mathematics II- Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	581
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	262
	Humanities & Social Sciences including Management/IC	EGEH0111	English	2-0-0	2	595
Lab	Basic Science Course	CHCE6006	Engineering Chemistry Lab1	0-0-4	1	580
	Humanities & Social Sciences including Management/IC	EGOC6005	Oral Communication Practice Lab	0-0-2	1	596
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	323
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	483
Total Credits					20	
SEMESTER III						
Theory	Basic Science Course/IC	MAPS0024	Mathematics III-Probability and Statistics	2-0-0	2	582

	Engineering Science Course/IC	ECEC0050	Analog Electronic Circuits	3-0-0	3	354
	Professional Core Courses/DC	CSOP0080	Object Oriented Programming	3-0-0	3	85
	Professional Core Courses/DC	CSDC0081	Digital Electronics	3-0-0	3	86
	Professional Core Courses/DC	CSDS0082	Data structure and Algorithm	3-0-0	3	87
	Engineering Science Course/IC	ECEC6039	Analog Electronic Circuits Lab	0-0-2	1	
Lab	Professional Core Courses/DC	CSOP6070	Object Oriented Programming Lab	0-0-4	2	164
	Professional Core Courses/DC	CSDC6071	Digital Electronics Lab	0-0-4	2	165
	Professional Core Courses/DC	CSDS6072	Data Structure and Algorithm Lab	0-0-4	2	165
Internship		BTIA8	Internship Programme		2	
		BTUH0002	Universal Human Values II: Understanding Harmony		3	605
Total Credits					**26**	
SEMESTER IV						
	Professional Core Courses/DC	MADM0025	Discrete Mathematics with Applications	3-1-0	4	161/583
	Professional Core Courses/DC	CSOA0083	Computer Organization & Architecture	3-0-0	3	88
Theory	Professional Core Courses/DC	CSRD0084	Database Management Systems	3-0-0	3	89
	Professional Core Courses/DC	CSAD0085	Design and Analysis of Algorithms	3-0-0	3	91
	Humanities & Social Sciences including Management/IC	MTOB0086	Organisational Behaviour	3-0-0	3	
	Professional Core Courses/DC	CSOA6073	Computer Organization & Architecture Lab	0-0-4	2	
Lab	Professional Core Courses/DC	CSRD6074	Database Management Systems Lab	0-0-4	2	166
	Professional Core Courses/DC	CSAD6075	Design and Analysis of Algorithms Lab	0-0-4	2	
	Mandatory Course/IC	CHES0029	Environmental Science		0	578
	Mandatory Course/IC	EDCI0200	Constitution of India	0-0-0	NC	
Total Credits					**22**	
SEMESTER V						
	Professional Core Courses/DC	CSFA0122	Formal Language & Automata Theory	3-0-0	3	124
	Professional Core Courses/DC	CSOS0123	Operating Systems	3-0-0	3	124
Theory	Professional Core Courses/DC	CSDC0124	Data Communication	3-0-0	3	126
	Professional Elective Courses/DE	CSAA0103	Advanced Algorithms	3-0-0	3	
		CSSE0127	Software Engineering			126
		CSAI0143	Artificial Intelligence			138

	Humanities & Social Sciences including Management/IC	MTEE0104	Economics for Engineers	3-0-0	3	599
Lab	Professional Core Courses/DC	CSOS6082	Operating Systems Lab	0-0-4	2	170
	Professional Core Courses/DC	CSDC6083	Data Communication Lab	0-0-4	2	171
Project	Project/DC	CSMI6084	Mini Project I	0-0-2	1	171
			Value Added Course		0	
Internship		BTIP13	Internship Seminar		3	
Total Credits					**23**	
SEMESTER VI						
Theory	Professional Core Courses/DC	CSCD0128	Compiler Design	3-0-0	3	128
	Professional Core Courses/DC	CSNT0129	Computer Networks	3-0-0	3	129
	Professional Elective Courses/DE	CSPD0144	Parallel and Distributed Algorithms	3-0-0	3	139
		CSAP0145	Advanced Computer Architecture			140
		CSML0146	Machine Learning			141
			Robotics Process Automation			
	Professional Elective Courses/DE	CSCC0147	Computational Complexity	3-0-0	3	142
		CSDS0148	Distributed Systems	3-0-0		142
		CSDM0149	Data Mining			143
	Open Elective Courses/IE	MTPO0106	Production and Operations Management	0-0-4	3	602
			Soft skills			
			Course from Swayam			
Lab	Professional Core Courses/DC	CSCD6085	Compiler Design Lab	0-0-4	2	163
	Professional Core Course/DC	CSNT6086	Computer Networks Lab	3-0-0	2	163
	Professional Elective Courses/DE	CSPP6094	Parallel and Distributed Algorithms Lab	0-0-2	1	172
		CSAC6095	Advanced Computer Architecture Lab			173
		CSML6096	Machine Learning Lab			173
			Robotics Process Automation Lab			
	Professional Elective Courses/DE	CSCC6097	Computational Complexity Lab	0-0-2	1	174
		CSDS6098	Distributed Systems Lab			175
		CSDM6099	Data Mining Lab			175
Project	Professional Elective Courses/DE	CSMI6091	Mini Project II	0-0-2	1	172
Total Credits					**22**	
SEMESTER VII						
Theory	Basic Science Course/IC	BOBY0003	Biology	2-0-0	2	593
	Professional Elective Courses/DE	CSCG0150	Computational Geometry	3-1-0	4	144
		CSOS0151	Advanced Operating Systems			145
		CSSN0152	Speech and Natural Language Processing			146
	Professional Elective Courses/DE	CSCY0153	Computational Number Theory	3-0-0	3	146
		CSRT0154	Real Time Systems			147
		CSIR0155	Information Retrieval			148
	Open Elective Courses/IE	CSEC0163	E-Commerce and Cyber Security	3-0-0	3	154
		CSIC0164	ICT for development			155
			Course from Swayam			

Lab	Professional Elective Courses/DE	CSCG6100	Computational Geometry Lab	0-0-2	1	176
		CSAS6101	Advanced Operating Systems Lab			176
		CSSN6102	Speech and Natural Language Processing Lab			177
	Project/DC	CSMP6103	Major Project- Phase I	0-0-4	2	178
			Value Added Course	0-0-0	NC	178
Internship			Internship		3	
Total Credits					18	
SEMESTER VIII						
Theory	Professional Elective Courses/DE	CSQC0156	Quantum Computing	3	DE	149
		CSAD0157	Ad Hoc and Sensor Networks			150
		CSNN0158	Neural Networks and Deep Learning			150
		CSBF0159	Blockchain Fundamentals			151
	Open Elective Courses/IE	CSCM0160	Cloud Computing	3	IE	152
		CACB0165	Cyber law and ethics			156
			Course from Swayam			
	Open Elective Courses/IE	CSBA0161	Business Analytics	3	IE	153
		CSNT0162	Computer Networks			154
			Course from Swayam			
Project	Project/DC	CSMP6104	Major Project- Phase II	3	DC	178
		PYTK0103	Essence of Indian Traditional Knowledge	0	NC	
Total Credits				**12**		
Total Programme Credits				**161**		

LIST OF OPEN ELECTIVES

Semester VII

E-Commerce and Cyber Security
ICT for development
Course from Swayam

Semester VIII

Open Elective –I

Cloud Computing
Cyber law and ethics
Course from Swayam

Open Elective –II

Business Analytics
Computer Networks
Course from Swayam

LIST of VALUE ADDED COURSES OFFERED BY THE DEPARTMENT

a. Introduction to Cyber security **(CSCS6106)**
b. 3D Designing. Modeling and printing **(CSDM6107)**

COMPUTER SCIENCE AND ENGINEERING -BTECH (HONOURS)
COURSE STRUCTURE

Specialization: Data Science

Sl. No.	Course Name	Semester	Credits	Page No
SYJP0001	Joy of Computing using Python	3	4	
CSID0166	Introduction to Data Science	4	4	157
CSMF0172	Mathematical Foundation for Computer Science	5	4	

4	Data Visualization	6	2	
5	Data Visualization Lab	6	2	
6	Data Analytics	7	4	
		Total	**20**	

Specialization: Internet of Things

Sl. No.	**Course Name**	**Semester**	**Credits**	**Page No**
SYJP0001	Joy of Computing using Python	3	4	
CSII0167	Introduction to IoT	4	4	157
CSRA0173	Introduction to Raspberry Pi and Arduino	5	2	
CSRA6108	Introduction to Raspberry Pi and Arduino Lab	5	2	
5	IoT Platform and System Design	6	4	
6	Smart Sensors and Sensor Networking	7	4	
		Total	**20**	

COMPUTER SCIENCE AND ENGINEERING- BTECH MINOR ENGINEERING
COURSE STRUCTURE

Semester	Subject	Course Codes	Credit	Page No
Sem III	Data Structures and Algorithms (Theory)	CSDA0168	4	158
	Data Structures and Algorithms (Lab)	CSDA6105	1	
Sem IV	Computer Organisation and Architecture / Course from Swayam	CSOA0169	4	159
Sem V	Formal language and automata theory/ Course from Swayam		3	
Sem VI	Database management systems / Course from Swayam		3	
	Database management systems Lab		1	
Sem VII	Operating systems / Course from Swayam	CSOS0170	4	160
Total Credits			**20**	

MASTER OF TECHNOLOGY (MTECH)
COMPUTER SCIENCE AND ENGINEERING

SEMESTER I						
Type	**Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
	Specialization: Data Science					
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	92
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	93
	Core 3	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific Elective I	CSSC0088	Data Science	3-0-0	3	93
		CSDI0089	Distributed Systems			94
		CSDP0090	Data Preparation and Analysis			95
	Prog. Specific Elective II	CSRS0091	Recommender System	3-0-0	3	96
		CSML0092	Machine Learning			97
		CSTN0093	Data Storage Technologies and Networks			98
Lab	Lab1	CSDT6076	Advanced Data Structures Lab	0-0-4	2	167
	Lab2	CSML6077	Machine Learning Lab	0-0-4	2	
	Specialization: Internet of Things					
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	92
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	93
	Core 3	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific	CSSC0088	Data Science	3-0-0	3	93

	Elective I	CSWA0094	Wireless Access Technologies			98
		CSMS0095	Mobile Applications and Services			100
	Prog. Specific Elective II	CSML0092	Machine Learning	3-0-0	3	97
		CSSI0096	Smart Sensors and Internet of Things			101
		CSLF0097	Logic and Functional programming			101
Lab	Lab1	CSDT6076	Advanced Data Structures Lab	0-0-4	2	167
	Lab 2	CSML6077	Machine Learning Lab	0-0-4	2	
	Specialization: Information Security					
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	92
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	
	Core 3	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific Elective I	CSDF0098	Digital Forensics	3-0-0	3	102
		CSEH0099	Ethical Hacking			103
		CSID0100	Intrusion Detection			104
	Prog. Specific Elective II	CSMR0101	Malware Analysis & Reverse Engineering	3-0-0	3	105
		CSSC0102	Secure Software Design and Enterprise Computing			106
		CSML0092	Machine Learning			
Lab	Lab1	CSDT6076	Advanced Data Structures Lab	0-0-4	2	167
	Lab2	CSML6077	Machine Learning Lab	0-0-4	2	
Audit	Audit 1	EGRW0015	English for Research Paper Writing	2-0-0	0	594
Total Credits					18	
SEMESTER II						
	Specialization: Data Science					
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	107
	Core 4	CSSP0104	Soft Computing	3-0-0	3	108
	Prog. Specific Elective III	CSDV0105	Data Visualization	3-0-0	3	108
		CSBD0106	Big Data Analytics			109
		CSDD0107	Data Warehouse and Data Mining			110
	Prog. Specific Elective IV	CSDS0108	Data Security and Access Control	3-0-0	3	111
		CSWD0109	Web Analytics and Development			112
		CSKD0110	Knowledge Discovery			113
		CSNL0111	Natural Language Processing			114
Lab	Lab3	CSAA6078	Advanced Algorithm Lab	0-0-2	2	168
	Lab4	CSDV6079	Data Visualization Lab	0-0-2	2	168
	Specialization: Internet of Things					
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	107
	Core 4	CSSP0104	Soft Computing	3-0-0	3	108
	Prog. Specific Elective III	CSNI0112	Sensor Networks and Internet of Things	3-0-0	3	115
		CSDV0105	Data Visualization			108
		CSAC0113	IoT Application and Communication Protocol			116
	Prog. Specific Elective IV	CSBD0106	Big Data Analytics	3-0-0	3	109
		CSNY0114	Network Security			117
		CSAM0115	Advanced Machine Learning			117
Lab	Lab3	CSAA6078	Advance Algorithms Lab	0-0-2	2	168
	Lab4	CSDV6079	Data Visualisation Lab	0-0-2	2	168
	Specialization: Information Security					
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	107
	Core 4	CSSP0104	Soft Computing	3-0-0	3	108
	Prog. Specific Elective III	CSEC0116	Data Encryption & Compression	3-0-0	3	118
		CSSW0117	Steganography & Digital Watermarking			119
		CSIT0118	Information Theory & Coding			120
	Prog. Specific Elective IV	CSRA0119	Security Assessment and Risk Analysis	3-0-0	3	121
		CSCD0120	Secure Coding			122
		CSBI0121	Biometrics			123
Lab	Lab3	CSAA6078	Advance Algorithms Lab	0-0-2	2	168

	Lab4	CSEN6080	Data Encryption & Compression Lab	0-0-2	2	169
Project		CSMI6081	Mini Project with Seminar	0-0-2	2	170
Audit	Audit 2 (MOOCs)	EDCI0100	Constitution of India	0-0-0	0	
Total Credits					18	
SEMESTER III						
	Specialization: Data Science					
Theory	Prog. Specific Elective V	CSCG0134	GPU Computing	3-0-0	3	130
		CSCL0135	Cloud Computing			131
		CSDD0136	Distributed Databases			132
	Specialization: Internet of Things					
	Prog. Specific Elective V	CSCL0135	Cloud Computing	3-0-0	3	133
		CSIS0137	IOT and Smart Cities			134
		CSEM0138	Emulation and Simulation Methodologies			134
	Specialization: Information Security					
	Prog. Specific Elective V	CSDM0139	Data Warehousing & Mining	3-0-0	3	135
		CSWI0140	Web Search & Information Retrieval			136
		CSDY0141	Database Security and Access Control			137
	Open Elective	CSBA0142	Business Analytics	3-0-0	3	137
Project	Dissertation	CSDI6092	Dissertation Phase – I	0-0-20	10	172
Total Credits				**6-0-20**	16	
SEMESTER IV						
	Specialization: Data Science					
Project	Dissertation	CSDI6093	Dissertation Phase – II	0-0-32	16	172
	Specialization: Internet of Things					
	Dissertation	CSDI6093	Dissertation Phase – II	0-0-32	16	172
	Specialization: Information Securities					
	Dissertation	CSDI6093	Dissertation Phase – II	0-0-32	16	172
Total Credits				0-0-32	16	

DEPARTMENT OF CIVIL ENGINEERING

BACHELOR OF TECHNOLOGY

SEMESTER I						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page No**
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	579
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	581
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	262
Lab	Basic Science Course	CHCE6007	Engineering Chemistry Lab	0-0-2	2	580
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	323
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	483
	Mandatory Course/IC	BTUH0001	Universal Human Values I: Student Induction Program	0-0-0	NC	604
Total Credits					18	
SEMESTER II						
Theory	Basic Science Course/IC	PSEP0039	Engineering Physics: Mechanics	3-1-0	4	589
	Basic Science	MAIN0013	Mathematics II-Multiple Integrals, Numerical	3-1-0	4	581

	Course/IC		Methods and Differential Equations			
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	85
	Humanities & Social Sciences including Management/IC	EGEH0111	English	2-0-0	2	595
Lab	Basic Science Course/IC	PSEG6017	Physics Lab for Engineers	0-0-2	1	592
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	244
	Humanities & Social Sciences including Management/IC	EGOC6005	Oral Communication Practice Lab	0-0-2	1	596
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	164
	Mandatory Course/IC	EDCI0100	Constitution of India	0-0-0	NC	
Total Credits					**20**	
SEMESTER III						
Theory	Engineering Science Course/IC	ECBE0051	Basic Electronics	1-0-0	1	355
	Basic Science Course/IC	BOBE0002	Biology for Engineering	3-0-0	3	576
	Engineering Science Course/IC	MNEM0034	Engineering Mechanics	3-1-0	4	
	Engineering Science Course/IC	CVES0046	Energy science and Engineering	1-1-0	2	186
	Basic Science Course/IC	MATD0028	Mathematics III- Transform Calculus and Discrete Mathematics	2-0-0	2	586
	Humanities & Social Sciences including Management/IC	CVIC0054	Introduction to Civil Engineering	3-0-0	3	197
Lab	Engineering Science Course/IC	ECBE6040	Basic Electronics Lab	0-0-2	1	
	Engineering Science Course/IC	CVCA6025	Computer Aided Civil Engineering Drawing Lab	1-0-2	2	245
	Internship	BTIA8	Internship Activity	0-0-2	2	
	Mandatory Course/IC	BTUH0002	Universal Human Values II: Understanding Harmony	3-0-0	3	605
Total Credits					**23**	
SEMESTER IV						
Theory	Engineering Science Course/DC	MNME0041	Elements of Mechanical Engineering	2-1-01	3	
	Professional core course/DC	CVIS0053	Instrumentation and sensor Technologies for Civil Engineering Applications	1-1-0	2	196
	Professional core course/DC	CVEG0047	Engineering Geology	1-0-0	1	187
	Professional core course/DC	CVDP0048	Disaster Preparedness & Planning	1-1-0	2	189
	Professional core course/DC	CVFM0049	Introduction to Fluid Mechanics	2-0-0	2	190
	Professional core	CVSM0050	Introduction to Solid Mechanics	2-0-0	2	191

	course/DC					
	Professional core course/DC	CVSG0051	Surveying & Geomatics	1-1-0	2	193
	Professional core course/DC	CVMT0052	Materials, Testing and Evaluation	1-1-0	2	194
	Professional core course/DC	CVIS6031	Instrumentation & Sensor Technologies for Civil Engineering Applications Lab	0-0-2	1	
Lab	Professional core course/DC	CVEG6026	Engineering Geology Lab	0-0-2	1	246
	Professional core course/DC	CVFM6027	Introduction to Fluid Mechanics Lab	0-0-2	1	247
	Professional core course/DC	CVSM6028	Introduction to Solid Mechanics Lab	0-0-2	1	247
	Professional core course/DC	CVSG6029	Surveying & Geomatics Lab	0-0-2	1	248
	Professional core course/DC	CVMT6030	Materials, Testing and Evaluation Lab	0-0-2	1	248
	Mandatory Course/IC	MTOB0086	Organizational Behaviour	3-0-0	0	
Total Credits					**22**	
SEMESTER V						
	Professional Core course/DC	CVMM0056	Mechanics of Materials	3-0-0	3	199
	Professional Core course/DC	CVHE0057	Hydraulic Engineering	2-0-0	2	200
	Professional Core course/DC	CVSE0058	Structural Engineering	2-1-0	3	202
	Professional Core course/DC	CVGE0059	Geotechnical Engineering	2-0-0	2	204
Theory	Professional Core course/DC	CVHW0060	Hydrology & Water Resources Engineering	2-1-0	3	206
	Professional Core course/DC	CVEE0061	Environmental Engineering	2-0-0	2	207
	Professional Core course/DC	CVTE0062	Transportation Engineering	2-0-0	2	209
	Humanities and Social Sciences including Management courses /IC	MTPP0105	Professional Practice, Law & Ethics	2-0-0	2	600
	Mandatory courses/IC	CVSL0200	Service Learning - Theory	2-0-0	NC	
	Professional Core course/DC	CVHE6031	Hydraulic Engineering Lab	0-0-2	1	249
	Professional Core course/DC	CVGE6032	Geotechnical Engineering Lab	0-0-2	1	250
Lab	Professional Core course/DC	CVEE6033	Environmental Engineering Lab	0-0-2	1	251
	Professional Core course/DC	CVTE6034	Transportation Engineering Lab	0-0-2	1	251
Internship		BTIP13	Internship Seminar	0-0-2	2	
Total Credits					25	
SEMESTER VI						
Theory	Professional Core courses/DC	CVCM0063	Construction Engineering & Management	2-1-0	3	210
	Professional Core courses/DC	CVEC0064	Engineering Economics, Estimation & Costing	2-1-0	3	212

	Professional Elective courses/ DE Elective-I	CVCS0065	Design of Concrete Structures I	3-0-0	3	214
		CVED0066	Civil Engineering Design I			215
	Professional Elective courses/ DE Elective-II	CVSA0068	Structural Analysis I	3-0-0	3	217
		CVBP0069	Building Construction Practice			218
		CVGI0070	Geographic Information Systems and Science			219
	Open Elective courses/IE	CVIC0071	Open Elective-I (Humanities) Soft Skills and Interpersonal Communication	3-0-0	3	220
	Professional Elective courses/ DC Elective-III	CVSS0072	Design of Steel Structures	3-0-0	3	221
		CVRS0073	Repairs and Rehabilitation of Structures			222
		CVPT0074	Physio Chemical Process of Water and Waste Water Treatment			223
	Professional Elective courses/ DE Elective-IV	CVRE0075	Railway Engineering	3-0-0	3	224
		CVOC0076	Open Channel Flow			225
		CVSM0077	Soil Mechanics II			226
Lab	Professional Core courses/DC	CVEC6035	Engineering Economics, Estimation & Costing-Lab	0-0-4	2	251
	Activity Point Programme	CVSL0200	Service Learning-Field Work (Mandatory Course)	0-0-6	NC	
	Internship	BTIP14	Internship (Survey Camp)	0-0-2	1	
Total Credits					24	
SEMESTER VII						
Theory	Engineering Science Course	MBLS0001	Life Science	1-0-2	2	577
	Professional Elective courses/ DE Elective V	CVCS0090	Design of Concrete Structures II	3-0-0	3	226
		CVHS0067	Design of Hydraulic Structures and Irrigation Engineering			216
		CVPC0091	Prestressed Concrete			228
	Professional Elective courses/ DE Elective VI	CVSA0092	Structural Analysis II	3-0-0	3	229
		CVPH0093	Port and Harbor Engineering			230
		CVTM0094	Traffic Engineering and Management			230
	Open Elective courses/IE	CVMS0095	Metro Systems and Engineering	3-0-0	3	232
		CVRG0103	Remote Sensing and GIS			240
	Project/DC	CVMP6049	Project I-Minor Project	0-0-2	1	253
	Internship	CVIT6041	Industrial Training		3	252
Total Credits					15	
SEMESTER VIII						
Theory	Professional Elective courses/ DE Elective VII	CVBE0096	Bridge Engineering	3-0-0	3	233
		CVBH0097	Basics of Computational Hydraulics			233
		CVSH0098	Solid and Hazardous Management			234
	Professional Elective courses/ DE Elective VIII	CVEE0099	Earthquake Engineering	3-0-0	3	236
		CVST0100	Structural Dynamics			237
		CVMM0107	Structural Analysis by Matrix Methods			241
	Open Elective courses/IE	CVEL0101	Environmental Law and policy	3-0-0	3	238
	Open Elective courses/IE	CVSE0102	Sustainable engineering and Technology-/Economic Policies in India	3-0-0	3	239
	Project/DC	CVPJ6043	Project-II	0-0-8	4	252
		PYTK0103	Essence of Indian Traditional Knowledge	0-0-0	NC	
Total Credits					**16**	
Total Programme Credits					**163**	

LIST of PROFESSIONAL ELECTIVE COURSES/OPEN ELECTIVES

I. Professional Elective Courses

BTECH

	Course code	Course Name	L-T-P	Credits
Semester VI				
Elective I	CVCS0065	Design of Concrete Structures I	3-0-0	3
	CVED0066	Civil Engineering Design I		
Elective II	CVSA0068	Structural Analysis I	3-0-0	3
	CVBP0069	Building Construction Practice		
	CVGI0070	Geographic Information Systems and Science		
Elective III	CVSS0072	Design of Steel Structures	3-0-0	3
	CVRS0073	Repairs and Rehabilitation of Structures		
	CVPT0074	Physico-chemical Processes of Water and Wastewater Treatment		
Elective IV	CVRE0075	Railway Engineering	3-0-0	3
	CVOC0076	Open Channel Flow		
	CVSM0077	Soil Mechanics II		
Semester VII				
Elective V	CVCS0090	Design of Concrete Structures II	3-0-0	3
	CVPC0091	Prestressed Concrete		
	CVHS0067	Design of Hydraulic Structures and Irrigation Engineering		
Elective VI	CVSA0092	Structural Analysis II	3-0-0	3
	CVPH0093	Port and Harbor Engineering		
	CVTM0094	Traffic Engineering and Management		
Semester VIII				
Elective VII	CVBE0096	Bridge Engineering	3-0-0	3
	CVBH0097	Basics of Computational Hydraulics		
	CVSH0098	Solid and Hazardous Waste Management		
Elective VIII	CVEE0099	Earthquake Engineering	3-0-0	3
	CVST0100	Structural Dynamics		
	CVMM0107	Structural Analysis by Matrix Methods		

I. Open Elective Courses

	Course code	Course Name	L-T-P	Credits
Semester VI Open Elective I	CVIC0071	Soft Skills and Interpersonal Communication	3-0-0	3
Semester VII Open Elective II	CVMS0095	Metro Systems and Engineering	3-0-0	3
	CVRG0103	Remote Sensing and GIS		
Semester VIII Open Elective III	CVEL0101	Environmental Law and Policy	3-0-0	3
Semester VIII Open Elective IV	CVSE0102	Sustainable Engineering and Technology	3-0-0	3

LIST OF COURSES FOR HONOURS AND MINORS

List of courses offered for Honours in Civil Engineering

Domain 1: Environmental Engineering

Sl. No.	Course Name	Credits	Link
1	Plastic Waste Management	2	https://nptel.ac.in/courses/105/105/105105184/
2	Electronic Waste Management	1	https://nptel.ac.in/courses/105/105/105105169/
3	Applied Environmental Microbiology	3	https://nptel.ac.in/courses/105/107/105107173/
4	Water and Wastewater Treatment	3	https://nptel.ac.in/courses/105/105/105105178/
5	Water Supply Engineering	3	https://nptel.ac.in/courses/105/105/105105201/
6	Environmental Remediation	3	https://nptel.ac.in/courses/105/107/105107181/
7	Environmental Chemistry and Microbiology	3	https://nptel.ac.in/courses/102/105/102105087/
8	Applied Environmental Microbiology	3	https://nptel.ac.in/courses/105/107/105107173/

9	Integrated Waste Management for a Smart City	3	https://onlinecourses.nptel.ac.in/noc21_ce46/preview -3rd semester students
10	Wastewater Treatment and Recycling	3	https://onlinecourses.nptel.ac.in/noc21_ce49/preview -5th Sem students

Domain 2: Construction Technology

Sl. No.	Course Name	Credits	Link
1	Land Scape Architecture and Site Planning-Basic Fundamentals	2	https://nptel.ac.in/courses/124/105/124105001/
2	Maintenance and Repair of Concrete Structures	3	https://nptel.ac.in/courses/105/106/105106202/
3	Basic Construction Materials	3	https://onlinecourses.nptel.ac.in/noc21_ce10/preview
4	Safety in Construction	2	https://nptel.ac.in/courses/105/102/105102206/
5	Development and Application of Special Concrete	3	https://nptel.ac.in/courses/105/104/105104206/
6	Principles of Construction Management	2	https://nptel.ac.in/courses/105/104/105104161/
7	Construction Methods and Equipment Management	2	https://nptel.ac.in/courses/105/103/105103206/
8	Concrete Technology	3	https://nptel.ac.in/courses/105/102/105102012/ https://nptel.ac.in/courses/105/104/105104030/ https://nptel.ac.in/courses/105/106/105106176/
9	Project Planning & Control	3	https://onlinecourses.nptel.ac.in/noc21_ce50/preview
10	Hydration, Porosity & Strength of Cementitious Materials - for 3rd semester	3	https://onlinecourses.nptel.ac.in/noc21_ce66/preview
11	Elastic Stability of Structures	3	https://onlinecourses.nptel.ac.in/noc22_ce91/preview
12	Plates and shells	3	https://onlinecourses.nptel.ac.in/noc22_ce80/preview

Minor courses offered from Civil Engineering Department

Sl. No.	Course Name	Credits	Link
1	Basic Construction Materials	3	https://nptel.ac.in/courses/105/106/105106206/ https://nptel.ac.in/courses/105/102/105102088/
2	Geographic Information System	3	https://nptel.ac.in/courses/105/107/105107155/ https://nptel.ac.in/courses/105/107/105107206/
3	Geomorphology	3	https://nptel.ac.in/courses/105/107/105107200/
4	Maintenance and Repair of Concrete Structures	3	https://nptel.ac.in/courses/105/106/105106202/
5	Remote Sensing-Principles and Applications	3	https://nptel.ac.in/courses/105/101/105101206/ https://nptel.ac.in/courses/105/103/105103193/ https://nptel.ac.in/courses/105/107/105107201/ https://nptel.ac.in/courses/105/108/105108077/ https://nptel.ac.in/courses/105/107/105107160/
6	Strategies for Sustainable Design	3	https://nptel.ac.in/courses/124/106/124106157/
8	Introduction to Civil Engineering Profession	2	https://nptel.ac.in/courses/105/106/105106201/
9	Architectural Conservation and Historic Preservation	2	https://nptel.ac.in/courses/124/105/124105003/
10	Safety in Construction	2	https://nptel.ac.in/courses/105/102/105102206/

11	Natural Hazards	2	Https://nptel.ac.in/courses/105/104/105104183/

LIST of VALUE-ADDED COURSES offered by the DEPARTMENT

1	CVAD6046	Training on Computer Aided Drafting	2-0-0	255
2	CVBA6047	Training on Building Modeling and analysis using STAAD Pro	2-0-0	256
3	CVMA6048	Training on Modeling and analysis using ABACUS	2-0-0	256
4	CVCR6050	Detailing and Drafting of Concrete Reinforcement	2-0-0	257

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER I						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	588
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	581
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	85
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	592
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	1	164
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	244
	Mandatory Course/IC	BTUH0001	Universal Human Values I: Student Induction Program	0-0-0	NC	604
Total Credits					18	
SEMESTER II						
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	579
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	581
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	262
	Humanities & Social Sciences including Manage- ment/IC	EGEH0111	English	2-0-0	2	595
Lab	Basic Science Course	CHEC6006	Engineering Chemistry Lab1	0-0-4	1	580
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	323
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	483
	Humanities & Social Sciences including Management/IC	EGOC6005	Oral Communication Practice Lab	0-0-2	1	596
Total Credits					20	
SEMESTER III						

Theory	Professional Core Courses/DC	EECA0041	Electrical Circuit Analysis	3-1-0	4	263
	Professional Core Courses/DC	EEAE0042	Analog Electronics	3-0-0	3	264
	Professional Core Courses/DC	EEMC0044	Electrical Machines – I	3-0-0	3	266
	Professional Core Courses/DC	EEDE0045	Digital Electronics	3-0-0	3	267
	Humanities & Social Sciences including Management/IC	MTEC0074	Economics for Engineers	2-0-0	2	597
Lab	Professional Core Courses/DC	EEAE6028	Analog Electronics Lab	0-0-2	1	323
	Professional Core Courses/DC	EEMC6029	Electrical Machines Lab - I	0-0-2	1	324
	Professional Core Courses/DC	EEDE6030	Digital Electronics Lab	0-0-2	1	325
	Mandatory Course/IC	EDCI0100	Constitution of India		NC	
	Mandatory Course/IC	CHES0029	Environmental Science		NC	578
	Internship	BTIA8	Internship Activity		3	
	Mandatory Course/IC	BTUH0002	Student Induction Program: Understanding Harmony	0-0-0	NC	605
Total Credits					21	
SEMESTER IV						
Theory	Engineering Science Course/IC	MNEE0042	Engineering Mechanics for Electronics and Electricals	3-1-0	4	456
	Professional Core Courses/DC	EEMS0046	Electrical Machines – II	3-0-0	3	268
	Professional Core Courses/DC	EEEF0043	Electromagnetic Fields	3-0-0	3	265
	Professional Core Courses/DC	EEPE0047	Power Electronics	3-0-0	3	269
	Basic Sciences Course/IC	MACS0027	Mathematics III – Complex Variable, Transform Calculus and Probability and Statistics	3-1-0	4	585
	Basic Sciences Course/IC	BOBI0001	Biology	2-1-0	3	575
	Humanities & Social Sciences including Management/IC	MTOB0069	Introduction to Organisational Behaviour	2-0-0	2	599
Lab	Professional Core Courses/DC	EEMS6031	Electrical Machines – II Lab	0-0-2	1	325
	Professional Core Courses/DC	EEPE6032	Power Electronics Laboratory	0-0-2	1	326
Total Credits					**24**	
SEMESTER V						
Theory	Professional Core Courses/DC	EEPS0072	Power Systems -I	3-0-0	3	289
	Professional Core Courses/DC	EECS0073	Control Systems	3-0-0	3	290
	Professional Core Courses/DC	EEMM0074	Microprocessors and Microcontrollers	3-0-0	3	291
	Professional Core Courses/DC	EESS0075	Signals and Systems	3-0-0	3	292

	Professional Elective Courses/DE	EEED0076 EEEW0077	Electrical Machine Design/ Electromagnetic Waves	2-0-0	2	293 294
	Open Elective Courses/SE/IE	EEED0078	Electronic Devices/Data Structures and Algorithms	3-0-0	3	262
Lab	Professional Core Courses/DC	EEMM6042	Microprocessors and Microcontrollers Laboratory	0-0-2	1	330
	Professional Core Courses/DC	EERS6043	Power Systems Laboratory - I	0-0-2	1	331
	Professional Core Courses/DC	EECS6044	Control Systems Laboratory	0-0-2	1	331
Project	Professional Core Courses/DC	EEMI6045	Mini Project-I	0-0-2	1	332
Internship		BTIP13	Internship Seminar		3	
Total Credits					24	
SEMESTER VI						
Theory	Professional Core Courses/DC	EEPS0079	Power Systems - II	3-0-0	3	295
	Professional Core Courses/DC	EEMI0080	Measurements and Instrumentation	2-0-0	2	296
	Humanities & Social Sciences including Management/IC	MTPO0106	Production and Operations Management	3-0-0	3	602
	Professional Elective Courses/DE	EEED0082 EEHV0083	Electrical Drives High Voltage Engineering	3-0-0	3	296
	Professional Elective Courses/DE	EEDS0084 EEDP0085	Digital Control Systems Digital Signal Processing	3-0-0	3	298 299
	Open Elective Courses/SE/IE	ECES0128	Embedded Systems(ECE) Operations Research (MNE)	3-0-0	3	
Lab	Professional Core Courses/DC	EEPS6046	Power Systems Laboratory - II	0-0-2	1	332
	Professional Core Courses/DC	EEMI6047	Measurements and Instrumentation Lab	0-0-2	1	333
	Professional Core Courses/DC	EEED6055	Electronic Design Laboratory	1-0-2	3	333
Project	Professional Core Courses/DC	EEMI6049	Mini Project-II	0-0-2	1	334
Total Credits					23	
SEMESTER VII						
	Humanities & Social Sciences including Management/IC	MTFC0107	Financial Management and Accounting		2	603
	Professional Core Courses/DC	EEAD0093	Analog and digital Communications		3	303
	Professional Elective Courses/DE	EESP0094 EERE0095	Power System Protection Renewable Energy		3	303 304
	Open Elective Courses/SE/IE		Power Plant Engineering(MNE) Introduction to Artificial Intelligence and Machine Learning (ECE) ICT for development (CSE) E commerce and cyber security (CSE) Metro Systems Engineering(CVE) Remote sensing and GIS (CVE)		3	

	Professional Core Courses/DC	EEIT6052	Industrial Training		3	
	Professional Core Courses/DC	EEMP6053	Major Project Phase-I		1	335
Total Credits					18	
SEMESTER VIII						
Theory	Professional Elective Courses/DE	EEPQ0096 EESD0116	Power Quality and FACTS Power System Dynamics and Control		3	305
	Professional Elective Courses/DE	EEIS0097 EECA0098	Industrial Electrical Systems Electrical Energy Conservation and Auditing		3	306 307
	Open Elective Courses/SE/IE		Internet of things (ECE) Bioinformatics (ECE) Cloud computing (CSE) Business Analytics (CSE) Robotics and Automation (MNE) Operations Research (MNE)		3	
	Mandatory Course/IC	PYTK0103	Essence of Indian Traditional Knowledge		NC	
Project	Professional Core Courses/DC	EEMP6054	Major Project Phase II and Viva Voce		3	336
Total Credits					12	
Total Programme Credits					160	

OPEN ELECTIVES- BTECH (EEE)

Semester V						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory	Open Elective Courses/ SE/IE	EEEL0096	Electrical Machines (L-T-P is different from "Electrical Machines (minor)" offered for BTECH Minor)	3-0-0	3	321
		EEWE0092	Waste to Energy	3-0-0		302
Semester VI						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory	Open Elective Courses/ SE/IE	EEOD0099	Optoelectronic Devices	3-0-0	3	308
		EEEL0100	Electrical and Electronics Materials			309
Semester VII						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory	Open Elective Courses/ SE/IE	EESS0075	Signals and Systems	3-0-0	3	292
		EEOT0101	Optimization Techniques			311
Semester VIII						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory	Open Elective Courses/ SE/IE	EEGE0102	Green Energy	3-0-0	3	311
Total Credits					**12**	

BTECH (HONOURS) – ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE

For B.Tech (Honors) in EEE, students will have to earn extra 18 Credits in addition to the regular BTECH courses. There are two domains for BTECH (Honors) in EEE for a student to opt for.
In each domain, courses for 12 credits will be taught in the physical classroom and 6 credits will be earned from NPTEL/SWAYAM courses in self-learning mode

Sl. No.	Domain	Course Code	Courses	L-T-P	Credit	Semester	Learning Mode
1	**Power Systems**	EEEU0103	Energy Efficiency in Electrical Utilities (Page No-312)	4-0-0	4	4	Taught
2		EEED0104	Electrical Distribution System Analysis (Page No-313	4-0-0	4	5	Taught
3			Ongoing NPTEL/SWAYAM courses	4-0-0	3	6	NPTEL/SWAYAM
4			Ongoing NPTEL/SWAYAM courses	4-0-0	3	7	NPTEL/SWAYAM
5		EEDM0105	DC Microgrid (Page No-314	4-0-0	4	8	Taught
Total Credits					**18**		
1	**Control Systems**	EEPO0106	Practical Applications of Op-Amp (Page No-315)	4-0-0	4	4	Taught
2			Ongoing NPTEL/SWAYAM courses	4-0-0	3	5	NPTEL/SWAYAM
3			Ongoing NPTEL/SWAYAM courses	4-0-0	3	6	NPTEL/SWAYAM
4		EESD0107	Sensors and Transducers (Page No-316)	4-0-0	4	7	Taught
5		EEPI0108	Process Control and Instrumentation(Page No-317)	4-0-0	4	8	Taught
Total Credits					**18**		

BTECH (MINOR) – ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE STRUCTURE

For BTECH Minor in EEE, a student must earn a **minimum of 18 credits** in addition to the regular BTECH courses, by choosing a combination of courses from the list below:

Semester III						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory		EEEM0109	Electrical Machines (Minor)	3-0-0	3	318
		EEEW0110	Electrical Wiring	2-0-2		319
Semester IV						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory		EEMI0080	Measurements and Instrumentation	2-0-2	3	296
		EEEL0100	Electrical and Electronics Materials	3-0-0		309
Semester V						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory		EEAE0042	Analog Electronics	3-0-0	3	264
		EECS0073	Controls System			290
		EEWE0092	Waste to Energy			302
Semester VI						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory		EEOD0099	Optoelectronic Devices	3-0-0	3	308
		EEBC0111	Basic Communication Systems			319
Semester VII						
Type	**Type of Course/**	**Course**	**Course Title**	**L-T-P**	**Credits**	**Page**

	Category	Code				
Theory		EEPS0072	Power Systems-I	3-0-0	3	289
		EEED0078	Electronic Devices			262
Semester VIII						
Type	**Type of Course/ Category**	**Course Code**	**Course Title**	**L-T-P**	**Credits**	**Page**
Theory		EEIS0097	Industrial Electrical Systems	3-0-0	3	306
		EECA0098	Electrical Energy Conservation and Auditing			307
Total Credits					**18**	

VALUE ADDED COURSES BY EEE Dept

Semester	Course Code	Course Title	L-T-P	Credits	Page
6	EEAR0112	Introduction to Arduino and Raspberry Pi	0-1-2	2	337
7	EEAL0113	AutoCAD Electrical	0-1-2	2	338
7	EEEL0114	Electrical Wiring	0-1-2	2	338
8	EEPY0115	Python for Electrical Engineering	0-1-2	2	339

MASTER OF TECHNOLOGY (MTECH)
ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER I						
Type	**Course Type/Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
	Specialization: Power Systems					
Theory	Core 1	EESA0048	Power System Analysis	3-0-0	3	270
	Core 2	EESD0049	Power System Dynamics-I	3-0-0	3	271
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Programme Specific Elective I	EEHP0050	High Power Converters	3-0-0	3	272
		EEWS0051	Wind and Solar Systems			273
	Programme Specific Elective II	EEPD0052	Electrical Power Distribution System	3-0-0	3	274
		EEMM0053	Mathematical Methods for Power Engineering			275
Lab	Lab1	EESS6033	Power System Steady State Analysis Lab	0-0-4	2	327
	Lab2	EERE6034	Renewable Energy Lab	0-0-4	2	327
		Specialization: Control Systems				
Theory	Core 1	EEMC0054	Mathematical Methods in Control	3-0-0	3	276
	Core 2	EENS0055	Non-Linear Systems	3-0-0	3	276
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Programme Specific Elective I		Robotics and Automation	3-0-0	3	
		EECL0056	Digital Control			277
		EENC0057	Non-Linear Control			277
	Programme Specific Elective II		Systems Biology	3-0-0	3	
		EESC0058	SCADA system and Applications			278
		EEDA0059	Design Aspects in Control			279
Lab	Lab1	EECT6035	Control Lab 1	0-0-4	2	328
	Lab 2	EECL6036	Control Lab 2	0-0-4	2	328
Audit	Audit 1	EGRW0015	English for Research Paper Writing	2-0-0	0	594
Total Credits				**16-0-8**	18	
SEMESTER II						
	Specialization: Power Systems					
Theory	Core 3	EEDP0060	Digital Protection of Power System	3-0-0	3	280

	Core 4	EEPD0061	Power System Dynamics-II	3-0-0	3	280
	Programme Specific Elective III	EERP0062	Restructured Power Systems	3-0-0	3	281
		EEAS0063	Advanced Digital Signal Processing			282
	Programme Specific Elective IV	EEAS0064	Power System Transients	3-0-0	3	283
		EEFC0065	FACTS and Custom Power Devices			284
Lab	Lab3	EEPL6037	Power System Protection Lab	0-0-4	2	328
	Lab4	EEPA6038	Power Electronics Applications to Power Systems Lab	0-0-4	2	329
	Specialization: Control Systems					
Theory	Core 3	EEOC0066	Optimal Control Theory	3-0-0	3	285
	Core 4	EESF0067	Stochastic Filtering and Identification	3-0-0	3	286
	Programme Specific Elective III	EECS0068	Advance Control System	3-0-0	3	286
		EEAL0069	Adaptive Learning and Control			287
	Programme Specific Elective IV	EEMR0070	Model Reduction in Control	3-0-0	3	288
		EERC0071	Robust Control			288
			Networked and Multi agent Control Systems			
			Advanced DSP			
Lab	Lab3	EEAL6039	Advanced Control Lab 1	0-0-4	2	329
	Lab4	EEAC6040	Advanced Control Lab 2	0-0-4	2	330
Project		EEMP6041	Mini Project	0-0-4	2	330
Audit	Audit 2 (MOOCs)	EDCI0100	Constitution of India	0-0-4	2	
Total Credits				**14-0-12**	**18**	
SEMESTER III						
	Specialization: Power Systems					
Theory	Prog. Specific Elective V	EESC0058	SCADA system and Applications	3-0-0	3	278
		EEMC0087	Advanced Micro-Controller Based Systems	3-0-0	3	300
		EEPQ0088	Power Quality			301
	Specialization: Control Systems					
	Prog. Specific Elective V	EEMD0089	Modeling and Control of Distributed parameter system	3-0-0	3	
		EESC0090	Stochastic Control			
		EESC0091	Computational Methods			
	Open Elective	EEWE0091	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3-0-0	3	
Project	Dissertation	EEDI6050	Dissertation Phase – I	0-0-20	10	334
Total Credits				**6-0-20**	**16**	
SEMESTER IV						
Project	**Specialization: Power Systems**					
	Dissertation	EEDI6051	Dissertation Phase – II	0-0-32	16	335
	Specialization: Control Systems					
	Dissertation	EEDI6051	Dissertation Phase – II	0-0-32	16	335

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
BACHELOR OF TECHNOLOGY

SEMESTER I						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	588
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	581
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	85
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	592
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	164
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	244
		BTUH0001	Universal Human Values I: Student Induction Program			604
Total Credits					18	
SEMESTER II						
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	579
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	581
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	262
	Humanities & Social Sciences including Management/IC	EGEH0111	English	2-0-0	2	595
Lab	Basic Science Course/IC	CHCE6006	Engineering Chemistry Lab1	0-0-4	1	580
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	323
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	483
	Humanities & Social Sciences including Management/IC	EGOC6005	Oral Communication Practice Lab	0-0-2	1	596
Total Credits					20	
SEMESTER III						
Theory	Professional Core Course /DC	ECED0043	Electronic Devices	3-0-0	3	347
	Professional Elective courses/ DE	ECSS0044	Signal and Systems	2-1-0	3	348
	Professional Core Course/DC	ECNT0045	Network Theory	2-1-0	3	349
	Professional Core Course/DC	ECDS0046	Digital System Design	3-0-0	3	350
	Basic Sciences Course /SC	MATC0026	Mathematics III- Transform Calculus, Complex Variable and Probability and Statistics	2-1-0	3	584
	Humanities and Social Science Course /IC	MTEC0074	Economics for Engineers	2-0-0	2	597
	Mandatory Course/IC	CHES0029	Environmental Science	0-0-0	NC	578
Lab	Professional Core Course /DC	ECED6034	Electronic Devices Lab	0-0-2	1	430
	Professional Core Course /DC	ECDS6035	Digital System Design Lab	0-0-2	1	430
Internship		BTIA8	Internship Activity		3	

	Mandatory Course/IC	BTUH0002	Universal Human Values II: Understanding Harmony	0-0-3	3	605
Total Credits					25	
SEMESTER IV						
Theory	Professional Core Course /DC	ECAC0047	Analog Circuits	3-0-0	3	351
	Professional Core Course /DC	ECEL0048	Electronic Measurements	3-0-0	3	352
	Basic Science Course /IC	BOBI0001	Biology	2-1-0	3	575
	Professional Core Course /DC	ECDP0049	Digital Signal Processing	2-1-0	3	352
	Engineering Science Course /IC	MNEE0042	Engineering Mechanics for Electronics and Electricals	3-1-0	4	456
	Humanities and Social Science Course /IC	MTOB0069	Introduction to Organisational Behaviour	2-0-0	2	599
Lab	Professional Core Course /DC	ECAC6036	Analog Circuits Lab	0-0-2	1	430
	Professional Core Course /DC	ECEL6037	Electronic measurements Lab	0-0-2	1	431
	Professional Core Course /DC	ECDP6038	Digital Signal Processing Lab	0-0-2	1	431
	Mandatory Course/IC	EDCI0200	Constitution of India	2-0-0	NC	
Total Credits					21	
SEMESTER V						
Theory	Professional Core Course /DC	ECAC0081	Analog and Digital Communication	3-0-0	3	384
	Professional Core Course /DC	ECMM0082	Microprocessor and Microcontroller	3-0-0	3	385
	Professional Core Course /DC	ECCA0083	Computer Architecture	3-0-0	3	386
	Professional Core Course /DC	ECPS0084	Probability Theory and Stochastic Processes	3-0-0	3	387
	Professional Elective Course /DE	ECPE0085	Power Electronics	3-0-0	3	388
		ECBE0086	Biomedical Electronics			389
		ECSS0087	Speech Signal Processing			389
	Open Elective Course/SE	ECNT0088	Nanotechnology	3-0-0	3	390
Lab	Professional Core Course /DC	ECAC6052	Analog and Digital Communication Lab	0-0-2	1	437
	Professional Core Course /DC	ECMM6053	Microprocessor and Microcontroller Lab	0-0-2	1	438
	Professional Core Course /DC	ECMI6054	Mini Project	0-0-2	1	438
Internship		BTIP13	Internship Seminar	0-0-0	3	
Total Credits					24	
SEMESTER VI						
Theory	Professional Core Course /DC	ECCS0089	Control System	3-0-0	3	391
	Professional Core Course /DC	ECNT0090	Computer Networks	3-0-0	3	392
	Professional Core Course /DC	ECEW0091	Electromagnetic Waves	3-0-0	3	393
	Professional Elective Course/DE	ECCD0092	CMOS Design	3-0-0	3	394
		ECNE0093	Nanoelectronics			395

		ECIC0094	Information Theory and Coding			396
	Open Elective Course/IE	ECRB0095	Robotics	3-0-0	3	396
	Open Elective Course/IE	ECES0128	Embedded Systems			428
	Humanities and Social Science Course /IC	MTPO0106	Production and Operations Management	3-0-0	3	602
Lab	Professional Core Course /DC	ECEW6057	Electromagnetic Waves Lab	0-0-2	1	439
	Professional Core Course /DC	ECNT6064	Computer Networks Lab	0-0-2	1	441
Internship		BTIP15	Industrial Training	0-0-0	0	
Total Credits					20	
SEMESTER VII						
Theory	Professional Core Course /DC	ECWP0102	Antennas and Wave Propagation / Wavelets	3-0-0	3	404
	Professional Elective Course /DE	ECES0103 ECMN0104	Embedded System/ Mobile Communication and Networks	3-0-0	3	404
	Professional Elective Course/DE	ECWN105 ECSC0106	Wireless Sensor Network/ Satellite Communication	3-0-0	3	406/ 407
	Open Elective Course/IC	ECAM0107	Introduction to Artificial Intelligence and Machine Learning	3-0-0	3	408
	Humanities and Social Science Course/IC	MTFC0107	Financial Management and Accounting	2-0-0	2	603
Internship		ECPR6061	Project-I	0-0-2	1	440
		ECTS6062	Training Seminar	0-0-0	4	441
Total Credits					20	
SEMESTER VIII						
Theory	Professional Elective Course/DE	ECOC0108 ECAS0109	Fiber Optic Communication / Adaptive Signal Processing	3-0-0	3	409/ 410
	Professional Elective Course /DE	ECMT0110 ECDV0111	Microwave Theory & Technique / Digital Image and Video Processing/ Mixed Signal Design	3-0-0	3	411
	Open Elective Course/IE	ECIT0112	Internet of Things	3-0-0	3	412
	Open Elective courses/IE	ECBI0113	Bioinformatics	3-0-0	3	413
Internship	Professional Core Course /DC	ECPR6063	Project-II	0-0-9	3	441
	Mandatory Course/IC	PYTK0103	Essence of Indian Traditional Knowledge		NC	
Total Credits					**15**	
Total Programme Credits					**163**	

LIST OF OPEN ELECTIVES

SEMESTER V						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
Theory	Open Elective Course/SE	ECNT0088	Nanotechnology	3-0-0	3	390
SEMESTER VI						
Theory	Open Elective Course/IE	ECRB0095	Robotics	3-0-0	3	396
	Open Elective Course/IE	ECES0128	Embedded Systems			428
SEMESTER VII						
Theory	Open Elective Course/IC	ECAM0107	Introduction to Artificial Intelligence and	3-0-0	3	408

			Machine Learning			
SEMESTER VIII						
Theory	Open Elective Course/IE	ECIT0112	Internet of Things	3-0-0	3	412
	Open Elective courses/IE	ECBI0113	Bioinformatics	3-0-0	3	413

LIST OF VALUE ADDED COURSES

SPRING						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
Theory	Value Added Course/DE	ECES6064	Electronic Display System	2-0-0	2	443
AUTUMN						
Theory	Value Added Course/DE	ECNA6065	Nanotechnology and Applications	2-0-0	2	443

LIST OF HONORS COURSES (IOT AND SENSOR TECHNOLOGY)

SEMESTER IV						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Professional Core Course/DC	ECST0114	Sensor Technology	3-1-0	4	414
SEMESTER V						
Theory	Professional Core Course/DC	ECBA0115	IoT Basics & Architecture	3-1-0	4	415
SEMESTER VI						
Theory	Professional Core Course/DC	ECWT0116	Web Technology	3-1-0	4	416
SEMESTER VII						
Theory	Professional Core Course/DC	ECML0117	Machine Learning	3-1-0	4	417
SEMESTER VIII						
Theory	Professional Core Course/DC	ECET0118	Embedded Systems and IOT	3-1-0	4	417

LIST OF HONORS COURSES (SIGNAL PROCESSING AND VLSI)

SEMESTER IV						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Professional Core Course/DC	ECVD0096	VLSI Design Technology	3-1-0	4	398
SEMESTER V						
Theory	Professional Core Course/DC	ECSV0119	Signal Processing for VLSI	3-1-0	4	418
SEMESTER VI						
Theory	Professional Core Course/DC	EDDS0120	Advance DSP	3-1-0	4	419
SEMESTER VII						
Theory	Professional Core Course/DC	ECML0117	Machine Learning	3-1-0	4	417
SEMESTER VIII						
Theory	Professional Core Course/DC	ECCV0121	Fundamentals of Computer Vision	3-1-0	4	420

LIST OF MINOR COURSES (ELECTRONICS AND COMMUNICATION)

SEMESTER IV						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Professional Elective Course/SE	ECDC0122	Digital Circuits	3-1-0	4	422
SEMESTER V						
Theory	Professional Elective Course/SE	ECSC0123	Semiconductor Devices and Circuits	3-1-0	4	423
SEMESTER VI						
Theory	Professional Elective Course/SE	ECFC0124	Fundamentals of Analog Electronic Circuit/ Principles of Communication	3-1-0	4	424
SEMESTER VII						
Theory	Professional Elective	ECIM0125	Introduction to Microprocessor and	3-1-0	4	425

	Course/SE		Microcontroller			
SEMESTER VIII						
Theory	Professional Elective Course/SE	ECIC0126 ECMC0127	Semiconductor IC Technology/ Microelectronics: Devices to Circuits	3-1-0	4	426/ 427

MASTER OF TECHNOLOGY (MTECH)
ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER I						
Type	**Course Type/Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
	Specialization: Power Systems					
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	357
	Core 2	ECDV0054	Digital Image and Video Processing	3-0-0	3	358
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific Elective I	ECAU0055	Audio Processing	3-0-0	3	359
		ECCV0056	Computer Vision			360
		ECAA0057	Advanced Computer Architecture			361
	Prog. Specific Elective II	ECSI0058	Statistical Information Processing	3-0-0	3	362
		ECVD0059	Voice and Data Networks			363
		ECVC0060	Audio Video Coding & Compression			364
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	433
	Lab2	ECDV6042	Digital Image and Video Processing Lab	0-0-4	2	433
	Specialization: Communications					
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	357
	Core 2	ECWM0061	Wireless and Mobile Communication	3-0-0	3	365
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific Elective I	ECSC0062	Satellite Communication	3-0-0	3	366
		ECWN0063	Wireless Sensor Networks			367
		ECON0064	Optical Networks			368
	Prog. Specific Elective II	ECCR0065	Cognitive Radio	3-0-0	3	369
		ECSI0058	Statistical Information Processing			362
		ECRC0066	RF and Microwave Circuit Design			370
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	433
	Lab 2	ECWM6043	Wireless and Mobile Communication Lab			434
	Specialization: Embedded System					
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	357
	Core 2	ECMA0067	Microcontroller and Applications	3-0-0	3	371
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	347
	Prog. Specific Elective I	ECPP0068	Parallel Processing	3-0-0	3	372
		ECAA0057	Advanced Computer Architecture			372
	Prog. Specific Elective II	ECWM0061	Wireless and Mobile Communication	3-0-0	3	365
		ECDV0054	Digital Image and Video Processing			358
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	433
	Lab2	ECMA6044	Microcontroller and Applications Lab	0-0-4	2	434
Audit	Audit 1	EGRW0015	English for Research Paper Writing	2-0-0	2	594
Total Credits				**16-0-8**	18	
SEMESTER II						
	Specialization: Signal Processing					
Theory	Core 3	ECPM0069	Pattern Recognition and Machine Learning	3-0-0	3	373
	Core 4	ECDE0070	Detection and Estimation Theory	3-0-0	3	374
	Prog. Specific Elective III	ECIA0071	IOT and Applications	3-0-0	3	375
		ECDD0072	Digital Design and Verification			376

	Prog. Specific Elective IV	ECBS0073	Biomedical Signal Processing	3-0-0	3	377
		ECDS0074	DSP Architecture			378
Lab	Lab3	ECPM6045	Pattern Recognition and Machine Learning Lab	0-0-4	2	434
	Lab4	ECDE6046	Detection and Estimation Theory Lab	0-0-4	2	435
		Specialization: Communications				
Theory	Core 3	ECRS0075	Antennas and Radiating Systems	3-0-0	3	379
	Core 4	ECCN0076	Advanced Communication Networks	3-0-0	3	380
	Prog. Specific Elective III	ECDS0074	DSP Architecture	3-0-0	3	378
		ECIA0071	IOT and Applications			375
	Prog. Specific Elective IV	ECPM0069	Pattern Recognition and Machine Learning	3-0-0	3	373
		ECMS0077	MIMO System			381
Lab	Lab3	ECRS6047	Antennas and Radiating Systems lab	0-0-4	2	435
	Lab4	ECCN6048	Advanced Communication Networks Lab	0-0-4	2	436
		Specialization: Embedded System				
Theory	Core 3	ECDS0074	DSP Architecture	3-0-0	3	378
	Core 4	ECSA0078	Embedded System and Applications	3-0-0	3	382
	Prog. Specific Elective III	ECDD0072	Digital Design and Verification	3-0-0	3	376
		ECIA0071	IOT and Applications			375
	Prog. Specific Elective IV	ECMT0079	Memory Technologies	3-0-0	3	382
		ECBS0080	Communication Buses and Interfaces			383
Lab	Lab3	ECDS6049	DSP Architecture lab	0-0-4	2	436
	Lab4	ECSA6050	Embedded System and Applications Lab	0-0-4	2	437
Project		ECMI6051	Mini Project	0-0-4	2	437
Audit	Audit 2 (MOOCs)	EDCI0100	Constitution of India	2-0-0	0	437
Total Credits				**14-0-12**	18	
SEMESTER III						
	Specialization: Signal Processing					
Theory	Prog. Specific Elective V	ECAI0096	Artificial Intelligence	3-0-0	3	397
		ECOT0097	Optimization Techniques			399
		ECRS0098	Remote Sensing			400
	Specialization: Communications					
	Prog. Specific Elective V	ECAI0096	Artificial Intelligence	3-0-0	3	397
		ECOT0097	Optimization Techniques			399
		ECRS0098	Remote Sensing			400
	Specialization: Embedded System					
	Prog. Specific Elective V	ECAI0096	Artificial Intelligence	3-0-0	**3**	397
		ECNN0099	Nanotechnology and Nanoelectronics			401
		ECSD0100	SoC Design			403
	Open Elective	ECBI0129	Bioinformatics	3-0-0	3	413
Project	Dissertation	ECDI6059	Dissertation Phase – I	0-0-20	10	439
Total Credits				**6-0-20**	**26**	439
SEMESTER IV						
Theory	**Specialization: Signal Processing**					
	Dissertation	ECDI6060	Dissertation Phase – II	0-0-32	16	440
	Specialization: Control Systems					
	Dissertation	ECDI6060	Dissertation Phase – II	0-0-32	16	440
	Specialization: Embedded System					
	Dissertation	ECDI6060	Dissertation Phase – II	0-0-32	16	440
Total Credits				0-0-32	16	

LIST OF OPEN ELECTIVES

SEMESTER III						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
Theory	Open Elective	ECBI0129	Bioinformatics	3-0-0	3	429

DEPARTMENT OF MECHANICAL ENGINEERING
BACHELOR OF TECHNOLOGY (BTECH)-MECHANICAL ENGINEERING
COURSE STRUCTURE

SEMESTER I						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**Page**
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	579
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	581
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	262
Lab	Basic Science Course	CHCE6007	Engineering Chemistry Lab	0-0-2	2	580
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	323
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	483
	Mandatory Course/IC	BTUH0001	Student Induction Program- Universal Human Values I	0-0-0	NC	604
Total Credits					**18**	
SEMESTER II						
Theory	Basic Science Course/IC	PSET0040	Engineering Physics: Electromagnetic Theory	3-1-0	4	590
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	581
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	85
	Humanities & Social Sciences including Management/IC	EGEH0111	English	2-0-0	2	595
Lab	Basic Science Course/IC	PSEG6017	Physics Lab for Engineers	0-0-2	1	592
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	244
	Humanities & Social Sciences including Management/IC	EGOC6005	Oral Communication Practice Lab	0-0-2	1	596
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	164
	Mandatory Course/IC	EDCI0100	Constitution of India	0-0-0	NC	
Total Credits					**20**	
SEMESTER III						
Theory	Basic Science course/IC	PSWO0049	Engineering Physics: Waves and Optics	3-0-1	4	591
	Basic Science course/IC	MACP0029	Engineering Mathematics III-Complex Variables, PDE and Probability and statistics	3-1-0	4	586
	Basic Science course/IC	BOBE0002	Biology for Engineering	3-0-0	3	576
	Engineering Science Course/IC	ECEE0052	Basic Electronics Engineering	3-1-0	4	354
	Engineering Science Course/IC	MNEM0034	Engineering Mechanics	3-1-0	4	447
	Professional core course/DC	MNBT0035	Basic Thermodynamics	3-1-0	4	448
	Audit Course	MNMD6024	Machine Drawing Lab	0-0-2	NC	483
	Internship	BTIP14	Internship Programme		2	
	Mandatory Course	BTUH0002	Universal Human Values II: Understanding Harmony	3-0-0	3	605
Total Credits					**28**	

SEMESTER IV						
Theory	Professional core course/DC	MNAP0036	Applied Thermodynamics	3-1-0	4	449
	Professional core course/DC	MNFM0037	Fluid Mechanics	3-1-0	4	450
	Professional core course/DC	MNSM0038	Strength of Materials	3-1-0	4	451
	Engineering Science Course/IC	MNSE0039	Materials Science and Engineering	3-0-0	3	452
	Professional core course/DC	MNIC0040	Instrumentation and Control	3-0-0	3	453
	Mandatory Course	CHES0029	Environmental Science	0-0-0	NC	578
Lab		MNMF6025	Mechanical Engineering Lab1: Materials and Manufacturing Lab	0-0-4	2	484
	Mandatory Course/IC	EDCI0100	Constitution of India	0-0-0	NC	
Total Credits					**20**	
SEMESTER V						
Theory	Professional core course/DC	MNHT0041	Heat Transfer	3-1-0	4	457
	Professional core course/DC	MNDM0042	Design of Machine Elements	3-1-0	4	458
	Professional core course/DC	MNMP0043	Manufacturing Processes	3-1-0	4	459
	Professional core course/DC	MNKT0044	Kinematics & Theory of Machine	3-1-0	4	460
	Humanities	MTEE0104	Economics for Engineers	3-0-0	3	599
Lab	Professional core course/DC	MNFT6026	Mechanical Engineering Lab2: Fluid and Thermal	0-0-4	2	485
		MNMI6027	Mini Project	0-0-2	1	485
	Internship	BTIP13	Internship Seminar		3	
	Mandatory Course/IC	MNSL0200	Service Learning		NC	487
Total Credits					**25**	
SEMESTER VI						
Theory	Professional core course/DC	MNMT0045	Manufacturing Technology	4-0-0	4	461
	Professional core course/DC	MNDD0046	Machine Design and Dynamics	3-1-0	4	462
	Professional Elective Courses I/DE	MNHM0047 MNMP0048	a) Hydraulic Machines b) Advance Manufacturing Processes	3-0-0	3	463 464
	Professional Elective Courses II/DE	MNCM0049 MNIC0050	a) Composite Materials b) Internal Combustion Engines	3-0-0	3	465 465
	Open Elective Humanities and Social Sciences including Management courses/IC	MTPO0106	Production and Operation Management	3-0-0	3	602
Lab	Professional core course/DC	MNDS6028	Mechanical Engineering Lab3: Design	0-0-4	2	486
Value Added Course		MNRF6032	Royal Enfield Fresher's Course		NC	489
Total Credits					19	
SEMESTER VII						
Theory	Professional core course/DC	MNAM0051	Automation in Manufacturing	3-0-0	3	466
	Professional Elective courses III/DE	MNRC0052 MNSE0053 MNSN0054	a) Refrigeration and Air Conditioning b) Non-conventional Sources of energy c) Solid Mechanics	3-0-0	3	467 468 469

	Professional Elective courses IV/DE	MNER0055 MNAE0056	a) Energy Conservation and Waste Heat Recovery b) Automobile Engineering	3-0-0	3	470 471
	Open Elective courses/IE	MNPE0057 MNQM0058	a) Power Plant Engineering b) Total Quality Management	3-0-0	3	472 472
Project	Professional core course/DC	MNMP6029	Major Project Phase I	0-0-2	2	486
	Internship	MNIT6030	Industrial Training		3	
Total Credits					17	
SEMESTER VIII						
	Professional Elective courses V /DE	MNCA0059 MNSG0060	a) CAD/CAM (COMPUTER AIDED DESIGN AND MANUFACTURING) b) Surface Engineering	3-0-0	3	474 475
	Professional Elective courses VI /DE	MNWT0061 MNGT0062	a) Welding Technology b) Gas Turbines and Jet Propulsion	3-0-0	3	476 477
	Open Elective courses/IE	MNOR0065	Operations Research	3-0-0	3	480
	Open Elective courses/IE	MNRA0064	Robotics and Automation	3-0-0	3	478
Project	Professional core course/DC	MNMP6031	Major Project Phase II	0-0-8	4	486
	Mandatory Course/IC	PYTK0103	Essence of Indian Traditional Knowledge		NC	
Total Credits					**16**	
Total Programme Credits					**163**	

LIST OF OPEN ELECTIVES- MECHANICAL ENGINEERING

SEMESTER VII						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
Theory	Open Elective Course/SE	MNPE0057	Power Plant Engineering	3-0-0	3	472
	Open Elective Course/SE	MNQM0058	Total Quality Management	3-0-0	3	473
SEMESTER VIII						
Theory	Open Elective Course/IE	MNOR0065	Operations Research	3-0-0	3	480
	Open Elective Course/IE	MNRA0064	Robotics and Automation	3-0-0	3	478

LIST OF VALUE ADDED COURSES- MECHANICAL ENGINEERING

VALUE ADDED COURSES						
Type	**Type of Course/ Category**	**Course Code**	**Course Name**	L-T-P	**Credits**	**Page**
SEMESTER IV						
Theory	Value Added Course/DE	MNIA6034	Introduction to AUTOCAD	2-0-0	2	489
SEMESTER VI						
Theory	Value Added Course/DE	MNRF6032	Royal Enfield Freshers Course	2-0-0	2	489
SEMESTER VII						
Theory	Value Added Course/DE	MNQC6033	Quantitative Aptitude for Competitive Examination	2-0-0	2	489

DEPARTMENT OF COMPUTER APPLICATIONS
BACHELOR OF COMPUTER APPLICATIONS (BCA)

SEMESTER I				
Type of Course	**Course Code**	**Course Title**	**Credits L-T-P**	**Page**
Core Course 1 (Theory)	CACP0058	Computer Programming in C Language	4-0-0	536
Core Course 1 (Lab)	CACP6008	Computer Programming in C Language Lab	0-0-2	555
Core Course 2 (Theory)	CALD0001	Digital Logic Design	4-0-0	496
Core Course 2 (Lab)	CADL6002	Digital Logic Design Lab	0-0-2	553
Ability Enhancement compulsory Course 1	EGEC0107	English Communication	2-0-0	594
Generic Elective Course 1 (Theory/ Theory-Tutorial)			4-0-0/5-1-0	
Generic Elective Course 1 (Lab)			0-0-2	
Total Credits			20	
SEMESTER II				
Core Course 3 (Theory)	CADS0011	Data Structures Using C	4-0-0	501
Core Course 3 (Lab)	CADS6009	Data Structures Using C Lab	0-0-2	556
Core Course 4 (Theory)	CAOA0007	Computer Organization and Architecture	4-0-0	499
Core Course 4 (Lab)	CAOA6006	Computer Organization and Architecture Lab	0-0-2	554
Ability Enhancement compulsory Course 2	CHES0002	Environmental Studies	2-0-0	578
Generic Elective Course 2 (Theory/ Theory-Tutorial)			4-0-0/5-1-0	
Generic Elective Course 2 (Lab)			0-0-2	
Mandatory	CASL0200	Service Learning	NC	573
Mandatory	EDCI0200	Constitution of India	NC	
Total Credits			20	
SEMESTER III				
Core Course 5 (Theory)	CAOS0025	Introduction to Operating Systems	4-0-0	511
Core Course 5 (Lab)	CAOS6020	Introduction to Operating Systems Lab	0-0-2	560
Core Course 6 (Theory)	CANW0074	Computer Networks Fundamentals	4-0-0	550
Core Course 6 (Lab)	CANW6010	Computer Networks Fundamentals Lab	0-0-2	556
Core Course 7 (Theory)	CAWT0013	Web Technologies	4-0-0	503
Core Course 7 (Lab)	CAWT6011	Web Technologies Lab	0-0-2	557
Skill Enhancement Course 1	CAMD0060	MEAN Stack Web Development	1-0-1	539
Generic Elective Course 3 (Theory/ Theory-Tutorial)			4-0-0/5-1-0	
Generic Elective Course 3 (Lab)			0-0-2	
Total Credits			26	
SEMESTER IV				
Core Course 8 (Theory)	CADB0028	Relational Database Management Systems	4-0-0	512
Core Course 8 (Lab)	CADB6022	Relational Database Management Systems Lab	0-0-2	561
Core Course 9 (Theory)	CASE0029	Basic Software Engineering	4-0-0	513
Core Course 9 (Lab)	CASE6023	Basic Software Engineering Lab	0-0-2	561
Core Course 10 (Theory)	CAIJ0038	Introduction to Java Programming	4-0-0	517
Core Course 10 (Lab)	CAIJ6029	Introduction to Java Programming Lab	0-0-2	563
Skill Enhancement Course 2	CAMP0061	Managerial Competencies For Professionals	1-1-0	539
Total Credits			26	
SEMESTER V				
Core Course 11 (Theory)	CADC0037	Data Communication	4-0-0	516
Core Course 11 (Lab)	CADC6028	Data Communication Lab	0-0-2	563
Core Course 12 (Theory)	CADA0062	Design and Analysis of Algorithm	4-0-0	540
Core Course 12 (Lab)	CADA6013	Design and Analysis of Algorithm Lab	0-0-2	558
Discipline Specific Elective 1	CADY0063	Introduction to Data analytics	4-0-0	541
	CAIT0064	Internet of Things	5-1-0	542
	CANM0065	Computer Oriented Numerical Methods	4-0-0	543

Discipline Specific Elective 1	CADY6041	Introduction to Data analytics Lab	0-0-2	568
	CANM6042	Computer Oriented Numerical Methods Lab	0-0-2	569
Discipline Specific Elective 2 / Mini Project	CACD0066	Compiler Design	4-0-0	544
	CATC0048	Theory of Computation	4-0-0	528
	CAMS0068	Computer Graphics	4-0-0	545
Mini Project	CAMI6046	Mini Project - BCA	0-0-2	569
Total Credits			24	
SEMESTER VI				
Core Course 13 (Theory)	CAPM0042	Python and Machine Learning	4-0-0	521
Core Course 13 (Lab)	CAPM6032	Python and Machine Learning lab	0-0-2	564
Core Course 14 (Theory)	CADW0069	Data Warehousing and Data Mining	5-1-0	546
Discipline Specific Elective 3	CANS0040	Network Security	5-1-0	519
	CAAD0036	Android Application Development Fundamentals	4-0-0	515
	CAIP0070	Digital Image Processing	4-0-0	547
	CAAD6047	Android Application Development Fundamentals Lab	0-0-2	569
	CADI6048	Digital Image Processing Lab	0-0-2	570
Discipline Specific Elective 4 / Major Project	CACC0071	Cloud Computing	4-0-0	548
	CAMO0041	Mobile Communication	4-0-0	520
	CAOR0073	Operation Research	4-0-0	549
Major Project	CAMP6050	Major Project - BCA	0-0-4	570
Total Credits			24	
Total Programme Credits			142	

Generic Electives

Generic Elective Course 1	CACF0008	Computer Fundamentals	4-0-0	500
Generic Elective Course 1	CACF6007	Computer Fundamentals Lab	0-0-2	554
Generic Elective Course 2	CAIB0059	IT Tools for Business	5-1-0	537
Generic Elective Course 3	CAEC0076	E-Commerce	5-1-0	551
Generic Elective Course 4	CACA0075	Computer Applications in Business	5-1-0	552

LIST OF VALUE-ADDED COURSES OFFERED BY THE DEPARTMENT

- Advance Web Application Development Techniques**(CAAW6053)**
- Blockchain **(CABC6052)**
- Robotic Process Automation (**CARP6051)**

MASTER OF COMPUTER APPLICATIONS (MCA)

Semester I					
Type	**Course Code**	**Course Name**	**Credits**	**Category**	**Page**
Theory	CAMF0043	Mathematical Foundation for Computer Science	4	DC	522
	CATC0048	Theory of Computation	4	DC	528
	CAOS0016	Operating Systems	4	DC	504
	CADA0044	Data Structures and Algorithms	4	DC	523
	CAPJ0018	Programming Through Java	4	DE	506
Lab	CAOS6012	Operating Systems Lab	2	DC	557
	CADA6033	Data Structures and Algorithms Lab	2	DC	564
	CAPJ6014	Programming Through Java Lab	2	DE	559
Total Credits			**26**		
Semester II					
	CASE0019	Software Engineering	4	DC	507
	CACC0045	Data Communication and Computer Networks	4	DC	524

Theory	CADM0046	Advanced Database Management Systems	4	DC	525
	CAIT0022	Internet Technology and Applications	4	DC	509
	CASI0047	Sensor Networks and Internet of Things	3	DE	527
Lab	CACC6034	Data Communication and Computer Networks Lab	2	DC	565
	CAIT6017	Internet Technology and Applications Lab	2	DE	559
	CADM6035	Advanced Database Management Systems Lab	2	DC	566
Mandatory	CASL0200	Service Learning/Community Engagement	NC	IE	573
Total Credits			**25**		
Semester III					
Theory	CACL0033	Cyber Law and IT Security	4	DC	515
	CAML0049	Machine Learning	4	DC	529
	CAEP0024	Enterprise Resource Planning	4	DC	510
	ECRM0042	Research Methodology and IPR	2	DE	347
		ELECTIVE-I Specialization I: Artificial Intelligence OR Specialization II: Data Science	4	DE	
		ELECTIVE-II Specialization I: Artificial Intelligence OR Specialization II: Data Science	4	DE	
Lab	CAML6036	Machine Learning Lab	2	DC	567
Project	CAMI6038	Minor Project - MCA	5	DC	
Audit Courses	EGCS0110	Communication Skills	NC	IE	595
	CMES0023	Entrepreneurship	NC	IE	
Total Credits			**29**		
Semester IV					
Project	CAMP6039	Major Project - MCA	18	DC	562
		Elective III Specialization III (Artificial Intelligence/Data Science)	2		
Total Credits			**20**		
Total Programme Credits			**100**		

Course Code	**Specialization I (Artificial Intelligence)**		**Page No**
CAPA0030	Principles of Artificial Intelligence		514
CAHC0050	Human Computer Interaction		529
CABI0051	Bioinformatics		530
CADL0052	Deep Learning		531
CASC0053	Soft Computing		532
Course Code	**Specialization II (Data Science)**		
CADS0054	Data Science		533
CAVS0055	Data Visualization for Data Science		534
CABD0056	Big Data Management		535
CAWA0057	Web Analytics and Development		535
Course Code	**Specialization III (Artificial Intelligence/Data Science)**		
	NPTEL Course of 8 - 12 Weeks. List of Courses to be provided by the department.		

SCHOOL OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

Creating a centre of excellence in teaching, training and research in the field of Computer Science and Engineering, to mould individuals into competent professionals to address local, national and global scientific, technological and social challenges.

MISSION

1. To create professionals sound in the theory and practice of Computer Science and Engineering by providing a learning ambience that promotes innovation and research-based activities.
2. To explore the frontiers of cutting-edge technologies through academia-industry collaboration and continuous learning to solve real-world challenges
3. To inculcate the spirit of self-sustainability through research, consultancy, and development activities.
4. To infuse ethical values, team spirit and a sense of social commitment in individuals for the betterment of the society through technology.

PROGRAM OUTCOMES (BTECH CSE)

PO 1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO 3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO 4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PO 5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

PO 6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO 11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projectsand in multidisciplinary

PO 12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOME (BTECH CSE)

PSO 1: Ability to apply knowledge of data structure, algorithm, programming skill & hardware to analyse and solve complex programming in interdisciplinary fields

PSO 2: Ability to use software, theoretical knowledge of computer science, communication technology & intelligent algorithms to build optimize solution pertaining to real world problem

PSO 3: Ability to work in multidisciplinary team in small- and large-scale projects by utilizing modern software engineering tools and emerging technology.

PROGRAM OUTCOMES (MTECH CSE)

PO 1: An understanding of the theoretical foundations and the limits of computing

PO 2: An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems
PO 3: An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society
PO 4: Understanding and ability to use advanced computing techniques and tools
PO 5: An ability to undertake original research at the cutting edge of computer science & its related areas
PO 6: An ability to function effectively individually or as a part of a team to accomplish a stated goal
PO 7: An understanding of professional and ethical responsibility
PO 8: An ability to communicate effectively with a wide range of audience
PO 9: An ability to learn independently and engage in life¬long learning
PO 10: An understanding of the impact of IT related solutions in an economic, social and environment context.

PROGRAM SPECIFIC OUTCOME (PSO)

Specialisation: Data science

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Develop programs that use data mining techniques on bigdata for clustering, classification and ranking using cloud infrastructure for research.

Specialisation: Internet of Things

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Design and develop code for various sensor-based applications for different sectors that use data collected through IoT deployment.

Specialisation: Information Security

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Design operational and strategic cyber-security strategies, policies, and solutions that use cyber security techniques, information assurance, digital forensics software/tools, encryption, machine learning, and secure coding for securing data.

MAPPING of COURSES TO PO/PSOs (BTECH CSE)

PO-PSO Mapping Table (B.Tech CSE)
1.1 Programming For Problem Solving
1.2 Programming For Problem Solving Lab
1.3 Physics for Technologist
1.4 Mathematics I - Calculus And Linear Algebra
1.5 Physics for technologists-Lab
1.6 Engineering Graphics And Design
1.7 Induction Programme
2.1 Engineering Chemistry
2.2 Mathematics II- Multiple Integrals, Numerical Methods and Differential Equations
2.3 Basic Electrical Engineering
2.4 English
2.5 Basic ChemistryLab1
2.6 Basic Electrical Engineering Laboratory
2.7 Workshop/ManufactuRing Practice
3.1 Object Oriented Programming
3.2 Object Oriented Programming LAB
3.3 Digital Computer Design
3.4 Digital Computer Design Lab
3.5 Data Structures
3.6 Data Structures Lab
4.1 Computer Organization and Architecture
4.2 Computer Organization and Architecture Lab
4.3 Database Management Systems
4.4 Database Management Systems Lab
4.5 Discrete Mathematics

4.6 Design and Analysis of Algorithms
4.7 Introduction to Organizational Behavior
4.8 Design and Analysis of Algorithms Lab
4.9 Environmental Sciences
5.1 Data communications
5.2 Formal language and automata theory
5.3 Operating Systems
5.4 Operating Systems Lab
5.5 Data communications lAB
5.6 Advanced Algorithms
5.7 Software Engineering
5.8 Artificial Intelligence
5.9 Economics for Engineers
5.10 Mini Project-I
5.11 Value added course
5.12 Internship
6.1 Compiler Design
6.2 Computer Networks
6.3 Computer Networks Lab
6.4 Compiler Design Lab
6.5 Production and Operations Management
6.6 Soft skills
6.7 Parallel and Distributed Algorithms
6.8 Advanced Computer Architecture
6.9 Machine Learning
6.10 Robotics Process Automation
6.11 Computational Complexity
6.12 Distributed Systems
6.13 Data Mining
6.14 Advanced Computer Architecture Lab
6. 15 Machine Learning Lab
6.16 Robotics Process Automation Lab
6.17 Computational Complexity Lab
6.18 Distributed Systems Lab
6.19 Data Mining Lab
6.20 Mini Project-II
7.1 Computational Geometry
7.2 Advanced Operating Systems
7.3 Speech and Natural Language Processing
7.4 Computational Number Theory
7.5 Real Time Systems
7. 6 Information Retrieval
7.7 E-Commerce and Data Security
7.8 ICT for development
7.9 Course from Swayam
7.10 Computational Geometry Lab
7.11 Advanced Operating Systems Lab
7.12 Speech and Natural Language Processing Lab
7.13 Biology
7.14 Major Project- Phase I
7.15 Value Added Course
8.1 Quantum Computing
8.2 Ad-Hoc and Sensor Networks
8.3 Neural Networks and Deep Learning
8.4 Blockchain Fundamentals
8.5 Cloud Computing
8.6 Cyner law and ethics
8.7 Course from Swayam

8.8 Business Analytics
8.9 Computer Networks
8.10 Essence of Indian Traditional Knowledge
8.11 Major Project- Phase II

	Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
Semester I	1.1			M									L	H		
	1.2			M									L	M		
	1.3	L														L
	1.4	M											L			L
	1.5	L														L
	1.6															L
	1.7						L	M		M	L					L
Semester II	2.1	L														
	2.2	M			L											L
	2.3	M											L			L
	2.4										H					L
	2.5	L														L
	2.6	M														L
	2.7	M		L									L			M
Semester III	3.1		M			L							M	H	M	L
	3.2		M			L							M	H	M	L
	3.3	M												M		
	3.4	M												M		
	3.5	H	M										M	H	M	
	3.5	M	M										M	H	M	
Semester IV	4.1	M	M										M	M		
	4.2	M	M										M	M		
	4.3		M			M							M	L	H	
	4.4		M			M							M	L	H	
	4.5	H											M		M	
	4.6		H		M								M	H	M	
	4.7								M							M
	4.8	M	H		M								M	H	M	
	4.9						L	H								L
Semester V	5.1				M	M							M		H	L
	5.2	H											M		M	
	5.3		M										M	H		
	5.4		M										M	M		
	5.5				M	H							M		M	
	5.6 Advanced Algorithms	L	H	M	M								H	M		
	5.7 Software Engineering	M	M	H	M	L						H	L	M	M	
	5.8 Artificial Intelligence		M	M	M	H							H	M		
	5.9															L
	5.10					M				H	M	H	M	M	M	H
	5.11															

	5.12 Internship Course															
Semester VI	6.1	L	M										M	H		
	6.2		M		M								M		H	L
	6.3		M		M	H							M		M	L
	6.4		M										M	M		
	6.5						L									L
	6.6 Soft Skill							M	M	M	L	M				L
	6.7		M	H	M									M	H	
	6.8	M		L	M	L								M	L	
	6.9	L	M	M	H	M								H	M	
	6.10		L	M	M	H								M	M	L
	6.11	L	M	M	M	M								H	M	
	6.12	L	L	M		M								M		L
	6.13		H			M									M	
	6.14	M		L	M	L								M	L	
	6.15					M								M	M	
	6.16				M	H									M	
	6.17			M		M								M		L
	6.18		H			M									M	
	6.19	M			M									M	L	
	6.20		H			M			L	M	M	H	M	M	M	H
Semester VII	7.1		M	H										H	M	
	7.2	L			M									L	M	
	7.3			M		M									L	M
	7.4		M		M									M	M	
	7.5			M										M		L
	7.6		L			M	M							M	L	L
	7.7					M	H						M		L	M
	7.8					M	L									L
	7.9															
	7.10	L			M										M	
	7.11			M		M									L	M
	7.12		M		M									M	M	
	7.13							M								M
	7.14		H	L	H	M				H	M	M	M	M	M	H
	7.15															
Semester VIII	8.1		M	M	M									H		
	8.2			L	M	L	L							M	M	L
	8.3			L	L	M									M	
	8.4			L		L										M
	8.5	L				M	L								M	L
	8.6						L		M							M
	8.7															
	8.8			H	M	M								M		
	8.9	M				L							L		L	
	8.10						H									M
	8.11		H	L	H	M				H	M	M	M	M	M	H

PROGRAM OUTCOMES (MTECH CSE)

PO 1: An understanding of the theoretical foundations and the limits of computing

PO 2: An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficientlysolving problems

PO 3: An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society

PO 4: Understanding and ability to use advanced computing techniques and tools

PO 5: An ability to undertake original research at the cutting edge of computer science & its related areas
PO 6: An ability to function effectively individually or as a part of a team to accomplish a stated goal
PO 7: An understanding of professional and ethical responsibility
PO 8: An ability to communicate effectively with a wide range of audience
PO 9: An ability to learn independently and engage in life long learning
PO 10: An understanding of the impact of IT related solutions in an economic, social and environment context.

PROGRAM SPECIFIC OUTCOME (PSO)

Specialisation: Data science

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Develop programs that use data mining techniques on bigdata for clustering, classification and ranking using cloud infrastructure for research.

Specialisation: Internet of Things

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Design and develop code for various sensor-based applications for different sectors that use data collected through IoT deployment.

Specialisation: Information Security

PSO 1: Apply the concept of theoretical knowledge of computer science, data structures, algorithms, mathematical computation and statistical formulae with respect to research methodology.
PSO 2: Design operational and strategic cyber-security strategies, policies, and solutions that use cyber security techniques, information assurance, digital forensics software/tools, encryption, machine learning, and secure coding for securing data.

Semester I												
Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
Advanced Data structure	M	H									H	M
Advanced Data structure Lab	M	M									H	M
Mathematical foundations of Computer Science	H										M	L
Research Methodology and IPR					M				L		H	
Specialisation: Data Science												
Machine Learning			M	H							M	H
Machine Learning Lab				H							M	H
Recommender System										M		
Data Storage Technologies and Networks					M						M	
Data Science		M		H								M
Distributed Systems			M									
Data Preparation and Analysis	M	M		M							H	M
Specialisation: Internet of Things												
Wireless Access Technology(CSMS0095)	M										M	H
Mobile application and services			H									H
Smart sensor and Internet of Things			M								H	H
Logical and functional programming				H								
English for Research								H			M	

Paper Writing												

Semester II												
Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
Advance Algorithms	M	H									M	H
Advance Algorithms Lab	M	M									M	
Soft Computing	M										M	
Mini Project	M	M	M	M	M	H	L	L	L		M	M
Constitution of India						M		M				L
Specialisation: Data Science												
Data Visualization			M								M	M
Data Visualisation Lab			M								M	M
Big Data Analytics				H						M		H
Data Warehouse and Data Mining	M			M								H
Data Security and Access Control				M			L			L	M	M
Web Analytics and Development				H							M	H
Knowledge Discovery	M	M									M	M
Natural Language Processing		M								L	M	L
Specialisation: Internet of Things												
Advanced machine learning			H	M							M	L
Network Security(CSNY0114)	M	H									M	M
Big Data Analytics				H						M	M	H
Sensor Network and Internet of Things	M	M	M									H
Data Visualization			M									M
Data Visualisation Lab			M									M
IoT Application and Communication Protocol					M						M	H
Specialisation: Information Security												
Data Encryption & Compression	M	H									H	M
Data Encryption & Compression Lab	M	H									M	
Steganography & Digital Watermarking	M		H								M	M
Information Theory & Coding	H	M									H	
Security Assessment and Risk Analysis					H					M	M	M
Secure Coding				M							M	
Biometrics				M							M	

Semester III												
Specialisation: Data Science												
Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
GPU Computing	M										M	M
Cloud Computing	M		H									M
Distributed Databases	M										M	H

Business Analytics				H								H
Dissertation Phase – I		M	M	M		H					M	M
Specialisation: Internet of Things												
IoT and Smart City			H	M							H	M
Emulation and simulation methodology			M	M							M	M
Cloud Computing	M		H									
Business Analytics				H							M	H
Dissertation Phase – I		M	M	M		H					M	M
Specialisation: Information Security												
Data Warehousing & Mining	H										H	L
Web Search & Information Retrieval				M							M	M
Database Security and Access Control	M			H								L
Business Analytics				H							H	M
Dissertation Phase – I		M	M	M		H					M	

Semester IV												
Specialisation: Data Science												
Courses	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PSO1	PSO2
Project Phase II		M	M	M		H					M	H
Specialisation: Internet of Things												
Project Phase II		M	M	M		H					M	H

DETAILED SYLLABUS
THEORY COURSES

CSPS0079: PROGRAMMING FOR PROBLEM SOLVING

(3 credits-45 Hours)

Course Outcomes

1. Define and describe various terms and concepts of C programming language (Remembering)
2. Compare and interpret information based on their understanding of the concepts of C language syntax, data types, control statements, functions, pointers, arrays, structures, files, graphics and hardware programming using C. (Understanding)
3. Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
4. Analyze their skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analyze)
5. Combine the various concepts and ideas learnt in C to plan, propose and develop a product. (Creating)
6. Evaluate various algorithms used for searching, sorting etc., in terms of correctness and computation cost. (Evaluate)

Module I (8 Hours)

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), and Idea of Algorithm: steps to solve logical and numerical problems. Types of Algorithm: Sequentially executed, Conditional Based, repetitive structure, Representation of Algorithm: Flowchart/Pseudo code with examples, from algorithms to programs; source code, variables (with data types) variables and memory, locations, Syntax and Logical Errors in compilation, object and executable code.

Module II (12 Hours)

Operators, precedence of operators, Arithmetic expressions, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Module III (5 Hours)

Arrays, Arrays (1-D, 2-D), Character arrays and Strings

Module IV (5 Hours)

Basic Algorithm Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module V (8 Hours)

Functions (including built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference, Recursion.

Module VI (7 Hours)

Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling.

Suggested Readings

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5	M6
CO1	H	M				
CO2			H			H
CO3	H	H				
CO4	L				H	H
CO5				H		
CO6	L			H		

CSOP0080: OBJECT ORIENTED PROGRAMMING

(3 credits – 45 hours)

Course Outcomes

1. Define the basic OOP syntax and semantics to write programs. (Remembering)
2. Illustrate the theoretical concepts such as data type, variables, conditional statements, iterations, etc., for various programming technologies. Students can also explain and relate the principles of interfaces, inheritance and packages in OOP. (Understanding)
3. Select the various access modifiers and apply them for granting restricted access to class, methods and variables while developing any applications. (Applying)
4. Examine user requirements for software functionality to decide whether basic Java concepts can meet user requirements. (Analyzing)
5. Choose an engineering approach to solving problems, starting from the various ways of giving an input through a program, choosing an optimal method of problem solving and getting the desired output. (Evaluating)
6. Develop solutions for real life problems by choosing between different basic Java concepts like polymorphism, inheritance, method overloading and method overriding. (Creating)

Module I (10 hours)

Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.

Module II (10 hours)

Features of object-oriented programming. Encapsulation, object identity, polymorphism–but not Inheritance in OO design.

Module III (15 hours)

Design patterns. Introduction and classification. The iterator pattern. Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features.

Module IV (10 hours)

Memory management. Generic types and collections GUIs. Graphical programming with Scala and Swing. The software development process.

The concepts should be practiced using C++ and Java. Pearl may also be introduced wherever possible.

Suggested Readings

1. Barbara Liskov, Program Development in Java, Addison-Wesley,2001
2. Any book on Core Java
3. Any book on C++

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H	M		
CO2		M		H
CO3		M		H
CO4	H		L	
CO5		M	H	
CO6	H			M

CSDC0081: DIGITAL ELECTRONICS

(3 credits – 45 hours)

Course Outcomes

1. Explain number systems, coding methods, Boolean algebra, logic circuits, logic families, and memory types. (Understanding)
2. Convert numbers between different number and coding systems and perform the basic arithmetic operations (addition, subtraction, division, and multiplication). (Applying)
3. Minimize Boolean functions using postulates and theorems of Boolean algebra, Karnaugh maps and Quine McCluskey method. (Applying)
4. Analyze combinational and sequential logic circuits to obtain Boolean expressions, state tables and state diagrams implemented by the circuits. (Analysing)
5. Design combinational and sequential logic circuits for given problem statements. (Creating)
6. Build logic gates using TTL, ECL and CMOS technologies. (Creating)

Module I: Data representation and arithmetic operations (5 Hours)

Introduction, numbering systems, decimal to binary conversion, binary coded decimal numbers, hamming code for error

correction, alphanumeric codes.

Module II: Algebra for Digital systems (8 Hours)
Binary addition, binary subtraction, complement representation of numbers, addition/ subtraction of numbers in 1's complement Notation, addition/subtraction of numbers in 2's complement Notation, binary multiplication, multiplication of signed numbers, binary division, arithmetic with binary coded decimal numbers, representation of integers, Floating point representation of numbers, Floating point arithmetic.

Module III: Logic gates and Boolean Algebra (7 Hours)
Introduction to Basic logic gates (AND, OR, NOT, NOR, NAND), Truth tables, simplification of truth tables, the K-map method, SOP and POS simplifications, Quine-McCluskey tabulation method.

Module IV: Combinational logic and Sequential logic (15 Hours)
Combinational logic: Introduction, Combinational circuits, Analysis procedure, design procedure Binary Adder-Subtractor, Decimal adder, binary multiplier, Magnitude comparator, decoders, encoders, multiplexers, HDL models and Combinational Circuits
Sequential logic: Introduction, Sequential circuits, Storage elements: Latches, Storage elements: Flip-flops, Analysis of clocked sequential circuits, State reduction and Assignment, Design procedure.

Module V: Digital integrated circuits (10 Hours)
Introduction, Special characteristics, Bipolar-Transistor characteristics, RTL and DTL circuits, Transistor-TransistorLogic,Emitter-Coupledlogic,Metal-oxidesemiconductor,complementary MOS, CMOS transmission gate circuits, Switch-level Modeling with HDL

Module VI: Memories (5 Hours)
Memory types and terminology, read only memory, Semiconductor RAMs, Non-volatile RAMs, Sequential memories, Programmable logic Devices, Magnetic memories, Optical disk memory, Charge coupled devices.

Suggested Readings
1. M.Morris Mano, Digital Logic and Computer Design, Pearson Education,2009
2. V.Rajaraman, An Introduction to Digital Computer Design, 5th ed.,PHI
3. R. P Jain,Modern Digital Electronics, 4thed.,TMH
4. William Stallings, Computer Organization,PHI

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H	M	L	L	M	H
CO2	H	H				
CO3			H			
CO4			M	H		
CO5			M	H		
CO6					H	

CSDS0082: DATA STRUCTURE AND ALGORITHM

(3 credits – 45 hours)

Course Outcomes
1. Explain the concept of different data types, primitive, derived and their representation and application through coding. (Understanding)
2. Apply the concept of ADT and linear and nonlinear data types and their representation. (Applying)
3. Apply these data types in various applications like arithmetic expression evaluation and conversion. (Applying)
4. Explain the concept of Graphs and Trees and their real time application. (Understanding)
5. Develop various searching and sorting techniques. (Creating)
6. Choose and implement efficient data structures and apply them to solve problems. (Evaluating)

Module I: Pointers and Structures (6 hours)
a. Pointers: chain of pointers, pointers and arrays, array of pointers, pointer to functions - passing parameters by value and by reference, dynamic memory allocation; Recursion.
b. Structures: pointers and structures.
c. Files: Sequential file handling, Indexed Sequential files, Reading and writing in random access files.

Module II: Preliminaries (3 hours)
Introduction to Data Structures; Development and analysis of algorithms.

Module III: Linear Data Structures (8 hours)
Arrays; Stacks and stack application; Queues; Linked lists, circular and doubly linked lists.

Module IV: Non-linear Data structures (8 hours)

a. Binary trees; representation in memory, traversals and operations.
b. Introduction to graphs, sequential representation of graphs, graph traversals- BFS, DFS, Shortest path algorithms -(Dijkstra's) Minimum Spanning trees - (Kruskal's, Prim's)

Module V: Advanced Data Structures (10 hours)
Binary search trees, AVL trees, B trees.

Module V: Sorting and Searching (10 hours)
Searching and data modification: Linear search, binary search, hashing techniques and collision resolution, Sorting techniques: selection, insertion, quick, radix, merge, merge-sort and heap sort.

Suggested Readings

1. Lipschutz, S., Data structures, Indian Adapted Ed, Tata McGraw Hill Publishing Company Limited, New Delhi,2006
2. Gilberg, Richard F. Forouzan, and Behrouz A., Data Structures, 2nd Ed, Course Technology, Cengage
3. Learning, New Delhi, 2005.
4. Pai,GA,DataStructuresandAlgorithms,1stEd,TataMcgrawHillPublishingCompanyLimited,New Delhi,2008.
5. Langsam,Augenstein,andTanenbaum,DataStructuresUsingCAndC++,2ndEd,PhiPublication,
6. New Delhi, 2007.
7. Krishnamoorthy R., Kumaravel, and G .Indirani, Data Structures Using C, 1st Ed., Tata Mcgraw Hill Publishing Company Limited, New Delhi,2008.
8. Horowitz,Sahni,SusanFreed,FundamentalsofDataStructuresinC,2nd Edition,Universitypress, 1997
9. AmiyaKumarRath,AlokKumarJagdev,DataStructuresusingC,2nd Edition,ScitechPublication,New Delhi,2009

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5
CO1	H	M	M		
CO2	H	H	H		
CO3	H	H	M		
CO4	L	H		H	H
CO5	M	M		H	H
CO6	L			H	H

CSOA0083: COMPUTER ORGANIZATION & ARCHITECTURE

(3 credits – 45 hours)

Course Outcomes

1. Recall the architecture and organization of major components of modern computer systems. (Remembering)
2. Explain the functioning and interconnection of major components of computer systems and different design issues associated with the design of any architecture. (Understanding)
3. Apply logic in designing simple control unit, instruction sets, instruction format, buses and register set etc. (Applying)
4. Compare and Analyse different styles, strategies and formats adopted for designing the instruction set, register set, memory organization and I/O transfer.(Analysing)
5. Assess various architectures and their design considerations. (Evaluating)
6. CO6: Construct and organize a new architecture by considering various design issues in order to make it more efficient with less overhead. (Creating)

Module I Introduction (8 hours)
Number representation; fixed and floating point number representation, IEEE standard for floating point representation. Error detection and correction codes: Hamming code. Digital computer generation, computer types and classifications, functional units and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. Introduction to x86 architecture.

Module II Central Processing Unit (8 hours)
Addition and subtraction of signed numbers, look ahead, carry adders. Multiplication: Signed operand multiplication, Booth's Multiplication Algorithm; Division Algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Processor organization, general register organization, stack organization and addressing modes.

Module III Control Unit (10 hours)

Instruction types, formats, instruction cycles and subcycles (fetch and execute etc), micro- operations, execution of a complete instruction. Hardwired and microprogrammed control: microprogramme sequencing, wide branch addressing, and microinstruction with next address field, prefetching microinstructions, concept of horizontal and vertical microprogramming.

Module IV Memory (8 hours)
Basic concept and hierarchy, semiconductor RAM memories, 2D and 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues (performance, address mapping and replacement) Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation.

Module V Input / Output (8 hours)
Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous and asynchronous communication, standard communication interfaces.

Module VI Pipelining (8 hours)
Basic Concepts, performance, floating point arithmetic, operations, instruction pipelining in RISC, pipelining in computer arithmetic, Data Hazard, Instruction hazard, Influence on Instruction set, datapath and controls consideration, Superscalar Operation.

Suggested Readings

1. William Stallings, Computer Organization, PHI
2. Vrunesic,Hamacher and Zaky, Computer Organization, TMH
3. M. Morris Mano, Computer System Architecture, PHI
4. Patterson, Computer Organisation and Design, Elsevier Pub. 2009
5. John P Hayes, Computer Organization, McGraw Hill
6. K.K Tripathi, Rajesh K. Gangawar, Microprocessor and its Applications, Acme Learning, New Delhi, 2010
7. Brey, Barry B, INTEL Microprocessors, PHI

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	H	H	M			
CO 3		H	H		H	
CO 4		H	H	H	H	
CO 5		H	H			L
CO 6		H	H	M	M	M

CSRD0084: DATABASE MANAGEMENT SYSTEMS

(3 credits – 45 hours)

Course Outcomes

1. Define the fundamental concepts necessary for designing, using and implementing database systems and applications. (Remembering)
2. Explain the core terms, concepts, and tools of relational database management systems. (Understanding)
3. Apply the techniques, components and tools of a typical database management system to build a comprehensive database information system. (Applying)
4. Apply relational algebra, TRC, and SQL to solve queries related to database tables. (Applying)
5. Compare and contrast all the physical file storage techniques and various facilities provided by database management systems. (Analyzing)
6. Evaluate and justify the database-related design diagrams related to any database project. (Evaluating)
7. Design ER-diagrams and corresponding schema diagrams for handling database projects. (Creating)

Module I (10 hours)

a. Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
b. Data models - Entity Relationship(ER), Enhanced Entity Relationship (EER): specialization, Aggregation, Mapping ER Model to Relational Model, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II (18 hours)
Relation Query Languages, SQL queries for retrieval and data changing commands, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal

Forms, Dependency Preservation, Lossless design.

Module III (8 hours)
Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV (10 hours)
a. Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
b. Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

Suggested Readings
1. Ramez Elmasri and Shamkant B Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
2. Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, 5th Edition, Mc-Graw Hill.
3. C.J. Date, Introduction to Database Systems, 8th ed., Pearson Education.
4. Bipin Desai, An introduction to Database System, Galgotia Publication.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2	H	H	M	
CO 3		H	H	M
CO 4		H	H	M
CO 5		M	H	H
CO 6			M	H
CO 7			M	H

CSRD0084: DATABASE MANAGEMENT SYSTEMS

(3 credits – 45 hours)

Course Outcomes
1. Define the fundamental concepts necessary for designing, using and implementing database systems and applications. (Remembering)
2. Explain the core terms, concepts, and tools of relational database management systems. (Understanding)
3. Apply the techniques, components and tools of a typical database management system to build a comprehensive database information system. (Applying)
4. Apply relational algebra, TRC, and SQL to solve queries related to database tables. (Applying)
5. Compare and contrast all the physical file storage techniques and various facilities provided by database management systems. (Analyzing)
6. Evaluate and justify the database-related design diagrams related to any database project. (Evaluating)
7. Design ER-diagrams and corresponding schema diagrams for handling database projects. (Creating)

Module I (10 hours)
a. Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
b. Data models - Entity Relationship(ER), Enhanced Entity Relationship (EER): specialization, Aggregation, Mapping ER Model to Relational Model, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II (18 hours)
Relation Query Languages, SQL queries for retrieval and data changing commands, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Module III (8 hours)
Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV (10 hours)
a. Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
b. Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed

Databases, Data Warehouse and Data Mining.

Suggested Readings

1. Ramez Elmasri and Shamkant B Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
2. Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, 5th Edition, Mc-Graw Hill.
3. C.J. Date, Introduction to Database Systems, 8th ed., Pearson Education.
4. Bipin Desai, An introduction to Database System, Galgotia Publication.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2	H	H	M	
CO 3		H	H	M
CO 4		H	H	M
CO 5		M	H	H
CO 6			M	H
CO 7			M	H

CSAD0085: DESIGN AND ANALYSIS OF ALGORITHMS

(3 credits – 45 hours)

Course Outcomes

1. Define algorithms, importance of analysis of an algorithm and their asymptotic bounds and relate the different types of problem and their solutions. (Remembering)
2. Explain different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms. (Understanding)
3. Build algorithms for given problems. (Applying)
4. Compare and analyze different design strategies. (Analyzing)
5. Assess various algorithms in terms of correctness, computation cost and memory space used. (Evaluating)
6. Formulate new algorithms for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Module I (9 hours)

a. Basic Concepts of Algorithms: Introduction, Notion of Algorithm, Fundamentals of Algorithmic Solving, Important Problem types, Fundamentals of the Analysis Framework – Asymptotic Notations and Basic Efficiency Classes.
b. Mathematical Aspects and Analysis of Algorithms: Mathematical Analysis of Non-recursive Algorithm, Mathematical Analysis of Recursive Algorithm – Example: Fibonacci Numbers, Empirical Analysis of Algorithms, Algorithm Visualization. (12 hours)

Module II (9 hours)

Analysis of Sorting and Searching Algorithms: Brute Force – Selection Sort and Bubble Sort – Sequential Search and Brute-force string matching – Divide and conquer – Merge sort – Quick Sort – Binary Search – Binary tree-Traversal and Related Properties – Decrease and Conquer – Insertion Sort – Depth first Search and Breadth First Search.

Module III (10 hours)

Algorithmic Techniques: Transform and conquer – Presorting – Balanced Search trees – AVL Trees – Heaps and Heap sort – Dynamic Programming – Warshall's and Floyd's Algorithm – Optimal Binary Search trees – Greedy Techniques – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman trees. Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving

Module IV (9 hours)

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Module V (8 hours)

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Suggested Readings

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.

4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H	M	M	L	L
CO2	H	H	L	L	L
CO3	M	M	H	H	L
CO4	M	M	H	L	M
CO5	L	M	M	H	M
CO6	M	M	M	H	M

CSMF0086: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

(3 credits)

Objectives

- To understand the mathematical fundamentals that are prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

Course Outcomes

1. Define and Recall the basic notions of discrete and continuous probability (Remembering)
2. Explain the methods of statistical inference, and the role that sampling distributions play in those methods (Understanding).
3. Apply discrete mathematics in formal representation of various computing constructs. (Applying)
4. Analyse the recent trends in distribution functions in various interdisciplinary fields (Analysing)
5. Evaluating the basic notions of Mathematics in the application areas of Computer Science & Engineering (Evaluating).
6. Elaborate the importance of analytical problem solving approach in engineering problems (Creating).

Module I (7 hours)

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Module II (7 hours)

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Module III (8 hours)

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Module IV (9 hours)

Graph Theory: Isomorphism, Planargraphs, graphcolorings, Hamilton circuits and Eulercycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Module V (10 hours)

Computer science and engineering applications: Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Module VI (4 hours)

Recent Trends in various distribution functions in the mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Suggested Readings

1. John Vince, Foundation Mathematics for Computer Science,Springer.
2. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

CSDT0087: ADVANCED DATA STRUCTURES
(3 credits)

Objectives:
The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.

- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Students should be able to come up with analysis of efficiency and proof of correctness.

Course Outcomes

1. Recall the mathematical background and abstractions for analysis of algorithms. (Remembering)
2. Explain the implementation of symbol tables using hashing techniques. (Understanding)
3. Apply amortized analysis on data structures, including binary search trees, mergeable heaps, and disjoint sets. (Applying)
4. Develop and Analyse algorithms for red-black trees, B-trees and Splay trees. (Analysing)
5. Develop and evaluate algorithms for text processing applications.(Evaluating)
6. Choose suitable data structures and develop algorithms for computational geometry problems. (Creating)

Module I (7 Hours)
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.
Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Module II (5 Hours)
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Module III (7 Hours)
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Module IV (11 Hours)
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth- Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common, Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Module V (10 Hours)
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Module VI (5 Hours)
Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

Suggested Readings

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson,2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley,2002.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M	M				
CO 2	M	H	H			
CO 3	M	M	M	H		
CO 4				H	M	
CO 5				M	H	
CO 6					M	H

CSSC0088: DATA SCIENCE
(3 credits)

Objectives:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Produce Python code to statistically analyse a dataset

- Critically evaluate data visualisations based on their design and use for communicating stories from data

Course Outcomes

1. Define the basics of the knowledge and expertise required to become a proficient data scientist. (Remembering)
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science. (Understanding)
3. Develop Python code to statistically Analyse a dataset. (Applying)
4. Analyse data visualizations based on their design (Analysing)
5. Evaluate the use of communicating stories from data (Evaluating)
6. Design and develop analytical report (Creating)

Module I (5 Hours)

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Module II (7 Hours)

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

Module III (10 Hours)

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naïve Bayes.

Module IV (10 Hours)

Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Module V (6 Hours)

Applications of Data Science, Technologies for visualisation, Bokeh (Python)

Module VI (7 Hours)

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.

Suggested Readings

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline.O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge UniversityPress.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M	M				
CO 2	H	M	H			
CO 3			M	H		
CO 4				H	M	
CO 5				M	H	
CO 6					M	H

CSDI0089: DISTRIBUTED SYSTEMS

(3 Credits)

Objectives

To introduce the fundamental concepts and issues of managing a large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Course Outcomes

1. Recall the fundamental concepts and issues of managing a large volume of shared data in a parallel and distributed environment. (Remembering)
2. Explain the distributed system architecture and its application in various fields. (Understanding)
3. Apply network virtualization and analyse pros and cons.(Applying)
4. Analyse design trends in distributed systems. (Analysing)
5. Formulate and evaluate remote method invocation and objects. (Evaluating, Creating)

Module I (8 Hours)

Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of

database and computer network concepts Distributed database management system architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Module II (10 Hours)
Distributed database design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation Semantics data control: View management; Data security; Semantic Integrity Control Query processing issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.

Module III (10 Hours)
Distributed query optimization: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms
Transaction management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models
Concurrency control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Module IV (7 Hours)
Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Module V (6 Hours)
Parallel database systems: Parallel architectures; parallel query processing and optimization; load balancing

Module VI (4 Hours)
Advanced topics: Mobile Databases, Distributed Object Management, Multi-databases

Suggested Readings
1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall,1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley,1992.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2	H	H	M			
CO 3		M	H	M		
CO 4				H	M	M
CO 5				M	H	

CSDP0090: DATA PREPARATION AND ANALYSIS
(3 Credits)

Objective
To prepare the data for analysis and develop meaningful Data Visualizations

Course Outcomes
1. List the data gathering and preparation techniques. (Remembering)
2. Explain the techniques as per utilisation. (Understanding)
3. Apply explorative analysis techniques. (Applying)
4. Analyse results after application of explorative analysis techniques. (Analysing)
5. Evaluate the data visualisation outcomes (Evaluating)
6. Formulate efficient techniques for data preparation and analysis. (Creating)

Module I (9 Hours)
Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real- time issues

Module II (10 Hours)
Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation And segmentation

Module III (12 Hours)
Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Module IV (14 Hours)
Visualization: Designing visualizations, Time series, Geo located data, Correlations and connections, Hierarchies and networks,

interactivity

Suggested Readings

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2	H	H	M	
CO 3		M	H	
CO 4			M	H
CO 5				M
CO6				H

CSRS0091: RECOMMENDER SYSTEM

(3 Credits)

Objectives:

- To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
- To automate a variety of choice – making strategies with the goal of providing affordable, personal, and high- quality recommendations

Course Outcomes

1. Relate techniques for making recommendations, including non-personalized, content- based, and collaborative filtering (Remembering)
2. Illustrate automation of a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations. (Understanding)
3. Apply techniques for making recommendations, including non-personalized, content- based, and collaborative filtering (Applying)
4. Analyse the choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations. (Analysing)
5. Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity. (Evaluating)
6. Design recommendation system for a particular application domain. (Creating)

Module I (8 Hours)

Introduction: Overview of Information Retrieval, Retrieval Models, Search and Filtering, Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Module II (8 Hours)

Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, discovering features of documents, pre- processing and feature extraction, obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

Module III (8 Hours)

Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

Module IV (8 Hours)

Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations of hybridization strategies

Module V (5 Hours)

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Module VI (8 Hours)

Types of Recommender Systems: Recommender systems in personalized web search, knowledge- based recommender system, social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

Suggested Readings

1. Jannach D., Zanker M. and Fel Fering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1sted.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1sted.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer (2011),1sted.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer (2013), 1st ed.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M	M				
CO 2	H	M	H			
CO 3			M	L		
CO 4				M	M	
CO 5				H	H	
CO 6				H		H

CSML0092: MACHINE LEARNING

(3 Credits)

Objectives:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning techniques and various feature extraction strategies.

Course Outcomes

1. Relate how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.(Remembering)
2. Illustrate supervised and unsupervised learning paradigms of machine learning. (Understanding)
3. Design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances. (Applying, Analysing)
4. Examine the Deep learning techniques and various feature extraction strategies. (Analysing)
5. Evaluate the results and compare in a different environment to have best results. (Evaluating)
6. Create applications as per the requirements in a suitable environment. (Creating)

Module I (10Hours) Supervised Learning (Regression/Classification)

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, non linearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module II (7 Hours) Unsupervised Learning

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Module III (6 Hours)

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical, Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module IV (8 Hours)

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module V (8 Hours)

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module VI (6 Hours)

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Suggested Readings

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2	H	H	M			
CO 3			H			
CO 4				H	M	
CO 5			M	M	H	M
CO 6						H

CSTN0093: DATA STORAGE TECHNOLOGIES AND NETWORKS

(3 Credits)

Objective

To provide learners with a basic understanding of Enterprise Data Storage and Management Technologies

Course Outcomes

1. Recall the various data storage techniques (Remembering)
2. Explain the basic understanding of Enterprise Data Storage and Management Technologies (Understanding)
3. Experiment with Storage System Architecture (Applying)
4. Analyse the Virtualization Technologies and Storage Area Network (Analysing)
5. Evaluate and deploy an efficient technique for data storage. (Evaluating & Creating)

Module I (7 Hours)

Storage Media and Technologies – Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.

Module II (8Hours)

Usage and Access – Positioning in the Memory Hierarchy, Hardware and Software, Design for Access, Performance issues.

Module III (7 Hours)

Large Storages – Hard Disks, Networked Attached Storage, Scalability issues, networking issues.

Module IV (8 Hours)

Storage Architecture- Storage Partitioning, Storage System Design, Caching, Legacy Systems.

Module V (10 Hours)

Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids. Storage QoS– Performance, Reliability, and Security issues.

Module VI (5 Hours)

Recent Trends related to Copy data management, Erasure coding, and Software Defined Storage appliances.

Suggested Readings

1. The Complete Guide to Data Storage Technologies for Network- centric Computing Paperback– Import, Mar 1998 by Computer Technology Research Corporation
2. Data Storage Networking: Real World Skills for the CompTIA Storage by Nigel Poulton

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2	H	H	M			
CO 3			H			
CO 4				H	M	
CO 5			M	M	H	M

CSWA0094: WIRELESS ACCESS TECHNOLOGIES

(3 credits)

Objectives:

- Overview of wireless access technologies, Fixed wireless access networks. Terminal mobility issues regarding wireless access to Internet
- Introduction to various Network topologies, hotspot networks, Communication links: point-to- point, point-to-multipoint, multipoint-to-multipoint.
- To provide an overview of Standards for most frequently used wireless access networks: WPAN, UWB, WLAN, WMAN, WWAN. Network services. Wireless access networks planning, design and installation.
- To get an insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements, link quality control.

Course Outcomes

1. Recall basics of wireless access technologies, Fixed wireless access networks and terminal mobility issues regarding wireless access to the Internet (Remembering)
2. Explain the various Network topologies, hotspot networks and Communication links. (Understanding)
3. Explain the standards for most frequently used wireless access networks. (Understanding)
4. Planning, design and installation of Wireless access networks (Applying)
5. Analyse and get an insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements and link quality control. (Analysing)
6. Estimate the requirements of accessories to establish a network (Evaluating)
7. Establish a network as per requirements. (Creating)

Module I (7 Hours)

Necessity for wireless terminals connectivity and networking. Wireless networking advantages and disadvantages, Overview of wireless access technologies. Narrowband and broadband networks, fixed and nomadic networks. Wireless local loop (WLL), Public Switched Telephone Network (PSTN) interfaces.

Module II (7 Hours)

Fixed wireless access (FWA) networks, frequency bands for different networks. Criterions for frequency bands allocation, Network topologies, hotspot networks. Communication links: point- to-point (PTP), point to multipoint (PMP), multipoint-to-multipoint (MTM).

Module III (9 Hours)

Standards for most frequently used wireless access networks: WPAN (802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11, Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN, HIPERACCESS),
WWAN (802.20), Other technologies for broadband wireless access, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution Service (MMDS). Ad Hoc networks, Network services. Services types based on carrier frequency and bandwidth.

Module IV (9 Hours)

Wireless access networks planning, design and installation. Services provision, legislative and technical aspects, Technical and economical factors for network planning: expenses, coverage, link capacity, network complexity and carrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment. Terminal mobility issues regarding wireless access to the Internet. Wireless networking security issues.

Module V (8 Hours)

Example of laptop or handheld PC wireless connection in real environment. PC wireless interface equipment. Wireless access network exploitation and management, software requirements, link quality control. Business model, wireless network services market, market research and marketing, service providers, wireless data application service providers (WDASP) and their role on the public telecommunication services market, billing systems.

Module VI (8 Hours)

Recent trends in wireless networking and various access mechanisms, new standards of wireless communication.

Suggested Readings

1. M. P. Clark, Wireless Access Networks: Fixed Wireless Access and WLL networks -- Design and Operation, John Wiley & Sons, Chichester
2. D. H. Morais, Fixed Broadband Wireless Communications: Principles and Practical Applications, Prentice Hall, Upper Saddle River
3. R. Pandya, Introduction to WLLs: Application and Deployment for Fixed and Broadband Services, IEEE Press, Piscataway

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2	L	H	M			
CO 3			H	M		
CO 4				H	M	
CO 5				M	H	
CO 6					M	H

CSMS0095: MOBILE APPLICATIONS AND SERVICES

(3 Credits)

Objectives

- This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
- It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smart phones and tablets.
- It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile

Course Outcomes

1. Relate and explain the emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets. (Remembering, Understanding)
2. Building the applications for different platform. (Applying)
3. Analyze the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile. (Analyzing)
4. Evaluate the results and compare in different environment to have best outcome. (Evaluating)
5. Create applications as per requirements in suitable environment. (Creating)

Module I (7 Hours)

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User.

Module II (7 Hours)

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.

Module III (9 Hours)

Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony, Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics.

Module IV (9 Hours)

Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer to-Peer Architecture, Android Multimedia.

Module V (8 Hours)

Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, More on Security, Hacking Android.

Module VI (5 Hours)

Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.

Suggested Readings

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H	M			
CO 3			H	M		

CO 4				H	H	
CO 5					M	H

CSSI0096: SMART SENSORS AND INTERNET OF THINGS
(3 Credits)

Objectives
- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and characteristics.

Course Outcomes
1. Explain the revolution of Internet in Mobile Devices, Cloud & Sensor Networks. (Understanding)
2. Identify the application areas of IOT. (Applying)
3. Examine the building blocks of Internet of Things and their characteristics. (Analyzing)
4. Evaluate the results and compare the performance in different environment. (Evaluating)
5. Construct IoT based products as per requirements for a suitable environment. (Creating)
6. List and explain the different sensors and illustrate their applications in smart devices. (Remembering)

Module I (7 Hours)
Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT.

Module II (7 Hours)
Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.

Module III (9 Hours)
Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors.

Module IV (10 Hours)
Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel

Module V (7 Hours)
Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor and Future scope of research in smart sensor.

Module VI (5 Hours)
Recent trends in smart sensor for day to day life, evolving sensors and their architecture.

Suggested Readings
1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing.
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H	M			
CO 3			H	M		
CO 4				H	M	
CO 5					H	M
CO 6						H

CSLF0097: LOGIC AND FUNCTIONAL PROGRAMMING
(3 credits)

Objectives:
- To further the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic

programming for IOT data analysis.
- To introduce basics of functional programming and constraint logic programming for nodes in IOT.
- Introduction into formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience.

Course Outcomes
1. Define sensors and relate their data collection technique with various criteria set by the users. (Remembering)
2. Explain the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming for IOT data analysis. (Understanding)
3. Experiment with the basics of functional programming and constraint logic programming for nodes in IOT. (Applying)
4. Examine the formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience. (Analysing)
5. Evaluate the results and compare in different environments to have best results. (Evaluating)
6. Create IoT based products as per requirements in a suitable environment. (Creating)

Module I (5 Hours)
Proposition Logic: Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table , Problem Solving with Semantic Table.

Module II (7 Hours)
Natural Deduction and Axiomatic Propositional Logic: Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments

Module III (7 Hours)
Introduction to Predicate Logic Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming

Module IV (12 Hours)
Semantic Tableaux & Resolution in Predicate Logic: Semantic Tableaux, Instantiation Rules, Problem- solving in Predicate Logic, Normal forms, Herbrand Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool, Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter.

Module V (9 Hours)
Lazy and Eager Evaluation strategies: Evaluation Strategies, Lazy Evaluation: Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning

Module VI (5 Hours)

Recent trends in logical and functional programming, predicate logics and various evaluation strategies.

Suggested Readings
1. John Kelly, "The Essence of Logic", Prentice-Hall India.
2. Saroj Kaushik, "Logic and Prolog Programming", New Age International Ltd

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2	M	H				
CO 3			H	M		
CO 4				H	M	
CO 5				M	H	M
CO 6					M	H

CSDF0098: DIGITAL FORENSICS

(3 Credits)

Course Outcomes
1. Recall the computer forensics related features of relevant legislations. (Remembering)
2. Explain the digital forensics related processes and procedures. (Understanding)
3. Utilize e-discovery tools to gather evidence from computers, mobiles, network, emails and the web. (Applying)

4. Analyse gathered forensics data to conduct an investigation. (Analysing)
5. Criticize digital forensics related case. (Evaluating)
6. Formulate plans for investigating real-world cyber-crimes. (Creating)

Module 1 (8 Hours)
Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber- criminalistics area, holistic approach to cyber-forensics

Module 2 (7 Hours)
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Module 3 (8 Hours)
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Module 4 (10 Hours)
Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Module 5 (8 Hours)
Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008

Module 6 (4 Hours)
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

Suggested Readings
1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H			M		
CO2		H				
CO3		M	H			
CO4				H		
CO5			M		H	
CO6				M		H

CSEH0099: ETHICAL HACKING
(3 Credits)

Course Outcomes
1. Recall the features of various cyber laws related to ethical hacking and the code of ethics for ethical hacking. (Remembering)
2. Explain the terms penetration testing, vulnerability analysis, and malware analysis. (Understanding)
3. Utilize various tools to gather data for penetration testing, vulnerability analysis, and malware analysis. (Applying)
4. Analyse gathered data to discover vulnerabilities. (Analysing)
5. Assess the exploitability of vulnerabilities present in a software or hardware. (Evaluating)
6. Maximize a detected vulnerability to hack a computer, mobile or network. (Creating)

Module 1 (9 Hours)
Introduction to Ethical Disclosure: Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure

Module 2 (8 Hours)
Penetration Testing and Tools: Using Metasploit, Using Back Track Live CD Linux Distribution

Module 3 (9 Hours)

Vulnerability Analysis: Passive Analysis, Advanced Static Analysis with IDA Pro, Advanced Reverse Engineering

Module 4 (10 Hours)
Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit

Module 5 (5 Hours)
Malware Analysis: Collecting Malware and Initial Analysis, Hacking Malware

Module 6 (4 Hours)
Case study of vulnerability of cloud platforms and mobile platforms & devices.

Suggested Readings
1. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition
2. Jon Erickson, Hacking: The Art of Exploitation, SPD

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H			M		
CO2		H				
CO3		M		H		
CO4			H	M		
CO5			M		H	
CO6				M		H

CSID0100: INTRUSION DETECTION
(3 Credits)

Course Outcomes
1. Recall the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems. (Remembering)
2. Explain the different classes of attacks and anomaly detection systems and algorithms. (Understanding)
3. Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share. (Applying)
4. Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion. (Analysing)
5. Evaluate the security posture of an enterprise. (Evaluating)
6. Formulate a plan to secure an enterprise network using an appropriate intrusion detection system. (Creating)

Module 1 (9 Hours)
The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detection and Intrusion Prevention Network and Host-based IDS

Module 2 (8 Hours)
Classes of attacks - Network layer: scans, denial of service, penetration Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/ sop Hesitated groups-Automated: Drones, Worms, Viruses

Module 3 (8 Hours)
A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS

Module 4 (8 Hours)
Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host- based Anomaly Detectors-Software Vulnerabilities State transition, Immunology, Payload Anomaly Detection

Module 5 (8 Hours)
Attack trees and Correlation of alerts-Autopsy of Worms and Botnets-Malware Detection- Obfuscation, polymorphism-Document vectors

Module 6 (4 Hours)
Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero day detection- Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception- Future: Collaborative Security

Suggested Readings

1. The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press ISBN 0-32130545-3
2. Crimeware, Understanding New Attacks and Defenses, Markus Jakobsson and Zulfikar Ramzan, Symantec Press, ISBN: 978-0-321-50195-0 2008

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H			M		
CO2		H				
CO3		M	H	M		M
CO4			M	H		
CO5			M		M	H
CO6				M	H	M

CSMR0101: MALWARE ANALYSIS & REVERSE ENGINEERING

(3 Credits)

Course Outcomes

1. Recall an insight of fundamentals of malware analysis (Remembering)
2. Explain the concept of malware and reverse engineering. (Understanding)
3. Utilize tools and techniques of malware analysis (Applying)
4. Analyse data with respect to Malware and Kernel Debugging (Analysing)
5. Evaluate results from analysed data. (Evaluating)
6. Create an environment to protect malware. (Creating)

Module 1 (11 Hours)

Fundamentals of Malware Analysis (MA), Reverse Engineering Malware (REM)Methodology, Brief Overview of Malware analysis lab setup and configuration, Introduction to key MA tools and techniques, Behavioral Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining Clam AV Signatures, Creating Custom Clam AV Databases, Using YARA to Detect Malware Capabilities, Creating a Controlled and Isolated Laboratory, Introduction to MA Sandboxes, Ubuntu, Zeltser's REMnux, SANS SIFT, Sandbox Setup and Configuration New Course Form, Routing TCP/IP Connections, Capturing and Analysing Network Traffic, Internet simulation using INet Sim, Using Deep Freeze to Preserve Physical Systems, Using FOG for Cloning and Imaging Disks, Using MySQL Database to Automate FOG Tasks, Introduction toPython ,Introduction to x86 Intel assembly language, Scanners: Virus Total, Jotti, and No Virus Thanks, Analysers: Threat Expert, CW Sandbox, Anubis, Joebox, Dynamic Analysis Tools: Process Monitor, Regshot, Handle Diff, Analysis Automation Tools: Virtual Box, VM Ware, Python , Other Analysis Tools

Module 2 (6 Hours)

Using TSK for Network and Host Discoveries, Using Microsoft Offline API to Registry Discoveries , Identifying Packers using PEiD, Registry Forensics with Reg Ripper Plugins:, Bypassing Poison Ivy's Locked Files, Bypassing Conficker's File System ACL Restrictions, Detecting Rogue PKI Certificates.

Module 3 (8 Hours)

Opening and Attaching to Processes, Configuration of JIT Debugger for Shell code Analysis, Controlling Program Execution, Setting and Catching Breakpoints, Debugging with Python Scripts and Py Commands, DLL Export Enumeration, Execution, and Debugging, debugging a VMware Workstation Guest (on Windows), Debugging a Parallels Guest (on Mac OS X). Introduction to Win Dbg Commands and Controls, Detecting Rootkits with Win Dbg Scripts, Kernel Debugging with IDA Pro.

Module 4 (8 Hours)

Memory Dumping with Moon Sols Windows Memory Toolkit, Accessing VM Memory Files Overview of Volatility, Investigating Processes in Memory Dumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA.

Module 5 (7 Hours)

Using WHOIS to Research Domains, DNS Hostname Resolution, Querying Passive DNS, Checking DNS Records, Reverse IP Search New Course Form, Creating Static Maps, Creating Interactive Maps.

Module 6 (5 Hours)

Case study of Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA

Suggested Readings

1. Michael Sikorski, Andrew Honig "Practical Malware Analysis: The Hands-On Guide to DissectingMalicious Software" publisher William Pollock

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H					
CO2		H				
CO3		M	H			M
CO4				H		
CO5			M		H	
CO6				M		H

CSSC0102: SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING

(3 Credits)

Course Outcomes

1. Recall the various software vulnerabilities. (Remembering)
2. Explain the software process vulnerabilities for an organization. (Understanding)
3. Apply techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment (Applying)
4. Analyse and monitor resources consumption in a software. (Analysing)
5. Evaluate results by interrelating security and software development process. (Evaluating)
6. Create methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws. (Creating)

Module 1 (8 Hours)

Secure Software Design Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance

Module 2 (9 Hours)

Enterprise Application Development Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Module 3 (8 Hours)

Enterprise Systems Administration Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Module 4 (8 Hours)

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Module 5 (8 Hours)

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Module 6 (4 Hours)

Case study of DNS server, DHCP configuration and SQL injection attack.

Suggested Readings

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H					
CO2		H				
CO3		M		H		M

CO4			H	M		
CO5			M		H	
CO6				M		H

CSAA0103: ADVANCED ALGORITHMS

(3 credits)

Course Outcomes

1. Recall different algorithms (Remembering)
2. Explain the applications of various algorithms (Understanding)
3. Apply computer algorithms for different purposes. (Applying)
4. Analyse the complexity/ performance of different algorithms. Categorize the different problems in various classes according to their complexity. (Analysing)
5. Evaluate the different problems in various classes according to their complexity. (Evaluation)
6. Elaborate the recent activities in the field of the advanced data structure. (Creating)

Module 1 (6 Hours)

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge weighted case (Dijkstra's), depth-first search and computation of strongly connected, components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Module 2 (7 Hours)

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting paths.

Module 3 (8 Hours)

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute, maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Module 4 (9 Hours)

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm.Schonhage-Strassen Integer Multiplication algorithm

Module 5 (10 Hours)

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method,Advanced Number Theoretic Algorithm

Module 6 (5 Hours)

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Suggested Readings

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	M			
CO 3		M	H	M		

CO 4			M	H	M	
CO 5					H	M
CO 6						H

CSSP0104: SOFT COMPUTING

(3 Credits)

Objectives:

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate techniques for a given scenario.
- To implement soft computing-based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide student hand-on experience on MATLAB to implement various strategies.

Course Outcomes

1. Identify and describe soft computing techniques and their roles in building intelligent machines. (Remembering & understanding)
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. (Applying)
3. Analyse genetic algorithms to combinatorial optimization problems. (Analysing)
4. Evaluate and discuss solutions by various soft computing approaches for a given problem. (Evaluating and creating).

Module I (7 Hours)

Introduction to soft computing and neural networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Module II (8 Hours)

Fuzzy logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Module III (8 Hours)

Neural networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Module IV (5 Hours)

Genetic algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Module V (12 Hours)

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Module VI (5 Hours)

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithms. Implementation of recently proposed soft computing techniques.

Suggested Readings

1. Jyh Shing Roger Jang, Chuen Tsai Sun, Eiji Mizutani, Neuro Fuzzy and Soft Computing, Prentice: Hall of India,2003.
2. George J. Klirand Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall,1995.
3. MATLAB Toolkit Manual.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					L
CO 2	H	H			M	
CO 3		M		H		
CO 4			M		M	M

CSDV0105: DATA VISUALISATION

(3 Credits)

Objectives:

- familiarize students with the basic and advanced techniques of information visualization and scientific visualization,
- to learn key techniques of the visualization process
- a detailed view of visual perception, the visualized data and the actual visualization interaction and distorting techniques

Course Outcomes

1. Recall the basic and advanced techniques of information and scientific visualization. (Remembering)
2. Explain the key techniques of the visualization process. (Understanding)
3. Apply detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques. (Applying)
4. Analyse different visualization techniques and their applicability to different types of data. (Analysing)
5. Compare techniques for visual mapping, geographic data and collaborative visualization. (Evaluating)
6. Create a process to have an understanding of large-scale abstract data. (Creating)

Module I (8 Hours)

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

Module II (8 Hours)

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Module III (8 Hours)

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

Module IV (10 Hours)

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

Module V (7 Hours)

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

Module VI (4 Hours)

Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.

Suggested Readings

1. WARD, GRINSTEIN, KEIM, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	L	H	H			
CO 3						
CO 4			M	H	H	
CO 5					H	
CO 6			H	H	H	M

CSBD0106: BIG DATA ANALYTICS

(3 Credits)

Objectives:

- Understand big data for business intelligence. Learn business case studies for big data analytics.
- Understand no sql big data management. Perform map-reduce analytics using Hadoop and related tools

Course Outcomes

1. Describe big data and use cases from selected business domains. (Remembering & Understanding)
2. Applying NoSQL big data management. (Applying)
3. Install, configure, and run Hadoop and HDFS and analyse the data. (Analysing)
4. Perform map-reduce analytics using Hadoop (Evaluating)
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for creating big data analytics. (Creating)

Module I (8 Hours)
What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and bigdata, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and bigdata, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

Module II (8 Hours)
Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map- reduce calculations.

Module III (8 Hours)
Data format, Analysing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java Interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

Module IV (8 Hours)

Map Reduce workflows, unit tests with MR Unit, test data and local tests, anatomy of Map Reduce jobrun, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

Module V (7 Hours)
Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.

Module VI (6 Hours)
Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Suggested Readings

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, “Big Data, Big Analytics:Emerging
2. Business Intelligence and Analytic Trends for Today’s Businesses”, Wiley, 2013.
3. P.J. Sadalage and M. Fowler, “NoSQL Distilled: A Brief Guide to the Emerging Worldof
4. Polyglot Persistence”, Addison-Wesley Professional,2012.
5. Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’Reilly,2012.
6. Eric Sammer, “Hadoop Operations”, O’Reilly,2012.
7. E. Capriolo, D. Wampler, and J. Rutherglen, “Programming Hive”, O’Reilly,2012.
8. Lars George, “HBase: The Definitive Guide”, O’Reilly,2011.
9. Eben Hewitt, “Cassandra: The Definitive Guide”, O’Reilly,2010.
10. Alan Gates, “Programming Pig”, O’Reilly, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	L	H	M			
CO 3			H			
CO 4			M	H	H	
CO 5					H	M

CSDD0107: DATA WAREHOUSING AND DATA MINING

(3 Credits)

Objectives:

- The objective of this course is to introduce data warehousing and mining techniques.
- Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

Course Outcomes

1. List the various data warehousing and data mining techniques. (Remembering)
2. Explain the principles, concepts, functions and various applications of data warehouse. (Understanding)
3. Apply data mining techniques for classification and prediction. (Applying)

4. Perform cluster, periodicity and social network analysis. (Analysing)
5. Evaluate and compare various data mining solutions for a given problem. (Evaluating)
6. Choose appropriate data warehousing and data mining techniques to build real-world systems. (Creating)

Module I (7 Hours)
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

Module II (7 Hours)
Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

Module III (8 Hours)
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

Module IV (9 Hours)
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

Module V (9 Hours)
Web Mining, Mining the webpage layout structure, mining weblink structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Module VI (5 Hours)
Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

Suggested Readings
1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication,2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.
3. G Dong and J Pei, Sequence Data Mining, Springer,2007.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	M	H				
CO 3		H	M			
CO 4		M	H	M		
CO 5				H	M	M
CO 6						H

CSDS0108: DATA SECURITY AND ACCESS CONTROL

(3 Credits)

Objective
The objective of the course is to provide fundamentals of database security. Various access control techniques mechanisms were introduced along with application areas of access control techniques.

Course Outcomes
1. Define access control in the database. (Remembering)
2. Explain the purpose and fundamentals of access control. (Understanding)
3. Identify the capabilities and limitations of various access control mechanisms. (Applying)
4. Analyse the data, identify the problems, and choose the relevant models and algorithms to apply. (Analysing)
5. Assess the strengths and weaknesses of various access control models and to Analyse their behaviour. (Evaluating)
6. Design and develop access control mechanisms for enterprise IT infrastructures. (Creating)

Module I (7 Hours)
Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

Module II (8 Hours)
Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy.

Module III (9 Hours)
Biba Integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company

Module IV (10 Hours)
Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Module V (7 Hours)
Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.

Module VI (4 Hours)
Recent Trends related to data security management, vulnerabilities in different DBMS.

Suggested Readings
1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli.
2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	M	H				
CO 3		M	M			
CO 4		M	H	H		
CO 5				M	M	L
CO 6					H	M

CSWD0109: WEB ANALYTICS AND DEVELOPMENT
(3 Credits)

Objective
The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.

Course Outcomes
1. Relate with core research communities, publications, focused on web and social media analytics and research questions engaged. (Remembering)
2. Discuss clickstream data collection techniques, their impact on metrics, and their inherent limitations. (Understanding)
3. Identify and interpret commonly used web metrics (Applying)
4. Analyse and evaluate tasks and techniques used in web analytics. (Analysis/Evaluation)
5. Elaborate the resulting insights to support website design decisions, campaign optimisation, search analytics, etc. (Creating)

Module I (8 Hours)
Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization

Module II (8 Hours)
Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys

Module III (8 Hours)
Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models

Module IV (12 Hours)
Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity

Module V (9 Hours)
Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation

Suggested Readings

1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analysing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann,304.
2. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
3. Easley, D. & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press. http://www.cs.cornell.edu/home/kleinber/networks- book/
4. Wasserman, S. &Faust, K. (1994). Social network analysis: Methods and applications. NewYork: Cambridge University Press.
5. Monge, P.R. &Contractor, N.S. (2003). Theories of communication networks. NewYork: Oxford University Press.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2	M	H			
CO 3		M	H		
CO 4		M	M	H	
CO 5				M	H

CSKD0110: KNOWLEDGE DISCOVERY

(3 Credits)

Objective
To conduct case studies on real data mining examples

Course Outcomes
1. Recall the basic terminologies like learning goals, concept representation, decision tree, computational learning, artificial neural network, classification. (Remembering)
2. Explain different categories of machine learning and machine learning methodologies and illustrate the theory behind designing a learning model. (Understanding)
3. Compare efficiency of different learning algorithms, classify supervised and unsupervised learning goals. (Understanding)
4. Apply different learning algorithms for real life classification problem, sketch the structure of different learning model such as neural network, support vector machine, naive bayes etc. (Applying)
5. Analyse decision tree learning, computational learning, artificial neural network and instance-based learning and how one learning overcomes the drawback in the other. (Analysing)
6. Judge in terms of different complexity which algorithms betters in what situation. (Evaluating).
7. Create and design ensemble-based learning, propose new learning for optimizing real life problems. (Creating)

Module I (7 Hours)
Introduction KDD and Data Mining - Data Mining and Machine Learning, Machine Learning and Statistics, Generalization as Search, Data Mining and Ethics

Module II (8 Hours)
Knowledge Representation - Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Trees for Numeric Predictions, Neural Networks, Clusters

Module III (9 Hours)
Decision Trees - Divide and Conquer, Calculating Information, Entropy, Pruning, Estimating Error Rates, The C4.5 Algorithm Evaluation of Learned Results- Training and Testing, Predicting Performance, Cross-Validation

Module IV (8 Hours)
Classification Rules - Inferring Rudimentary Rules, Covering Algorithms for Rule Construction, Probability Measure for Rule Evaluation, Association Rules, Item Sets, Rule Efficiency

Module V (6 Hours)
Numeric Predictions - Linear Models for Classification and Numeric Predictions, Numeric Predictions with Regression Trees, Evaluating Numeric Predictions

Module VI (7 Hours)
Artificial Neural Networks – Perceptrons, Multilayer Networks, The Backpropagation Algorithm Clustering - Iterative Distance-

based Clustering, Incremental Clustering, The EM Algorithm

Suggested Readings

1. Data mining and knowledge discovery handbook by Maimon, Oded(etal.)
2. Data Cleansing: A Prelude to knowledge Discovery

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	H	M		
CO 3		M	M	H		
CO 4		M	H	H		
CO 5				M	M	L
CO 6					H	M
CO 7				H	L	L

CSNL0111: NATURAL LANGUAGE PROCESSING

(3 Credits)

Objectives

The goals for this course are to study:

- algorithms and methods for building computational models of natural language understanding, including syntactic analysis, semantic representations, discourse analysis, and statistical and corpus- based methods for text processing and knowledge acquisition
- issues involved in natural language understanding
- applications that can benefit from natural language processing, such as information extraction, question answering, machine translation, and spoken language understanding. By the end of the course, students will have a good understanding of and appreciation for natural language processing, and have the necessary skills to build natural language processing tools.

Course Outcomes

1. Recall algorithms and methods for building computational models of natural language processing (Remembering)
2. Explain syntactic analysis, semantic representations, discourse analysis, and statistical and corpus-based methods for text processing and knowledge acquisition. (Understanding)
3. Apply the methods of natural language processing. (Applying)
4. Analyse Issues involved in natural language processing. (Analysing)
5. Evaluate and generate applications that can benefit from natural language processing, such asinformation extraction, question answering, machine translation, and spoken language understanding. (Evaluating &creating)

Module I (10 hours)

Introduction to NLP, Knowledge in language processing, Representation and Understanding, Organization of NLP systems, Models and algorithms, Linguistic Essentials

Module II (15 hours)

Grammars and Parsing - Syntactic Processing: Collocations; Regular Expression and Automata; Morphology and Finite-State Transducers; N-grams; Word Classes and Part-of-Speech Tagging; Context-Free Grammars for English; Parsing with Context-Free Grammars: Top-down parsing, Bottom-up parsing; Features and Unification; Lexicalized and Probabilistic Parsing

Module III (10 hours)

Semantic processing: Representing Meaning; Semantic Analysis: Integrating semantic analysis to parsers, Semantic Grammars; Lexical Semantics; Word Sense Disambiguation and Information Retrieval: Selection- Restriction based disambiguation, Machine learning approaches; Dictionary based approaches, Information retrieval

Module IV (7 hours)

Pragmatics: Discourse, Dialogue and Conversational Agents: Dialogue acts, Automatic Interpretation of Dialogue acts; Natural Language Generation: Discourse Planning; Machine Translation: Direct Translations, Translation using Statistical techniques
Module V (3 hours)
NLP Applications and Tools: Sentiment Analysis, Text Summarization, Text Entailment, Machine Translation, Question Answering, Cross Lingual Information Retrieval (CLIR), NLTK, WordNet

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5

CO 1	H				
CO 2	M	H	M		
CO 3		M	H	L	
CO 4		M	M	H	M
CO 5				M	H

CSNI0112: SENSOR NETWORKS AND INTERNET OF THINGS
(3 credits)

Objectives

- The course gives an overview of various topics related to wireless sensor networks, which are expected to be the basis for the emerging internet-of-things.
- The course covers topics with relation to various sub disciplines of computer science such as hardware, operating systems, distributed systems, networking, security and databases.
- Able to understand wireless sensor network (WSN) specific issues such as localization, time synchronization, and topology control are addressed as well.

Course Outcomes

1. Define the function of sensors. (Remembering)
2. Explain how to connect sensors to the environment. (Understanding)
3. Organize and connect sensors together to have generated output. (Applying)
4. Examine hardware and software level consideration for IoT sensors. (Analyzing)
5. Evaluate results from data. (Evaluating)
6. Creating a real time application. (Creating)

Module I (7 Hours)
Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security.

Module II (8 Hours)
IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote control.

Module III (8 Hours)
Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Module IV (10 Hours)
Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases.

Module V (7 Hours)
IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device

Module VI (5 Hours)
Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.

Suggested Readings

1. Mandler, B., Barja, J., MitreCampista, M.E., Cagá_ová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H				
CO 3			H	H		
CO 4				H	M	

CO 5					H	
CO 6						H

CSAC0113: IOT APPLICATIONS AND COMMUNICATION PROTOCOLS
(3 credits)

Objectives

- Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration.
- Open source/commercial electronics platform for IoT-Raspberry Pi, Arduino, Arm Mbed LPC.
- Open source /commercial enterprise cloud platform for IoT-Ayla, iO Bridge, Libellium, Axeda, Cisco fog cloud.

Course Outcomes

1. Define IoT and respective protocols. (Remembering)
2. Explain the functions of different layers of communication protocol. (Understanding)
3. Identify the different functions with respect to different layers. (Applying)
4. Distinguish protocol and functionalities. (Analyzing)
5. Evaluate the sensor collected data in connection to communication layer. (Evaluating)
6. Create applications using different communication protocol. (Creating)

Module I (7 Hours)

Basic function and architecture of a sensor — sensor body, sensor mechanism, sensor calibration, sensor maintenance, cost and pricing structure, legacy and modern sensor network. Development of sensor electronics — IoTvs legacy, and open-source vs traditional PCB design style Development of sensor communication protocols, Protocols: Modbus, relay, Zigbee, Zwave, X10, Bluetooth, ANT, etc. Business driver for sensor deployment — FDA/EPA regulation, fraud/ tempering detection, supervision, quality control and process management Different kind of calibration Techniques: manual, automation, infield, primary and secondary calibration — and their implication in IoT Powering options for sensors: battery, solar, Witricity, Mobile and PoE.

Module II (9 Hours)

Zigbee and Zwave — advantage of low power mesh networking. Long distance Zigbee. Introduction to different Zigbee chips. Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Introduction of Bluetooth vendors & their review. Wireless protocols such as Piconet and packet structure for BLE and Zigbee Other long distance RF communication link. LOS vs NLOS links, Capacity and throughput calculation Application issues in wireless protocols: power consumption, reliability, PER, QoS, LOS.

Module III (9 Hours)

PCB vs FPGA vs ASIC design Prototyping electronics vs Production electronics, QA certificate for IoT CE/CSA/UL/IEC/RoHS/IP65 Basic introduction of multi-layer PCB design and its workflow Electronics reliability-basic concept of FIT and early mortality rate Environmental and reliability testing-basic concepts Basic Open source platforms: Arduino, Raspberry Pi, Beaglebone.

Module IV (7 Hours)

Introduction to Mobile app platform for IoT: Protocol stack of Mobile app for IoT, Mobile to server integration, iBeacon in IoS, Window Azure, Linkafy Mobile platform for IoT, Axeda, Xively.

Module V (8 Hours)

Database implementation for IoT : Cloud based IoT platforms, SQL vsNoSQL, Open sourced vs. Licensed Database, Available M2M cloud platform, AxedaXively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT &T M2M platform, Google M2M platform.

Module VI (5 Hours)

Recent trends in home automation, IOT-locks, Energy optimization in home

Suggested Readings

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H	M			
CO 3			H	M		
CO 4			M	H	M	

CO 5					H	
CO 6						H

CSNY0114: NETWORK SECURITY
(3 credits)

Objectives:
- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- Explore network security and how they are implemented in real world.
- To get an insight of various issues of Web security and biometric authentication.

Course Outcomes
1. Recall the basics of security and various types of security issues. (Remembering)
2. Explain the different cryptography techniques available and various security attacks. (Understanding)
3. Apply network security and how they are implemented in the real world. (Applying)
4. Analyse available biometric techniques and how they are used in today's world. (Analysing)
5. Evaluate the security issues on the web and how to tackle them. (Evaluating)
6. Elaborate the various issues of web security and biometric authentication. (Creating)

Module I (6 Hours)
Data security: Review of cryptography. Examples RSA, DES, ECC.

Module II (7 Hours)
Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols

Module III (9 Hours)
Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPSec.

Module IV (10 Hours)
Web security – SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access Control, firewalls and host/network intrusion detection.

Module V (8 Hours)
Other topics: Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication.

Module VI (5 Hours)
Recent trends in IOT security, IDS and Biometric.

Suggested Readings
1. W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2. W. Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3. Schneier. Applied Cryptography. Wiley, 1999

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	M	H				
CO 3		M	H			
CO 4			M	H		
CO 5				M	H	
CO 6					H	M

CSAM0115: ADVANCED MACHINE LEARNING
(3 credits)

Objectives:
- To introduce key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering and probabilistic modeling.
- To give a broad view of the general issues arising in the application of algorithms to analysing data, common terms used, and common errors made if applied incorrectly.
- To demonstrate a toolbox of techniques that can be immediately applied to real world problems, or used as a basis for

future research into the topic

Course Outcomes

1. Recall and explain the key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering and probabilistic modeling. (Remembering, Understanding)
2. Explain the general issues arising in the application of algorithms, commonly used terms, and the common errors made if applied incorrectly. (Understanding)
3. Demonstrate a toolbox of techniques that can be immediately applied to real world problems, or used as a basis for future research into the topic. (Applying)
4. Analyse the Kernel methods for handling high dimensional and non-linear patterns. (Analysing)
5. Evaluate the State-of-the-art algorithms such as Support Vector Machines and Bayesian networks.
6. (Evaluating)
7. Solve real-world machine learning tasks: from data to inference. (Creating)

Module I (7 Hours)

Key concepts, Supervised/Unsupervised Learning, Loss functions and generalization, Probability Theory, Parametric vs Non-parametric methods, Elements of Computational Learning Theory Ensemble Learning, Bagging, Boosting, Random Forest

Module II (7 Hours)

Kernel Methods for non-linear data, Support Vector Machines, Kernel Ridge Regression, Structure Kernels, K ernel PCA, Latent Semantic Analysis

Module III (8 Hours)

Bayesian methods for using prior knowledge and data, Bayesian inference, Bayesian Belief Networks and Graphical models, Probabilistic Latent Semantic Analysis, The Expectation-Maximisation (EM) algorithm, Gaussian Processes

Module IV (9 Hours)

Dimensionality Reduction - CCA, LDA, ICA, NMF – Canonical Variates - Feature Selection vs Feature Extraction

Module V (9 Hours)

Filter Methods - Sub-space approaches - Embedded methods, Low-Rank approaches - Recommender Systems Application areas - Security - Business - Scientific

Module VI (5 Hours)

Recent trends in supervised and unsupervised learning algorithm, dimensional reducibility, feature selection and extraction

Suggested Readings

1. Christopher M. Bishop, Pattern Recognition and Machine Learning.
2. John Shawe -Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	M	H				
CO 3		M	H	M		
CO 4			M	H		
CO 5				M	H	
CO 6					M	H

CSEC0116: DATA ENCRYPTION AND COMPRESSION

(3 Credits)

Course Outcomes

1. List the different encryption techniques adopted in both traditional and modern cryptographic mechanisms. (Remembering)
2. Infer the logic adopted in different cryptographic algorithms, and their countermeasures.
3. (Understanding)
4. Apply the concepts gathered from the fundamentals of cryptographic approaches in solving related problems. (Applying)
5. Analyse the working of the different encryption and compression algorithms. (Analysing)
6. Compare and contrast the working of different data encryption and compression mechanisms.
7. (Evaluating)
8. Choose appropriate encryption and compression algorithms to build real-world systems. (Creating)

Module 1 (8 Hours)
Introduction to Security: Need for security, Security approaches, Principles of security, Types of attacks.
Encryption Techniques: Plaintext, Cipher text, Substitution Vs Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size.

Module 2 (10 Hours)
Symmetric & Asymmetric Key Cryptography: Algorithm types & Modes, DES, IDEA, Differential & Linear Cryptanalysis, RSA, Symmetric &Asymmetric key together, Digital signature, Knapsack algorithm. User Authentication Mechanism: Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall.

Module 3 (9 Hours)
Case Studies of Cryptography: Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions, Conventional Encryption and Message Confidentiality, Conventional Encryption Principles, Conventional Encryption Algorithms, Location of Encryption Devices, Key Distribution. Public Key Cryptography and Message Authentication: Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, RSA, Digital, Signatures, Key Management.

Module 4 (7 Hours)
Introduction: Need for data compression, Fundamental concept of data compression coding, Communication model, Compression ratio, Requirements of data compression, Classification. Methods of Data Compression: Data compression-- Loss less and Lossy.

Module 5 (10 Hours)
Entropy encoding-- Repetitive character encoding, run length encoding, Zero/Blank encoding; Statistical encoding-- Huffman, Arithmetic & Lempel-Zivcoding; Source encoding-- Vector quantization (Simple vector quantization & with error term); Differential encoding—Predictive coding, Differential pulse code modulation, Delta modulation, Adaptive differential pulse code modulation; Transform based coding: Discrete cosine transform JPEG standards; Fractal compression

Module 6 (4 Hours)
Recent trends in encryption and data compression techniques.

Suggested Readings
1. Cryptography and Network Security by B. Forouzan, McGraw-Hill.
2. The Data Compression Book by Nelson, BPB.
3. Cryptography & Network Security by Atul Kahate, TMH.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	M	H	M	L		
CO 3		M	H	M		
CO 4		L	M	H	M	
CO 5				M	H	M
CO 6				L	M	H

CSSW0117: STEGANOGRAPHY AND DIGITAL WATERMARKING
(3 Credits)

Course Outcomes
1. Define the terms Steganography, Steganalysis and Digital Watermarking. (Remembering)
2. Explain the various techniques for Steganography, Steganalysis and Digital Watermarking.
3. (Understanding)
4. Utilize various tools available to perform Steganography. (Applying)
5. Analyse data to detect and extract hidden information. (Analysing)
6. Defend against steganography and digital watermarking attacks. (Evaluating)
7. Develop frameworks for secure communication. (Creating)

Module 1 (8 Hours)
Steganography: Overview, History, Methods for hiding (text, images, audio, video, speech etc.), Issues: Security, Capacity and Imperceptibility, Steganalysis: Active and Malicious Attackers, Active and passive steganalysis.

Module 2 (10 Hours)

Frameworks for secret communication (pure Steganography, secret key, public key steganography), Steganography algorithms (adaptive and non-adaptive),

Module 3 (7 Hours)
Steganography techniques: Substitution systems, Spatial Domain, transform domain techniques, spread spectrum, Statistical steganography, Cover Generation and cover selection, Tools: EzStego, FFEn code, hide 4PGP, Hide and Seek, S Tools etc.)

Module 4 (5 Hours)
Detection, Distortion, Techniques: LSB Embedding, LSB Steganalysis using primary sets, Texture based

Module 5 (10 Hours)
Digital Watermarking: Introduction, Difference between Watermarking and steganography, History,
Classification (Characteristics and Applications), Types and techniques (Spatial-domain, Frequency- domain, and Vector quantization-based watermarking), Attacks and Tools (Attacks by Filtering, Re-modulation, Distortion, Geometric Compression, Linear Compression etc.), Watermark security & authentication.

Module 6 (5 Hours)
Recent trends in Steganography and digital watermarking techniques. Case study of LSB Embedding, LSBSteganalysis using primary sets.

Suggested Readings
1. Peter Wayner, "Disappearing Cryptography–Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2002.
2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker, "Digital Watermarking and Steganography", Morgan Kaufmann Publishers, New York, 2008.
3. Information Hiding: Steganography and Watermarking-Attacks and Countermeasures by Neil F. Johnson, Zoran Duric, Sushil Jajodia.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L			
CO 2	M	H	M	L		
CO 3		M	H	M		
CO 4		L	M	H	M	
CO 5					H	M
CO 6				L	M	H

CSIT0118: INFORMATION THEORY AND CODING

(3 Credits)

Course Outcomes
1. List the various coding and compression techniques. (Remembering)
2. Explain the working of lossless and lossy compression techniques. (Understanding)
3. Apply encoding techniques to encode data and perform error detection and correction.
4. (Applying)
5. Compare the various coding and compression techniques for text, video and image. (Analysing)
6. Measure information in terms of probability and entropy. (Evaluating)
7. Combine compression and coding techniques to build end-to-end systems. (Creating)

Module 1 (8 Hours)
Information and entropy information measures, Shannon's concept of Information. Channel coding, channel mutual information capacity (BW)

Module 2 (10 Hours)
Theorem for discrete memory less channel, information capacity theorem, Error Detecting and error correcting codes

Module 3 (8 Hours)
Types of codes: block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques

Module 4 (5 Hours)
Compression: loss less and lossy, Huffman codes, LZW algorithm, Binary Image compression schemes, run length encoding, CCITT group 3 1-DCompression, CCITT group 3 2D compression, CCITT group 42DCompression.

Module 5 (10 Hours)
Convolutional codes, sequential decoding. Video image Compression: CITT H261 Video coding algorithm, audio (speech) Compression. Cryptography and cipher.

Module 6 (4 Hours)
Case study of CCITT group 3 1-DCompression, CCITT group 3 2Dcompression.

Suggested Readings
1. Fundamentals in information theory and coding, Monica Borda, Springer.
2. Communication Systems: Analog and digital, Singh and Sapre, Tata McGraw Hill. Multimedia Communications Fred Halsall.
3. Information Theory, Coding and Cryptography R Bose.
4. Multimedia system Design Prabhat K Andleigh and Kiran Thakrar.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	M	L		
CO 3	L	M	H	M		
CO 4		L	M	H	M	
CO 5				L	H	M
CO 6					M	H

CSRA0119: SECURITY ASSESSMENT AND RISK ANALYSIS
(3 Credits)

Course Outcomes
1. List and define the various Contingency Planning components. (Remembering)
2. Explain the escalation process from incident to disaster in case of security disaster. (Understanding)
3. Plan countermeasures to threats. (Applying)
4. Analyse risks. (Analysing)
5. Recommend contingency strategies including data backup and recovery and alternate site selection for business resumption planning. (Evaluating)
6. Design Incident Response Plan, Disaster Recovery Plan and Business Continuity Plan for sustained organizational operations. (Creating)

Module 1 (8 Hours)
SECURITY BASICS: Information Security (INFOSEC) Overview: critical information characteristics – availability information states – processing security counter measures education, training and awareness, critical information characteristics – confidentiality critical information characteristics–integrity, information states – storage, information states – transmission, security countermeasures -policy, procedures and practices, threats, vulnerabilities.

Module 2 (11 Hours)
Threats to and Vulnerabilities of Systems: definition of terms (e.g., threats, vulnerabilities, risk), major categories of threats (e.g., fraud, Hostile Intelligence Service (HOIS), malicious logic, hackers, environmental and technological hazards, disgruntled employees, careless employees, HUMINT, and monitoring), threat impact areas, Countermeasures: assessments (e.g., surveys, inspections), Concepts of Risk Management: consequences (e.g., corrective action, risk assessment),cost/ benefit analysis of controls, implementation of cost effective controls, monitoring the efficiency and effectiveness of controls (e.g., unauthorized or inadvertent disclosure of information), threat and vulnerability assessment

Module 3 (8 Hours)
Security Planning: directives and procedures for policy mechanism, Risk Management: acceptance of risk(accreditation), corrective actions information identification, risk analysis and/or vulnerability assessment components, risk analysis results evaluation, roles and responsibilities of all the players in the risk analysis process, Contingency Planning/Disaster Recovery: agency response procedures and continuity of operations, contingency plan components, determination of backup requirements, development of plans for recovery actions after a disruptive event, development of procedures for off-site processing, emergency destruction procedures, guidelines for determining critical and essential workload, team member responsibilities in responding to an emergency situation

Module 4 (7 Hours)
Policies and Procedures Physical Security Measures: alarms, building construction, cabling, communications centre, environmental controls (humidity and air conditioning), filtered power, physical access control systems (key cards, locks and

alarms) Personnel Security Practices and Procedures: access authorization/ verification(need-to-know), contractors, employee clearances, position sensitivity, security training and awareness, systems maintenance personnel, Administrative
Security Procedural Controls: attribution, copyright protection and licensing, Auditing and Monitoring: conducting security reviews, effectiveness of security programs, investigation of security breaches, privacy review of accountability controls, review of audit trails and logs

Module 5 (8 Hours)
Operations Security (OPSEC): OPSEC surveys/OPSEC planning INFOSEC: computer security – audit, Cryptography-encryption (e.g., point-to-point network, link), cryptography-key management (to include electronic key), cryptography-strength (e.g., complexity, secrecy, characteristics of the key)

Module 6 (3 Hours)
Case study of threat and vulnerability assessment

Suggested Readings
1. Principles of Incident Response and Disaster Recovery, Whitman &Mattord, Course Technology ISBN:141883663X
2. (Web link) http://www.cnss.gov/Assets/pdf/nstissi_4011.pdf

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L			
CO 2	M	H	M	M		
CO 3		M	H	M	L	
CO 4			M	H	M	
CO 5			L	M	H	M
CO 6				L	M	H

CSCD0120: SECURE CODING
(3 Credits)

Course Outcomes
1. Recall the basics of secure programming. (Remembering)
2. Explain the most frequent programming errors leading to software vulnerabilities. (Understanding)
3. Identify security problems in software. (Applying)
4. Compare the solutions for handling security problems in software. (Analysing)
5. Assess the vulnerabilities present in software. (Evaluating)
6. Design and develop secure programs. (Creating)

Module 1 (10 Hours)
Introduction to software security, managing software security risk, selecting software development Technologies, An open source and closed source, Guiding Principles for software security, Auditing software, Buffet overflows, Access control, Race conditions, Input validation, Password authentication

Module 2 (6Hours)
Anti-tampering, protecting against denial-of-service attack, copy protection schemes, Client-side security, Database security, applied cryptography, Randomness and determinism

Module 3 (8 Hours)
Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals SQL Injection, Command Injection, Failure to Handle Errors, and Security Touch points

Module 4 (8 Hours)
Cross Site Scripting, Magic URLs, Weak Passwords, Failing to Protect Data, Weak random numbers, improper use of cryptography

Module 5 (8 Hours)
Information Leakage, Race Conditions, Poor usability, failing to protect network traffic, improper use of PKI, trusting network name resolution

Module 6 (5 Hours)
Case study of Cross Site Scripting, Magic URLs, Weak Passwords Buffer Overflows, Access control, Race conditions

Suggested Readings

1. J. Viega, M. Messier. Secure Programming Cookbook, O'Reilly.
2. M. Howard, D. LeBlanc. Writing Secure Code, Microsoft
3. J. Viega, G. McGraw. Building Secure Software, Addison Wesley

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	M			
CO 3	L	M	H	M		
CO 4	L		M	H	M	
CO 5			L	M	H	M
CO 6				L	M	H

CSBI0121: BIOMETRICS

(3 Credits)

Course Outcomes

1. Define biometrics. (Remembering)
2. Explain the various modules constituting a biometric system. (Understanding)
3. Identify Biometric System Vulnerabilities. (Applying)
4. Compare the various Biometric technologies. (Analysing)
5. Evaluate the challenges and limitations associated with biometrics. (Evaluating)
6. Design security systems incorporating biometrics. (Creating)

Module 1 (7 Hours)

Introduction and Definitions of biometrics, Traditional authenticated methods and technologies.

Module 2 (10 Hours)

Biometric technologies: Fingerprint, Face, Iris, Hand Geometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA.

Module 3 (6 Hours)

The Law and the use of multi biometrics systems.

Module 4 (11 Hours)

Statistical measurement of Biometric.Biometrics in Government Sector andCommercial Sector.

Module 5 (9 Hours)

Case Studies of biometric system, Biometric Transaction. Biometric System Vulnerabilities.

Module 6 (5 Hours)

Recent trends in Biometric technologies and applications in various domains.Casestudy of 3D face recognition and DNA matching.

Suggested Readings

1. Biometrics for network security, Paul Reid, Hand book of Pearson
2. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition,Springer Verlag,2003.
3. A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in NetworkedSociety, Kluwer Academic Publishers, 1999.
4. J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology,Design and Performance Evaluation, Springer, 2004.
5. Anil Jain, Arun A. Ross, Karthik Nanda Kumar, Introduction to biometric, Springer, 2011.
6. Biometric Systems: Technology, Design and Performance Evaluation, J. Wayman, A.K. Jain, D. Maltoni, and D. Maio.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	M			
CO 3		M	H	M	L	
CO 4		L	M	H	M	
CO 5					H	M
CO 6					M	H

CSFA0122: FORMAL LANGUAGE AND AUTOMATA THEORY

(3 Credits-45 Hour)

Course Outcomes

1. Define basic terminology like Deterministic and Non deterministic automata, Pushdown Automata, Parse Tree, Regular Languages, Turing Machines etc. (Remembering)
2. Explain the concepts, core terms and tools used in automata theory.(Understanding)
3. Choose the techniques, components and tools of a typical automated machine and apply it in designing new machines. (Applying)
4. Identify which input pattern would be accepted by a Turing Machine, Pushdown Automata, Finite Automata etc. (Applying)
5. Compare and contrast various types of machines in Automata theory and relate it to everyday appliances like washing machines, fans, etc. (Analyzing)
6. Evaluate the correctness, computation cost and complexity for an automation. (Evaluating)
7. Design new automata and Turing machines for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Module I: Theory of Automata (7 Hours)

Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NDFA, Mealy and Moore Models, Minimization of Finite Automata.

Module II: Formal Languages, Regular Sets and Regular Grammars (12 Hours)

Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars Exercises.

Module III: Context-free Languages (13 Hours)

Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages Exercises

Module IV: Pushdown Automata Turing Machines and Linear Bounded Automata (13 Hours)

Basic Definitions, Acceptance by pda, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

Suggested Readings

1. K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science, BPB Publication, Prentice-Hall of India, Second Edition.
2. H.R. Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India.
3. H.E. Hopcraft and J.D. Ullamn, Introduction to Automata Theory, Languages and Computation, Narosa Publications.
4. J.C. Martin, Introduction to Languages and the Theory of Automata, Tata McGraw-Hill International, 2003..
5. C.H. Papadimitriou, Computation Complexity, Addison-Wesley.
6. Linz Peter, An Introduction to Formal Languages and Automata,Narosa.
7. Kain, Theory of Automata and Formal Language, McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			H
CO2	H	M		H
CO3		M		H
CO4	H		L	
CO5		M	H	
CO6	H			M
CO7		L		H

CSOS0123: OPERATING SYSTEMS

(3 Credits-45 Hours)

Course Outcomes

1. Elaborate what operating systems are, what they do and how they are designed and constructed. (Creating)
2. Define process concept like process scheduling, inter-process communication, process synchronization and concurrency. (Remembering)
3. Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm. (Understanding)
4. Identify different page replacement algorithms to solve problems. (Applying)
5. Explain how the file system, mass storage and I/O are handled in a modern computer system. (Remembering, Understanding)
6. Analyze the mechanisms necessary for the protection and security of computer systems. (Analysing)

Module I: Introduction (5 hours)
Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module II: Processes (7 hours)
Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching, Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3: Inter-process Communication (7 hours)
Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4: Deadlocks (5 hours)
Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5: Memory Management (10 hours)
Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation, Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory, Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 6: (11 hours)
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

Suggested Readings:
1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
4. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
5. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
6. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H	M			
CO 3		H	H	H		

CO 4			H	M		
CO 5				M	H	
CO 6				M	M	H

CSDC0124: DATA COMMUNICATIONS

(3 Credits-45 Hours)

Course Outcomes

1. Recall the fundamentals of data communication and various techniques of communications. Students will also be able to recall the layered structure of computer network. (REMEMBERING)
2. Explain about different network topology and the type of protocol required for different communication technique. (UNDERSTANDING)
3. Develop different network topology using various networking devices. (APPLYING)
4. Compare different networking devices. Students will also be able to analyse different network behaviour depending on performance parameters. (ANALYSING)
5. Evaluation of network performance based on implementation policy, protocol, topology etc. (Evaluating)
6. Construct networks required for organization, depending on availability of hardwares and softwares (CREATING)

Module I (12hours)

Introduction to data communications: A communications model, Data communications, Networking, Protocols and Protocol architecture, Characteristics of data transmission: Concepts and Terminology, Analog and digital data transmission, Transmission impairments. Transmission media: Guided transmission media, Wireless transmission data encoding, Digital data-Digital signals, Digital data- Analog signals, Analog data-Digital signals, and Analog data-Analog signals.

Module II (10 hours)

Data communication interface: Asynchronous and Synchronous transmission, Line configurations, Interfacing. Data link control, Flow control, Error detection, Error control, High-level data link control (HDLC), Other data link control protocols.

Module III (12 hours)

Data communications hardware: Terminals- Introduction, Basic terminal components, Enhanced terminal components, General-purpose terminals, Remote job entry terminals, Transaction terminals, Clustering of terminal devices. Communications processing hardware introduction, Switching processors, Multidrop lines, Multiplexers, Concentrators, Front-end processors.

Module IV (11 hours)

Modems: Network attachment and regulations, Line conditioning and leased lines, Modems and modem circuits. Multiplexing: Frequency-division multiplexing, Synchronous time- division multiplexing: Characteristics, TDM Link control, Digital carrier systems statistical time-division multiplexing: Characteristics.

Suggested Readings

1. William Stallings, Data and Computer Communications, Sixth Edition, Pearson Education Asia.
2. Prakash C. Gupta, Data Communications and Computer Networks, PHI
3. B.A. Forouzan, Data Communications and Networking, TMH.
4. William L. Scweber, Data Communication, McGraw Hill.
5. Tenenbaum, A. S., Computer Networks (Fourth Edition), New Delhi: Prentice-Hall India
6. Larry L. Peterson and Bruce S. Davie, Computer Networks: A systems approach, 3rd Edition, Morgan Kaufmann Publishers.
7. Mary E.S. Loomis, Data Communications, PHI.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	M	H		
CO 3		M	H	
CO 4			H	M
CO 5			M	M
CO 6				H

CSSE0127: SOFTWARE ENGINEERING

(3 Credits-45 Hour)

Course Outcome

1. Relate and recall the life cycle models of a software. (Remembering)

2. Classify and differentiate various software complexities. (Understanding)
3. Utilize different software architectures and identify the best feasible one. (Applying)
4. Examine and design any software product. (Analysing)
5. Formulate various design diagrams and find solutions to problems. (Creating)
6. Justify a practical solution towards a software applying development and also deploy a product of their own. (Evaluating).

Module I (7 Hours):

a. The Product and The Process: The Product - Evolving Role of Software, Software (Characteristics, Components and Applications;
b. The Process – Software Engineering A Layered Technology, The Software Process, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models (The Incremental Model, The Spiral Model, The Component Assembly Model, The Concurrent Development Model), The Formal Methods Model, Fourth Generation Techniques;
c. Project Management Concepts – The Management Spectrum (People, The Problem, The Process and The Project);
d. Software Process and Project Metrics – Measures, Metrics and Indicators, Metrics in the Process and Project Domains, Software Measurement, Reconciling Different Metrics Approaches, Metrics for Software Quality;
e. Software Project Planning – Observation on Estimating, Project Planning Objectives, Software Scope, Resources, Project Estimation Technique – Empirical estimation techniques (Expert Judgement Technique, Delphi Cost Estimation), Heuristic estimation techniques (COCOMO Model), Halstead Software Science (An Analytical Technique), The Make-Buy Decision;

Module II (7 Hours)

a. Project Scheduling and Tracking - Basic Concepts, The Relationship between People and Effort, Defining a Task set for the Software Project, Selecting Software Engineering Tasks, Defining a Task Network, Scheduling, The Project Plan;
b. Software Projects Risks, Quality Assurance and Configuration Management: Risk Management- Reactive Vs. Proactive Risk Strategies, Software Risk, Risk Identification, Risk Projection, Risk (Mitigation, Monitoring and Management), Safety Risks and Hazards, The RMMM Plan;
c. Software Quality Assurance - Quality Concepts, The Quality Movement, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Quality Assurance, Software Reliability, The SQA Plan, The ISO 9000 Quality Standards;
d. Software Configuration Management - Software Configuration Management, The SCM Process, Identification of Objects in the Software Configuration, Version Control, Change Control, Configuration Audit, Status Reporting;
e. System Engineering - Computer Based Systems, Product Engineering

Module III (15 Hours)

a. Analysis and Design: Analysis Concepts and Principles - Requirements Analysis, Communication Techniques, Analysis Principles, Software Prototyping, Specification, Specification Review;
b. Analysis Modeling- The Elements of the Analysis Model, Data Modeling, Functional Modeling and Information Flow, Behavioral Modeling, The Mechanics of Structured Analysis, The Data Dictionary;
c. Design Concepts and Principles - Software Design and Software Engineering, The Design Process, Design Principles, Design Concepts, Effective Modular Design, Design Heuristic for Effective Modularity, The Design Model, Design Documentation;
d. Design Methods - Data Design, Architectural Design, The Architectural Design Process, Architectural Design Optimization, Interface Design, Human-Computer Interface Design, Interface Design Guidelines, Procedural Design;
e. Design For Real Time systems - Real Time Systems;
f. Case studies on diagram - Use case, Class, Activity, Sequence

Module IV (8Hours)

a. Software Testing: Software Testing Methods - Software Testing Fundamentals, Test Case Design, White Box Testing, Basis Path Testing, Control Structure Testing, Black Box Testing, Testing for Specialized Environments;
b. Software Testing Strategies - A Strategic Approach to Software Testing, Strategic Issues, Unit Testing, Integration Testing, Validation Testing, System Testing, The Art of Debugging;
c. Technical Metrics for Software - Software Quality, A Framework for Technical Software Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance

Module V (7 Hours)

a. Object Oriented Software Engineering: Object Oriented Concepts and Principles - The Object-Oriented Paradigm, Object Oriented Concepts, Identifying the Elements of an Object Model, Management of Object-Oriented Software Projects
b. Object Oriented Analysis - Object Oriented Analysis, Domain Analysis, Generic Components of the Object-Oriented Analysis Model, The OOA Process, The Object Relationship Model, The Object Behavior Model
c. Object Oriented Design - Design for Object Oriented Systems, The Generic Components of the OO Design Model, The Systems Design Process, The Object Design Process, Design Patterns, Object Oriented Programming

d. Advanced Topics In Software Engineering: Cleanroom Software Engineering- The Cleanroom Approach, Functional Specification, Design Refinement and Verification, Cleanroom Testing
e. Software Reuse - Management Issues, The Reuse Process, Domain Engineering, Building Reusable Components, Classifying and Retrieving Components, Economics of Software Reuse
f. Reengineering - Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, Economics of Reengineering.
g. Computer Aided Software Engineering - Case Definition, Building Blocks of Case, Taxonomy of Case Tools, Integrated Case Environments, The Integration Architecture, The Case Repository

Suggested Readings

1. Roger S. Pressman, Software Engineering A Practitioner's Approach, Fourth Edition, Tata McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, Second Edition, Prentice Hall of India Private Limited.
3. Ian Sommerville, Software Engineering, Sixth Edition, Addison Wesley, Pearson Education.
4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals Of Software Engineering, Second Edition, Prentice Hall of India Private Limited, New Delhi, 2002.
5. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, Modern Systems Analysis and Design, Second Edition, Pearson Education.
6. Richard E Fairley, Software Engineering Concepts, Tata McGraw Hill Publishing Company Limited, New Delhi, 1997.
7. Hans Van Vilet, Software Engineering Principles and Practice, Second Edition, John Wiley and Sons, Ltd

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H	M			
CO 3		H	H	H		
CO 4			H	M		
CO 5			M	M	H	
CO 6				H	M	H

CSCD0128: COMPILER DESIGN

(3 credits- 45 hours)

Course Outcomes

1. Recall the application of compiler in program execution (Remembering)
2. Demonstrate the various types of parser and their merits and demerits. It also explains about error handling technique in compiler construction. (UNDERSTANDING)
3. Applying different parsing technique to input string. (APPLYING)
4. Compare and analysis different techniques of parsing. (ANALYSING)
5. Decide which parsing technique will be most suitable for any input given to them. Students will also be able to know how to convert the given grammar to its respective non-left recursive grammar if it requires for certain type of parsing technique. (EVALUATING).
6. Construct intermediate code generation, code optimization, run time environment etc. during compilation.(CREATING)

Module I (9 hours)

Introduction to compiling: Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis. Role of Lexical Analyser –Input Buffering – Specification of Tokens.

Module II (9 hours)

Syntax Analysis: Role of the parser –Writing Grammars –Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser. Syntax Directed translation: Syntax Directed definition, Construction of syntax trees, Bottom Up Evaluation of S-Attributed Definitions.

Module III (15 hours)

a. Intermediate Code Generation: Intermediate languages – Declarations – Assignment Statements –Boolean Expressions – Case Statements – Back patching – Procedure calls.
b. Code Generation: Issues in the design of code generator – The target machine – Runtime Storage management – Basic Blocks and Flow Graphs – Next-use Information – A simple Code generator – DAG representation of Basic Blocks – Peephole Optimization.

Module IV (12 hours)
Code Optimization and Run time Environments: Introduction – Principal Sources of Optimization – Optimization of basic Blocks – Introduction to Global Data Flow Analysis – Runtime Environments – Source Language issues – Storage Organization – Storage Allocation strategies – Access to non-local names – Parameter Passing.

Suggested Readings
1. Compilers Principles, Techniques and Tools- Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Pearson Education.
2. Introduction to Compiler Techniques- J.P. Bennet, Tata McGraw-Hill.
3. Compiler Construction: Principles and Practice Learning. - Kenneth C. Louden, Thompson.
4. Practice and Principles of Compiler Building with C- HenkAlblas and Albert Nymeyer, PHI.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	M			
CO 2	M	M		
CO 3		H	M	
CO 4		M		
CO 5		M	M	
CO 6			M	H

CSNT0129: COMPUTER NETWORKS
(3 credits- 45 hours)

Course Outcomes
1. Define topology implementing different routing protocols that best suits a real time demand application, network and transport layer. (Remembering)
2. Explain the different network topologies, network, transport and application design issues and the importance of QoS in a network. (Understanding)
3. Solve different problems related to sub-netting, configuring working routing protocols in some model network topology and implement presentation layer security. (Applying)
4. Distinguish TCP from OSI and Analyze different layer protocols, sub-netting application layer security. (Analyzing)
5. Judge which protocol operate in which layer and why. (Evaluating)
6. Formulate the pros, cons and implementation of different IEEE based protocols. (Creating)

Module I (7 hours)
Review of OSI, TCP/IP models, Switching Techniques: Circuit Switching, Switching Techniques: Packet Switching, Multiple Accesses –RANDOM ACCESS-ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization.

Module II (9 hours)
X.25, ATM, LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET –Bridges.

Module III (12 hours)
Network Layer: IP addressing methods, Subnetting, ARP, RARP, BOOTP, DHCP – Routing – Distance Vector Routing – Link State Routing – Routers.

Module IV (9 hours)
Transport layer: Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.

Module V (8 hours)
Application Layer: Domain Name Space (DNS), EMAIL, Network Security-PLAYFAIR CIPHER, AES, DES, Public key cryptosystem and RSA, Message authentication code using Hash Function, Introduction to Kerberos.

Suggested Readings
1. Andrew S. Tanenbaum , Computer Networks, PHI
2. Larry L. Peterson and Bruce S. Davie, Computer Networks –A system approach.
3. Behrouz A. Forouzan, Data communication and Networking, Tata McGraw-Hill.
4. William Stallings, Data and Computer Communication, Pearson Education.
5. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education.

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5
CO 1			H	M	M
CO 2			M	H	M
CO 3			M		H
CO 4	H			L	
CO 5	L		H	L	
CO 6	M	H			

CSCG0134: GPU COMPUTING
(3 Credits)

Objectives
The objective of the course is to learn concepts of parallel programming, learn parallel programming with Graphics Processing Units (GPUs), implement programs on GPUs, and learn debugging and profiling of programs written for GPUs.

Course Outcomes
1. Describe the basic concepts of GPUs and parallel programming (Remembering)
2. Explain the hardware and software aspects of GPU (Understanding)
3. Use GPU for applications such as Image Processing, Graph algorithms, Simulations and Deep Learning. (Applying)
4. Analyze GPU programs to detect errors (Analyzing)
5. Evaluate the efficiency of GPU programs (Evaluating)
6. Develop GPU programs including programs for concurrent data structures and programs employing different synchronization techniques (Creating)

Module I (12 Hours)
Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU/GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA Open CL/Open ACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps/Wave fronts, Thread blocks/Workgroups, Streaming multiprocessors, 1D/2D/3D thread mapping, Device properties, Simple Programs

Module II (7 Hours)
Memory:Memoryhierarchy,DRAM/global,local/shared,private/local,textures,ConstantMemory,Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Module III (9 Hours)
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU
Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Module IV (7 Hours)
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Module V (5 Hours)
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Module VI (5 Hours)
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

Suggested Readings
1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN:978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN:978-0124159334)

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					M
CO 2	M	H	M			
CO 3		M	H	L		

CO 4		M	M	H	M	
CO 5				M	H	
CO 6			H	H		L

CSCL0135: CLOUD COMPUTING

(3 Credits)

Objectives:

- The student will also learn how to apply trust – based security model to real – world security problems.
- An overview of the concepts, processes, and best practices needed to success fully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Course Outcomes

1. Basics of cloud computing(Remembering)
2. Understanding cloud computing architecture and cloud computing model(Understanding)
3. Identify security aspects of each cloud model (Applying)
4. Develop a risk management strategy for moving to the cloud (Analysing)
5. Implement a public cloud instance using a public cloud service provider (Evaluating)
6. Apply trust based security model to different layer (Creating)

Module I (8 Hours)

IntroductiontoCloudComputing

Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloudcomputing.

Module II (8 Hours)

Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model

Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Module III (8 hours)

Security Issues in Cloud Computing, Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security

Identity and Access Management, Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

Module IV (8 hours)

Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS

Privacy Issues: Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications,

U.S. Laws and Regulations, International Laws and Regulations.

Module V (8 hours)

Audit and Compliance: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/ External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Module VI (5 hours)

ADVANCED TOPICS: Recent developments in hybrid cloud and cloud security

Suggested Readings

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2,2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice),Tim Mather, ISBN-10: 0596802765, O' Reilly Media, September2009

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6

CO 1	H	M				
CO 2	M	H				
CO 3		M	H	L		
CO 4		M	M	H	M	
CO 5			M	H	M	M
CO 6			H	H		L

CSDD0136: DISTRIBUTED DATABASES

(3 Credits)

Objectives

The objective of course is to provide insight to distributed database, normalization techniques and integrity rules, and to learn about parallel database systems along with object oriented models.

Course Outcomes

1. Describe the concepts related to distributed database, normalization techniques and integrity rules, parallel database systems, and distributed object database management systems. (Remembering)
2. Explain concepts related to distributed DBMS architecture, query processing, transaction management, distributed concurrency control, distributed object database management systems etc. (Understanding)
3. Apply normalization to make efficient retrieval from database and query. (Applying)
4. Analyze design issues and efficiency of query statements. (Analyzing)
5. Choose appropriate distributed database design for a given application. (Evaluating)
6. Create distributed databases, parallel database systems, and object database systems for a given problem. (Creating)

Module I (10 Hours)

Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS.

Module II (7 Hours)

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control.

Module III (8 Hours)

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing.

Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking based concurrency control algorithms.

Module IV (7 Hours)

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Module V (8 Hours)

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.

Module VI (5 Hours)

Recent approaches, models and current trends in improving the performance of Distributed Database.

Suggested Readings

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H				
CO 3		M	H	L		

CO 4		M	M	H	M	
CO 5			M	H	M	M
CO 6				M	H	L

CSCL0135: CLOUD COMPUTING

(3 credits)

Objectives:

- The student will also learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Course Outcomes

1. The basics of cloud computing(Remembering)
2. Illustrate cloud computing architecture and cloud computing model(Understanding)
3. Identify and apply security aspects of each cloud model (Applying)
4. Analyse a risk management strategy for moving to the cloud (Analysing)
5. Implement and evaluate a public cloud instance using a public cloud service provider (Evaluating)
6. Create a trust based security model to different layer (Creating)

Module I (10 Hours)

Introduction to Cloud Computing

Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing.

Module II (11 Hours)

Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model

Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Module III (10 hours)

Security Issues in Cloud Computing, Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security

Identity and Access Management, Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

Module IV (11 hours)

Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS

Privacy Issues: Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications,

U.S. Laws and Regulations, International Laws and Regulations.

Module V ((8 hours)

Audit and Compliance: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/ External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Module VI (4 hours)

ADVANCED TOPICS: Recent developments in hybrid cloud and cloud security

Suggested Readings

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H				
CO 3			H	M		
CO 4			M	H	H	
CO 5					H	
CO 6						H

CSIS0137: IOT AND SMART CITIES

(3 Credits)

Objectives

- Explain the basic methodologies and techniques of the arts and humanities, social sciences, business, and science and technology
- To describe the current practices and future trends about smart city
- Capacity of critique the current practice and provide recommendations

Course Outcomes

1. List the various applications of smart cities (Remembering)
2. Explain the IoT reference architecture, fundamental knowledge of the sustainable and smart city (Understanding)
3. Identify different technologies used for sustainable smart cities (Applying)
4. Analyze the learnt knowledge to conduct a case study in an organized way. (Analyzing)
5. Estimate the ability to present the study clearly to audiences; Demonstration of critical thinking and discovering. (Evaluating)
6. Formulate the methods to design public mobile services aimed at efficiency, cost-saving and participation with attention for e-inclusion (Creating)

Module I (8 hours)

Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning.

Module II (9 hours)

IoT Reference Architecture- methods to assist local governments to develop international good e-practice

Module III (8 hours)

Methods to redesign and redefine back and front offices in order to build smarter and transparent governments

Module IV (8 hours)

Methods to design public mobile services aimed at efficiency, cost-saving and participation with attention for e-inclusion

Module V (10 hours)

Methodologies for user involvement, profiling customers and identifying needs; test methodologies to transfer these needs in appropriate services; and test techniques to fit the right channel to the specific services and customers thereby setting a framework for a higher level of e-services in the NSR

Module VI (5 hours)

Pilot new service channels, bluetooth services for public transport, online forms in mobile phones and wireless city services

Suggested Readings

1. Smart City on Future Life - Scientific Planning and Construction by XianyiLi
2. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) byNicosKomninos
3. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H				
CO 3			H	M		
CO 4			M	H	H	
CO 5					H	
CO 6						H

CSEM0138: EMULATION AND SIMULATION METHODOLOGIES

(3 Credits)

Objectives

- This module teaches the fundamentals of simulation and emulation methodologies providing guidance on how to design a performance evaluation campaign
- Set up a test scenario, select the appropriate models, level of granularity
- Metrics for statistical correctness, and discuss the differences between simulation and emulation platforms and how to use them for accurate performance evaluation of communications.

Course Outcomes

1. Define and explain the fundamental concepts of Discrete Event Simulations. (Remembering)
2. Explain about the communication and networking techniques used in DES. (Understanding)
3. Identify the various Application-based Granularity Requirements. (Applying)
4. Analyze the performance evaluation of Statistical Tools (Analyzing)
5. Assess the evaluation of communications for ITS. (Evaluating)
6. Discuss the recent trends of simulation and emulation for IOT. (Creating)

Module I (8 hours)

Fundamentals of Discrete Event Simulations (DES)

Module II (8 hours)

Model-based representation for DES, from communication and networking, to mobility and data traffic.

Module III (8 hours)

Application-based Granularity Requirements: from bit-level, packet-level, to system-level evaluation, and their appropriate selection as a function of the application requirements.

Module IV (12 hours)

Fundamentals on Random Numbers, Fundamentals on Statistical Tools for Performance Evaluation, Simulation vs. Emulations

Module V (8 hours)

Case study for the evaluation of communications for ITS.

Module VI (4 hours)

Recent trends in simulation and emulation for IOT, model based and application based granularity presentation

Suggested Readings

Jack L. Burbank, An Introduction to Network Simulator 3, Wiley

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H				
CO 3			H			
CO 4				H		
CO 5					H	
CO 6					M	H

CSDM0139: DATA WAREHOUSING & MINING

(3 Credits)

Course Outcomes

1. Illustrate different classification, prediction, sequential pattern algorithms (remembering and Understanding)
2. Construct cluster, periodicity and social network analysis. (Applying)
3. Analyze technique to extract patterns from time series data and it application in real world (Analysing)
4. Apprise the Graph mining algorithms to Web mining (Evaluating)
5. Design computing framework for Big Data (Creating)

Module 1 (12 hours)

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns.

Module 2 (15 hours)

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis; Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

Module 3 (12 hours)
Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Module 4 (6 hours)
Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

Suggested Readings
1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			M
CO2		H		
CO3		M	H	
CO4				H
CO5			M	H

CSWI0140: WEB SEARCH& INFORMATION RETRIEVAL

Course Outcomes
1. Recall basic theories and analysis tools as they apply to information retrieval. (Remembering and Understanding)
2. Apply the understanding of problems and potentials of current IR systems. (Applying)
3. Analyze different retrieval algorithms and systems. (Analysing)
4. Evaluate various indexing, matching, organizing, and evaluating methods to IR problems. (Evaluating)
5. Formulate various theoretical IR research. (Creating)

Module 1 (15 hours)
Information retrieval model, Information retrieval evaluation, Searching the Web, Document Representation, Query languages and query operation, Meta-data search.

Module 2 (15 hours)
Indexing and searching, Scoring and ranking feature vectors, Ontology, domain specific search, parallel and distributed information retrieval.

Module 3 (10 hours)
Text and multimedia languages, Social networks.

Module 4 (5 hours)
Recent trends in Web search and Information retrieval techniques.

Suggested Readings
1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, CambridgeUniversity Press, 2008 (available at http://nlp.stanford.edu/IR-book).
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman.
3. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, AddisonWesley, 2009 (available at http://ciir.cs.umass.edu/irbook/).
4. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2ndEdition).

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			
CO2		H		
CO3		M	H	
CO4			M	H
CO5				H

CSDY0141: DATABASE SECURITY AND ACCESS CONTROL

(3 Credits)

Course Outcomes

1. Summarize the access control and implement classical models and algorithms. (Remembering and Understanding)
2. Identify the capabilities and limitations of various access control mechanisms. (Applying)
3. Analyze the data, identify the problems, and choose the relevant models and algorithms to apply. (Analysing)
4. Assess the strengths and weaknesses of various access control models and to analyze their behaviour. (Evaluating)
5. Design and develop access control mechanisms for enterprise IT infrastructures.(Creating)

Module 1 (15 hours)

Introduction to Access Control, Purpose and fundamentals of access control, brief history,Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations,

Module 2 (15 hours)

Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy, Biba Integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multiline Insurance Company.

Module 3 (10 hours)

Smart Card based Information Security, Smart card operating system, fundamentals, design and implantation principles, memory organization, smartcard files, file management, atomic operation, smart card data transmission, ATR,PPS Security techniques- user identification , smart card security, quality, assurance and testing , smart card life cycle-5 phases, smart card terminals.

Module 4 (5 hours)

Recent trends in Database security and access control mechanisms. Case study ofRole-Based Access Control (RBAC) systems.

Suggested Readings

1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandramouli.
2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			
CO2		H		
CO3		M	H	
CO5			H	

CSBA0142: BUSINESS ANALYTICS

(3 Credits)

Course Outcomes

1. Recall the scope of business analytics (Remembering)
2. Interpret the modeling relationships and trends in data, simple linear regression. (Understanding)
3. Experiment with knowledge of data analytics (Applying)
4. Analyze critically in making decisions based on data and deep analytics. (Analysis)
5. Asses technical skills in predictive and prescriptive modeling to support business decision-making.(Evaluating)
6. Adapt the ability to translate data into clear, actionable insights.(Creating)

Module 1 (8 hours)

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2 (8 hours)

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module 3 (8 hours)
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predictive Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

Module 4 (9 hours)
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation Using Analytic Solver Platform, New- Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Module 5 (8 hours)
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

Module 6 (4 hours)
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Suggested Readings
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H					
CO2		H				
CO3		M	H			M
CO4				H		
CO5			M		H	
CO6				M		H

CSAI0143: ARTIFICIAL INTELLIGENCE
(3 credits – 45 hours)

Course Outcomes
1. Describe the key aspects of intelligent agents, evolutionary computing, handling of uncertainity, and expert systems. (Remembering)
2. Explain the AI techniques for searching, knowledge representation and inference, planning, natural language processing, and machine learning. (Understanding)
3. Apply AI techniques for searching, reasoning, and planning to solve problems. (Applying)
4. Infer knowledge from given facts and rules using Propositional and First-Order logic. (Analyzing)
5. Evaluate the performance of the different search algorithms. (Evaluating)
6. Develop algorithms and programs that use AI techniques to solve real-world problems. (Creating)

Module 1(10hours)
Overview of Artificial intelligence: Problems of AI, AI technique, Tic-Tac-Toe problem. Intelligent Agents: Agents and environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving: Problems, Problem Space and search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. Search techniques: Solving problems by searching: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.

Module 2(15 hours)

Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms and optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions and strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening. Knowledge and reasoning: Knowledge representation issues, representation and mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic: Representing simple fact in logic, representing in stant and ISA relationship, computable functions and predicates, resolution, natural deduction.

Module 3 (10hours)

Representing knowledge using rules: Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge. Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets and fuzzy logics. Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Natural Language processing: Introduction, Syntactic processing, semantic analysis, discourse and pragmatic processing.

Module 4 (10 hours)

Learning: Forms of learning, Inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning and genetic learning. Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition. Basic knowledge of programming language like Prolog and Lisp.

Suggested Readings

1. Ritch and Knight, Artificial Intelligence, TMH.
2. S. Russel and P. Norvig, Artificial Intelligence a Modern Approach, Pearson.
3. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI.
4. S. Kaushik, Logic and Prolog Programming, New Age International.

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4
CO1	M	L	L	H
CO2	M	L	M	H
CO3	H	H	M	
CO4		H	H	
CO5	H	H		
CO6	H	M	H	L

CSPD0144: PARALLEL AND DISTRIBUTED ALGORITHMS

(3 credits – 45 hours)

Course Outcomes

1. Recall the primitives of MPI, OpenMP, and POSIX Thread API. (Remembering)
2. Explain the benefits and challenges of parallel and distributed computing. (Understanding)
3. Apply design, development, and performance analysis of parallel and distributed applications. (Applying)
4. Analyze the performance of parallel/distributed algorithms. (Analysis)
5. Formulate a parallel/distributed approach to solve a given problem. (Creating)

Module I (8 lectures)

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing; Parallel Programming Platforms: Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques

Module II (10 lectures)

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads; Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations; Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics

Module III (12 lectures)

Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks - Send and Receive Operations, MPI - the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators; Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics - Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, OpenMP - a Standard for Directive Based Parallel Programming

Module IV (15 lectures)
Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication; Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort; Graph Algorithms: Definitions and Representation, Minimum Spanning Tree - Prim's Algorithm, Single-Source Shortest Paths - Dijkstra's Algorithm, All-Pairs Shortest Paths; Search Algorithms for Discrete Optimization Problems: Definitions and Examples, Sequential Search Algorithms, Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms

Suggested Readings
1. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, Introduction to Parallel Computing, Pearson Education India, 2004.
2. Michael J Quinn, Parallel Programaming in C with MPI and OpenMP, McGraw Hill, 2017.
3. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1			H	
CO2	H	H		
CO3		M	H	M
CO4	L	H		
CO5			M	H

CSAP0145: ADVANCED COMPUTER ARCHITECTURE

(3 credits – 45 hours)

Course Outcomes
1. Describe techniques for building instruction, arithmetic and memory access pipelines. (Remembering)
2. Discuss the basic concepts associated with parallel computing environments, pipelining, and parallel programming. (Understanding)
3. Apply program transformation techniques to remove data dependencies. (Applying)
4. Analyze code segments to identify data dependencies. (Analysing)
5. Assess collision free schedules for pipelines. (Evaluating)
6. Develop programs for different parallel processing models including shared memory programming and distributed computing. (Creating)

Module I (12 hours)
Introduction to Parallel Processing: Shared Memory Multiprocessing, Distributed Memory, Parallel Processing Architectures-Introduction-Parallelism in sequential Machines, Abstract Model of Parallel Computer, Multiprocessor Architecture, Array Processors.

Module II (10 hours)
Pipelining and Super Scalar Techniques, Linear Pipeline Processors, Non-Linear Pipeline processors, Instruction pipeline design, Arithmetic pipeline Design, Super Scalar and Super pipeline Design.

Module III (11 hours)
Programmability Issues - An Overview, Operating system support, Types of Operating Systems, Parallel Programming models, Software Tools-Data Dependency Analysis- Types of Dependencies, Program Transformations, Shared Memory Programming.

Module IV (12 hours)
Thread-based Implementation, thread Management, Attributes of Threads, Mutual Exclusion with Threads, Mutex Usage of Threads, Thread implementation, Events and Conditions variables, Deviation Computation with Threads, Java Threads, Distributed Computing: Message Passing Model, General Model, Programming Model, PVM-Algorithms for Parallel Machines, Debugging Parallel programming, Other Parallelism Paradigms.Analysis of parallel algorithm, Matrix operations.

Suggested Readings
1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, \ Programmability, McGraw Hill.

2. M. Sasikumar, D. Sikhare and P. Ravi Prakash, Introduction to Parallel Processing, PHI.
3. W. Stallings, Computer Organization and Architecture, PHI.
4. K. Parthasarathy, Advanced Computer Architecture, Thomson Business Information.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H	H	H	H	H	H
CO2	H	H				
CO3			H			
CO4			M	H		
CO5			M	H		
CO6					H	

CSML0146: MACHINE LEARNING

(3 credits – 45 hours)

Course Outcomes

1. Draw knowledge about basic concepts of Machine Learning and describe what is involved in learning from data.
2. Discuss machine learning techniques suitable for a given problem and explain the variety of learning algorithms.
3. Solve basic image classification problems and handwritten character recognition using various machine learning techniques.
4. Research a small scale computer vision system using machine learning techniques.
5. Evaluate a Deep Learning model with small scale dataset for a real life problem.
6. Formulate and design how to perform evaluation of learning algorithms and model selection.

Module 1 (10 hours)

Foundations for ML: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. ML Techniques overview.

Module 2 (13 hours)

Linear regression, Decision Trees: ID4, C4.5, CART. Pruning. Overfitting, Python Exercise. K-Nearest Neighbors, K-Nearest Neighbor algorithm; Python Exercise. Naïve Bayes, Model Assumptions, Probability estimation, Use Naive Bayes with Scikit learn in Python. Logistic Regression, Support Vector Machines, The dual formulation, Maximum margin, SVM for classification and regression problems. Implement an SVM classifier in SKLearn/Scikit-learn. Ensembles methods, Bagging & boosting, C5.0 boosting, Random forests.

Module 3 (10 hours)

Unsupervised Learning: Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering; Dealing with continuous, categorical values in K-Means, Agglomerative clustering, Constructing a hierarchical cluster, K-Medoids, k-Mode and density-based clustering, Measures of quality of clustering. Python exercise.

Module 4 (12 hours)

Neural Network basics (Perceptron and MLP, FFN, Backpropagation), Convolution Neural Networks, Image classification, Text classification, Image classification and hyper-parameter tuning, Famous architectures - AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet-v1, Emerging NN architectures,Recurrent Neural Networks, Building recurrent NN, Long Short-Term Memory, Time Series Forecasting, Auto-encoders and unsupervised learning, Stacked auto-encoders and semi-supervised learning, Regularization - Dropout and Batch normalization.

Suggested Readings

1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
3. Hastie, T., R. Tibshirani, and J. H. Friedman. The Elements of Statistical Learning: Data Mining, Inference and Prediction. New York, NY: Springer, 2001. ISBN: 9780387952840.
4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H	M	M	H
CO2	H	H	H	M

CO3	M	M	H	M
CO4	M	M	H	H
CO5	L	M	L	H
CO6	M	M	M	L

CSCC0147: COMPUTATIONAL COMPLEXITY

(3 credits – 45 hours)

Course Outcomes

1. Classify decision problems into appropriate complexity classes, including P, NP, PSPACE and complexity classes based on randomised machine models and use this information effectively.(Understanding)
2. State precisely what it means to reduce one problem to another, and construct reductions for simple examples. (Remembering)
3. Classify optimisation problems into appropriate approximation complexity classes and use this information effectively. (Applying)
4. Use the concept of interactive proofs in the analysis of optimisation problems. (Applying)

Module 1 (10 lectures)

Introduction. Easy and hard problems. Algorithms and complexity. Turing machines. Models of computation. Multitape deterministic and non-deterministic Turing machines. Decision problems. The Halting Problem and Undecidable Languages. Counting and diagonalisation. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem.

Module 2 (13 lectures)

Deterministic Complexity Classes. DTIME[t]. Linear Speed-up Theorem. PTime. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability. NP and NP-completeness. Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NP-completeness. Cook-Levin Theorem. Polynomial transformations: 3-satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.

Module 3 (10 lectures)

Space complexity and hierarchy theorems. DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NL-completeness. NL=coNL. Hierarchy theorems.

Module 4 (12 lectures)

Optimization and approximation. Combinatorial optimisation problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, travelling salesman problem, minimum partition. Randomized Complexity. The classes BPP, RP, ZPP. Interactive proof systems: IP = PSPACE.

Suggested Readings

1. Computational Complexity - A Modern Approach, Sanjeev Arora and Boaz Barak, Cambridge University Press, 2009.
2. Computational Complexity Theory, Steven Rudich and Avi Wigderson, American Mathematical Society.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	H		
CO 2	M	H	M	
CO 3		H	H	H
CO 4			H	M

CSDS0148: DISTRIBUTED SYSTEMS

(3 credits – 45 hours)

Course Outcomes

1. Define the various evolutionary steps of distributed computing (Remembering)
2. Compare and define the various distributed computing system models. (Understanding/ Remembering)
3. Compile the purpose of using message passing mechanisms and illustrate the various synchronization techniques used in distributed computing. (Applying/ Understanding)
4. Categorize distributed computing systems based on load balancing and load sharing approaches. (Analyzing)
5. Conclude the use of replication and fault tolerance to analyze the efficiency of a distributed computing system. (Evaluating/Analyzing)

6. Rewrite the necessity of having a global naming system and explain why security is such an essential component in designing a trustable distributed system. (Evaluating)

Module 1(10hours)
Fundamentals: Introduction, Models and Features, Concept of distributed operating system ,Issues in design of a distributed operating system. Message Passing: Good message passing system, IPC, Synchronization, Buffering, Multi-datagram messages, Encoding and decoding techniques, Process addressing ,Failure handling, Group communication; Remote procedure calls(RPC)-Models, Communication protocols, RPC, Light weight RPC.

Module 2 (12hours)
Distributed Shared Memory: Architecture, Thrashing, Granularity, Advantages. Synchronization: Introduction, Clock Synchronization, Event handling, Mutual Exclusion; Deadlock–Conditions, Avoidance, Prevention, Recovery.

Module 3 (11hours)
Resource and Process Management: Features of a good scheduling algorithm, Task assignment approach, Load balancing and load sharing approach, Introduction to process management, Process migration, Threads. Distributed File Systems: Introduction, Features, Models, Accessing models; sharing Semantics and caching schemes, replication, Fault Tolerance, Atomic transactions.

Module 4 (12hours)
Naming: Introduction, Features, Fundamental Terminologies and concepts, System oriented names, Human oriented names, Name caches. Security: Potential attacks to computer system,Cryptography,Authentication,digitalsignatures,AccessControl.

Suggested Readings
1. P. K. Sinha, Distributed Operating Systems: Concepts and Design, PHI.
2. A. S.Tanenbaum, Distributed Operating Systems, Pearson.
3. G. Coulouris, J. Dollimore and T. Kindberg, Distributed Systems: Concepts and Design, Pearson.
4. A. Silberschatz and P. Galvin, Operating System Concepts, John Wiley.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			L
CO2	H			M
CO3	L	H		
CO4			H	
CO5			H	

CSDM0149: DATA MINING

(3 credits – 45 hours)

Course Outcomes
1. Describe the technological enablers, principles, concepts, functions and various applications of data warehousing. (Remembering)
2. Explain the technical concepts in building a data warehouse, architectural and organizational issues and technological advancement in data mining. (Understanding)
3. Solve the market basket problems and Construct the association and dependency rules in various data mining algorithms. (Applying)
4. Analyze and distinguish the data mining algorithms based on utility factor and their pros and cons in application.(Analyze)
5. Evaluate the different approaches of data warehousing development and data mining algorithm with various technologies. (Evaluating)
6. Design the various concepts of web mining for practical applications .(Creating)

Module 1 (10hours)
Definitions and characteristics, Multi-dimensional data model, Warehouse schema. DataMarts: Datamarts, types of datamarts, loading a datamart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart. Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi-dimensional view, snowflake schema; OLAPtools.

Module 2 (12hours)
Building of a Data Warehouse, Architectural strategies and organizational issues, design considerations, data content, distribution of data, Tools for Data Warehousing Data Mining: Definitions; KDD(Knowledge Discovery database) versus Data

Mining; DBMS versus Data Mining,DataMiningTechniques;Issuesandchallenges;ApplicationsofDataWarehousing and Data mining in Government.

Module 3 (16hours)
A priori algorithm ,Partition algorithm, Dynamic inset counting algorithm,FP–tree growth algorithm; Generalized association rule. Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH,CURE; Categorical clustering, STIRR, ROCK, CACTUS. Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with pre-sorting.

Module 4 (7hours)
Web content Mining, Web structure Mining, Web usage Mining, Text Mining. Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

Suggested Readings
1. C.S.R.Prabhu, DataWarehousing-Concepts,Techniques,Products,Application,PHI.
2. AKPujari,DataMiningTechniques,UniversitiesPress.
3. BersonandS.J.Smith, DataWarehousing,DataMiningandOLAP,TMH.
4. M.H.Dunham,DataMiningIntroductoryand AdvancedTopics, Pearson

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M		
CO 2	M	H	M	L
CO 3		M	H	
CO 4		M	H	L
CO 5			H	M
CO 6				H

CMCG0150: COMPUTATIONAL GEOMETRY

(3 Credits – 45 Hours)

Course Outcomes
1. Construct algorithms for simple geometrical problems (Applying)
2. Solve linear programs geometrically (Applying)
3. Apply geometric techniques to real-world problems in graphics. (Applying)
4. Analyze randomized algorithms for small domain problems. (Analyzing)
5. Develop efficient algorithms using line-point duality. (Creating)

Module 1 (11 Hours)
Polygon triangulation: area of a simple polygon, counting the number of triangulations in a convex polygon, Plane sweep -- the general paradigm, Line segment intersection, Doubly Connected Edge List (DCEL), Triangulation of a monotone polygon, Triangulations of Planar Point Sets, The Delaunay Triangulation, Computing the Delaunay Triangulation

Module 2(9 Hours)
Convex hull in 2D -- lower bound, Graham's scan, Jarvis march, output sensitive Chan's algorithm. Range search -- Kd tree, Range tree, Fractional Cascading, Art Gallery theorem. Convex hull in 3D--The Complexity of Convex Hulls in 3-Space, Computing Convex Hulls in 3-Space

Module 3(9 Hours)
Linear Programming: The Geometry of Casting, Half-Plane Intersection, Incremental Linear Programming, Randomized Linear Programming, Unbounded Linear Programs
Arrangements and Duality-- Computing the Discrepancy, Duality, Arrangements of Lines, Levels and Discrepancy

Module 4(10 Hours)
Voronoi Diagrams: The Post Office Problem, Definition and Basic Properties, Computing the Voronoi Diagram, Voronoi Diagrams of Line Segments, Farthest-Point Voronoi Diagrams
Point Location: Knowing Where You Are, Point Location and Trapezoidal Maps, A Randomized Incremental Algorithm, Dealing with Degenerate Cases

Module 5(6 Hours)
Robot Motion Planning: Getting Where You Want to Be, Work Space and Configuration Space, A Point Robot, Minkowski Sums, Translational Motion Planning

Suggested Readings

1. Computational Geometry: Algorithms and Applications, Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Springer Verlag
2. Computational Geometry -- An Introduction, Franco Preparata and Michael Ian Shamos, Springer Verlag
3. Computational Geometry in C, Joseph O'Rourke, Cambridge University Press
4. Lecture Notes by David Mount - http://www.cs.umd.edu/~mount/754/Lects/754lects.pdf

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	H			
CO 2			H		
CO 3	M	M	M	H	H
CO 4				H	
CO 5			H		

CSOS0151: ADVANCED OPERATING SYSTEMS

(3 credits – 45 hours)

Course Outcomes

1. Define the concepts of concurrent processes, deadlock, process synchronization and list the various conditions for identifying these scenarios. (Remembering)
2. Explain the advanced terms like distributed deadlock, distributed mutual exclusion and distributed file system etc. (Remembering)
3. Apply various algorithms like Lamport's algorithm and Ricart- Agarwala algorithm to solve the problem of distributed mutual exclusion. (Applying)
4. Compare techniques of implementing distributed file systems, distributed shared memory, different load scheduling algorithms like- load balancing and load sharing. (Analysing)
5. Determine the requirements of security and protection for a computer system and estimate the efficiency of different security models. (Evaluating)
6. Discuss the design and implementation issues of multiprocessor operating systems. (Creating)

Module I (10 hours)

Concepts of processes, Concurrent processes, Threads, Overview of different classical synchronization problems, Monitors, Communicating Sequential processes (CSP), Process deadlocks: Introduction, causes of deadlocks, Deadlock handling strategies, Models of deadlock.

Module II (11 hours)

Distributed operating system: Architectures, Issues in Distributed operating systems, Limitations of Distributed Systems, Lamport's logical clock, Global states, Chandy-Lampert's global state recording algorithm, Basic concepts of Distributed Mutual Exclusion, Lamport's Algorithm, Ricart-Agrawala Algorithm; Basic concepts of Distributed deadlock detection, Distributed File system, Architecture, Design issues, SUN Network File system, Basic concepts of Distributed shared memory, Basic concepts of Distributed Scheduling, Load balancing, Load sharing

Module III (12 hours)

Multiprocessor System: Motivation, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions and requirements; Design and Implementation Issue; Introduction to parallel programming; Multiprocessor Synchronization. Performance, Coprocessors, RISC and data flow: Introduction, Necessity, Measures, Techniques, Bottlenecks and Saturation, Feedback loops, Coprocessors, RISC.

Module IV (12 hours)

Analytic Modeling: Introductions, Queuing Theory, Markov Process. Security and Protection: Security-threats and goals, Penetration attempts, Security Policies and mechanisms, Authentication, Protections and access control Formal models of protection, Cryptography, worms and viruses.

Suggested Readings

Milan Milenkovic, Operating Systems Concepts and Design, TMH.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	H		
CO 2		H		

CO 3		H		
CO 4		H		
CO 5				H
CO 6			H	M

CSSN0152: SPEECH AND NATURAL LANGUAGE PROCESSING

(3 credits-45Hours)

Course Outcomes

1. Recall algorithms and methods for building computational models of speech and natural language processing (Remembering)
2. Explain syntactic analysis, semantic representations, discourse analysis, phonetics, and automatic speech recognition. (Understanding)
3. Apply statistical and corpus-based methods and algorithms for text and speech processing. (Applying)
4. Analyse syntactic structure and meaning of given text taking into account ambiguity. (Analysing)
5. Evaluate the performance of algorithms and models used for text and speech processing. (Evaluating)
6. Develop natural language and speech processing systems for applications such as information extraction, question answering, machine translation etc. (Creating)

Module I (5 Lectures)

Introduction to NLP, Knowledge in language processing, Representation and Understanding, Organization of NLP systems, Models and algorithms, Linguistic Essentials

Module II (12 Lectures)

Grammars and Parsing - Syntactic Processing: Collocations; Regular Expression and Automata; Morphology and Finite-State Transducers; N-grams; Word Classes and Part-of-Speech Tagging; Context-Free Grammars for English; Parsing with Context-Free Grammars: Top-down parsing, Bottom-up parsing; Features and Unification; Lexicalized and Probabilistic Parsing

Module III (12 Lectures)

Semantic processing: Representing Meaning; Semantic Analysis: Integrating semantic analysis to parsers, Semantic Grammars; Lexical Semantics; Word Sense Disambiguation and Information Retrieval: Selection- Restriction based disambiguation, Machine learning approaches; Dictionary based approaches, Information retrieval

Module IV (7 Lectures)

Pragmatics :Discourse, Dialogue and Conversational Agents: Dialogue acts, Automatic Interpretation of Dialogue acts; Natural Language Generation: Discourse Planning; Machine Translation: Direct Translations, Translation using Statistical techniques

Module V (7 Lectures)

Phonetics: Articulatory Phonetics, Phonetic features, Phonetic variations, Acoustic phonetics and signals; Speech Synthesis: Text normalization, Phonetic analysis, Prosodic analysis; Automatic Speech Recognition: Speech recognition architecture, Feature extraction - MFCC vectors, Search and decoding; Text-to-speech

Module VI (2 Lectures)

NLP Applications and Tools :Sentiment Analysis, Text Summarization, Text Entailment, Machine Translation, Question Answering, Cross Lingual Information Retrieval (CLIR), NLTK, WordNet

Suggested Readings

1. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education
2. Christopher D. Manning, Hinrich Schütze, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts
3. James Allen, Natural Language Understanding, 2/e, Pearson Education

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	H	H	L		L	
CO2		L	L	H	L	
CO3		L	M	M	H	
CO4		H	H			
CO5		H	H	M		
CO6		L	L	H		H

CSCY0153: COMPUTATIONAL NUMBER THEORY

(3 credits – 45 hours)

Course Outcomes

1. Define the concepts of discrete mathematics, probability, cryptography.(Remembering)
2. Extend and explain the discrete mathematical concepts to modular arithmetic. (Understanding)
3. Apply the concepts of number theory in finite field and polynomial theory(Applying)
4. Analyze the number theory using different algorithmic approach like Primality testing algorithms, Integer factoring algorithms. (Analyzing)
5. Evaluate the algorithms in real time problem solving applications. (Evaluating)
6. Integrate the mathematical concept to computational model using software tools. (Creating)

Module 1 (8 lectures)

Introduction todiscrete mathematical structures (groups, rings, fields), Probability, Algorithms for integer arithmetic, GCD, Montgomery modular arithmetic and exponentiation, congruence, Chinese remainder theorem, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, rational approximations, Hensel's lemma .

Module 2 (15 lectures)

Finite fields and their representation, Prime fields, extension fields, representation of extension fields, primitive elements, normal basis, optimal normal basis, irreducible polynomials, Algorithms for polynomialsRoot-finding and factorization, Lenstra-Lenstra-Lovasz algorithm, polynomials over finite fields, Elliptic curves: The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.

Module 3 (15 lectures)

Integer factoring algorithms: Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method, Primality testing algorithms, Fermat test, Miller-Rabin test, Solovay-Strassen test, AKS test, Computing discrete logarithms over finite fields: Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.

Module 4 (7 lectures)

Applications: Algebraic coding theory, cryptography, cryptology, Basic introduction to software packages like Mathematica, Maple, PARI etc.

Suggested Readings

1. A. Das, Computational number theory, Chapman and Hall/CRC.
2. V. Shoup, A computational introduction to number theory and algebra, Cambridge University Press.
3. I. Niven, H. S. Zuckerman and H. L. Montgomery, An introduction to the theory of numbers, John Wiley.
4. J. von zurGathen and J. Gerhard, Modern computer algebra, Cambridge University Press.
5. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press.
6. A. J. Menezes, editor, Applications of finite fields, Kluwer Academic Publishers.
7. A Course in Computational Algebraic Number Theory, Cohen, Henri, springer.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	M	H		
CO 3		M	H	L
CO 4			H	
CO 5				H
CO6				H

CSRT0154: REAL TIME SYSTEMS

(3 credits – 45 hours)

Course Outcomes

1. Recognize the characteristics of a real-time system in context with real time scheduling. (Remembering)
2. Describe concepts of Real-Time systems and modelling(Understanding)
3. Classify various resource sharing mechanisms and their related protocols.(Analysing)
4. Interpret the basics of real time communication by the knowledge of real time models and protocols. (Evaluating)
5. Apply the basics of RTOS in interpretation of real time systems. (Applying).
6. Design a particular Real time system for solving real world problems.(Creating).

Module I: Introduction(8 Hours)

Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Module II: Real Time Scheduling (12 hours)
Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

Module III: Resource Sharing (12 hours)
Effect of Resource Contention and Resource Access Control (RAC), Non preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources, Controlling Concurrent Accesses to Data Objects.

Module IV: Real Time Communication (8 hours)
Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols.

Module V: Real Time Operating Systems and Databases (5 hours)
Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Concurrency Control, Overview of Commercial Real Time databases.

Suggested Reading
1. R. Mall, Real-Time Systems, Pearson , 2007
2. P. A. Laplante, Real-Time Systems Design & Analysis, Willey , 2011
3. S. V. Iyer& P. Gupat, Embedded Real-Time System Programming, Tata McGraw Hill , 2004
4. R. Kamal, Embedded System Architecture, Programming and Design, Tata McGraw Hill , 2007

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H	H	M	
CO 3			H	M	
CO 4			M	H	
CO 5			H	M	H
CO 6			M	M	M

CSIR0155: INFORMATION RETRIEVAL

(3 credits – 45 hours)

Course Outcomes
1. Define Information Retrieval Systems and its objectives (Remembering)
2. Interpret models like vector-space, probabilistic, statistical, and other language models to identify how they can be applied to the document retrieval problem. (Understanding)
3. Anticipate clustering algorithms like hierarchical agglomerative clustering and k-means algorithm. (Analyze)
4. Identify the basic concepts related to Tolerant Retrieval, evaluation of IR systems and Latent Semantic Indexing. (Understanding)
5. Identify the concepts behind Query Expansion and Probabilistic Information Retrieval. (Understanding)
6. Discover XML Indexing Search and basic operations of image processing that support IR (Understanding)

Module 1 (10 lectures)
Introduction to Information Retrieval, Design Features of Information Retrieval Systems, Indexing, Elimination of Stop Words, Stemming, Zipf's Law, Information Retrieval Models- Classical, Non-Classical, Alternative, Boolean Model, Probabilistic Model, Vector Space Model, Term Weighting, Similarity Measures, Cluster Model, Fuzzy Model, Latent Semantic Indexing Model

Module 2 (15 lectures)
Tolerant Retrieval-Wild card queries, Permuterm index, Bigram index, spelling correction, Edit distance, Jaccard coefficient, Soundex Evaluation of IR Systems, Relevance, Effectiveness Measures, Precision and Recall, User-centered evaluation,

Document, and concept clustering - hierarchical clustering, k-means, Web retrieval - Page rank, difficulties of Web retrieval, Document clustering.

Module 3 (10 lectures)
Eigen vectors, Singular value decomposition, Low-rank approximation, Problems with Lexical Semantics, Relevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Query Expansion and its types, Query drift, Probabilistic relevance feedback, Probability ranking principle, Binary Independence Model, Bayesian network for text retrieval.

Module 4 (10 lectures)
Data vs. Text-centric XML, Text-Centric XML retrieval, Structural terms, Introduction to content Based Image retrieval, Challenges in Image retrieval, Image representation, Indexing and retrieving images, Relevance feedback.

Suggested Readings
1. Introduction to Information Retrieval by Christopher D. Manning
2. Natural Language Processing and Information Retrieval by Tanveer Siddiqui and U. S. Tiwary

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	L	L
CO 2	H	M	L	L
CO 3	L	H	L	L
CO 4	L	H	H	L
CO 5	L	L	H	L
CO6	L	L	L	H

CSQC0156: QUANTUM COMPUTING

(3 credits – 45 hours)

Course Outcomes
1. Explain the working of a Quantum Computing program, its architecture and program model.
2. Develop the mathematical foundation for Quantum Computing.
3. Understand the architecture of a Quantum Computing platform.
4. Program quantum algorithm on major toolkits.

Module 1 (6 hours)
Introduction to Quantum Computing - Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing - Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement

Module 2 (9 hours)
Mathematical Foundation for Quantum Computing, Matrix Algebra - basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

Module 3 (10 hours)
Building Blocks for Quantum Program, Architecture of a Quantum Computing platform, Details of q-bit system of information representation - Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc. Programming model for a Quantum Computing Program - Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits.

Module 4 (20 hours)
Quantum Algorithms, Basic techniques exploited by quantum algorithms - Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks. Major Algorithms, Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm. OSS Toolkits for implementing Quantum program, IBM quantum experience, Microsoft Q, Rigetti PyQuil (QPU/QVM)

Suggested Readings
1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4

CO 1	H			
CO 2		H	M	
CO 3		M	H	M
CO 4			M	H

CSAD0157: AD HOC AND SENSOR NETWORKS

(3 credits – 45 hours)

Course Outcomes

1. Recall and Understand the concept design issues in ad hoc and sensor networks (Remembering)
2. Understand the different types of MAC protocols.(Understanding)
3. Apply the concept of routing protocol in adhoc network (Applying)
4. Analyse the TCP issues in adhoc networks. (Analysing)
5. Formulate the architecture and protocols of wireless sensor networks. (Evaluating)

Module 1 (9 hours)

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) : architectures, Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc network

Module 2 (9 hours)

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

Module 3 (9 hours)

Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

Module 4 (9 hours)

Single node architecture: hardware and software components of a sensor node – WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

Module 5 (9 hours)

Issues in WSN routing – OLSR- Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation-QOS in WSN-Energy Efficient Design-Synchronization-Transport Layer issues.

Suggested Readings

1. C. Siva Ram Murthy, and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols “, Prentice Hall Professional Technical Reference, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.
3. Feng Zhao and Leonides Guibas, “Wireless Sensor Networks”, Elsevier Publication – 2002.
4. Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005
5. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
6. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2	M	H			
CO 3			M		
CO 4			M		
CO 5				M	H

CSNN0158: NEURAL NETWORKS AND DEEP LEARNING

(3 credits – 45 hours)

Course Outcomes

1. Summarize the role of Deep learning in Machine Learning Applications.(Understanding)
2. To design and implement Deep Learning Applications. (Creating)

3. Critically Analyse Different Deep Learning Models in Image Related Projects. (Analysing)
4. To design and implement Convolutional Neural Networks. (Applying)
5. Apply Deep Learning in NLP and Image Processing.(Applying)

Module I(12 hours)
INTRODUCTION TO ANN
Features , structure and working Computing Comparison of BNN and ANN, Backpropagation networks : (BPN)Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning. Basics of Artificial Neural Networks -History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture,

Module II (9 hours)
TRAINING NEURAL NETWORK
Risk minimization, loss function, backpropagation, regularization, model selection, and optimization. Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Module III (15 hours)
INTRODUCTION TO DEEP LEARNING ARCHITECTURES
Feed Forward Neural Networks,Gradient Descent, Back Propagation Algorithm, Vanishing Gradient problem, Mitigation,RelU Heuristics for Avoiding Bad Local Minima, Heuristics for Faster Training, Nestors Accelerated Gradient Descent, Regularization ,Dropout.CNN Architectures, Convolution, Pooling Layers, Transfer Learning, Image Classification using Transfer Learning,LSTM, GRU, Encoder/Decoder Architectures ,Autoencoders, Standard- Sparse, Denoising ,Contractive, Variational Autoencoders, Adversarial Generative Networks Autoencoder and DBM

Module IV (9 hours)
APPLICATIONS OF NEURAL NETWORKS DEEP LEARNING
Image Segmentation, Object Detection, Automatic Image Captioning, Image generation with Generative Adversarial Networks,Video to Text with LSTM Models, Attention Models for Computer Vision, Case Study: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks, Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs.

Suggested Readings
1. Ian Good Fellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
4. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018. 6. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H	M	
CO 3		M	H	M
CO 4			H	
CO 5		M		M

CSBF0159: BLOCKCHAIN FUNDAMENTALS
(3 credits – 45 hours)

Course Outcome
1. The student will be able to identify the history, technology, and applications of Blockchain (Remembering)
2. The student will be able to explain Blockchain applications (Understanding)
3. The student will be able to demonstrate Blockchain concepts clearly and persuasively (Applying)
4. The student will be able to assess crypto currency exchanges and wallets safely (Evaluate)
5. The student will be able to create Crypto token (Create)

Module I (8 hours)
Distributed systems, Byzantine Generals problem, Consensus, History of Blockchain Technology, Cryptographic Hashes, Digital Signatures, Peer to Peer Networks

Module II (12 hours)
Introduction to Blockchain, Generic elements of a Blockchain, Features of a Blockchain, Applications of Blockchain technology, Tiers of Blockchain technology, Types of Blockchain, Hash-based Ledgers, Hash Validation - Proof Of work, Proof of stake, UTXO Model, Wallets and Private Keys, Ask-the-Expert session

Module III (10 hours)
Consensus in Blockchain, , CAP theorem and Blockchain, Structure of a Block: Header, Merkle trees, Benefits and limitations of Blockchain, Smart Contracts, Types of Blockchains

Module IV (10 hours)
Platforms to implement Blockchain: Ethereum – Ether, Gas, Solidity, Multichain - permission, asset, streams, Hyperledger – Architecture, Framework (Fabric, Sawtooth Lake)

Module IV (5 hours)
Design Thinking, Business Awareness, Customer Handling, Case studies: Smart contract for crowd funding, Stock market transactions.

Reference Books and Articles
1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Wattenhofer, The Science of the Blockchain
3. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
4. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
5. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
6. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4
CO1	H	M		
CO2	M	M	H	
CO3	M	M	H	
CO4	L		M	H
CO5			H	M

CSCM0160: CLOUD COMPUTING

(3 credits – 45 hours)

Course Outcomes
1. Define the various evolutionary steps of computation. (Remembering)
2. Illustrate security issues associated with cloud computation. (Understanding)
3. Apply the use of a virtual private cloud in Amazon web service andExperiment with the management console for virtualization using hypervisors. (Applying)
4. Develop an application using map reduce program and create an application and deploy on real time cloud platform like IBM Bluemix. (Creating)
5. Analyze the concepts of Big data and Hadoop components. (Analyzing)
6. Develop and assess a real time application deployed on cloud platform. (Creating/Evaluating)

Module 1(10 hours)
Introduction to Cloud Computing, the Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication-as-a-Service, Infrastructure-as-a-Service, Monitoring-as-a-Service, Platform-as-a-Service, Software-as-a-Service, Building Cloud Network

Module 2 (13 hours)
Datain the cloud: Relational databases, Cloud file systems: GFS and HDFS, Big Table, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module 3 (14 hours)
Putting Security on the Spot with Questions: Understanding Security Risks, Reducing Cloud Security Breaches, Implementing Identity Management, Benefits of identity management, Aspects of identity management, Playing Detective: Detection and Forensics, Activity logs, HIPS and NIPS, Data audit, Encrypting Data, Creating a Cloud Security Strategy

Module 4 (8 hours)
Virtualization and the Cloud: Visualizing Virtualization, Characteristics, Using a hyper visor in virtualization, Abstracting hardware assets, Managing Virtualization, Foundational issues, Abstraction layer, Provisioning software, Virtualizing storage, Hardware provisioning, Security issues, Taking Virtualization into the Cloud.

Suggested Readings
1. Cloud Computing for Dummies by Judith Hurwitz, R. Bloor, M. Kaufman, F. Halper, (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff, Cambridge.
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman, Pearson
5. Cloud Security and Privacy by Tim Malhar, S. Kumaraswamy, S. Latif (SPD,O'REILLY)
6. Cloud Computing: A Practical Approach, Anthony T Velte, et.al McGraw Hill,
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	H			
CO 3		H		
CO 4		M	H	
CO 5		H		
CO6			H	
CO7				H
CO8				H

CSBA0161: BUSINESS ANALYTICS
(3 credits – 45 hours)

Course Outcomes
1. Define data analysis in business and about decision making. (Remembering)
2. Interpret data to establish new relationships and patterns. (Understanding)
3. Experiment with data, distribution of data and statistical inferences. (Applying)
4. Investigate and examine problems in business. (Analyzing)
5. Evaluate analytics to solve business problems. (Evaluating)
6. Propose business analytic approaches into effective courses of action. (Creating)

Module 1 (11 hours)
Introduction to data analysis and decision making. Modeling and models.

Module 2 (12 hours)
Exploring data: Basic Concepts, distribution of single variables. Finding relationship among variables. Probability, Probability distribution and decision making.

Module 3 (11 hours)
Sampling and sampling distribution. Similarity, Neighbors, and Clusters. Hypothesis Testing

Module 4 (11 hours)
Regression Analysis: estimating relationships**.** Regression Analysis: statistical inference. Time series analysis and forecasting

Suggested Readings
1. Albright and Winston, Business Analytics: Data analysis and decision making (5th edition).
2. Foster Provost and Tom Fawcett, Data Science for Business (1st edition) O'RELLY.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	M	H		
CO 3		H	M	
CO 4		M	H	
CO 5			H	
CO 6				H

CSNT0162: COMPUTER NETWORKS

(Theory - 3 Credits)

Course Outcomes

1. Describe various technologies used for data communication (Understanding)
2. Identify possible errors in data transfer and solutions for them (Applying)
3. Describe the various protocols used in data communication (Remembering)
4. Classify the routing protocols and analyze how to assign the IP addresses for the given network (Applying)
5. Identify security issues in networks and available protection mechanisms (Applying)

Module 1 (10 hours)

Introduction to Computer networks, Topology of networks, Protocol Stack, OSI and TCP/IP models, Switching – Circuit Switching, Packet Switching and Message Switching.

Module 2 (12 hours)

Data link layer, Types of errors, Error detection and correction, Hamming distance, Cyclic Redundancy Check(CRC), checksum, Hamming code, Multiple Access, Random Access, ALOHA, pure ALOHA and slotted ALOHA, CSMA/CD and SCMA/CA, Polling, Wired LANs, Ethernet - IEEE standards.

Module 3 (14 hours)

Network layer, Networking and Internetworking devices - Repeaters, Bridges, Routers, Gateways, Logical addressing, Network Address Translation(NAT), Internet protocols, Address Mapping, Error reporting and multicasting - Delivery, Forwarding and Routing algorithms, Distance Vector Routing, Link State Routing.

Module 4 (12 hours)

Transport layer, Process-to-process Delivery: UDP, TCP and SCTP, Congestion control and Quality of Service, Application Layer, Domain Name Systems-Remote Login-Email FTP, WWW, HTTP, Introductory concepts on Network management: SNMP.

Module 5 (12 hours)

Cryptography and Network Security: Introduction, Types of attacks, confidentiality and integrity, various terminologies in cryptography, Basics of Symmetric Key Ciphers, block cipher and stream cipher, Basics of Asymmetric Key Ciphers – RSA Cryptosystem. Message Digest: Hash Function, Digital Signature.

Suggested Readings

1. Data Communications and Networking, 4th Edition, Behrouz A Forouzan, 2007, TMH.
2. Computer Networks, 4th Edition, Andrew S Tannenbaum, 2003, PHI.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H	M		
CO 3		H	H	H	
CO 4			H		
CO 5					H

CSEC0163: E-COMMERCE & CYBER SECURITY

(3 credits – 45 hours)

Course Outcomes

1. Find the scopes of e-commerce and their association with different trade cycles.
2. Summarize the concept of business to consumer mode of transaction in e-commerce.
3. Present the legal issues associated with electronic documents, jurisdiction issues, copyrights etc.
4. Explain and categorize the in-depth knowledge of EDI and its constituent elements.
5. Evaluate the symmetric and asymmetric cryptosystem implementations on e-commerce.
6. Integrate the gathered knowledge on certain case studies like internet bookshops, electronic newspapers, virtual auctions etc.

Module 1(10 hours)

Definition, Scope of E-Commerce, Hardware requirements, E-Commerce and Trade Cycle, Electronic Markets, Electronic Data Interchange and Internet Commerce. Business to Business E-Commerce: Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.

Module 2(15 hours)
Risks-Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, service provider liability, Enforceable on line contract. Security Issues: Security Solutions-Symmetric and Asymmetric Cryptosystems, RSA, DES,AES and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET)Protocol, Electronic cash over internet, Internet Security.

Module 3 (10hours)
Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with VB, ASP, SQL.

Module 4 (10 hours)
Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual Auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

Suggested Readings
1. D. Whitley, E-Commerce-Strategy, Technologies and Applications, TMH.
2. K. K. Bajaj, E-Commerce- The Cutting Edge of Business, TMH.
3. W. Clarke, E-Commerce through ASP, BPB.
4. M. Reynolds, Beginning E-Commerce with VB, ASP, SQL Server7.0 and MTS, Wrox.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			
CO2	L		H	
CO3		H		
CO4	H	M		L
CO5		H		
CO6			L	H

CSIC0164: ICT FOR DEVELOPMENT
(3 credits – 45 hours)

Course Outcomes
1. Define the various terms and technologies used for Information and Communication System. (Remembering)
2. Analyze the foundational and implementation issues of ICT.(Analyzing)
3. Illustrate the various impacts of ICTs on Social and Economical developments. (Understanding)
4. Classify and compare the models of e-Governance with ICTs and its impact on the Environment sustainability. (Applying)
5. Conclude and evaluate the various aspects of ICTs in future. (Evaluating)

Module 1: Information and Communication System Overview (12 lectures)
Definition of terms – Elements and Components – Basics of Information theory – Objectives of communications – components and methods of communications – Hardware subsystem (PC, Network, Enterprise, Grid and Cloud Computing) – Internet, Intranet, WEB technology in communication .

Module 2: Foundations and Implementation of ICT4D (7 lectures)
ICT4D value chain, Technological foundations of ICT4D, Human foundations, Institutional foundations, Implementing ICT4D: Strategy, Design and implementation, Adoption, monitoring and use.

Module 3: ICTs for Economic and Social development (11 lectures)
Economic growth: Development goal, ICTs and micro-economic growth, ICTs and meso-economic growth, ICTs and macro-economic growth, Poverty eradication: Development goal, ICTs and financial poverty, ICTs and livelihoods, Social development: Development goal, ICTs health, ICTs education.

Module 4: ICTs for e-Governance and Environment Sustainability (10 lectures)
Good Governance: Development goal, ICTs for e-Services, ICTs for e-Accountability, ICTs for e-Democracy, Environment Sustainability: Development goal, ICTs for e-Mitigation, e-Monitoring, e-Strategy, e-Adaptation, e-Resillience.

Module 5: Future of ICT4D (5 lectures)
Future directions, Development 2.0, Data intensive development, Open development.

Suggested Readings
1. The Language of ICT: Information and Communication Technology, Tim Shortis, 2001, Routledge.
2. Information and Communication Technology for Development (ICT4D), Richard Heeks, 2017,Taylor and Francis.

3. Information and Communications Technologies for Development: A Comparative Analysis of Impacts and Costs, Balaji, P. and Keniston, K

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3		M	H	M	
CO 4				H	
CO 5					H

CSCB0165: CYBER LAW AND ETHICS

(3 credits – 45 hours)

Course Outcomes

1. Identify knowledge related to the constitution and its legal issues in cyberspace. (Remembering)
2. Explain the different cybercrimes, and the related cyber laws. (Understanding)
3. Demonstrate the different perspectives of professional ethics and responsibilities of engineers. (Understand)
4. Illustrate the concepts behind Cyber Torts, Intellectual Property Rights.(Understanding)
5. Describe the concepts in connection to dispute resolution in cyberspace. (Understanding)

Module 1 (10 lectures)

Constitutional & Human Rights Issues in Cyberspace Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace – Access to Internet, Right to Privacy, Right to Data Protection, Cyber Crimes & Legal Framework Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud Cyber terrorism, Cyber Defamation.

Module2 (15 lectures)

Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies, Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering

Module3 (10 lectures)

Cyber Torts Cyber Defamation, Different Types of Civil Wrongs under the IT Act 2000, Intellectual Property Issues in Cyber Space Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues.

Module4 (10 lectures)

Dispute Resolution in Cyberspace, Concept of Jurisdiction, Indian Context of Jurisdiction, and IT Act, 2000. International Law and Jurisdictional Issues in Cyberspace, Dispute Resolutions.

Suggested Readings

1. Engineering Ethics M. Govindarajan, S. Natarajan, V. S. Senthilkumar Prentice –Hall, 2004
2. Constitution of India, Professional Ethics and Human Rights Shubham Singles, Charles E. Haries, and et al Cengage Learning India 2018
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi.
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute.
5. Jonthan Rosenoer, Cyber Law, Springer, New York.
6. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	L	L
CO 2	M	H	L	L
CO 3	L	H	L	L
CO 4	L	L	H	L
CO 5	L	L	L	H

CSID0166: INTRODUCTION TO DATA SCIENCE

(3 Credits)

Course Outcomes

1. Recall the fundamental concepts used in data science. (Remembering)
2. Explain the key concepts in data science, including their real-world applications and the toolkit used by data scientists. (Understanding)
3. Apply various statistical techniques to find the underlying facts on various datasets. (Applying)
4. Analyze the different data using statistical and machine learning techniques. (Analyzing)
5. Evaluate the effectiveness of various data visualization techniques for real life applications. (Evaluating)
6. Design and develop various data visualization methods for a given problem. (Creating)

Module I: (8Hours)

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Module II: (10 Hours)

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Module III: (10 Hours)

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic.

Module IV: (10Hours)

Data visualization: Introduction, Types of data visualization, Data for visualization, Applications of Data Science Technologies for visualization.

Module V: (7 Hours)

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.

Suggested Readings:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.
3. Rafael A. Erizarry. Introduction to data science: Data Analysis and Prediction Algorithms, CRC Press.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	M	M	
CO 2		H	M	M	
CO 3			H		
CO 4			H		
CO 5				H	
CO 6				H	H

CSII0167: INTRODUCTION TO IoT

(3 Credits)

Course Outcome

1. Recall the fundamental concepts of IoT. (Remembering)
2. Explain the different protocols and architecture of IoT. (Understanding)
3. Apply various protocols to IoT applications. (Application)
4. Develop IoT applications to solve real world problems. (Creating)

Module I: (8 Hours)

IoT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

Module II: (12 Hours)

IoT Protocols - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BAC Net Protocol– Modbus – KNX – Zigbee– Network layer – APS layer Security

Module III: (9 Hours)
IoT Architecture - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Module IV: (10 Hours)
Web of Things - Web of Things versus Internet of Things – Two Pillars of the Web, Architecture Standardizationfor WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals andBusiness Intelligence.

Module V: (6 Hours)
IoT Applications - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Suggested Readings:
1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer,
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley,

References:
1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications,
3. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493-9357-1ia, 2011, ISBN: 978-1-● 4493-9357-1

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H	H			
CO2		H	H	M	
CO3		H	H	M	
CO4		M	M	H	H

CSDA0168: DATA STRUCTURES AND ALGORITHMS

(4 credits – 60 hours) (L-T-P:4-0-0)

Course Outcomes
1. Explain the concept of different data types, primitive, derived and their representation and application through coding. (Understanding)
2. Apply the concept of ADT and linear and nonlinear data types and their representation. (Applying)
3. Apply these data types in various applications like arithmetic expression evaluation and conversion. (Applying)
4. Explain the concept of Graphs and Trees and their real time application. (Understanding)
5. Develop various searching and sorting techniques. (Creating)
6. Choose and implement efficient data structures and apply them to solve problems. (Evaluating)

Module I Introduction
Introduction to data structures, Data Type, Abstract Data Type, Data Structure, Fundamental and Derived Data Types; Pointers and Structures. Complexity analysis: Time and Space, asymptotic bounds.

Module II Arrays and Lists (16 Hours)
a. Array as a data structure, Representation of arrays: single and multidimensional, Address calculation using column and row major ordering; insertion and deletion in arrays; use of arrays for matrix representation and manipulation (addition, multiplication), use of arrays for large integer representation and their addition.
b. Linked List as a data structure; operations on lists; singly linked list (with one or two external pointers), doubly linked list, circular list; use of linked lists for polynomial representation and manipulation (addition and multiplication), and sparse matrix representation and manipulation (inputting, adding, and displaying in matrix form)

Module III Stacks and Queues (14 Hours)
Stacks and Queues as data structures; implementation of stacks and queues using arrays and linked lists; Circular Queue, Priority Queue; Application of stacks: Conversion of infix (containing arithmetic operators including exponential operator, and parenthesis) to postfix and prefix expressions; evaluation of postfix expression

Module IV Trees and Graphs (16 Hours)

a. Binary Trees and General Trees, Representation of trees using linked lists, Binary tree traversal methods, recursive and non-recursive algorithms for traversal methods, Binary search trees (creation, insertion and deletion of a node), threaded binary trees (construct and traverse a right in-threaded binary tree); Height balanced (AVL) binary trees (construct and traverse an AVL tree), multi-way search trees (construction and traversal); B-tree (construction and traversal of a B-tree of given order)

b. Introducing Graphs; Graph representation: Adjacency matrix, adjacency lists, incidence matrix, Traversal schemes : Depth first search, Breadth first search (Recursive and non- recursive algorithms); Shortest Path algorithms (Dijkstra's), Spanning tree, Minimal spanning tree algorithms (Kruskal's algorithm)

Module V Searching and Sorting (14 Hours)

Linear and binary search, Indexed search; Hashing, Hash Functions (division method, mid square method, folding), Analysis of ideal hash function; Conflict resolution (linear and quadratic probe, double hashing, separate chaining, coalesced chaining); Analysis of collision resolution techniques; Sorting algorithms (Insertion, Selection, Bubble, Quick, Merge, Radix, Heap). Analysis of recursive procedures: Master theorem, recursion tree.

Suggested Readings

1. Lipschutz, S., Data structures, Indian Adapted Ed, Tata McGraw Hill Publishing Company Limited, New Delhi,2006
2. Gilberg, Richard F. Forouzan, and Behrouz A., Data Structures, 2nd Ed, Course Technology, Cengage
3. Learning, New Delhi, 2005.
4. Pai, GA, Data Structures and Algorithms, 1st Ed, Tata Mcgraw Hill Publishing Company Limited, New Delhi,2008.
5. Langsam, Augenstein, and Tanenbaum, Data Structures Using C And C++,2nd Ed, Phi Publication, New Delhi, 2007.
6. Krishnamoorthy R., Kumaravel, and G .Indirani, Data Structures Using C, 1st Ed., Tata Mcgraw Hill Publishing Company Limited, New Delhi,2008.
7. Horowitz, Sahni, Susan Freed, Fundamentals of Data Structures in C,2nd Edition, University press, 1997
8. Amiya Kumar Rath, Alok Kumar Jagdev, Data Structures using C, 2nd Edition, Scitech Publication, New Delhi,2009

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H	M	M		
CO2	M	H	H		
CO3	H	H	M		
CO4	L	H		H	H
CO5	M	M		H	H
CO6	L			H	H

CSOA0169: COMPUTER ORGANIZATION AND ARCHITECTURE

(4 credits – 60 hours) (L-T-P:4-0-0)

Course Outcomes

1. Relate the architecture and organization major components of modern computer systems. (Remembering)
2. Explain the functioning and interconnection of major components of computer systems. (Understanding)
3. Apply different design issues associated with the design of any architecture. Apply their logic in designing simple control unit, instruction sets, instruction format, buses and register set etc. (Applying)
4. Compare and Analyse different styles, strategies and formats adopted for designing the instruction set, register set, memory organization etc. (Analysing)
5. Assess various architectures and their design considerations. (Evaluating)
6. Construct and organize a new architecture by considering various design issues in order to make it more efficient with less overhead. (Creating)

Module I Introduction (10 hours)

Number representation; fixed and floating point number representation, IEEE standard for floating point representation. Error detection and correction codes: Hamming code. Digital computer generation, computer types and classifications, functional units and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer.

Module II Central Processing Unit (10 hours)

Addition and subtraction of signed numbers, look ahead carry adders. Multiplication: Signed operand multiplication, Booth's Multiplication Algorithm; Division Algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Processor organization, general register organization, stack organization and addressing modes.

Module III Control Unit (12 hours)
Instruction types, formats, instruction cycles and subcycles (fetch and execute etc), micro- operations, execution of a complete instruction. Hardwire and microprogrammed control: microprogramme sequencing, wide branch addressing, and microinstruction with next address field, pre-fetching microinstructions, concept of horizontal and vertical microprogramming. Control Memory, Control Word, Microinstruction, Microprogram, Mapping of Instructions; Instruction Formats (Three- Address Instructions, Two-Address Instructions and Zero-Address Instructions); Addressing modes.

Module IV Memory (10 hours)
Basic concept and hierarchy, semiconductor RAM memories, 2D and 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues (performance, address mapping and replacement) Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation.

Module V Input / Output (10 hours)
Input Output Interface, I/O Bus, Memory Bus, Isolated I/O, Memory-Mapped I/O; Asynchronous Data Transfer, Strobe Control, Handshaking; Modes of Transfer- viz. Direct Memory Access, Programmed I/O, and Interrupt-Initiated I/O; Priority Interrupt (Daisy-Chain Priority, Parallel Priority Interrupt, Priority Encoder); Input-Output Processor; Serial Communication(Character-Oriented Protocol and Bit-Oriented Protocol).

Module VI Pipelining (8 hours)
Basic Concepts, performance, floating point arithmetic, operations, instruction pipelining in RISC, pipelining in computer arithmetic, Data Hazard, Instruction hazard, Influence on Instruction set, datapath and controls consideration, Superscalar Operation.

Suggested Readings
1. M. Morris Mano, Computer System Architecture, Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2. V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996
3. William Stallings, Computer Organization and Architecture, Sixth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002

Mapping of COs to Syllabus

Course Outcome	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO1	M	H		M	M	
CO2	M	H			H	
CO3			H			
CO4		H		H		
CO5		H		M	M	
CO6						H

CSOS0170: OPERATING SYSTEMS

(4 credits – 60 hours) (L-T-P:4-0-0)

Course Outcomes
1. Elaborate what operating systems are, what they do and how they are designed and constructed. (Creating)
2. Define process concept like process scheduling, inter-process communication, process synchronization and concurrency. (Remembering)
3. Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm. (Understanding)
4. Identify different page replacement algorithms to solve problems. (Applying)
5. Explain how the file system, mass storage and I/O are handled in a modern computer system. (Remembering, Understanding)
6. Analyze the mechanisms necessary for the protection and security of computer systems. (Analysing)

Module I (15 hours)
a. Introduction to operating systems, Simple batch system, Multiprogramming and time sharing systems, Personal computer systems, Parallel systems, Distributed systems and Real time systems.
b. Operating system structures: System components, protection system, OS services, System calls.
c. Process management: Process concept, Process scheduling, Operation on processes, Cooperating processes, Interprocess communication, Threads CPU scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

Module II (15 hours)
a. Deadlocks: System model, Deadlock characterization methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, recovery from Deadlock. b)Memory Management: Background, Logical versus physical address

space, Swapping, Contiguous allocation, Paging, Segmentation.

b. Virtual Memory: Background, Demand paging, Performance of demand paging, Page replacement, Page replacement algorithms, Allocation of frames, Trashing.

Module III (15 hours)

File-system Interface: File concept, Access methods, Allocation methods, Directory implementation, Recovery.

Module IV (15 hours)

a. I/O Systems: Overview, I/O hardware, Application of I/O interface, Kernel I/O - subsystem, Transforming I/O requests to hardware operations.

b. Secondary storage structure: Disk structure, Disk scheduling, Disk management, Swap space management, Disk reliability, Case studies LINUX, WINDOW NT.

Suggested Readings

1. Abraham Silberschatz, Peter Bear Galvin, Operating system concepts, Addison Wesley.
2. Madnik and Donovan, Operating systems, McGraw Hill.
3. Andrew, S. Tannenbaum, Modern operating system, PHI.
4. Harvey M. Deitel, Operating Systems, Second Edition, Pearson Education Pvt. Ltd.
5. William Stallings, Operating Systems, Prentice Hall of India.
6. Pramod Chandra P. Bhatt – An Introduction to Operating Systems, Concepts and Practice, PHI.

Mapping of COs to Syllabus

Course Outcome	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	H			
CO 3		H		
CO 4		H		
CO 5			H	M
CO 6			M	H

MADM0025: DISCRETE MATHEMATICS WITH APPLICATIONS

(4 credits – 60 hours)

Course Outcomes

1. Interpret a given logic sentence in terms of predicates, quantifiers, and logical connectives. (Understanding)
2. Solve a given problem using deductive logic and prove the solution based on logical inference. (Applying)
3. Classify the algebraic structure for a given a mathematical problem. (Analysing)
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
5. Develop the given problem as graph networks and solve with techniques of graph theory. (Creating)

Module I: Sets, Relation and Function (14 lectures)

Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module II: Introduction to Counting (8 lectures)

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module III: Propositional Logic: (12 lectures)

Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module IV: Algebraic Structures and Morphism (14 lectures)

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module V: Graphs and Trees (12 lectures)

Graphs and their properties, Degree, Connectivity, Path, Cycle,Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Suggested Readings

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata Mcgraw - Hill
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
6. Discrete Mathematics, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson, Tata McGraw – Hill

Mapping of COs to syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4			M	H	
CO 5					H

LABORATORY COURSES

CSNT6086: COMPUTER NETWORKS LAB

(2 credits)

Course Outcomes

1. Recall different basic networking commands and utilities and lean different network topologies and associated network terminologies such as routing tables, ARP table etc. (Remembering)
2. Distinguish different header values of different layer protocols in a packet by using tools such as Wireshark, tcpdump etc. (Analyzing)
3. Interpret the knowledge to view fragmentation, segmentation behavior of packets in a network. (Understanding)
4. Apply the knowledge to analyze fragmentation, segmentation behavior of packets in a normal network and hybrid network demanding special flag value set. (Applying)
5. Design network topology implementing different routing protocols that best suits a real time demand. (Creating)
6. CO6: Judge which protocol operates in which layer and why by analyzing and observing network traces. (Evaluating)

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5
CO1			H		
CO2		H			H
CO3	L		H	H	
CO4	H		M	H	H
CO5			H		
CO6	M	H	L	H	

CSCD6085: COMPILER DESIGN LAB

(2 credits)

Course Outcomes

1. Recall and illustrate the different syntax of compiler construction tools like LEX and YACC. (UNDERSTANDING, REMEMBERING)
2. Experiment with regular expression to match the pattern. (APPLYING)
3. Solve various problem using LEX and YACC. (CREATING)
4. Interpret the techniques of parsing practically. (UNDERSTANDING)
5. Analyze different rules using standard parser generator YACC. (ANALYZING)
6. Evaluate problems using both LEX and YACC together. (EVALUATING)

Module I

1. Introduction to LEX and YACC. Preferable on UNIX but any other version is also acceptable.
2. Writing simple scanner for accepting and validating floating point numbers and fixed point numbers
3. Writing simple scanners for tokenizing C or BASIC programs. The Program will output the list of token to a file and classify them by type of token
4. Writing a program to pick out comments in a C ++ program or a JAVAProgram

Module II

1. Developing a rudimentary C Preprocessor capable of handling the “define, ifdef, ifndef, include” directives. More ambitious students can implement substitution of Macros with arguments.
2. Converting simple finite Automata into programs.
3. Write a program using LEX to find number of character, words and lines in an input file
4. Write a program using LEX to find all the words starting with a specific alphabet
5. Write a program using LEX to find number of comment lines in a C input file.
6. Write a program using LEX to identify an identifier.
7. Write a program using LEX to extract all the numbers from an input string.
8. Write a program using LEX to find and display all the floating point numbers from an input string.

Module III

1. Using LEX find a specific word and reverse the same and display.
2. Using LEX, display a word in pyramidal order.
3. Write a program to identify shortest string from an input file and reverse the string.
4. Find all the even numbers and find their summation.

5. Find the largest number from an input string and reverse it.
6. Find all vowels from an input string
7. Using LEX find the summation of mathematical series.
8. Write a program to recognize the language {a,b,ab,aab,aaab,…….}
9. Find all the numbers from an input file and check whether these are Armstrong number or not.
10. Extract all the words ending with punctuation symbol/
11. From a C source file, extract the following syntax,

a. Printf("Anything");

12. From a C source file, validate the format of "For loop".
13. From a C source file, validate the format of "Do – while loop".
14. From a C source file, validate the format of "If –then-else " statement.
15. Validate the email address using LEX
16. Identify an input number as binary number and convert it to its corresponding decimal Number

Module IV

1. Implementation of YACC for various parser to parse string
2. Using YACC, develop a simple calculator for various arithmetic operation
3. Validate a phone number with respect to ISD code, STD code and 6 digit number. If it s validated then reverse the number (excluding ISD and STD code)
4. Find and display all the keywords from a C input file

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3		M	H	
CO 4			M	H
CO 5				M
CO 6			M	M

CSPL6069: PROGRAMMING FOR PROBLEM SOLVING LAB

(2 credits)

Course Outcomes

1. Relate the programming logic (Remembering)
2. Illustrate the theoretical concepts learnt in C programming language. (Understanding)
3. Apply existing algorithms in writing programs using C language and also do graphics programming. (Applying)
4. Analyze their skills for choosing the right data structure, functions, data types and develop logic to write programs in C. (Analyzing)
5. Evaluate the sorting and searching algorithms through implementation in terms of correctness and computation cost. (Evaluating)
6. Combine the various concepts and ideas leant in C to plan, propose and develop a product. (Creating)

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5	M6
CO1	H				L	
CO2	H	H				
CO3				H	M	
CO4	L				H	H
CO5	M	L		H		
CO6			H		H	M

CSOP6070: OBJECT ORIENTED PROGRAMMING LAB

(2 credits)

Course Outcomes

1. List various GUI and thus will be able to select the suitable GUI to resolve a given problem. (Remembering)
2. Compare the various utility class like vector, stack, Hash Table, String Tokenizer, etc. (Understanding)
3. Apply their knowledge to solve practical problems like reading from a dataset, writing into a file and develop games using JAVA program. (Applying)

4. Analyse the efficiency of various programs with respect to time and space complexity. They will also be able to modify a weak program into a more efficient one. (Analyzing)
5. Evaluate the performance of various swing GUI components and design various applications using Swings, depending upon the problem domain. (Evaluating)
6. Design various methods for drawing lines, rectangles, polygons and ovals and based on their practical knowledge will be able to develop cost effective and user-friendly applications. (Creating)

List of Experiments:

1. Program on concept of classes and objects.
2. Programs on use of memory management.
3. Programs using polymorphism – i) operator overloading ii) Dynamic binding
4. Programs on use of operator overloading.
5. Programs on exception handling and use of templates.
6. Programs on file handling
7. Design problem on stock and accounting of a small organization, railway reservation, payroll preparation and optimization problem.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7
CO1	H		M	M			
CO2		M	H				
CO3					M	H	
CO4		H			H		L
CO5					H		
CO6		L		H			H

CSDC6071: DIGITAL ELECTRONICS LAB

(2 credits)

Course Outcomes

1. Recall the truth table of all logic gates. (Remembering)
2. Explain the working of combinational and sequential logic circuits. (Understanding)
3. Model the structure and behavior of digital logic circuits using hardware description language. (Applying)
4. Illustrate the truth table and timing diagram for combinational and sequential logic circuits. (Analysis)
5. Design combinational and sequential logic circuits for given problem statements. (Creating)

List of Experiments

1. To study the Truth tables of logic gates
2. To realize half/full adder and half/full adder subtractor
3. Simulation with VDHL
   a. Adders
   b. Subtractors
   c. Logic gates
   d. MUX and DEMUX

Mapping of Cos to syllabus

Course Outcomes	Experiment 1	Experiment 2	Experiment 3
CO 1	H		
CO 2	H	M	
CO 3	H	M	
CO 4		H	L
CO 5			H

CSDS6072: DATA STRUCTURE AND ALGORITHM LAB

(2 credits)

Course Outcomes

1. Explain the concept of different data types, primitive, derived and their representation and application through coding. (Understanding)
2. Apply the concept of ADT and linear and nonlinear data types and their representation. (Applying)

3. Apply these data types in various applications like arithmetic expression evaluation and conversion. (Applying)
4. Explain the concept of Graphs and Trees and their real time application. (Understanding)
5. Develop various searching and sorting techniques. (Creating)
6. Choose and implement efficient data structures and apply them to solve problems. (Evaluating)

Solution of problems on

1. dynamic memory allocation
2. structures and pointers to structures
3. Arrays
4. Stacks and Stack application, Queues
5. Linked Lists, Circular and Doubly Linked Lists.
6. Binary Trees
7. Searching and data modification: Linear Search, Binary Search, Hashing.
8. Sorting Techniques: Selection, Insertion, Bubble, Merge, Heap, Quick, Radix, and Merge-Sort.

Mapping of Cos to syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8
CO1	H	M	M					
CO2	H	H	H					
CO3			M	H	M			
CO4				H	H	M		
CO5				L	M	H		
CO6							H	H

CSRD6074: DATABASE MANAGEMENT SYSTEMS LAB

(2 credits)

Course Outcomes

1. Define various types of SQL commands and structure of PL/SQL programming (Remembering)
2. Explain which command would be used for a given query (Understanding)
3. Apply correctly use the techniques, components and tools of a typical database management system to build a comprehensive database information system (Applying)
4. Apply SQL commands and PL/SQL programs to solve problems related to database tables. (Applying)
5. Compare and contrast the various ways of solving a query for optimization. (Analysing)
6. Evaluate and justify the database designed for any database project (Evaluating)
7. Design schema diagrams for handling database projects (Creating)

(10 different Programs to be created and executed on the following areas)

1. Use of SQL Syntax: Insertion, Deletion Join), Updating using SQL.
2. Program segments in embedded SQL using C as host language to find the average grade point of a student, etc.
3. Program for Log based data recovery technique.
4. Program on data recovery using check point technique.
5. Concurrency control problem using lock operations.
6. Use of package (ORACLE) for programming approaches.
7. Use of package (DB2) for programming approaches.
8. Programs on JDBC/ODBC to employee's / student's information of a particular department.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8
CO 1		H						
CO 2	H	M						
CO 3		M		M	H			H
CO 4	H	H						
CO 5			H					
CO 6			M	H	H			
CO 7			M			H	H	M

CSAD6075: DESIGN AND ANALYSIS OF ALGORITHMS LAB

(2 credits)

Course Outcomes

1. List existing algorithms and recall how to analyse them using graph notation. (Remembering)
2. Demonstrate the existing algorithms. (Understanding)
3. Apply existing algorithms in designing different applications. (Applying)
4. Analyze execution time of standard algorithms. (Analyzing)
5. Evaluate algorithms in terms of time and space efficiency. (Evaluating)
6. Create efficient applications by using right algorithm depending on input pattern and size. (Creating)

Syllabus

1. Using Graph notation to prove that bubble sort algorithm has time complexity (n^2)
2. Implement the Dynamic programming technique and Analyse the algorithm using the graph notation.
3. Implement the Greedy programming technique and Analyse the algorithm using the graph notation.
4. Implement the Divide and Conquer technique and Analyse the algorithm using the graph notation.
5. Design a small file compressor and de-compressor by using Huffman coding technique

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5
CO 1	H				
CO 2		H		H	
CO 3			H		
CO 4		M	M	M	
CO 5					H
CO 6					M

CSDT6076: ADVANCED DATA STRUCTURES LAB

(3 Credits)

Course Outcomes:

1. Demonstrate and explain the various operations of Binary search trees. (Understanding)
2. Develop a program to implement B-Trees and 2-3 Trees. (Applying)
3. Develop a program and test for the pattern matching algorithms like Bayer-Moore and Knuth-Morris-Pratt algorithms. (Creating)
4. Demonstrate the implementation of compression algorithms using program. (Understanding)
5. Develop algorithms for text processing applications. (Creating)

Program List:

Experiment No.	**List of Experiments**
Module 1	
1	Implementation of BST and AVL trees.
2	Implementation of 2-3 trees, B-trees.
3	Implementation of Red Black Trees
Module 2	
4	Pattern matching using Boyer-Moore algorithm.
5	Knuth-Morris-Pratt algorithm for pattern matching.
Module 3	
6	Huffman Algorithm for data compression.
7	Finding Longest Common Subsequence using a dynamic programming technique.
8	Implementation of Standard tries, Suffix tries and Compressed tries
Module 4	
9	Construction of Priority Search Trees, Searching in a Priority Search Tree.
10	Construction of Priority range Trees
Module 5	
11	Implementation of Quad Trees

Suggested Readings:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H				
CO 3			M			
CO 4				H	M	
CO 5						H

CSAA6078: ADVANCED ALGORITHM LAB

(3 Credits)

Course Outcomes

1. Recall and explain the fundamentals of design and analysis of basic data structures and experiment with the implementation process. (Remembering, Understanding, Applying)
2. Examine and evaluate the concepts in the specification and analysis of programs. (Analysing, Evaluating)
3. Elaborate the principles for good program design, especially the uses of data abstraction. (Creating)

Module 1:

1. Program to find Breadth First Search of a graph.
2. Program to find Depth First Search of a graph.
3. Program to find strongly connected components of a graph.
4. Implement Prim's algorithm to find a minimal spanning tree of a graph.
5. Implement Kruskal's algorithm to find a minimal spanning tree of a graph.
6. Implement Dijkstra's algorithm to find the shortest path in a graph.

Module 2:

1. Implementation of algorithms to compute a maximum weight maximal independent set.
2. Implementation of graph matching algorithms.
3. Implementation of Ford-Fulkerson Method to compute maximum flow.
4. Implementation of Edmond-Karp maximum-flow algorithm.

Module 3:

1. Implement Strassen's Algorithm.
2. Implement Floyd Warshall Algorithm.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	M	
CO 2	M	H	M
CO 3		M	H

CSDV6079: DATA VISUALISATION LAB

(2 credits)

Course Outcomes

1. Recall the design process to develop visualization methods and visualization systems, and methods for their evaluation. (Remembering)
2. Create and process data and visual mapping and the visualization (Creating).
3. Illustrate an understanding of large-scale abstract data. (Understanding)
4. Analyse data in various perspectives. (Analysing)
5. Evaluate the results generated from various applications. (Evaluating)
6. Create visualization methods for different applications. (Creating)

List of Experiments

1. Program to recursively subdivide a tetrahedron to form a 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.
2. Program to implement Liang-Barsky line clipping algorithm.
3. Program to draw a color cube and spin it using OpenGL transformation matrices.
4. Program to create a house-like figure and rotate it about a given fixed point using OpenGL functions.
5. Program to implement the Cohen-Sutherland line-clipping algorithm. Make provision to specify the input line, window for clipping and view port for displaying the clipped image.

6. Program to create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral.
7. Program, using OpenGL functions, to draw a simple shaded scene consisting of a teapot on a table. Define suitably the position and properties of the light source along with the properties of the properties of the surfaces of the solid object used in the scene.
8. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing. Use OpenGL functions.
9. Program to fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.)
10. Program to display a set of values {fij} as a rectangular mesh. Project: 11. Develop a suitable Graphics package to implement the skills learnt in the theory and the exercises indicated in Part A. Use the OpenGL..
11. Program to recursively subdivide a tetrahedron to form 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.
12. Program to implement Liang-Barsky line clipping algorithm.
13. Program to draw a color cube and spin it using OpenGL transformation matrices.
14. Program to create a house-like figure and rotate it about a given fixed point using OpenGL functions.
15. Program to implement the Cohen-Sutherland line-clipping algorithm. Make provision to specify the input line, window for clipping and view port for displaying the clipped image.
16. Program to create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral.
17. Program, using OpenGL functions, to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the properties of the surfaces of the solid object used in the scene.
18. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing. Use OpenGL functions.
19. Program to fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.) Program to display a set of values {fij} as a rectangular mesh.
20. Project: 1. Develop a suitable Graphics package to implement the skills learnt in the theory and the exercises indicated in Part A. Use the OpenGL.

CSEN6080: DATA ENCRYPTION AND COMPRESSION LAB

(3 Credits)

Course Outcomes

1. Recall the different encryption techniques adopted in both traditional and modern cryptographic mechanisms. (Remembering)
2. Interpret cryptographic algorithms, and their countermeasures. (Understanding)
3. Apply fundamental cryptographic approaches in solving related problems. (Applying)
4. Analyse the working of the different encryption and compression algorithms. (Analysing)
5. Compare and contrast the working of different data encryption and compression mechanisms. (Evaluating)
6. Choose appropriate encryption and compression algorithms to build real-world systems. (Creating)

Module 1:

1. Implementation of run length encoding
2. Implementation of Lempel-Ziv coding

Module 2:

1. Implementation of Huffman Encoding of a sequence
2. Implementation of Huffman Decoding of a compressed bit sequence.

Module 3:

1. Implementation of RC4 algorithm.
2. Implementation of S-DES algorithm for data encryption

Module 4:

1. Implementation of RSA Algorithm

Module 5:

1. Implementation of SHA
2. Implementation of MD5

Module 6:

1. Implementation of JPEG algorithm.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2	M	H	M			
CO 3		M	H	M		
CO 4			M	H	M	
CO 5				L	H	M
CO 6					M	H

CSMI6081: MINI PROJECT WITH SEMINAR

(2 Credits)

Course Outcomes

1. Recall the software development life cycle and fundamental phases of system/application/software design and research. (Remembering)
2. Explain how to carry out a project work and explain the importance of different phase of a system design, workflow and time estimation with research outlook. (Understanding)
3. Implement a system and plan how to perform research for real time application along with hardware and softwares. (Applying)
4. Compare the feasibility of a project in terms of time, effort and money.(Analyze)
5. Evaluate a project based on its efficiency applicability robustness, user friendliness etc., with socio economic factors (Evaluating)
6. Design applications by critically examining and scientifically designing each phase of the project.(Creating)

CSOS6082: OPERATING SYSTEMS LAB

(2 Credits)

Course Outcomes

1. Recall and label the basic commands in Linux. (Remembering)
2. Classify system calls, library functions calls to write on standard output device (Understanding)
3. Experiment with shell programs.(Applying)
4. Analyze and compare between different file systems like ext4/FAT/NTFS.(Analyzing)
5. Construct programs on process scheduling, page replacement algorithms.(Creating)
6. Evaluate free space management using programs.(Evaluating)

List of Experiments

1. Simple Unix-C programs: Programs using system calls, library function calls to display and write strings on standard output device and files.
2. Programs using fork system calls.
3. Programs for error reporting using errno, perror( ) function.
4. Programs using pipes.
5. Shell programming.
6. Programs to simulate process scheduling like FCFS, Shortest Job First and Round Robin.
7. Programs to simulate page replacement algorithms like FIFO, Optimal and LRU.
8. Programs to simulate free space management.
9. Programs to simulate virtual memory.
10. Programs to simulate deadlock detection.
11. Study of file systems: UNIX/FAT/NTFS.
12. Study of Windows registry.

Suggested readings

E-resource for learning: Linux-Ubuntu, www.spoken-tutorial.org

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12
CO1	H		M			L						
CO2	H	M	M				L					
CO3		H		M	H							

CO4											H	
CO5						H	H			H		
CO6								H	M			M

CSDC6083: DATA COMMUNICATION LAB

(2 Credits)

Course Outcomes

1. Define various networking devices and various networking commands(REMEMBERING)
2. Illustrate different network topology (UNDERSTANDING)
3. Apply different networking protocol in different network topology. (APPLYING)
4. Compare different topology and functioning of different protocols. (ANALYSING)
5. Assess the types of network required for an organization, Depending on availability of hardwares and softwares (CREATING)
6. Construct a HTTP server and implement various commands (EVALUATING)

Experiments can be done using simulation software like CISCO Packet Tracer or any other relevant simulation software or by using hardware.

1. PC-to-PC communications under WinXP/Win98 direct cable connection with null modem
   a. Using serial ports and RS-232 C cable connection, and
   b. Using parallel ports and direct parallel cable connection.
2. PC-to-PC communications under WinXP/Win98 dial-up networking with modem and 4- line exchange.
3. PC-to-PC communications under WinXP/Win98 hyper terminal with modem and 4-line exchange.
4. Simple file transfer between two systems (without protocols): By opening socket connection to a server on one system and sending a file from one system to another.
5. Writing a Chat application:
   a. One-One: By opening socket connection and displaying what is written by one party to the other.

b. Many-Many (Broad cast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.

6. Introduction to Packet Tracer
7. Simulation of Telnet: Provide a user interface to contact well-known ports, so that client- server interaction can be seen by the user.
8. TFTP- Client: To develop a TFTP client for file transfer.
9. HTTP-Server: Develop a HTTP server to implement the commands – GET, POST, HEAD, DELETE. The server must handle multiple clients.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M		
CO 2		H	M	
CO 3		H	H	H
CO 4		M	M	
CO 5		M	M	M
CO 6			M	H

CSMI6084: MINI PROJECT I

(2 Credits)

Course Outcomes

1. Recall the software development life cycle and fundamental phases of system/application/software design and research. (Remembering)
2. Explain how to carry out a project work and explain the importance of different phase of a system design, workflow and time estimation with research outlook. (Understanding)
3. Implement a system and plan how to perform research for real time application. (Applying)
4. Compare the feasibility of a project in terms of time, effort and money.(Analyze)
5. Evaluate a project based on its efficiency applicability robustness, user friendliness etc., with socio economic factors (Evaluating)
6. Design applications by critically examining and scientifically designing each phase of the project.(Creating)

CSMI6091: MINI PROJECT II

(2 credits)

Course Outcomes

1. Recall the software development life cycle and fundamental phases of system/application/software design and research. (Remembering)
2. Explain how to carry out a project work and explain the importance of different phase of a system design, workflow and time estimation with research outlook. (Understanding)
3. Implement a system and plan how to perform research for real time application. (Applying)
4. Compare the feasibility of a project in terms of time, effort and money.(Analyze)
5. Evaluate a project based on its efficiency applicability robustness, user friendliness etc., with socio economic factors (Evaluating)
6. Design applications by critically examining and scientifically designing each phase of the project.(Creating)

CSDI6092: DISSERTATION- I / INDUSTRIAL PROJECT

(10 Credits)

Course Outcomes

1. Recall the enhanced research areas which can be undertaken (Remembering).
2. Illustrate the research gap within the topic that he / she undertakes (Understanding).
3. Apply algorithm to solve the problem stated (Applying).
4. Analyse and categorize the data to be collected to carry on with the research (Analysis).
5. To evaluate the outcome which is expected from the research (Evaluating).
6. Create and implement the methodology to have an outcome (Creation).

CSDI6093: DISSERTATION II

(16 Credits)

Course Outcomes

1. Recall and relate desertation phase I to identify the basic problem specific outcome (Remembering).
2. Illustrate the research gap within the topic that he / she undertake (Understanding).
3. Make use of the algorithm implemented in Phase I for accuracy (Application).
4. Compare the results with the existing system to identify its accuracy (Analysis).
5. Evaluate and summarize the outcome which is expected from the research (Evaluating).
6. Creating an outcome based on the methodology implemented (Creation).

CSPP6094: PARALLEL AND DISTRIBUTED ALGORITHMS LAB

(2 credits)

Course Outcomes

1. List the MPI, OpenMP, Pthread, and Java Thread data types and functions. (Remembering)
2. Explain the MPI, OpenMP, Pthread, and Java Thread primitives available for parallel and distributed programming. (Understanding)
3. Apply MPI, OpenMP, and Pthread primitives to implement parallel and distributed programs. (Applying)
4. Analyze errors in parallel/distributed programs due to data races, deadlocks, overlapping buffers, type mismtches, and leaks. (Analyzing)
5. Evaluate the efficiency of given parallel/distributed programs. (Evaluating)
6. Formulate a parallel/distributed approach to solve a given problem. (Creating)

List of Experiments

1. Introduction to distributed memory programming with MPI
2. Introduction to shared memory programming with OpenMP/Pthreads
3. Pthreads: Starting, Running, and Stopping Threads; Producer-Consumer Synchronization and Semaphores; Barriers and Condition Variables
4. Write programs to parallelize the Trapezoidal Rule
5. Write programs to parallelize sorting algorithms
6. Write programs to parallelize Matrix-Vector and Matrix-Matrix Multiplication
7. Write programs to implement multi-threaded linked list
8. Write programs to parallelize tree search
9. Write programs to parallelize n-body solvers

10. Introduction to Java Threads

Suggested Readings

1. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
2. Michael J Quinn, Parallel Programaming in C with MPI and OpenMP, McGraw Hill, 2017.
3. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, Introduction to Parallel Computing, Pearson Education India, 2004.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10
CO 1	H	H	H							
CO 2	H	H	H							
CO 3	H	H	H							
CO 4				H	H	H				
CO 5							H	H	H	H

CSAC6095: ADVANCED COMPUTER ARCHITECTURE LAB

(2 credits)

Course Outcomes

1. Describe techniques for building instruction, arithmetic and memory access pipelines. (Remembering)
2. Discuss the basic concepts associated with parallel computing environments, pipelining, and parallel programming. (Understanding)
3. Apply program transformation techniques to remove data dependencies. (Applying)
4. Analyze code segments to identify data dependencies. (Analysing)
5. Assess collision free schedules for pipelines. (Evaluating)
6. Develop programs for different parallel processing models including shared memory programming and distributed computing. (Creating)

List of Experiments

1. Introduction to distributed memory programming with MPI
2. Introduction to shared memory programming with OpenMP/Pthreads
3. Pthreads: Starting, Running, and Stopping Threads; Producer-Consumer Synchronization and Semaphores; Barriers and Condition Variables
4. Write programs to parallelize the Trapezoidal Rule
5. Write programs to parallelize sorting algorithms
6. Write programs to parallelize Matrix-Vector and Matrix-Matrix Multiplication
7. Write programs to implement multi-threaded linked list
8. Write programs to parallelize tree search
9. Write programs to parallelize n-body solvers
10. Introduction to Java Threads

Suggested Readings

1. Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
2. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, McGraw Hill, 2017.
3. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, Introduction to Parallel Computing, Pearson Education India, 2004.

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4
CO1		H		
CO2	H	M	M	H
CO3			H	
CO4			H	
CO5		H		

CSML6096: MACHINE LEARNING LAB

(2 Credits)

Course Outcomes

1. Apply various classification algorithms to solve classification problem on real world data. (Applying)

2. Apply Clustering algorithms to solve any clustering problem. (Applying)
3. Analyse the performance of various classification algorithms. (Analysing)
4. Select appropriate models for solving a specific problem. (Evaluating)
5. Design neural network based classifiers to classify real world data. (Creating)

List of Experiments

1. Write a program to implement Linear Regression. Use an appropriate dataset to illustrate the working of linear regression.
2. Write a program to implement Decision Tree. Illustrate the classification of sample data using an appropriate dataset.
3. Write a program to demonstrate the classification of sample data using KNN algorithm.
4. Write a program to implement Bayes Classifier for the classification of sample data.
5. Write a program to implement logistic regression for the classification of sample data.
6. Write a program to implement Support Vector Machine. Illustrate the classification of sample data using an appropriate dataset.
7. Write a program to demonstrate the classification of sample data using Random Forest algorithm.
8. Performance analysis of various classification methods using standard matrices applied on confusion matrix.
9. Write a program to implement K-Means Clustering Algorithm.
10. Write a program to implement Agglomerative Clustering Algorithm.
11. Write a program to implement a classifier using MLP. Use appropriate dataset to demonstrate the process of classification.
12. Write a program to implement a sample CNN. Use appropriate dataset to test the performance of the classifier.
13. Implement transfer learning using state of art CNN models. Use appropriate dataset to test the performances of such models.

Mapping of COs to Syllabus

Course Outcome	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12	Exp 13
CO 1	H	H	H	H	H	H	H				H	H	
CO 2									H	H			
CO 3								H					H
CO 4											H		H
CO 5											H	H	

CSCC6097: COMPUTATIONAL COMPLEXITY LAB

(2 credits)

Course Outcomes

1. Classify decision problems into appropriate complexity classes, including P, NP, PSPACE and complexity classes based on randomized machine models and use this information effectively. (Understanding)
2. State precisely what it means to reduce one problem to another, and construct reductions for simple examples. (Remembering)
3. Classify optimization problems into appropriate approximation complexity classes and use this information effectively. (Applying)
4. Use the concept of interactive proofs in the analysis of optimization problems. (Applying)

Experiments:

1. Programs to illustrate space complexity, complexity classes, and hierarchy theorems.
2. Problems and proofs on reductions of decision and optimization problems.
3. Problems on randomness in computation, combinatorial optimization problem, polynomial approximations schemes.
4. Proofs such as interactive proofs and their relation to approximation.

Suggested Readings

- Computational Complexity - A Modern Approach, Sanjeev Arora and Boaz Barak, Cambridge University Press, 2009.
- Computational Complexity Theory, Steven Rudich and Avi Wigderson, American Mathematical Society.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4
CO 1	H	M		
CO 2	M	H	M	
CO 3		L	H	M

CO 4			L	H

CSDS6098: DISTRIBUTED SYSTEMS LAB
(2 credits)

Course Outcomes:
1. Describe the basic technique of establishing a client-server network using python socket programming. (Remembering)
2. Discuss the basic concepts associated with peer-to-peer networking using python socket libraries. (Understanding)
3. Apply consensus algorithms to a distributed computer network using python language. (Applying)
4. Analyze how common logical clocks can properly synchronize events in a distributed environment. (Analyzing)
5. Assess the map-reduce paradigm used in Hadoop and evaluate the time associated with task completion in such a platform. (Evaluating)
6. Develop programs to solve various problems associated with distributed systems. (Creating)

List of programs:

Module I
Implement client-server application using socket programming.

Module II
Implement peer-to-peer application using socket programming.

Module III
Implement consensus algorithms to allow agreement among processes running in a peer-to-peer environment.

Module IV
Implement algorithms to synchronize clocks to create a common logical clock among peers in a distributed environment.

Module V
Understand the concept of map-reduce and implement it in a distributed environment.

Suggested Readings
P. K. Sinha, *Distributed Operating Systems*: Concepts And Design, PHIG. Coulouris, J. Dollimore and T. Kindberg, Distributed Systems: Concepts And Design, Pearson

Mapping of COs to Syllabus

Course Outcomes	M1	M2	M3	M4	M5
CO1	H	M	L		
CO2	M	H	L		
CO3		L	H	M	
CO4		L	M	H	
CO5					H
CO6		L	H	H	M

CSDM6099: DATA MINING LAB
(2 credits)

Course Outcomes
1. Recall the concepts related to ETL. (Remembering)
2. Interpret the association rules, classification and clusters in large data sets. (Understanding)
3. Perform the preprocessing of data and apply mining techniques on it. (Applying)
4. Solve real world problems in business and scientific information using data mining. (Creating)
5. Classify web pages, extracting knowledge from the web. (Analyzing)
6. Assess data mining techniques and methods to large data sets. (Evaluating)
7. Compare and contrast the various classifiers. (Analyzing)

List of Experiments
1. Creation of a Data Warehouse.
2. Implement Apriori Algorithm.
3. Implement FP-Growth Algorithm.
4. Implement K-means clustering.
5. Implement One Hierarchical clustering algorithm.
6. Implement Bayesian Classification.

7. Implement Decision Tree.
8. Implement Support Vector Machines.
9. Applications of classification for web mining.
10. Case Study on Text Mining or any commercial application.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9
CO1	H	M							
CO2		H	M	M					
CO3			H	H	L				
CO4					H				
CO5						M		M	
CO6								H	H
CO7						H	H		

CSCG6100: COMPUTATIONAL GEOMETRY LAB

(2 credits)

Course Outcomes

1. Construct algorithms for simple geometrical problems (Applying)
2. Apply geometric techniques to real-world problems in graphics. (Applying)
3. Analyze computational geometrical algorithms for small domain problems. (Analyzing)
4. Develop efficient computational geometrical algorithms. (Creating)

Implement the following task constructing algorithms in C language.

1. Area of a Polygon
2. Triangulating a polygon
3. Convex Hull in two dimensions
4. Convex Hull in three dimensions
5. Delaunay triangulation
6. Segment/ray-segment intersection
7. Segment/ray-triangle intersection
8. Point in polygon
9. Point in polyhedron
10. Intersecting convex polygons
11. Minkowski convolution with a convex polygon
12. Multilink robot arm reachability

Suggested Readings

1. Computational Geometry in C, Joseph O'Rourke, Cambridge University Press
2. http://www.science.smith.edu/~jorourke/books/ftp.html

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M			
CO 2		H	M		
CO 3	M	M	H	M	M
CO 4			M	H	

CSAS6101: ADVANCED OPERATING SYSTEMS LAB

(2 credits)

Course Outcomes

1. Demonstrate the understanding on shell designing and scripting (Understanding)
2. Build and experiment with distributed operating systems algorithms (Applying)
3. Recall the basic concepts of distributed mutual exclusions (Remembering)
4. Experiment with the applications of distributed scheduling algorithms (Applying)
5. Construct a multithreaded program to understand the implementation issues of multiprocessor system.(Creating)
6. Design a program to classify and compare the security threats relating to virus (Understanding)

List of Experiments

1. Design and develop a shell that supports atleast 10 commands.
2. Design and develop a program to implement Lamport's algorithm.
3. Use ECOS operating system to develop a program for controlling accessing to a pool of resources using mutexes and condition variables.
4. Develop a program for a forward scheduling for unequal distribution.
5. Design a multi-class multithreaded program which simulates multiple sleeping barbers, wherein all in one barbershop having a finite number of chairs in the waiting room. Each customer is instantiated from a single customer class & each barber is instantiated from a single barber class.
6. Develop a program to identify the virus classification, such as boot sector infector, file infector and macro virus.

Suggested Readings

1. Milan Milenkovic, Operating Systems Concepts and Design, TMH.
2. M. Singhal and N.G. Shivaratri, Advanced Concepts in Operating Systems, TMH.
3. A. Silberschatz, P.B. Galvin and G. Gagne, Operating System Concepts, John Wiley and Sons.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3		H		
CO 4		H		
CO 5			H	M
CO 6				H

CSSN6102: SPEECH AND NATURAL LANGUAGE PROCESSING LAB

Course Outcomes

1. List the functions provided by NLTK for natural language processing. (Knowledge)
2. Explain of the various NLTK functions and corpora available for natural language processing. (Understanding)
3. Implement NLTK programs for part of speech tagging, syntax analysis, semantic analysis etc. (Applying)
4. Analyze the structure and meaning of given text. (Analyzing)
5. Evaluate the performance of classifiers used for text classification. (Evaluating)
6. Combine different NLTK functions to build applications for natural language processing and understanding. (Creating)

Module I (4 Hours)

Natural Language Toolkit (NLTK): Installation and getting started; Accessing text corpora; Ngrams; Conditional Freqquency Distribution; Regular expressions for detecting word patterns; Regular expressions for tokenizing text

Module II (3 Hours)

Using a tagger; Tagged corpora; Automatic tagging, Ngram tagging;

Module III (4 Hours)

Classify text; supervised classification; Naive Bayes classifiers; Information extraction; Chunking; Named entity recognition; Relation extraction

Module IV (4 Hours)

Parsing with context free grammars; Dependency grammar; Grammar development; Grammatical features; Processing feature structures; Natural language understanding; Propositional logic; First order logic

Suggested Readings

1. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly Media.
2. Jacob Perkins, Python Text Processing with NLTK 2.0 Cookbook, O'Reilly Media.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H	M		
CO2		H	H	
CO3		M		H
CO4			L	H
CO5		L	H	
CO6	L		H	H

CSMP6103: MAJOR PROJECT-PHASE 1

(2 credits)

Course Outcomes

1. Recall the software development life cycle and fundamental phases of system/application/software design and research. (Remembering)
2. Explain how to carry out a project work and explain the importance of different phase of a system design, workflow and time estimation with research outlook. (Understanding)
3. Implement a system and plan how to perform research for real time application. (Applying)
4. Compare the feasibility of a project in terms of time, effort and money. (Analyze)
5. Evaluate a project based on its efficiency applicability robustness, user friendliness etc., with socio economic factors (Evaluating)
6. Design applications by examining and scientifically designing each phase of the project.(Creating)

CSMP6104: MAJOR PROJECT - PHASE II

(3 credits)

Course Outcomes

1. Define and choose the Software Development Life Cycle and fundamental phases of system / application / software design and research. (Remembering)
2. Demonstrate how to carry out a project work and understand the importance of different phases of a system design, workflow and time estimation with research outlook. (Understanding)
3. Construct a system and identify how to perform research for real time application. (Applying)
4. Analyze the feasibility of a project in terms of time, effort and money. (Analyzing)
5. Evaluate a project based on its efficiency, applicability, robustness, user friendliness etc., with socioeconomic impact. (Evaluating)
6. Design applications by examining and scientifically designing each phase of a project work. (Creating)

CSDA6105: DATA STRUCTURES AND ALGORITHM LAB

(1 credit) (L-T-P:0-0-2)

Course Outcomes

1. Explain the concept of different data types, primitive, derived and their representation and application through coding. (Understanding)
2. Apply the concept of ADT and linear and nonlinear data types and their representation. (Applying)
3. Apply these data types in various applications like arithmetic expression evaluation and conversion. (Applying)
4. Explain the concept of Graphs and Trees and their real time application. (Understanding)
5. Develop various searching and sorting techniques. (Creating)
6. Choose and implement efficient data structures and apply them to solve problems. (Evaluating)

Solution of problems on

1. dynamic memory allocation
2. structures and pointers to structures
3. Arrays
4. Stacks and Stack application,Queues
5. Linked Lists, Circular and Doubly Linked Lists.
6. Binary Trees
7. Searching and data modification: Linear Search, Binary Search, Hashing.
8. SortingTechniques: Selection, Insertion, Bubble, Merge, Heap, Quick, Radix, and Merge-Sort.

Mapping of COs to syllabus

Course Outcome	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8
CO1	H	M	M					
CO2	H	H	H					
CO3			M	H	M			
CO4				H	H	M		
CO5				L	M	H		
CO6							H	H

VALUE ADDED COURSE

CSCS6106: INTRODUCTION TO CYBER SECURITY

Duration: 30 hours

Objectives

This course is designed to explore cyber security as a potential specialization in an IT career. Today's interconnected world makes everyone more susceptible to cyber-attacks. It explores cyber trends, threats—along with the broader topic of cyber security in a way that will matter to the user. For instance, students will learn how to protect personal privacy online while gaining additional insight on the challenges companies, and governmental and educational institutions face today.

Course/Learning Outcomes

1. Understand the importance of safe on-line behaviors (Understanding)
2. Analyzing the different types of malware and attacks (Analysing)
3. Identifying the protection strategies used organizations against attacks (Applying)

Module I: The Need for Cyber security (5 lecturers)

The Need for Cyber security, Personal Data: Introduction to Personal Data, cyber security definition, Online and Offline Identity, Computing Devices, Personal Data as a Target, Organizational Data: Introduction to Organizational Data, Types of Organizational Data, Confidentiality, Integrity, and Availability, The Impact of a Security Breach: The Consequences of a Security Breach, Security Breach Example 1, Security Breach Example 2, Security Breach Example 3, Attackers and Cyber security Professionals, The Profile of a Cyber Attacker, Types of Attackers, Internal and External Threats, Cyber warfare: Overview of Cyber warfare, The Purpose of Cyber warfare, The Need for Cyber security

Module II: Attacks, Concepts and Techniques (7 lecturers)

Introduction: Attacks, Concepts and Techniques, Analyzing a Cyberattack, Security Vulnerability and Exploits, Finding Security Vulnerabilities, Types of Security Vulnerabilities, Categorizing Security Vulnerabilities, Identify Vulnerability Terminology, Types of Malware and Symptoms, Types of Malware, Symptoms of Malware, Identify Malware Types, Methods of Infiltration, Social Engineering: Wi-Fi Password Cracking, Phishing, Vulnerability Exploitation: DoS, DDos, and SEO, SEO Poisoning , The Cybersecurity Landscape: Identify the Attack Type, Blended Attack, Impact Reduction, Attacks, Concepts and Techniques

Module III: Protecting Your Data and Privacy (5 lecturers)

Introduction: Protecting Data and Privacy, Protecting Devices and Network, Use Wireless Networks Safely, Protect Your Computing Devices , Use Unique Passwords for Each Online Account, Use Passphrase Rather Than a Password, Email and Web Browser Privacy

Module IV: Protecting the Organization (10 lecturers)

Introduction: Protecting the Organization, Firewalls: Firewall Types, Identify the Firewall Type, Port Scanning, Identify the Port Scan Response, Security Appliances, Identify the Security Appliance, Detecting Attacks in Real Time, Detecting Malware, Detecting Attacks in Real Time, Protecting Against Malware, Security Best Practices, Behavior Approach to cyber security, Behavior-Based Security, Behavior-Based Security, NetFlow and Cyber attacks, Cisco's Approach to Cyber security, CSIRT, Security Playbook, Tools for Incident Prevention and Detection, IDS and IPS, Identify Cyber security Approach Terminology, Behavior-Based Security, Behavior-Based Security, NetFlow and Cyber attacks, Cisco's Approach to Cyber security, CSIRT, Security Playbook, Tools for Incident Prevention and Detection, IDS and IPS, Identify Cyber security Approach Terminology.

Module V: Will Future Be in Cyber security? (3 lecturers)

Introduction, Cyber security Legal and Ethical Issues, Education and Careers, Legal and Ethical Issues in Cyber security Careers, Legal Issues in Cyber security, Ethical Issues in Cyber security, Cyber security Jobs

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M			
CO 2		H	M		
CO 3			H	H	M

DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a recognized leader in Civil Engineering education and learning experiences providing state of the art education guided by innovative research and consultancy, inclusive technology and managerial skills for industry as well as societal needs towards sustainable development.

MISSION

1. To make the department a center of excellence in Civil Engineering education which equips students with a strong conceptual foundation coupled with practical insight to meet the global industrial and environmental challenges.
2. To produce spiritually inspired socially committed and intellectually competent professionals of high caliber and strong ethical principles to serve the society and nation through teamwork and societal leadership.
3. To establish the department as a recognized center of research for developing sustainable solutions to engineering problems by providing knowledge base and consultancy services to the community.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

1. To equip the students with necessary technical skills and professional expertise that make them competent for immediate employment or to pursue postgraduate studies in Civil Engineering disciplines.
2. To produce graduates who are spiritually motivated for life-long learning and morally committed for successful careers as civil engineers, managers, administrators, educators, engineering consultants and entrepreneurs.
3. To enhance students' abilities to identify and take up project and research topics which would be highly useful for the society considering the present environmental and industrial needs of the country.
4. To make the students able to communicate their innovative ideas to be effective in collaboration with other civil engineering teams that will make them achieve leadership positions to solve different challenges of civil engineering problems.
5. To develop a sense of understanding of the multidisciplinary approach and an ability to relate engineering issues to the broader context of individuals and society for sustainable development.

PROGRAM OUTCOMES – UG PROGRAMMES

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES – B.TECH CIVIL ENGINEERING

PSO 1: **Professional skills:** The ability to analyse and design civil engineering structures as per the provisions in Indian standards and other relevant codes like buildings, bridges, tunnels, highways, railways, airports, docks and harbors, water and sewage treatment plants etc.

PSO 2: **Problem solving and managerial skills**: The ability to manage large infrastructural projects by making use of latest project management techniques for optimum utilisation of resources.

PSO 3: **Innovation and entrepreneurship**: Acquire state-of-the-art scientific knowledge and identify solutions to problems in various civil engineering domains that will create new horizons for entrepreneurial ventures.

PSO 4: **Research and development:** To create an eco-system of research to cater to the needs of society and industrial requirements.

BTECH CIVIL ENGINEERING- List of courses

Course Code	Course Title	Course Number
CHCE0027	Engineering Chemistry	1.1
MACL0012	Mathematics I - Calculus and Linear Algebra	1.2
EEBE0038	Basic Electrical Engineering	1.3
CHCE6007	Engineering Chemistry Lab	1.4
EEBL6027	Basic Electrical Engineering Laboratory	1.5
MNWM6023	Workshop/Manufacturing Practice	1.6
PSEP0039	Engineering Physics: Mechanics	2.1
MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	2.2
CSPS0079	Programming for Problem Solving	2.3
EGEH0111	English	2.4
PSEG6017	Physics Lab for Engineers	2.5
CVED6024	Engineering Graphics and Design	2.6

EG0C6005	Oral Communication Practice Lab	2.7
CSPL6069	Programming for Problem Solving Lab	2.8
ECBE0051	Basic Electronics	3.1
BOBE0002	Biology for Engineering	3.2
MNEM0034	Engineering Mechanics	3.3
CVES0046	Energy Science and Engineering	3.4
MATD0028	Mathematics III- Transform Calculus and Discrete Mathematics	3.5
CVIC0054	Introduction to Civil Engineering	3.6
ECBE6040	Basic Electronics Lab	3.7
CVCA6025	Computer Aided Civil Engineering Drawing Lab	3.8
BTIA8	Internship Activity	3.9
BTIP910	Student Induction Program- Universal Human Values II	3.10
MNME0041	Elements of Mechanical Engineering	4.1
CVIS0053	Instrumentation and Sensor Technologies for Civil Engineering Applications	4.2
CVEG0047	Engineering Geology	4.3
CVDP0048	Disaster Preparedness & Planning	4.4
CVFM0049	Introduction to Fluid Mechanics	4.5
CVSM0050	Introduction to Solid Mechanics	4.6
CVSG0051	Surveying & Geomatics	4.7
CVMT0052	Materials, Testing and Evaluation	4.8
CVIS6031	Instrumentation & Sensor Technologies for Civil Engineering Applications Lab	4.9
CVEG6026	Engineering Geology Lab	4.10
CVFM6027	Introduction to Fluid Mechanics Lab	4.11
CVSM6028	Introduction to Solid Mechanics Lab	4.12
CVSG6029	Surveying & Geomatics Lab	4.13
CVMT6030	Materials, Testing and Evaluation Lab	4.14
MTOB0086	Organizational Behaviour	4.15
CVMM0056	Mechanics of Materials	5.1
CVHE0057	Hydraulic Engineering	5.2
CVSE0058	Structural Engineering	5.3
CVGE0059	Geotechnical Engineering	5.4
CVHW0060	Hydrology & Water Resources Engineering	5.5
CVEE0061	Environmental Engineering	5.6
CVTE0062	Transportation Engineering	5.7
MTPP0105	Professional Practice, Law & Ethics	5.8
CVHE6031	Hydraulic Engineering Lab	5.9
CVGE6032	Geotechnical Engineering Lab	5.10
CVEE6033	Environmental Engineering Lab	5.11
CVTE6034	Transportation Engineering Lab	5.12
BTIP12	Internship Seminar	5.13
CVCM0063	Construction Engineering & Management	6.1
CVEC0064	Engineering Economics, Estimation & Costing	6.2
CVCS0065	Design of Concrete Structures I	6.3
CVED0066	Civil Engineering Design I	6.4
CVSA0068	Structural Analysis I	6.5
CVGI0070	Geographic Information Systems and Science	6.6
CVHS0071	Soft Skills and Interpersonal Communication	6.7

CVSS0072	Design of Steel Structures	6.8
CVRS0073	Repairs and Rehabilitation of Structures	6.9
CVPT0074	Physicochemical Process of Water and Waste Water Treatment	6.10
CVRE0075	Railway Engineering	6.11
CVOC0076	Open Channel Flow	6.12
CVSM0077	Soil Mechanics II	6.13
CVEC6035	Engineering Economics, Estimation & Costing Lab	6.14
BTIP13	Internship (Survey Camp)	6.15
MBLS0001	Life Science	7.1
CVCS0090	Design of Concrete Structures II	7.2
CVHS0067	Design of Hydraulic Structures and Irrigation Engineering	7.3
CVPC0091	Prestressed Concrete	7.4
CVSA0092	Structural Analysis II	7.5
CVPH0093	Port and Harbor Engineering	7.6
CVTM0094	Traffic Engineering and Management	7.7
CVMS0095	Metro Systems and Engineering	7.8
CVRG0103	Remote Sensing and GIS	7.9
CVMP6049	Project-I Minor Project	7.10
CVIT6041	Industrial Training	7.11
CVBE0096	Bridge Engineering	8.1
CVBH0097	Basics of Computational Hydraulics	8.2
CVSH0098	Solid and Hazardous Waste Management	8.3
CVEE0099	Earthquake Engineering	8.4
CVST0100	Structural Dynamics	8.5
CVMM0107	Structural Analysis by Matrix Methods	8.6
CVEL0101	Environmental Law and Policy	8.7
CVSE0102	Sustainable Engineering and Technology/Economic Policies in India	8.8
CVPJ6043	Project-II	8.9

MAPPING OF POS, PSOS VS. COURSES

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1.1	H	L		L		M	M		M	M		L	L			M
1.2	L	H	M		M	M		M	H	M	M	M		M		M
1.3	M	M		L	L				L					L	L	
1.4	M	M	M	L	L		M		L			L	L			M
1.5	M	M		L	L				L					L	L	
1.6					H				M			H		L	M	
2.1	H	M		L		M	M		M	M		L	L			M
2.2	L	H	M		M	M		M	H	M	M	M		M		M
2.3	L	M			M											M
2.4						L			L	M						L
2.5	H	M		L		M	M		M	M		L	L			M
2.6	L		M		H								M			
2.7						L			L	M						L
2.8	L	M			M											M

3.1	M	M		L	L				L					L	L	
3.2							M									L
3.3	H	M		L		M	L					L	M		L	
3.4	M		L		M		H					M			M	L
3.5	L	H	M		M	M		M	H	M	M	M		M		M
3.6	L	L	L	L	L	M	L	M			M	L	L	M		
3.7	M	M		L	L				L					L	L	
3.8	L		M		H								M			
3.9	M	H	M	L	M	M	L	L	H	M	M	M	H	M		
3.10						M	L	H	M	L		L		L		
4.1	H	M		L		M	M		M	M		L	M		L	
4.2	M	M		L	H				L					L	L	
4.3	M						L					L	L	L		
4.4			H	M	M	H	H		M	M		M	M	M		L
4.5	M	M		L	L								M	L		M
4.6	H	M	M	L		L						L	M		L	M
4.7	M		L		M				H	M			H	M		
4.8	M					L							M		L	M
4.9	M	M		L	H				L					L	L	
4.10	M						L					L	L	L		
4.11	M	M		L	L								M	L		M
4.12	H	M	M	L		L						L	M		L	M
4.13	M		L		M				H	M			H	M		
4.14	M					L							M		L	M
4.15								H	H	M	M	L		M	M	
5.1	H	M	M	L		L						L	M		L	M
5.2	M	H		L	M								H	M		M
5.3	M	H	M	M	L							L	M	M		M
5.4	M	M	H				L					L	M	M		
5.5	H	H	M	M			M		M			L	M	M		
5.6	H	M	M			H	H					L	H		M	
5.7	H	M	M			L							H	M		
5.8						L		H	M	M	H	M		M		
5.9	M	H		L	M								H	M		M
5.10	M	M	H				L					L	M	M		
5.11	H	M	M			H	H					L	H		M	
5.12	H	M	M			L							H	M		
5.13		M	M	M	H	L	L	L	H	M	M	M	M	H		M
6.1	M				M	M		M	H	M	H	L		M		
6.2		M			M						H			M		
6.3	H	M	H	H					M			M	H	H		
6.4	M	M	H	M	H		H					L	H			M
6.5	M	H	M	H	L							M	H	H		M
6.6	M	M			H	L					L	L	M			M
6.7						M		M	H	H	M			M		
6.8	H	M	H	H					M			M	H	H		
6.9	H				H		M		M			M	M			M
6.10	M	M			M		H					M	H			M
6.11	M	L				L							H			

6.12	M	M	M	M									M			L
6.13	M	M	H				L					L	M	M		
6.14		M			M						H			M		
6.15		M	M	M	H	L	L	L	H	M	M	M	M	H		M
7.1	M						M		H				H			L
7.2	H	M	H	H					M			M	H	H		
7.3	H	H	M	M			M		M			L	M	H		
7.4	H	M	H	H					M			M	H	H		
7.5	M	H	M	H	L							M	H	H		M
7.6	M	L				L							H			
7.7	M	M			M		H					M	H			M
7.8	M	M	H		H	L	L						H	M		
7.9	M	M			M		H					M	H			M
7.10	H	H	H	M	M				H	M		H	H			M
7.11		M	M	M	H	L	L	L	H	M	M	M	M	H		M
8.1	H	M	H	H					M			M	H	H		
8.2	M	M	M	M	H								M			M
8.3	L		M			M	M				H	L	M			
8.4	M	H				M	M					M	H			M
8.5	M	H	M	H	L							M	H	H		M
8.6	M	H	M	H	L							M	H	H		M
8.7			L			M	H	H	L	M	L	M		M		H
8.8	M			L		M	H	M	M	M	L	M		H		M
8.9	H	H	H	M	M				H	M		H	H			

DETAILED SYLLABUS
THEORY COURSES

CVES0046: ENERGY SCIENCE AND ENGINEERING

(2 credits) (L:T:P: 1-1-0)

Objective

The objective of this Course is to provide an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear. Energy conservation methods will be emphasized from a Civil Engineering perspective. The knowledge acquired lays a good foundation for design of various civil engineering systems/ projects dealing with these energy generation paradigms in an efficient manner.

Course/Learning Outcomes

Upon successful completion of the course, the students will be able to:

1. List and generally explain the main sources of energy and their primary applications nationally and internationally
2. Estimate the energy demands and make comparisons among energy uses, resources, and technologies.
3. Analyze the challenges and problems associated with the use of various energy sources, including fossil fuels, regarding future supply and the impact on the environment.

Module I (4 hours)

Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the Environment.

Module II (6 hours)

Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) -past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

Module III (6 hours)

Energy & Environment: Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

Module IV (7 hours)

Civil Engineering Projects connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems

Module V (7 hours)

Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated);

LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Suggested Readings

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. A Kraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
7. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
8. Related papers published in international journals

Mapping of COs to Syllabus

Course Outcomes	CO 1	CO 2	CO 3
Module I	H		
Module II	H		
Module III		H	
Module IV			H
Module V		H	

CVEG0047: ENGINEERING GEOLOGY

(1 credit)

Objective

The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

Course/Learning Outcomes

At the end of the course, the students will be able to:

1. Study of physical properties and identification of rocks, minerals depending on geological classification.
2. Apply geological principles to rock masses and discontinuities for use in engineering design e.g., rock slopes, foundation.

Module I: 2 Hours

Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite

Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

Module II 4 Hours

a. Petrology- Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone.

b. Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module III 1 Hour

Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module IV 2 Hours

Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module V 2 Hours

Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of the water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India

Module VI 2 Hours

Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affect the quality of rock engineering and design. Basic elements and structures of rock that are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging. Rock Quality Designation. Rock mass description.

Module VII 1 Hour

Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment given to such structures.

Module VIII 1 Hour

Rock Mechanics- Subsurface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and shear strength of rocks, Bearing capacity of rocks.

Suggested Readings

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2
Module I	H	L
Module II	M	H
Module III	H	L
Module IV	L	H
Module V	H	M
Module VI	H	M
Module VII	L	H
Module VIII	M	H

CVDP0048: DISASTER PREPAREDNESS & PLANNING MANAGEMENT

2 Credits - (L:T:P: 1:1:0)

Objectives

The objectives of the course are to understand basic concepts in Disaster Management , definitions and terminologies used in Disaster Management, types and Categories of Disasters, the Challenges posed by Disasters and the Impacts of Disasters Key Skills

COURSE/LEARNING OUTCOMES

Upon successful completion of the course, the students will be able to:

1. Define the application of Disaster Concepts to Management
2. Explain the Relationship between Development and Disasters.
3. Make use of the understanding of different categories of Disasters

Module I: 2 Hours

Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Module II: 8 Hours

Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module III: 6 Hours

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module IV: 8 Hours

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post- disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module V: 6 Hours

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land- use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Suggested Readings

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	L	L	
Module II	M	H	L	
Module III		M	H	L
Module IV		L	M	H
Module V			H	

CVFM0049: INTRODUCTION TO FLUID MECHANICS

2 credits (L: T:P:2-0-2)

Objectives

The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. Training to analyse engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

Course/Learning Outcomes

At the end of the course, the student will be able to:

1. CO1: Understand and define the broad principles of fluid statics, kinematics and dynamics
2. CO2: Classify fluid flow; apply the continuity, momentum and energy principles
3. CO3: Apply dimensional analysis, and application of fluid mechanics problem to pipe flow , pressure measurements and hydrostatic forces

Module I: 6 Hours

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Module II: 8 Hours

Fluid Statics - Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro-manometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Module III: 8 Hours

Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Streamline, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Module IV : 8 Hours

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturi meter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

Suggested Readings

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chandramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, McGraw Hill.
5. MOOCs Link : https://swayam.gov.in/nd1_noc20_ce59/preview

Mapping of COs to syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H	L	L
Module II	H	L	L
Module III	L	H	L
Module IV	L	M	H

CVSM0050: INTRODUCTION TO SOLID MECHANICS

2 credits- (L:T:P: 2-0-0)

Objective

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.

COURSE/LEARNING OUTCOMES

On completion of the course, the student will be able to:

1. Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
2. Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods.
3. Analyze various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams.
4. Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin-walled members.

Module I : 2 Hours

a. Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram,Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain.
b. Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

Module II: 2 Hours

Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module III: 3 Hours

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contraflexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module IV: 2 Hours

a. Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.
b. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Module V :3 Hours

Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinate beams.

Module VI: 2 Hours

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal

stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Module VIII: 1 Hour
Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

Suggested Readings

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC,New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi. MOOCs Link: https://swayam.gov.in/nd1_noc20_ce34/preview

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	M	L	
Module II	M	H		
Module III			H	
Module IV		H		
Module V				H

CVSG0051: SURVEYING AND GEOMATICS

2 credits

Objectives
Objectives of this course is to introduce the students to various types of surveying and to prepare them to work with survey observations and perform calculations.

COURSE/LEARNING OUTCOMES
On completion of the course the students will be able to:
1. Identify different types of surveying and their applicability.
2. Recognise the importance and uses of remote sensing and other modern techniques in various civil engineering works.
3. Execute traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and mapping.
4. Operate the techniques, skills, and applicable tools of the discipline for application in engineering and surveying activities.

Module I: Introduction to Surveying (4 hours)
Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

Module II: Triangulation and Trilateration (6 Hours)
Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation – network- Signals. Baseline - choices - instruments and accessories -

extension of base lines – corrections - Satellite station - reduction to centre - Intervisibility of height and distances – Trigonometric leveling - Axis single corrections.

Module III: Curves (5 hours)
Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Module IV: Modern Field Survey Systems (6 Hours)
Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

Module V: Photogrammetry Surveying (6 Hours)
Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Module VI: Remote Sensing (3 Hours)
Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Suggested Readings

1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	H			
Module III	H			
Module IV				H
Module V		H		M
Module VI		M		H

CVMT0052: MATERIALS, TESTING AND EVALUATION

(2 credits - 30 Hours)(L:T:P:1-1-0)

Objective
The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.

- Make measurements of behavior of various materials used in Civil Engineering.
- Provide physical observations to complement concepts learnt
- Introduce experimental procedures and common measurement instruments, equipment, devices.

- Exposure to a variety of established material testing procedures and techniques
- Different methods of evaluation and inferences drawn from observations.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

1. List the different materials used in civil engineering applications.
2. Execute planning an experimental program, selecting the test configuration, selecting the test specimens and collecting raw data.
3. Compare and explain various modes of failure in compression, tension, and shear.

Module I (5 hours)

Introduction to Engineering Materials covering, Cements, M-Sand, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these

Module II (5 hours)

Introduction to Material Testing covering, What is the “Material Engineering”?; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundamentals and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics

Module III (5 hours)

Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.

Tutorials (15 hours)

From the above modules covering, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

Suggested Readings

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
4. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
5. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
6. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
7. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)
8. Related papers published in international journals

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II		H	
Module III			M

CVIS0053: INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS

(2 credits- 30 Hours)

COURSE/LEARNING OUTCOMES

After completing the course students will be able to:

1. Explain the noise added during measurements and transmission, the measurement of electrical variables and the requirements during the transmission of measured signals.
2. Identify the requirements in the calibration of sensors and instruments.
3. Analyze the errors during measurements
4. Decide proper sensor technologies for specific applications
5. Construct Instrumentation/Computer Networks
6. Design and set up measurement systems and do the studies

Module I:

Fundamentals of Measurement, Sensing and Instrumentation: definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

Module II:

Sensor Installation and Operation: i) Prediction of the response of sensors to various inputs; ii) Construction of a conceptual instrumentation and monitoring program; iii order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

Module III:

Data Analysis and Interpretation covering a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

Module IV:

Frequency Domain Signal Processing and Analysis covering Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution

Tutorials from the above modules demonstrating clearly the understanding and use for the sensors and instruments used for the problems posed and inferences drawn from the measurement and observations made along with evaluation report

Suggested Readings

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Heinemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press

3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Iya Gertsbakh (2010), Measurement Theory for Engineers, Springer

CVIC0054: INTRODUCTION TO CIVIL ENGINEERING

(3 Credits) (L: T:P :3-0-0)

Objective

The Objective of this course is to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering, to motivate the students to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness and to expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

COURSE /LEARNING OUTCOMES

After finishing this course students will be able to:

1. Know what constitutes civil engineering and explore various possibilities of a career in this field and
2. define the Sustainability of the Environment, including its Aesthetics, Identify the potentials of Civil Engineering for Employment creation and its Contribution to the GDP
3. Identify the various areas available to pursue and specialize within the overall field of Civil Engineering
4. Identify the vast interfaces this field has with the society at large.
5. Design creative and innovative work and showcase monuments, heritage structures, nationally important heritage infrastructure, and impressive projects to serve as sources of inspiration.

Modules I (6 Hours)

a. Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career.
b. History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers.
c. Overview of National Planning for Construction and Infrastructure Development; Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works;
d. Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities.

Module II: 6 Hours

Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

Module III (6 Hours)

a. Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes.
b. Basics of Construction Management & Contracts Management: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment;

Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management.

Module IV (8 Hours)

Environmental Engineering & Sustainability: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction; Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunneling ;Hydraulics, Hydrology & Water Resources Engineering: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures Power Plant Structures: Chimneys, Natural & Induced Draught Cooling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects; Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies; Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; Traffic & Transportation Engineering: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.

Module V (4 hours)

Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; non-Destructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs. Industrial lectures: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning;

Module VI (6 Hours)

Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Greenhouse Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.

Module VII (6 hours)

Computational Methods, IT, IoT in Civil Engineering: Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD, GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …)

Module VIII (3 hours)

Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction.

Suggested Readings

1. Chen, W.F and Liew,J Y R (Eds)., The Civil Engineering Hand Book, Second Edition, CRC press (Taylor and Francis.
2. Dalal, K. R.,Essentials of Civil Engineering,Charotar Publishing House
3. Gopi ,S., Basic Civil Engineering , Pearson Publishers
4. Kandya, A.A.,Elements of Civil Engineering,Charotar Publishing house

5. Rangawala, S. C.,and dalal, K.B.,Engineering materials, Charotar publishing House.
6. Rangawala, S. C.,and dalal, K.B.,Building Construction , Charotar publishing House.

Mapping of COs to Syllabus:

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	L		M
Module II			H	
Module III		H		
Module IV		H		
Module V				
Module VI			H	
Module VII			H	

CVMM0056: MECHANICS OF MATERIALS

(3 Credits-45 hours) (L:T:P:3-0-0)

Objectives

The objective of this Course is to introduce to continuum mechanics and material modeling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system.

COURSE /LEARNING OUTCOMES

At the end of the course, the student will be able to:

1. Explain deformation and strain under different load action and response in terms of forces and moments
2. Analyse the structures under axial and torsional loading, and buckling
3. Calculate the stresses and deflections of indeterminate beams.
4. Apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes

Module I : 6 Hours

Deformation and Strain covering description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder;

Module II: 6 Hours

Generalized state of stress and strain: Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Haigh-Westerguard's stress space.

Module III: 6 Hours

Momentum Balance and Stresses covering Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion

Module IV: 6 Hours

Mechanics of Deformable Bodies covering Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses,

Module V: 3 Hours

Force-Stress-Equilibrium covering Multiaxial Stress and Strain

Module VI: 3 Hours
Displacement – Strain covering Multiaxial Strain and Multiaxial Stress-strain Relationships

Module VII: 3 Hours
Elasticity and Elasticity Bounds covering Stress-strain-temperature Relationships and Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure of Materials,

Module VIII: 8 Hours
Bending: Stress and Strains; Deflections and Torsion covering Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelectricity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

Module IX: 4 Hours
Structural stability; Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design

Suggested Reading

1. Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.
2. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
3. Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India.
4. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
5. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
6. Gere, J. M., and S. P. Timoshenko. Mechanics of Materials. 5th ed. Boston: PWS Kent Publishing, 1970.
7. Ashby, M. F., and D. R. H. Jones. Engineering Materials, An Introduction to their Properties and Applications. 2nd ed. Butterworth Heinemann.
8. Collins, J. A. Failure of Materials in Mechanical Design. 2nd ed. John Wiley & Sons, 1993.
9. Courtney, T. H. Mechanical Behavior of Materials. McGraw-Hill, 1990. MOOCs Link: https://swayam.gov.in/nd1_noc20_ce50/preview

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	H			
Module III		H		
Module IV			H	
Module V	H			
Module VI	H			
Module VII	H			
Module VIII		H		
Module IX		H		M

CVHE0057: HYDRAULIC ENGINEERING

(2 Credits-30 hours) (L:T:P:2-0-0)

Objectives

To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

COURSE /LEARNING OUTCOMES

At the end of the course, the student will be able to:

1. Define different types of flows, classify different types of flow in an open channel and pipe flow, apply their knowledge of fluid mechanics in addressing problems in open channels.
2. Solve problems in uniform, gradually and rapidly varied flows in steady state conditions solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
3. Analyze and design artificial channels with rigid and mobile boundary and pipe networks.

Module I: (2 hours)

Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.

Module II: (4 hours)

Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

Module III: (4 hours)

Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Module IV: (3 hours)

Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problems.

Module V: (2 hours)

Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Module VI: (3 hours)

Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n_. Most economical section of channel. Computation of Uniform flow, Normal depth.

Module VII: (4 hours)

Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

Module VIII: (3 hours)
Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow- Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation,

Module IX: (3 hours)
Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problems.

Module X: (2 hours)
Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to inviscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web-based modelling in water resources engineering.

Suggested Readings

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Open channel Flow, K. Subramanya, Tata McGraw Hill.
4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
5. Burnside, C.D., "Electromagnetic Distance Measurement," Beekman Publishers, 1971. MOOCs, Link: https://nptel.ac.in/courses/105/103/105103096/

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	H		
Module III			H
Module IV			H
Module V	H	M	L
Module VI		H	
Module VII		H	
Module VIII			
Module IX	H		M
Module X			H

CVSE0058: STRUCTURAL ENGINEERING

(3 Credits - 45 Hours) (L:T:P:2-1-0)

Objectives
This course aims at providing students with a solid background on principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be held besides lectures.
Prerequisites: Engineering Mathematics, Engineering Physics, Introduction to solid mechanics

COURSE/LEARNING OUTCOMES

At the end of the course, the student will be able to:

1. Describe the role and responsibilities of structural engineers; identify different load types and understand the behaviour of structural materials and members under the loads and thus classify different structural systems.
2. Able to evaluate the determinacy/indeterminacy and stability/instability of beams, trusses and frames.
3. Execute the knowledge of structural mechanics and explain the design philosophies in addressing design problems of structural engineering.
4. Demonstrate the concepts of Prestressed Concrete and fireproofing of structures

Module I: (9 hours)

Introduction-Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design. Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads.

Module II: (12 hours)

Materials and Structural Design Criteria: Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;

Module III: (15 hours)

Design of Structural Elements: Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems

Module V: (9 hours)

System Design Concepts: Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection

Suggested Readings

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall,N.J., 2003.
3. Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996
4. Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.
5. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
6. MacGregor, J. G., Reinforced Concrete: Mechanics and Design, 3rd Edition, Prentice Hall, New Jersey, 1997.
7. Nawy, E. G., Reinforced Concrete: A Fundamental Approach, 5th Edition, Prentice Hall, New Jersey.
8. Wang C-K. and Salmon, C. G., Reinforced Concrete Design, 6th Edition, Addison Wesley, New York.
9. Nawy, E. G. Prestressed Concrete: A Fundamental Approach, Prentice Hall, NJ,(2003).
10. Related Codes of Practice of BIS Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
11. W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000.

12. NBC, National Building Code, BIS (2017).
13. ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia, 2002.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II		H	H	
Module III			H	
Module IV				H

CVGE0059: GEOTECHNICAL ENGINEERING

(2 Credits - 30 hours) (L:T:P: 2-0-0)

Objectives

With the successful completion of the course, the student should have the capability to: Understand the different types of soil based on formation and their engineering properties. Students will be exposed to the theories and concepts of soil mechanics in order to estimate and predict its behavior. The subject of geotechnical engineering involves various soil properties, characteristics of soil, stresses experienced by soil and its strength, different field and laboratory experiments which are essential to find different soil parameters etc. Students are expected to learn the fundamental knowledge of soil mechanics and be able to perform various tests to evaluate soil properties. Students will be able to analyze the slope stability of different types of soil and they should also have the knowledge of different types of subsurface investigation.

COURSE/LEARNING OUTCOMES

On completion of this course, students will be able to -

1. Classify types of soil based on their formation mechanism, particle size distribution and index properties.
2. Define phase diagrams and effect of capillary action and seepage flow direction on the effective stress and its relation with pore pressure.
3. Relate Effective stress, pore pressure parameters and Consolidation characteristics of soil
4. Investigate the stability of slopes and shear strength characteristics of soil

Module I: (3 hours)

Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc.

Module II: (7 hours)

a. Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups
b. Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method.
c. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified

soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

Module III: (6 hours)

a. Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.
b. Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory

Module IV: (6 hours)

a. Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.
b. Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

Module V: (4 hours)

Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test

Module VI: (4 hours)

a. Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.
b. Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

Suggested Readings

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R Rao, New age international publishers
2. Soil Mechanics and Foundations by B.C Punmia , Ashok Kr Jain and Arun Kr Jain
3. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy
4. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
5. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
6. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
7. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
8. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning MOOCs Link: https://nptel.ac.in/courses/105/105/105105168/

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	M		
Module II	H			
Module III			H	

Module IV		M	H	
Module V			H	
Module VI				H

CVHW0060: HYDROLOGY AND WATER RESOURCES ENGINEERING

(3 Credits-45 hours) (L-T-P:2-1-0)

Objectives

This course is intended to make the students exposed to the key features of hydrological science including precipitation, data analysis, rainfall-runoff analysis, ground water hydrology, hydrographs, flood routing, hydrological design, risk analysis and uncertainty.it also familiarizes the students with important aspects of irrigation and dams & spillways.

COURSE /LEARNING OUTCOMES

After the completion of the course, the students will be able to

1. Define various stages of hydrologic cycle, hydrograph, unit hydrograph, routing etc.
2. Interpret different applications of unit hydrograph and explain the theory of flood routing and differentiate reservoir routing from channel routing.
3. Compute average precipitation depth for a catchment, infiltration capacity from Horton's equation etc. and solve problems related to flood hydrographs and unit hydrographs.
4. Compile the concepts of surface hydrology with groundwater hydrology and conclude that for proper management of watersheds hydrologic analysis is critical.
5. Analyze problems related to precipitation, infiltration and other abstractions, hydrographs, flood routing, ground water hydrology, routing etc.

Module I: (3 hours)

Introduction - hydrologic cycle, water-budget equation, history of hydrology, World water balance, applications in engineering, sources of data.

Module II: (4 hours)

Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth area- duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Module III: (6 hours)

Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

Module IV: (6 hours)

Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.

Module V: (6 hours)

Ground-water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

Module VI: (6 hours)

a. Water withdrawals and uses – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of

crops-Crops and crop seasons in India, cropping pattern, duty and delta;

b. Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

Module VII: (6 hours)

Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

Module VIII: (8 hours)

a. Dams and spillways - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams.

b. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

Suggested Readings

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4	CO5
Module I	H				
Module II			H		
Module III			M		
Module IV		H			
Module V				H	
Module VI				H	
Module VII			H	M	
Module VIII			L	M	H

CVEE0061: ENVIRONMENTAL ENGINEERING

(2 credits-30 hours) (L-T-P:2-0-0)

Objectives

Starting with an introductory lesson on environment vis-a-vis pollution of its components, this course basically deals with various issues related to water supply to community as well as waste water treatment and disposal which constitutes a prime area of practice for civil engineers. Through this course students will get familiarize with land pollution, noise pollution and air pollution.

COURSE/LEARNING OUTCOMES

After successfully studying this course, students will be able to:

1. Relate the impact of humans on environment and environment on humans

2. Summarize the principles and operation of water, waste water, solid waste and air pollution treatment systems and the required appurtenances and accessories.
3. Plan strategies to control, reduce and monitor pollution and select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air.
4. Adapt with basic environmental legislation

Module I: 8 hours

a. Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.
b. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module II: 7 Hours

Sewage- Domestic and Stormwater, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module III: 3 Hours

Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module IV: 2 Hours

Noise- Basic concept, measurement and various control methods.

Module V: 5 Hours

Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on the environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module VI: 3 Hours

Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Module VII: 2 Hours

Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Suggested Readings

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.

3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw Hill International Editions, New York 1985. 4. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
4. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
5. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
6. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
7. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	L	H	M	
Module II		H	M	
Module III		H	M	
Module IV		H	M	
Module V	H	H	M	L
Module VI		H		
Module VII				H

CVTE0062: TRANSPORTATION ENGINEERING

(2 credits-30 hours) (L-T-P:2-0-0)

Objective

This course introduces Transportation Engineering, a core civil engineering practice in the field with prime focus on the highway engineering sector. On completion a student should be competent enough for planning and designing of different types of roads with necessary quality control in road construction and maintenance.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Carry out traffic studies and surveys involved in planning and highway alignment
2. Design the geometric elements of highways and expressways and flexible and rigid pavements as per IRC
3. Implement traffic regulation and control measures
4. Characterize pavement materials

Module I: (3 hours)

Highway development and planning: Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation.

Module II: (10 hours)

Geometric design of highways: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Module III: (4 hours)

Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems

Module IV: (3 hours)

Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests,

requirements for different types of pavements. Problems

Module V: (10 hours)

Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

Suggested Readings

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Mapping of Cos to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	L		
Module II		H		
Module III	M	L	H	
Module IV				H
Module V		H		

CVCM0063: CONSTRUCTION ENGINEERING & MANAGEMENT

(3 credits- 45 hours) (L-T-P:3-0-0)

Objective

The objectives of this course are to make students understand the concepts of Project Management for planning to execution of Projects, contracts, equipment, network analysis tools for cost and time estimation etc. which are pertinent to the management of a construction project.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

1. Plan and develop project organization for executing construction projects.
2. Apply knowledge and skills of modern construction practices and techniques.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Organize and monitor the construction projects with respect to time and cost

Module I (2 hours)

Basics of Construction- Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution; Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail.

Module II (8 hours)

Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions

underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module III (8 hours)
Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module IV (4 hours)
Construction Equipment basics: Conventional construction methods vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

Module V (8 hours)
Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance (LOB) technique, resource constraints and conflicts; resource aggregation, allocation, smoothing and leveling. Common Good Practices in Construction

Module VI (8 hours)
Project Monitoring & Control- Supervision, record keeping, periodic progress reports, and periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Module VII (5 hours)
Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Module VIII (2 hours)
Construction Costs: Make-up of construction costs; Classification of costs, time-cost trade-off in construction projects, compression and decompression.

Suggested Readings
1. Varghese, P.C., “Building Construction”, Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015

7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	H			
Module III		H	M	
Module IV		~~M~~ H	~~H~~ M	
Module V			H	
Module VI			H	
Module VII			M	
Module VIII				H

CVEC0064: ENGINEERING ECONOMICS, ESTIMATION & COSTING

(3 credits- 45 hours) (L-T-P:3-0-0)

Objectives

This subject will introduce the students to the basics of estimation of quantity and cost of civil engineering projects including the methods of tendering and contracting. It also deals with the valuation of properties.

COURSE / LEARNING OUTCOMES

At the end of the course students will be able to:

1. Identify fiscal and monetary policies and how this affects the economy.
2. Interpret the function of market and prices, identify key microeconomic indicators and measures of economic growth, change and development details of rate analysis for various task.
3. Relate the knowledge of the laws of supply, demand and equilibrium to analyse the responses of market, explain the concepts of gross domestic product, inflation and unemployment and how they are measured detailing of various structures specification.
4. Develop quantity estimates of civil engineering materials required in a particular project and the cost of the project and conduct property valuation and tendering process.

Module I: (3 hours)

Basic Principles and Methodology of Economics. Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes

Module II: (2 hours)

Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

Module III: (3 hours)

Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

Module IV: (2 hours)

Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in

Monetary, Fiscal, Social, External sectors.

Module V: (7 hours)

Estimation / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying

Module VI: (6 hours)

Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

Module VII: (hours)

Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price build-up: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management .

Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Suggested Readings

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, Building & Engineering Contracts
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I		M	H	
Module II	H			
Module III			H	
Module IV	H			

Module V		M		H
Module VI		H	H	M
Module VII			H	H

CVCS0065: DESIGN OF CONCRETE STRUCTURES I

(3 credits – 45 hours)

Objectives

The objective of this course is to familiarize the students with all fundamental concepts of reinforced cement concrete design. RCC has been the predominant structural entity in the present day civil engineering constructions. The main goal of this course is to provide students with all information concerning different principles, ways of analyzing, as well as structural designing and detailing of RCC elements. The knowledge acquired will lay a good foundation for analysis and design of various civil engineering structures/systems in a reliable manner.

COURSE/LEARNING OUTCOMES

After completion of the course students will be able to:

1. Explain the design philosophies of reinforced concrete structures.
2. Analyse reinforced concrete structural systems for bending, shear, bond and torsion.
3. Carry out analysis and design of concrete structural elements such as beams, columns, slabs and footings.

Module I: (8 hours)

Introduction to loads, stresses and design philosophies: Study of the strength, behavior, and design of indeterminate reinforced concrete structures, load and stresses, load combinations, working stress and limit state approach

Module II: (12 hours)

Design for bending, shear, bond and torsion: Analysis and design of sections in bending – working stress and limit state method, rectangular and T-sections, beams with reinforcement in compression, design for shear and bond, mechanism of shear and bond failure, design of shear using limit state concept, development length of bars, design of sections in torsion

Module III: (9 hours)

Design of slabs Design of one-way slab, design of two-way slabs, design of flat slab – direct method, circular slab, slab type staircase, placement of reinforcement in slabs, voided slab

Module IV: (8 hours)

Design of compression members: Short column, columns with uni-axial and bi-axial bending, long columns, use of design charts

Module V: (8 hours)

Design of foundation Wall footing, isolated and combined footing for columns

Suggested Readings

1. IS 456-2000 - Code of practice for R.C.C design.
2. S. Unnikrishnan Pillai and Devadas Menon, Reinforced Concrete Design, Tata McGraw- Hill
3. S. Ramamrutham and R. Narayan, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company (P) Ltd.
4. P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India Ltd
5. N. Krishna Raju, Structural Design and Drawing - Reinforced Concrete and Steel, Universities Press Ltd.
6. Dr. B.C Punmia, Ashok Kr Jain and Arun Kr Jain, Reinforced Concrete Structures Vol. I, Laxmi Publications

7. S.S. Bhavikatti, Design of R.C.C structural Elements Vol. I, New age international publishers.
8. H. Mehra and V. N Vazirani, Limit State Design, Khanna Publishers MOOCs Link: https://nptel.ac.in/courses/105/105/105105105/

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H	H	
Module II		M	
Module III			H
Module IV			H
Module V			H

CVED0066: CIVIL ENGINEERING DESIGN I

(3 credits – 45 hours)(L:T:P:2:1:0)

Objectives

The objective of this course is to familiarize the students with all fundamental concepts of civil engineering design. The main goal of this course is to provide students with all information concerning risk and vulnerability, health and safety in civil engineering design. The course will lay a good foundation for computer aided drawing and design of civil engineering structures in a reliable manner through application of state of the art techniques like geomatics, GIS etc.

COURSE/LEARNING OUTCOMES

After completion of the course students will be able to:

1. Model the structural behaviour of different reinforced concrete structural elements through CAD techniques.
2. Design and detail different elements of reinforced concrete structural systems subjected to gravity and lateral loads.
3. Carry out environmental impact assessment, risk and vulnerability analysis in design.

Module I: Concept of civil engineering design (12 hours)

Concept of design and its contribution to the quality of life, introduction to civil engineering design, the role of geomatics, the environment, and scientific laws in design

Module II: Introduction to design of civil engineering infrastructure (18 hours)

Design of buildings and civil engineering infrastructure, site appraisal, risk and vulnerability in design, health and safety in civil engineering design, environmental impact assessment

Module III: Computer aided drawing and design (15 hours)

Civil engineering drawing, CAD techniques, introduction to GIS techniques, application of GIS in civil engineering projects

Suggested Readings

1. B. L. Davies, A. J. Robotham, A. Yarwood, Computer Aided Drawing and Design, Springer-Science + Business Media, B.V.
2. S. Choudhury, D. Chakrabarti, S. Choudhury, An Introduction to Geographic Information Technology, I. K. International
3. S. Labi, Introduction to Civil Engineering Systems, Wiley
4. C. D. Ghilani, Elementary Surveying: An Introduction to Geomatics, Pearson
5. B. M. Ayyub, Vulnerability, Uncertainty and Risk: Analysis, Modeling and Management, ASCE
6. Institution of Civil Engineers, The Management of Health and Safety in Civil Engineering

7. S. C. Basu Roy, Handbook of Modern Technology in Civil Engineering, A. Nabhi Publication
8. N. S. Raman, A. R. Gajbhiye, S. R. Khandeswar, Environmental Impact Assessment, I. K. International
9. N. Madhu, R. Sathikumar and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India
10. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I			H
Module II		H	
Module III	H		

CVHS0067: DESIGN OF HYDRAULIC STRUCTURES & IRRIGATION ENGINEERING

(3 Credits – 45 hours)

Objective

This course aims at the implementation of the principles of fluid mechanics, hydraulics and geotechnical engineering for the design of various hydraulic structures like dams, weirs, cross-drainage structures etc. The course will also introduce the various design procedures for lined and unlined canals.

COURSE OUTCOMES/ LEARNING OUTCOMES

The students will be able to

1. Perform the stability analysis of gravity dams
2. Explain the causes of failure of different types of dams and their design criteria
3. Design minor irrigation structures such as regulators, cross drainage works etc.

Module I (10 hours)

Diversion head works- layout and functions of components, Weir and barrage- Causes of failure of weirs on permeable soils - Bligh's theory. Design of vertical drop weir. Khosla's theory of independent variables- Khosla's corrections-Use of Khosla's charts.

Module II (10 hours)

Irrigation canals, canal alignment- cross section of unlined canals- Design of canals through alluvial soils- Kennedy's theory and Lacey's theory. Cross drainage works-Types, selection of suitable type, Type of aqueducts. Regulation Works - Canal falls-necessity, classification. Canal regulators- Regulator cum road bridge- Head regulators and cross regulators.

Module III (15 hours)

Dams-Types, Gravity dam – selection of site- forces acting - stability analysis and modes of failure – Principal and shear stresses - Problems - Elementary profile –limiting height of gravity dams- high and low dams- Practical profiles, Functions of various components shafts, keys, water stops, and different types of gallery, Grouting. Instrumentation in dams.

Module IV (10 hours)

Arch dams-types, methods for design (list only)-Thin cylinder theory. Earth dams-types, causes for failure and design criteria. Spillways-Types. Effective length of spillway- Ogee type spillway profile. Energy dissipation below spillways - Stilling basins- Indian standard Type I and Type II.

Suggested Readings

1. Garg S.K, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2006.
2. Modi. P. N., Irrigation Water Resources and Water Power Engineering, Standard Book House, 2009.
3. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications Pvt. Ltd., 2010.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I			H
Module II			H
Module III	H	M	
Module IV		H	

CVSA0068: STRUCTURAL ANALYSIS-I

(3 Credits-45 Hours) (L: T: P: 2:1:0)

Objective

This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering.

COURSE/LEARNING OUTCOMES

After successful completion of the course students will be able to:

1. Define statically determinate and indeterminate structural members and bending moment shear force, strain energyprinciples, different methods of finding internal forces and deflections.
2. Classify beams frames and columns in terms of determinacy, stability and dimensions, buckling behaviour of columns and struts with different end conditions.
3. Apply principles of statics etc. to determine the energy principles for analyzing the frames and beams, determination various stresses acting on a body, analysis of various arches, cables and bridges.
4. Analyse indeterminate structural members with different types of loadings, fixity and estimate the safe load carrying capacity of structural members.

Module I: 10 Hours

Fundamentals of Statically Determinate Structures: Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's reciprocal theorems. Computation of internal forces in statically determinate structures such as plane truss, plane frame, grids.

Arches, Cables and **Suspension Bridges*:*** Calculation of internal forces in three hinge arches with circular and parabolic shapes subjected to various types of loading. Forces and end actions in cables due to various types of loading. Unstiffened three hinged parabolic and catenary type suspension bridge.

Module II: 17 Hours

Displacement of Determinate Beams and Plane Truss: Differential equation of elastic curve, relation between moment, slope and deflection, Macaulay's method, Moment Area Method, Conjugate Beam Method applied to beams. Joint displacement of determinate plane truss using unit load method.

Strain Energy: Strain Energy Resilience, strain energy due to axial loads & flexure, proof resilience, modulus of resilience, impact loads, and sudden loads.

Module III: 10 Hours

Direct and Bending stresses: Members subjected to eccentric loads, middle third rule, kernel of section, chimney subjected to wind pressure, retaining walls, dams subjected to hydraulic pressure.

Columns and Struts: Buckling of columns, different end conditions, effective length, least radius of gyration, Euler's and Rankine's formula, columns with initial curvature, eccentrically loaded columns, columns with lateral loading

Module IV: 8 Hours

Fixed Beams & Consistent Deformation Method: Computation of fixed-end actions for various types of loads and secondary Effects using basic principles beams of varying moment of inertia. Analysis of

propped cantilever beams & beams of varying moment of inertia using Consistent Deformation Method

Suggested Readings

1. L.S. Negi, Theory and Problems in Structural Analysis, Tata McGraw Hill Pub, 1997.
2. Junnarkar. S. B and Shah H.J- Mechanics of Structures Vol 1 & Vol.2 – 27th Edition, Charotar Publishers, 2008.
3. Wang C.K. - Intermediate Structural Analysis – Tata McGraw Hill Publishers, 2010.
4. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, " Theory of structures", Laxmi Publications Pvt. Ltd., New Delhi, 2004
5. BhaviKatti, S.S, "Structural Analysis –Vol. 1 & Vol. 2", Vikas Publishing Pvt Ltd., New Delhi, 2008.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	L	H	
Module II	H	H		
Module III		H	H	M
Module IV			H	H

CVBP0069: BUILDING CONSTRUCTION PRACTICE

(3 credits—45 hours)

Objectives

The objective of this course is to familiarise students about the characteristics of construction materials used in civil engineering and to develop the skills for identification of suitable construction materials for civil engineering projects. The course deals with all the general practices in construction of substructure and superstructure of a building.

COURSE/LEARNING OUTCOMES

After successful completion of the course students will be able to:

1. Understand the construction equipment's practices and techniques to be used in the field.
2. Select appropriate construction material and heavy equipment based on applications, utilization, productivity, and other factors.
3. Identify the components of building and the factors to be considered in building construction and develop the construction practices and techniques and assess various precautionary measures pertaining to construction materials

Module I: General practices in building construction (18 hours)

Specifications, details and sequence of activities and construction co-ordination, site clearance, marking, earthwork, masonry - stone masonry, bond in masonry, concrete hollow block masonry, flooring, damp proof courses, construction joints, movement and expansion joints, pre cast pavements, building foundations, basements, temporary shed, centering and shuttering, slip forms, scaffoldings, de-shuttering forms, fabrication and erection of steel trusses, frames, braced domes, laying brick, weather and water proof, roof finishes, acoustic and fire protection

Module II: Sub structure construction (14 hours)

Techniques of box jacking, pipe jacking, under water construction of diaphragm walls and basement, tunnelling techniques, piling techniques, well and caisson, sinking cofferdam, cable anchoring and grouting, driving diaphragm walls, sheet piles, shoring for deep cutting, well points, dewatering and stand by plant equipment for underground open excavation

Module III: Super structure construction (13 hours)

Launching girders, bridge decks, offshore platforms, special forms for shells, techniques for heavy decks, in-situ pre-stressing in high rise structures, material handling, erecting light weight components on tall structures, support structure for heavy equipment and conveyors, erection of articulated structures,

braced domes and space decks

Suggested Readings

1. B. C. Punmia, Ashok K. Jain, Arun K. Jain, 'Building Construction', Eleventh Edition, Laxmi Publications
2. S. K. Duggal, 'Building Materials', CRC Press
3. M. K. Gupta, 'Practical Handbook on Building Construction', A Nabhi Publication
4. Rangwala, 'Building Construction', Charotar Publications
5. P. Purushothama Raj, 'Building Construction Materials and Techniques', Pearson
6. S. K. Khanna, 'A Textbook of Building Construction', S. Chand

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H	M	
Module II			H
Module III			H

CVGI0070: GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE

(3 credits – 45 hours) L:T:P:3-0-0)

Objective

This elective course is designed to familiarise the students with the modern tools of geographic information systems (GIS) which are useful for analysis and interpretation of occurrences on the earth's surface. Foundation of GIS will help the students to go ahead for using this tool in decision making and bio-physical modelling.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Define the different types of maps, coordinate systems and recognize the importance and ease of surveying using remote sensing.
2. Understand fundamental concepts and practices of Geographic Information Systems (GIS) and advances in Geospatial Information Science and Technology.
3. Apply basic graphic and data visualization concepts and GIS analysis to address geospatial problems and/or research questions and demonstrate the proficiency in the use of GIS tools to create maps that are fit-for-purpose and effectively convey the information they are intended to.

Module I (15 hours)

Investigation of geographic information systems (GIS) and science (GIScience) including theory and applications areas. Use of a current widely-used GIS computer software system.

Module II (15 hours)

Aspects of geographic data entry and editing, spatial analysis, and map development and display to be considered.

Module III (15 hours)

Relationship of GIS to the Global Positioning System (GPS) and satellite generated data.

Suggested Readings

1. Satheesh Gopi, R. Sathikumar, N. Madhu, Advanced Surveying — Total Station, GIS and Remote Sensing, Pearson Education.
2. Paul Longely, M.F. Goodchild, et al., Geographic Information System, Volume I and II, John Wiley and Sons, Inc. 1999.

3. J.B. Cambell, Introduction to Remote Sensing, Taylor and Francis, London, 1996

Mapping of COs to syllabus

Course Outcome	CO1	CO2	CO3
Module I		H	M
Module II	H		
Module III			H

CVIC0071: SOFT SKILLS AND INTERPERSONAL COMMUNICATION

(3 credits – 45 hours)

Objective

The objective of this course is to equip students with the vital communication and soft skills to succeed in the highly competitive international arena. This course specifically aims at imparting fundamental soft skills and their practical social and workplace usage. The course also attempts to enable students to identify and overcome the barriers in interpersonal relationships, and to employ oral and written communication, teamwork, leadership, problem-solving and decision-making skills, to gain best results.

COURSE/LEARNING OUTCOMES

At the end of the course, students will be able to:

1. Understand the significance and essence of a wide range of soft skills.
2. Learn how to apply soft skills in a wide range of routine social and professional settings.
3. Learn how to employ soft skills to improve interpersonal relationships
4. Learn how to employ soft skills to enhance employability and ensure workplace and career success.

Module I (10 hours)

a. Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development.
b. Self-Discovery: Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue.
c. Positivity and Motivation: Developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation; Enhancing Motivation Levels.

Module II (12 hours)

a. Interpersonal Communication: Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.
b. Public Speaking: Skills, Methods, Strategies and Essential tips for effective public speaking.
c. Group Discussion: Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective.
d. Non-Verbal Communication: Importance and Elements; Body Language.
e. Teamwork and Leadership Skills: Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.

Module III (11 hours)

a. Interview Skills: Interviewer and Interviewee – in-depth perspectives. Before, During and After the Interview. Tips for Success.
b. Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness.
c. Etiquette and Manners – Social and Business.
d. Time Management – Concept, Essentials, Tips.
e. Personality Development – Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.

Module IV (12 hours)

a. Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills.
b. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution.
c. Stress Management: Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and 8 Impact of Stress; Measurement and Management of Stress
d. Leadership and Assertiveness Skills: A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behaviour; Assertiveness Skills.
e. Emotional Intelligence: Meaning, History, Features, Components, Intrapersonal and Management Excellence; Strategies to enhance Emotional Intelligence.

Suggested Readings

1. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012.
2. English and Soft Skills – S.P. Dhanavel, Orient Blackswan India, 2010.

CVSS0072: DESIGN OF STEEL STRUCTURES

3 credits-45 Hours (L:T:P:2:1:0)

Objectives

This course deals with the basic concepts and their applications in the field of design of steel structures. Keeping in mind the skyrocketing trend of application of steel as a construction material in present day construction engineering, this course is intended to be the stepping stone for the students to the modern construction industry.

COURSE/LEARNING OUTCOMES

1. Define the design approaches using steel sections of various types, identify the advantages of steel structures over concrete structures
2. Classify different types of steel sections and connections that are used in the design of steel structures and compare their adequacy to different types of externally applied loadings.
3. Analyse designed connections and members and inspect the deficiencies in the connections in case the connections turn out to be unsafe and take part in providing remedial measures in case of failure prediction.
4. Estimate the performance of a designed member, examine a steel structure for any faults and defects and take steps to minimize it, predict whether a particular design are sufficient for a given situation.

Module I 5 Hours

Introduction and design approach: Properties of Structural Steel I.S. Rolled Sections, I.S. Specifications, Permissible and Working Stresses, Limit State Design Method

Module II 8 Hours

Connections: Type of Connections, Bolted and Welded Connections, Strength and Efficiency of Bolted and Welded Joints, Design of lap and butt joint, Modes of failure of a Bolted joint, Advantages and Disadvantages of Welded joints, Design of Eccentric Connections

Module III 6 hours

Tension Members: Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of tension members subjected to axial tension and bending, splicing of tension members.

Module IV 10 Hours

Design of compression members: Modes of failure of a column, Buckling Failure, Effective Length,

Slenderness Ratio, Design of Concentrically and Eccentrically Loaded Built-Up Compression Members, Laced and Battened Columns Column Base: Centrally and Eccentrically loaded Base Plate Design, Flat Slab Base, Gusseted Base, Grillage Foundation

Module V 10 Hours
Beams: Design Procedure, Simple and Built Up Beams, Laterally Restrained and Unrestrained Beams, Plate Girder: Plate Thickness, Web Crippling, Web Buckling Beam Column: Eccentricity of Load, Interaction Formulae, Design Procedure

Module VI 6 Hours
Introduction to Plastic analysis; Simple cases of beams and frames; All design steps/process to as per the most recent BIS code of practices

Suggested Readings
1. IS 800:2007-Code of practice for Steel Design
2. N.Subramanian, Design of Steel Structures
3. S.S. Bhavikatti, Design of Steel Structures
4. S.Ramamrutham, Design of Steel Structures
5. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Design of Steel Structures
6. MOOCs Link : https://nptel.ac.in/courses/105/105/105105162/

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	L	M	H	
Module III				H
Module IV				H
Module V				H
Module VI				H

CVRS0073: REPAIRS AND REHABILITATION OF STRUCTURES

(3 credits-45 Hours) (L:T:P: 2:1:0)

Objective
To make the students gain knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing and retrofitting of structures and demolition procedures.

COURSE OUTCOMES
1. Understand special types of concrete and their use and different engineering properties of hardened concrete.
2. Estimate the properties of concrete using NDTs.
3. Understand various damage detection and rehabilitation techniques in case of RCC structures.

Module I (20 hours)
Properties of hardened concrete, Strength and durability of concrete, Modern trends in concrete manufacture and placement techniques, Methods of transportation, Placing and curing, extreme weather concreting, special concreting methods, Vacuum dewatering of concrete, underwater concreting. Properties and applications of High-performance concrete, reactive powder concrete, Lightweight, heavyweight and mass concrete, fibre reinforced concrete, self-compacting concrete, Fly ash Concrete, Fibre reinforced Concrete, Polymer Concrete, Epoxy resins and screeds for rehabilitation – properties and application, Emerging trends in replacement of fine aggregates.

Module II (15 hours)
Introduction to NDT, Situations and contexts where NDT is needed, classification of NDT procedures,

visual inspection, half-cell electrical potential methods, Schmidt Rebound hammer test, resistivity measurement, electromagnetic methods, radiographic testing, ultrasonic testing infrared thermography, ground penetrating radar, radioisotope gauges, other methods.

Module III (10 hours)
Damages in RCC structures- Cracks in concrete, corrosion of reinforcement. Repair, rehabilitation and retrofitting of structures, Damage assessment of concrete/steel structures, materials and methods for repairs and rehabilitation, Damage assessment and Evaluation models, Damage testing methods, Importance of re-analysis, execution of rehabilitation strategy, case studies.

Suggested Readings
1. K. Ravishankar, T. S. Krishnamoorthy, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers.
2. Hand book on 'Seismic Retrofitting of Buildings' Published CPWD, Indian Building Congress in Association with IIT Madras, Narosa Publishing House.
3. M. Nevile, "Concrete Technology", Prentice Hall, New York.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II		H	M
Module III			H

CVPT0074: PHYSICOCHEMICAL PROCESSES OF WATER AND WASTE WATER TREATMENT

(3 credits-45 Hours) (L:T:P: 2:1:0)

Objective
This course gives an introduction into the physical and chemical water, wastewater, sludge, solid waste and waste gas treatment processes. The course is useful for students interested in the operation and planning of municipal and industrial water, wastewater and waste treatment plants.

COURSE/LEARNING OUTCOMES
After successful completion of the course students will be able to:
1. Describe the most important physical and chemical water, wastewater, sludge, solid waste and waste gas treatment processes
2. Explain the theoretical background of relevant physical and chemical treatment units
3. Choose favourable treatment methods for specific water, waste and gases
4. Design and dimension the most common physical and chemical unit processes

Module I 5 Hours
Water – Quality, Standards and Criteria: Physical, chemical and biological water quality parameters; Water quality guidelines, criteria and standards; Wastewater Effluent standards

Module II 6 Hours
Purification of water- Natural treatment processes- Physical, chemical and biological processes. Water treatment technologies- overview. Primary, Secondary and tertiary treatment-Unit operations &unit processes

Module III 5 Hours
Screening & Grit removal: Screens; grit channels, aerated grit chambers;

Module IV 7 Hours
Settling Tanks, Coagulation and Flocculation: Theory of settling; Types of settling; Settling Tanks;

Coagulation-flocculation; Flash mixing tanks and flocculation tanks; Tube settlers and plate settlers.

Module V 3 Hours
Aeration: Diffused and surface and gas transfer processes.

Module VI 6 Hours
Filtration Systems: Filtration theory and filter hydraulics; Slow sand filters; Rapid gravity filters; Pressure filters; Multimedia filters.

Module VII 5 Hours
Disinfection: Chlorination; Ozonation; UV radiation

Module VIII 8 Hours
Other Water Treatment Technologies: Ion-exchange process; Adsorption process- Adsorption equilibria-adsorption isotherms; membrane processes (nano-filtration, ultrafiltration and reverse osmosis).

Suggested Readings

1. Metcalf and Eddy, "Wastewater Engineering – Treatment and Reuse", Tata McGraw Hill.
2. Syed R. Qasim, Edward Motley, Guang Zhu, "Water Works Engineering"- Planning, Design and Operation, PHI
3. Weber W.J., "Physico-chemical Processes for Water Quality Control", John-Wiley
4. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engg.", McGraw Hill
5. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning
6. Hammer, M.J. and Hammer, M.J. Jr., "Water and Wastewater Technology", PHI Learning

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I				
Module II	H			
Module III		H	H	
Module IV		H	H	H
Module V		H	H	
Module VI		H	H	
Module VII		H	H	
Module VIII			H	H

CVRE0075: RAILWAY ENGINEERING

(3 credits – 45 hours) (L-T-P:3-0-0)

Objective
This elective course is in continuation with the course of Transportation Engineering with prime focus on various aspects of railway engineering. On completion a student should be competent enough in the planning and design of various components related to railway infrastructure.

COURSE/LEARNING OUTCOMES
On completion of the course, the students will be able to:
1. Illustrate the various elements of geometric design of railways.
2. Design Track geometry for a railway line and railway crossings and find solutions to practical problems.
3. Assess the capacity on a railway section.

Module I: Introduction to railways, its component parts and its functions (10 hours)
Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses;

Module II: Railway Alignment (15 hours)
Rails, sleepers; ballast; subgrade and formation, track fittings and fastenings, creep of rails, rail joints and welding of rails;

Module III: Railway Geometric Design (20 hours)
Geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards; railway tunneling; signaling and interlocking; maintenance of railways and high-speed trains.

Suggested Readings
1. S.P. Arora, S.C. Saxena, A Textbook of Railway Engineering, Dhanpat Rai Publications
2. S. Chandra and M.M. Agarwal, Railway Engineering, University Press, New Delhi
3. S.C. Rangwala, Principles of Railway Engineering, Charotar Publishing House Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II		H	
Module III		H	M

CVOC0076: OPEN CHANNEL FLOW

(3 Credits – 45 hours)

Objective
This course utilizes the concept of Hydraulic engineering to analyze various unsteady flow situations in open channels by numerical techniques. The course also illustrates the procedure of hydraulic routing in open channels.

COURSE/ LEARNING OUTCOMES
1. Ability to develop the open channel flow equations for unsteady cases from the governing equations.
2. Apply FDM techniques to solve unsteady Navier-Stokes and St. Venant's equations.
3. Apply FVM techniques to solve unsteady Navier-Stokes and St. Venant's equations.
4. Apply numerical techniques to solve problems related to hydraulic routing

Module I (8 hours)
Unsteady flow in open channels- terminologies, causes, applications, methods of study. Navier- Stokes equations, one- and two- dimensional St. Venant's Equations, Method of Characteristics.

Module II (15 hours)
Finite difference methods- Explicit and implicit schemes, convergence, stability, MacCormack Scheme, ADI scheme, artificial viscosity, Beam and Warming Schemes.

Module III (15 hours)
Finite volume method- types of grids, approximation of surface and volume integrals, central, upwind and hybrid formulations.

Module IV (7 hours)
Dam break analysis, Hydraulic routing – types, methods of routing.

Suggested Readings
1. Chaudhry, M. H. (2008) "Flow in open channels", Springer.

2. Chaudhry, M. H. (1979) "Applied hydraulic transients", Van Nostrand Reinhold Company.
3. Chung, T. J. (2003) "Computational fluid dynamics", Cambridge.

Mapping of COs to syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	M	H		
Module III			H	
Module IV				H

CVSM0077: SOIL MECHANICS II

(3 credits – 45 hours)

Objectives

To apply principles of soil mechanics to engineering problems pertaining to retaining structure , foundation and embankments.

Course /Learning Outcomes

On successful completion of the course students will be able to:

1. Illustrate different construction practices for excavation with advantages and disadvantages of each method.
2. Determine the safety analysis for slopes with different methods
3. Design retaining wall subjected to various loads and sheet pile wall with different methods.

Module I: Earth pressures (15 hours)

Application of soil mechanics to determine earth pressures, earth pressure at rest, Rankine and Coulomb's theories for active and passive states, influence of surcharge, water table, wall friction and deformation on earth pressure. Culmann's graphical method, point of application.

Module II: soil retaining structures (15 Hours)

Analysis of retaining walls, design considerations for retaining walls, cuts, excavations and sheet piles, instrumentation

Module II: Stability of slopes (15 hours)

Finite and infinite slopes, concept of factor of safety, Swedish method, friction circle method, Taylor's stability number and chart, effect of submergence, steady seepage and sudden drawdown conditions.

Suggested Readings

1. Gopal Ranjan, A. S. R Rao, Basic and Applied Soil Mechanics, New Age International Publishers
2. V. N. S. Murthy, Geotechnical Engineering, Marcel Dekker, Inc.
3. Dr. B.C. Punmia, Ashok Kr Jain and Arun Kr Jain, Soil Mechanics and Foundations, Laxmi Publications
4. P. Purushothama Raj, Soil Mechanics and Foundation Engineering, Pearson

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	L	H	
Module II		M	H
Module III		H	

CVCS0090: DESIGN OF CONCRETE STRUCTURES II

(3 credits) (L-T-P: 3-0-0)

Objectives

The objective of this course is to introduce the theory and application of analysis and design of reinforced

concrete structures and to familiarize the students with professional and contemporary issues in the design and fabrication of reinforced concrete members. The course focuses on understanding the behaviour of reinforced concrete components and systems subjected to gravity as well as lateral loads. This course will enable the students to perform analysis and design of pre-stressed as well as reinforced concrete members and connections with the application of relevant Indian Standard design codes.

COURSE/LEARNING OUTCOMES

After completion of the course students will be able to:

1. Analyse reinforced concrete structural systems under gravity and lateral loads and understand the design features
2. required for the earthquake resistant construction of structures.
3. Design and detail different elements of structural systems such as reinforced concrete water tanks, staircases and
4. retaining walls and columns, and masonry walls under gravity and lateral loads.
5. Design and detail bridge culverts and simple span girders corresponding to the IRC loadings, and understand the concepts of prestressed concrete, design prestressing end block and compute losses in prestress.

Module I: Moment distribution in beams and frames (5 Hours)

Design of continuous beams and building frames, moment redistribution

Module II: Design and detailing for wind and seismic loads (8 Hours)

Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, Detailing for earthquake resistant construction – ductility criteria

Module III: Design of water tanks (8 Hours)

Water tank and staging, introduction, design criteria, design of rectangular and circular water tank, design of Intze tank, staging for overhead tank

Module IV: Introduction to bridge engineering and prestressed concrete (15 Hours)

Investigation for bridges, IRC loadings, design of slab culvert, design of simple span girders, design of end block, prestressed concrete, introduction, pre-stressing system, losses in pre-stress

Module V: Staircases and retaining walls (6 Hours)

Design of staircases, design of cantilever and counter forte type retaining wall, design of masonry walls and columns.

Suggested Readings

1. IS 456-2000 **-** Code of practice for R.C.C design.
2. S. Unnikrishna Pillai and Devadas Menon, Reinforced Concrete Design, Tata McGraw- Hill
3. S. Ramamrutham and R. Narayan, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company (P) Ltd.
4. P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India Ltd
5. N. Krishna Raju, Structural Design and Drawing - Reinforced Concrete and Steel, Universities Press Ltd.
6. Dr. B.C Punmia, Ashok Kr Jain and Arun Kr Jain, Reinforced Concrete Structures Vol. I, Laxmi Publications
7. S.S. Bhavikatti, Design of R.C.C structural Elements Vol. I, New age international publishers.
8. H. Mehra and V. N Vazirani, Limit State Design, Khanna Publishers

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	H		
Module III		H	
Module IV			H
Module V		H	

CVPC0091: PRESTRESSED CONCRETE

(3 credits) (L-T-P: 3-0-0)

Objective

It deals with the concepts of analysis and design of Prestressed Concrete sections , deflection of prestressed beams , design for flexure , shear , axial force , bond ; Transmission length , Codal provisions.

COURSE/LEARNING OUTCOMES

1. Recognize the different types of prestressed members , to identify the various types of loads acting on the section and analyse the prestressed sections .
2. Differentiate between pre-tensioned and post-tensioned concrete, Short term and long – time deflection.
3. Apply the standard methodologies as per IRC codes to predict the response of the prestressed concrete section
4. Analyse the prestressed concrete beams under various loading; identify the deflection patterns and evaluate the structural design of these structures to determine the reinforcement required and assess the performance of the structure

Module I: 15 Hours

Concept of prestressing materials for prestressed concrete, I.S. specifications; Analysis of prestressed resultant stress at section, thrust line, load balancing concept, stress in tendons, Design of simple section

Module II: 15 Hours

Deflection of prestressed concrete beams; Factors influencing deflection, deflection of uncracked and cracked members, Long time deflection, Codal provisions

Module III: 8 Hours

Design of prestressed concrete sections; Design for flexure, shear, axial force, bond and bearing, Design of prestressed members

Module IV: 7 Hours

Transfer of prestress, Transfer by bond, transmission length, code provisions for bond and transmission length

Suggested Readings

1. N. Rajagopalan , Prestressed Concrete , Narosa Book Distributers Pvt. Ltd.
2. G.S . Pandit , Prestressed Concrete 1st Edition , CBS Publisher
3. Naaman A.E., Prestressed Concrete Analysis and Design Fundamentals, McGraw Hill
4. S. Ramamrutham , Prestressed Concrete , Dhanpat Rai Publishing Company .

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II		H	M	
Module III				H
Module IV			M	H

CVSA0092: STRUCTURAL ANALYSIS II

(3 credits) (L-T-P: 3-0-0)

Objectives

The course is designed to understand the classical methods of analysis of framed structures for external loads. It also highlights the approximate methods of analysis. Analysis of multistory frames for lateral load is discussed in the course. It also focuses on Matrix method of structural analysis and moving loads and influence lines.

COURSE/LEARNING OUTCOMES:

After successful completion of the course students will be able to

1. Define static and kinematic indeterminacies of structures and influence line diagrams; list different types of loading in a multi-storey frame and state the methods applicable for these loading classes:
2. Construct influence line diagrams for different types of rolling loads and make use of it to interpret the response of a bridge under moving loads,
3. Analyse the frames subjected to gravity load and lateral load as well as structural members subjected to moving loads and estimate the design parameters of the structural members under different load combinations and critical positions of moving loads.

Module I: Approximate Analysis of Multi-Storied Frames (10 hours)

Approximate Analysis of Multi-Storied frames subjected to Vertical Loads, Method of Substitute Frames; Analysis of Building Frames subjected to Horizontal Loads, Portal Method and Cantilever Method

Module II: Matrix Analysis of Framed Structures (18 hours)

Basic concepts of Structural Analysis, Deformation in Framed Structures, Equilibrium, Compatibility, Static and Kinematic Indeterminacy, Action and Displacement Equations, Principle of Superposition, Equivalent joint loads, Energy Concepts, Virtual Work, Flexibility and Stiffness Matrices and their derivation and application, Local and global stiffness matrices, relationship between flexibility and stiffness matrix

Module III: Moving loads and Influence Lines (17 hours)

a. Moving loads and influence lines: Application to determinate structures-influence lines for support reactions, shear force, bending moment for beams, trusses, 3-hinged arch, suspension bridges
b. Muller-Breslau's principles: Influence lines for statically indeterminate beams, influence lines for support reactions, bending moment, shear force in propped cantilever, two span continuous beams and for two hinged arches

Suggested Readings

1. V. N. Vazirani, M. M. Ratwani and S. K. Duggal, Analysis of Structures, Volume I and II, Khanna Publishers
2. R. Vaidyanathan and P. Perumal, Structural Analysis, Volume I and II, Laxmi Publications
3. Thandavamoorthy, Structural Analysis, Oxford Press
4. Gupta, Pandit and Gupta, Theory of Structures, McGraw Hill
2. B. C. Punmia, Theory of Structures, Laxmi Publications
3. S. Ramamrutham, Theory of Structures, Dhanpat Rai Publishing Company (P) Ltd.
4. V. K. M. Selvam, Fundamentals of Limit Analysis of Structures, Dhanpat Rai Publications

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	M		H
Module III	M	H	

CVPH0093: PORT AND HARBOUR ENGINEERING

(3 credits) (L-T-P: 3-0-0)

Objective

The primary objective of the course is to develop a knowledge and understanding of a wide range of port and harbour design and construction issues and of sustainable solutions in the port environment.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Explain the significance of ports and harbours as a mode of transport.
2. Demonstrate the fundamental principles of wave hydrodynamics and port cargo handling and the basic design of port layout.
3. Design, plan and integrate port and harbour infrastructure. Explain the construction, maintenance and renovation aspects of ports and inland waterways.

Module I: Harbour Planning (10 Hours)

Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations

Module II: Docks and Repair Facilities (15 Hours)

Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar

Module III: Dredging and Coastal Protection (10 Hours)

Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile

Module IV: Port facilities (10 Hours)

Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

Suggested Readings

1. S. Seetharaman, “Construction Engineering and Management”, 4th Edition , Umesh publications, New Delhi, 1999.
2. Richand L. Silister, “Coastal Engineering Volume I & II, Elsevier Publishers, 2000.
3. Pera Brunn, “Port Engineering”, 1st Edition, Gulf Publishing Company, 2001

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II		H	M
Module III			H
Module IV		M	H

CVTM0094: TRAFFIC ENGINEERING AND MANAGEMENT

(3 credits – 45 hours)

Objective

This elective course is designed to familiarize the students with the concepts of traffic engineering by providing general concepts of planning, functional design, traffic operation and management of road transportation. Forecasting of traffic, probabilistic approach towards traffic flow theory, highway capacity and study of road accidents has been introduced in detail.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. CO1: Define the traffic components and assess the traffic characteristics and related problems.
2. CO2: To develop a strong knowledge base of traffic planning and its management in any transportation area.
3. CO3: Understand elements of highway safety and approaches to accident Studies.
4. CO4: To provide knowledge of traffic control devices forecasting tools and their techniques in transportation interaction.

Module I: Traffic Forecast and Transportation Demand Management (12 hours)

Traffic Forecast: General travel forecasting principles, Different methods of traffic forecast - Mechanical and Analytical methods, Demand relationships, Methods for future projection; Design Hourly Volume for Varying Demand Conditions: Concept of Design vehicle units and Determination of PCU under mixed traffic conditions, Price-volume relationships, Demand functions. Determination of design hourly volume; Critical Hour concept

Module II: Highway Capacity and Level of Service (7 hours)

Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections. Problems in Mixed Traffic flow; Case studies

Module III: Accident Studies (8 hours)

Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors influencing traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions.

Module IV: Traffic Flow Theory and Simulation (18 hours)

Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies.

Suggested Readings

1. L.R. Kadiyali, “Traffic Engineering and Transport Planning”, Khanna Publication.
2. C.J. Khisty and B.K. Lall, “Transportation Engineering: An Introduction” Prentice Hall Publication
3. G.V. Rao, “Transportation Engineering”, Tata McGraw Hill.
4. S.K. Khanna and C.E.G. Justo, “Highway Engineering”, Nem Chand and Bros, Roorkee.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			M
Module II	M	HF		
Module III			H	

Module IV		H		

CVMS0095: METRO SYSTEMS AND ENGINEERING

(3 credits) (L-T-P: 3-0-0)

Objective

The primary objective of the course is to develop a knowledge and understanding of the Metro rail system and the role of various fields of engineering in construction and smooth functioning of the metro rail network.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Explain various components of a metro rail track and outline the process of railway track construction; classify railway stations and recognize the importance of railway track maintenance.
2. Analyse the automatic fare collection system of metro rail network.
3. Design and solve problems related to tunneling and ventilation in underground railway tracks.
4. Analyse, compute and design components related to power supply and substations for metro rail network.

Module I: (3 Hours)

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

Module II: (12 Hours)

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

Module III: (10 Hours)

Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

Module IV: (10 Hours)

Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

Module V: (10 Hours)

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Suggested Readings

1. Satish Chandra and Agarwal M. M., Railway Engineering, Oxford University Press.
2. S.P. Arora, S.C. Saxena, A Textbook of Railway Engineering, Dhanpat Rai Publications
3. S.C. Rangwala, Principles of Railway Engineering, Charotar Publishing House Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	M		
Module II	H		M	
Module III		H		
Module IV			H	
Module V				H

CVBE0096: BRIDGE ENGINEERING

(3 credits) (L-T-P: 3-0-0)

Objective

It deals with the concepts of analysis and design of some advanced R.C.C bridges and steel bridges, their foundations and further their inspection and maintenance.

COURSE/LEARNING OUTCOMES

After successful completion of the course students will be able to:

1. Recognize the different types of bridges and their suitability, and identify the various classes of loading acting on the bridges.
2. Analyse and design the superstructure components of RC and steel bridges with respect to various IRC loadings.
3. Analyse and design the substructure components of RC and steel bridges

Module I: 3 Hours

General; classification of bridges, site selection, geometric and hydraulic design consideration

Module II: 7 Hours

Loading standards for highway and railway bridges, general design consideration; optimum spans

Module III: 12 Hours

Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, arch bridge; Special requirements for Prestressed Concrete bridges

Module IV: 8 Hours

Steel bridges: plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge

Module V: 15 Hours

Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats; seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance

Suggested Readings

1. N. Krishna Raju, Design of Bridges , 4th Edition , Oxford and IBH publishing Co. Pvt. Ltd.
2. Jagadeesh and Jayaram , Design of Bridge Structures , PHI Learning Private Ltd.
3. Johnson Victor, Essentials of Bridge Engineering, 6th Edition , Oxford and IBH publishing Co. Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	H	M	
Module III		H	
Module IV		H	
Module V			H

CVBH0097: BASICS OF COMPUTATIONAL HYDRAULICS

(3 credits) (L-T-P: 3-0-0)

Objectives

This course introduces the governing equations describing the flow and transport in surface and subsurface water systems and the application of finite difference methods for the solution of these governing equations.

COURSE/LEARNING OUTCOMES

After successful completion of the course students can:

1. Explain the one-, two- and three-dimensional flow equations and know when to use their approximations.
2. Analyze a numerical scheme for numerical diffusion, dispersion, stability and convergence.
3. Implement different numerical schemes for hydraulics related problems appearing in civil engineering.

Module I: Introduction to the governing equations of fluid flow (16 Hours)

Concept of control volume and control mass/ system; Reynold's Transport Theorem; Derivation of continuity equation, momentum equation (Navier-Stokes equations) and energy equation for finite control volume and infinitesimally small fluid element fixed in space; Derivation of one-dimensional St. Venant equation to model open-channel flow; Derivation of flow equation in groundwater; Derivation of generalized contaminant transport equation in groundwater for both reactive and non-reactive transport.

Module II: Introduction to finite difference, finite volume and finite element methods (17 Hours)

Classification of partial differential equations- hyperbolic, parabolic and elliptic differential equations; General behavior of different classes of partial differential equation; Finite difference methods: difference equations, explicit and implicit approaches, error and stability analysis of explicit and implicit techniques; Finite Volume Methods: Philosophy, discretization procedure; Finite element method: Rayleigh-Ritz, Collocation and Galerkin methods.

Module III: Application of Finite difference methods in CFD (12 Hours)

Application of Crank Nicholson technique, The Lax-Wendroff Technique and MacCormack's Technique for the solution of Navier-Stokes equations and contaminant transport equation in groundwater and surface water; Introduction to numerical computation in Scilab (Free and opensource).

Suggested Readings

1. Anderson Jr., J.D (1995). Computational Fluid Dynamics - the Basics with applications. McGraw-Hill, Inc., New York.
2. Hoffman, J.D. (2001). Numerical methods for engineers and scientists. Marcel Dekker, Inc., New York.
3. White, F.M. (2008). Fluid Mechanics. Tata McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	H	M	
Module III		M	H

CVSH0098: SOLID AND HAZARDOUS WASTE MANAGEMENT

(3 credits) (L-T-P: 3-0-0)

Objective

This course provides an in-depth understanding of solid and hazardous waste characteristics and management. Some basics of radioactive waste characterization and handling are also provided.

COURSE/LEARNING OUTCOMES:

After completion of the course students will be able to

1. Explain municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies
2. Identify sources, types and composition of solid waste with methods of handling, sampling and storage and treatment of solid waste.
3. Select the appropriate method for solid waste collection, transportation, redistribution and disposal.

4. Describe methods of disposal of hazardous solid waste.

Module I: Municipal Solid Waste Management (16 Hours)
Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options
Hazardous Waste Management: Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects
Radioactive Waste Management**:** Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options

Module II: Environmental Risk Assessment (5 Hours)
Defining risk and environmental risk; methods of risk assessment; case studies

Module III: Relevant Regulations (2 Hours)
Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules; biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules

Module IV: Physicochemical Treatment of Solid and Hazardous Waste (9 Hours)
Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapour extraction, air stripping, chemical oxidation); ground water contamination and remediation

Module V: Biological Treatment of Solid and Hazardous Waste (8 Hours)
Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation

Module VI: Landfill design (5 Hours)
Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I		H	M	
Module II	H			
Module III	H		L	
Module IV	M	H		
Module V	M	H		
Module VI	L	M		H

Suggested Readings

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by Kanti L. Shah *1999,* Prentice Hall.
2. Solid and Hazardous Waste Management 2007 by S.C. Bhatia Atlantic Publishers & Dist.
3. Pichtel, John. Waste Management Practices: Municipal, Hazardous and Industrial. CRC Press, Taylor and Francis Group, 2005.
4. LaGrega, Michael D., Buckingham, Philip L. and Evans, Jeffrey C. Hazardous Waste Management. Waveland Press Inc., Reissue Edition, 2010.
5. Watts, Richard J. Hazardous Wastes - Sources, Pathways, Receptors. Wiley (1 Edition), 1998.
6. www.epa.gov US Environmental Protection Agency
7. www.envfor.nic.in Ministry of Environment, Forest and Climate Change, Government of India

CVEE0099: EARTHQUAKE ENGINEERING

(3 credits) (L-T-P: 3-0-0)

Objective

The main objective of this course is to illustrate the fundamentals of structural and soil dynamics to foresee the potential consequences of strong earthquakes on urban areas and civil infrastructure. The course deals with the problems and solutions in attaining efficient earthquake-resistant structures and facilities. This course will be a stepping stone towards designing, constructing and maintaining structures to perform at earthquake exposure up to the expectations and in compliance with building codes.

COURSE OUTCOMES

On completion of the course students will be able to:

1. Explain the basic elements of engineering seismology and theory of vibrations.
2. Understand the earthquake behaviour of buildings; illustrate the detailing requirements of buildings for earthquake resistant construction; classify the methods of dynamic analysis and translate the analytical outputs into mitigating effects of earthquake on structures and identify the codal provisions for ductile detailing of structures, base isolation techniques, vibration control measures
3. Solve the equations of dynamic motions to compute the magnitude of ground vibrations; predict the liquefaction potential of soil; apply earthquake analysis methods as per Indian Standard Codes to find out the response spectrum of SDOF and MDOF systems.
4. Estimate the seismic performance of building with respect to site specific response and design spectra.

Module I: Elements of seismology (6 Hours)

Causes of earthquake, geological faults, tectonic plate theory, elastic rebound, epicentre, hypocentre, primary, shear and Raleigh waves, seismogram, magnitude and intensity of earthquakes, magnitude and intensity scales, spectral acceleration, information on some disastrous earthquakes

Module II: Analysis of single and multi-degree of freedom systems (6 Hours)

SDOF idealization - equations of motion of SDOF system for mass as well as base excitation, free vibration of SDOF system, response to harmonic excitation, impulse and response to unit impulse, Duhamel integral, introduction to multiple degree of freedom systems, two degree of freedom system, normal modes of vibration, natural frequencies, mode shapes, decoupling of equations of motion, concept of mode superposition (no derivations)

Module III: Elements of seismology (18 Hours)

Causes of earthquake, geological faults, tectonic plate theory, elastic rebound, epicentre, hypocentre, primary, shear and Raleigh waves, seismogram, magnitude and intensity of earthquakes, magnitude and intensity scales, spectral acceleration, information on some disastrous earthquakes

Module IV: Design of earthquake resilient structures (15 Hours)

Response of structures to earthquake, response and design spectra, design earthquake, concept of peak ground acceleration, site specific response spectrum, effect of soil properties and damping, liquefaction of soils, importance of ductility, methods of introducing ductility into RC structures, design methodology, codal provisions and design as per the codes IS 1893, IS 13920 and IS 4326, base isolation techniques, vibration control measures, important points in mitigating effects of earthquake on structures

Suggested Readings

1. Mario Paz, Structural Dynamics: Theory and Computation, CBS Publishers, 2004
2. Manish Shrikhande and Pankaj, Earthquake Resistant Design of Structures, Phi Learning, 2006
3. Vinod Hosur, Earthquake-Resistant Design of Building Structures, Wiley and Sons
4. Anil K. Chopra, Dynamics of Structures Theory and Application to Earthquake Engineering, Pearson Education Singapore Pte Ltd.
5. Sekaran Rajasekaran, Structural Dynamics of Earthquake Engineering: Theory and Application, Woodhead Publishing Limited

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	H	M		
Module III	M	H	H	
Module IV		H	H	H

CVST0100: STRUCTURAL DYNAMICS

(3 credits) (L-T-P: 3-0-0)

Objectives

The primary objective of this course is to learn the methods of analysing structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses, etc. This course will help in understanding the analytical methods and procedures in a way that emphasize physical insight. On completion of this course, the students will be able to apply the structural dynamics theory to real-world problems like seismic analysis and design of structures.

COURSE OUTCOMES

1. The students will understand the fundamental theory of dynamic equations of motion, fundamental analysis methods for dynamic systems, dynamic properties and behaviour of civil structures, modeling approach of dynamic response in civil engineering applications
2. The students will be able to apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
3. The students will be able to create simple computer models for engineering structures using knowledge of structural dynamics
4. The students will be able to apply structural dynamics theory to earthquake analysis, response, and design of structures and interpret dynamic analysis results for design, analysis and research purposes

Module I: Introduction to dynamic behaviour of structures (6 Hours)

Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation

Module II: SDOF systems (12 Hours)

Analysis of single-degree-of-freedom systems, free vibrations, damped and undamped free vibrations, critical damping, and response, periodic loading expressed in harmonics, dynamic load factor, response of SDOF to impulsive loading, rectangular, triangular pulses, Duhamel Integral, response to general dynamic loading, numerical schemes such as Wilson-Theta, Newmark-Beta, constant linear acceleration, time domain and frequency domain analysis

Module III: MDOF systems (12 Hours)

Multi-degree freedom system, stiffness and flexibility approaches, Lumped-mass matrix, free vibrations,

fundamental frequencies and mode shapes, orthogonality of modes, numerical schemes to find mode shapes and frequencies, damped and undamped vibrations of MDOF, response of MDOF to dynamic loading, formulations of equations of motion, normal coordinates, mode superposition method, modal matrix, numerical scheme of Wilson and Newmark

Module IV: Response spectrum analysis (15 Hours)

Response spectrum concepts, simple inelastic structural systems, structural response to earthquake, response spectrum design earth quake, IS code provisions for multistory frames, introduction to systems with distributed mass and flexibility, free vibrations of uniform beams, differential equation and solution boundary conditions, finite difference solution, finite element, Ritz Approach free vibrations of simply supported plate

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	M	H		
Module III	M	H	M	
Module IV			H	H

Suggested Readings

1. Sekaran Rajasekaran, Structural Dynamics of Earthquake Engineering: Theory and Application, Woodhead Publishing Limited
2. Anil K. Chopra, Dynamics of Structures, Prentice Hall, Second Edition, ISBN0-13-086973-2
3. Additional Recommended Text: Leonard Meirovitch, Fundamentals of Vibrations, McGraw Hill, ISBN 0070413452

CVEL0101: ENVIRONMENTAL LAWS AND POLICY

(3 credits) (L-T-P: 3-0-0)

Objectives

To explain the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control and to equip the students with the skills needed for interpreting laws, policies and judicial decisions

COURSE/LEARNING OUTCOMES:

After successfully completing the course students will be able to:

1. **CO1**:be familiar with the laws, policies and institutions in the field of environment
2. **CO2**: acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective
3. **CO3**: acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution

Module I: 9 Hours

Basic Concepts in Environmental Law. An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL–liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts.

Module II: 9 Hours

Forest, Wildlife and Biodiversity related laws Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006.

Strategies for conservation–Project Tiger, Elephant, Rhino, leopard

Module III: 13 hours
Air, Water and Marine Laws National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986

Module IV: 6 Hours
Environment protection laws and large Projects Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects.

Module V: 3 Hours
Hazardous Substances and Activities Legal framework: EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability.

Module VI: 5 Hours
International Environmental law an introduction to International law; sources of international law; law of treaties; signature, ratification Evolution of international environmental law: Customary principles; Common but differentiated responsibility, Polluter pays principle.

Suggested Readings

1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Desai A. (2002) Environmental Jurisprudence, 2nd ed., Modern Law House, Allahabad.
2. Gadgil M. and Guha R. (1995) Ecology and Equity, Oxford, New Delhi.
3. Gadgil M. and Guha R. (1997) This Fissured Land, Oxford, New Delhi.
2. Guha R. (2000) Environmentalism: A Global History, Oxford, New Delhi.
3. Kamala S. and Singh U.K. (eds.) (2008) Towards Legal Literacy: An Introduction to Law in India, Oxford, New Delhi.
4. Leelakrishnan P. (2006) Environmental Law Case Book, 2nd ed, Lexis Nexis, India.
5. Sands P. (2002) Principles of International Environmental Law, 2nd ed, Cambridge.
6. Singh C. (1986) Common Property and Common Poverty, Oxford, New Delhi.
7. Upadhyay S. and Upadhyay V. (2002) Hand Book on Environmental Law- Forest Laws, Wildlife Laws and the Environment; Vols. I, II and III, Lexis Nexis- Butterworths-India, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H	M	
Module II		H	
Module III		H	
Module IV		H	
Module V		H	
Module VI	H		M

CVSE0102: SUSTAINABLE ENGINEERING & TECHNOLOGY

(3 credits) (L-T-P: 3-0-0)

Objectives
This course introduces concepts green chemistry and different techniques to achieve sustainability.

COURSE OUTCOMES

After learning this course, the students should be able to

1. Understand the different principles of sustainable development and design for various infrastructural applications.
2. Comprehend the concepts of Cleaner Technologies and waste management.
3. Outline the concepts and regulations related to Green Productivity and emerging technologies.

Module I: 15 Hours

Principles of sustainable developments, SDGs, Concepts of green technology/design/architecture, and its principles. Importance, history and evolution of Green Technology. Design Criteria and major elements for consideration - Green building. Green Building Technologies & Case Studies.

Module II: 10 Hours

Concept of Cleaner Production, Definition of Cleaner Production, Role of Industry, Government and Institutions in cleaner Production. Introduction to Life Cycle Assessment (LCA).

Module III: 10 Hours

Green Productivity concepts, methodology & techniques, Eco-efficiency vs. eco-effectiveness, Guidelines of APO on Green Productivity, CEPI Index.

Module IV: 5 Hours

Principles & Management of Municipal Waste Management. 3 R concepts in solid waste management

Module V: 5 Hours

Emerging technologies and their techno economic evaluation.

Suggested Readings

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Green Productivity and Cleaner Production: A Guidebook for Sustainability Hardcover by Guttila Yugantha Jayasinghe, Shehani Sharadha Maheepala, 2020
4. Cleaner Production and its implementation in Industries, Dr Bharat Jain, GCPC3.
5. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II	M	H	
Module III		H	
Module IV			H
Module V			H

CVRG0103: REMOTE SENSING AND GIS

(3 credits) (L-T-P: 3-0-0)

Objective

This elective course is designed to familiarise the students with the modern tools of remote sensing and geographic information systems (GIS) which are useful for analysis and interpretation of occurrences on the earth's surface. Foundation of GIS will help the students to go ahead for using this tool in decision making and bio-physical modelling.

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Comprehend fundamental concepts and practices of Remote Sensing and Geographic Information Systems (GIS) and advances in Geospatial Information Science and Technology and define the different types of maps, coordinate systems and recognise the importance and ease of surveying using remote sensing.
2. Apply basic graphic and data visualization concepts.
3. Apply GIS analysis to address geospatial problems and/or research questions.
4. Demonstrate proficiency in the use of remote sensing tools to create maps that are fit-for-purpose and effectively convey the information they are intended to.

Module I: (15 Hours)

Introduction to Remote Sensing – Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Module II: (10 Hours)

Investigation of geographic information systems (GIS) and science (GIScience) including theory and applications areas. Use of a current widely used GIS computer software system.

Module III (10 Hours)

Aspects of geographic data entry and editing, spatial analysis, and map development and display to be considered.

Module IV (10 Hours)

Relationship of GIS to the Global Positioning System (GPS) and satellite generated data.

Mapping of COs to Syllabus

	CO1	CO2	CO3	CO4
Module I	H		M	
Module II	L	H	M	
Module III		M	L	H
Module IV		M	H	

Suggested Readings

1. Satheesh Gopi, R. Sathikumar, N. Madhu, Advanced Surveying — Total Station, GIS and Remote Sensing, Pearson Education.
2. Paul Longely, M.F. Goodchild, et al., Geographic Information System, Volume I and II, John Wiley and Sons, Inc. 1999.
3. J.B. Cambell, Introduction to Remote Sensing, Taylor and Francis, London, 1996

CVMM0107: STRUCTURAL ANALYSIS BY MATRIX METHODS

(3 credits) (L-T-P: 3-0-0)

Objectives

The course is designed to understand the matrix methods of analysis of framed structures for external loads. Analysis of multistory frames for lateral loads is also discussed in the course.

COURSE/LEARNING OUTCOMES:

1. Students will be able to define and classify statically determinate and indeterminate structural members and bending moment shear force, strain energy principles, different methods of finding internal forces and deflections.

2. Apply principles of statics etc to determine the energy principles for analysing the frames and beams by classical, iterative and matrix methods
3. Students will be able to analyse structural members with different types of loadings and different types of fixity and interpret the assumptions and limitations inherent in the analysis methods.
4. Test the load carrying capacity of structural members and estimate the safety and determine response of structures by classical, iterative and matrix methods

Module I: 15 Hours

Review of basic concepts in structural analysis:
structure (structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy); loads (direct actions, indirect loading); response (equilibrium, compatibility, force-displacement relations); levels of analysis; analysis of statically determinate structures (trusses, beams, frames); applications of principle of virtual work and displacement-based and force-based energy principles; deriving stiffness and flexibility coefficients.
Review of analysis of indeterminate structures: Force methods: Statically indeterminate structures (method of consistent deformations; theorem of least work). Displacement Methods: Kinematically indeterminate structures (slope-deflection method; moment distribution method).

Module II: 6 Hours

Matrix concepts and Matrix analysis of structures: Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigenvalues and eigenvectors. Introduction; coordinate systems; displacement and force transformation matrices; Contra-gradient principle; element and structure stiffness matrices; Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches.

Module III: 10 Hours

Matrix analysis of structures with axial elements: Introduction: Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof); One-dimensional axial structures: Analysis by conventional stiffness method (two dof per element) and reduced element stiffness method (single dof);Analysis by flexibility method; Plane trusses: Analysis by conventional stiffness method (four dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method; Space trusses: Analysis by conventional stiffness method (six dof per element) and reduced element stiffness method (single dof).

Module IV: 14 Hours

Matrix analysis of plane and space frames: Conventional stiffness method for plane frames: Element stiffness (six dof); generation of structure stiffness matrix and solution procedure; dealing with internal hinges and various end conditions; Reduced stiffness method for plane frames: Element stiffness (three DOF); ignoring axial deformations; dealing with moment releases, hinged and guided fixed end supports; Flexibility method for plane frames: Force transformation matrix; element flexibility matrix; solution procedure (including support movements); Ignoring axial deformations; Stiffness method for space frames: Introduction; element stiffness matrix of space frame element with 12 DOF and 6 DOF; coordinate transformations; analysis by reduced stiffness method (six DOF per element);

Suggested Readings

1. Devdas Menon, “Advanced Structural Analysis", Narosa Publishing House, 2009.
2. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
4. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
5. Devdas Menon, "Structural Analysis", Narosa Publishing House, 2008

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4

Module I	H			
Module II		H		
Module III		H	M	L
Module IV		H		

LABORATORY COURSES

CVED6024: ENGINEERING GRAPHICS AND DESIGN

(3 credits) (L-T-P: 1-0-4)

Objectives

This course is designed to teach the basics of engineering drawing and drafting utilizing free hand sketching as well as computer aided modeling. The fundamental principles of projections and dimensioning as well as the overview of computer graphics, customizations, annotations, layering and other functions of computer aided designs viz. geometric and topological designs of engineered components are taught.

COURSE/LEARNING OUTCOMES

After completing the course students will be able to:

1. Demonstrate drawing methodology of lettering with ISO specifications , concepts of representative factors for drawing various types of scales , the theory and methodology for different types of conic and cycloidal curves , the concept of orthographic projection for drawing projection of points , lines , planes and the concept of dimensioning , drawing complex solids , concept of isometric scale , projection and views , perspective projection of simple 1,2 and 3D figures.
2. Explain the application and functionalities of computer aided drafting software like QCAD and AUTOCAD.
3. Apply the theoretical knowledge of engineering drawing to draw precise , accurate , neat and unambiguous drawings following the proper dimensioning specifications and drawing methodology that would be required in design pertaining civil and mechanical engineering.
4. Judiciously evaluate the concept of drawing 1,2 and 3D figures in orthographic , isometric and perspective projections in line with BIS design and drawing specifications.

Module I: Introduction to Engineering Drawing (5 hours)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module II: Orthographic Projections (5 hours)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes

Module III: Projection of Solids (5 hours)

a. Projections of Regular Solids: Solids inclined to both the Planes- Auxiliary Views, simple annotation, dimensioning and scale
b. Sections and Sectional Views of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views, development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, sectional orthographic views of geometrical solids

Module IV: Floor Plan Drawings (5 hours)

Industry and dwellings (foundation to slab only)

Module V: Isometric Projections (5 hours)

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions, Isometric Views of lines, Planes, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Module VI: Overview of Computer Graphics (5 hours)

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]

Module VII: Customization and CAD Drawing (5 hours)
Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically, producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles

Module VIII: Annotations, layering and other functions (5 hours)
Application of dimensions to objects, application of annotations to drawings; Setting up and use of layers, layers to create drawings, create, edit and use customized layers; changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface, Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views, Spatial visualization exercises, dimensioning guidelines, tolerancing techniques; dimensioning and scale Multiview of dwelling

Module IX: Team design project demonstrating geometry and topology of engineered components (5 hours)
Creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids, meshed topologies for engineering analysis and tool-path generation for component manufacture, geometric dimensioning and tolerancing, Use of solid-modeling software for creating associative models at the component and assembly levels, floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling, Introduction to Building Information Modelling (BIM).

Suggested Readings

1. N. D. Bhatt, V. M. Panchal, P. R. Ingle (2014), Engineering Drawing, Charotar Publishing House
2. M. B. Shah and B. C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. B. Agrawal and C. M. Agrawal (2012), Engineering Graphics, TMH Publication
4. K. L. Narayana and P Kannaiah (2008), Text book on Engineering Drawing, SciTech Publishers
5. Corresponding set of CAD Software Theory and User Manuals

CVCA6025: COMPUTER-AIDED CIVIL ENGINEERING DRAWING (LAB)
(2 Credits) (L:T:P: 1-0-2)

COURSE /LEARNING OUTCOMES
At the end of the course students will be able to:
1. Do a detailed study of an engineering artefact.
2. Illustrate a design idea/concept graphically/visually.
3. Develop parametric design and the conventions of formal engineering drawing.
4. Construct and interpret 2D & 3D drawings and produce designs using a combination of 2D and 3D software.

Module I (2 Hours)
INTRODUCTION: Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

Module II (2 Hours)
SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Module III (1 Hour)
MASONRY BONDS: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall.

Module IV (7 Hours)
BUILDING DRAWING: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

Module V (3 Hours)
PICTORIAL VIEW: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM)

Suggested Readings

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons

CVEG6026: ENGINEERING GEOLOGY LAB
(1 Credit)

COURSE OUTCOMES
On completion of the course the students will be able to:
1. CO1: Categorize rocks and minerals by their origin and engineering properties.
2. CO2: Apply geological principles to rock masses and discontinuities for use in engineering design e.g., rock slopes, foundation.

List of Experiments:
1. Study of physical properties of minerals.
2. Study of different groups of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite;

Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet,Galena, Gypsum.

5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties, Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrology): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps. https://swayam.gov.in/nd1_noc20_ce33/preview

CVFM6027: FLUID MECHANICS LAB

(1 Credit)

COURSE OUTCOMES

At the end of the course, the students will have the ability to:

1. CO1: Calculate coefficient of discharge for orifices and notches and determine the impact of jet on vanes
2. CO2: Verify Bernoulli's theorem
3. CO3: Understand stability of floating bodies and calculate hydrostatic pressures
4. CO4: Visualize fluid flow and calculate Reynold's number

List of Experiments:

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli's Theorem
6. Venturimeter
7. Orifice meter
8. Impacts of jets
9. Flow Visualisation -Ideal Flow
10. Length of establishment of flow
11. Velocity distribution in pipes
12. Laminar Flow

CVSM6028: SOLID MECHANICS (STRENGTH OF MATERIALS) LAB

(1 Credit)

COURSE OUTCOMES

At the end of the course, the students will have the ability to:

1. Analyse the behaviour of the solid bodies subjected to various types of loading.
2. Apply knowledge of materials and structural elements to the analysis of simple structures.
3. Undertake problem identification, formulation and solution using a range of analytical methods.
4. Analyse and interpret laboratory data relating to behavior of structures and the materials they are made of and undertake associated laboratory work individually and in teams.

List of Experiments:

1. Tension test

2. Bending tests on simply supported beam and Cantilever beam.
3. Compression test on concrete
4. Impact test (ME Lab)
5. Shear test
6. Investigation of Hooke's law that is the proportional relation between force and stretching in elastic deformation,
7. Determination of torsion and deflection,
8. Measurement of forces on supports in statically determinate beam,
9. Determination of shear forces in beams,
10. Determination of bending moments in beams,
11. Measurement of deflections in statically determinate beam,
12. Measurement of strain in a bar
13. Bend test steel bar;
14. Yield/tensile strength of steel bar.

CVSG6029: SURVEYING & GEOMATICS LAB

1 Credit

COURSE OUTCOMES

On completion of the course the students will be able to:

1. Identify different types of surveying instruments and their applicability.
2. Execute profile levelling; determine Reduced Level, latitudes, departures, and coordinates of control points and balancing errors in a traverse and Implement curve setting work using appropriate instruments.
3. Operate the techniques, skills, and applicable tools of the discipline for application in engineering and surveying activities.
4. Investigate horizontal, vertical, and zenith angles with a transit, theodolite, and total station or survey grade GNSS instruments.

List of experiments:

1. Ranging- direct and indirect
2. Chain triangulation
3. Compass traversing- open and closed traverse
4. Levelling- Profile, Cross section and Fly leveling
5. Plane table traversing
6. Contouring- direct and indirect
7. Theodolite surveying- open and closed traverse
8. Curve setting – circular and combined curve
9. Trigonometric leveling- accessible and inaccessible objects
10. Total station surveying

CVMT6030: MATERIALS, TESTING LAB

1 Credit

COURSE OUTCOMES

On completion of the course the students will be able to:

1. Determine the specific gravity of coarse aggregate and fine aggregate by sieve analysis.
2. Classify soil based on standard geotechnical engineering practice.
3. Identify the grade and properties of bitumen.

List of Experiments:

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality control
3. Tensile Strength of materials & concrete composites
4. Compressive strength test on aggregates
5. Tension I - Elastic Behaviour of metals & materials
6. Tension II - Failure of Common Materials
7. Direct Shear - Frictional Behaviour
8. Concrete I - Early Age Properties
9. Concrete II - Compression and Indirect Tension
10. Compression – Directionality
11. Soil Classification
12. Consolidation and Strength Tests
13. Torsion test
14. Hardness tests (Brinnel's and Rockwell)
15. Tests on closely coiled and open coiled springs
16. Theories of Failure and Corroboration with Experiments
17. Tests on unmodified bitumen and modified binders with polymers
18. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
19. Concrete Mix Design as per BIS

CVIS6031: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS LAB (TO BE TAKEN BY EEE DEPARTMENT)

(2 Credits; L:T:P :0-0-2)

COURSE/LEARNING OUTCOMES

After successfully studying this course, students will be able to:

1. Differentiate between analog and digital signal processing.
2. Identify the different sensors and gauges for instrumentation.
3. Calibrate the sensors and detect the errors during measurement.

List of Experiments:

1. Instrumentation of typical civil engineering members/structures/structural elements
2. Use of different sensors, strain gauges, inclinometers,
3. Performance characteristics
4. Errors during the measurement process
5. Calibration of measuring sensors and instruments
6. Measurement, noise and signal processing
7. Analog Signal processing
8. Digital Signal Processing
9. Demonstration & use of sensor technologies

CVHE6031: HYDRAULIC ENGINEERING LAB

1 Credit

COURSE OUTCOMES

At the end of the course, the students will have the ability to:

1. Calculate flow parameters for venturi flume.
2. Verify boundary layer theorem.
3. Understand gradually varied flow and rapid varied flow.
4. Visualize flow through pipes and identify laminar flow and turbulent flow.

5. Determine the head losses for flow through pipes.

List of Experiments:

1. Flow Visualization
2. Studies in Wind Tunnel
3. Boundary Layer
4. Flow around an Aerofoil / circular cylinder
5. Uniform Flow
6. Velocity Distribution in Open channel flow
7. Venturi Flume
8. Standing Wave Flume
9. Gradually Varied Flow
10. Hydraulic Jump
11. Flow under Sluice Gate
12. Flow through pipes
13. Turbulent flow through pipes
15. Laminar flow through pipes
16. Major losses / Minor losses in pipe

CVGE6032: GEOTECHNICAL ENGINEERING LAB

1 Credit

COURSE/LEARNING OUTCOMES

After successfully studying this course, students will be able to:

1. Identify the index properties and engineering properties of soil.
2. Understand the laboratory tests used for determination of physical, index and Engineering properties of soil.
3. Calculate the values of different engineering properties of soil.

List of Experiments:

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
2. Consistency limits by Plastic limit
3. Consistency limits by Shrinkage limit.
4. Permeability test using Constant-head test method.
5. Permeability test using Falling-head method.
6. Compaction test: Standard Proctor test.
7. Compaction test: Modified Proctor test.
8. Relative density.
9. Consolidation Test.
10. Triaxial Test (UU)
11. Vane shear test
12. Direct Shear Test
13. Unconfined Compression Strength Test.
14. MOOCs Link: https://swayam.gov.in/nd1_noc20_ce48/preview

CVEE6033: ENVIRONMENTAL ENGINEERING LAB

1 Credit-(L-T-P:0-0-2)

COURSE/LEARNING OUTCOMES

After successfully studying this course, students will be able to:

1. Implement and demonstrate instructions regarding various parameters of water and sewage quality testing and air quality assessment.
2. Demonstrate experimental procedures for water and air quality analysis
3. Produce report on various parameters of water and sewage quality tests and air quality analysis.
4. Present and justify results of water and sewage quality tests air quality monitoring.

List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
2. Bacteriological quality measurement: MPN,
3. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
4. Ambient noise measurement

CVTE6034: TRANSPORTATION ENGINEERING LAB

(1 credit)

COURSE/LEARNING OUTCOMES

After successfully studying this course, students will be able to:

1. Identify engineering properties of aggregates.
2. Calculate the engineering properties of soil.
3. Identify the grade & properties of bitumen.

List of Experiments

1. To determine the IMPACT VALUE of coarse aggregates by use of IMPACT MACHINE.
2. To determine the ABRASION VALUE of coarse aggregates by use of LOS ANGELES MACHINE.
4. To determine the Flakiness Index and Elongation Index of coarse aggregates.
5. To determine the MARSHALL STABILITY of Bitumen mix.
6. To determine the SOFTENING POINT of Bitumen.
7. To determine the DUCTILITY of Bitumen.
8. To determine the Specific Gravity of Bitumen.
9. To determine the Penetration of Bitumen.
10. To determine the CALIFORNIA BEARING RATIO of soil.

CVEC6035: ENGINEERING ECONOMICS, ESTIMATION AND COSTING PRACTICAL CLASS

2 Credits

COURSE/LEARNING OUTCOMES

On completion of the course, the students will be able to:

1. Explain how competitive bidding works and how to submit a competitive bid proposal.

2. Examine present worth, future worth and annual worth analysis on one of more economic alternatives.
3. Formulate the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
4. Develop a competitive bid proposal.

List of Group assignments:

1. Deriving an approximate estimate for a multi-storeyed building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
   a. Ground plus three storied RCC Framed structure building with blockwork walls
   b. bridge with minimum 2 spans
   c. factory building
   d. road work
   e. cross drainage work
   f. Ground plus three storied building with load-bearing walls
   g. Cost of finishes, MEP works for (f) above
3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Preparation of Bar bending schedule.

CVIT6041: INDUSTRIAL TRAINING

(3 credits)

Objectives

During the semester break at the end of the third year, the students are required to undergo an industrial training. The purpose of the industrial training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through classroom teaching and lab activities, in an on-the-job situation. After the period of training, students are required to present their experience in the form of reports and seminar presentations. Students will be evaluated on the seminar, viva-voce examination and written reports.

COURSE / LEARNING OUTCOMES:

On completion of the course the students will be able to:

1. Relate the lessons learned in a classroom into real world experience set in a professional practice-oriented environment.
2. Summarize the activities required for a complete project and develop professional skills such as team work, effective communication and social interaction.
3. Make use of the latest software to analyze problems related to Civil Engineering and adapt to software and equipment as per the industrial requirements.
4. Identify, formulate and model problems and find engineering solution based on a system.

CVPJ6043: PROJECT-II

(4 credits) (L-T-P: 0-0-8)

Objectives

Each student group consisting of not more than 5 members is expected to plan, analyze and design a multistoried building and verify the work with a design and analysis software package.Students will identify and plan a multistoried building, prepare the drawings and perform gravity analysis followed by seismic analysis. There will be three progress seminars - after the planning after the gravity and seismic analysis,after designing and detailing which will be evaluated by a panel of internal examiners. This will be followed by verification of the analysis and design using a software package. The project work will be

concluded with quantity estimation and preparation of report. The internal assessment shall be evaluated by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester.

COURSE/LEARNING OUTCOMES:

On completion of the course the students will be able to:

1. List different types of buildings and components, their analyses and design methods and demonstrate a sound technical knowledge on planning a civil Engineering project.
2. Identify the support conditions and types of members in a building frame.
3. Analyse the structural members to arrive at the design values.
4. Design the structural members of a project optimizing the cost and materials and Use design software for analyzing different types of structures.
5. Compile all the analysis results for the design of different members.

CVMP6049: PROJECT I-MINOR PROJECT

(1 credit) (L-T-P: 0-0-2)

Objectives

To develop the capacity of the students to convert theoretical knowledge base to practical systems for performing creative tasks and analysis and hence suggest solutions to problems pertaining to civil engineering. Each student group consisting of not more than 5 members is expected to plan, analyze and design a multistoried building and verify the work with a design and analysis software package.

During the first phase of the Project students will identify and plan a multistoried building, prepare the drawings and perform gravity analysis followed by seismic analysis. There will be two progress seminars - after the planning and after the seismic analysis, which will be evaluated by a panel of internal examiners.

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

1. Work in a team to select a problem for project work
2. Review and evaluate the available literature on the chosen problem
3. Formulate the methodology to solve the identified problem
4. Apply the principles, tools and techniques to solve the problem
5. Prepare and present project report

CVSL0200: SERVICE LEARNING

(2 credit)

Objective

Service Learning is an experience-based approach to education. It is a course-based service experience that produces the best outcomes when meaningful service activities are related to the course material through reflection and critical inquiry. It deepens and enriches the theoretical and conceptual side of learning. Service-Learning combines – Academic Instruction, Meaningful Service and Critical and Reflective thinking.

Module I

Introduction to service learning-Its philosophy, historical background, purpose, value & theoretical framework; Locating Service Learning within the University context, Basic elements of service learning, Historical context of University Community Partnership; Understanding Community &Community Partnership; Ethical understanding of partnership; Understanding the agency of the Community – as co-educators; Community barriers; Understanding of society & social issues; Culture and Power Dynamics;

Power & Privilege; social responsibility and engagement with the community.

Module II

a. Disaster management: Basic concepts and definition – hazard , disaster , impacts of disaster , types of hazards , types of disaster ; vulnerability , types of vulnerability , risk , capacity ;
b. Pre-disaster phase activities – awareness campaign in the community , prevention , mitigation measures; Preparedness, participatory learning action with the community , identifying community shelters , protecting livestock , making use of available resources within the community , mock drills, skill training , self-made life jackets , community stock of granary , survival kits , first- aid drill , identify early signs , identify critical facilities and their location like school , shelters , police etc .
c. During and post-disaster disaster activities - Early warning dissemination, response action , evacuation of temporary shelters , use of relief camps , arrangement of safe drinking water and sanitation , assist in rescue and relief efforts , carcass disposal , search , rescue , relief , recovery – safe reconstruction , rehabilitation , identifying safe routes .
d. Field work : Students are required to help the community in designing safe playgrounds , in training them with mock drills and in identifying similar relief and community shelter during and post disaster phase .

Module III

Syllabus for CVE (Field Work): Identification, use and application of different materials used for construction of concrete structures; preparation of concrete, Brick masonry procedure; Types of bond – English and Flemish; temporary structures like formwork, scaffolding, shuttering etc ; Ties , stirrups , reinforcements used in building construction; Casting of slabs , columns , beams ; Types and methods of curing .

Suggested Readings

1. R. Subramanian , " Disaster Management " , Vikas Publishing house .
2. B.C. Punmia , " Building Construction " , Laxmi Publications .
3. M.S. Shetty , " Concrete Technology Theory and Practice " , S Chand Publishing .
4. R.K. Rajput , " Engineering materials " , S Chand & Company.
5. Varghese P.C , "Limit State Design of Reinforced Concrete" , Prentice Hall India Learning Private Limited.

VALUE ADDED COURSES

CVAD6046: TRAINING ON COMPUTER AIDED DRAFTING

(2 Credits - L: T: P :0-0-4) (30 Hrs)

Objectives

The objective of this value-added training course is to teach the student about the usage of Auto CAD and basic drawing fundamentals in various civil engineering applications, especially in building drawing.

Module I (5 Hours)

Introduction to AutoCAD: File menu of AutoCAD with New, Open, Save, Save as and Close; Basic 2D commands like Line, Circle, Ellipse, Multi Line, Construction Line, Polyline, Point, Donut, Ellipse, Polygon, Rectangle, Arc; Erase, Snap, Redraw, Regenerate, Zoom, Pan. Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales.

Module II (5 Hours)

Symbols and Sign Conventions: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Module III (5 Hours)

Editing of AutoCAD Drawing: Modify Properties of Drawing Entity: Copy, Move, Rotate, Mirror, Offset; Array, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer, Fillet; Block, WBlock, Insert and Explode; Area, Volume and associated commands with Civil Engineering application.

Module IV (5 Hours)

Advanced 2D Commands: Application of LAYER command in Civil Engineering: Layer command with its all its sub commands, Line type, Color & Dimension command – linear, aligned, arc length, radius, Diameter, Centre, Leader, Baseline and Continuous Dimensioning, tolerance, override and Dimension updates Text and DTEXT commands with Text Style Hatch command.

Module V (5 Hours)

Building Drawing: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

Module 6 (5 Hours)

Plotting of 2D & 3D Drawings: Introduction to basic 3D commands. PLAN, ELEVATION, and 3D Views of Residential and Commercial Building. PLOT and its Sub Command for Plotting Drawing on A1, A2 and A3 Size Paper using Printer and / or Plotter.

COURSE /LEARNING OUTCOMES

At the end of the course students will be able to:

1. Demonstrate basic concepts and functions of the AutoCAD software.
2. Infer drawings through editing/modifying techniques in AutoCAD.
3. Design and interpret 2D & 3D Civil Engineering drawings.

Suggested Readings

1. Subhash C Sharma & Gurucharan Singh (2005), “Civil Engineering Drawing”, Standard Publishers
2. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education,

3. Venugopal (2007), “Engineering Drawing and Graphics + AUTOCAD”, New Age International Pvt. Ltd.,
4. Balagopal and Prabhu (1987), “Building Drawing and Detailing”, Spades publishing KDR building, Calicut, (Corresponding set of) CAD Software Theory and User Manuals.
5. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.

CVBA6047: TRAINING ON BUILDING MODELING AND ANALYSIS USING STAAD-PRO

Course Outcomes

After successfully completing the course students will be able to:

1. Model a building structure
2. Analyse and design a building structure for various loadings like Dead Load, Live Load and Earthquake Load.
3. Model steel truss and water tank
4. Analyse and design a steel truss and water tank for various loadings like Dead Load, Live Load and Earthquake Load.

Module I: 6 Hours

Creating Models, Structures, Graphical Interface, Steel Designing, Design of Concrete Structures

Module II: 7 Hours

Specification of Member Properties, Material Constants, Specify Supports, Specify Loads and Analysis Type, Annotating the Displacements

Module III:7 Hours

Creating Models of a Reinforced Concrete Framed Structure, Modelling and Analysis of a Slab, Interoperability Feature, Interactive Design Information, Creating Models Using Graphical Interface

Module IV: 6 Hours

Performing Analysis and Designing for Dead Loads, Live Loads, Earthquake Loads and Wind Loads, Viewing Results Using the Output File, Viewing Post Post –Processing, Stress Contours, Specifying Post-Analysis Print Commands.

Module V: 4 Hours

Producing on Onscreen Report, Viewing Supports Reaction. Assessment

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II		M		
Module III	H		H	
Module IV		H		H

CVMA6048: TRAINING ON MODELING AND ANALYSIS USING ABACUS

COURSE OUTCOMES

1. Students will be able to solve linear and nonlinear problems
2. Students will be able to submit and monitor analysis jobs
3. Students will be able to view simulation results using the interactive interface of Abaqus

Day 1: Linear and nonlinear structural analysis.
Day 2: Static, dynamic and heat transfer analysis.
Day 3: Material models: linear elasticity, hyper elasticity and metal plasticity.
Day 4: Loads and constraints. Modeling contact. Selecting the appropriate elements for your problem.

Day 5: Feature-based modeling, parts and assemblies.
Day 6: Working with CAD geometry and imported meshes.
Day 7: Mesh generation techniques. Creating, submitting and monitoring analysis jobs. Viewing simulation results. Restarting an analysis

CVCR6050: DETAILING AND DRAFTING OF CONCRETE REINFORCEMENT

Objective
This value-added course will provide knowledge on drafting features and the reinforcement details of different structural members like slabs, beams, columns, and foundations.

Course/learning outcomes:
After successful completion of the course, students will be able to
1. Understand layout, graphics, scales, reinforcement drawing, drafting principles and features.
2. Perform analysis and design civil engineering structure using SAP 2000.
3. Understand various reinforcement details of the beam, column, slab, foundations, beam-to-beam connection, beam-column joint, and corbels.

Module I (5 Hours):
Drafting principles for layout and reinforcement drawings: Technical drawings of concrete structures, scales, basic line types, types of drawing, layout drawing, principles of drafting, reinforcement drawing, drafting principles, elevation and longitudinal sections, cross-sections, typical notes in reinforcement drawing.

Module II (8 Hours):
Detailing of beams: Anchorage of longitudinal reinforcement, detailing of flexural reinforcement and pretension tendons, types of anchorage, sliding shear failure, mechanical anchorages, arch action, closely spaced transverse stirrups, anchorage of Stirrups, types of Stirrups, reinforcement details in beam, crack control provided by shear reinforcement, support and loading points, slab supported by upturned beam, beam-to-beam connection, half-Joint or dapped-end joint.

Module III (8 Hours):
Detailing of slab: Detailing for crack control, flexural cracking, restrained shrinkage cracking in slabs, types of reinforcement provided in slab, placing of reinforcement.
Detailing of column: Lapped compressive splices, typical tie arrangements in columns, details of bar diameter, detailing of beam-column connections, knee connections, reinforcement detail of three member connections and four-member connections, reinforcement detail of corbels.

Module IV (9 Hours):
Reinforcement detailing of foundation: Isolated footing, combined footing, strip footing, raft footing and pile foundations, reinforcement cover, reinforcement distribution in footing.
Complete knowledge of SAP2000: Learn structural analysis and design of a residential building using SAP2000, analyze and design any kind of civil engineering structure, export the designed data to excel for further calculations, calculate lumped mass, base shear and storey shear.

Mapping of COs to syllabus:

Course Outcomes	CO1	CO2	CO3
Module I	H		
Module II		M	H
Module III		M	H
Module IV	M	H	M

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To be a centre of technological excellence for outstanding education and research in electrical and electronics engineering, contributing to the world socially committed engineers capable of accepting the continuous challenges of technological advancements.

MISSION

The department of Electrical and Electronics Engineering of Don Bosco College of Engineering and Technology, School of Technology, Assam Don Bosco University seeks to:

- Achieve excellence in teaching, research, practice and extension activities in the fields of Engineering in general and Electrical and Electronics Engineering in particular.
- Provide a strong foundation for the students to make them professionally competent for industry and research.
- Create an environment for the holistic development of individuals, encouraging them to serve the society with commitment and integrity.
- Offer necessary support and guidance to individuals to shape their ideas into reality.

PROGRAMME OUTCOMES (POs) OF B. TECH IN ELECTRICAL AND ELECTRONICS ENGINEERING

PO 1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM-SPECIFIC OUTCOMES (PSO) OF B.TECH. IN ELECTRICAL AND ELECTRONICS ENGINEERING

PSO 1: Ability to apply and communicate the knowledge gained during the course of the program from all engineering as well as mathematics, basic sciences, social sciences courses and to identify, formulate and solve real-life problems faced in industries and/or research work.

PSO 2: Ability to solve ethically and professionally various electrical and electronics engineering problems to meet desired needs within realistic constraints.

PSO 3: Ability to demonstrate a systematic and procedural knowledge in electrical and electronics engineering for research and development, teaching and service in relevant industry.

PSO 4: Ability to work professionally in the areas of power systems, control systems, manufacturing, software etc. and recognize the need to engage in life-long learning.

PROGRAMME-SPECIFIC OUTCOMES (PSO) OF M.TECH. IN ELECTRICAL AND ELECTRONICS ENGINEERING (SPECIALIZATION- POWER SYSTEMS)

PSO 1: Ability to apply the enhanced knowledge in advanced technologies for modeling, analyzing and solving contemporary issues in the power sector with a global perspective and to carry out detailed and independent investigation on multifaceted complex problems in the area of power systems and to envisage advanced research in allied thrust areas.

PSO 2: Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.

PSO 3: Ability to critically analyze and identify real-life engineering problems in the area of power systems; and professionally and ethically provide strategic solutions satisfying the safety, societal, cultural, financial and environmental aspects/ needs with an eagerness for continued pursuance of research to design, develop or propose theoretical and practical methodologies towards the research and development support for the power system infrastructure.

PSO 4: Ability to utilize and develop modern tools for modeling, analyzing and solving various scientific problems related to power systems and to take up technical/administrative challenges including the management of various projects of interdisciplinary nature, working in a team with mutual understandings to take unsophisticated challenges leading and motivating the group to inculcate multidisciplinary and collaborative approach.

PROGRAMME-SPECIFIC OUTCOMES (PSO) OF M.TECH. IN ELECTRICAL AND ELECTRONICS ENGINEERING (SPECIALIZATION- CONTROL SYSTEMS)

PSO 1: Ability to apply the enhanced knowledge in advanced technologies for modeling, analyzing and solving contemporary issues in system and control engineering with a global perspective and to carry out detailed and independent investigation on multifaceted complex problems in the area of system engineering and control and to envisage advanced research in allied thrust areas.

PSO 2: Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.

PSO 3: Ability to critically analyze and identify real-life engineering problems in the area of control systems; and professionally as well as ethically provide strategic solutions satisfying the safety, societal, cultural, financial and environmental aspects/ needs with an eagerness for continued pursuance of research to design, develop or propose methodologies, both of academic and applied nature, in the area of mathematical and applied control systems.

PSO 4: Ability to use the techniques, skills and modern control engineering tools necessary for engineering practices and to take up technical/administrative challenges including the management of various projects of interdisciplinary nature, while working in a team with mutual understandings to take unsophisticated challenges leading and motivating the group to inculcate multidisciplinary and collaborative approach.

LIST OF COURSES- BTECH (EEE)

Course code	Course Name
EEBE0038	Basic Electrical Engineering
EEBL6027	Basic Electrical Engineering Laboratory
EECA0041	Electrical Circuit Analysis
EECA0042	Analog Electronics
EEMC0044	Electrical Machines – I
EEDE0045	Digital Electronics
EEAE6028	Analog Electronics Lab
EEMC6029	Electrical Machines-I Lab
EEDE6030	Digital Electronics Lab
EEEF0043	Electromagnetic Fields
EEMS0046	Electrical Machines – II
EEPE0047	Power Electronics
EEMS6031	Electrical Machines-II Lab

EEPE6032	Power Electronics Laboratory
EEEF0043	Electromagnetic Fields
EEEU0092	Energy Efficiency in Electrical Utilities (Honors)
EEPS0072	Power Systems -I
EECS0073	Control Systems
EECS6044	Control Systems Laboratory
EEMM0074	Microprocessors and Microcontrollers
EESS0075	Signals and Systems
EEED0076	Electrical Machine Design
EEEW0077	Electromagnetic Waves
EEED0078	Electronic Devices
EEMI6045	Mini Project-I
EEMM6042	Microprocessors and Microcontrollers Laboratory
EERS6043	Power Systems-I Laboratory
EEPS0079	Power Systems - II
EEMI0080	Measurements and Instrumentation
EEED0082	Electrical Drives
EEHV0083	High Voltage Engineering
EEDS0084	Digital Control Systems
EEDP0085	Digital Signal Processing
EEES0086	Embedded Systems
EEOD0099	Optoelectronic Devices
EEPS6046	Power Systems-II Laboratory
EEMI6047	Measurements and Instrumentation Lab
EEED6048	Electronic Design Laboratory
EEMI6049	Mini Project-II
EEAD0093	Analog and Digital Communication
EESP0094	Power System Protection
EERE0095	Renewable Energy Systems
EEOT0101	Optimization Techniques
7.5	Electrical Materials
7.6	Wind and Solar Energy Systems
EEIT6052	Industrial Internship Seminar
EEMP6053	Major Project Phase-I
8.1	Power Quality and FACTS
8.2	Power System Dynamics and Control
8.3	Electrical Energy Conservation and Auditing
8.4	Industrial Electrical Systems
8.5	Power Plant Engineering
8.6	Major Project Phase-II

Mapping of Courses to PO/PSO

Course code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EEBE0038	M	M											M		L	
EEBL6027	M	M											M		L	
BTIA8			M			H		L	H	M		H		H		
EECA0041	H	H	M										H	L	L	
EECA0042	H	M		M	M								H	M	M	
EEEF0043	H	M	L										H		M	
EEMC0044	M	H	L	L									H	M	H	M
EEAE6028	L	L		L	H								M	L	L	H
EEMC6029	M	H	L	L									H	M	H	M
EEDE6030	H	L	M		H								H	L	L	L

EEDE0045	H	L	M										H	L	L	L
EEMS0046	M	H	L	L									H	M	H	M
EEPE0047	L	M	L	M	M								M	L	M	
EEMS6031	M	H	L	L									H	M	H	M
EEPE6032	L	M	L	M	H								M	L	M	
EEEU0092	M	M	H	L	H	H	H	M	L		M	M	H	M	L	M
EEPS0072	M	H	L	M	M	M							L	L	H	H
EECS0073	M	M	M	H	L								M	H	M	H
EESS0075	L	H		M	M		L						H	L	M	L
EEED0078	L	M	L	H	M								M	L	M	L
EEED0076	M	H		M	H								M	L	M	H
EEMM6042	H	L	H	L	H								M	L	M	L
EERS6043	M	H	L	M	M	M							L	L	H	H
EEMI6045	H	M	L	H	M				M	M	M	M	M	M	L	H
BTIP12			M			H		L	H	M		H		H		
EEEW0077	M	H				L							M	L	L	
EEMM0074	H	L	H	L	H								M	L	M	L
EECS6044				L	H								L	L	L	H
EEPS0079	M	H	L	M	M	M							L	L	H	H
EEMI0080	M	L	H	L	H								H	L	M	L
EEED0081	H	M		L	H								M	M	L	M
EEED0082	M	H		L	H								M	L	M	H
EEHV0083			M			H	L	M					M		M	H
EEDS0084	L	M	M	H	M								M	H	M	H
EEDP0085	L	H		M	H		L						H	L	M	L
EEES0086	H	L	H	L	H								M	L	M	L
EEOD0099	H	H	L	M	H	M							M	H	M	H
EEPS6046	M	H	L	M	M	M							L	L	H	H
EEMI6047	M	L	H	L	H								H	L	M	L
EEED6048	H	M		L	H								M	M	L	M
EEMI6049	H	M	L	H	M				M	M	M	M	M	M	L	H
7.1	L		M	L	H	L							L	L	M	M
EESP0094	L	M	H	L	L								M	L	L	H
7.3	L	L	M	L	M	L	H						M			H
7.4	M	M	L	L	H								H			M
7.5			M	L		M	H						L		M	L
7.6	L	L	M	L	M	L	H						M			H
7.7	L		M	M	H	M	M	M	H	M	L	H	H	M	M	H
7.8	H	M	L	H	H				M	M	M	M	M	M	L	H
8.1	M	H	L	M	M	M							L	L	H	H
8.2	M	H	L	M	M	M							L	L	H	H
8.3	M	L	H		L	M	H	M				M	H	L	L	H
8.4	M	L	H	L	H								H	L	M	L
8.5	H	H	M	L			M						L	L	M	H
8.6	H	M	L	H	H				M	M	M	M	M	M	L	H

DETAILED SYLLABUS

THEORY COURSES

EECE0022/ EEED0078: ELECTRONIC DEVICES

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Distinguish between the various types of transistors. (Understanding)
2. Outline the principles of semiconductor Physics. (Understanding)
3. Describe the mathematical models of semiconductor junctions and MOS transistors for circuits and Systems. (Applying)
4. Categorize general specifications and deploy abilities of the electronic devices, and assemblies. (Analyzing)

Module I (8 Lectures)

Semiconductor materials, crystal lattices, bulk crystal growth, epitaxial growth.

Bonding forces and energy bands in solids, charge carriers in semiconductors- electrons and holes, intrinsic and extrinsic materials; Carrier concentrations- Fermi level, temperature dependence; Drift of carriers- conductivity and mobility.

Excess carriers in semiconductors- optical absorption, luminescence, carrier lifetime, photoconductivity; Diffusion of carriers- diffusion and recombination.

Module II (8 lectures)

PN junction formation, open circuit condition; forward bias- diffusion current, recombination and total current; Depletion layer capacitance, diffusion capacitance and dynamic resistance; I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.

Module III (8 lectures)

BJT, Construction, Operation, Amplifying Action, Common base (CB) dc characteristics, common base amplifier, common emitter (CE) characteristics, Ebers-Moll Model, Biasing, low frequency small signal model, Coupling and bypass capacitors.

Module IV (8 lectures)

Junction Field Effect Transistor (JFET), JFET amplifier; Metal Oxide Field Effect Transistor (MOSFET) - Field effect and inversion, Enhancement MOSFET, threshold voltage.

Module V (7 lectures)

a. Light Emitting Diodes (LED), Hetero-junction high intensity LEDs, LED characteristics.
b. Solar Cells- Principles of photovoltaic devices, series and shunt resistance, solar cell materials, devices and efficiencies.
c. PIN diodes, photodiodes, semiconductor optical amplifiers and lasers.

Module VI (6 lectures)

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process, Ion implanted MOS transistors and Poly-Si Gates.

Suggested Readings

1. D. Neamen, D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
2. NPTEL Lectures
3. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson, 20
4. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley & Sons, 2006.
5. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ. Press, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H	M			
CO 3					H	H
CO 4		H		H		

EEBE0038: BASIC ELECTRICAL ENGINEERING

(4 Credits – 60 hours) (L-T-P: 3-1-0)

Objectives:

- To understand and Analyse basic electric and magnetic circuits.
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations.

Course Outcomes

2. Define basic terminologies related to electrical circuits and machines. (Remembering)
3. Explain the working principle, construction, applications of dc machines and ac machines. (Understanding)
4. Explain basics of converters, domestic wiring and Electrical Installations. (Understanding)
5. Implement network theorems to simplify and solve a complex circuit. (Applying)
6. Interrogate basic DC as well as AC circuits. (Analyzing)

Module I (18 lectures)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module II (16 lectures)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module III (14 lectures)

DC Machines: Principle of operation of generators and motors, construction of DC machine, EMF and Torque Equations, Classification and applications of DC machines.

Transformer: Construction and principle of operation of a single-phase transformer, EMF equation, introduction of auto-transformer.

Induction Motor: Classification and applications, Construction and principle of operation of single phase and three-phase induction motor

Module IV (6 lectures)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module V (6 lectures)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Readings

1. J.B. Gupta, “Basic Electrical Engineering”, S.K Kataria and Sons.
2. P.V. Prasad, S. Sivanagaraju, K.R. Varmah, Chikku Abraham, “Basic Electrical Engineering, Cengage Learning India.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H		M		M
CO 2		H	H		
CO 3				H	H
CO 4	H				
CO 5	M			M	

EECA0041: ELECTRICAL CIRCUIT ANALYSIS

(4 Credits - 60 hours) (L-T-P: 3-1-0)

Objective

To understand the physical laws that governs the response of electrical circuits and networks. The students obtain equations to solve circuits in steady and in transitory state through the application of mathematical tools

Course Outcomes

1. Define and relate the various network theorems used for circuit analysis. (Remembering)
2. Analyze circuits in the sinusoidal steady-state and two-port circuit behaviour. (Understanding)

3. Determine the transient and steady-state response of electrical circuits. (Applying)
4. Evaluate graph of a network, tie-set matrix, loop currents, cut-set matrix and their node-pair potentials. (Analysing)

Module I (16 lectures)
Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity Theorem, Compensation Theorem, Tellegen's Theorem, Substitution Theorem, Voltage and current divider rule. Analysis with dependent current and voltage sources. Node and Mesh analysis, Source transformation, Concept of Duality and Dual Networks.

Module II (10 lectures)
Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient response.

Module III (9 lectures)
Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, Effective and RMS values, Average power and complex power. Three phase circuits. Mutually coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module IV (11 lectures)
Review of Laplace Transforms, Analysis of Electrical Circuits using Laplace Transform for standard inputs, convolution integral, Inverse Laplace transform, transformed network with initial conditions, Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), Series and Parallel Resonances.

Module V (8 lectures)
Two port networks, terminal pairs, relationship of two-port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, Interconnections of two- port networks.

Module VI (6 lectures)
Graph of network, concept of tree branch, tree link. Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials

Suggested Readings
1. D Roy Choudhury, Networks and Systems, New Age International
2. Abhijit Chakrabarti, Circuit Theory (Analysis and Synthesis), Dhanpat Rai and Co., New Delhi
3. ME Van Valkenburg, Network Analysis, Prentice Hall
4. Joseph Administer, Electric Circuits, Schaum's Outline Series
5. David A Bell, Electric Circuits, 6th ed., PHI
6. MS Shukhija and TK Nagsarkar, Circuits and Networks, Oxford University Press, 2010
7. William H. Hayt Jr., Jack E. Kemmerly, Steven M. Durbin, Engineering Circuit Analysis, 6/e, TMH.
8. Ravish R Singh, Network Analysis and Synthesis, Mc Graw Hll Education.
9. K.M. Soni, Circuits &Systems, S.K. Kataria & Sons.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2		L	H		H	
CO 3			L	H		
CO 4						H

EEAE0042: ANALOG ELECTRONICS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
This course aims to familiarize the student with the concept of diode circuits, BJT circuits, MOSFET circuits etc. Also, the course introduces OpAmp and its different applications in electronic circuits.

Course Outcomes
1. Explain the characteristics of transistors. (Understanding)
2. Classify various modes of transistors working. (Understanding)
3. Compare different OP-AMP circuits. (Evaluating)
4. Design various rectifier, amplifier circuits and oscillators. (Creating)

Module I (4 lectures)
P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module II (10 lectures)
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common- collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuit.

Module III (8 lectures)
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high-frequency equivalent circuit.

Module IV (7 lectures)
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product).

Module V (10 lectures)
Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module VI (6 lectures)
Hysteresis Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators.Precision rectifier, peak detector. Monoshot.

Suggested Readings
1. A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J.V. Wait, L.P. Huelsman and G.A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1		H		L		
CO 2		H				
CO 3				H	H	H
CO 4	H	H	H			

EEEF0043: ELECTROMAGNETIC FIELDS

(3 Credits-45 hours) (L-T-P: 3-0-0)

Objective
The objective of the course is to introduce the students to various electromagnetic field related quantities including vector differential and integral operators, electrostatics, magnetostatics and related applications.

Course Outcomes
1. Relate the concepts of electromagnetism with the operations of Electrical Machines and Power Transmission Systems. (Understanding)
2. Identify the laws involved in Generating and Motoring Actions of different Machines. (Applying)
3. Distinguish between guided and free space propagation of Electromagnetic Waves. (Analysing)
4. Estimate forces on the objects due to various Electromagnetic Fields. (Evaluating)

Module I (8 lectures)
a. Vector algebra- addition, subtraction, components of vectors, scalar and vector multiplications, triple products.
b. Three orthogonal coordinate systems (rectangular, cylindrical and spherical).

c. Vector calculus differentiation, Partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors.
d. Conversion of a vector from one coordinate system to another.

Module II (6 Lectures)
a. Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications.
b. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module III (7 lectures)
a. Current and current density, Ohms Law in Point form, Continuity of current.
b. Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line.
c. Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module IV (6 lectures)
Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module V (6 lectures)
Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module VI (6 lectures)
Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module VII (6 lectures)
Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Suggested Readings
1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.
10. U.A. Bakshi, A.V. Bakshi, "Electromagnetic Fields", Technical Publications, 2013.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI	Module VII
CO 1			L		H		
CO 2					H		
CO 3						L	H
CO 4	M	H		H	M		

EEMC0044: ELECTRICAL MACHINES-I

(3 Credits-45 hours) (L-T-P: 3-0-0)

Objective

The objective of this course is to equip the students with a basic understanding of DC machines and transformer fundamentals, different parts of these machines and help to gain the skills for operating DC machines and transformers. The course also equips students with the ability to understand and analyse the different circuits of DC machines and transformers.

Course Outcomes

1. List different types of dc machines. (Remembering)
2. Explain principle of operation of dc motor and dc generator, transformers (Understanding)
3. Differentiate different circuits used in dc motors and generators and transformers (Analyzing)
4. Solve problems related to the performances in terms of losses, efficiency, and regulation of different types of dc machines and transformers. (Applying)

Module I: Magnetic circuits, Electromagnetic force and torque (12 hours)

Review of magnetic circuits ohm's law of magnetic circuit, series and parallel magnetic circuit, B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples -galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.

Module II: DC machines (6 hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation, flux per pole, induced EMF in an armature coil, commutation, lap and wave windings, Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction.

Module III: DC machine - motoring and generation (8 hours)

Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. DC motor starters. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Module IV: Single phase Transformers (8 hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses

Module V: Three phase Transformers (11 hours)

Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Suggested Readings

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Education, 2013.
2. J.B. Gupta, "Theory and performance of Electrical machines" S.K. Kataria and sons. 2017
3. A.E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
4. M.G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
5. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
6. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1			H		
CO 2		H		H	
CO 3			H	H	H
CO 4			H	H	H

EEDE0045: DIGITAL ELECTRONICS

(3 Credits-45 hours) (L-T-P: 3-0-0)

Objective

The objectives of this course are to introduce the concept of digital and binary systems and give students the concept of digital electronics. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits, modules and subsystems.

Course Outcomes

1. Define the basic terminologies related to digital electronics and logic design. (Remembering)
2. Explain the fundamentals of basic logic gates, combinational and sequential circuits, digital converters and memories. (Understanding)
3. Apply simplification methods for minimizing logic expressions. (Applying)
4. Design and implement combinational and sequential circuit. (Creating)

Module I (9 Lectures)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal, hexadecimal number, binary, arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module II (10 Lectures)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module III (10 Lectures)

A 1-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, J- K-T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module IV (8 Lectures)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Module V (8 Lectures)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge decoupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Suggested Readings

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
3. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
4. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", PHI.
5. B. Somanathan Nair, "Digital Electronics and Logic Design", PHI
6. G. K Kharate, "Digital Electronics", Oxford.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	M	H	M	M	M
CO 3		H	M		
CO 4			H	H	M

EEMS0046: ELECTRICAL MACHINES-II

(3 Credits-45 hours) (L-T-P: 3-0-0)

Objective

This course provides a basic understanding of AC machinery fundamentals, machine parts and helps to gain the skills for operating AC machines. The course also equips students with the ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.

Course Outcomes

1. List various parts of all important ac machines (Remembering)
2. Explain the basic principle of operation of ac machines. (Understanding)
3. Analyze performance characteristics of ac machines. (Analysing)
4. Develop equivalent circuits and phasor diagram of different ac motors and generators. (Creating

Module I (8 Lectures)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module II (4 Lectures)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module III (13 Lectures)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque-speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module IV (8Lectures)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module V (12 Lectures)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Suggested Readings

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 1984.
6. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H		H	H	H
CO 2		H	H	H	H
CO 3			H	H	H
CO 4			H	M	H

EEPE0047: POWER ELECTRONICS

(3 Credits-45 hours) (L-T-P: 3-0-0)

Objective

The course helps to develop an in-depth understanding of the power electronics devices and circuits for current and voltage control and protection. The course helps in the learning of switching characteristics and various arrangement of power switching devices for realizing rectifier, inverter and choppers and triggering methods of SCRs.

Course Outcomes

1. Explain the working of different power converters such as rectifiers, choppers and inverters. (Understanding)
2. Identify different power electronic devices and their characteristics. (Applying)
3. Compare the various types of power electronics converters and application. (Evaluating)
4. Choose a suitable type of converter for electrical application and construct. (Creating)

Module I (8 lectures)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module II (9 lectures)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module III (5 lectures)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module IV (5 lectures)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module V (10 lectures)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Module VI (8 lectures)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

Suggested Readings

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	M			
CO 2	H	M	M	M
CO 3		H	M	H
CO 4				M

EESA0048: POWER SYSTEM ANALYSIS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective

The objective of this course is to give the knowledge of various methods of load flow, analysis of various types of faults in power systems, concept of security & contingency analysis of power systems and their needs for maintaining security of the system. It also introduces the concept of state estimation and the phenomenon of voltage instability in power systems.

Course Outcomes

1. Find different parameters for the analysis of power system. (Remembering)
2. Explain methods of state estimation in power system. (Understanding)
3. Organize various contingencies according to their severity. (Applying)
4. Analyse simultaneous fault using generalized method. (Analysing)

5. Determine voltage magnitude and phase-angles at all buses for the given data using various methods of load flow. (Evaluating)

Module I: Load Flow (10 hours)
Overview of Newton-Raphson, Gauss-Seidel, fast-decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variables in load flow.

Module II: Fault Analysis (7 hours)
Simultaneous faults, short circuit and open conductor faults, generalized method of analysis of simultaneous faults in power systems.

Module III: Security Analysis (7 hours)
Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking.

Module IV: Power System Equivalents (5 hours)
WARD equivalents (Kron reduction), WARD equivalent circuits for power flow studies, REI equivalents for power systems.

Module V: State Estimation (8 hours)
Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.

Module VI: Voltage Stability (8 hours)
Introduction to voltage instability scenario in a single machine infinite bus system, Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow.

Suggested Readings
1. J. J. Grainger and W. D. Stevenson, “Power system analysis”, McGraw Hill, 2003.
2. A. R. Bergen and Vijay Vittal, “Power System Analysis”, Pearson, 2000.
3. L. P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International, 2006.
4. G. L. Kusic, “Computer aided power system analysis”, Prentice Hall India, 1986.
5. A. J. Wood, “Power generation, operation and control”, John Wiley, 1994.
6. P. M. Anderson, “Faulted power system analysis”, IEEE Press, 1995.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M		H			H
CO 2		M		M	H	
CO 3			H	H		
CO 4		H	M			
CO 5	H					H

EESD0049: POWER SYSTEM DYNAMICS-I

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
The objective of this course is to give the concept of power system dynamics and its physical interpretation, development of mathematical models for synchronous machine and modeling of induction motor, prime mover controller, load modeling in power systems and stability analysis with and without power system stabilizer.

Course Outcomes
1. List the various stability problems in power systems. (Remembering)
2. Describe the modeling of electrical machines and excitation systems. (Understanding)
3. Solve problems related to various electrical machines and excitation systems. (Applying)
4. Find different parameters of Electrical machines. (Alalyzing)
5. Experiments to observe power system dynamics using simulation. (Evaluating)

Module I: Synchronous Machine (8 hours)
a. Basic concepts of stability, types of stability, stability phenomena Armature and field structure, MMF waveforms, equations, Direct and quadrature axes, Mathematical description of a synchronous machine, Basic equations of synchronous machine.

b. Park's Transformation (modified), Flux-linkage equations.

Module II: Synchronous Machine Equations (8 hours)
Voltage and current equations, Stator self and mutual inductances, mutual inductances between stator and rotor, Electrical power and torque equations
per unit stator and rotor voltage, flux, inductance, power and torque, phasor representation, dq-0 transformations of stator and rotor Current and Voltage, rotor angle, Formulation of State-space equations, Equivalent

Module III: Modeling and Analysis of Synchronous Machine (6 hours)
Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines

Module IV: Small Signal Model (8 hours)
Introduction to frequency model. Models of governor, turbine, power system stabilizer and FACTS devices.

Module V: Excitation System and Load (8 hours)
Excitation systems requirements, Elements of an excitation system, types of excitation systems: dc excitation systems, ac excitation systems, static excitation systems, Recent developments and future trends, Philips-Heffron model, PSS Load modeling.

Module VI: Induction Motors (7 hours)
Modeling of Induction Motors, equation of induction machines, steady state characteristics modeling of Prime mover, Prime mover controllers.

Suggested Readings
1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia, New Delhi, 1981.
2. J. Machowski, J. Bialek & J. R. W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E. W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002.
5. D. Mondal, A. Chakrabarti & A. Sengupta, "Power System Small Signal Stability Analysis and Control", Academic Press, 2014.
6. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
7. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2	H	H	L		M	M
CO 3	H	H				M
CO 4		H	M	M	M	
CO 5	L					

EEHP0050: HIGH POWER CONVERTERS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
Students will be able to understand the need of high power rated converters and analyze the different topologies involved for these converters. It will provide a holistic approach to comprehend the design of protection circuits for these converters.

Course Outcomes
1. Define the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems. (Remembering)
2. Explain the working of multi-level VSIs, DC-DC switched mode converters, Cyclo-converters and PWM techniques. (Understanding)
3. Analyze performance of converters based on output characteristics. (Analyzing)
4. Compare various types of Power Inverters. (Evaluating)

Module I: Power Switching Devices (10 hours)
Power electronic systems: an overview of PSDs, multi-pulse diode rectifier, multi-pulse SCR rectifier .

Module II: Power Inverters (15 hours)
Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, Cascaded, H bridge multilevel inverter. Diode clamped multilevel inverters, flying capacitor multilevel inverter, PWM current source inverters.

Module III: Power Inverters (13 hours)
DC to DC switch mode converters, AC voltage controllers: Cyclo-converters, matrix converter.

Module IV: Power Inverters (7 hours)
Power conditioners and UPS, design aspects of converters, protection of devices and circuits.

Suggested Readings
1. N. Mohan, T. M. Undel & W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989.
2. M. H. Rashid, "Power Electronics", Prentice Hall of India, 1994.
3. B. K. Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
4. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H		
CO 2			M	
CO 3			M	M
CO 4				M

EEWS0051: WIND AND SOLAR SYSTEMS)

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective:
The objectives of this course are-
To expose the students to wind and solar energy systems.To make the students understand the factors involved in installation and commissioning of a Solar or Wind plant and to facilitate the students learn the dynamics involved when solar and wind energy systems are interconnected with power system grid.

Course Outcomes
1. Distinguish the various renewable energy sources. (Understanding)
2. Identify various advantages and disadvantages of wind and solar energy systems. (Applying)
3. Identify the possibility of solar power generation in India and across the globe. (Applying)
4. Develop new renewable energy generation system. (Creating)

Module I (8 hours)
Historical development and current status of wind and solar systems. Characteristics of wind and solar power generation. Network integration issues of renewable energy systems.

Module II (8 hours)
Generators and power electronics for wind turbines, Use of DFIG for wind energy, power quality standards for wind turbines, Technical regulations for interconnections of wind farms with power systems.

Module III (8 hours)
Isolated wind systems, reactive power and voltage control, economic aspects.

Module IV (8 hours)
Impact of wind energy systems on power system dynamics and stability, Wind energy systems grid connection and power system interconnection issues.

Module V (6 hours)
Introduction of solar systems, merits and demerits of solar energy conversion systems, solar concentrators, various applications of solar energy conversion systems.

Module VI (7 hours)
Solar thermal power generation, PV power generation, Energy Storage device. Designing the solar system for small installations.

Suggested Readings
1. Thomas Ackermann (Editor), "Wind Power in Power Systems", John Wiley & Sons. Ltd., 2005.
2. Siegfried Heier, "Grid Integration of Wind Energy Conversion Systems", 2nd Edition, John Wiley and Sons Ltd, 2006.
3. K. Sukhatme & S. P. Sukhatme, "Solar Energy", 3rd Edition, Tata McGraw Hill, 1996.

4. NPTEL Lectures

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2		H	M			
CO 3					H	H
CO 4				H	H	

EEPD0052: ELECTRICAL POWER DISTRIBUTION SYSTEM

(3 Credits – 45 hours) (L-T-P: 3-0-0)

Objective

The objective of this course is to make the students familiar with topics on electrical distribution system planning, load characteristics, application of distribution transformers, design of sub-transmission lines, distribution substations, primary systems, and secondary systems, voltage drop and power-loss calculations, application of capacitors, harmonics on distribution systems, voltage regulation, and smart grid concepts.

Course Outcomes

1. Demonstrate the knowledge of various distribution transformers, load characteristics, and associated factors. (Understanding)
2. Illustrate primary and secondary distribution networks. (Understanding)
3. Analyze voltage drops in distribution systems and choose proper measures to counteract voltage drops. (Analyzing)
4. Explain the integration of smart grid with the distribution management system. (Evaluating)

Module I: Distribution System Planning and Automation (8 hours)

Introduction, Distribution System Planning, Factors Affecting System Planning, Present Distribution System Planning Techniques, Central Role of the Computer in Distribution Planning, Distribution System Automation, load characteristics, Diversified demand, Non-coincident demand, Coincidence factor, Contribution factor problems, Relationship between the Load and Loss Factors, Load Forecasting, Rate structure, Customer billing.

Module II: Application of Distribution Transformers (8 hours)

Types of Distribution transformers, Regulation, Efficiency, single-phase transformer connections, Three-phase transformer connections, Auto-transformer, Booster transformer, phasor diagrams, Grounding Transformers.

Module III: Design of Sub-transmission Lines and Distribution Substations (8 hours)

Sub-station bus schemes, Rating of distribution substation, Service area with multiple feeders, Sub-station application curves, Percent voltage drop calculations, Substation Grounding, Types of Ground Faults.

Module IV: Design Considerations of Primary and Secondary Systems (8 hours)

Radial type, Loop type primary feeder, primary feeder loading, Radial Feeders with Uniformly Distributed Load, Introduction to Secondary Systems, secondary Banking, Secondary networks, Network transformers, Economic Design of Secondaries - General Total Annual cost (TAC), equation with and without constraints, Unbalanced loads and voltages.

Module V: Voltage-Drop and Application of capacitors (8 hours)

3-phase and Non 3-phase primary lines, Single-phase two-wire laterals with ungrounded neutral, Single-phase two-wire ungrounded laterals, Application of capacitors to distribution systems, Effect of series and shunt capacitors, power factor correction, Economic justification for capacitors, Optimum location for capacitor bank.

Module VI: Concept of Smart Grid (5 hours)

Need for Establishment of Smart Grid, Distributed Automation, SCADA, Integration of Smart Grid with the Distribution Management System, Evolution of Smart Grid, Smart Microgrids, Topology of a Microgrid, Consumer Information Service (CIS), Automatic Meter Reading (AMR).

Suggested Readings

1. Turan Gönen, “Electric Power Distribution Engineering”, CRC Press, 2014.
2. A. S. Pabla, “Electric Power Distribution”, McGraw Hill Education (India) Private Limited, 2011.
3. T. A. Short, “Electric Power Distribution Equipment And Systems”, CRC Press, 2004.
4. Kamalesh Das, “Electrical power Systems for Industrial Plants”, Jaico Publishing House, 2007.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	H		M		L
CO 2			H	H		
CO 3			M		H	
CO 4	M					H

EEMM0053: MATHEMATICAL METHODS OF POWER ENGINEERING

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective

The objective of this course is to make the students understand the relevance of mathematical methods to solve engineering problems and to facilitate the students to learn how to apply the mathematical methods for a given engineering problem.

Course Outcomes

1. Demonstrate an understanding about vector sources, linear transformation, Eigen values and eigenvectors of linear operators. (Understanding).
2. Apply the knowledge of linear programming problems in various fields of power engineering. (Applying).
3. Utilize various techniques of nonlinear programming for solving constrained and unconstrained nonlinear programming problems. (Applying)
4. Justify the use of stochastic processes in the field of power engineering. (Evaluating)

Module I: Vectors and Linear Transformation (6 hours)

Definition of group and field, Vectors and vector spaces, Characterization of vector spaces, Linear transformation, Singular and Non-singular transformation, Matrix representation of linear transformation.

Module II: Eigen Vectors of Linear Operator (6 hours)

Eigen values and Eigen vectors of linear operator, Eigen spaces, Eigen basis for matrices, Eigen decomposition.

Module III: Introduction to Linear Programming (9 hours)

Linear programming problems, Graphical method, Simplex method, Dual-Simplex method, Duality, Non Linear programming problems.

Module IV: Introduction to Non-Linear Programming (8 hours)

Unconstrained problems, Newton's method, Hessian matrix, Search methods, Constrained problems.

Module V: Constrained Optimization (8 hours)

Lagrange method, Interpretation of Lagrange multipliers, Quadratic Programming problem, Kuhn-Tucker conditions, Random variables, Distributions.

Module VI: Stochastic Model/ Process (8 hours)

Definition, Independent random variables, Marginal and Conditional distributions, Elements of Stochastic process, State space, Index set.

Suggested Readings

1. Kenneth Hoffman & Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992.
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004.
3. Irwin Miller and Marylees Miller, "John E. Freund's Mathematical Statistics", 6th Edition, PHI, 2002.
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi, 1994.
5. Papoulis and S. Pillai, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002.
6. John B. Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000.
7. Hillier F. S. and Liebermann G. J., "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001.
8. Simmons D. M., "Non Linear Programming for Operations Research", PHI, 1975.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H				
CO 2			H			
CO 3				H	H	
CO 4						H

EEMC0054: MATHEMATICAL METHODS IN CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective

This course aims to give the students an understanding of foundational concepts in linear algebra and random processes for use in control systems. Students will understand Probability and Random variables.

Course Outcomes

1. Define vector space vector space axioms, vector space properties. (Remembering)
2. Explain responses of linear systems to any given input signal. (Understanding)
3. Apply matrix properties and functions to a given problem. (Applying)
4. Solve problems of control system Engineering using probability theory. (Creating)

Module I (10 hours)

Linear Spaces – Vectors and Matrices, Transformations, Norms, Matrix Factorization.

Module II (10 hours)

Eigen value, Eigenvectors and Applications, SVD and Applications, Projections and Least Square Solutions.

Module III (10 hours)

Probability, Random variables, Probability distribution and density functions, Joint density and conditional distribution, Functions of random variables and random vectors.

Module IV (5 hours)

Characteristic functions and correlation matrices, Random Processes and properties.

Module V (5 hours)

Response of Linear systems to stochastic inputs, PSD theorem.

Suggested Readings

1. G. Strang, “Introduction to Linear Algebra”, 4th Edition, Wellesley-Cambridge Press, 2009.
2. Papoulis and S. Pillai, “Probability, random variable and stochastic processes”, Mcgraw Hill, 2002.
3. H. Stark and J. W. Woods, “Probability and random processes with application to signal processing”, Pearson Education Asia, 2002.
4. J. A. Gubner, “Probability and Random processes for Electrical and Computer engineers”, Cambridge Univ. Press. 2006.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	L			
CO 2			H		
CO 3				H	
CO 4					H

EENS0055: NON-LINEAR SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective

This course aims at introducing fundamental concepts of nonlinear dynamical systems and understanding basic tools for mathematical analysis as well as applications.

Course Outcomes

1. Choose tools for stability analysis and response evaluation of control problems with significant nonlinearities. (Remembering)
2. Identify the design problem and distinguish between the controls strategies. (Applying)
3. Analyse non linear systems using describing function methods. (Analysing)
4. Interpret stability of nonlinear systems from Lyapunav stability analysis. (Understanding)

Module I (10 hours)

Introduction to nonlinear systems: Examples of phenomena, models & derivation of system equations.

Module II (15 hours)

Fundamental properties: Existence & uniqueness, Dependence on initial conditions & parameters. Phase plane analysis. Limit cycles & oscillations. Describing function method and applications. Circle criterion.

Module III (12 hours)
Lyapunov stability of autonomous systems. Perturbation theory & Averaging. Singular perturbation model and stability analysis.

Module IV (8 hours)
Basic results on Lie algebra. Controllability and Observability of nonlinear systems. Bifurcations. Chaos. Synchronization.

Suggested Readings
1. H. K. Khalil, "Nonlinear systems", 3 rd edition, Prentice Hall, 2001.
2. J. J. E. Slotine and W. Li, "Applied nonlinear systems", Prentice Hall, 1991.
3. A. Nijemjer and A. van der schaft, "Nonlinear dynamical control systems", Springer, 1989.
4. M. Vidyasagar, "Nonlinear Systems Analysis, Society for Industrial and Applied Mathematics", 2002.
5. S. Strogatz, "Nonlinear Dynamics and Chaos", West view Press, 2001.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1		H	H	
CO 2	H	L	L	
CO 3		H		
CO 4			H	

EECL0056: DIGITAL CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
This course aims to familiarize the student with the concept of discretization. The objective is to introduce the students to discrete-time system representations and digital control and make the learn to design controllers for digital systems.

Course Outcomes
1. Define a discrete time system. (Remembering)
2. Explain sampled data system. (Understanding)
3. Model control system on differential samping. (Applying)
4. Analyse digital systems in time domain and frequency domain. (Analysing)

Module I (15 hours)
Introduction to discrete-time systems, Frequency domain approach – Analysis and discretization, Time domain approach, analysis and discretization, State space formulation for discretized systems.

Module II (15 hours)
Engineering aspects of computer controlled systems, Sampled data systems, Control of Sampled data systems.

Module III (15 hours)
Concept of differential sampling, Closed loop analysis of differentially sampled systems, Control design based on differential sampling, Recent applications of Digital Control.

Suggested Readings
1. K. Ogata, "Discrete-time Control Systems", 2nd Ed., Prentice-Hall, 1995.
2. Benjamin C. Kuo, "Digital Control Systems", 2nd Ed., Oxford University Press, 1999.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H		
CO 2		H	
CO 3			H
CO 4	H		

EENC0057: NONLINEAR CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
This course aims to study concepts and techniques for stability analysis and learning control design of nonlinear systems.

Course Outcomes
1. Define tangent vectors, vector fields. (Remembering)
2. Explain Passivity analysis and applications to control design. (Understanding)
3. Apply deeper ideas from mathematics and specifically from geometry to engineering problems. (Applying)
4. Design control system using disturbance decoupling.(creating)

Module I (8 hours)
Overview of nonlinear Control-Introduction to Advanced Calculus, Elementary notions of Topology, Smooth Manifolds, Sub-manifolds, Tangent Vectors, Vector Fields.

Module II (7 hours)
Lyapunov stability for autonomous and non-autonomous systems, Input-Output Stability and Input-to-State Stability Absolute Stability.

Module III (8 hours)
Passivity analysis and applications to control design, Lyapunov-based feedback control design. Feedback linearization and back stepping.

Module IV (7 hours)
Sussmann's Theorem and global Decompositions, The Control Lie Algebra, the observation space.

Module V (8 hours)
Local Co-ordinates, Transformations, Exact Linearization via Feedback, The Zero dynamics, Local Asymptotic Stabilization, Asymptotic Output Tracking.

Module VI (7 hours)
Disturbance Decoupling, High Gain Feedback, Additional Results on Exact Linearization, Observers with Linear Error Dynamics.

Suggested Readings
1. H. K. Khalil, "Nonlinear Systems", 3rd edition, Prentice Hall, 2001.
2. H. K. Khalil, "Nonlinear Control", Pearson, 2015.
3. J. J. E. Slotine and W. Li, "Applied nonlinear systems", Prentice Hall, 1991.
4. A. Nijemjer and A. van der schaft, "Nonlinear dynamical control systems", Springer, 1989.
5. M. Vidyasagar, "Nonlinear Systems Analysis", Society for Industrial and Applied Mathematics, 2002.
6. Alberto Isidori, "Nonlinear Control Systems", Third Edition, Springer, 1995.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2			H			
CO 3				L	H	
CO 4						H

EESC0058: SCADA SYSTEM AND APPLICATIONS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
This course aims to familiarize the student with the concept of SCADA and its functions, to know SCADA communication and to get an insight into its application.

Course Outcomes
1. Explain the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications. (Understanding)
2. Make use of knowledge about SCADA architecture, various advantages and disadvantages of each system. (Applying)
3. Analyse the single unified standard architecture IEC 61850. (Analysing)
4. Select suitable SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server. (Evaluating)

Module I (15 hours)

Introduction to SCADA: Data acquisition system, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation and Industries SCADA.

Module II (15 hours)
Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems, SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850.

Module III (15 hours)
SCADA Communication: various industrial communication technologies - wired and wireless methods and fiber optics, Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

Suggested Readings
1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke and Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", Penn Well Books, 2006.
4. David Bailey and Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well, 1999.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M	L			L
CO 2				H		
CO 3				H	M	
CO4			H			

EDA0059: DESIGN ASPECTS IN CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective
This course aims to familiarize the student to the tools and techniques of control system design. Introduction to various aspects of controller design philosophy, learning PID Controller are incorporated into the course.

Course Outcomes
1. Tell about FOPDT and SOPDT systems. (Remembering)
2. Explain zero dynamics in servo control. (Understanding)
3. Model a control system given its parameters. (Applying)
4. Design observer. controllers like PI, PID in a given control system. (Evaluating)

Module I (15 hours)
System Modelling, review of concepts, FOPDT and SOPDT systems and identification of Smith Predictor and its variations.

Module II (15 hours)
PID Controllers – review PID Tuning – Ziegler Nichols, Cohen-Coon techniques. State feedback review – pole placement, Eigen structure assignment, Eigen structure – time response relation, Controller gain selection, controller robustness, disturbance rejection.

Module III (15 hours)
Frequency Domain Loop Shaping, Lag, Lead and Lag-lead compensators, Zero dynamics in servo control, Unstable zero dynamics – control design, Observer – concept and design, Case studies – Applications.

Suggested Readings
1. Karl J. Astrom and Richard M. Murray, "Feedback Systems: An Introduction for Scientists and Engineers", Princeton University Press, 2010.
2. Thomas Kailath, "Linear Systems", Prentice-Hall.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III

CO 1	H		
CO 2			H
CO 3		H	
CO4	M		H

EEDP0060: DIGITAL PROTECTION OF POWER SYSTEM

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Illustrate the use of mathematical methods for relaying purposes. (Understanding)
2. Apply the digital relaying techniques in power system protection. (Applying)
3. Assess effectiveness of digital relays over the electromechanical ones for power system protection requirements. (Evaluating)
4. Design digital protection systems for power system applications. (Creating)

Objective

The objectives of this course are-

- To provide an overview of the numerical relays and their working
- Introduce a mathematical approach towards protection
- To provide a detailed treatment of algorithms for numerical protection

Module I (6 hours)

Evolution of digital relays from electromechanical relays, Types of digital relays, Performance and operational characteristics of digital protection.

Module II (6 hours)

Mathematical background to protection algorithms, Finite difference techniques.

Module III (8 hours)

Interpolation formulae, forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

Module IV (8 hours)

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing. Error, sample and hold circuits, multiplexers, analog to digital conversion, digital filtering concepts, digital relay as a unit consisting of hardware and software, Integration of Digital Relays into SCADA systems.

Module V (8 hours)

Mathematical basis of numerical techniques and relay algorithms, Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh based algorithms.

Module VI (8 hours)

Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm. Least Squares based algorithms. Differential equation based algorithms. Traveling Wave based Techniques. Digital Differential Protection of Transformers.Digital Line Differential Protection. Recent Advances in Digital Protection of Power Systems.

Suggested Readings

1. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009.
2. A. T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press, 1999.
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006.
4. S. R. Bhide, “Digital Power System Protection” PHI Learning Pvt. Ltd., 2014.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1		H		M	
CO 2	M		H		L
CO 3	H		L		
CO 4			M		H

EEPD0061: POWER SYSTEM DYNAMICS-II

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Recall the basic concepts of dynamic systems and stability definition. (Remembering)
2. Explain the different stability problems arise in power system. (Understanding)
3. Identify different stability problems faced by modern power systems, e.g., multi-machine stability, large signal stability, etc. (Applying)
4. Analyze the stability problems and implement modern control strategies, e.g., damper, AGC etc. (Analyzing)
5. Assess voltage and frequency stability in power systems. (Evaluating)

Objective

The objective of this course is to give the concept of power system dynamics, interpretation of power system dynamic phenomena and various forms of stability problems in power systems & their mitigation technique.

Module I: Power System Stability (8 hours)

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System, Analysis of stability.

Module II: Damper (8 hours)

Effect of Damper, Flux Linkage Variation and AVR.

Module III: Large Signal Stability (8 hours)

Large Signal Rotor Angle Stability, Dynamic Equivalents and Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer.

Module IV: Multi-Machine Stability (6 hours)

Asynchronous Operation and Resynchronization, concept of multi-Machine Stability.

Module V: Voltage Stability (6 hours)

Dynamic Analysis of Voltage Stability, Voltage Collapse and classification, typical scenario of voltage collapse, Prevention of voltage collapse.

Module VI: Frequency Stability (6 hours)

Introduction to Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures.

Suggested Readings

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, 1994.
2. J. Machowski, J. Bialek and J. Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997.
3. L. Leonard Grigsby (Ed.), “Power System Stability and Control”, Second edition, CRC Press, 2007.
4. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”, Springer, 2006.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H		M		M	M
CO 2		H	H	M	L	L
CO 3			H	H	M	
CO 4		H		H		
CO 5					H	H

EERP0062: RESTRUCTURED POWER SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Explain the various types of regulations in power systems. (Understanding).
2. Illustrate the Technical and Non-technical issues in Deregulated Power Industry.(Understanding).
3. Identify the need of regulation and deregulation. (Applying)
4. Interpret different market mechanisms and various entities in the market. (Applying)

Objective

The objective of this course is to introduce the concepts of restructuring and deregulation of electricity market. This will enable the students to understand the need behind the requirement for deregulation of the electricity market. This course focuses on the understanding of the money, power & information flow in a deregulated power system.

Module I: Introduction to Electricity Market (10 hours)
Fundamentals of electricity market deregulation and restructured system, Market power, Market models and architecture, Independent System Operator (ISO), Power Exchange (PX), Market Clearing Price (MCP), Day-Ahead and Hour-Ahead Markets, Elastic and Inelastic Markets, Social welfare maximization.

Module II: Optimal Power Flow (11 hours)
OPF: Role in vertically integrated systems and in restructured markets, Transmission Open Access, Power Wheeling, Congestion management, Transfer Capability: Definitions and calculations- Available Transfer Capability (ATC).

Module III: Hedging Tools for Managing Risks in Electricity Markets (8 hours)
Optimal bidding; Risk assessment, Hedging; Transmission Pricing; Electricity Pricing: Volatility, Risk and Forecasting.

Module IV: Ancillary Services & Distributed Generations (6 hours)
Ancillary Services, Distributed generation in restructured markets, IT applications in restructured markets.

Module V: Indian sector and Global Electric Utility Markets (10 hours)
Developments in India, Working of restructured power systems in various countries, Standard Market Design (SMD), PJM, Recent trends in Restructuring.

Suggested Readings

1. Mohammad Shahidehpour and Muwaffaq Alomoush, “Restructured electrical power systems: operation, trading and volatility”, Marcel Dekker.
2. Kankar Bhattacharya, Jaap E. Daadler and Math H. J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
3. Lorrin Philipson and H. Lee Willis, “Understanding electric utilities and de-regulation”, Marcel Dekker Pub., 1998.
4. L. L. Lai, “Power System Restructuring and Deregulation: Trading, Performance and Information Technology”, Wiley, 2001.
5. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley and Sons, 2002.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	L			
CO 2		H	H		
CO 3			M	H	
CO 4				M	H

EEAS0063: ADVANCED DIGITAL SIGNAL PROCESSING

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Demonstrate knowledge about the time domain and frequency domain representations as well analysis of discrete time. (Understanding)
2. Apply the design techniques for IIR and FIR filters and their realization structures. (Applying)
3. Utilize knowledge about the finite word length effects in implementation of digital filters. (Applying)
4. Make use of the knowledge about the various linear signal models and estimation of the power spectrum of stationary random signals. (Applying)

Objective
The course helps to develop an in-depth understanding of the digital signal processing techniques. The course helps in learning of the methods used to structure and design various filters and understand their characteristics.

Module I: Fundamentals of Discrete-Time Signal and System (8 hours)
Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms.

Module II: Discrete-Time Signals in the Transfer Domain (8 hours)

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bi-linear transformation method.

Module III: Digital Filter Structures and Design (8 hours)
FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

Module IV: Analysis of Finite Word length Effects (8 hours)
A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.

Module V: Linear Signal Models and Power Spectrum Estimation (7 hours)
All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

Module VI: Optimum Linear Filters (6 hours)
Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Suggested Readings

1. Sanjit K. Mitra, "Digital Signal Processing: A computer-based approach", Tata McGraw-Hill Edition, 1998.
2. Dimitris G. Manolakis, Vinay K. Ingle & Stephen M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill international edition 2000.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	H				L
CO 2			H	M	L	H
CO 3	M		M	H		
CO 4		M			H	M

EEAS0064: POWER SYSTEM TRANSIENTS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Explain the reasons for occurrence of transients in a power system. (Understanding)
2. Utilize the knowledge of various transients that could occur in power systems and their mathematical formulation. (Applying)
3. Illustrate the use of insulation in various equipment in power systems. (Applying)
4. Analyze the power system for transient analysis. (Analyzing)
5. Design various protective devices in power systems for protecting equipment and personnel. (Creating)

Objective
The objective of this course is to introduce the concepts of power system transients. Students will be able to learn the reasons for occurrence of transients in a power system. This will enable the students to understand the change in parameters like voltage & frequency during transient. This course also focuses on the lightning phenomenon and its effect on the power system.

Module I: (8 hours)
Fundamental circuit analysis of electrical transients; Laplace Transform method of solving simple Switching transients; Damping circuits-Abnormal switching transients; Three-phase circuits and transients; Computation of power system transients.

Module II (7 hours)
Principle of digital computation-Matrix method of solution; Modal analysis- Z transform; Computation using EMTP; Lightning, switching and temporary over voltage; Physical phenomena of lightning.

Module III (6 hours)
Interaction between lightning and power system; Influence of tower footing resistance and Earth Resistance; Switching: Short line or kilometric fault; Energizing transients - closing and re-closing of lines; line dropping, load rejection - over voltages induced by faults.

Module IV (8 hours)

Switching HVDC line; Travelling waves on transmission line, Circuits with distributed Parameters; Wave Equation; Reflection, Refraction, Behaviour of Travelling waves at the line terminations; Lattice Diagrams - Attenuation and Distortion; Multi-conductor system and Velocity wave.

Module V (8 hours)
Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS); Coordination between insulation and protection level; Statistical approach.

Module VI (8 hours)
Protective devices; Protection of system against over voltages, lightning arresters, substation earthing.

Suggested Readings
1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991.
2. Y. G. Paithankar, "Fundamentals of Power System Protection", Prentice Hall India Learning Private Limited, 2010.
3. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno and Koichi Yamabuki, "Power System Transients: Theory and Applications", CRC Press, 2016.
4. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education, 2006.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2		H	H	L		
CO 3					H	
CO 4			M	H		
CO 5						H

EEFC0065: FACTS AND CUSTOM POWER DEVICES

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. List various FACTS devices. (Remembering)
2. Describe fundamental principles of Passive and Active Reactive Power Compensation Schemes. (Understanding)
3. Identify suitable FACTS devices for specific applications. (Applying)
4. Experiments with various FACTS devices to improve Power quality. (Evaluating)

Objective
This course gives an introduction to the of flexible ac transmission systems to enhance controllability and power transfer capability in ac systems, involves applications of power electronics in power systems in the range of a few tens to hundred megawatts to improve reliability of power supply and opens up new opportunities for controlling power and enhancing the usable capacity of present, as well as new and upgraded lines.

Module I: Power flow control (6 hours)
Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System - Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line - Shunt compensation, Series compensation Phase angle control, Reactive power compensation Shunt and Series compensation principles, Reactive compensation at transmission and distribution level.

Module II: Shunt compensator (10 hours)
Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM, Operation and control of TSC, TCR and STATCOM -Compensator control, Comparison between SVC and STATCOM.

Module III: Series compensator and regulators (15hours)
Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators, TCVR and TCPAR Operation and Control, Applications, Static series compensation, GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

Module IV: Combined compensator (8 hours)
SSR and its damping Unified Power Flow Controller, Circuit Arrangement, Operation, and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control-Applications, Introduction to interline power flow controller.

Module V: Power quality (6hours)

Modeling and analysis of FACTS, Controllers, Simulation of FACTS controllers, Power quality problems in distribution systems, harmonics, loads that create harmonics, modeling, harmonic propagation, series and parallel resonances mitigation of harmonics, passive filters, active filtering – shunt, series and hybrid and their control, Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners, IEEE standards on power quality.

Suggested Readings

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.
2. X. P. Zhang, C Rehtanz and B. Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer, Verlag, Berlin, 2006.
3. N. G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K. S. Suresh Kumar and S. Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, New York, 1982.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2	L	H	H	H	
CO 3		H	H	H	M
CO 4		M	M		

EEOC0066: OPTIMAL CONTROL THEORY

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Relate the mathematical methods used in optimal control to derive the solution to variations of the problems studied in the course. (Remembering)
2. Explain dynamic programming and its use in control system engineering. (Understanding)
3. Apply principle of optimality to decision making. (Applying)
4. Utilize the standard algorithms for numerical solution of optimal control problems and use MATLAB to solve fairly simple but realistic problems. (Applying)

Objective

This course aims at introducing the basic and fundamental concepts of optimal control theory, controller design. The course also introduces computational aspects of optimal control.

Module I (15 hours)

Review of Matrix Computations. Maximization of functional of a single and several functions using calculus of variations, Constrained externals, Euler-Lagrange Equation, Necessary conditions for optimal control, Pontryagin's minimum principle and state inequality constraints, Minimum time problems, Minimum control effort problems.

Module II (15 hours)

Linear quadratic regulator problems, Riccati Equation, Singular intervals in optimal control problems, The principle of optimality, Application of the principle of optimality to decision making, Dynamic programming applied to routing problems.

Module III (15 hours)

Solving optimal control problems using dynamic programming, Discrete linear regulator problem, Hamilton-Jacobi-Bellman Equation, Numerical Techniques to determine optimal trajectories, Numerical Aspects of Optimization.

Suggested Readings

1. M. Athans and P. L. Falb, "Optimal Control: An Introduction to the Theory and Its Applications", Dover Books on Engineering, 2006.
2. D. S. Naidu, "Optimal Control Systems", CRC Press, 2002.
3. D. Liberzon, "Calculus Of Variations and Optimal Control Theory: A Concise Introduction", Princeton University Press, Dec 2011.
4. Frank L. Lewis, Draguna Vrabie and Vassilis L. Syrmos, "Optimal Control", 3rd Edition, Wiley, 2012.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H	H	
CO 2		M	H
CO 3		H	
CO 4	M		H

EESF0067: STOCHASTIC FILTERING AND IDENTIFICATION

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Tell about different filtering and prediction methods for system design. (Remembering)
2. Take part in convergence analysis of Recursive Identification methods. (Analyzing)
3. Elaborate essential stochastic modeling tools including Markov chains and queuing theory. (Creating)
4. Design control system based on adaptive control. (Creating)

Objective

This course aims at introducing fundamental concepts of stochastic filtering, prediction, control. The course introduces non-linear system identification.

Module I (15 hours)

Introduction to Parameter Estimation and System Identification, MMSE estimation including LMS, Gaussian case, Wiener filtering & prediction, Kalman filtering & prediction, Extended Kalman filtering and its variations, Predictors for difference equation based models including ARMA, Box Jenkins & others.

Module II (15 hours)

Statistical properties of Least Squares estimation and its relationship with Bayes estimation (ML, MAP), convergence analysis, CR bound, Recursive Least Squares, Iterative methods for nonlinear Least Squares Identification problem: Different approaches for linear dynamical system, Offline identification methods including Least Squares, Prediction error framework, Pseudo-linear regression (PLR) & Instrument variable methods. Recursive Identification of linear dynamical system: RLS, PLR, Prediction error framework & its application to ARMA & Innovations representation, Convergence Analysis of Recursive Identification methods: Associated ODE, Martingale.

Module III (15 hours)

Nonlinear system identification, Subspace based method of system identification, Applications including LQG and adaptive control.

Suggested Readings

1. A. Papoulis and S. Pillai, “Probability, random variable and stochastic processes”, McGraw Hill, 2002.
2. T. Soderstrom and P. Stoica, “System Identification”, Prentice-Hall, 1989.
3. Lennart Ljung, “System Identification”, Prentice-Hall, 2nd edition, 1999.
4. S. Thomas Alexander: “Adaptive Signal processing, Theory and applications”, Springer-Verlag, 1986.
5. R. Isermann and M. Munchhof, “Identification of Dynamic Systems”, Springer-Verlag, 2011.
6. B. D. O. Anderson and J. B. Moore, “Optimal Filtering”, Dover Books on Electrical Engineering, 2005.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		H	H
CO 3		H	
CO 4			H

EECS0068: ADVANCE CONTROL SYSTEM

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Define different approaches for modeling of dynamic systems. (Remembering)
2. Explain philosophy of optimal control system. (Understanding)
3. Apply the concepts of linear algebra and their applications to control systems. (Applying)

4. Design linear quadratic controller, reduced order observer,compensator (Creating)

Objective

The course provides glimpses into the advanced methods of modelling and analysis of the dynamical systems. The course is a strong step in inculcating the research aptitude in the students.

Module I (15 hours)

Math Modelling of Dynamical Systems: Newtonian and Lagrangian approaches, Concept of dynamical state of a system, Concept of equilibrium point, linearization of nonlinear model. Review of Linear Algebra concepts: Field, Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalisation

Module II (15 hours)

Modern Control Analysis: Concept and computation of systems modes, controllability theorem and its proof, Observability theorem and its proof, Controllable and observable subspaces. Stability Analysis: Stability of linear systems, stability types and their definitions for any general system, Stability of an equilibrium point, Lyapunov stability theory for LTI systems, Quadratic forms and Lyapunov functions.

Module III (15 hours)

Modern Control Design: Converting the math model to controllable canonical form and its use for pole placement, Concept of linear observer and its design, Design of reduced order observer, Compensator design using separation principle, Poles of compensator, Open-loop and close-loop systems. Optimal Control Theory: Introduction to the philosophy of optimal control, formulation of optimal control problem, different performance criterion, Linear quadratic regulator (LQR) and optimum gain matrix, Riccati equations, conceptual models and statistical models for random processes, Kalman filter.

Suggested Readings

1. Bernard Friedland, “Control System Design: An Introduction to State-Space Methods”, Dover Publications, Inc. Mineola, New York, 2012.
2. Thomas Kailath, “Linear Systems”, Prentice-Hall Inc., New Jersey, 1986.
3. M. Gopal, “Modern Control System Theory”, New Age International (P) Limited, New Delhi, 2000.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		H	
CO 3	H		
CO4	L		H

EEAL0069: ADAPTIVE LEARNING AND CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Recall detailed knowledge of classical system identification and the development and properties of various methods. (Remembering)
2. Utilize detailed knowledge of robust adaptive control, neural network based control (Applying)
3. Apply adaptive and learning techniques for control design for uncertain dynamical systems. (Applying)
4. Design control system based on predictive control. (Creating)

Objective

The course introduces adaptive and learning techniques for control design for uncertain dynamical systems. The course also introduces learning based control.

Module I (15 hours)

Introduction to adaptive control, Direct and indirect adaptive control, Model reference adaptive control, Parameter convergence, Persistence of excitation, Review of Lyapunov stability theory.

Module II (15 hours)

Adaptive backstepping, Adaptive control of nonlinear systems, Composite adaptation, Robust adaptive control, Neural Network-based control.

Module III (15 hours)
Reinforcement learning-based control, Repetitive learning control, Predictive control,

Suggested Readings
1. Bernard Friedland, "Control System Design: An Introduction to State-Space Methods", Dover Publications, Inc. Mineola, New York, 2012.
2. Thomas Kailath, "Linear Systems", Prentice-Hall Inc., New Jersey, 1986.
3. M. Gopal, "Modern Control System Theory", New Age International (P) Limited, New Delhi, 2000.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		H	
CO 3		H	
CO4		M	H

EEMR0070: MODEL REDUCTION IN CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Identify Source of Large Models. (Remembering)
2. Explain sliding mode control for control system design. (Understanding)
3. Make use of Pade approximation for control system design. (Applying)
4. Apply model reduction techniques for a given control design problem. (Applying)

Objective
The course introduces the concept of model reduction of large scale dynamics models from various engineering disciplines. The course also introduces model reduction in control.

Module I (15 hours)
Introduction to Model Reduction, Source of Large Models – Circuits, EM systems, Mechanical Systems. Classical Model Reduction Methods – Modal reduction.

Module II (15 hours)
Pade approximation and moment matching, Routh Approximants, Modern Methods - SVD (Grammian) based methods, Krylov based methods, SVD-Krylov based methods, MOR for Nonlinear Systems – SVD & POD Methods.

Module III (15 hours)
Model Reduction in Control, Sliding Mode Control – Review, SMC as model reducing control, Higher Order Sliding Mode.

Suggested Readings
1. A. C. Antoulas, "Approximation of Large Scale Dynamical Systems", SIAM, 2005.
2. Ed. Alfio Quarteroni and Gianluigi Rozza, "Reduced Order Methods for Modeling and Computational Reduction", Springer, 2014.
3. M. Jamshidi, "Large-scale systems: modelling & control", North Holland, New York, 1983.
4. C. Edwards and S. Spurgeon, "Sliding Mode Control: Theory and Applications", CRC Press, 1998.
5. B. Bandyopadhyay, S. Janardhanan and S. Spurgeon, "Advances in Sliding Mode", Springer, 2013.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		H	
CO 3		H	
CO4	M		H

EERC0071: ROBUST CONTROL

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Define LTI systems and its applications. (Remembering)

2. Explain Passive system for frequency domain and time domain. (Understanding)
3. Assess stability and performance of passive systems. (Evaluating)
4. Design robust control system based on Riccatti equation (Creating)

Objective

This course introduces the concept of to control techniques with greater emphasis on robustness to modelling uncertainty. The course introduces how to handle parameter variations, and presence of disturbances and noise.

Module I (15 hours)

Modelling of uncertain systems, Signals and Norms, Lyapunov theory for LTI systems.

Module II (15 hours)

Passive systems- frequency domain, Passive systems- time domain, Robust Stability and performance, Stabilizing controllers - Co prime factorization.

Module III (15 hours)

LQR, LQG problems, Ricatti equations and solutions, Ricatti equation solution through LMI, H-infinity control and mu-synthesis, Linear matrix inequalities for robust control.

Suggested Readings

1. L. Fortuna, M. Frasca (Eds.), “Optimal and Robust Control”, CRC Press, 2012.
2. K. Zhou, J. C. Doyle and K. Glover, “Robust and Optimal Control”, Prentice Hall, 1996.
3. J. C. Doyle, B. A. Francis and A. R. Tannenbaum, “Feedback Control Theory”, Macmillan, 1992.
4. Benefits of FACTS Transmission line compensation, Uncompensated line –

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		H	
CO 3		H	
CO4		M	H

EEPS0072: POWER SYSTEM- I

(3 Credits-45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. List the various components used in a power system. (Remembering)
2. different protection schemes used to prevent faults in power system. (Understanding)
3. Identify suitable protection scheme used for a particular type of fault. (Applying)
4. Find various performance parameters of a power system by using given data. (Analyzing)
5. Experiments with Solar PV cell and formulate the I-V and P-V characteristics of PV panels. (Evaluating)

Objective

This is the basic course, which aims to make students aware of the basic concepts of electrical power systems and spells out the various components of an electrical power system. This course is the stepping-stone to make students understand how to model and analyze the power system under steady state operating conditions, under faulted conditions and the transient behavior of power systems whenever it is subjected to a fault.

Module I: Basic Concepts (8 lectures)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Synchronous Grids and Asynchronous (DC) interconnections. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module II: Power System Components (15 lectures)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Neutral Grounding transformers. Transformer Parameters. Single phase equivalent of three-phase transformers.
Synchronous Machines: Steady-state performance characteristics. Real and Reactive Power Capability Curve of generators. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module III: Over-Voltages and Insulation Requirements (4 lectures)
Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges.

Module IV: Fault Analysis (6 lectures)
Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Module V: Introduction to Protection Systems (6 lectures)
Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Module VI: Introduction to DC Transmission & Renewable Energy Systems (6 lectures)
DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). Solar PV systems: I-V and P-V characteristics of PV panels. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines

Suggested Readings

1. C.L. Wadhwa, “Electrical Power systems”, (5th Edition) New Age International Publishers.
2. D.P. Kothari, I.J. Nagrath, “Power System Engineering”, Second edition, Tata McGraw Hill.
3. W.D. Stevenson Jr., Elements of Power System Analysis, Mc Graw Hill.
4. V.K Mehta, Rohit Mehta, “Principles of Power Systems”, S. Chand.
5. Leon Freris, David Infi eld, “Renewable Energy in Power Systems”, Wiley, A John Wiley & Sons, Ltd, Publication.
6. Ashfaq Husain, “Electrical Power systems”, (5th Edition) CBS Publishers.
7. R. Gupta, “Generation of Electrical Energy”, S. Chand & Co. Ltd. N. Delhi
8. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
9. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
10. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2			M		H	
CO 3				L	H	
CO 4		H		M		
CO 5						H

EECS0073: CONTROL SYSTEMS

(3 Credits - 45 hours) (L-T-P : 3-0-0)

Course Outcomes

1. Define feedback and feed-forward control architecture. (Remembering)
2. Illustrate the concepts related to the operation analysis and stabilization of closed loop and open loop control systems using various control techniques. (Understanding)
3. Apply block diagram representations for simplifying complex control systems. (Applying)
4. Examine different controllers based on empirical tuning rules. (Analysing)

Objective
This course aims to familiarize the student with the concept mathematical modelling and analysis of Linear Time-Invariant (LTI) systems. Also, the course enables one to understand the concept of stability and its assessment for linear-time invariant systems. Design of simple feedback controllers is introduced. Mathematical modelling techniques like transfer function and state-space representations are introduced.

Module I: Introduction to Control Problem (5 lecture)

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Module II: Time Response Analysis (10 lecture)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module III: Frequency-Response Analysis (10 lecture)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module IV: Introduction to Controller Design (10 lecture)
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Module V: State Variable Analysis (10 lecture)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Suggested Readings
1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H		
CO 2	H	M		
CO 3			H	M
CO 4			H	

EEMM0074: MICROPROCESSORS AND MICROCONTROLLERS

(3 Credits - 45 hours) (L-T-P : 3-0-0)

Course Outcomes
1. List the various functional blocks of microprocessors and microcontrollers. (Remembering)
2. Explain the operation and configuration of the various functional blocks and pins of 8051 microcontroller. (Understanding)
3. Explain the functions of the assembly language instructions of 8051 microcontroller. (Understanding)
4. Make use of 8051 assembly language instructions to write programs for a given application. (Applying)
5. Design microcontroller based system for simple applications. (Creating)

Objective
This course provides an in-depth understanding of the architecture and operation of microprocessors and microcontroller, assembly language programming and microcontroller interfacing techniques. The students will be able to design and implement microcontroller-based systems in both hardware and software and can apply this knowledge to more advanced structures.

Module I: Fundamentals of Microprocessors (6 lecture)
Fundamentals of microprocessor architecture. 8-bit microprocessor and microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Module II: The 8051 Architecture (9 lecture)

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Module III: Instruction Set and Programming (8 lecture)
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Module IV: Timer, Serial Port and Interrupt Programming (10 lecture)
SFRs of Timers, Timer programming in assembly language and C, RS232 basics, Synchronous and asynchronous communication, SFRs for Serial Communication, Serial Port programming in assembly language and C, Interrupts of 8051, Interrupt programming in assembly language and C.

Module V: External Interfacing and Applications (12 lecture)
External memory interfacing, LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, ADC and DAC interfacing, sensors interfacing.

Suggested Readings
1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning, 2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education, 2009.
4. R. S. Gaonkar, “Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996.
5. D. A. Patterson and J. H. Hennessy, “Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.
7. Relevant datasheets.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	H	H	M		
CO 3		H		H	M
CO 4			M	H	
CO 5				H	H

EESS0075: SIGNALS AND SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
At the end of this course, students will be able to:
1. Define the basic terms related to continuous and discrete time LTI systems. (Remembering)
2. Classify the signals and systems into continuous-discrete, time varying-time invariant and linear-nonlinear types. (Understanding)
3. Make use of Fourier, Laplace and z-Transforms techniques in analysis of signals and systems. (Applying)
4. Examine the signals and systems by using the results of the transform techniques. (Analysing)
5. Estimate the continuous time equivalence of a discrete signal by applying reconstruction techniques. (Evaluating)

Objective
The Objective of the course is to acquaint the students with the various types of signals, which form the basis of electronic communication. The course also is intended to provide the theoretical background necessary to understand the working of any signal processing system and apply the techniques.

Module I: Introduction to Signals and Systems (10 hours)
a. Signals and systems as seen in everyday life and in various branches of engineering and science.

b. Signal properties: periodicity, absolute integrability, determinism and stochastic character.
c. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals;
d. Continuous and discrete time signals, continuous and discrete amplitude signals.
e. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module II: Behaviour of Continuous and Discrete-Time LTI Systems (12 hours)

a. Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations.
b. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role.
c. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module III: Fourier, Laplace and Z-Transforms (17 hours)

a. Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.
b. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour.
c. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module IV: Sampling and Reconstruction (6 hours)

a. The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.

Suggested Readings

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H		M	
CO 2	M	H		
CO 3			H	M
CO 4			H	L
CO 5			L	H

EEED0076: ELECTRICAL MACHINE DESIGN

(2 Credits - 30 hours) (L-T-P: 2-0-0)

Course Outcomes

1. Select proper materials for the design of electrical machines. (Remembering)
2. Design transformer, induction motor and synchronous machine. (Creating)
3. Execute software programs for designing electrical machines. (Applying)

Module I: Introduction (6 Lectures)

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Module II: Transformers (6 Lectures)

Sizing of a transformer, main dimensions, kVA output for single and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no-load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Module III: Induction Motors (6 Lectures)
Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Module IV: Synchronous Machines (6 Lectures)
Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Module V: Computer Aided Design (CAD) (6 Lectures)
Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Suggested Readings
1. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
3. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
4. R.K.Agarwal, "Electrical Machine Design
5. Rajini, V.S. Nagarajan "Electrical machine design", Pearson Education,2018

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	L	L	L	
CO 2		H	H	H	
CO 3					H

EEEW0077: ELECTROMAGNETIC WAVES

(2 Credits – 30 hours) (L-T-P: 2-0-0)

Course Outcomes
1. Relate the Electromagnetic Field quantities with the behaviour of Electromagnetic Waves. (Understanding)
2. Model Electromagnetic Wave propagating media for guided and free space propagation. (Applying)
3. Examine the working conditions of Transmission Lines, Waveguides and Antennae. (Analysing)

Objective
The objective of the course is to introduce the students with the study of the behaviour of electromagnetic waves, which have a one-dimensional spatial dependence (plane waves). The course will also provide a basis for fundamental theoretical as well as practical concepts related to plane waves.

Module I: Transmission Lines (6 lectures)
Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module II: Maxwell's Equations (5 lectures)
Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module III: Uniform Plane Wave (4 lectures)
Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module IV: Plane Waves at Media Interface (5 lectures)

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module V: Waveguides (5 lectures)
Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide- general approach, Rectangular waveguides.

Module VI: Antennas (5 lectures)
Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Suggested Readings
1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
4. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
5. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1		H	L	L		
CO 2			M	M	H	
CO 3	H				H	M

EEPS0079: POWER SYSTEM II

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Describe the concept of power System economics and management. (Remembering)
2. Explain the method of power system planning, operation and control. (Understanding)
3. Carry out numerical analysis for solving power system problems. (Applying)
4. Experiments with various load flow method, power quality issues and control of power systems. (Evaluating)

Objective
This course introduces the numerical methods for analyzing the power system in steady state and gives an understanding of the methods to control the voltage, frequency and various stability constraints in a synchronous grid also the monitoring and control and basics of economics of a power system.

Module I: Power Flow Analysis (7 hours)
Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Module II: Stability Constraints in Synchronous Grids (9 hours)
Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Module III: Control of Frequency and Voltage (9 hours)
Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap-Changing Transformers. Power flow control using embedded dc links, phase shifters.

Module IV: Monitoring and Control (10 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Module V: Power System Economics and Management (10 hours)
Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Wholesale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Suggested Readings
1. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O.I.Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. R. Bergen and V.Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1					H
CO 2	H	M	H	M	
CO 3	L	H			
CO 4	H	L	H		

EEMI0080: MEASUREMENTS AND INSTRUMENTATION

(2 Credits – 30 hours) (L-T-P: 2-0-0)

Objective
This subject is aimed at familiarizing the students with the principle, construction and uses of instruments utilized for the measurement of Current, Voltage, Resistance, Inductance, beside the measurement of passive elements.

Course Outcomes
1. Define various static characteristics of measurement systems. (Remembering)
2. Utilize the concepts of various instruments for measuring different electrical and non-electrical quantities (Applying)
3. Explain instrumentation systems using different sensors and transducers. (Evaluating)

Module I: Concepts Relating to Measurements and Errors (10 hours)
a. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
b. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.

Module II: Sensors and Transducers (10 hours)
a. a)Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
b. b)Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors. Measurements of R, L and C.

Module III: Measuring Instruments (10 hours)
Digital Multimeter, True RMS meters, Clamp-on meters, Meggers. Digital Storage Oscilloscope.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H		M
CO 2		H	H
CO 3		H	M

EEED0082: ELECTRICAL DRIVES

(3 credits-45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Describe the characteristics of D.C motor and relate the armature voltage control. (Remembering)
2. Explain the characteristics of the induction motor and recount the torque speed characteristics. (Understanding)

3. Implement knowledge of working of chopper fed DC drive and identify the quadrant of operation. (Applying)
4. Interrogate the impact of rotor resistance and assume the slip-ring induction motor for speed control. (Analyzing)
5. Check the ability to design a three-phase voltage source inverter and define the scalar control of the induction motor. (Evaluating)

Objective

Students will be able to understand and analyze the characteristics of various a.c and d.c motors and demonstrate the speed control using the power electronics converter.

Module I: DC motor characteristics (6 hours)

Review of emf and torque equations of DC machine, evaluation of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, armature voltage control for varying motor speed.

Module II: Chopper fed DC drive and Multi-quadrant DC drive (10 hours)

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper. Review of motoring and generating modes operation of a separately excited dc machine, four-quadrant operation of dc machine.

Module III: Closed-loop control of DC Drive (9 hours)

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions.

Module IV: Induction motor characteristics (8 hours)

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency.

Module V: Scalar control and Control of slip ring induction motor (12 hours)

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, slip regulation. Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, slip power recovery.

Suggested Readings

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modelling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2				H	M
CO 3		H	M		
CO 4				H	M
CO 5		M	H		

EEHV0083: HIGH VOLTAGE ENGINEERING

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Recall the concept of generation and measurement of D. C., A.C., & Impulse voltages. (Remembering)
2. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials. (Understanding)
3. Analyze the various tests on H. V. equipment and on insulating materials, as per the standards. (Analyzing)
4. Evaluate the various high voltage transmission system such as HVAC, HVDC etc. (Evaluating)

Objective

The subject helps in the detailed analysis of breakdown that occurs in gaseous, liquids and solid dielectrics and information about generation and measurement of high voltage and current along with high voltage testing methods.

Module I: Breakdown in Gases (8 hours)
Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge.

Module II: Breakdown in liquid and solid Insulating materials (7 hours)
Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Module III: Generation of High Voltages (7 hours)
Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Module IV: Measurements of High Voltages and Currents (7 hours)
Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Module V: Lightning and Switching Over-voltages (7 hours)
Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Module VI: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 hours)
Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Suggested Readings
1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		H	M		
CO 2		H				H
CO 3				H	H	
CO 4				H		H

EEDS0084: DIGITAL CONTROL SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Name different methods available for stability analysis of a system in the digital domain. (Remembering)
2. Classify various stability states of a system. (Understanding)
3. Model a system in a discrete domain. (Applying)
4. Analyse performance of digital controllers and systems. (Analysing).

Objective
This course aims to familiarize the student with the concept of system analysis and design in discrete-domain. Also, the course enables one to understand the concept of discrete representation of LTI systems, design and analyse digital controllers. Design of state feedback and output feedback controllers are introduced.

Module I: Discrete Representation of Continuous Systems (6 hours)
Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Module II: Discrete System Analysis (6 hours)

Z-Transform and Inverse Z Transform for analysing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time-response of discrete time system.

Module III: Stability of Discrete Time System (5 hours)
Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Module IV: State Space Approach for Discrete Time Systems (10 hours)
State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Module V: Design of Digital Control System(10 hours)
Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Module VI: Discrete Output Feedback Control (8 hours)
Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Suggested Readings
1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.
4. C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1		M	H	H	L	
CO 2			H	H		
CO 3				M	H	M
CO 4	H	H	H			

EEDP0085: DIGITAL SIGNAL PROCESSING

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Describe signals mathematically in continuous and discrete-time, and in the frequency domain. (Remembering).
2. Understanding the analytical tools such as Discrete Fourier Transforms, Fast Fourier Transforms and Z-Transforms essential for digital signal processing. (Understanding)
3. Implement digital signal processing for analysis of real-life signals. (Applying)
4. Check digital filters for various applications. (Evaluating)

Objective
This course aims to familiarize the student with the concept of signals and systems in discrete domain. Also, the course enables one to represent signals mathematically in continuous and discrete-time, and in the frequency domain. Analysis in Z-domain along with discrete Fourier transform is introduced. Design of digital filters and application of digital signal processing is introduced.

Module I: Discrete-Time Signals and Systems (6 hours)
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Module II: Z-Transform (6 hours)
Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using Z-Transform, Properties of Z-Transform for causal signals, Interpretation of stability in Z-domain, Inverse Z- transforms.

Module III: Discrete Fourier Transform (10 hours)
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Module IV: Design of Digital Filters (15 hours)
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Module V: Applications of Digital Signal Processing (8 hours)
Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Suggested Readings
1. S. K. Mitra, "Digital Signal Processing: A computer-based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H		H		
CO 2	H	H	H	M	
CO 3				M	H
CO 4			M	H	

EEMC0087: ADVANCED MICROCONTROLLER BASED SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. List the various functional blocks of a basic computer. (Remembering)
2. Recall the architecture of PIC microcontrollers. (Remembering)
3. Summarize the architecture of Intel 8051 and 8086 microcontrollers and microprocessors. (Understanding)
4. Summarize the architecture of DSP processors and FPGA. (Understanding)
5. Develop Intel and PIC microcontroller based systems. (Applying)

Objective
The course will help to develop an in-depth understanding of the basic computer architecture and organizations. Students will be able to understand the architecture and application of advanced microcontrollers, DSP processors and FPGA.

Module I: Basic Computer Organization (7 hours)
Basic computer organization. Accumulator based processes, Architecture, Memory Organization, I/O organization.

Module II: Intel 8051 Microcontroller and 8086 Microprocessor (14 hours)
Intel 8051, Intel 8086- Registers, Memories. I/O Ports, Serial communication. Timers, Interrupts, Programming. Intel 8051-Assembly language programming, Addressing operations, Stack & Subroutines, Interrupts-DMA.

Module III: PIC Microcontrollers (8 hours)
PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

Module IV: Digital Signal Processors (8 hours)
Digital Signal Proc Processor (DSP) – Architecture, Programming, Introduction to FPGA.

Module V: Applications (8 hours)
Microcontroller development for motor control applications. Stepper motor control using microcontroller.

Suggested Readings
1. John. F. Wakerly, "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Ramesh S. Gaonker, "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994.
3. Raj Kamal, "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
5. John Morton, "The PIC microcontroller: your personal introductory course", Elsevier, 2005.

6. Dogan Ibrahim, “Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series”, Elsevier, 2008.
7. Microchip datasheets for PIC16F877.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	L	L	L	
CO 2			H		H
CO 3		H			H
CO 4				H	L
CO 5		L	L	L	H

EEPQ0088: POWER QUALITY

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Explain about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads. (Understanding)
2. Explain the series and shunt active power filtering techniques for harmonics. (Understanding)
3. Classify different power quality issues. (Analyzing)
4. Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components. (Creating)
5. Improve power factor based on static VAR compensators. (Creating)

Objective

The objective of this course is to introduce the different power quality issues faced by the power system and understand the recommended practices by various standard bodies like IEEE, IEC, etc. on voltage & frequency, harmonics and understanding the concept of STATIC VAR Compensators in power systems.

Module I: Power quality issues (8 hours)

Introduction-power quality-voltage quality-overview of power, Quality phenomena classification of power quality issues, Power quality measures and standards-THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices.

Module II: Harmonics (8 hours)

Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices, SMPS, Three-phase power converters-arcing devices, saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Module III: Modeling of systems (6 hours)

Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, Ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

Module IV: Improvement and control in power system (6 hours)

Power factor improvement- Passive Compensation, Passive Filtering, Harmonic, Resonance, Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three-Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

Module V: Hamilton-Jacobi-Bellman model (8 hours)

Introduction to Hamilton-Jacobi-Bellman equation - model reference adaptive systems (MRAS) - Design hypothesis.

Module VI: Control methods (8 hours)

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested Readings

1. G. T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007.
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000.
3. J. Arrillaga, “Power System Quality Assessment”, John Wiley, 2000.
4. J. Arrillaga, B. C. Smith, N. R. Watson and A. R. Wood, “Power system Harmonic Analysis”, Wiley, 1997.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1		H		L	
CO 2			H		H
CO 3		H		H	
CO 4		H			
CO 5			L	H	

EEWE0092: WASTE TO ENERGY

(3 Credits – 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Select the appropriate method for Biomass pyrolysis, biomass gasification and biomass combustion for waste to energy conversion. (Remembering)
2. Explain waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies. (Understanding)
3. Implement energy conversion system for conversion of waste to electrical energy. (Applying)
4. Design cooking stoves, digester, gasifier. (Creating)

Objective

The objective of this course is to introduce different sources, processes to carry on waste to energy conversion. The students will be able to design different systems and devices for converting waste materials to useful energy.

Module I: Introduction to Energy from waste (9 hours)

Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors.

Module II: Biomass Pyrolysis (9 hours)

Pyrolysis, Types, slow, fast, Manufacture of charcoal, Methods, Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module III: Biomass Gasification (9 hours)

FiFixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Module IV: Biomass Combustion (9 hours)

Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation, Operation of all the above biomass combustors.

Module V: Biogas (9 hours)

Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, Types of biogas Plants, Applications, Alcohol production from biomass, Bio-diesel production, Urban waste to energy conversion, Biomass energy programme in India.

Suggested Readings:

1. Ashok V. Desai, “Non Conventional Energy”, Wiley Eastern Ltd., 1990.
2. K. C. Khandelwal and S. S. Mahdi, “Biogas Technology - A Practical Hand Book - Vol. I & II”, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. D. S. Challal, “Food, Feed and Fuel from Biomass”, IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan, “Biomass Conversion and Technology”, John Wiley & Sons, 1996.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	H	H	H	
CO 2	H	M	M	M	M
CO 3			H	H	
CO 4				H	M

EEAD0093: ANALOG AND DIGITAL COMMUNICATIONS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Define different modulation techniques. (Remembering)
2. Apply probability and random process principles for noise analysis in communication channels. (Applying)
3. Analyze and compare different analog modulation schemes for their efficiency and bandwidth. (Analysing)
4. Estimate the inter symbol interference in digital modulation schemes. (Evaluating)

Objective

This course aims to familiarize the students with the concepts of communication systems. The course enables one to understand different modulation techniques both in analog and digital domains. Also, the course enables one to understand the behaviour of a communication channel and errors associated.

Module I: Review of Signals and Systems and Analog Modulation (10 hours)

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Module II: Review of Probability and Random Process and Noise in Different Modulation Schemes (6 hours)

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module III: Pulse Data Communication (8 hours)

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Module IV: Signal Detection (6 hours)

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations.

Module V: Digital Modulation (15 hours)

Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.Digital Modulation trade-offs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Suggested Readings

1. Haykin S., “Communications Systems”, John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., “Communication Systems Engineering”, Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., “Principles of Communication Engineering”, John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., “Digital Communication”, Kluwer Academic Publishers, 2004.
6. Proakis J.G., “Digital Communications”, 4th Edition, McGraw Hill, 2000.
7. H P Hsu, “Analog and Digital Communications”, Special Indian Edition 2006, Tata McGraw Hill

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M	M		M
CO 2		H	M	M	
CO 3	H				
CO 4	M				H

EESP0094: POWER SYSTEM PROTECTION

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Recall the basic concepts of CT, PT, relays, CB and power system protection attributes. (Remembering)
2. Summarize the different components of a protection system. (Understanding)
3. Develop the understanding of digital protection basic principles. (Applying)

4. Analyse the various protection schemes for different power system components. (Analysing)
5. Evaluate fault current due to different types of fault in a network. (Evaluating)

Objective

The objective of this course is to introduce the students to power system protection problems and the basic concepts of its modeling and analysis. This course introduces the basic theory, construction, usage of current and voltage transformers, relays and circuit breakers. It covers the protection systems used for electric machines, transformers, bus-bars, overhead and underground lines, over- voltages, and digital protection.

Module I: Introduction and Components of a Protection System (8 hours)

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers.

Module II: Faults and Over-Current Protection (8 hours)

Review of Fault Analysis, Sequence Networks. Introduction to Over-current Protection and over-current relay coordination.

Module III: Equipment Protection Schemes (12 hours)

Directional, Distance, Differential protection. Transformer and Generator protection. Bus-bar Protection, Bus Bar arrangement schemes. Feeder Protection. Earth fault relays.

Module IV: Digital Protection (8 hours)

Comparators, Introduction and block diagram of numerical relay, Computer-aided protection, Sampling Theorem.

Module V: System Protection and Simulation of Protection Schemes (9 hours)

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, Under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Simulation of transients.

Suggested Readings

1. J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, New York, 1987.
2. Y. G. Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.
3. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.
4. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008.
5. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.
6. P. M. Anderson, “Power System Protection”, Wiley-IEEE Press.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	H	H	M		
CO 3		H		H	M
CO 4			M	H	
CO 5				H	H

EERE0095: RENEWABLE ENERGY SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Choose the most suited energy generation systems for potential locations of applications. (Remembering)
2. Understand the basic physics of wind and solar power system.(understanding)
3. Identify the potential fields of renewable energy applications. (Applying)
4. Examine the power electronic interfaces for renewable energy systems. (Analyzing)

Objective:

The objective of this course is to understand and analyze the importance and potential of renewable energy, study the working principle and mechanism of the different renewable energy sources and to introduce the different renewable energy sources and its application in the current context

Module I: Physics of Wind Power (6 hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module II: Wind generator topologies (6 hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Power electronic converters. Generator-Converter configurations, Converter Control.

Module III: The Solar Resource (5 hours)
Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module IV: Solar Photovoltaic (10 hours)
Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Module V: Network Integration Issues (10 hours)
Overview of grid code technical requirements. Voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems, Integration in Smart Grid System.

Module VI: Solar Thermal Power Generation (2 hours)
Technologies, Fresnel reflector, solar pond, elementary analysis.

Module VII: Micro Hydel Generation (3 hours)
Operating principles. Power and Efficiency of Micro Hydel plant. Control, Automation and Monitoring in a Small Hydro Plant. Components of a microhydel power plant, Load balancing.

Module VIII: Bioconversion (3 hours)
Biomass, physical and biological thermal methods of bioconversion. Solid fuels, ethanol, methanol, vegetable oils. Biomass fuels in IC engines. Alcohol fuels, vegetable oils, producer gas.

Suggested Readings

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. G.D. Rai, Non-conventional energy sources, Khanna publishers.
4. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
5. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems”, John Wiley and Sons Ltd., 2006.
6. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
7. J.A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8
CO 1	M	M						
CO 2			M			H		
CO 3				L	H			
CO 4				H	M			

EEPQ0096: POWER QUALITY AND FACTS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. List the effect of shunt and series reactive compensation. (Remembering)
2. Explain the working principles of FACTS devices. (Understanding)
3. Compare performance of various FACTS devices. (Analyzing)
4. Experiment with various FACTS devices to mitigate power quality issues. (Evaluating)

Objective
This course gives an introduction to the power quality and application of Flexible Ac Transmission Systems to enhance controllability and power transfer capability in ac systems and involves applications of power electronics devices in power systems to improve reliability of power supply and opens up new opportunities for controlling power and enhancing the usable capacity of present, as well as new and upgraded lines.

Module I: Series/Shunt Reactive Power Compensation (4 hours)
Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Module II: Thyristor-based Flexible AC Transmission Controllers (8 hours)
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch, Configurations/Modes of Operation, Harmonics and control of SVC and TCSC, Fault Current Limiter.

Module III: Voltage Source Converter based FACTS controllers (12 hours)
a. Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs, Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation.
b. FACTS controller: Principle of Operation, operation of STATCOM ,Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller, Principle of Operation and Control. Working principle of Interphase Power Flow Controller, Other Devices: GTO Controlled Series Compensator.

Module IV: Application of FACTS (8 hours)
Application of FACTS devices for power-flow control and stability improvement, Simulation example of power swing damping in a single-machine infinite bus system using a TCSC, Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Module V: Power Quality Problems in Distribution Systems (8 hours)
Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve. Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

Module VI: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)
Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies, Series Active Filtering, Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Suggested Readings
1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGrawHillEducation, 2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	H	M	M		
CO 2		M	M	M		M
CO 3		M	M	L		L
CO 4		L	M	L	H	M

EEIS0097: INDUSTRIAL ELECTRICAL SYSTEMS

(3 Credits – 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. List the various components and define the various terminologies used in residential, commercial and industrial electrical systems. (Remembering)
2. Explain the construction, operations and application of various electrical components used and different methods employed in design of residential, commercial and industrial electrical systems. (Understanding)
3. Determine the ratings of various components used in residential, commercial and industrial electrical systems. (Applying)
4. Design residential, commercial and industrial electrical systems for a given problem. (Creating)

Objective
The objective of this course is to introduce the students to electrical wiring systems for residential, commercial and industrial consumers. The various concepts related to illumination systems for residential and commercial premises will be studied. Industrial Electrical System Automation is covered in detail.

Module I: Electrical System Components (8 hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays,MPCB, Electric shock and Electrical safety practices

Module II: Residential and Commercial Electrical Systems (8 hours)
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices,earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Module III: Illumination Systems (8 hours)
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Module IV: Industrial Electrical Systems I (8 hours)
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Module V: Industrial Electrical Systems II (6 hours)
DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Module VI: Industrial Electrical System Automation (7 hours)
Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Suggested Readings
1. S. L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. Web site for IS Standards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO1	H	M	H	M	M	M
CO2	L	H	H	H	H	H
CO3	M	H	H	M	M	L
CO4	L	H	H	H	M	L

EECA0098: ELECTRICAL ENERGY CONSERVATION AND AUDITING

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Apply the concept of energy management to improve energy efficiency in different electrical systems. (Applying)
2. Analyze the concepts of different energy efficient devices. (Analyzing)
3. Choose the appropriate energy conservation methodology for a particular energy source. (Evaluating)
4. Adapt new and efficient methodology to auditing. (Creating)

Objective
The objective of the course is to introduce energy conservation methodologies and importance of energy audit, measurement, energy performance diagnosis and analysis and carryout financial analysis and cost prediction for energy saving. The course also addresses the energy management issues in various sectors.

Module I: Energy Scenario (6 hours)
Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment,

energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module II: Basics of Energy and its various forms (7 hours)
Electricity tariff, load management and maximum demand control, power factor improvement, election & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Module III: Energy Management & Audit (6 hours)
Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module IV: Energy Efficiency in Electrical Systems (7 hours)
Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Module V: Energy Efficiency in Industrial Systems (8 hours)
Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Module VI: Energy Efficient Technologies in Electrical Systems (8 hours)
Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Suggested Readings

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online).
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).
3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org).

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	L		H			
CO 2					H	H
CO 3		L		M	L	M
CO 4	L		H	L		

EEOD0099: OPTOELECTRONIC DEVICES

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Describe and show the working of basic optoelectronics devices such as optical sources, detectors, optical amplifiers and connectors, etc. (Remembering)
2. Explain the nature and performances of various types of optical sources, photodetectors, connectors and couplers (Understanding)
3. Implement mathematical models to compute the efficiencies and other parameters related to optoelectronic sources, detectors and amplifiers. (Applying)

4. Check the performance characteristics of optical sources, detectors, optical amplifiers and other optoelectronics components. (Evaluating)

Objective

The course is intended to give the students an exposure to the design criteria for semiconductor optical sources including light emitting diodes and laser diodes, optical detectors, amplifiers and connectors for a variety of applications.

Module I: Sources (15 hours)

Light Emitting Diodes (LEDs), LED Structures, LED types, Fabrication of LED, Light Source Materials, Internal Quantum Efficiency, Modulation Capacity, Transient Response, Power– Bandwidth Product, Laser Diodes, Laser Diode Modes and Threshold Conditions, Single mode operation, Mode locking, Q-switching, Holography, Resonant Frequencies, Laser Diode Structures and Radiation Patterns, Single Mode Lasers, Modulation of Laser Diodes, Temperature Effects, Light Source Linearity, Modal Partition and Reflection Noise.

Module II: Detectors (10 hours)

PIN Photo-Detector, Avalanche Photodiodes, Photo-Detector Noise, Noise Sources, Signal-to-Noise Ratio, Depletion Layer Photocurrent, Response Time, Avalanche Multiplication Noise, Temperature Effects on Avalanche Gain, Photodiode Materials.

Module III: Amplifiers and Switches (10 hours)

Optical Amplifiers, Semiconductor Laser Amplifiers, Fiber Amplifiers, Rare Erbium Doped Fiber Amplifiers, Raman Fiber Amplifiers, Brillion Fiber Amplifiers, Amplifier Gain, Noise Figure, Bandwidth, Photonic Switching, Integrated Optical Switches.

Module IV: Connectors and Couplers (10 hours)

Cylindrical Ferrule Connector, Bi-Conical Ferrule Connectors, Double Eccentric Connectors, Duplex Fiber Connectors, Expanded Beam Connectors, Beam Splitter, Three Port Couplers, Four Port Couplers, Directional Couplers, Star Couplers, Lenses for Coupling Improvement.

Suggested Readings

1. J. Wilson, J.F.B. Hawkes, “Optoelectronics - An Introduction”, Prentice Hall of India Private Limited.
2. G. Keiser, “Optical Fiber Communications”, McGraw Hill.
3. D.K. Mynbaev and L.L. Scheiner, “Fiber Optic Communications Technology”, Pearson.
4. S.K. Sarkar, “Optical Fibers and Fiber Optic communication system”, S. Chand and Co.
5. J.C. Palais, “Fiber Optic Communications”, Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H		H	H
CO 2	H	H	M	H
CO 3	H	H	M	L
CO 4	H	H	M	

EEEL0100: ELECTRICAL AND ELECTRONICS MATERIALS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Describe basic terminologies related to properties of materials used in electrical engineering. (Remembering)
2. Explain the electrical and thermal characteristics of conducting, semiconducting, insulating and magnetic materials for the manufacturing of electrical machines and electronic components. (Understanding)
3. Implement advanced studies in solar photovoltaic material for green and clean power generation in view of sustainable development through environmental and safety aspects. (Applying)
4. Compare different material behavior. (Analyzing)
5. Check the performance of different electrical materials. (Evaluating)

Objective

The objective of the course is to provide the knowledge of different electrical engineering materials and their applications in designing electrical equipment. The course also provides the study of thermal properties for the efficient design and long-life cycle of electrical equipment.

Module I: Conductors (8 hours)

Classification: High conductivity, high resistivity materials, Fundamental requirements of high conductivity materials and high resistivity materials, Mobility of electron in metals, Factors affecting conductivity and resistivity of electrical material.
Thermoelectric Effect: See back effect, Peltier effect, Thomson effect. Commonly used high conducting materials, properties, characteristics and applications of copper, aluminum, bronze, brass, High resistive materials, Constantan, platinum, nichrome, properties, characteristics, Materials used for AC and DC machines.

Module II: Semiconductors and Superconductors (8 hours)
General concepts, energy bands, Types of semiconductors: intrinsic Semiconductors, extrinsic Semiconductors. Compound semiconductor, amorphous semiconductor. Hall effect, drift, mobility, diffusion in Semiconductors. Semiconductors and their applications.
Superconductors: Superconductivity, Properties of Superconductors, Critical field, Meissner effect, Type-I and type-II Superconductors.

Module III: Dielectrics and Insulators (8 hours)
Properties of gaseous, liquid and solid dielectric, dielectric as a field medium, Electric conduction in gaseous, liquid and solid dielectric, Breakdown in dielectric materials, mechanical and electrical properties of dielectric materials, Effect of temperature on dielectric materials, polarization, loss angle and dielectric loss. Petroleum based insulating oils, transformer oil, capacitor oils, and properties. Classification of insulation (Solid) and application in AC and DC machines. Solid electrical insulating materials, fibrous, paper boards, yarns, cloth tapes, sleeving wood, impregnation, plastics, filling and bounding materials, fibrous, film, mica, rubber, mica-based materials, ceramic materials.

Module IV: Magnetic Materials (8 hours)
Basic terms, Classification of magnetic material, diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic and amorphous material. Hysteresis loop, magnetic susceptibility, coercive force, curie temperature. Magnetostriction, factors affecting permeability and hysteresis loss. Common magnetic materials, Soft and hard magnetic materials. Electric steel, sheet steel, cold rolled grain-oriented silicon steel, hot rolled grain-oriented silicon steel, hot rolled silicon steel sheet.

Module V: Insulating Materials (6 hours)
Gaseous materials-Oxide gases, electronegative gases, hydrocarbon gases; Liquid materials-mineral oils, silicon liquids, hydrocarbon liquids; Solid Materials-Paper and boards, Resins (Polymers), Rubbers-natural and synthetic, glass, ceramics, asbestos.

Module VI: Modern Engineering Materials (7 hours)
Materials for Electronic Components - Resistors, Capacitors, Inductors, Relays, Bipolar transistors, Field effect transistor (FET), Integrated circuits, Power devices.
Nanotechnology – Introduction, Nano-devices, applications.
Solar/Photovoltaic Cell- Introduction, Photo-generation of charge carriers, p-n junction, Light absorbing materials: Silicon thin films, concentrating photovoltaic.

Suggested Readings

1. S. L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. S.P. Seth, “A Course in Electrical Engineering Materials”, Dhanpat Rai Publishing Co Pvt Ltd.
5. Web site for IS Standards.
6. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.
7. A. J. Dekker, “Electrical Engineering Materials”. PHI Pvt. Ltd.
8. C. S. Indulkar and S. Thiruvengadam, “Electrical Engineering Materials”, S. Chand Publication.
9. G. P. Chhaiotra and B.K. Bhat, “Electrical Engineering Materials”, Khanna Publication, 1991.
10. N. Alagappan and N.T. Kumar, “Electrical Engineering Materials”, 34th edition, Technical Teachers' Training Institute, Madras, Tata McGraw-Hill Education.
11. P.L. Kapur, “A Text Book of Electrical and Electronics Engineering Materials”, 8th edition, Khanna Publishers.
12. S.K. Bhattacharya, “Electrical and Electronics Engineering Materials and Components”, Khanna Publishers.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1		H		H		
CO 2	H	H		H		

CO 3	M	H	M	H		
CO 4	H	H	H	M	M	M
CO 5	L	H	M			H

EEOT0101: OPTIMIZATION TECHNIQUES

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Define and explain the importance in solving engineering problems using Linear Programming. (Remembering)
2. Identify and describe the various types of formulation methods like Simplex Method, Dual Simplex Method. (Understanding)
3. Establish the need for linear programming and classify different non-linear programming methods in solving system. (Analysing)
4. Evaluate the performance characteristics of genetic algorithm and particle swarm optimization. (Evaluating)

Objective

This subject introduces optimization theory and its importance in solving of engineering problems. Students can learn linear and nonlinear programming, constrained and unconstrained optimization in this subject

Module I: Introduction & Linear Programming (18 hours)

Importance in solving system engineering problems, Introduction to Linear Programming problem-Formulation, Simplex Method, Dual Simplex Method, Sensitivity Analysis, Duality in Programming.

Module II: Introduction to Nonlinear Programming (10 hours)

Unconstrained optimization-formulation of quadratic optimization problems, gradient descent and steepest descent methods, Quasi-Newton Method, Fibonacci and golden section, Quadratic Interpolation method.

Module III: Constrained Optimization (10 hours)

Direct optimization, Cutting plane methods, methods of feasible direction, analytic center cutting plane methods, Multi-objective optimization-Genetic Algorithm, Kuhn-Tucker conditions.

Module IV: Dynamic Programming (7 hours)

Principle of optimality, recursive equation approach, application to shortest route, Cargo Loading, allocation & production, schedule problems.

Suggested Readings

1. S. S. Rao, Optimization theory and applications, Wiley Eastern Ltd.
2. K. V. Mittal, Optimization methods, Wiley Eastern Ltd.
3. R. Fletcher, “Practical Optimization”, John Wiley and Sons, New York.
4. M. S. Bazaraa, H. D. Sherali and C. Shetty, “Nonlinear Programming, Theory and Algorithms”, John Wiley and Sons, New York.
5. N. A. Kheir, “System modeling and computer simulation”, Marcel Decker, New York.
6. G.A Korn., “Interactive Dynamic System Simulation”, McGraw Hill, N.Y.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	L		
CO 2	H	L		
CO 3	M	H	M	
CO 4		M	M	H

EEGE0102: GREEN ENERGY

(3 Credits: 45 Hours) (L-T-P: 3-0-0)

Course Outcomes

1. List and recognize the various renewable energy resources and their importance. (Remembering)
2. Summarize the power generation using renewable energy resources. (Understanding)
3. Identify the potential fields of renewable energy applications. (Applying)
4. Experiments with modeling of renewable energy resources. (Evaluating)

Objective

The objective of this course is to introduce the different renewable energy resources and their applications. The course helps in understanding the importance and potential of renewable energy resources, the working principles and mechanisms of the different renewable energy sources and their analysis in the current context.

Module I: Introduction (3 hours)

Energy needs of India, classification of energy sources, energy efficiency and energy security, importance of renewable energy resources.

Module II: Solar Energy (11 hours)

Basic concepts, types of collectors, collection systems, photo voltaic (PV) technology: solar thermal effect, solar cells, characteristics of PV systems, equivalent circuit, and array design, building integrated PV system and efficiency calculations, applications.

Module III: Wind Energy (10 hours)

Wind power systems, wind speed and power relation components, turbine types, turbine rating. Choice of generators and site selection, wind energy forecasting, variable speed operation, maximum power operation.

Module IV: Bio energy (9 hours)

Bio-mass and bio-gas: principles of bio-conversion, bio-gas digesters types, gas yield, and combustion characteristics, fermentation and wet processes, applications-utilization for cooking.

Module V: Other renewable energy Resources (12 hours)

Hydro energy, Geothermal energy, ocean thermal energy, wave energy, Tidal energy, waste to energy, heat to energy, Fuel cells: types and applications.

Suggested Readings

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. G.D. Rai, Non-conventional energy sources, Khanna publishers.
4. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
5. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems”, John Wiley and Sons Ltd., 2006.
6. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
7. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	L	L	L	L	L
CO 2		M	M	M	
CO 3		H	H	L	L
CO 4		H	H		

EEEU0103: ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

(4 Credits- 60 Hours) (L-T-P : 4-0-0)

Objective

The objective of this course is to familiarize the students regarding the various electrical systems and the methods adopted for determining the efficiency of the common household and industrial electrical utilities. The course also deals with the energy conservation bills and codes in practice in India. This course is designed for all engineering students, scholars, academicians and practitioners.

Course/Learning Outcomes:

At the end of the course, the students will be able to:

1. Explain energy management based on demand/load control. (Understanding)
2. Identify opportunities for Energy Saving in Electrical Utilities. (Applying)
3. Examine the implementation of ECBC in Electrical Installations in Buildings. (Analyzing)
4. Estimate efficiency of Electrical Equipment installed at various utilities. (Evaluating)

Module I: Electrical Systems (24 hours)

Electric Power Supply Systems, Electricity Billing, Load Management, Demand Control, Significance of Power Factor, Transformers, Transmission and Distribution Losses, Demand Side Management, Harmonics, Analysis of Electrical Power Systems.

Module II: Energy Efficiency in Electrical Utilities (16 hours)
Energy efficiency calculations and energy saving opportunities in electrical utilities: Electrical Motors, Compressors, HVAC and Refrigeration Systems, Fans and Blowers, Pumps and Pumping System, Cooling Towers, Lighting System, Diesel and Natural Gas Generating System.

Module III: Energy Conservation in Buildings and ECBC (20 hours)
Building definition as in the Energy Conservation Bill 2010, Energy Conservation Building Code (ECBC), Compliance approaches, ECBC guidelines on building envelope, heating ventilation and air conditioning system, service hot water, lighting, electrical power, building water pumping systems. Uninterruptible power supply. Escalators and elevators. Building Management System (BMS), star rating of buildings, energy efficiency measures in buildings.

Suggested Readings
1. Martinez, Daniel M., Ben W. Ebenhack and Travis P. Wagner, "Energy Efficiency: Concepts and Calculations", Elsevier, 2019.
2. Desideri, Umberto and Francesco Asdrubali (eds.), "Handbook of energy efficiency in buildings: a life cycle approach", Butterworth-Heinemann, 2018.
3. Sumper, Andreas, and Angelo Baggini, "Electrical energy efficiency: technologies and applications", John Wiley & Sons, 2012.
4. "Energy Efficiency in Electrical Utilities: Guide Book for NCE", Bureau of Energy Efficiency, 2015.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H		
CO 2		M	H
CO 3		L	H
CO 4		H	

EEED0104: ELECTRICAL DISTRIBUTION SYSTEM ANALYSIS

(4 Credits- 60 Hours) (L-T-P: 4-0-0)

Course Outcomes
1. Define terms related to electrical power distribution system. (Remembering)
2. Explain the concepts of various distribution transformers and feeders, load characteristics, and associated factors. (Understanding)
3. Model various components of an electrical distribution system. (Applying)
4. Analyze distribution systems, short circuit faults and load flows. (Analyzing)
5. Evaluate the Electrical distribution system for optimum performance. (Evaluating.

Objective
The objective of this course is to make the students familiar with topics on electrical distribution system planning, load characteristics, application of distribution transformers, design of sub-transmission lines, distribution substations, primary systems, and secondary systems, voltage drop and power-loss calculations, application of capacitors, harmonics on distribution systems, voltage regulation, and smart grid concepts. This course shall introduce the modeling of the components (feeders, distribution transformer, regulators, capacitors, loads, distributed generation, storage, etc.) and analysis methods (load flow, short-circuit, etc.), specially developed for the distribution system.

Module I: Structure & Planning of a distribution system (13 hours)
Introduction to Electrical Distribution System, Distribution System Planning, Factors Affecting System Planning, Present Distribution System Planning Techniques, Central Role of the Computer in Distribution Planning, Distribution System Automation, load characteristics, Diversified demand, Non-coincident demand, Coincidence factor, Contribution factor problems, Relationship between the Load and Loss Factors, Load Forecasting.
Distribution feeder configurations and substation layouts, Nature of loads in a distribution system, Load allocation in a distribution system.

Module II: Design consideration and Approximate methods of analysis (15 hours)

Types of Distribution transformers, Regulation, Efficiency, single-phase transformer connections, Three-phase transformer connections, Auto-transformer, Booster transformer, phasor diagrams, Grounding Transformers.
Radial type, Loop type primary feeder, primary feeder loading, Radial Feeders with Uniformly Distributed Load, Introduction to Secondary Systems, secondary Banking, Secondary networks.
Computation of transformer and feeder loading; "K" Factors and their applications, voltage drop and power loss calculations; Distribution of loads and various geometric configurations.

Module III: Modeling of distribution system components (17 hours)
3-phase and Non 3-phase primary lines, Single-phase two-wire laterals with ungrounded neutral, Single-phase two-wire ungrounded laterals, Application of capacitors to distribution systems, Effect of series and shunt capacitors, power factor correction, Economic justification for capacitors, Optimum location for capacitor bank.
Modeling of Overhead lines, feeders and cables, Single and three-phase distribution transformers, Voltage regulators, Load models in distribution system; Application and modeling of Capacitor banks; Modeling of Distributed generation.

Module IV: Distribution system analysis (15 hours)
Load flow analysis: Algorithms & Examples - Backward/forward sweep method, Direct approach method, Direct approach method for weakly meshed systems, Gauss Implicit Z-matrix Method.
Short-circuit analysis: Sequence-components vs. phase-variable based methods; Direct approach method for Short-circuit analysis- LG, LLG, LLLG, and LL Faults, Weakly meshed system; Applications of distribution system analysis and future smart-grid.

Suggested Readings

1. Turan Gönen, "Electric Power Distribution Engineering", 3rd Edition, CRC Press, 2014.
2. William H. Kersting, "Distribution System Modeling and Analysis", 4th Edition, CRC Press, 2018.
3. Abdelhay A. Sallam, Om P. Malik, "Electric Distribution Systems", 2nd Edition, Wiley-IEEE, 2019.
4. Biswarup Das (Ed.), "Power Distribution Automation", IET Power and Energy, 75, 2016.
5. Juan M. Gers, "Distribution System Analysis and Automation", IET Power and Energy, 68, 2013.
6. S. Pabla, "Electric Power Distribution", McGraw Hill Education (India) Pvt. Limited, 2011.
7. T. A. Short, "Electric Power Distribution Equipment and Systems", CRC Press, 2006.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		L
CO 2	L	H	M	
CO 3		L	H	M
CO 4		M		H
CO 5		M	L	H

EEDM0105: DC MICROGRID

(4 Credits - 60 hours) (L-T-P: 4-0-0)

Course Outcomes
1. List the various microgrid components. (Remembering)
2. Describe the modeling and control of microgrid. (Understanding)
3. Solve problems related to microgrid operation and control. (Applying)
4. Experiments with modeling of renewable energy resources. (Evaluating)

Objective
This course details the fundamental concepts of microgrid and its components, types, advantages of microgrid compared to the central conventional grid. Particularly the course describes general concepts and application, control strategies and principle of operation of DC microgrid.

Module I: Introduction of microgrid (10 hours)
Overview of microgrids, concepts of microgrids, microgrid and distributed generation, microgrid vs conventional power system, AC and DC microgrid with distributed energy resources, power electronics for microgrid, power electronic converters in microgrid applications.

Module II: Modeling of microgrid components (20 hours)

Distributed energy resources (DERs) modelling I: PV system, MPPT, and grid-tied interface – Distributed energy resources modeling, Microturbine, energy storage and other DERs, Distribution power flow, Modeling of converters in microgrid power system (AC /DC and DC/AC Converters Modeling), Modeling of Renewable Energy Resources (Modeling of Wind Energy System, Photovoltaic System, Modeling of Energy Storage System.

Module III: Control of Microgrid (15 hours)

Microgrid Dynamics and Modeling, Microgrid Operation Modes and Standards, Microgrid Control Architectures, Intelligent Microgrid Operation and Control, Energy Management in Microgrid System, DC Microgrid System Architecture and AC Interface, DC Microgrid Dynamics and Modeling, Control of DC Microgrid System, Applications of DC Microgrids, Cyber Security in Microgrids.

Module IV: Stability analysis of Microgrid (15 hours)

Stability in Microgrid, Stability Analysis of DC Microgrid, Stability Analysis of DC Microgrid, DC Microgrid stabilization strategies (passive damping method), DC Microgrid Stabilization Strategies (Impedance/Admittance stability criteria), DC microgrid stabilization using nonlinear Techniques.

Suggested Readings

1. Fusheng Li, Ruisheng Li and Fengquan Zhou, “Microgrid Technology and Engineering Application”, Elsevier, 2015
2. S. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks”, Institution of Engineering and Technology, 2009
3. Nikos Hatziargyriou, “Microgrids Architectures and Control”, John Wiley Sons, 2014
4. Manuela Sechilariu and Fabrice Locment, “Urban DC Microgrid: Intelligent Control and Power Flow Optimization”, Butterworth-Heinemann, 2016

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2	H	H		
CO 3		L	H	L
CO 4		H		

EEPO0106: PRACTICAL APPLICATIONS OF OPAMP

(4 Credits - 60 hours) (L-T-P: 4-0-0)

Course Outcomes

1. Understand the operation of the basic building blocks of analog system. (Understanding)
2. Understand and analyze the Op-Amps. (Understanding)
3. Understand feedback techniques and its advantages. (Understanding)
4. Design amplifiers using Op-Amps. (Creating)

Objective

This course is a system design-oriented course aimed to provide exposure on applications of op-amps and its importance in the real world. Since analog circuits play a crucial role in the implementation of an electronic system, this course emphasis 0n complete system design with initial discussion on circuit design. As part of this course, students can build analog systems using analog ICs and study their macro models.

Module I: Basics of Op-Amps (15 hours)

Understanding the Datasheet of Op-Amps, introduction to op-amps and discussion on its characteristics by simulation and experiment, basics of Hysteresis and the need of hysteresis in switching circuits.

Module II: Some applications of Op-Amps (15 hours)

Op-Amp Circuits Analog-to-Digital Converter (ADC) Digital-to-Analog Converter (DAC) using Op-Amps

To design and build a function generator capable of generating square wave and a triangular wave of a known frequency using simulation and experiment by TI analog system lab kit pro.

Module III: Advanced applications of Op-Amps (15 hours)

To design and build a voltage-controlled oscillator using simulation and TI analog system lab kit pro.

To design and build an automatic volume control using simulation and TI analog system lab kit pro.

To design and build a constant current drive circuit for measuring unknown resistance using simulation and experiment on breadboard.

Module IV: Signal conditioning of Op-Amps (15 hours)

To design and build a temperature-controlled system using op-amps as ON-OFF controller and Proportional controller by simulation and Experiment on breadboard.

To design and build a signal conditioning circuit for the thermocouple to compensate for temperature correction.

To design and Implement a speed controller of a DC motor using simulation and experiment.

Suggested Readings

1. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J.V. Wait, L.P. Huelsman and G.A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2	H	M	M	
CO 3				H
CO 4			H	H
CO 5			M	H

EESD0107: SENSORS AND TRANSDUCERS

(4 Credits - 60 hours) (L-T-P: 4-0-0)

Course Outcomes

1. Make use of different types of electrical and industrial sensors as well as transducers for practical applications. (Applying)
2. Determine the performance parameters of the electrical sensors for relevant application. (Analyzing)
3. Test electrical circuits and set-up using sensors and transducers of different types. (Creating)

Objective

The objective of this course is to familiarize the students with the various electrical sensors and transducers used in different applications. Measurement techniques for electrical as well as non-electrical quantities using the sensors and transducers are to be dealt with in detail in the subject.

Module I: Introduction to Electrical Measurement (6 hours)

Electrical measurement and measuring instruments, Analog and digital instruments, Performance of measuring instruments- Error, Accuracy, Precision, Sensitivity, Resolution and Repeatability of measurement. Primary and Secondary instruments.

Module II: Sensors and Transducers (22 hours)

Introduction to Sensors and Transducers, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers.

Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer.

Synchros and Resolvers, Induction Potentiometers, Micro Electromechanical Systems.

Module III: Measurement of Non – Electrical Quantities (17 hours)

Temperature Measurement, Flow Measurement – Introduction, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Meters, Wire Anemometers.

Measurement of Displacement, Measurement of Velocity/ Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power.

Measurement of Liquid Level, Measurement of Viscosity.

Suggested Readings

1. Mike J. Usher and D. A. Keating, “Sensors and transducers: characteristics, applications, instrumentation, interfacing”, Macmillan International Higher Education, 1996.
2. A. K. Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Company, 2019.
3. D. Patranabis, “Sensors and Tranducers”, PHI Learning Pvt. Ltd., 2003.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1		H	M
CO 2	L	H	
CO 3		M	H

EEPI0108: PROCESS CONTROL AND INSTRUMENTATION

(4 Credits – 60 hours) (L-T-P: 4-0-0)

Course Outcomes

At the end of this course, students will be able to

1. Understand any kind of process by framing it in block diagram, mathematical model and different process variables. (Understanding)
2. Select different types of controller like electronic, pneumatic and hydraulic. (Remembering)
3. Explain advanced control techniques for process control. (Evaluating)
4. Design various controllers like PI, PID, PD for application in process control. (Creating)

Objective

This course aims to provide in depth understanding of designing and implementing practical control strategies in process control.

Module I: Introduction (8 hours)

Introduction to Process Control. Control objectives, servo regulatory control, classification of process variables.

Module II: Modeling of processes (12 hours)

Modeling basics, Degree of Freedom, Mass Balance, Energy Balance equations, linearization of nonlinear systems, Modeling of Level Tank System, Continuous Stirred Tank Heater, Continuous Stirred Tank Reactor, Transfer function. Dynamic behavior of first and second order processes, Obtaining First Order Plus Time Delay (FOPTD) model with Process Reaction curve. Obtaining second order model of processes.

Module III: Elements of process control (15 hours)

Dead time, Interacting and non-interacting systems, self -regulation, inverse response, capacity of process, integrating systems, multi capacity process. Dynamic behavior of first and second order processes, Obtaining First Order Plus Time Delay (FOPTD) model with Process Reaction curve. Obtaining second order model of processes.

Module IV: Common controller modes (15 hours)

Controller Modes, ON-OFF, Multi position, time proportional controller, Theory Proportional, Integral and Derivative modes, PI, PD, PID Controller, Dynamic Behavior of closed loop systems with P, I, D, PI, PID modes. Application and tuning, ZN Tuning (Open-loop and Closed loop), Performance criteria, Integral criteria, pneumatic and electronic controllers to realize various control actions.

Module V: Some advance control Techniques (10 hours)

Cascade Control, Feed-forward Control, ratio Control, Selective Control, Inferential Control, Introduction to adaptive control. Examples of Drum Boiler, Heat Exchanger and CSTR, Feedforward+Feedback Control of Heat Exchanger, Air Fuel Ratio Control for Drum Boilers. Level Control in Drum Boiler, Shrinking and Swelling, Inverse response of Drum Boiler.

Suggested Readings

1. Stephanopoulos. G, “Chemical Process Control”, Prentice Hall of India, New Delhi, 1984.
2. Curtis. D. Johnson, “Process control Instrumentation Technology”, Prentice Hall of India, New Delhi, 1984.
3. F.G. Shinskey, “Process Control Systems Application Design and Adjustment”, McGraw Hill International.1988.
4. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, “Process Dynamics and Control”, Wiley Dreamtech India (P) Ltd, New Delhi, 2013.
5. B. Wayne Bequette, “Process control, modeling, Design and simulation”, Prentice Hall of India (P) Ltd., 2015.

6. Thomas Marlin, “Process Control Designing Processes and Control for Dynamic Performance”, Tata MC Graw Hill,2012.
7. Surekha Bhanot, “Process Control Principles and Applications”, Oxford 2008.

Mapping of COs to Syllabus

Course Outcomes	Module 1	ModuleII	Module III	Module IV	Module V
CO1	M	H			
CO2				H	
CO3				H	L
CO4				M	H

EEEM0109: ELECTRICAL MACHINES (Minor)

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Explain principle of operation of various electrical machines. (Understanding)
2. Identify different types of dc and ac machines. (Applying)
3. Classify different types of dc and ac machines. (Analyzing)
4. Compare the performances in terms of losses, efficiency, and regulation of different types of dc and ac machines. (Evaluating)

Objective

This course on Electrical Machines, generally offered for students who do not major in Electrical Engineering, is an introductory course in electro-mechanical energy conversion devices. This course gives an introduction to DC as well as AC machines and transformers, to enable the students to use this knowledge for applying to situations arising in their disciplines.

Module I: D.C. Machines (15 hours)

Operating principle, generator & motor action, construction, types of excitation, emf & torque equations, power stages & efficiency. Commutation & Armature Reaction, characteristics & application of d.c generators, starting & speed control of d.c motors, characteristics & applications of d.c motors, electric braking.

Design of D.C Machines: Output equation, Main dimensions, Armature design, Armature windings, Design of commutator and brushes, Design of Field systems, Design of interpoles.

Module II: Transformers (10 hours)

Operating principle, classification, construction, emf equation, phasor diagrams, equivalent circuit model, losses & efficiency, voltage regulation, polarity test, autotransformers, three-phase transformer connections, & instrument transformers.

Module III: Induction Machines (10 hours)

Three-phase induction motors. Principle of operation, construction, types. Rotating magnetic field, emf equation of an AC Machine, torque developed in an induction motor, equivalent circuit model, torque-speed characteristics, starting & speed control. Single phase induction motors, starting, application.

Module IV: Synchronous Machines (10 hours)

Construction, types & operating principle of synchronous generator, A.C armature windings, equivalent circuit, phasor diagrams, voltage regulation, parallel operation, synchronization, Power Angle characteristics, effect of field excitation change. Synchronous Motor, principle, starting, hunting, damper windings. Special Purpose Motors: Stepper Motor, Universal Motor, shaded-pole Motor.

Suggested Readings

1. Fitzgerald, Kingslay and Umans, “Electric Machinery”, Tata McGraw-Hill.
2. Chapman, “Electric Machinery Fundamentals”, McGraw-Hill Higher Education.
3. Nagrath and Kothari, “Electric Machines”, Tata McGraw-Hill.
4. Guru and Hiziroglu, “Electric Machinery and Transformer, Oxford University press.
5. P.S. Bimbhra, “Electric Machinery”, Khanna Publishers.
6. Vincent Deltoro, “Basic Electric Machines”, Prentice Hall.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H	H	H
CO 2	M	M	M	M

CO 3	M	M	M	M
CO 4	H	H	H	H

EEEW0110: ELECTRICAL WIRING

(3 Credits - 45 hours) (L-T-P: 2-0-2)

Course Outcomes

1. Define and explain the difference between direct current and alternating current. (Remembering)
2. Describe conditions likely to affect severity of electrical shock while maintaining safety during installation. (Remembering)
3. Demonstrate the different conductor systems used in residential and light commercial wiring in accordance with the codes and authorities for installation. (Applying)
4. Analyze the essential tools for residential wiring and be able to discuss the basic principles of tool-use and care. (Analysing)

Objective

To improve student electrical wiring skills through systematic training to enable students to create and test different electrical circuits using suitable electrical equipment, wires, protective devices and wiring accessories.

Module I: Basic Electrical Circuits (9 hours)

Measurement of Electrical quantities like Voltage, Currents, Resistance, Impedance, power factor and energy, Various Electrical Symbols, Electricity conductor, insulator, and resistance, Single-phase & three-phase circuits, Serial connection-diagram, Series and Direct Board-different types.

Module II: Different types of electrical wiring / installations (12 hours)

Two-way switch-wiring, 3-phase wiring, Overhead service connection, Definition and testing procedure of voltage current power MCB and bus bars, Earthing Connection – Different earthing systems.

Module III: Fundamentals of electricity-safety measures and precautions, first aid/Tools and equipment (12 hours)

Safely handling Tools & Equipment /Fire Fighting and use of fire extinguishers, Fires in electrical Circuits & Precautions, General Safety of Tools & equipment, Measuring tools, wire gauges etc. Classification, Identification of the electrical equipment cables, wires and electrical accessories.

Module IV: House Wiring Practical (12 hours)

House Wiring by PVC Casing Capping including Testing, House Wiring by PVC Rigid Pipe including Testing, Industrial Wiring by MS Pipe Including Testing, Measurement of Earth Resistance by Earth Tester, Common Faults in AC & DC Fans, Regulators and Remedies

Suggested Readings

1. J.B. Gupta, “A Course in Electrical Installation Estimating and Costing”, S.K. Kataria & Sons.
2. S.L. Uppal and G.C. Garg, “Electrical Wiring Estimating & Costing”, Khanna Publishers.
3. Satheesh Kumar, “Electrical Wiring: An Introduction”, Ane Books Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	L		M
CO 2	L	L	H	M
CO 3	M	H	L	H
CO 4	M	M	H	H

EEBC0111: BASIC COMMUNICATION SYSTEMS

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Objective

This course is intended as a base course to introduce a student with core areas other than Electronic communication, to basic communication systems. It introduces a student to Signals and different types of modulation. On completion of the course a student should be able to undertake other courses which have elements of Communication Techniques included in them.

Course Outcomes

1. Compare the performance of AM, FM and PM schemes with reference to SNR. (Understanding)
2. Understand noise as a random process and its effect on communication receivers. (Understanding)
3. Evaluate the performance of PCM, DPCM and DM in a digital communication system. (Evaluating)
4. Identify source coding and channel coding schemes for a given communication link. (Applying)

Module I (6 hours)

a. Review of signals and systems and Fourier analysis.
b. Introduction to Probability and Random process, Random variables, distribution and density functions. Statistical averages, Power spectral density, Energy spectral density, Correlation and convolution. Review of signals and systems and Fourier analysis.

Module II (17 hours)

a. Modulation, need for modulation and its types, Amplitude modulation, generation and detection of AM, DSB-SC, SSB-SC and VSB, Introduction to AM receivers and transmitters, super heterodyne receiver.
b. Angle modulation- Frequency and phase modulation, Relationship between FM and PM waves, Generation and detection of FM – NBFM and WBFM, Introduction to FM transmitters. Noise in AM and FM.

Module III (10 hours)

a. Pulse Modulation- Sampling of analog signal, Sampling theorem, PAM-generation and detection, PPM and PDM and its generation, quantization, PCM, PCM systems, Encoder-decoder, DPCM, DM and ADM, TDM and FDM.
b. Baseband binary PAM systems. Intersymbol interference (ISI). Nyquists's criterion for distortionless baseband binary transmission. Nyquist and Raised Cosine Pulses. Square-root Splitting of the Nyquist Pulse. Baseband M-ary, PAM systems. Optimum detection. Matched filters, correlation receivers.

Module IV (12 hours)

a. Digital Modulation- Binary communication, On-Off Keying and ASK, Frequency Shift Keying (FSK), Phase shift keying (PSK) and QPSK.
b. Detection of binary signals, Multi symbol signalling, Quadrature Amplitude Modulation (QAM). Introduction to Information theory and coding.

Suggested Readings

1. George Kennedy, “Electronic Communication Systems”, McGraw Hill.
2. Taub and Schilling, “Principles of Communication Systems”, TMH.
3. B.P. Lathi, “Modern Digital and Analog Communication Systems”, Oxford University press.
4. Roddy Coolen, “Communication Systems”, PHI.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1		H	M	
CO 2	H		M	
CO 3		M	H	
CO4			M	H

EESD0116: POWER SYSTEM DYNAMICS AND CONTROL

(3 Credits – 45 hours) (L-T-P: 3-0-0)

Course Outcomes

1. Define basic terminologies and problems related to power system dynamics. (Remembering)
2. Understand the problem of power system stability and its impact on the system. (Understanding)
3. Model different power system components for the study of stability. (Applying)
4. Analyse steady-state and transient power system dynamics and use numerical integration methods. (Analysing)
5. Explain the Angular stability analysis in Single Machine Infinite Bus System and in multi-machine systems, frequency and voltage stability, methods to improve stability. (Evaluating)

Objective

The objective of this course is to introduce the students to power stability problems and the basic concepts of modeling and analysis of dynamical systems. Modeling of power system components - generators, transmission lines, excitation and prime mover controllers - is covered in detail. Stability of single machine and multi-machine systems is analyzed using small-signal analysis techniques. The impact of stability problems on power system planning and operation is also brought out.

Module I: Introduction to Power System Operations (3 hours)
Introduction to power system stability. Introduction to Power System Control. Power system stability problem- basic concepts and definitions- rotor angle stability, voltage stability and voltage collapse, classification of stability. Design and operating criteria for stability.

Module II: Analysis of Power System Dynamics and Numerical Methods (5 hours)
Swing Equation. Analysis of Steady State. Analysis of Transient Stability. Equal Area Criterion. Analysis using Numerical Integration Techniques- Euler Method, Modified Euler method, Runge-Kutta method. Numerial approximation of solutions, A-Stabilty. Numerical stability of explicit integration methods, Stiffness in transient stability. Implicit integration methods.

Module III: Modeling of Synchronous Machines and Associated Controllers (12 hours)
Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module IV: Modeling of other Power System Components (10 hours)
Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

Module V: Stability Analysis (11 hours)
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Module VI: Enhancing System Stability (4 hours)
Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures- Preventive Control. Emergency Control.

Suggested Readings
1. K. R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002.
2. P. Kundur, “Power System Stability and Control”, McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 1997.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2		H	M		H	L
CO 3			H	H	L	
CO 4		H		M	H	
CO 5	M				H	H

EEEL0096: ELECTRICAL MACHINES

(3 Credits - 45 hours) (L-T-P: 3-0-0)

Course Outcomes
1. Explain principle of operation of various electrical machines. (Understanding)
2. Identify different types of dc and ac machines. (Applying)
3. Classify different types of dc and ac machines. (Analyzing)
4. Compare the performances in terms of losses, efficiency, and regulation of different types of dc and ac machines. (Evaluating)

Objective
This course on Electrical Machines, generally offered for students who do not major in Electrical Engineering, is an introductory course in electro-mechanical energy conversion devices. This course gives an introduction to DC as well as AC machines and transformers, to enable the students to use this knowledge for applying to situations arising in their disciplines.

Module I: D.C. Machines (15 hours)

Operating principle, generator & motor action, construction, types of excitation, emf & torque equations, power stages & efficiency. Commutation & Armature Reaction, characteristics & application of d.c generators, starting & speed control of d.c motors, characteristics & applications of d.c motors, electric braking.

Design of D.C Machines: Output equation, Main dimensions, Armature design, Armature windings, Design of commutator and brushes, Design of Field systems, Design of interpoles.

Module II: Transformers (10 hours)

Operating principle, classification, construction, emf equation, phasor diagrams, equivalent circuit model, losses & efficiency, voltage regulation, polarity test, autotransformers, three-phase transformer connections, & instrument transformers.

Module III: Induction Machines (10 hours)

Three-phase induction motors. Principle of operation, construction, types. Rotating magnetic field, emf equation of an AC Machine, torque developed in an induction motor, equivalent circuit model, torque-speed characteristics, starting & speed control. Single phase induction motors, starting, application.

Module IV: Synchronous Machines (10 hours)

Construction, types & operating principle of synchronous generator, A.C armature windings, equivalent circuit, phasor diagrams, voltage regulation, parallel operation, synchronization, Power Angle characteristics, effect of field excitation change. Synchronous Motor, principle, starting, hunting, damper windings. Special Purpose Motors: Stepper Motor, Universal Motor, shaded-pole Motor.

Suggested Readings

1. Fitzgerald, Kingslay and Umans, “Electric Machinery”, Tata McGraw-Hill.
2. Chapman, “Electric Machinery Fundamentals”, McGraw-Hill Higher Education.
3. Nagrath and Kothari, “Electric Machines”, Tata McGraw-Hill.
4. Guru and Hiziroglu, “Electric Machinery and Transformer, Oxford University press.
5. P.S. Bimbhra, “Electric Machinery”, Khanna Publishers.
6. Vincent Deltoro, “Basic Electric Machines”, Prentice Hall.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H	H	H
CO 2	M	M	M	M
CO 3	M	M	M	M
CO 4	H	H	H	H

LABORATORY COURSES

BTIP13: INTERNSHIP SEMINAR

(3 Credits)

Course Outcomes

1. Relate theory and practical with real life examples. (Remembering)
2. Explain the engineering processes involved in the industry. (Understanding)
3. Identify the importance of learning the practical aspects of engineering education. (Applying)
4. Analyse application of the theory into the practical field. (Analysing)
5. Value the engineering education and its utility. (Evaluating)
6. Discuss the actual technological advancements in the industry. (Creating)

EEBL6027: BASIC ELECTRICAL ENGINEERING LABORATORY

(1 Credit- 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Find different parameters related to basic electrical circuits. (Remembering)
2. Explain the procedure for performing experiments related to DC and AC circuits. (Understanding)
3. Identify various rotating AC and DC machines. (Applying)
4. Compare the theoretical prediction with experimental results. (Analyzing)
5. Check errors and correction of meters by calibration (Evaluating)
6. Construct a circuit to perform a particular experiment. (Creating)

List of experiments:

1. Calibration of a Voltmeter.
2. Calibration of an Ammeter.
3. Calibration of milliammeter as a voltmeter.
4. Calibration of a millivoltmeter as an ammeter.
5. Verification of Thevenin's theorem.
6. Resonance in series RLC circuit
7. Reversal of direction of rotation of 3-phase induction motor by changing phase sequence.
8. Different types of Connections of the transformer.
9. Demonstration of DC and AC machines.
10. Demonstration of LT switchgear.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10
CO 1	H	H	H	H	H	H	H	H	H	H
CO 2	H	H	H	H	H	M	M	M	M	M
CO 3				L		L	L	L	L	L
CO 4	M	M	M	M	H	H	H	H	H	H
CO 5	H	H	H	H	L	L	L	L	L	L
CO 6	H	H	H	H	H	H	H	H	H	H

EEAE6028: ANALOG ELECTRONICS LAB

(1 Credit - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Explain the working principle and operate the various components used in the laboratory. (Understanding)
2. Identify different electronic components and devices. (Applying)
3. Experiment with various electronic components. (Applying)
4. Analyze the characteristics of various electronic components and circuits such as diodes, BJTs, FETs, Voltage Regulators, amplifiers and filters. (Analyzing)
5. Design various electronic circuits based on the requirement. (Creating)

Objective

This course aims to familiarize hands-on experiments on different circuits based on diodes, BJT, JFET etc. The course also aims to familiarize simple electronic amplifier designs, OpAmp configurations and wave generators.

List of experiments:

1. To study the Characteristics of a diode.
2. To Study the Characteristics of Zener Diodes.
3. Half-wave and Full-wave rectifiers.
4. Clamping and Clipping circuits.
5. Static Characteristics of a Bipolar Junction Transistor (CE Mode).
6. To Study The Characteristics of JFET.
7. Series voltage Regulator.
8. Design of amplifiers: Transistor amplifiers with and without feedback.
9. Inverting and non-inverting op-amps.
10. Op-amp linear applications: adders, subtractors.
11. Op-amp based active filters.
12. Square wave generators.

Suggested Readings

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

Mapping of COs to Syllabus

Course Outcomes	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9	Expt 10	Expt 11	Expt 12
CO 1	H	H	H	H	H	H	H	H	H	H	H	H
CO 2	M	M	M	M	M	M	M	M	M	M	M	M
CO 3		H				H						
CO 4		H	H			H						
CO 5										H	H	H

EEMC6029: ELECTRICAL MACHINES LAB-I

(1 Credits - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Select various dc machines and single-phase transformers for different applications. (Remembering)
2. Utilize different machines for different applications, e.g., speed control, voltage control, load tests etc. (Applying)
3. Evaluate efficiency, voltage regulation speed regulation of dc machines and single-phase transformers. (Evaluating)

List of experiments:

1. To obtain magnetization characteristics of a d.c. shunt generator
2. To obtain load characteristics of a d.c. compound generator –
   a. Cumulatively compounded
   b. Differentially compounded
3. To obtain load characteristics of a dc shunt generator
4. To obtain load characteristics of a dc series generator
5. To obtain efficiency of a dc shunt machine using Swinburn’s test
6. To perform Hopkinson’s test and determine losses and efficiency of DC machine
7. To obtain speed-torque characteristics of a dc shunt motor
8. To obtain speed control of dc shunt motor using-
   a. armature resistance control
   b. field control
9. To obtain speed control of dc separately excited motor using the Ward Leonard method
10. To study polarity and ratio test of single-phase transformers
11. To obtain efficiency and voltage regulation of a single-phase transformer by Sumpner’ s test

Mapping of COs to Syllabus

Course Outcomes	Expt.1	Expt.2	Expt.3	Expt.4	Expt.5	Expt.6	Expt.7	Expt.8	Expt.9	Expt.10	Expt.11
CO 1	H										
CO 2		H	M	H			H	H	H	H	H

CO 3					H	H					

EEDE6030: DIGITAL ELECTRONICS LAB

(1 Credit - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Demonstrate the truth table of various expressions and combinational circuits using logic gates. (Understanding)
2. Identify different components of digital electronics. (Applying)
3. Evaluate various combinational circuits such as adders, subtractors, comparators, multiplexers and de-multiplexers. (Evaluating)
4. Design various combinational circuits. (Creating)
5. Construct flips-flops counters and shift registers. (Creating)

Objective

This course will enable students to get practical experience in design, realization and verification of Demorgan's Theorem, SOP, POSforms. They will be able to realize Full/Parallel Adders, Subtractors, Multiplexer, Demultiplexers, Decoders , Flip-Flops, Shift registers and counters using logic gates.

List of Experiments:

1. To verify the truth tables of the basic logic gates.
2. To verify De-morgan's Theorem for 2 variables using universal gates.
3. To verify the sum-of product and product-of-sum expressions using universal gates.
4. To design and implement a Full Adder using basic logic gates.
5. To design and implement a Full subtractor using basic logic gates.
6. To design and implement 4-bit Parallel Adder/ subtractor using IC 7483.
7. To realize 4:1 Multiplexer using gates.
8. To realize 1:8 Demux and 3:8 Decoder using IC74138.
9. To realize the following flip-flops using NAND Gates. (a) Clocked SR Flip-Flop (b) JK Flip-Flop.
10. To realize the following shift registers using IC7474 (a) SISO (b) SIPO (c) PISO (d) PIPO.
11. To realize the Ring Counter and Johnson Counter using IC7476.
12. To realize the Mod-N Counter using IC7490.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12
CO 1	H	H	H	M	M	M	L	L	L	L	L	L
CO 2	H	L	M	M	M	M	H	L	L	L	L	L
CO 3				H	H	H	H	H	H	H	H	H
CO 4			H	H	H	H						
CO 5									H	H	H	H

EEMS6031: ELECTRICAL MACHINES-II LAB

(1 Credit-30 hours) (L-T-P : 0-0-2)

Course Outcomes

1. Study the method of synchronization of alternators with the infinite bus. (Remembering)
2. Explain the procedure for performing experiments related to AC machines. (Understanding)
3. Combine the different components to perform a particular experiment on AC machines. (Creating)
4. Determine the characteristics of different types of AC machines and their performances. (Evaluating)

Objective

This course provides a basic understanding of different characteristics of AC machines, machine parts and helps to gain the skills for operating AC machines.

List of experiments:

1. To perform no load and blocked rotor tests on a three-phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three-phase induction motor and draw:
   a. Torque -speed characteristics

b. Power factor-line current characteristics

3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
4. To study speed control of three phase induction motor by keeping the V/f ratio constant.
5. To study speed control of three phase induction motor by varying supply voltage.
6. To perform open circuit and short circuit tests on a three-phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
7. To determine V-curves and inverted V-curves of a three-phase synchronous motor.
8. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
9. Scott connection of 3-phase transformer
10. Load test of 3-phase transformer

Mapping of COs to Syllabus

Course Outcomes	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment 8	Experiment 9	Experiment 10
CO 1						M		H		
CO 2	M	M	M	M	M	M	M	M	M	M
CO 3	M	M	M	M	M	M	M	M	M	M
CO4		H				H	H			

EEPE6032: POWER ELECTRONICS LAB

(1 Credit –30 hours) (L-T-P : 0-0-2)

Course Outcomes

1. Define different power electronics components.(Remembering).
2. Construct various firing circuits of SCR.(Creating)
3. Determine the V-I characteristics of different types of power electronics switches. (Evaluating)
4. Design circuits for AC to DC, DC to DC and DC to AC conversions. (Creating)

Objective

The objective of the course is to Analyse the various characteristics of the power electronics devices, design and test various arrangements of power devices based rectifiers and inverters and choppers under power electronics systems.

List of Experiments:

1. Study of R, RC and UJT firing circuits.
2. Study UJT firing circuits.
3. Study of V-I characteristics of SCR.
4. Determination of Holding current and Latching current of SCR.
5. Single phase half-wave controlled rectifier
6. Single phase full-wave controlled bridge rectifier.
7. Study of V-I characteristics of MOSFET.
8. Study of UJT firing circuit.
9. Study of BUCK converter.
10. Study of BOOST converter.
11. Study of BUCK-BOOST converter.
12. Study of Single-phase square wave inverter.
13. Study of PWM inverter.

Suggested Readings

1. M.R. Rashid, Power Electronic Circuits, Devices and Applications, Third Edition, PHI.
2. N. Mohan, T.M. Underloned and W.P. Robbins, Power Electronic Converters, Applications and Design, John Wiley and Sons.

Mapping of COs to Syllabus

Course Outcomes	Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt. 5	Expt. 6	Expt. 7	Expt. 8	Expt. 9	Expt. 10	Expt. 11	Expt. 12	Expt. 13
CO 1	M	M	M	M	M	M	M	M					

CO 2									H	H	H	M	
CO 3		H	H				H	H					
CO 4					H	H					H	H	H

EESS6033: POWER SYSTEM STEADY STATE ANALYSIS LAB

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Recall characteristics of IGBT and thyristor. (Remembering)
2. Demonstrate the knowledge of Y-bus and Z-bus formation. (Understanding)
3. Find various performance parameters of a power system by using given data. (Analyzing)
4. Develop program for economic dispatch problems of electrical energy. (Creating)

List of Experiments:

1. Simulation of IGBT Inverters
2. Simulation of Thyristor Converters
3. Transient Stability Studies
4. Short Circuit Studies
5. Evaluation of Z-Bus and Y-Bus
6. Economic Load Dispatch
7. Gauss Seidel Load Flow analysis
8. Newton Raphson Load Flow analysis
9. Load Forecasting and Unit Commitment

Suggested Readings

1. C.L. Wadhwa, Electrical Power systems, (5th Edition) New Age International Publishers.
2. D.P. Kothari, I.J. Nagrath, Power System Engineering, Second edition, Tata McGraw Hill.

Mapping of COs to Experiments

Course Outcomes	Expt.1	Expt.2	Expt.3	Expt.4	Expt.5	Expt.6	Expt.7	Expt.8	Expt.9
CO 1	M	M							
CO 2			H	H					
CO 3					H		H	H	
CO 4						H			H

EERE6034: RENEWABLE ENERGY LAB

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Identify the V-I characteristics of solar panels. (Applying)
2. Utilize the concepts of Solar Energy and Wind Energy conversion techniques in practical situations. (Applying)
3. Determine the power output from Solar and Wind Farms. (Evaluating)

List of Experiments:

1. Power Curves
2. Build a Wind Farm model.
3. Test the Capabilities of Solar PV array in partial shading condition.
4. Effect of Temperature on Solar Panel Output
5. Variables Affecting Solar Panel Output
6. Effect of Load on Solar Panel Output
7. Wind Turbine Output: The Effect of Load
8. Test the Capabilities of Solar Panels and Wind Turbines

Mapping of COs to Syllabus

Course Outcomes	Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt. 5	Expt. 6	Expt. 7	Expt. 8
CO 1	H							
CO 2		H	M	H			H	H
CO 3					H	H		

EECT6035: CONTROL LAB 1

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Name the MATLAB commands associated with a robust control system. (Remembering)
2. Model common non-linearities used in control systems. (Applying)
3. Model and analyse digital control system. (Applying)
4. Design and simulate control system models. (Creating)

List of experiments:

1. Design and simulation of Linearised models using MATLAB/PSPICE.
2. Simulation and analysis of State space models for continuous time and discrete time systems using MATLAB/PSPICE.
3. Design and Simulation of LTI models of Feedback Control System using MATLAB/PSPICE.
4. Simulation and analysis of Digital Control System using MATLAB/PSPICE.
5. Simulation and Stability analysis of control systems with common nonlinearities using MATLAB/PSPICE.
6. Familiarization and use of the MATLAB command associated with Robust Control Systems.
7. Familiarization and use of PSIM software.

EECL6036: CONTROL LAB 2

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Compare position, velocity, and adaptive control. (Understanding)
2. Explain adaptive control system (understanding)
3. Explain analog and digital servo system. (Understanding)
4. Construct PLC based system.(Creating)
5. Design ladder logic for PLC. (Creating)

List of experiments:

1. Designing of Ladder logic for various practical applications.
2. Execution of the Ladders using PLC's.
3. Study of Analog and Digital Servo Systems.
4. Experiment on Position Control System.
5. Experiment on Velocity Control System.
6. Experiment on Adaptive Control System.
7. Experiment on Nonlinear Control Systems.

EEPL6037: POWER SYSTEM PROTECTION LAB

(2 Credits) (L-T-P: 0-0-4)

Course Outcomes

1. Show the ability to propose models for radial and parallel feeder protection. (Remembering)
2. Demonstrate applications of practical power system protection schemes. (Understanding)
3. Apply the knowledge of different types of relays components in practical power system applications. (Applying)
4. Examine the performance characteristics of relays in equipment protection. (Analyzing)
5. Evaluate fault currents due to different types of faults in a network. (Evaluating)

List of experiments (any 8):

1. Introduction to Power System Protection
2. Evaluate fault currents due to different types of faults in a network
3. Over Current Relay (OCR) Testing System - To Plot IDMT Characteristics of OCR
4. Over Current Relay Testing System - To Perform Experiment on Definite/ Instantaneous Mode Setting of the relay.
5. Characteristics of a Differential Relay - To Plot Characteristics of % Biased Differential Relay (Merz-Price Method).
6. Pick-up Test for Differential Relay
7. Transformer Differential Protection Testing - For Transformer In-Zone Trips Fault
8. Transformer Differential Protection Testing - For Transformer Out-Zone or Non-Trip Faults
9. Principle of Reverse Power Protection

10. Concept of Radial Feeder Protection
11. Concept of Parallel Feeder Protection

Mapping of COs to Syllabus

Course Outcomes	Exp.1	Exp. 2	Exp.3	Exp.4	Exp.5	Exp.6	Exp.7	Exp.8	Exp.9	Exp.10	Exp.11
CO 1	H	H				M			M	H	H
CO 2	L	L	H	H			H	H			
CO 3			H	M	H	M			H	H	H
CO 4			H	M	H	H			L		
CO 5	L	H	H			H	H				

EEPA6038: POWER ELECTRONICS APPLICATION TO POWER SYSTEM LABORATORY

(2 Credits - 30 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Identify the suitable power electronic devices for designing different power electronic converters. (Applying)
2. Examine the performance characteristics of different types of FACTS devices. (Analyzing)
3. Experiment with various power electronic circuits used in power system applications. (Evaluating)
4. Design different types of power electronic converters. (Creating)

List of Experiments:

Any ten experiments will be performed

1. Three phase fully controlled rectifier
2. Multi-level inverters
3. Active power filters
4. Non-isolated DC- DC converter
5. Characteristic of SVC
6. Characteristic of STATCOM
7. Characteristic of TCSC
8. Improvement of power quality using shunt compensation
9. Improvement of power quality using series compensation
10. Solar power integration to grid
11. Vector control of inverter

Suggested Readings

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. M.R. Rashid, Power Electronic Circuits, Devices and Applications, Third Edition, PHI.

Mapping of COs to Experiments

Course Outcomes	Expt.1	Expt.2	Expt.3	Expt.4	Expt.5	Expt.6	Expt.7	Expt.8	Expt.9	Expt.10	Expt.11
CO 1	H	H	H	H							
CO 2					H	H	H	L	L		L
CO 3	M	M	M								
CO 4	H	H		M						L	

EEAL6039: ADVANCED CONTROL LAB 1

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Analyse non-linear systems. (Analysing)
2. Examine responses of discrete time systems from state space modeling. (Analysing)
3. Design and simulate pole placement design for regulator. (Creating)
4. Design and simulate discrete control system models. (Creating)

List of experiments:

1. State space modelling of discrete time systems and study of responses.
2. Pole placement design for regulator and tracking discrete time systems.

3. Observer design for discrete time systems.
4. Design of digital Kalman filter.
5. Optimal control design of digital systems.
6. Analysis of non-linear systems using describing function methods.
7. Phase plane analysis of nonlinear systems.

EEAC6040: ADVANCED CONTROL LAB 2

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Demonstrate the position control of DC servomotor with P, PI control actions. (Understanding)
2. Determine Magnetic Amplifier Characteristics with different possible connections.(Evaluating)
3. Measure the AC servo motor characteristics. (Evaluating)
4. Determine the time response of a closed-loop second-order process with P Control, PI and PID control. (Evaluating)
5. Design compensation systems using lead, lag and lead-lag compensator. (Creating)

List of experiments:

1. Characteristics of Synchros: (a) Synchro transmitter characteristics (b) Implementation of error detector using synchro pair.
2. Determination of Magnetic Amplifier Characteristics with different possible connections.
3. To determine the time response of a closed-loop second-order process with P Control, PI Control and PID control and to determine the effect of disturbance on a process.
4. To study the compensation of the second order process by using: (a) Lead Compensator (b) Lag Compensator (c) Lead-Lag Compensator.
5. To determine AC servo motor characteristics.
6. To study the position control of DC servomotor with P, PI control actions

EEMP6041: MINI PROJECT (M.Tech)

(2 Credits - 60 hours) (L-T-P: 0-0-4)

Course Outcomes

1. Apply practical knowledge within the chosen area of technology for project development. (Applying)
2. Demonstrate the skills to carry out research work independently. (Understanding)
3. Plan for executing projects with a comprehensive and systematic approach. (Applying)
4. Take part in development of technical projects as an individual or in a team. (Analyzing)
5. Develop effective communication skills for presentation of project related activities. (Creating)

Process:

1. Literature Review
2. Synopsis Presentation
3. Progress Presentation
4. Hardware/Software Project Execution
5. Final Presentation and Demonstration of the Project

EEMM6042: MICROPROCESSOR AND MICROCONTROLLER LAB

(1 Credits - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Demonstrate the usage of Keil software in writing, compiling and debugging 8051 programs (Understanding)
2. Make use of the 8051 assembly language instructions to write programs for a given problem. (Applying)
3. Examine the output of each line of an 8051 program code. (Analysing)

List of Experiments

1. Interfacing of 8051 development kit to PC and programmer.
2. Data transfer operation from registers and internal data memory.
3. Addition and subtraction of two 8 bit numbers.
4. Addition of two 16-bit numbers.

5. Addition of an array of 8-bit numbers.
6. Subtraction of two 16-bit numbers.
7. Multiplication and division of two 8-bit numbers.
8. Multiplication of two 16-bit numbers.
9. Interfacing of LEDs and Switches.
10. Interfacing of seven segment displays.
11. Interfacing of 16 x 2 LCD.
12. Interfacing of ADC.

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12
CO 1	H											
CO 2		H	H	H	H	H	H	H	H	H	H	H
CO 3		H	H	H	H	H	H	H	M	M	M	M

EERS6043: POWER SYSTEMS LABORATORY-I

(1 Credit: 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Recall the basic concept of programming language. (Remembering)
2. Demonstrate the ability to model and simulate the compensation techniques in transmission line. (Understanding)
3. Develop simple model for power system protection. (Applying)
4. Find various performance parameters of a power system by using given data. (Analyzing)
5. Experiments with Solar PV cell and formulate the I-V and P-V characteristics of PV panels. (Evaluating)

Objective

This course is the stepping-stone to make students understand how to model and analyze the power system under steady state operating condition, under faulted conditions and the transient behavior of power system whenever it is subjected to a fault.

List of Experiments:

1. Introduction to simulation software.
2. To Study the Ferranti Effect of a transmission line/cable.
3. Reactive power compensation (capacitive/ inductive)
4. Computation of inductance for overhead transmission line.
5. Computation of capacitance for overhead transmission line.
6. Fault current calculation for single line to ground fault.
7. Computation of power from solar generation.
8. To Study the over-current relay and the effect of PSM and TSM.
9. To study the differential Protection of a three-phase delta-delta connected transformer.

Suggested Readings

1. C.L. Wadhwa, “Electrical Power systems”, 5th Edition, New Age International Publishers.
2. D.P. Kothari, I.J. Nagrath, “Power System Engineering”, Second edition, Tata McGraw Hill.
3. V.K Mehta, Rohit Mehta, “Principles of Power Systems”, S. Chand.
4. Ashfaq Husain, “Electrical Power systems”, 5th Edition, CBS Publishers.
5. R. Gupta, “Generation of Electrical Energy”, S. Chand & Co. Ltd. N. Delhi
6. Leon Freris, David Infield, “Renewable Energy in Power Systems”, Wiley, A John Wiley & Sons, Ltd, Publication, 2012.

Mapping of COs to Experiments

Course Outcomes	Expt.1	Expt.2	Expt.3	Expt.4	Expt.5	Expt.6	Expt.7	Expt.8	Expt.9
CO 1	H	H	L						
CO 2			H						
CO 3								H	H
CO 4				H	H	H			
CO 5							H		

EECS6044: CONTROL SYSTEMS LABORATORY

(1 Credit - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Recall different SciLab functions used in control system analysis. (Remembering)
2. Understand and simulate the transfer function of a system. (Understanding)
3. Develop SciLab code for control system analysis. (Applying)
4. Analyse stability of system with pole-zero map. (Analyzing)
5. Determine the transient and steady-state of a system. (Evaluating)

Objective

This course aims to familiarize different concepts of control systems with SciLab simulations.

List of experiments:

Part I:
Basics of Scilab
Introduction to SciLab: variables, loop, functions etc.
Matrix operations
Plotting
Introduction to Xcos
Part II:
Concepts of control systems simulation with Scilab
(Any seven experiments from the following list)
To study transfer function of first order and second order systems with SciLab simulations.
To Study the block diagram reduction techniques with SciLab simulations.
To Study the pole-zero plotting with SciLab simulations.
To Study the time-response of a first order system with SciLab simulations.
To Study the time-response of a second order system with SciLab simulations.
To Study the Bode diagram of different systems with SciLab simulations.
To Study the Nyquist diagram of different systems with SciLab simulations.
Transfer function to state-space and state-space to transfer conversion with SciLab simulations.
Speed control of a DC motor with SciLab simulations.

Mapping of COs to Syllabus

Course Outcomes	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9
CO 1	H	H	H	H	H	H	H	H	H
CO 2	H	H						H	
CO 3			H	H	H				
CO 4			H						
CO 5				H	H				

EEMI6045: MINI PROJECT-I

(1 Credit)

Course Outcomes

1. Use different components to make the circuits used in the projects. (Applying)
2. Examine a designed circuit for expected output. (Analyzing)
3. Experiment with the designed circuits for the expected results. (Evaluating)
4. Design circuits to obtain desired output. (Creating)

EEPS6046: POWER SYSTEMS LABORATORY-II

(1 Credits -30 hours) (L-T-P: 0-0-2)

Course Outcomes

1. Find Y-bus parameters. (Remembering)
2. Apply knowledge of Y- bus matrix for load flow problem. (Applying)
3. Analyze load-frequency control in Power System. (Analysing)
4. Compare performance of series and shunt compensation. (Evaluating)

Experiments

1. Formation of Y-bus matrix using programming language.

2. Load flow analysis using Gauss seidel Method.
3. Load flow analysis using Newton Raphson Method.
4. Series compensation.
5. Shunt compensation.
6. Automatic Load Frequency control.
7. Automatic Voltage Regulator.
8. Contingency analysis of the power system.
9. Application of various numerical methods for power system analysis.
10. Generation of V-I and V-P characteristics of Solar PV Power Plant.

Mapping of COs to Syllabus

Course Outcomes	Expt.1	Expt.2	Expt.3	Expt.4	Expt.5	Expt.6	Expt.7	Expt.8	Expt.9	Expt.10
CO 1	H									
CO 2		H	M	H			H	H	H	H
CO 3					M	H	M			
CO 4					H	H				

EEMI6047: MEASUREMENTS AND INSTRUMENTATION LAB

(1 Credits - 30 hours) (L-T-P: 0-0-2)

Course Outcomes

At the end of the course, students will be able to

1. Select the electrical measuring instruments for determining a particular electrical parameter. (Remembering)
2. Make use of statistical data analysis and computerized data analysis to determine an unknown electrical parameter. (Applying)
3. Decide the best methods to determine an electrical parameter. (Evaluating)

List of Experiments:

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of High resistance and Insulation resistance using Megger.
5. Usage of DSO for steady state periodic waveforms produced by a function generator.
6. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
7. Usage of DSO to capture transients like a step change in R-L-C circuit.
8. Current Measurement using Shunt, CT, and Hall Sensor
9. Measurement of medium resistance using Wheatstone's bridge.
10. Measurement of three-phase real power using two wattmeter method.
11. Measurement of three-phase reactive power using two wattmeter method.
12. Study of smart energy meter.
13. Measurement of earth resistance using earth tester megger

Mapping of COs to Syllabus

Course Outcomes	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12	Exp 13
CO 1	H	H	H	H	L	L	L	L	H	H	H	L	L
CO 2	H	H	H	H	M	M	M	L	H	H	H	L	M
CO 3	H	H	H	H	M	M	M	H	H	H	H	H	H

EEED6055: ELECTRONIC DESIGN LABORATORY

(3 Credits - 45 hours) (L-T-P: 1-0-4)

Course Outcomes

1. Recall the basic concepts of electrical and electronics measurements. (Remembering)
2. Classify various OpAmp based amplifiers. (Understanding)
3. Estimate the output of different electronic components used in the electronic system design. (Evaluating)
4. Create an electronic system. (Creating)

Objective

This course aims to familiarize the students with the concepts of practical measurement and instrumentation system. The course enables one to understand the concept of data acquisition with popular development boards such as Arduino. At the end of the course, students should be able to design basic electronic systems.

Theory: Electronics Design Concepts (15 hours)

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design. Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations.

List of Experiments:

1. To study different temperature sensors.
2. Study of OpAmp based amplifiers.
3. Study of instrumentation amplifier.
4. Study of Arduino microcontroller development board for designing of embedded systems.
5. Data acquisition using Arduino microcontroller development board.
6. Group projects involving various electronic hardware.

Suggested Readings

1. A. S. Sedra and K. C. Smith, “Microelectronic circuits”, Oxford University Press, 2007.
2. 2 P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1997.
3. H.W. Ott, “Noise Reduction Techniques in Electronic Systems”, Wiley, 1989.
4. W.C. Bosshart, “Printed Circuit Boards: Design and Technology”, Tata McGraw Hill, 1983.
5. G.L. Ginsberg, “Printed Circuit Design”, McGraw Hill, 1991.

Mapping of COs to Syllabus

Course Outcomes	Experiment1	Experiment 2	Experiment 3	Experiment 4	Experiment 5	Experiment 6
CO 1	H	M				
CO 2			M		H	
CO 2			M		H	
CO 3				L	H	

EEMI6049: MINI PROJECT-II

Course Outcomes

1. Recall the benefits of using microcontrollers and microprocessors in circuits. (Remembering)
2. Identify suitable controllers and processors among the different controllers and processors available for their work. (Applying)
3. Compare the difference between the circuits using controllers and those not using it. (Analysing)
4. Construct a fully automotive circuit depending upon their requirement. (Creating)

EEDI6050: DISSERTATION PHASE-I

(10 Credits) (L-T-P : 0-0-20)

Course Outcomes

1. Select a project of interest. (Remembering)
2. Defend the topic of interest for continuing work, by doing initial studies on it. (Understanding)
3. Prepare a working methodology for the project for its successful completion. (Applying)
4. Design and experiment on the selected project. (Analysing)
5. Devise tools and methods for experimenting and troubleshooting for getting expected outcomes. (Evaluating)
6. Explain, justify and defend the project work by presenting the work and writing a report. (Creating)

Objective

During this Phase-I of the M.Tech dissertation, the student will start a research project, applying the knowledge acquired during the first two semesters and also incorporating the recent trends in the chosen area. It should include phases of design, implementation and reporting. This project is to be executed individually within or outside the campus. The mode and

components of evaluation and the weightage attached to them shall be published by the department/Institute at the beginning of the semester. At least one review paper is expected to be published by the student in this phase.

EEDI6051: DISSERTATION PHASE–II

(16 Credits) (L-T-P: 0-0-32)

Course Outcomes

1. Define the problem encountered in Phase-I and find suitable methodology to be adopted for the project work. (Remembering)
2. Classify the whole project work in various modules and explain the working model of the proposed work by demonstrating the different modules. (Understanding)
3. Apply mathematical skills to learn how these skills are important in engineering and construct software implementation skills and design skills especially from a systems perspective. (Applying)
4. Analyse the advanced electrical power or control systems and different problems encountered in designing a system. (Analysing)
5. Evaluate the complete system and perceive future scopes of the work carried out. (Evaluating)
6. Elaborate the performance of the work done, contrast on limitations of the system designed. and compile a technical report on the project (Creating)

Objective

During the Phase-II of M.Tech dissertation, the student will carry forward and complete the work that they have started in Phase-I. It is required that the student will publish at least one research paper in a well-known reputed journal to augment their work during this phase. Published papers will carry extra weightage during evaluation. The mode and components of evaluation and the weightage attached to them shall be published by the department at the beginning of the semester.

EEMP6053: MAJOR PROJECT PHASE-I

(1 Credit)

Course Outcomes

1. Find different areas of research in the field of electrical engineering. (Remembering)
2. Explain the importance of research in the chosen topic of interest. (Understanding)
3. Apply theoretical knowledge to find out an appropriate topic of importance for research in the undergraduate level. (Application)
4. Analyse research work of technological importance published in various reputed national and international journals. (Analysing)
5. Decide on a research problem and objective of research to be carried out within a semester. (Evaluating)
6. Compile the part of project work completed this semester. (Creating)

During the last year of their study, B. Tech. students are required to take up a major project. This may be an individual project or a group project. The Major Project is an integral learning experience that encourages students to break away from the compartmentalization of the different courses they have studied during the three years of their study and aims to provide opportunities to explore the interrelationships and interconnectedness of the various courses and gather them together into a single learning experience.

The major project focuses upon the following:

a. Interdisciplinary: The major project provides a platform for students to apply the knowledge and skills acquired from different courses.
b. Collaboration: It encourages students to work in groups over an extended period of time. They clarify the task, plan their work, share the responsibilities and work towards the successful completion of the project.
c. Process and Product: Project work focuses on both process and product. The process would include collaboration, gathering and processing of information. The product may take the form of a working model, a complete software package, etc.
d. Written and Oral presentation: Project work provides students with opportunities to present their findings as a written thesis in a prescribed format and orally with an intended audience and purpose in mind.

During the first phase in the seventh semester, students are expected to choose the project, prepare a synopsis under the guidance of a project supervisor appointed by the department, present the synopsis to the committee set up for the purpose, get approval for the synopsis and start the project work. Students are expected to submit weekly activity reports and present a progress seminar during this phase. They will also undergo a viva voce examination, in which they will be examined on all the basic areas of the discipline in which they have chosen their project.

a. E-resource for learning
b. LaTeX, www.spoken-tutorial.org

EEMP6054: MAJOR PROJECT (PHASE II) AND VIVA VOCE

(3 Credits)

During the second phase, students are expected to focus on the process and completion of the projects and prepare project reports under the guidance of the Supervisors. The internal assessments shall be evaluated by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester. The External assessment shall have the following components:

Project Implementation:	40 marks
Seminar presentation:	20 marks
Viva voce examination:	20 marks
Project documentation:	20 marks

Course Outcomes

1. Show different stages of project work for the selected topic. (Remembering)
2. Summarize the contribution of the project to the benefit of the society. (Understanding)
3. Make use of observations, experimental and theoretical findings for establishing a conclusion. (Applying)
4. Analyse the observations and results obtained during the project work. (Analysing)
5. Evaluate the results obtained from the project work. (Evaluating)
6. Compile a technical report on the project work. (Creating)

VALUE ADDED COURSES

EEAL0113: AUTOCAD ELECTRICAL

(2 Credits: 30 hours) (L-T-P : 0-1-2)

Course Outcomes

1. Demonstrate methods of customizing AutoCAD Electrical symbols, circuits, and databases, title block linking, reporting tools, templates, and project files. (Understanding)
2. Build schematic drawings such as ladder logic and single wire and multi wire circuits, panel drawings, and PLC-I/O circuits using automated commands for symbol insertion, component tagging, wire numbering, and drawing modification. (Creating)

Objective

The main objective of this course is to learn how to use the powerful electrical drawing creation tools in the AutoCAD Electrical software.

Module I: Introduction to auto CAD Electrical (6 hours)

Introduction to Electrical CAD interface, Electrical Components and wires, Design methodologies,Project files, Accessing project files,Add a drawing to a project file, managing drawings in a project, Project manager Drawing list.

Module II: Schematic I and schematic II (6 hours)

a. schematic I: Single wires/ Components, Referencing, Ladders, Insert wires, Edit wires, 3 phase components,Source and destination Signal Arrows, Insert component, parent/child components
b. Schematic II: Multiwire and circuits, Dashed Link Lines, 3 Phase Ladders.

Module III Editing Commands and panel drawings (6 hours)

a. Editing commands: Edit Component, Updating Drawings, Scoot & Align, Move & Copy Component, Delete & Surfer Component, Copy Catalogue Assignment, Copy Installation/Location Code Values, Attribute Editing Commands:
b. Insert Footprint and component, Edit footprint, Assign Item numbers, Add balloons.

Module IV: Terminals and Point-to-Point Wiring Drawings (6 hours)

a. Terminals: Insert Terminal Symbols, Multiple Level Terminals, Multiple Insert Component command, insert jumpers, Terminal Strip Editor, DIN Rail Command.
b. Point-to-Point Wiring Drawings: Insert & Edit Connectors, Insert Splices, Insert Multiple Wires, Bend Wires.

Module V: Symbol creation (6 hours)

Schematic Symbols, Naming Convention, Icon Menu Wizard, AutoCAD Electrical Databases, Project & Catalog Databases, Footprint Lookup Database, Insert PLC, Insert Individual PLC I/O Points.

Suggested Readings:

1. James D. Bethune, “Engineering Graphics with AutoCAD 2020”, Macromedia Press.
2. Gaurav Verma and Matt Weber, “AutoCAD Electrical 2021 Black Book”, 6th Edition, Cadcamcae Works.
3. Sham Tickoo, “AutoCAD Electrical 2021: A Tutorial Approach”, 2nd Edition, CADCIM Technologies.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module v
CO 1	H	M	M	M	H
CO 2		H	M	M	

EEAR0112: INTRODUCTION TO ARDUINO AND RASPBERRY PI

(2 Credits - 30 hours) (L-T-P:0-1-2)

Course Outcomes

1. List the different I/O pins available on the Arduino and Raspberry Pi. (Remembering)
2. Execute software programs on Arduino and Raspberry Pi. (Applying)

Module I : Introduction to Arduino (15 hours)

Introduction to Arduino, Arduino boards and their specification, Arduino integrated development environment, Arduino UNO development board, Programming the Arduino boards, Interfacing LEDs, Interfacing switches, interfacing LCDs, Serial

communication, Interfacing analog sensors, PWM control, DC motor interfacing, Servo motor interfacing, Stepper motor interfacing. Circuit design, programming, testing and debugging.

Module II: Introduction to the Raspberry Pi (15 hours)
Introduction to the Raspberry Pi: Features, GPIO. Linux System Administration: Overview, Files & Process, Directories, Basic commands etc. Some common Troubleshooting, Network configuration: interfaces, Configuring the Raspberry Pi: config.txt, cmdline.txt. Pi as Media Centre, Web Server etc.Introduction to python: IDLE, variables, input, loop, installing GPIO library. Hardware hacking, Pi with Arduino, IOT etc.

Suggested Readings:
1. Arduino Programming: Step-by-step guide to mastering arduino hardware and software by Mark Torvalds
2. Raspberry Pi User Guide by Gareth Halfacree and Eben Upton

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II
CO 1	H	H
CO 2	H	H

EEEL0114: ELECTRICAL WIRING

(2 Credits - 30 hours) (L-T-P: 0-1-2)

Course Outcomes
1. Define and explain the difference between direct current and alternating current. (Remembering)
2. Describe conditions likely to affect severity of electrical shock while maintaining safety during installation. (Remembering)
3. Demonstrate the different conductor systems used in residential and light commercial wiring in accordance with the codes and authorities for installation. (Applying)
4. Analyze the essential tools for residential wiring and be able to discuss the basic principles of tool-use and care. (Analysing)

Objective
To improve student electrical wiring skills through systematic training to enable students to create and test different electrical circuits using suitable electrical equipment, wires, protective devices and wiring accessories.

Module I: Basic Electrical Circuits (9 hours)
Measurement of Electrical quantities like Voltage, Currents, Resistance, Impedance, power factor and energy, Various Electrical Symbols, Electricity conductor, insulator, and resistance, Single-phase & three-phase circuits, Serial connection-diagram, Series and Direct Board-different types.

Module II: Different types of electrical wiring / installations (12 hours)
Two-way switch-wiring, 3-phase wiring, Overhead service connection, Definition and testing procedure of voltage current power MCB and bus bars, Earthing Connection – Different earthing systems.

Module III: Fundamentals of electricity-safety measures and precautions, first aid/Tools and equipment (12 hours)
Safely handling Tools & Equipment /Fire Fighting and use of fire extinguishers, Fires in electrical Circuits & Precautions, General Safety of Tools & equipment, Measuring tools, wire gauges etc. Classification, Identification of the electrical equipment cables, wires and electrical accessories.

Module IV: House Wiring Practical (12 hours)
House Wiring by PVC Casing Capping including Testing, House Wiring by PVC Rigid Pipe including Testing, Industrial Wiring by MS Pipe Including Testing, Measurement of Earth Resistance by Earth Tester, Common Faults in AC & DC Fans, Regulators and Remedies.

Suggested Readings
1. J.B. Gupta, “A Course in Electrical Installation Estimating and Costing”, S.K. Kataria & Sons.
2. S.L. Uppal and G.C. Garg, “Electrical Wiring Estimating & Costing”, Khanna Publishers.
3. Satheesh Kumar, “Electrical Wiring: An Introduction”, Ane Books Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H	L	

CO 2	L	L	H
CO 3	M	H	L
CO 4	M	M	H

EEPY0115: PYTHON FOR ELECTRICAL ENGINEERING

(2 Credits: 30 hours) (L-T-P: 0-1-2)

Course Outcomes

1. Simulate Electrical Systems using Python. (Applying)
2. Evaluate the performance of new Electrical designs using Python. (Evaluating)
3. Construct Electrical systems using Python. (Creating)

Objective

The objective of this course is to familiarize the students with the Python Programming environment and its various applications in simulating Electrical Systems. The course will be a combination of tutorial and practical classes, focusing on hands-on exercises to be done by the students using Python and its various modules.

Module I: Introduction to Python (8 hours)

Python Packages, Anaconda, Python Editors, Resources, Installing Python. Python IDE, Python Shell, Running Python from the Console, Scripting Mode. Basic Python Program, Variables, Built-in Functions, Python Standard Library, Using Python Libraries, Packages and Modules, Plotting in Python.

Module II: Python Programming (6 hours)

Loops in Python programming, Creating Functions in Python, Creating Classes in Python, Creating Python Modules, File Handling in Python, Error Handling in Python, Debugging in Python, Installing and using Python Packages.

Module III: Python for Mathematics Applications (6 hours)

Mathematics in Python, Linear Algebra in Python, Complex Numbers in Python, Differential Equations, Optimization. Using Python for Simulations, Differential Equations, Discrete Systems, Real-Time Simulations.

Module IV: Python for Electrical Engineering Applications (10 hours)

Numerical Methods using Python, Numerical integration, Solving ordinary differential equations, Root finding, Interpolation, Curve fitting, Fourier transforms.

Python used for Control Applications, Transfer Functions, State Space Models, Frequency Response, Stability Analysis.

Applications of Python in- Electromagnetics, Circuit Analysis, Electrical Power Systems, Power Electronics, Signal Processing, Electrical System Modeling and Simulation.

Suggested Readings

1. Hans-Petter Halvorsen, "Python". Available: https://www.halvorsen.blog/documents/programming/python/python.php
2. Hans-Petter Halvorsen, "Python for Science and Engineering", 2019. Available: https://www.halvorsen.blog/documents/programming/python/resources/Python%20for%20Science%20and%20Engineering.pdf
3. Hans-Petter Halvorsen, "Python for Science and Engineering- YouTube Video playlist".Available:https://www.youtube.com/playlist?list=PLdb-TcK6Aqj2hlH55Bn5oxFlvyoVbXxQS
4. Hans-Petter Halvorsen, "Python for Control Engineering", 2020, Available: https://www.halvorsen.blog/documents/programming/python/resources/Python%20for%20Control%20Engineering.pdf
5. Hans-Petter Halvorsen, "Python for Control Engineering- YouTube Video Playlist", Available:https://www.youtube.com/playlist?list=PLdb-TcK6Aqj1Kg6pV3zlrpUnPIRwG2_Ox
6. Hans Fangohr, 'Introduction to Python for Computational Science and Engineering",2018.Available: https://fangohr.github.io/python/book/Introduction-to-Python-for-Computational-Science-and-Engineering.pdf

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	M	M		H
CO 2			M	H
CO 3		M	L	H

EESL0200: SERVICE LEARNING

(2 Credits – 30 hours)

Course Outcomes

1. Define and explain the understanding of Community-University Engagement (CUE) and outline CUE in relation to higher education policy in India. (Remembering)
2. Analyze and identify the social responsibility of higher education institutions to facilitate engaged teaching, research & service. (Analyzing)
3. Determine the various methods and tools on Community-Based Participatory Research (CBPR). (Evaluating)
4. Evaluate how Higher education institutions can undertake community engagement post COVID-19. (Evaluating)
5. Design a plan for the engagement of students with the community through engaged teaching, research and service. (Creating)

Objective

The objective of this course is to understand the theory and practice of community university engagement. The students provide an insight on the theme of Social Responsibility of Higher Education Institution (HEI) and to introduce community based participatory research and the tools to facilitate engaged research.

Module I: Community University Engagement (CUE) (6 Hours)

History of Community University Engagement (CUE) in Indian Higher Education Policy, Fostering Social Responsibility by Higher Education: COVID-19 and Beyond, Current status and possible interventions, Recent initiatives, Principles of community engagement,

Module II: Social Responsibility of HEIs (5 Hours)

Understanding Social Responsibility of HEIs – Engaged Teaching, Research & Service, Community Engaged teaching and research, Community based participatory research, practice based learning, Community service, Effective Methods and Tools for Engaging Community in Research

Module III: Community Engagement through Electrical and Electronics Engineering (19 Hours)

Power sector scenario including generation, transmission, and distribution scenario of India, Duties and responsibilities of Assistant Electricity Meter Reader, Billing and cash collector and their career progression, Develop circuit and wiring diagram and electrical signage, code specifications to plan wiring layouts, consumption points accurately, as may be required, Standard location of service line connection, layout of main switch, circuit breakers required at main board, Install the protective device i.e.ratings as per the load, Replacement of damaged switches, MCB, fan- capacitor, regulator, lighting points i.e. holder, choke, starters, water coolers and their pump & motor, Operate principle of single phase motor, various types of motors like self start, capacitor start, capacitor run, universal motors and their applications and functions of condenser, Earth testing, Build a wind farm model, Application of drone technology in agriculture, search and rescue, wildlife tracking etc.

Suggested Readings

1. W. James Jacob, Stewart E. Sutin, John C. Weidman, John L. Yeager, “Community Engagement in Higher Education: Policy Reforms and Practice”, Springer, 2015.
2. David Coghlan, Mary Brydon-Miller, “The SAGE Encyclopedia of Action Research”, SAGE, 2014.
3. Book on Electricity rules.
4. Kronick, Robert F., “Emerging Perspectives on Community Schools and the Engaged University”, IGI Global,2019
5. Tami L. Moore, “Community-University Engagement: A Process for Building Democratic Communities”, John Wiley & Sons, 2014.
6. Marshall Welch, “Engaging Higher Education: Purpose, Platforms, and Programs for Community Engagement”, Stylus Publishing, 2016.
7. Barbara Jacoby, “Building Partnerships for Service-Learning”, John Wiley & Sons, 2003.
8. Becca Berkey, Emily A. Eddins, Patrick M. Green, Cara Meixner, “Reconceptualizing Faculty Development in Service-Learning/Community Engagement: Exploring Intersections, Frameworks, and Models of Practice”, Stylus Publishing, 2018.
9. Datasheets from the internet.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To cultivate nation builders, with scientific and engineering expertise and moral integrity, committed towards the upliftment of society.

MISSION

The department of Electronics and Communication Engineering of Don Bosco College of Engineering and Technology, School of Technology, Assam Don Bosco University seeks to provide young and enthusiastic minds with sound theoretical and practical knowledge in electronics and communication technologies, so that they grow up into competent individuals, capable of:

- Converting ideas into reality
- Standing up to challenges to lead from the front and provide progressive solutions
- Contributing towards the growth and development of new technologies
- Creating a positive impact on global society and contributing towards the welfare of mankind

PROGRAM OUTCOMES (POS)

PO 1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES OF B. TECH IN ELECTRONICS AND COMMUNICATION ENGINEERING

PSO 1: **Knowledge and Analysis:** An ability to understand and analyse the principles and working of different electronic systems.

PSO 2: **Product Development:** An ability to utilize their knowledge, skills and resources to demonstrate and implement technology-based systems as per the requirement.

PSO 3: **Problem Solving:** Ability to offer real time and efficient solutions for the problems that are directly or indirectly related to Electronics and Communication Engineering areas and will contribute towards the development of society.

PSO 4: **Skill Development:** Ability to collaborate different fields of science and technology with right blend of attitude and aptitude for placements and higher education or to become a successful Entrepreneur and a worthy global citizen.

PROGRAMME OUTCOMES OF M.TECH. IN SIGNAL PROCESSING:

PO 1: Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

PO 2: Ability to identify, formulate and solve engineering problems in the signal processing areas such as Developing robust and problem specific algorithms for acquisition, processing, analysis, synthesis of signals, to be applied in Signal Processing, Machine Vision and Communication Networks.

PO 3: Ability to understand and use different software tools in the domain of signal processing. Analysis and Verification of algorithms, Functional and timing Simulation on platforms like MATLAB, code composer studio and assembly language.

PO 4: Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

PO 5: Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

PROGRAMME OUTCOMES OF M.TECH IN COMMUNICATIONS:

PO 1: Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

PO 2: Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like optical communication, satellite communication, wireless communication, networking, RF-microwave, antennas, measurements and standards in communication.

PO 3: Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

PO 4: Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

PO 5: Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

PROGRAMME OUTCOMES OF M.TECH IN VLSI AND EMBEDDED SYSTEM:

PO 1: Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

PO 2: Identify, formulate and solve engineering problems in the broad areas like System Design using VLSI and Embedded Platforms and tools, Semiconductor Technologies, Applications in Signal Processing, Machine Vision and Communication Networks.

PO 3: Use different software tools in the domain of VLSI and Embedded Systems Design, Analysis and Verification such as Design entry, Synthesis, Functional and Timing Simulation, Floor-planning, Place and route, Layout editors, RTL schematic, Platform specific EDA sets, MATLAB.

PO 4: Design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

PO 5: Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

BTECH

Sl. No.	COURSE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
1	PSPT0038	H	L	L													
2	MACL0012	H	M														
3	CSPS0079	L	M			H											M
4	PSTC6016	H	L	L						M							
5	CSPL6069	L	M			H				M							M
6	CVED6024	H		M						M						L	L
7	BTIP7						H		M				H				
8	CHEC0027	H	L													L	
9	MAIN0013	H	M													L	
10	EEBE0038	M	H												M	M	L
11	EGEH0111										H		M				L
12	CHCE6006	H	M							M							
13	EEBL6027	M	H							M					M	M	L

14	MNWM6023			H		L				M					M		L
15	EGOC6005										H		M				L
16	BTIP9						H		M				H		L		
17	ECED0043	M	M	M										H		L	M
18	ECSS0044	M	H											M	L	H	L
19	ECNT0045	M	H	L										H	L	M	M
20	ECDS0046	L	M	H										H	M	H	L
21	MATC0026	M	H													M	M
22	MTEC0074											M	H				L
23	CHES0029			M				H								L	
24	ECED6034	M	M	M						M				H		M	M
25	ECDS6035	L	M	M						M				H	M	H	L
26	BTIA8				H	M	M						L		M		
27	BTIP10						H	H	M				H		L		M
28	ECAC0047		M	M										H		M	M
29	ECEL0048	L		M											H	M	
30	BOBI0001	H	M					L									M
31	ECDP0049		M	M	H									H		M	L
32	MNEE0042	H	M	M											M		
33	MTOB0069									M	M	H	M				M
34	ECAC6036		M	M						M				H		M	M
35	ECEL6037			M						M					H	M	
36	ECDP6038		M	M	H					M				H		M	L
37	BTIP11						M	L	H				H		L		M
38	ECAC0081	M	M	L										H	M	M	
39	ECMM0082		M	M		M								M	M	H	
40	ECCA0083		M	M										H			H
41	ECPS0084		M		M									M		H	M
42	ECPE0085	L	M		M									H		M	
43	ECBE0086	M	M												M		H
44	ECSS0087		M		M									H		M	L
45	ECNT0088	L	M											M	M		H
46	ECAC6052	M	M	L						M				H	M	M	
47	ECMM6053		M	M		H				M				M	M	H	
48	ECMI6054		L	M						H		M	L	M	H	L	L
49	BTIP12				M	M	L				H		L		M		M
50	ECCS0089		M	M										M	L	H	
51	ECNT0090	L	M			M								H			M
52	ECEW0091		M	M		M								H		M	
53	ECCD0092		M	M		M								H	M	M	
54	ECNE0093	L	M			M								M		H	M
55	ECIC0094		M		H									H		M	
56	ECRB0095	M		M		L	M								H		H
57	MTPO0106											H	M				L
58	ECEW6057		M	M		H				M				M		M	
59	ECNT6058	L	M			M								H			M
60	BTIP13				M	H	L			M	M			M			L
61	7.1 (Antenna and Wave Propagation)			M		M		L						H	M		
62	7.2.A (Embedded System)			H	M	M								M	H	L	

63	7.2.B (Mobile Communication and Networks)			M		L		L						H	L	M	
64	7.3.A (Wireless Sensor Network)			M		M								M		M	H
65	7.3.B (Satellite Communication)			M		M		L						H		M	
66	7.4 (Introduction to Artificial Intelligence and Machine Learning-OE)			M		M										H	M
67	7.5 (Financial Management and Accounting)											H	L				M
68	7.6 (Project-I)		M	M	H		M	H		H				M	H	M	M
69	7.7 (Training Seminar)							M			H			M			M
70	8.1.A (Fiber Optic Communication)			M		M								H		M	L
71	8.1.B (Adaptive Signal Processing)			H		M										H	M
72	8.2.A (Microwave Theory & Technique)		M	L		M		L						H		L	
73	8.2.B (Digital Image and Video Processing)			M	H	M									M	H	M
74	8.2.C (Mixed Signal Design)		M	L		M								M	L	H	
75	8.3 (Internet of Things)			M		H								M	M	M	H
76	8.4	L	M											M		M	H

	(Bioinformatics)																
77	8.5 (Project-II)		M	M	H		M	H		H				M	H	M	M
78	8.6 (Essence of Indian Traditional Knowledge)						M		H				M				L

MAPPING of COURSES to PO/PSOs (M.Tech – Signal Processing)

Sl. No.	Course Type	COURSE	PO1	PO2	PO3	PO4	PO5	Remarks
1	Core 1	ECAP0053	H	H	H			Employability
2	Core 2	ECDV0054	M	H	H	M	L	Employability
3	Core	ECRM0042	L			M	H	
4	Audit 1	EGRW0015				L	M	
5	Prog. Specific Elective I	ECAU0055		H	H	M		Skill Development
6		ECCV0056		H	H	M	L	Skill Development
7		ECAA0057		H	H	M		Employability
8	Prog. Specific Elective II	ECSI0058	M	H	M	M		
9		ECVD0059	M	H	M	M		Skill Development
10		ECVC0060	L	H	H	H		Employability
11	Lab1	ECAP6041	M	H	H	H		
12	Lab2	ECDV6042	M	H	H	H		
13	Core 3	ECPM0069	L	H	H	H	L	Skill Development
14	Core 4	ECDE0070	M	H	M	M		
15	Prog. Specific Elective III	ECIA0071	M	H	M	H	H	Entrepreneurship
16		ECDD0072	H	M	H	L		Skill Development
17	Prog. Specific Elective IV	ECBS0073	M	H	H	H	M	Skill Development
18		ECDS0074	M	H	H			Employability
19	Lab3	ECPM6045	L	H	H	H	M	
20	Lab4	ECDE6046	M	M	H	H	M	
21	Project	ECMI6051	M	M	H	H	H	
22	Audit 2 (MOOCs)	EDCI0100					M	
23	Prog. Specific Elective V	ECAI0096	M	H	H	H	L	
24		ECOT0097	M	H	H	H		
25		ECRS0098	M	H	H	H	L	
26	Open Elective	Bioinformatics	H	H				
27	Dissertation (Phase I & II)	ECDI6059	M	M	H	H	H	

MAPPING of COURSES to PO/PSOs (M.Tech – Communication)

Sl. No.	Course Type	COURSE	PO1	PO2	PO3	PO4	PO5	Remarks
1	Core 1	ECAP0053	H	M	H			Employability
2	Core 2	ECWM0061	M	H		M		Employability
3	Core	ECRM0042	L			M	H	
4	Audit 1	EGRW0015				L	M	
5	Prog. Specific Elective I	ECSC0062	M	H	M			Skill Development
6		ECWN0063	L	H	H	H		Employability
7		ECON0064	L	H	H			Employability
8	Prog. Specific Elective II	ECCR0065		H	M			
9		ECSI0058	M	M	H	M		Skill Development
10		ECRC0066	M	H				
11	Lab1	ECAP6041	M	M	H	H		
12	Lab2	ECWM6043	M	H	H			
13	Core 3	ECRS0075	M	H	H	M		Skill Development

14	Core 4	ECCN0076		H	M			
15	Prog. Specific Elective III	ECDS0074	M	H	M	H	H	Entrepreneurship
16		ECIA0071	H	M	H	L		Skill Development
17	Prog. Specific Elective IV	ECPM0069	L	H	H	H		Skill Development
18		ECMS0077	M	H	H			Employability
19	Lab3	ECRS6047	M	M	H	H	M	
20	Lab4	ECCN6048	M	M	H	H	M	
21	Project	ECMI6051	M	M	H	H	H	
22	Audit 2 (MOOCs)	EDCI0100					M	
23	Prog. Specific Elective V	ECAI0096	M	M	H	H	L	
2		ECOT0097	M	H	H	H		
25		ECRS0098	M	H	H	H		
26	Open Elective	Bioinformatics	H	H				
27	Dissertation (Phase I & II)	ECDI6059	M	M	H	H	H	

MAPPING of COURSES to PO/PSOs (M.Tech – VLSI and Embedded System)

Sl. No.	Course Type	COURSE	PO1	PO2	PO3	PO4	PO5	Remarks
1	Core 1	ECAP0053	H	H	H	L		Employability
2	Core 2	ECMA0067	M	M	H	M		Employability
3	Core	ECRM0042	L			M	H	
4	Audit 1	EGRW0015				L	M	
5	Prog. Specific Elective I	ECPP0068	M	H	H			
6		ECAA0057		H	H	M		Employability
7	Prog. Specific Elective II	ECWM0061	M	H		M		Employability
8		ECDV0054	M	H	H	M	L	Employability
9	Lab1	ECAP6041	M	H	H	H	M	
10	Lab2	ECMA6044	M	H	H	H	M	
11	Core 3	ECDS0074	M	H	H			Employability
12	Core 4	ECSA0078	M	M	H	M	L	Employability
13	Prog. Specific Elective III	ECDD0072	H	M	H	L		Skill Development
14		ECIA0071	M	H	M	H	H	Entrepreneurship
15	Prog. Specific Elective IV	ECMT0079	M	H	M			Employability
16		ECBS0080	M	H	H			
17	Lab3	ECDS6049	M	H	H	H	M	
18	Lab4	ECSA6050	M	H	H	H	M	
19	Project	ECMI6051	M	M	H	H	H	
20	Audit 2 (MOOCs)	EDCI0100					M	
21	Prog. Specific Elective V	ECAI0096	M	H	H	H	L	
22		ECNN0099	M	H		H		
23		ECSD0100	M	H	H	H		
24	Open Elective	Bioinformatics	H	H				
25	Dissertation (Phase I & II)	ECDI6059	M	M	H	H	H	

DETAILED SYLLABUS

THEORY COURSES

ECRM0042 RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHT (L-T-P: 2-0-0)
(2 credits-30 hours)

Objective:
This course is designed to help students to identify research problems in various fields. It aims at giving potential researchers the knowledge of effectively analysing and interpreting results and presenting the findings to the scientific and technological community of the world. This course also aims at motivating students to bring about their creative ideas for innovation and establishing research impact in the global for a through intellectual ownership.

Course Outcomes
1. Find research problems in various fields (Remembering).
2. Illustrate the concepts related to patents, trademark and copyright (Understanding).
3. Apply scientific investigations to find solutions for research problems of interest (Applying).
4. Develop technical writing and presentation skills (Applying).
5. Analyze the available literature and compile literature review for knowing the state of the art in the areas of interest (Analyzing/ Creating).
6. Formulate a research problem for a given engineering domain (Creating)

Module I (12 Hours)
Meaning, sources, scope and objective of a research problem; Good research problem criteria and characteristics, errors in selecting a research problem; Research problem solutions– approaches for investigation; Approaches to effective literature studies; Data collection, analysis, interpretation and instrumentation; Plagiarism and ethical practices.

Module II (10 Hours)
Effective writing; Research proposal development and its format; Different report types.

Module III (8 Hours)
a. Nature of intellectual property: Patent, design, trade and copyright; Patenting and development process; Patent grant under PCT and procedure; Geographical indications.
b. Patent rights: Administration of patent systems, scope, information and databases, technology licensing.
c. New developments and case studies.

Suggested Readings
1. Goddard Wayne, Melville Stuart, Research Methodology: An Introduction For Science And Technology Students, Juta & Co. Ltd.
2. Kumar Ranjit, Research Methodology A Step By Step Guide For Beginners, SAGE publications Inc.
3. Halbert J. Debora, Resisting Intellectual Property, CRC press.
4. Menell S. Peter, Lemley A. Mark, Merges P. Robert, Intellectual Property In New Technological Age, Clause 8 Publishing.
5. C.R. Kothari, Research Methodology Methods and Techniques, New Age International

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H		L
CO 2	M		H
CO 3	H	L	
CO 4	L	H	M
CO 5	H	M	L
CO6	H	M	L

ECED0043 ELECTRONIC DEVICES (L-T-P: 3-0-0)
(3 credits-45 hours)

Objective:
This course introduces basic semiconductor material, semiconductor junction properties, electronic devices and electronic circuit design. The course will also help in understanding the operation of simple devices such as p-n junctions and

optoelectronic devices. More complex devices such as Bipolar Junction Transistors (BJT) and Field Effect Transistors (FETs), will also be introduced. It also introduces basic processes used in fabricating semiconductor devices and integrated circuits. The objective is to develop the background knowledge necessary to understand semiconductor physics and state-of-the-art semiconductor technology related to device fabrication processes.

Course Outcomes

1. Define the basic principles associated with how electrons behave. (Remembering)
2. Relate the basic principles of single pn junction devices and their operations. (Understanding)
3. Apply knowledge and understanding of bipolar junction devices and their operation principles to making electronic circuits. (Applying)
4. Examine operation and working of field effect transistors electronic circuits and deduce their outputs. (Analyzing)
5. Interpret processes that are used in fabricating electronic devices and ICs. (Evaluating)

Module I (3 Hours)

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon

Module II (12 Hours)

P-N Junction: P-N junction characteristics, I-V characteristics, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors; Generation and recombination of carriers; Poisson and continuity equation; small signal switching models; Avalanche breakdown, Zener diode, Schottky diode LED, photodiode and solar cell; Diode circuits.

Module III (15 Hours)

Bipolar Junction Transistor: BJT types; BJT configurations; I-V characteristics, Ebers-Moll Model, BJT biasing; bias stability, small signal analysis, low frequency transistor models and analysis, estimation of voltage gain, input resistance, output resistance etc.

Module IV (9 Hours)

MOSFET: Introduction to MOSFET, MOSFET types; I-V characteristics, CMOS. Biasing and Stabilization of Q-point, small signal models of MOS transistor, MOS capacitor, C-V characteristics.

Module V (6 Hours)

Integrated circuit fabrication process: Oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Suggested Readings

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas “Semiconductor Physics and Devices,” McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ.Press, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	M	M	
CO 2	L	H	H	H	
CO 3	L	H	H	H	
CO 4	L	H	H	H	
CO 5					H

ECSS0044 SIGNALS AND SYSTEMS (L-T-P: 2-1-0)

(3 credits-45 hours)

Objective:

The objective of this course on Signals and Systems is to acquaint the student with the various types of signals which form the basis of electronic communication and to provide the theoretical background necessary to understand the working of any electronic communication system.

Course Outcomes

1. Define different types of signals and systems. (Remembering)

2. Illustrate the fundamentals of LTI systems and different transforms. (Understanding)
3. Apply the knowledge of different transforms to study the properties of different signals and systems. (Applying))
4. Analyze the characteristics of different systems to implement in communication systems. (Analysing)

Module I (6 hours)
Signals and systems as seen in everyday life, and in various branches of engineering and science. Definition and Classification of signals: continuous and discrete time signals. Types of signals: Analog and Digital signals, Deterministic and random signals, periodic and aperiodic signals, power and energy signals, even and odd signals. Standard signals: Impulse, Step, Ramp, Exponential, Gate, Signum, Rectangular and Sinc. Analysis of different signal types. Operation on signals, System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Module II (7 hours)
Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of LSI systems. System representation through differential equations and difference equations.

Module III (12 hours)
Fourier series representation. The Continuous-time Fourier Transform (CTFT) and its properties. The Discrete-Time Fourier Transform (DTFT) and its properties. The Discrete Fourier Transform (DFT). The notion of a frequency response and its relation to the impulse response. Convolution/ multiplication and their effect in the frequency domain, magnitude and phase response. Parseval's Theorem. Energy Spectral Density (ESD) and Power Spectral Density (PSD). Auto-correlation and Cross-correlation functions. The idea of signal space and orthogonal bases.

Module IV (11 hours)
The Laplace Transform: definition and properties, inverse Laplace transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence (ROC), poles and zeros of system. Initial value and final value theorem. Laplace domain analysis. Solution to differential equations and system behavior. The z-Transform for discrete time signals and systems: definition and properties, inverse Z-transform, eigen functions, region of convergence (ROC), z-domain analysis.

Module V (9 hours)
State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. Sampling: Definition, mathematical model and types. The Sampling Theorem and its implications: Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first- order hold, and so on. Aliasing, its effects and methods to eliminate aliasing. Relation between continuous and discrete time systems.

Suggested Readings
1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. P Ramesh Babu, R Ananda Natarajan, Signals and Systems, SciTech Publications, 2006.
4. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
5. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
6. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International, 1999.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H	M	M	
CO 3			H	H	
CO 4		M	L	L	H

ECNT0045 NETWORK THEORY (L-T-P: 2-1-0)
(3 credits-45 hours)

Objective:
The objective of this course is to introduce the laws that govern the response of electrical circuits and networks. This course will help in understanding various network theorems, two port networks, resonance circuits, electrical filter circuits and analysis of steady and transient state of electrical circuits.

Course Outcomes

1. Define various network theorems and mathematical tools used in network analysis. (Remembering)
2. Explain various network theorems, mathematical tools used in network analysis and various electrical circuits. (Understanding)
3. Implement network theorems and various electrical circuits. (Applying)
4. Compare various network theorems and various electrical circuits. (Analysing)
5. Choose network theorems and electrical circuits for various networks. (Evaluating)

Module I (20 hours)

Voltage division rule, current division rule. Star-Delta conversion, Kirchhoff's current law (KCL, Kirchhoff's voltage law (KVL), Node and Mesh analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tallegen's theorem as applied to AC. circuits.

Module II (10 hours)

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Module III (15 hours)

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Suggested Readings

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	H	L
CO 2	H	H	H
CO 3	H	L	H
CO 4	H	L	H
CO 5	M	M	M

ECDS0046 DIGITAL SYSTEM DESIGN (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective:

The objectives of this course are to introduce the concept of digital and binary systems and give students the concept of digital electronics. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits, modules and subsystems.

Course Outcomes

1. Define and illustrate various laws and axioms associated with digital logic design. (Remembering - Understanding)
2. Apply Boolean laws for solving and minimizing logic functions practically. (Applying)
3. Analyse different types of combinational and sequential circuits. (Analysing)
4. Evaluate the behaviour of different digital circuits. (Evaluating)
5. Design and build various combinational circuits and sequential circuits. (Creating)

Module I (8 hours)

Logic Simplification and Combinational Logic Design: Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Module II (9 hours)
MSI devices: Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Module III (12 hours)
Sequential Logic: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Module IV (8 hours)
Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Module V (8 hours)
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modelling styles in VHDL, Data types and objects, Dataflow, Behavioural and Structural Modelling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Suggested Readings
1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition ,2006.
4. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2	H				
CO 3		H	H		
CO 4			H	M	
CO 5					H

ECAC0047 ANALOG CIRCUITS (L-T-P: 3-0-0)
(3 Credits – 45 hours)

Objective:
To understand the basic concepts in the design of electronic circuits using Linear Integrated Circuits and their application in the processing of analog signals. The course also helps in learning the linear and non-linear applications of operational amplifiers (OpAmps), the theory and applications of analog multipliers, ADC and DAC and a few special function integrated circuits.

Course Outcomes
1. Define the linear and non-linear applications of BJT and op-amp. (Remembering)
2. Classify and comprehend the working principle of different circuits based on BJT and op-amp. (Understanding)
3. Apply the methods learned in the class to design and implement practical projects. (Applying)
4. Analysis of modern analog circuits using integrated circuits. (Analysing)
5. Design, layout, and testing of Analog circuits. (Evaluating/ Creating)

Module I (10 hours)
High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Module II (15 hours)
Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

Module III (15 hours)

OPAMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation. Open loop and closed loop concept, virtual ground, equivalent circuit, ideal characteristics, ideal transfer curve, OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, difference amplifier, precision rectifier, comparator, zero crossing detector, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Module IV (5 hours)

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Suggested Readings

1. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd.
2. T.R. Ganesh Babu and B. Suseela, Linear Integrated Circuits, Scitech Publications (India) Pvt. Ltd.
3. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
4. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
5. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
7. Publishing, Edition IV 6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H	H	
CO 3			H	
CO 4			H	
CO 5			H	M

ECEL0048 ELECTRONIC MEASUREMENTS (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective:

The course is aimed at introducing the concept of measurement and the related instrumentation requirement as a vital ingredient of electronics and communication engineering to learn basic concepts of electronic measurements, importance of signal generators and signal Analysers in measurements and relevance of digital instruments in measurements.

Course Outcomes

1. Describe the fundamental concepts and principles of instrumentation. (Remembering)
2. Classify and explain the various types of instruments required in measurements. (Understanding)
3. Measure the various parameters related to Electronics measuring instruments. (Applying)
4. Elaborate the performance of different measuring instruments based on the nature and performance characteristics and assess their importance in measurement. (Evaluating)
5. Elaborate the function of various types transducers in measuring different physical parameters. (Evaluating)

Module I (10 hours)

a. Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics- speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters - Multirange, Range extension/Solid state and differential voltmeters, AC voltmeters - multi range, range extension, shunt. Thermocouple type RF ammeter, Ohmmeters series type, and shunt type, Multimeter for Voltage, Current and resistance measurements.
b. AC Bridges- Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance - Schering Bridge. Wheatstone bridge. Wien Bridge, Errors and precautions in using bridges. Q-meter

Module II (20 hours)

a. Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO, Measurement of amplitude and frequency, Lissajous method of frequency measurement, standard specifications of CRO.

b. Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope. Probes for CRO- Active and Passive, attenuator type, Frequency counter, Time and Period measurement
c. Wave Analysers, Harmonic Distortion Analysers, Spectrum Analysers, Digital Fourier Analysers.
d. Signal Generator - fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform.

Module III (15 hours)

a. Transducers- active and passive transducers : Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors. Introduction to various sensors- Optical, Bio-medical etc.
b. Measurement of physical parameters force, pressure, velocity, humidity, moisture, speed, proximity and displacement. Data acquisition systems.

Suggested Readings:

1. A.K. Sawhney, Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai, 2009
2. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques,1st Ed.,PHI
3. H. S. Kalsi, Electronic Instrumentation, TMH India
4. D. Patranabis, Sensors and Transducers, 2nd Ed., PHI.
5. David A. Bell, Electronic Instrumentation and Measurements, 2nd Ed., PHI

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H		
CO 2	H	M	
CO 3		H	
CO 4	H		
CO 5			H

ECDP0049 DIGITAL SIGNAL PROCESSING (L-T-P: 2-1-0)

(3 credits – 45 hours)

Objective:

The course aims at providing a framework to understand various aspects of digital signal processing and will deal with the design methodology of digital FIR & IIR filters along with various signals, discrete time systems and transforms.

Course Outcomes

1. Define and outline the fundamental concepts of signals and systems. (Remembering)
2. Classify the different types of signals and discrete time systems, digital filters and different methods of designing digital filters. (Understanding)
3. Design and analyse digital filters for different specifications. (Applying/ Analysing)
4. Evaluate the method of different filter design techniques and different types of filters. (Evaluating)
5. Design different IIR and FIR systems. (Creating)

Module I (10 hours)

a. Discrete time signals: Sequences; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Elementary examples; Classifications of discrete time signals; Operations on discrete time signals.
b. Discrete time system: Discrete systems attributes; Properties of discrete time system; Classification of discrete time systems.

Module II (15 hours)

a. Analysis of LTI systems: Analysis and response (convolution sum) of discrete - time linear LTI system; Z-Transform; Constant coefficient differences equations and their solutions.
b. Frequency Analysis LTI systems: Discrete Fourier Transform (DFT); Circular convolution; Overlap savemethods and overlap add method; Fast Fourier Transform (FFT); FFT Algorithms.
c. Implementation of Discrete Time Systems: Recursive and non-recursive discrete time system; Realization of FIR & IIR system

Module III (10 hours)

a. Design of FIR Digital filters: Window method; Park-McClellan's method.

b. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters; Impulse Invariance method, Matched Z-transform method, Backward difference method and bilinear transformation method.

Module IV (10 hours)

a. Effect of finite register length in IIR & FIR filter design; Parametric and non-parametric spectral estimation.
b. Introduction to multirate signal processing.
c. Applications of DSP.

Suggested Readings:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Pearson.
2. SK Mitra, Digital Signal Processing, Pearson
3. P Ramesh Babu, Digital Signal Processing, SciTech
4. S. Salivahanan, Digital Signal Processing, TMH
5. J. R. Johnson, Introduction of Digital Signal Processing, PHI.
6. Emmanuel C Ifeachor and Barrie W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	H		
CO 2	H			
CO 3		M	H	
CO 4				H
CO 5				H

ECEC0050 ANALOG ELECTRONIC CIRCUITS (L-T-P: 3-0-0)

(3 Credit-45 hours)

Objective:

The course provides basic analog electronic circuit design techniques and analytical skills using diodes, op-amps, FETs and BJTs. The student will develop the ability to apply basic engineering sciences to the design, analysis and operation of electronics devices and circuits and problem solving skills of electronic circuits.

Course Outcomes

1. Define various terminologies related to different analog electronic devices and circuits. (Remembering)
2. Illustrate the basic working principle and operation of various electronic components and circuits. (Understanding)
3. Solve problems related to the modeling and design of various analog circuits. (Applying)
4. Analyse the characteristics/working principle/operation of various analog circuits. (Analysing)
5. Design and develop different analog electronic circuits. (Creating)

Module I (7 hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, LED, photodiode, clamping and clipping circuits

Module II (10 Hours)

PNP and NPN transistors, Structure and I-V characteristics of a BJT, BJT as a switch, BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers, phototransistor, Small signal equivalent circuits (h-parameter model) and analysis CE configuration.

Module III (10 Hours)

JFET and MOSFET structure and I-V characteristics, JFET and MOSFET as a switch, as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, CMOS inverter

Module IV (4 Hours)

Internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, output voltage swing)

Module V (7 Hours)

Op-amp as Inverting and non-inverting amplifier. Op-Amp applications in constant gain multiplier, Voltage summing, Integrator, Differentiator and controlled sources. Differential amplifier, instrumentation amplifier, active filters, voltage regulator, Zero Crossing Detector, Square-wave and triangular-wave generators

Module VI (7 Hours)
555 Timer: Block diagram, Monostable operation, Astable operation Regulated Power Supply: Voltage feedback regulation, Current limiting characteristics, Power supply characteristics, Current boosters, Switching regulators

Suggested Readings

1. A. S. Sedra and K. C. Smith, Microelectronic Circuits, Oxford University Press, New York
2. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education
3. S Salivahanan, N Suresh Kumar and A Vallavaraj, Electronic Devices and Circuits, Tata McGraw-Hill
4. Robert L. Boylestad and Lowis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, New Delhi
5. David A. Bell, Electronic Devices and Circuits, 4th Edition, Prenice Hall of India, New Delhi
6. Ramakant A Gayakwad Op-Amps and Linear Integrated Circuits, 4th Edition, PHI Learning Publishers

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H	M	H		
CO 2	H	H	H		H	H
CO 3	L	H	M		M	L
CO 4		L	L		H	M
CO 5	H	H	M		M	L

ECBE0051 BASIC ELECTRONICS (L-T-P: 1-0-0)

(1 Credit-15 hours)

Objective:
This course will provide a broad overview of basic electronic components, devices and circuits. The students will develop the ability to apply the basic knowledge in design, analysis and operation of these devices and circuits.

Course Outcomes
1. Define the various terminologies related to semiconducting materials, basic electronic devices, and simple electronic circuits and systems. (Remembering)
2. Illustrate the basic working principle and operation of various active components like diodes and transistors. (Understanding)
3. Apply the knowledge of transistors to design amplifiers and oscillators. (Applying)
4. Analyse the characteristics/working principle/operation of semiconductors devices and systems. (Analysing)
5. Evaluate the performance & characteristics of different types of electronic circuits. (Evaluating)
6. Design and develop different types of electronic circuits (Creating)

Module I (4 hours)
Diodes and Applications: Semiconductor Diode – Construction, Operation, V-I Characteristics, Static & Dynamic Resistance, Ideal versus Practical, , Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.

Module II (4 hours)
Transistors: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action; BJT Configurations – Common Base, Common Emitter and Common Collector, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of JFET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits.

Module III (4 hours)
Amplifiers & Oscillators: Classification of transistor amplifiers and oscillators; Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies,Current Series and Voltage Series Feedback Amplifiers; Oscillators – Basic Features, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators.

Module IV (3 hours)

Operational Amplifiers and Applications: Introduction to Op-Amp, Op-Amp as Differential Amplifier, Parameters of Op-Amp – CMRR, PSRR, Slew Rate; Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Inverting & Non-inverting amplifier.

Number System & Digital Electronics: Introduction to decimal and binary number system; Logic gates– AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, universal gates.

Suggested Readings

1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India
2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH
5. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	M			
CO 2		H	H	
CO 3			H	
CO 4			H	H
CO 5			H	
CO 6				H

ECEE0052 BASIC ELECTRONICS ENGINEERING (L-T-P: 3-1-0)

(4 Credits-60 hours)

Objective:

This course is intended to give a preliminary understanding of the world of Electronics-Semiconducting materials and basic devices, simple circuits and communication systems. It will also serve to create a better appreciation of going digital and to generate continued interest in the course.

Course Outcomes

1. Define the various terminologies related to semiconducting materials, basic electronic devices, simple electronic circuits and systems,digital logic circuits and communication systems. (Remembering)
2. Illustrate the basic working principle and operation of various electronic components and circuits. (Understanding)
3. Solve problems related to the modeling and design of various analog and digital electronic circuits. (Applying)
4. Design and develop different types of electronic circuits. (Creating)

Module I (18 hours)

Semiconductor Devices and Applications: Introduction to types of semiconductors – Intrinsic & Extrinsic, N-type and P-types, Energy Band Diagram; Introduction to P-N junction Diode – Construction, Operation, and V-I characteristics, Static & Dynamic Resistance, Ideal versus Practical, Half wave and Full-wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener diode and its characteristics, Zener diode as voltage regulator; Regulated power supply IC based on 78XX and 79XX series, Introduction to Bipolar Junction Transistor (BJT) – Construction, Operation; BJT Configurations – Common Base, Common Emitter and Common Collector, input-output and transfer characteristics, Operating Point; BJT as a single stage CE amplifier, frequency response and bandwidth.

Module II (16 hours)

Operational Amplifier and its Applications: Introduction to Operational Amplifiers – Equivalent circuit, Transfer Characteristics, Op-Amp input modes and parameters, Ideal Characteristics; Op- Amp in Open Loop Configuration, Op-Amp with Negative Feedback, Concept of Virtual Ground, Practical Op-Amp IC 741, Inverting and Non-inverting Amplifier; Applications of Op-Amp – Summing and Difference Amplifier, Unity Gain Buffer, Comparator, Integrator and Differentiator, Log Amplifier, Instrumentation Amplifier.

Timing Circuits and Oscillators: Oscillators – Basic Features, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator; RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators

Module III (14 hours)

Digital Electronics Fundamentals: Number System and Boolean Algebra, Basic and Universal Gates –Symbols, Truth tables, logic expressions; Logic simplification using K- map, Logic ICs, Half and Full Adder/Subtractor, Multiplexers, Demultiplexers, Flip-Flops, Shift Registers and Counters; Block diagram of Microprocessor/Microcontroller and their applications.

Module IV (12 hours)

Electronic Communication Systems: The Elements of Communication System, IEEE Frequency Spectrum, Signals and its Classification, Types of Signals; Transmission Media – Wired and Wireless, Baseband and Passband transmission; Modulation – Types of Modulation, Need for modulation, AM and FM Modulation schemes; Mobile communication systems – Cellular Concept and Block Diagram of GSM System.

Suggested Readings

1. Bell, "Electronic Devices & Circuits" Oxford, 5th edition, 2015.
2. Floyd , "Electronic Devices" Pearson Education, 9th edition, 2012.
3. R.P. Jain , "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition, 2007.
4. Frenzel, "Communication Electronics: Principles and Applications", Tata McGraw Hill, 3rd Edition,2001.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	M	H
CO 2	H	H		M
CO 3	H	M	H	
CO 4	H	M	L	L

ECAP0053 ADVANCED DIGITAL SIGNAL PROCESSING (L-T-P: 3-0-0)

(3 Credit-45 hours)

Objective:

This course is intended to make the students learn the essential advanced topics in digital signal processing that are necessary for successful post graduate-level research. The course includes a review of the linear constant-coefficient system properties covered in an undergraduate DSP course, and then examines a variety of filter structures, time-varying and adaptive systems, fast algorithms, and other topics relevant to the research areas of the students.

Course Outcomes

1. Recall and illustrate theory of different filters and algorithms. (Remembering, Understanding)
2. Choose the best algorithm for adaptive filter design. (Applying)
3. Understand theory of multirate DSP, solve numerical problems and write algorithms. (Understanding, Applying)
4. Analyse theory of prediction and solution of normal equations. (Analysing)
5. Examine applications of DSP at block level. (Analysing)
6. Interpret the utilization of advanced algorithms like LMS, MMSE etc., for designing adaptive filters. (Evaluating)
7. Design the various types of digital filters. (Creating)

Module I (10 Hours)

Overview of DSP: Discrete time signals and Systems. Characterization in time and frequency, LTI System, the Z-transform, DFT, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR, FIR differentiators.

Module II (7 Hours)

Multi rate DSP: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, polyphase filters, QMF, digital filter banks, Applications in sub-band coding.

Module III (8 Hours)

inear prediction & optimum linear filters: Stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Module IV (8 Hours)

Introduction to adaptive signal processing:Adaptive Filters, FIR adaptive filters: steepest descent adaptive filter, LMS algorithm, Gradient Adaptive Lattice, Minimum mean square criterion, Recursive Least Square algorithm, Applications: noise cancellation, channel equalization, adaptive recursive filters, recursive least squares, Kalman Filter.

Module V (7 Hours)
Estimation of Spectra from Finite-Duration Observations of Signals: Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis, Algorithms for Spectrum Estimation.

Module VI (5 Hours)
Application of DSP & Multi rate DSP: Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

Suggested Readings
1. J. G. Proakis and D. G. Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems-Filter Banks– Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S. Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6. D. G. Manolakis, V.K. Inglean and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		M	L		
CO 2			M	H	L	
CO 3		H			M	L
CO 4			H	M	L	
CO 5	M		L			H
CO 6			M	L	H	

ECDV0054 DIGITAL IMAGE AND VIDEO PROCESSING (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective:
This course is intended to give the students an overview of important topics of image and video processing. The course starts with an introduction to the basics of image and video processing such as sampling, aliasing etc. and image transforms like DFT, DCT etc. and then moves on to advanced topics such as image and video restoration, segmentation, compression etc. It also introduces the students to concepts of colour image processing.

Course Outcomes
1. Define key stages of image processing (Remembering)
2. Explain key stages of image processing (Understanding)
3. Implement image enhancement, restoration, data compression techniques (Applying)
4. Compare object recognition tools (Analyzing)
5. Choose image enhancement technique and object recognition tool for specific applications (5, Evaluating)

Module I (10 Hours)
Digital Image and Video Fundamentals: Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms. Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform.

Module II (8 Hours)
Image and Video Enhancement and Restoration: Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

Module III (10 Hours)
Image and Video Segmentation: Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

Module IV (7 Hours)
Colour image Processing: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full Colour processing.

Module V (5 Hours)
Image and Video Compression: Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment.

Module VI (5 Hours)
Object recognition: Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier.

Suggested Readings
1. Ed. Al Bovik ,"Handbook of Image and Video Processing", 2nd Edition, Academic Press,2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press,2011.
3. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall,2008.
4. M. Tekalp, "Digital Video Processing",2nd Edition, Prentice Hall,2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford UniversityPress, 2016.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	M	M	M	M	M	M
CO 2	M	M	M	M	M	M
CO 3	H	H	H	L	H	L
CO 4	L	L	L	L	L	H
CO 5	H	H	L	L	L	H

ECAU0055 AUDIO PROCESSING (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective:
This course is intended to introduce the students to the fundamentals of audio processing and then move on to more advanced topics such as LPC, speech coding etc. The course also delves into applications of audio processing such as speech recognition and speaker recognition.

Course Outcomes
1. Define principal characteristics of speech, various speech analysis and synthesis systems (Remembering)
2. Explain principal characteristics of speech, various speech analysis and synthesis systems (Understanding)
3. Implement speech analysis and synthesis systems, speech coding, speech and speaker recognition(Applying)
4. Compare various techniques for speech analysis and synthesis, speech coding, speech and speaker recognition (Analyzing)
5. Choose suitable one amongst various techniques for speech analysis and synthesis, speech coding, speech and speaker recognition (Evaluating)

Module I (8 Hours)
Principle Characteristics of Speech: Linguistic information, Speech and Hearing, Speech production mechanism, Acoustic characteristic of speech Statistical Characteristics of speech. Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model.

Module II (10 Hours)
Speech Analysis and Synthesis Systems: Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction.

Module III (7 Hours)
Linear Predictive Coding Analysis: Principle of LPC analysis, Maximum likelihood spectral estimation, Source parameter estimation from residual signals, LPC Encoder and Decoder, PARCOR analysis and Synthesis, Line Spectral Pairs, LSP analysis and Synthesis.

Module IV (10 Hours)
Speech Coding: Reversible coding, Irreversible coding and Information rate distortion theory, coding in time domain: PCM, ADPCM, Adaptive Predictive coding, coding in Frequency domain: Sub band coding, Adaptive transform coding, Vector Quantization, Code Excited Linear Predictive Coding (CELP).

Module V (5 Hours)
Speech Recognition: Principles of speech recognition, Speech period detection, Spectral distance measure, Structure of word recognition system, Dynamic Time Warping (DTW), Theory and implementation of Hidden Markov Model (HMM).

Module VI (5 Hours)
Speaker recognition: Human and Computer speaker recognition Principles Text dependent and Text Independent speaker recognition systems. Applications of speech Processing.

Suggested Readings
1. Sadaoki Furui, "Digital Speech Processing, Synthesis and Recognition" 2nd Edition, Taylor & Francis, 2000.
2. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education, 1979.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H	M	L	L	L
CO 2	H	H	M	L	L	L
CO 3	L	H	M	H	H	H
CO 4	L	H	M	H	H	H
CO 5	L	H	M	H	H	H

ECCV0056 COMPUTER VISION (L-T-P: 3-0-0)
(3 credits- 45 hours)

Objective:
The course is intended to make an insight into different aspects of Computer Vision and Machine learning, working principles, systems associated and applications.

Course Outcomes
1. Recall the working of camera and explain behavior of various sources, surfaces, shadows, human visual systems etc. (Remembering/ Understanding)
2. Illustrate the image formation models and feature extraction for computer vision. (Understanding)
3. Apply various image analysis operations on the images and videos such as segmentation, counting objects, shape determination, feature extraction etc. (Applying)
4. Analyze algorithms for high level vision analysis such as object detection and classifications using input features and classifiers. (Analyzing)
5. Evaluate the segmentation and motion detection and estimation techniques. (Evaluating)
6. Develop small applications and detect the objects in various applications. (Creating)

Module I (10 Hours)
Image Formation Models: Colour- Generation, Human Perception, Representation, Model for an Image Colour; Camera: Pinhole and Lens Types, geometric Camera model and Camera calibration; Monocular imaging system, Orthographic & Perspective Projection, Binocular imaging systems, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Radiometry, Projections, Transforms- Fourier, Hough and Radon; Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Module II (8 Hours)
Feature Extraction: Image representations (continuous and discrete), Scene Segmentation and Labeling; Counting Objects; Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges;

Module III (10 Hours)
Shape Representation and Segmentation: Statistical Decision Theory; Pattern Recognition Principles; Clustering Approach- K-Means Clustering; Parametric Approach- Bayes' Classifier; Relaxation Approach; Shape Similarity Based Recognition; Expert System; Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet

descriptors, B-Splines, Least Squares and Eigen Vector Line Fitting, Medial representations, Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation

Module IV (5 Hours)
Motion Detection and Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Background Subtraction and Modeling, Optical Flow, KLT, Spatio Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Structure from motion, Motion Tracking in Video.

Module V (7 Hours)
Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition, Geometric templates from spatial relations, Probabilistic and inferential methods- neural networks, support vector machines; Recognition by relations between templates.

Module VI (5 Hours)
Applications of Computer Vision: Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing.

Suggested Readings

1. D. Forsyth and J. Ponce, "Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, Springer Verlag London Limited, 2011.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga,"Introduction to Statistical Pattern Recognition",2ndEdition, Morgan Kaufmann, 1990.
5. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
6. B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
7. E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc, 2012.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H			L	M	M
CO 2		H	L			M
CO 3		M	H		L	L
CO 4	L			M	H	M
CO 5				H	M	L
CO 6	M	L	M	M	M	H

ECAA0057 ADVANCED COMPUTER ARCHITECTURE (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective:
The main objective of this course is to introduce the students with the concept of parallelism and pipelining, the design aspects and challenges. After this course students will be able to evaluate the issues in vector and array processors. They will also learn about high performance scalable multithreaded and multiprocessor systems.

Course Outcomes
1. Define the concept of pipelining and parallelism in various computer architectures. (Remembering)
2. Explain pipelining in software and hardware and hazards associated with it. (Understanding)
3. Identify various issues associated with vector and array processors. (Applying)
4. Analyse different types of multiprocessor architectures. (Analysing)
5. Compare the performance of multiprocessors and multithreaded architectures. (Evaluating)
6. Discuss parallel algorithms for multiprocessors. (Creating)

Module I (5 Hours)
Parallel Processing and Pipelining Processing- Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture.

Module II (10 Hours)

Pipeline Architecture-Principles and implementation of Pipelining, Classification of pipelining processors, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Advanced pipelining techniques, Software pipelining, VLIW (Very Long Instruction Word) processor.

Module III (8 Hours)
Vector and Array Processor- Issues in Vector Processing, Vector performance modeling, SIMD Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors: Matrix Multiplication.

Module IV (7 Hours)
Multiprocessor Architecture - Loosely and Tightly coupled multiprocessors, Inter Processor communication network, Time shared bus, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP).

Module V (5 Hours)
Multithreaded Architecture- Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development.

Module VI (10 Hours)
Parallel algorithms for multiprocessors- Classification and performance of parallel algorithms, operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).

Suggested Readings
1. Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing” McGraw Hill Education, 2012.
2. Kai Hwang, “Advanced Computer Architecture”, McGraw Hill Education, 1993.
3. William Stallings, “Computer Organization and Architecture, Designing for Performance” Prentice Hall, 6th edition, 2006.
4. Kai Hwang, “Scalable Parallel Computing”, McGraw Hill Education, 1998.
5. Harold S. Stone “High-Performance Computer Architecture”, Addison-Wesley, 1993.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2	M	H			
CO 3	M		H		
CO 4				H	
CO 5				M	H
CO 6	L		M	L	H

ECSI0058 STATISTICAL INFORMATION PROCESSING (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
This course is intended to introduce the students to the concepts of information processing. The course starts with the fundamental concepts of random variables and then moves on to random processes, random signal modelling, spectral analysis etc. It also covers concepts of information theory and source coding.

Course Outcomes
1. Define the statistical parameters associated with random variables and random processes. (Remembering)
2. Explain concept of various random signal models like MA, AR, ARMA etc. (Understanding)
3. Identify various hypothesis and methods to estimates parameters in statistical model. (Applying)
4. Inspect concepts of spectral analysis using functions like autocorrelation, periodogram etc.(Analyzing)
5. Evaluate information content, entropy, channel capacity etc. using various source and channel coding techniques (Evaluating)
6. Discuss application of information theory in the area of discrete mathematics (Creating)

Module I (10 Hours)
Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebycheff inequality theorem, Central Limit theorem, Discrete & Continuous RandomVariables. Random process: Expectations, Moments, Ergodicity,

Discrete-Time Random Processes Stationary process, autocorrelation and autocovariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Module II (5 Hours)
Random signal modeling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Module III (10 Hours)
Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test ,Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Module IV (5 Hours)
Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic Signals.

Module V (8 Hours)
Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon-Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Module VI (7 Hours)
Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes, & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

Suggested Readings
1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill,2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill,2000.
3. MouradBarkat , "Signal Detection and Estimation", Artech House, 2nd Edition,2005.
4. R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968.
5. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland,1977.
6. Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2	M	H			
CO 3	M		H		
CO 4		M		H	
CO 5	L				H
CO 6	L			M	H

ECVD0059 VOICE AND DATA NETWORKS (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective:
This course is intended to give the students an exposure to the design criteria of voice and data networks. The course starts with network design and performance issues in general, moves on to introducing the students to issues in design of voice and data networks and then gives an extensive idea on voice networks and data networks.

Course Outcomes
1. Define the fundamental concepts of network design and network performance issues, network terminology etc. (Remembering)
2. Explain concepts of voice and data networks. (Understanding)
3. Apply designs of voice and data networks such as link layer design etc. (Applying)

4. Inspect concepts of inter-networking, IP protocol and addressing CIDR, TCP, UDP etc. (Analyzing)
5. Evaluate Queuing models, traffic models, Markov systems etc. (Evaluating)
6. Discuss congestion avoidance, quality of service in packet networks etc. (Creating)

Module I (8 Hours)
Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Module II (7 Hours)
Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Module III (8 Hours)
Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Module IV (7 Hours)
Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks,

Module V (10 Hours)
Inter-networking, Bridging, Global Internet, IP protocol and addressing, Subnetting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to End Protocols, TCP and UDP, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Module VI (5 Hours)
Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

Suggested Readings

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall,1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman,2004.
4. Walrand,"Communications Network: A First Course", 2nd Edition, McGraw Hill,2002.
5. Leonard Kleinrock, "QueueingSystems,Volume I: Theory", 1st Edition, John Wiley and Sons,1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill,1987

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H	H			
CO 3			H	M		
CO 4				H	H	
CO 5				H	H	
CO 6						H

ECVC0060 AUDIO, VIDEO CODING AND COMPRESSION (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
This course is designed to give the students an idea about multimedia systems and processing. The course starts with basic coding techniques such as Huffman coding etc. and transforms such as DCT etc. and then gives an extensive idea on video and audio coding along with their compression systems.

Course Outcomes
1. Define the fundamental concepts of multimedia systems and processing. (Remembering)
2. Outline concepts of lossy and lossless image compression systems, still image compression standards etc. (Understanding)
3. Make use of standards of audio and video coding. (Applying)

4. Analyse motion estimation algorithms. (Analyzing)
5. Evaluate multimedia synchronization, audio-video interleaving video indexing and retrieval etc. (Evaluating)
6. Discuss applications of audio coding, video coding and various compression systems. (Creating)

Module I (5 Hours)
Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques.

Module II (10 Hours)
Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards: JBIG and JPEG.

Module III (8 Hours)
Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, other fast search motion estimation algorithms.

Module IV (5 Hours)
Video Coding Standards: MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard.

Module V (7 Hours)
Audio Coding: Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation, Format and encoding, Psychoacoustic Models.

Module VI (10 Hours)
Multimedia Synchronization: Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity. Video Indexing and Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing.

Suggested Readings
1. Iain E.G. Richardson, “H.264 and MPEG-4 Video Compression”, Wiley,2003.
2. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kaufmann, 2012
3. Mohammed Ghanbari, “Standard Codecs: Image Compression to Advanced Video Coding”, 3rd Edition, The Institution of Engineering and Technology, 2011.
4. Julius O. Smith III, “Spectral Audio Signal Processing”, W3K Publishing,2011.
5. Nicolas Moreau, “Tools for Signal Compression: Applications to Speech and Audio Coding”, Wiley, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H				
CO 2	L	H				
CO 3			H	H	H	
CO 4			H	H	M	
CO 5					H	H
CO 6					H	H

ECWM0061 WIRELESS AND MOBILE COMMUNICATION (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
This course is intended to make the students learn the essential advanced topics in wireless communication. The course starts with an introduction to basics of wireless communication such as cellular concepts and then moves on to important advanced topics related to multiple access techniques, equalizers, fading etc. It also introduces the students to 4G and 5G standards that are relevant topics for today’s times.

Course Outcomes
1. Define the fundamental concepts of cellular communication, multiple access techniques etc. (Remembering)
2. Outline concepts of GSM, GPRS etc. (Understanding)
3. Utilize GSM, CDMA etc. (Applying)

4. Analyse spectral efficiency based on multiple access techniques, equalizers in communication receivers etc. (Analysing)
5. Evaluate path loss, fading, diversity etc. (Evaluating)
6. Discuss 3G, 4G and 5G standards. (Creating)

Module I (10 Hours)
Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS),2.75 G Standards: EDGE.

Module II (8 Hours)
Spectral efficiency analysis based on multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas, Wireless network planning (Link budget and power spectrum calculations).

Module III (10 Hours)
Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Module IV (5 Hours)
Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Module V (7 Hours)
Code Division Multiple Accesses: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Module VI (5 Hours)
Higher Generation Cellular Standards: 3G Standards, evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Suggested Readings
1. V. K. Garg, J. E. Wilkes, “Principle and Application of GSM”, Pearson Education, 5thedition,2008.
2. V. K. Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition,2009.
3. T. S. Rappaport, “Wireless Communications Principles and Practice”, 2ndedition,PHI, 2002.
4. William C. Y. Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH,1995.
5. Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten, London, 1997.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L			
CO 2	H		M		L	
CO 3	L			M	H	
CO 4		H	M		L	
CO 5		M	H	H	L	
CO 6				M	M	H

ECSC0062 SATELLITE COMMUNICATION (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective
This course is intended to give the students an exposure to the important concepts of satellite communication. The course starts with fundamental principles of satellite communication and architecture of satellites. It then introduces the students to more advanced topics such as orbital analysis, satellite subsystems, link budget etc.

Course Outcomes

1. Define the brief history of satellite systems and fundamental concepts of satellite communication. (Remembering)
2. Outline concepts of satellite subsystems, modulation and multiple access schemes used in satellite communication etc. (Understanding)
3. Make use of orbital analysis, satellite link budget etc. (Applying)
4. Analyse phenomena in satellite communication such as effect of solar eclipse on satellite, Doppler shift etc. (Analysing)
5. Evaluate subsystems such as AOCS, communication subsystem etc. (Evaluating)
6. Discuss VSAT, DBS-TV etc. (Creating)

Module I (8 Hours)

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Module II (10 Hours)

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal Day.

Module III (10 Hours)

Satellite subsystems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication subsystem, power subsystems, antenna sub-system.

Module IV (7 Hours)

Typical Phenomena in Satellite Communication: Effect of Solar Eclipse on satellite, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Module V (5 Hours)

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Module VI (5 Hours)

Modulation and Multiple Access Schemes used in satellite communication, Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO, GPS.

Suggested Readings

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", PearsonEducation India,2011.
3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L		M		
CO 2			H	M	L	
CO 3	L	H	M			
CO4		L		H	M	
CO 5					H	
CO 6				L	M	H

ECWN0063 WIRELESS SENSOR NETWORKS (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

The objective of this course is to make the students to understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology, medium access control protocols and address physical layer issues, sensor management , sensor network middleware, operating systems. Also to learn key routing protocols for sensor networks and main design issues, transport layer protocols for sensor networks, and design requirements

Course Outcomes

1. Recall and illustrate the Concepts, Network Architecture and Applications of Ad-hoc and Wireless Sensor Networks. (Remembering, Understanding)
2. Illustrate the Concepts, Architecture of ad-hoc and sensor networks and MAC layer protocols. (Understanding)
3. Identify the design of routing protocols for ad-hoc and wireless networks. (Applying)
4. Analyse the protocol design issues of Ad-hoc Networks. (Analysing)
5. Elaborate and Evaluate the QOS related performance measurements of ad-hoc and sensor networks. (Evaluating, Creating)

Module I (5 Hours)

Introduction: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Module II (8 Hours)

Hardware:Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Module III (7 Hours)

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Module IV (10 Hours)

Overview of sensor network protocols:Sensor network protocols (details of at least 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Module V (5 Hours)

Data dissemination and processing: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Module VI (10 Hours)

Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

Suggested Readings

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
4. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				L
CO 2		L	M	M	H	H
CO 3		H	L	M	M	M
CO4	L		H	M		M
CO 5			M	L	M	H

ECON0064 OPTICAL NETWORKS (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

This course is intended to give the students an exposure to the design criteria of optical networks. The course starts with fundamentals such as SONET etc. and then deals with practical optical network design issues such as network performance, fault management, optical layer protection schemes etc.

Course Outcomes

1. Define the fundamental concepts of optical networks. (Remembering)
2. Outline concepts of SONET, SDH etc. (Understanding)
3. Utilize WDM network elements, OADM architectures etc. (Applying)
4. Analyse network survivability, WDM network design etc. (Analysing)
5. Evaluate network management functions, optical layer services, interfacing etc. (Evaluating)
6. Discuss concepts of OTDM, PON, AON etc. (Creating)

Module I (5 Hours)

SONET/SDH: Optical transport network, IP, routing and forwarding, multiprotocol label switching.

Module II (8 Hours)

WDM network elements: Optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Module III (7 Hours)

Control and management: Network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Module IV (5 Hours)

Network Survivability: Protection in SONET/SDH & client layer, optical layer protection schemes

Module V (10 Hours)

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Module VI (10 Hours)

Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

Suggested Readings

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3rd edition,2010.
2. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		M	L		
CO 2	H	M	L	M		
CO 3		H	L		M	L
CO 4		H	H		H	
CO 5			H		M	
CO 6			M		L	H

ECCR0065 COGNITIVE RADIO (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

This course will help the students to understand the spectrum scarcity problem and how cognitive radio deals with this problem. It will also deal with the contribution of cognitive radio systems in wireless networks and its architectures that enable the development of the cognitive radio network (both centralized and distributed). After this course students will be able to learn the technologies to allow an efficient use of TVWS for radio communications. It also discusses various cognitive radio standards along with various research challenges for deployment of cognitive radio networks.

Course Outcomes

1. Recall and illustrate the fundamental concepts of cognitive radio networks. (Remembering, Understanding)
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it. (Applying)
3. Examine technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies. (Analysing)

4. Elaborate and evaluate the fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation. (Evaluating, Creating)

Module I (10 Hours)
Introduction: Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Module II (10 Hours)
Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Module III (8 Hours)
Optimization Techniques of Dynamic Spectrum Allocation:Linear programming, convex programming, nonlinear programming, integer programming, dynamic programming, stochastic programming.

Module IV (7 Hours)
Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Module V (5 Hours)
Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Module VI (5 Hours)
Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

Suggested Readings
1. Ekram Hossain, Dusit Niyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd., 2009.
3. Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition, 2009.
4. HuseyinArslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, SorenAndersson, “Optimizing Wireless Communication Systems” Springer, 2009.
6. Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press, 2009.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	M	L	L	
CO 2		H	H	M		L
CO 3		H		H	M	L
CO 4	L	M	H	L	H	H

ECRC0066 RF AND MICROWAVE CIRCUIT DESIGN (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective
The objectives of this course are to provide students with RF circuit fundamentals for designing various circuit building blocks in a typical RF transceiver. At the completion of the course, students should appreciate the workings of RF transceivers. They are expected to be able to design key building blocks of RF transceivers, including low-noise amplifiers, standard matching circuits, RF amplifiers, mixers, power amplifiers and RF oscillators.

Course Outcomes
1. Explain the behavior of RF passive components and model active components. (Understanding)
2. Perform transmission line analysis. (Applying, Analysing)
3. Demonstrate use of Smith Chart for high frequency circuit design. (Understanding)
4. Justify the choice/selection of components from the design aspects. (Evaluating)

5. Contribute in the areas of RF circuit design. (Creating)

Module I (8 Hours)
Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Module II (7 Hours)
Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, the scattering matrix, transmission matrix, Signal flow graph.

Module III (10 Hours)
Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Module IV (5 Hours)
Nonlinearity And Time Variance in Microwave Circuits: Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Module V (10 Hours)
Microwave Semiconductor Devices And Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Module VI (5 Hours)
Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.

Suggested Readings

1. Matthew M. Radmanesh, “Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior
2. Design”, AuthorHouse, 2009.
3. D.M.Pozar, “ Microwave engineering” ,Wiley, 4th edition, 2011.
4. R.Ludwig and P.Bretchko, “R. F. Circuit Design”, Pearson Education Inc, 2009.
5. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, “Microwave Circuit Design Using Linear And Non Linear Techniques”, John Wiley 1990.
6. S.Y. Liao, “Microwave circuit Analysis and Amplifier Design”, Prentice Hall 1987.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	H	L		L
CO 2	H	M	L			
CO 3	H	H	M	M		L
CO4		M	H	H	L	M
CO 5	L	L	M	M	H	H

ECMA0067 MICROCONTROLLERS AND APPLICATIONS (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
The course helps to develop an in-depth understanding of the operation of microcontrollers, assembly language programming and microcontroller interfacing techniques. The students will be able to design and implement microcontroller based systems in both hardware and software and can apply this knowledge to more advanced structures.

Course Outcomes
1. Define various terminologies related to microprocessor and microcontrollers. (Remembering)
2. Compare between microprocessor and microcontroller and to explain the internal organization of 8051 microcontroller and PIC16C61 microcontroller. (Understanding)
3. Apply 8051 microcontroller to solve real life problems. (Applying)
4. Analyze the performance of 8051 microcontroller and to design and develop 8051 based system. (Analyzing)
5. Explain the fundamentals of PIC microcontroller. (Understanding)

Module I (7 hours)
Introduction: History of Microcontrollers and Microprocessors. Differences between Microcontrollers and Microprocessors, Introduction to MPU of different categories- such as Microcontroller-8051, AVR, PIC, etc., their specific features, advantages.

Module II (10 hours)
Microcontroller 8051: Introduction; MCS-51 Architecture; Registers, I/O Ports, Memory organization.

Module III (12 hours)
Assembly Language Microcontroller 8051: Instructions, Addressing modes, Arithmetical, Logical, Jumps, Loops and Call etc., Interrupts Timers/ Counters and Serial Communications.

Module IV (8 hours)
Application of MCS-51: Interfacing 7-segment display, LCD, Key board, ADC etc. Development of instrumentation system such as temperature, pressure, flow, frequency, pulse width, voltage, rpm, pH etc. monitoring. Generation of PWM wave, Data-logger, alarm enunciators, PID controller, programmable controller and interlock control.

Module V (8 hours)
Introduction to PIC microcontrollers: Architecture, Mid-Range instruction Set, Power Input and Decoupling, Reset, Watchdog Timer, System Clock/Oscillators.

Suggested Readings
1. M. A. Mazidi and J. G. Mazidi, the 8051 Microcontroller and Embedded Systems
2. A V Deshmukh, Microcontrollers: Theory and Applications
3. Subrata Ghoshal, 8051 Microcontroller-Internals, Instructions, Programming and Interfacing, Pearson
4. Md Ali Mazidi, Rolin D. Mc-Kindly and Janice Gillistie, the 8051 Microcontroller and Embedded System Using Assembly and C
5. Lyla B. Das, Embedded Systems-An Integrated Approach, Pearson
6. Relevant Data Sheets

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	L		
CO 2		H	M	M	
CO 3			H	M	
CO 4		L	M	H	
CO 5					H

ECPP0068 PARALLEL PROCESSING (L-T-P: 3-0-0)
(3 Credits- 45 hours)

Objective
The objective of this course is to expose the students to the concept of parallel processing and pipelining. In this course students are introduced to the limitations of different architectures of computer. After this course students will be able to Analyse the performance parameters for different architectures.

Course Outcomes
1. Define parallel processing and pipeling, multiprocessor architecture, multithreaded architectures and multithreaded processors (Remembering)
2. Explain parallel processing and pipeling, multiprocessor architecture, multithreaded architectures and multithreaded processors (Understanding)
3. Implement parallel programming techniques (Applying)
4. Compare various parallel processing and pipelining techniques, multiprocessor architecture, multithreaded architectures and multithreaded processors and various operating systems for multiprocessors. (Analyzing)
5. Choose suitable one amongst various parallel processing and pipeling techniques, multiprocessor architecture, multithreaded architectures and multithreaded processors and various operating systems for multiprocessors (Evaluating)

Module I (5 hours)
Overview of Parallel Processing and Pipelining, Performance analysis, Scalability

Module II (10 hours)

Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining

Module III (10 hours)
VLIW processors, Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture

Module IV (5 hours)
Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions

Module V (10 hours)
Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues

Module VI (5 hours)
Operating systems for multiprocessors systems, Customizing applications on parallel processing platforms

Suggested Readings
1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", MGH International Edition
2. Kai Hwang, "Advanced Computer Architecture", TMH
3. V. Rajaraman, L. Sivaram Murthy, "Parallel Computers", PHI.
4. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L	H	H	M	L
CO 2	H	L	H	H	M	L
CO 3	M	M	L	L	H	L
CO 4	H	L	H	H	M	H
CO 5	H	L	H	H	M	H

ECPM0069 PATTERN RECOGNITION AND MACHINE LEARNING (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
The course is intended to make an insight into different statistical models for pattern recognition problems. This course includes different statistical models, linear regression models, different machine learning tools like Neural Network, Fuzzy Logic and different clustering techniques.

Course Outcomes
1. Define various terminologies used in probability theory and statistics, Linear models, neural networks, linear discriminant functions (Remembering)
2. Explain various terminologies used in probability theory and statistics, Linear models, neural networks, linear discriminant functions, unsupervised learning methods (Understanding)
3. Implement various Linear models, neural networks, linear discriminant functions, unsupervised learning methods (Applying)
4. Compare various Linear models, neural networks, linear discriminant functions, unsupervised learning methods (Analyzing)
5. Choose suitable one amongst various neural networks, linear discriminant functions, unsupervised learning methods for specific application (Evaluating)

Module I (10 Hours)
Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Module II (5 Hours)
Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for classification

Module III (10 Hours)
Neural Network: Perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Module IV (8 Hours)
Linear discriminant functions: Decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Module V (7 Hours)
Algorithm independent machine learning: Lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

Module VI (5 Hours)
Unsupervised learning and clustering: k-means clustering, fuzzy k-means clustering, hierarchical clustering.

Suggested Readings
1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H	H	H	L	L
CO 2	H	H	H	H	L	H
CO 3	L	H	H	H	M	H
CO 4	L	H	H	H	M	H
CO 5	M	L	H	H	M	H

ECDE0070 DETECTION AND ESTIMATION THEORY (L-T-P: 3-0-0)

(3 Credits- 45 Hours)

Objective
The objective of the course is to familiarize the students with mathematical understanding of signal detection and estimation. This course also intends to use various approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.

Course Outcomes
1. Explain of data computing algorithms like PCA, SVD etc. (Understanding)
2. Identify various measures of random processes associated with LTI system. (Applying)
3. Analyse the concepts of random processes in detection and estimation theory. (Analysing))
4. Discuss the design of different types of filters like Kalman and Weiner. (Creating)

Module I (5 Hours)
Review of Vector Spaces: Vectors and matrices: notation and properties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigenvalues and eigenvectors.

Module II (7 Hours)
Properties of Symmetric Matrices: Diagonalization of symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Module III (10 Hours)
Stochastic Processes: Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclostationary process, and spectral factorization.

Module IV (10 Hours)
Detection Theory: Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes' criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Module V (5 Hours)
Estimation Theory: Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Module VI (8 Hours)
Topics in Kalman and Weiner Filtering: Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter. Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPIRIT, DOA Estimation.

Suggested Readings
1. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory", Prentice Hall, 1993
2. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume II: Detection Theory", 1st Edition, Prentice Hall, 1998
3. Thomas Kailath, BabakHassibi, Ali H. Sayed, "Linear Estimation", Prentice Hall, 2000.
4. H. Vincent Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1998.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H				
CO 2		L	H			
CO 3	M			H	H	
CO 4				L	M	H

ECIA0071 IOT AND APPLICATIONS (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
The main objective of this course is to introduce the students with the concept of IOT and M2M. In this course they will study IOT architecture and applications in various fields along with the security and privacy issues in IOT.

Course Outcomes
1. Choose recent technologies related to IOT and Web technologies. (Understanding)
2. Illustrate the concept of IOT, M2M Security and privacy issues in IOT. (Understanding)
3. Apply the concept of IOT architecture and Web technologies. (Applying)
4. Analyze IOT architecture and applications in various fields. (Analyzing)

Module I (10 Hours)
IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module II (8 Hours)
M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT ValueChains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module III (7 Hours)
IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module IV (10 Hours)
IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module V (5 Hours)
Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues

Module VI (5 Hours)

Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Suggested Readings

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3. CunoPfister, "Getting Started with the Internet of Things", OReilly Media, 2011

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	M	L		M
CO 2		M			M	M
CO 3			L	L		L
CO4	M		M	H	L	

ECDD0072 DIGITAL DESIGN AND VERIFICATION (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective

The objective of the course is to familiarize the students with Front end design and verification techniques and create reusable test environments. This course also intends to perform verification of increasingly complex designs more efficiently and effectively.

Course Outcomes

1. Define combinational, sequential logic design and PLDs. (Remembering)
2. Explain the design methodology of HDL (VHDL/Verilog). (Understanding)
3. Explain the architecture of PLDs. (Understanding)
4. Apply HDL coding techniques for various combinational and sequential circuit design. (Applying)
5. Compare different circuit designs for speed, power and noise optimization. (Analysing)
6. Verify increasingly complex designs more efficiently and effectively. (Evaluating)
7. Use EDA tools like Xilinx, Cadence, Mentor Graphics for various electronic design. (Creating)

Module I (10 Hours)

Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families. Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, prefetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.

Module II (8 Hours)

Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and testbench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS

Module III (7 Hours)

System Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language: Perl, Tcl/Tk

Module IV (8 Hours)

Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect & Electromigration.

Module V (7 Hours)

Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices.

Module VI (5 Hours)

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface.

Suggested Readings

1. Douglas Smith, “HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog”, Doone publications, 1998.
2. Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Prentice Hall, 2nd Edition, 2003.
3. Doug Amos, Austin Lesea, Rene Richter, “FPGA based Prototyping Methodology Manual”, Synopsys Press, 2011.
4. Christophe Bobda, “Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications”, Springer, 2007.
5. Janick Bergeron, “Writing Testbenches: Functional Verification of HDL Models”, Second Edition, Springer, 2003.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L		H	
CO 2	M	H		L		
CO 3	M	M		L	H	
CO4	M	H	H	M	L	
CO 5	L	M	M	H		L
CO 6			M	H	H	
CO 7			L	L	M	H

ECBS0073 BIOMEDICAL SIGNAL PROCESSING (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective

The course will help to develop an in-depth understanding of different types of biomedical signals. The students will be able to identify and Analyse different biomedical signals.

Course Outcomes

1. Define the fundamentals of biomedical signals. (Remembering)
2. Interpret the various types of biomedical signals. (Understanding)
3. Experiment with various types of biomedical signals using various technological tool. (Applying)
4. Analyze and assess biomedical signals using various technological tool. (Analyzing)

Module I (5 hours)

Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters

Module II (5 hours)

Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC’s DAC’s) Processing, Digital filtering

Module III (7 hours)

Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time- frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)

Module IV (9 hours)

Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.

Module V (8 hours)

Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multiresolution analysis (MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA)

Module VI (6 hours)

Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples

Suggested Readings

1. W. J. Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall, 1993.
2. Eugene N Bruce, “Biomedical Signal Processing and Signal Modeling”, John Wiley & Son’s publication, 2001.

3. Myer Kutz, “Biomedical Engineering and Design Handbook, Volume I”, McGraw Hill, 2009.
4. D C Reddy, “Biomedical Signal Processing”, McGraw Hill, 2005.
5. Katarzyn J. Blinowska, JaroslawZygarewicz, “Practical Biomedical Signal Analysis Using MATLAB”, 1st Edition, CRC Press, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H	M	L		
CO 3			H	M	M	M
CO 4				H	H	M

ECDS0074 DSP ARCHITECTURE (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective

The objective of the course is to familiarize the students with architecture of various DSP hardware. It aims to equip the students with ability to design, programming (assembly and C), and testing code using Code Composer Studio environment and other tools at an intermediate to advanced level that will serve them well towards tackling various problems in this discipline.

Course Outcomes

1. Recall, illustrate and summarize the DSP Architecture. (Remembering, Understanding)
2. Make use of TMS320C6X family DSP processor. (Applying)
3. Explain and solve signal processing problems with the help of FPGA based DSP system. (Understanding, Applying)
4. Develop DSP based Assembly Language Programming. (Creating)
5. Examine and explain complete design of DSP system. (Analyzing, Evaluating)

Module I (10 Hours)

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core Algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Module II (15 Hours)

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Module III (10 Hours)

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC Moduleby ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Module IV (5 Hours)

Application of DSPs for signal processing, communication and multimedia. Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware.

Module V (5 Hours)

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.

Suggested Readings

1. M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
2. Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,“Parallel Programming in OpenMP”, 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, “Multicore Embedded systems”, 1st Edition, CRC Press,2010.

5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	M		L
CO 2		H	M	L	
CO 3			L	M	H
CO 4			H	M	L
CO 5	M	M	L	H	H

ECRS0075: ANTENNAS AND RADIATING SYSTEMS (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

The objective of this course is to introduce students with the concept of antennas, their principle of operation, analysis and their applications. It will also cover the theory of wave propagation over ground, through the troposphere and ionosphere; diversity principles; propagation effects in microwave systems, satellite, space, and radar links.

Course Outcomes

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution. (Applying)
2. Compute the array factor for an array of identical antennas. (Applying)
3. Estimate the input impedance, efficiency and ease of match for antennas. (Evaluating)
4. Design antennas and antenna arrays for various desired radiation pattern characteristics. (Creating)

Module I (10 Hours)

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Module II (8 Hours)

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.

Module III (7 Hours)

LinearArrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Module IV (8 Hours)

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Module V (7 Hours)

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Module VI (5 Hours)

Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

Suggested Readings

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering handbook", Mc-Graw Hill, 1984.
4. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L	L		

CO 2		M	H	L	L	
CO 3	M	H	H	M		L
CO 4	M	L		H	H	

ECCN0076 ADVANCED COMMUNICATION NETWORK (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

The main objective of the course is to familiarize the students with concepts in communication networking. This course is intended to teach the students about various protocols in communication networking. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in this discipline.

Course Outcomes

1. Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
2. Understand advanced concepts in Communication Networking. (Understanding)
3. Understand the mechanisms in Quality of Service in networking. (Understanding)
4. Apply the basic concepts to build efficient networks. (Applying)
5. Analyse the network from layers of OSI and TCP/IP model perspective. (Analysing)
6. Evaluate and measure the performance issues in different networks. (Evaluating)
7. Design and develop protocols for Communication Networks. (Creating)

Module I (8 Hours)

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Module II (10 Hours)

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP).Leaky bucket algorithm and its properties.

Module III (10 Hours)

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Module IV (7 Hours)

IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Module V (5 Hours)

Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

Module VI (5 Hours)

IPV4, IPV6, IP tunnelling, IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

Suggested Readings

1. Jean Wairand and Pravin Varaiya, “High Performance Communications Networks”, 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag, 2001.
3. Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach”, Morgan Kaufman Publishers, 2004.
5. George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6

CO 1	H					
CO 2			H	M	M	M
CO 3		H				
CO 4						H
CO 5	H					M
CO 6					H	M
CO 7						H

ECMS0077 MIMO SYSTEM (L-T-P: 3-0-0)
(3 Credits- 45 hours)

Objective
This course covers the fundamentals of Multiple input multiple output (MIMO) antenna based wireless communication systems. This course covers important concepts of MIMO communication such as capacity computation, error probability analysis, transmitter and receiver design, multi-user communication, etc. After completion of the course the participants will be able to apply the methods for performance analysis and design of advanced wireless communication systems.

Course Outcomes
1. Explain channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO. (Understanding)
2. Illustrate, Analyse and interpret the cooperative and coordinated multi-cell MIMO and MIMO in 4G (LTE, LTE-Advanced, WiMAX). (Understanding, Analysing, Evaluating)
3. Perform Mathematical modelling and analysis of MIMO systems. (Creating)

Module I (5 Hours)
Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Module II (10 Hours)
Diversity, exploiting multipath diversity, transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

Module III (10 Hours)
The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Module IV (8 Hours)
Codebooks for MIMO, Beam forming, Beam forming principles, increased spectrum efficiency, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former

Module V (7 Hours)
Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre- coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre- coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models

Module VI (5 Hours)
Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

Suggested Readings
1. Claude Oestges, Bruno Clerckx, “MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design”,Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6

CO 1	H	H	H	M	M	
CO 2		L	M	H	H	L
CO 3	L	M	M	M	L	H

ECSA0078 EMBEDDED SYSTEMS AND APPLICATIONS (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

The objective of this course is to expose the students to the features of advanced microcontrollers such as PIC and AVR. In this course students are introduced to the architecture, programming and interfacing of all these microcontrollers. Industrial applications of these microcontrollers are also introduced in this course.

Course Outcomes

1. Define various terminologies related to PIC and AVR microcontroller. (Remembering)
2. Explain the internal organization of PIC and AVR microcontroller. (Understanding)
3. Apply and analyze PIC and AVR microcontroller based system. (Applying)
4. Design and develop PIC and AVR microcontroller based system. (Creating)

Module I (10 Hours)

PIC Microcontroller: Overview of PIC Microcontrollers, PIC16CXX Series: Architecture, Memory Organization, Registers, Oscillator Connections, Reset Actions, I/O ports, Interrupt, Timers, ADC, Watch Dog timer, Instruction Set

Module II (10 Hours)

PIC16F8XX Series:

a) Architecture, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Instruction Set, Capture/Compare/PWM Module, MSSP Module, USART, Watch Dog Timer.
b) Assembly Language Programming using PIC16CXX and PIC16F8XX

Module III (10 Hours)

PIC24FXX Family Microcontroller: Architecture, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, Watch Dog timer, ADC, PWM, Serial Communications, Programming using Embedded C.

Module IV (15 Hours)

AVR Microcontroller:

a. Introduction, History, Importance of AVR, Naming Convention of AVR, Mega AVR Series.
b. ATMega8 Microcontroller: Architecture, Pin Diagram, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Watch Dog timer.
c. ATMega16 Microcontroller: Architecture, Pin Diagram, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Watch Dog timer.
d. Programming using ATMega8 and ATMega16.

Suggested Readings

1. V. Deshmukh, Microcontroller: Theory and Applications, TMG, 1st Edition
2. Md. Ali Mazidi, Rolin D. Mckinlay, Danny Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C, Pearson, 1st Edition
3. Md. Ali Mazidi, SarmadNaimi, SepehrNaimi, The AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson, 1st Edition
4. Relevant Data Sheets

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			M
CO 2		H	M	L
CO 3		M	H	L
CO 4			M	H

ECMT0079 MEMORY TECHNOLOGIES (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

The course helps to develop an in-depth understanding of the various memory types. The students will be able to learn. After this course students will be able to design semiconductor memory circuits and subsystems. They can also identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.

Course Outcomes

1. Define various memory architecture. (Remembering)
2. Explain memory circuits and subsystems. (Understanding)
3. Apply various fault models, modes and mechanisms in semiconductor memories and their testing procedures. (Applying)
4. Analyse advanced memory technologies. (Analysing)
5. Assess various high density memory packing technologies. (Evaluating)
6. Discuss memory testing and reliability issues and start of the art memory chip design. (Creating)

Module I (10 hours)

Random Access Memory Technologies, Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

Module II (5 hours)

DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs. SRAM and DRAM Memory controllers.

Module III (5 hours)

Non-Volatile Memories, Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories

Module IV (10 hours)

Semiconductor Memory Reliability and Radiation Effects, General Reliability Issues, RAM Failure Modes and Mechanism, Non-volatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues, Radiation Hardened Memory Characteristics, Radiation Hardness Assurance and Testing

Module V (10 hours)

Advanced Memory Technologies and High-density Memory Packing Technologies,Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, MagnetoResistive Random Access Memories (MRAMs), Experimental Memory Devices

Module VI (5 hours)

Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging

Suggested Readings

1. Ashok K Sharma, “Advanced Semiconductor Memories: Architectures, Designs and Applications”, Wiley Interscience
2. KiyooItoh, “VLSI memory chip design”, Springer International Edition
3. Ashok K Sharma,” Semiconductor Memories: Technology, Testing and Reliability, PHI

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	M			
CO 2	L	H	H	L		
CO 3		M	H	L		
CO 4			M	H		
C0 5				L	H	
C0 6				L	M	H

ECBS0080 COMMUNICATION BUSES AND INTERFACES (L-T-P: 3-0-0)

(3 Credits- 45 hours)

Objective

This main objective of this course is to introduce the students with the concept of various communication buses. After this course students will be able to develop APIs for configuration, reading and writing data onto serial bus and can also design and develop peripherals that can be interfaced to desired serial bus

Course Outcomes

1. Define various terminologies related to communication buses. (Remembering)
2. Compare various communication buses. (Understanding)
3. Explain the architecture of various communication buses. (Understanding)
4. Apply and analyze the concept of various communication buses. (Applying/ Analyzing)

Module I (8 hours)
Serial Busses, Physical interface, Data and Control signals, features

Module II (8 hours)
Limitations and applications of RS232, RS485, I2C, SPI

Module III (8 hours)
CAN - Architecture, Data transmission, Layers, Frame formats, applications

Module IV (8 hours)
PCI - Revisions, Configuration space, Hardware protocols, applications

Module V (8 hours)
USB - Transfer types, enumeration, Descriptor types and contents, Device driver

Module VI (5 hours)
Data Streaming Serial Communication Protocol, Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable

Suggested Readings

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems", Lakeview Research, 2nd Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2nd Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 – 200x
6. Technical references onwww.can-cia.org; www.pcisig.com; www.usb.org

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L				
CO 2		H	M	M	M	
CO 3			H	H	H	
CO 4			L	L	L	H

ECAC0081 ANALOG AND DIGITAL COMMUNICATIONS (L-T-P: 3-0-0)

(3 credits – 45hrs)

Objective
This course is aimed at introducing to the student the fundamentals of the theory of Communication. The course will provide in-depth knowledge of communication fundamentals, various analog modulation techniques, base band and bandpass digital communications, performance of communication systems in the presence of noise.

Course Outcomes

1. Define various modulation techniques (Remembering)
2. Explain various modulation techniques (Understanding)
3. Implement techniques for analog as well as digital communication (Applying)
4. Compare various schemes of signal detection (Analyzing)
5. Choose schemes for signal generation and detection (Evaluating)

Module I (18 Hours)
Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module II (18 Hours)
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Module III (9 Hours)
Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver).Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Suggested Readings
1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.
4. Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering'',JohnWiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication'', KluwerAcademic Publishers, 2004.
6. Proakis J.G., "Digital Communications", McGraw Hill,4th Edition, 2000.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	H	L
CO 2	H	H	L
CO 3	M	M	M
CO 4	L	L	H
CO 5	M	M	M

ECMM0082 MICROPROCESSORS AND MICROCONTROLLERS (L-T-P: 3-0-0)

(3 Credits – 45 hrs)

Objective
The objective of the course is to expose the student to develop an in-depth understanding of the operation of microprocessors and microcontrollers and to introduce the assembly language programming and microprocessor/microcontroller interfacing techniques.

Course Outcomes
1. Explain and compare the internal organization of various microprocessors and microcontrollers. (Understanding)
2. Apply the knowledge of programming for interfacing peripheral devices. (Applying)
3. Compare the performance of various microprocessors. (Evaluating)
4. Develop and design systems using different microprocessor and microcontrollers. (Creating)

Module I (20 Hours)
Overview of microcomputer systems and their building blocks: Microprocessor architecture along with its operation: Pins and signals, Register organization, ALU, control unit, Timing and control module of 8085 microprocessor; memory organization; Instruction set and assembly language programming of 8085: Instruction set of 8085, Memory and I/O Addressing, Assembly language programming using 8085 instruction set, instruction cycle, machine cycles, T-states, state transition diagram, use of stack and subroutine; Concepts of interrupts and Direct Memory Access;Introduction to 8086 microprocessor

Module II (12 Hours)
Memory and I/O Interfacing: Interfacing memory (RAM and ROM), Interfacing a keyboard, interfacing a LED and seven segment displays, interfacing A/D converter, D/A converter; Programmable Peripheral Interface Devices: 8155, 8255, timer, serial I/O using SID, SOD, parallel I/O; Asynchronous and synchronous data transfer using 8251A, Programming DMA controller: 8257, Programming interrupt controller: 8259, Arithmetic Coprocessors; System level interfacing design

Module III (8 Hours)
Concepts of virtual memory, Cache memory, Advanced Coprocessor Architectures- 286, 486, Pentium.

Module IV (5 Hours)

Microcontroller(Architecture and Programming): Introduction to 8051 Microcontrollers (Architecture, Pin description), 8051 Assembly level language programming, I/O port programming, 8051 addressing modes, arithmetic & logic instruction, 8051 interrupt, interfacing to 8255, Introduction to RISC processors; AVR-ATmega series

Suggested Readings

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. Krishna Kant, Microprocessors and Microcontrollers- Architecture, Programming and System Design 8085, 8086, 8051, 8096, PHI
3. Barry B Brey, The Intel Microprocessor (Architecture, programming and interfacing), Pearson.
4. M. A. Mazidi, J. Mazidi J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson.
5. M. A. Mazidi, S. Naimi, S. Naimi, The AVR Microcontroller and Embedded Systems, Pearson.
A. K. Roy and K. M. Burchandi, Advanced Microprocessor and peripherals (Architecture, programming and interfacing), TMH
6. Douglas V. Hall, Microprocessor and Interfacing, TMH
7. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L	M	H
CO 2		H	M	L
CO 3		M	H	
CO 4	H	M	L	H

ECCA0083 COMPUTER ARCHITECTURE (L-T-P: 3-0-0)

(3 Credits – 45 hrs)

Objective

The objective this course on Computer Architecture is to acquaint the students with the knowledge of basic computer architecture. This course will also provide an idea on processor and memory organization. The concept of parallel processing and its application will also be given to the students.

Course Outcomes

1. Describe the basic principles of computer's working (Understanding)
2. Analyze the performance of computers (Analyzing)
3. Illustrate how computers are designed and built (Applying/ Creating)
4. Understand and evaluate issues affecting modern processors (caches, pipelines etc.)(Evaluate)

Module I (10 Hours)

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Queues, Subroutines.

Module II (15 Hours)

Processor organization, Information representation, number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats. Control Design, Instruction sequencing, Interpretation, Hardwired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit

Module III (10 Hours)

Memory organization, device characteristics, RAMS, ROM, Memory management, Concept of Cache & associative memories, Virtual memory. System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces

Module IV (10 Hours)

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network

Suggested Readings

1. V .CarlHamacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbaum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall.

4. M.M.Mano, “Computer System Architecture”, Edition
5. C.W.Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
6. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	L	L
CO 2	H	M	L	L
CO 3		H	M	H
CO 4		M	H	L

ECPS0084 PROBABILITY THEORY AND STOCHASTIC PROCESSES (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

The objective of this course is to familiarize the students with probability theory, random variables and its characteristics. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in this discipline.

Course Outcomes

1. Define probability theory, random variable, laws of number, limit theorem and random process. (Remembering)
2. Explain PMF, PDF and CPDF of random variable. (Understanding)
3. Demonstrate an understanding of statistical properties like mean, variance, moments and various inequalities of random variable. (Applying)
4. Analyze convergence of random sequences. (Analyzing)
5. Evaluate PMF, PDF, CPDF and PSD in various random processes. (Evaluating)
6. Design LTI systems and estimate the statistical properties. (Creating)

Module I (8 Hours)

Basic Probability: Sets and set operations; Probability space; Conditional probability and Bayes theorem; combinatorial probability and sampling models.

Module II (10 Hours)

Discrete and Continuous Random Distributions: Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions; Conditional distribution and density functions.

Module III (10 Hours)

Statistical Properties of Random Variable: Random variable - Mean, variance, moments, characteristic functions; Joint distributions, functions of one and two random variables; Two random variables- Mean, variance, moments, characteristic functions; Markov, Chebyshev and Chernoff bounds;

Module IV (7 Hours)

Random Sequences: Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Module V (10 Hours)

Random Processes: Random process, Stationary processes, Mean and covariance functions, Ergodicity, Transmission of random process through LTI, Power spectral density.

Suggested Readings

1. H. Stark and J. Woods, “Probability and Random Processes with Applications to Signal Processing”, Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes”, Fourth Edition, McGraw Hill.
3. K. L. Chung, “Introduction to Probability Theory with Stochastic Processes”, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability”, UBS Publishers,
5. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Stochastic Processes”, UBS Publishers
6. S. Ross, “Introduction to Stochastic Models”, Harcourt Asia, Academic Press.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M		L	
CO 2	M	H			
CO 3		M	H		
CO 4		L	M	H	
CO 5		M	L		H
CO 6	L		M		H

ECPE0085 POWER ELECTRONICS (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

The course intends to introduce the students to the basic theories of power semiconductor devices and passive components and their practical applications in power electronics. Further, the students will be familiarized with the principle of operation, design and synthesis of different power conversion circuits and their applications and thereby provide a strong foundation for further study and practical application of power electronic circuits and systems.

Course Outcomes

1. Describe the basic operation and compare performances of various power semiconductor devices, passive components and switching circuits. (Understanding)
2. Build and test circuits using power devices such as SCR. (Applying)
3. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters (Analyzing)
4. Evaluate the role of power electronics in the improvement of energy usage efficiency and the applications of power electronics in emerging areas. (Evaluating)
5. Design and analyze power converters circuits and learn to select suitable power electronic devices by assessing the requirements of application fields. (Creating)

Module I (10 Hours)

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations.

Introduction to power devices: TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Module II (15 Hours)

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, control techniques for choppers – Time Ratio Control (TRC) and Current Limit C(CLC), Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

Module III (10 hours)

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

Module IV (10 Hours)

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive.P M Stepper motor Drive.

Suggested Readings

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.

4. V.R.Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla: Thyristorised Power Controllers", New Age International Publishers.SCR manual from GE, USA.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	L	
CO 2	L	H	M	M
CO 3		H	M	L
CO 4		H	M	H
CO 5		M	H	L

ECBE0086 BIOMEDICAL ELECTRONICS (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

The objective of this course is to familiarize students with human physiology and various aspects of measuring various parameters from the human body.

Course Outcomes

1. Define and characterize the sources of biomedical signals. (Remembering)
2. Explain the characteristics of medical instruments and related errors. (Understanding)
3. Apply Bio-electrodes and Bio-amplifiers to understand the principle of biomedical electronic circuits. (Applying)
4. Analyze the biological processes like other electronic processes. (Analysing)
5. Assess the needs of using various biomedical instruments & their limitations. (Evaluating)

Module I (15 hours)

Brief introduction to human physiology, Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases

Module II (15 hours)

Bio-electrodes and biopotential amplifiers for ECG, EMG, EEG, etc., Measurement of blood temperature, pressure and flow, Impedance plethysmography,

Module III (15 hours)

Ultrasonic, X-ray and nuclear imaging, Prostheses and aids: pacemakers, defibrillators, heart-lung machines, artificial-kidney, aids for the handicapped, Safety aspects.

Suggested Readings

1. C. Raja Rao and S. K. Guha, Medical Electronics and Biomedical Instrumentation, University Press, 2000.
2. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
3. J.G. Webster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
4. A. M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	H	M
CO 2	M	H	L
CO 3	M	H	H
CO 4	L	H	M
CO 5	M	H	H

ECSS0087 SPEECH SIGNAL PROCESSING (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

This course intends to introduce the students to the fundamentals of speech and audio processing. The course starts with the basics of the human speech production system and then moves on to how signal processing has been used to analyse and model systems to replicate human speech.

Course Outcomes

1. Define and outline the fundamental concepts of digital signal processing related to speech processing. (Remembering)
2. Illustrate the fundamentals of digital speech processing including speech coding techniques, pitch estimation etc.(Understanding)
3. Analyse the human auditory system, speech signals, models for speech production etc. (Analysing)
4. Evaluate a speech signal, speech production system, LPC and CELP models etc. (Evaluating)
5. Design a simple model for speech production. (Creating)

Module I (10 Hours)

Introduction: Speech production and modelling, Human Auditory System; General structure of speech coders; Classification of speech coding techniques– parametric, waveform and hybrid; Requirements of speech codecs– quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Module II (15 Hours)

Linear Prediction of Speech: Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Linear Prediction Coding: LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.

Module III (10 Hours)

Speech Quantization: Scalar quantization, uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization.

Module IV (10 Hours)

Code Excited Linear Prediction: CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero- state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP. Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729 standards

Suggested Readings

1. A.M. Kondoz, “Digital Speech”, Second Edition (Wiley Students Edition), 2004.
2. W.C. Chu, “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, Wiley Inter science, 2003.
3. L. Rabiner and B-H Juang, “Fundamentals of Speech Recognition”, Pearson.
4. L.R. Rabinu and R.W. Schafer, ‘Digital Processing of Speech Signals’, Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	L	
CO 2	H	L	M	
CO 3	H		M	L
CO 4	L	H	M	M
CO 5			H	H

ECNT0088 NANOTECHNOLOGY (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

This course will introduce the students to the field of Nanotechnology. The course is designed to build up a basic understanding of the nano concepts. It will provide the students the knowledge of synthesis of nanomaterials, their characterization techniques as well as touch upon some applications of nanotechnology.

Course Outcomes

1. Recognize the principles underlying the field of Nanotechnology (Remembering)
2. Relate the concepts underlying this disruptive field of new technology (Understanding)
3. Build knowledge on fabrication processes of new materials and devices in the nanoscale (Applying)
4. Analyze nanomaterials for applications in various technologies (Analysis)
5. Assess new materials and devices in the nanoscale using various characterization tools (evaluation)

Module I (11 hours)
Basics of Nanotechnology: Importance of Nanotechnology, History of Nanotechnology, Properties of Nanomaterials, Difference between Bulk and Nanomaterial, Molecular building blocks for nanostructure systems, Forces between atoms and molecules, Size effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress. Particles and grain boundaries, Strong Intermolecular forces, Electrostatic and Vander Waals forces between surfaces.

Module II (11 hours)
Physics of nanomaterials: Atomic scale structure of nanomaterials; Concept of quantum confinement: 0D, 1D and 2D nanostructures; Electronic and optical characteristic properties of quantum dots, quantum wires etc.; Nanophotonics, Plasmonics – plasmons and surface plasmons, SPR, Core-shell quantum dots.

Module III (12 hours)
Synthesis/fabrication techniques of nanomaterials: Top down approach, Lithography – electron beam and ion beam techniques, Etching – wet and dry etching, Bottom up approach - Solvent based and template based synthesis, other important synthesis methods like CVD, PVD etc.; Doping, Nucleation, Growth and Stability of colloidal nanoparticles, concept of self- assembly.

Module IV (5 hours)
Characterization methods: Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Atomic force microscopy (AFM), Scanning Tunneling Microscopy (STM).

Module V (6 hours)
Applications: Different application of Nanotechnology, Micro and Nano electromechanical systems.

Suggested Readings
1. G. L. Hornyak, J. Dutta, H. F. Tibbals, A. Rao Introduction to nanoscience CRC Press
2. G. L. Hornyak, J. Dutta, H. F. Tibbals, A.Rao Introduction to nanotechnology CRC Press
3. T. Pradeep, Nano: The Essentials McGraw Hill
4. D. Maclurcan and N. Radywyl (Eds.) Nanotechnology and Global Sustainability CRC Press
5. E. Lichtfouse, J. Shwarzbauer, D. Robert, Environmental Chemistry for a Sustainable World Vol.2 Springer Verlag

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	L			
CO 2	M	H	L		
CO 3	L	M	H		
CO 4	L	L	M	H	
CO 5	L	M	M	L	H

ECCS0089 CONTROL SYSTEM (L-T-P: 3-0-0)
(3 Credits – 45 hrs)

Objective
To introduce different types of systems and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical systems to construct equivalent electrical models for analysis.

Course Outcomes
1. Define a system and illustrate its study state behavior (Understanding)
2. Interpret and explain stability of a system using different tests (Understanding)
3. Solve linear, non-linear and optimal control problems (Applying)
4. Design various controllers (Creating)

Module I (5 Hours)
Introduction to control problem: Industrial Control examples, System with dead-time, System response. Control hardware and their models: potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servo motors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Transfer Function, Block diagram, and signal flow graph analysis.

Module II (7 Hours)

Feedback control systems: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. Proportional, integral and derivative systems. Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Module III (7 Hours)
Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

Module IV (11 Hours)
Frequency-response analysis: Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

Module V (8 Hours)
State variable Analysis: Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of system matrix, solution of state equations, concept of controllability & observability.

Module VI (7 Hours)
Introduction to Optimal control & nonlinear control, Optimal Control problem, Regulator problem, Output regulator, tracking problem. Nonlinear system: Basic concept & analysis.

Suggested Readings
1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. Nagrath& Gopal, "Modern Control Engineering", New Age International, New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L		H	
CO 2	L		H	H	M	
CO 3		L	M	M		H
CO 4		H	M	M	L	

ECNT0090 COMPUTER NETWORKS (L-T-P: 3-0-0)
(3 CREDITS – 45 hours)

Objective
The course intended at understanding the principles and practice of designing, building and operating computer networks particularly the internet.

Course Outcomes
1. Describe and discuss the various concepts of networking thoroughly. (Remembering/ Understanding)
2. Evaluate the design of a network for a particular application. (Evaluating)
3. Analyze the performance of the network. (Analyzing)

Module I (11 Hours)
Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering Concepts.

Module II (16 Hours)
Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. Transport layer: Connectionless transport - User Datagram Protocol, Connection- oriented transport – Transmission Control Protocol, Remote Procedure Call.

Module III (5 Hours)

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Module IV (5 Hours)
Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Module V (8 Hours)
Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing
Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing,

Suggested Readings
1. J.F. Kurose and K. W. Ross, "Computer Networking – A top-down approach featuring the Internet", Pearson Education, 5th Edition
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall
4. S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education
5. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, "Computer networks", Prentice Hall
7. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall
8. William Stallings, "Data and Computer Communications", Prentice Hall

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	H	M	L	L
CO 2	M	H	L	M	H
CO 3	M	H	H		H

ECEW0091 ELECTROMAGNETIC WAVES (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
The course is aimed at introducing the concept of electromagnetic waves which is a prerequisite to understand the theory behind antenna design and microwave engineering. This subject is aimed to provide basic knowledge on wave propagation through transmission line and waveguides.

Course Outcomes
1. Define the fundamentals of transmission line theory, uniform plane wave and radiation characteristics of an antenna. (Remembering)
2. Explain the characteristics and wave propagation on high frequency transmission lines, demonstrate and carry out impedance transformation on transmission lines. (Understanding)
3. Solve related problems using the concepts of wave propagation, waveguides and antennas. (Applying)
4. Analyze different parameters like standing wave, reflection coefficient, and impedance, etc. using Smith chart, and wave propagation on metallic waveguides in modal form. (Analyzing)
5. Compare the basic theories in understanding the working of related structures and wave propagation. (Evaluating)

Module I (12 hours)
Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low-loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Module II (15 hours)
Maxwell's Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface. Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor. Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Module III (8 hours)
Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Module IV (10 hours)
Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna.

Suggested Readings
1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. NarayanaRao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, Electromagnetics, Prentice Hall.
5. Mathew N. O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001.
6. K. D. Prasad, Antenna & Wave Propagation, SatyaPrakashan, New Delhi, 2009

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	H	M	H
CO 2	H			
CO 3		H	H	H
CO 4	H	L	L	
CO 5	H	M	M	M

ECCD0092 CMOS DESIGN (L-T-P: 3-0-0)
(3 credits-45 hours)

Objective
The objectives of this course are to introduce the concept IC technology and VLSI Design. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits, modules subsystems using CMOS technology.

Course Outcomes
1. Define basics of IC technology and MOS transistor. (Remembering)
2. Explain the physical and mathematical concept of MOS transistors and demonstrate CMOS circuits and logic design rules. (Understanding)
3. Apply the logic design rules to design various CMOS circuits and layouts. (Applying)
4. Design different CMOS circuits using various logic families. (Creating)

Module I (12 hours)
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, MOS Theory Analysis: Basic Electrical Properties of MOS Circuits, Non-ideal behavior of the MOS Transistor, Transistor as a switch, Integrated Resistors and Capacitors. Ids-Vds Relationships, MOS Transistor Threshold Voltage V_{th}, g_m, g_{ds}, Figure of Merit ω_0, Short Channel and Narrow Channel Width Effects. Pass Transistor, Transmission Gate, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits

Module II (13 hours)
Integrated Circuit Layout- CMOS Circuits and Logic Design Rules: MOS Layers, Stick Diagrams, Design Rules and Layout, 2µm, 1.2 µm Design Rules, Rules for Vias and Contacts, Stick Diagrams and Simple Symbolic Encodings for NMOS, PMOS, CMOS and BiCMOS Logic Gates. Scaling of CMOS Circuits.

Module III (10 hours)
CMOS Circuit Characterization and Performance Estimation- Sheet Resistance RS and its Concept to MOS, Area Capacitance Units, Calculations – RC Delay model, linear delay model, Driving Large Capacitive Loads, logical path efforts. Power, interconnect and Robustness, power dissipation and reliability in CMOS circuit layout.

Module IV (10 hours)
Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Suggested Readings

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Mapping of COs to Syllabus

Course outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H		M	
CO 2	H		L	
CO 3		H		
CO 4		M		H

ECNE0093 NANOELECTRONICS (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

This course will introduce the students to electronics or electron behaviour at the nanoscale. The course is designed to build up an understanding of particle behavior at nano dimensions. Students will be able to see the effects of nanoscale dimensions on electronic devices and how CMOS technology is expected to be affected because of this. This will also open to them the technologies that are likely to take over electronic functions due to consistent size reduction or scaling.

Course Outcomes

1. Recognize the principles underlying the field of Nanotechnology (Remembering)
2. Relate the concepts of quantum mechanics to nano dimensions. (Understanding)
3. Develop understanding of the effect of scaling on electronic devices. (Applying)
4. Analyze new materials and devices for nano sized electronics. (Analysis)
5. Assess new materials and devices in the nanoscale for electronic applications. (Evaluation)

Module I (15 hours)

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids.

Module II (15 Hours)

Kronig-Penny Model. Brillouin Zones. Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.).

Module III (15 Hours)

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band Structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.

Suggested Readings

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	M	L
CO 2	H	H	M
CO 3	M	H	H
CO 4	M	H	H
CO 5	M	H	H

ECIC0094 INFORMATION THEORY AND CODING (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

The objectives of this course are to introduce the mathematical concept required for data communication course. The course also provides concepts error detecting, correcting and controlling techniques used in communication.

Course Outcomes

1. Define the fundamentals of information theory, entropy and various coding & decoding techniques. (Remembering)
2. Illustrate different models of information sources, coding theorems and information channels. (Understanding)
3. Apply the theoretical knowledge gained to implement it in various continuous and discrete channels as well as communication systems. (Applying)
4. Analyze different coding and decoding techniques. (Analyzing)

Module I (11 hours)

Revision of Probability and Random Process, Digital Communication. Information Theory-Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Markov Statistical Model of Information Sources, Entropy, Markov sources and Information rate of Markov Sources.

Module II (15 hours)

Source Coding theorems- Shannon's noiseless coding theorem; Encoding of discrete sources, Shannon's noisy coding theorem and converse for discrete channels; Information Channels- Communication Channels. Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity- Calculation of channel capacity and bounds for discrete channels, Channel Capacity of Binary Symmetric Channel, Binary Erasure Channel, Application to continuous channels.

Module III (19 hours)

Techniques of coding and decoding; Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, Types of Codes, Linear Block Codes- matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes. Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Suggested Readings

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	H	M
CO 2	H	H		
CO 3	L	H	M	M
CO 4			H	H

ECRB0095 ROBOTICS (L-T-P: 3-0-0)

(3 credits-45 hours)

Objective

The objective of this course is to impart knowledge about industrial robots for their control and design.

Course Outcomes

1. Define and illustrate the basic knowledge of various robot structures and their workspaces. (Remembering, Understanding)
2. Perform kinematic and dynamic analyses with simulation. (Applying, Analyzing)
3. Design control laws for a robot. (Creating)
4. Integrate mechanical and electrical hardware for a real prototype of robotic device. (Creating)
5. Select a robotic system for a given application. (Evaluating)

Module I (3 Hours)

Introduction to Robotics: Types and components of a robot, Classification of robots, closed-loop and open loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Module II (7 Hours)
Robot Kinematics and Dynamics: Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics. Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

Module III (10 Hours)
Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations. Vision applications in robotics.

Module IV (12 Hours)
Robot Control: Basics of control: Transfer functions, Control laws: P, PD, PID. Non-linear and advanced controls

Module V (3 Hours)
Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Module VI (10 Hours)
Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications

Suggested Readings

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, NewDelhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006
3. NikuSaeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, NewDelhi.
4. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
5. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
6. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi,2009
7. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modelling and Control", John Wiley and Sons Inc, 2005
8. Steve Heath, "Embedded System Design", 2nd Edition, Newnes, Burlington, 2003
9. Merzouki R., Samantaray A.K., Pathak P.M. and Bouamama B. Ould, "Intelligent Mechatronic System: Modeling, Control and Diagnosis", Springer.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	H	M	L		
CO 2		H		M	L	
CO 3			L	H	M	L
CO 4	L		H	M		M
CO 5		M		L	H	H

ECAI0096 ARTIFICIAL INTELLIGENCE (L-T-P: 3-0-0)

(3 credits- 45 hours)

Objective
The main objective of the course is to familiarize the students with concepts of Artificial Intelligence, search techniques and knowledge representation issues. This course also aims to equip the students with knowledge of fuzzy logic and its uses for artificial intelligence, game playing and natural language processing.

Course Outcomes
1. Define Artificial Intelligence and different techniques of Artificial Intelligence. (Remembering)
2. Relate components of a Planning system, AI in solutions that require problem solving, inference, perception, knowledge representation, learning ANN and Fuzzy logic. (Understanding)
3. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, learning, ANN and Fuzzy logic (Applying)
4. Analyze the different approaches to AI in solutions that require problem solving, inference, perception, knowledge representation, learning, game playing, ANN and Fuzzy logic (Analyzing)

Module I (10 Hours)
What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate- And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Module II (10 Hours)
Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Module III (8 Hours)
Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bayes' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory

Module IV (5 Hours)
Fuzzy Logic, Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and- Filler Structures: Conceptual Dependency, Scripts, CYC.

Module V (7 Hours)
Game Playing: Overview, And Example Domain: Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction.

Module VI (5 Hours)
Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

Suggested Readings
1. Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009.

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	M	M	L	L	L	L
CO 2	L	H	H	L	L	L
CO 3		M	H	H	L	L
CO 4	L	M	L	L	M	M

ECVD0096 VLSI DESIGN TECHNOLOGY (L-T-P: 3-1-0)
(4 credits – 60 hours)

Objective
The objective of this course is to deal with the study of the technology and building blocks of integrated circuits including salient features of digital circuits, structured systems and design automation in the field of VLSI. The scope of this course includes an introduction to practical considerations and design of integrated circuits.

Course Outcomes
1. Recall, illustrate and summarize the fabrication process of BJT and MOSFET. (Remembering - Understanding)
2. Analyze the MOS transistors under external bias. (Analyzing)
3. Develop CMOS logic. (Applying)
4. Inspect different PLDs for system design. (Analyzing)

5. Evaluate the performance of CMOS circuits. (Evaluating)

Module I (8 Hours)
Introduction: Historical perspective, Introduction to IC Fabrication Techniques, VLSI design methodologies, VLSI design flow, Design hierarchy, Design Style. Introduction to CAD technology. The Bipolar Technology, Fabrication of BJT. Fabrication of MOSFETS, NMOS fabrication, CMOS n-well process.

Module II (10 Hours)
MOS Transistor: MOS transistor under external bias, Structure and Operation of MOSFET (Threshold Voltage), MOSFET V-I Characteristics (Gradual Channel Approximation, Channel Length Modulation, Substrate bias effect and Measurement of Parameters), MOSFET scaling and small geometry effects. MOSFET capacitances (Oxide Related Capacitance and Junction Capacitance). Modelling of MOS Transistors- Basic concept the SPICE level-1 models, the level –2 and level –3 model equations.

Module III (12 Hours)
MOS Inverters: Static characteristics of MOS Inverter: Voltage transfer characteristics, Noise Immunity and Noise Margins, Power and Area Considerations, Speed of operation, Inverters with resistive load and with n-type MOSFET load, CMOS inverter and characteristics. Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasitic switching power dissipation of CMOS inverters.

Module IV (15 Hours)
Logic Design using CMOS
Combinational MOS logic circuits, CMOS logic circuits, state style, Complex logic circuits, pass transistor logic, Sequential logic circuit – introduction, SR latch, clocked latch & flip-flop circuits, CMOS D latch and edge triggered flip-flop. Design considerations (Layer Representation), Design Style (Stick Diagrams), Design Rules.
Dynamics logic circuits: Dynamic logic, basic principles, high performance dynamics CMOS circuits, Dynamic Ram, SRAM, flash memory.

Module V (15 Hours)
System Design
Systems design method, Design strategies, combinational and Sequential module, ROM implementation, PLDs, PLA, PAL, Sequential System design, State Machines (Mealy Circuit and Moore Circuit) Concept of FPGA, Standard cell based design, Design capture tools, Hardware definition languages such as VHDL and packages. Xlinx (introduction),
Introduction to IRSIM and GOSPL (open source packages), Design verification and testing, Simulation at various levels including timing verification, Faults models. Design strategies for testing chip level and system level test techniques.

Suggested Readings
1. S.M. Kang and Y. Leblebici, CMOS Digital integrated Circuits: Analysis and Design, TMH.
2. Perry, VHDL Programming by Example, TMH.
3. Rabeyet. al, Digital Integrated Circuits: A Design Perspective, Pearson.
4. R.A. Geiger, P.E. Allen et al, VLSI Design Techniques for Analog and Digital Circuits, McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	L		
CO 2	L	H	M		
CO 3		L	M	H	
CO 4			L	M	H
CO 5		M	H	L	

ECOT0097 OPTIMIZATION TECHNIQUES (L-T-P: 3-0-0)
(3 credits – 45 hours)

Objective
The objective of the course is to familiarize the students about various optimization methods and algorithms necessary for solving various optimization problems.

Course Outcomes
1. Define single variable, multivariable and constrained and intelligent optimization techniques and also principles of genetic programming. (Remembering)

2. Illustrate the importance of optimization. (Understanding)
3. Apply basic concepts of mathematics to formulate an optimization problem.(Applying)
4. Analyze and appreciate a variety of performance measures for various optimization problems. (Analysing)
5. Evaluate and measure the performance of an optimization algorithm. (Evaluating)
6. Design algorithms, the repetitive use of which will lead reliably to finding an approximate solution. (Creating)

Module I (7 Hours)
Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Module II (5 Hours)
Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Module III (8 Hours)
Single Variable Optimization Problems: Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Module IV (10 Hours)
Multi Variable and Constrained Optimization Technique: Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method ,Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method.

Module V (8 Hours)
Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammer Approach – Example Problems

Module VI (7 Hours)
Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Suggested Readings
1. S. S. Rao, “Engineering Optimisation: Theory and Practice”, Wiley, 2008.
2. K. Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall, 2005.
3. C.J. Ray, “Optimum Design of Mechanical Elements”, Wiley, 2007.
4. R. Saravanan, “Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
5. D. E. Goldberg, “Genetic algorithms in Search, Optimization, and Machine learning”, Addison-Wesley Longman Publishing, 1989.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		H	L		
CO 2		L	H	H	M	
CO 3	H		L	M	M	L
CO 4	L		H	M		M
CO 5		M		M	H	H
CO 6		L		H	M	H

ECRS0098 REMOTE SENSING (L-T-P: 3-0-0)
(3 credits- 45 hours)

Objective
This course is intended to introduce the students to the concepts of remote sensing. The course starts with the physics used in remote sensing and then gives an idea about the types of platforms and satellites. It also deals with advanced topics such as microwave scatterometry, thermal and hyper spectral remote sensing etc.

Course Outcomes

1. Define the concepts behind the physics of remote sensing. (Remembering)
2. Outline concepts of data acquisition and different platforms such as LANDSAT, SPOT etc. (Understanding)
3. Make use of optical sensors and different types of scanners. (Applying)
4. Analyse different types of RADAR, characteristics of microwave images etc. (Analyzing)
5. Evaluate thermal and hyper spectral remote sensing etc. (Evaluating)
6. Discuss data analysis and data processing techniques. (Creating)

Module I (10 Hours)
Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing, Effects of Atmosphere Scattering, Different types, Absorption, Atmospheric window, Energy interaction with surface features, Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Module II (5 Hours)
Data Acquisition: Types of Platforms, Different types of aircrafts, Manned and Unmanned space crafts, sun synchronous and geosynchronous satellites.
Types and characteristics of different platforms: LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc.

Module III (10 Hours)
Photographic products, B/W color, color IR film and their characteristics, resolving power of lens and film, Optomechanical electro optical sensors, across track and along track scanners, multispectral scanners and thermal scanners, geometric characteristics of scanner imagery, calibration of thermal scanners.

Module IV (10 Hours)
Scattering System: Microwave scatterometry, types of RADAR, SLAR, resolution, range and azimuth, real aperture and synthetic aperture RADAR. Characteristics of Microwave images: topographic effect, different types of Remote Sensing platforms, airborne and space borne sensors, ERS, JERS, RADARSAT, RISAT, Scatterometer, Altimeter, LiDAR remote sensing, principles, applications.

Module V (5 Hours)
Thermal and Hyper Spectral Remote Sensing: Sensors characteristics, principle of spectroscopy, imaging spectroscopy, field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing, thermal sensors, principles, thermal data processing, applications.

Module VI (5 Hours)
Data Analysis: Resolution, Spatial, Spectral, Radiometric and temporal resolution, signal to noise ratio, data products and their characteristics, visual and digital interpretation, Basic principles of data processing, Radiometric correction, Image enhancement, Image classification, Aerial Laser Terrain Mapping.

Suggested Readings

1. Lillesand.T.M. and Kiefer.R.W ,"Remote Sensing and Image interpretation", 6th Edition, John Wiley & Sons, 2000.
2. John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, PrenticeHall,1995.
3. Richards, John A., Jia, Xiuping, "Remote Sensing Digital Image Analysis",5th Edition, Springer-Verlag Berlin Heidelberg, 2013.
4. Paul Curran P.J. Principles of Remote Sensing, 1st Edition, Longman Publishing Group, 1984.
5. Charles Elachi, Jakob J. van Zyl, "Introduction to ThePhysicsand Techniques of Remote Sensing", 2nd Edition, Wiley Serie,2006.
6. Sabins, F.F.Jr, "Remote Sensing Principles and Image Interpretation", 3rd Edition, W. H. Freeman & Co,1978.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L				
CO 2		H	M			
CO 3			H	H		
CO 4			M	H	H	
CO 5					H	H
CO 6						H

ECNN0099 NANOTECHNOLOGY AND NANOELECTRONICS (L-T-P: 3-0-0)
(3 credits – 45 hours)

Objective

This course will introduce the students to Nanotechnology. The course is designed to build up a basic understanding of the nano concepts. It will provide the students the knowledge of synthesis of nanomaterials, their characterization techniques as well as touch upon some applications of nanotechnology. This course will also introduce the students to nano and molecular

Course Outcomes

1. Recognize the concepts underlying this disruptive field of new technology (Remembering)
2. Illustrate the processes involved in making nano components and material. (Understanding)
3. Apply this knowledge for fabrication of new materials and devices in the nanoscale (Application)
4. Analyze new materials and devices in the nanoscale using various characterization tools (Analysis)
5. Evaluate materials for their various properties (Evaluating)
6. Creating solutions for practical problems with appropriate use of nano-materials. (Creating)

Module I (8 Hours)

Basics of Nanotechnology: History, Properties of Nanomaterials, Difference between Bulk and Nanomaterial, Molecular building blocks for nanostructure systems, Forces between atoms and molecules - Particles and grain boundaries – strong Intermolecular forces – Electrostatic and Vander Waals forces between surfaces, Properties of nanomaterials.

Module II (8 Hours)

Physics of nanomaterials: Atomic scale structure of nanoparticles, nanotubes, nanowires, nanodots etc.; electronic and optical characteristic properties of quantum dots, quantum wires and quantum wells; concept of quantum confinement: 0D, 1D and 2D nanostructures; Size effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress. Nanophotonics, Nanofluidics, Nanothermodynamics, Plasmonics – plasmons and surface plasmons, SPR, Core-shell quantum dots and quantum-dot-quantum wells.

Module III (10 Hours)

Synthesis and Characterization of nanomaterials: Top down approach, Lithography – electron beam and ion beam techniques, Etching – wet and dry etching, Bottom up approach - Solvent based and template based synthesis, other important synthesis methods like CVD, PVD etc.; Doping, Nucleation, Growth and Stability of colloidal nanoparticles, concept of self-assembly. Characterization methods: Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Atomic force microscopy (AFM), X-ray diffraction spectroscopy (XRD), Optical characterization.

Module IV (12 Hours)

Fundamentals of Nanoelectronics: Quantum particles, Quantum mechanics of electrons, Free and confined electrons, Band theory of solids, Single electron/few electron devices, Coulomb blockade, Semiconductor quantum wells, quantum wires and quantum dots, Nanosensors, Micro and Nano electromechanical systems, Photonic crystals, Nanopiezotronics.

Module V (7 Hours)

Molecular Electronics: Electronic and optoelectronic properties of molecular materials - Electrodes and contacts – functions – molecular electronic devices - elementary circuits using organic molecules- Organic materials based rectifying diode switches – TFTs- OLEDs- OTFTs – logic switches.

Suggested Readings

1. G. L. Hornyak, J. Dutta, H. F. Tibbals, A. Rao Introduction to nanoscience, CRC Press
2. G. L. Hornyak, J. Dutta, H. F. Tibbals, A.Rao Introduction to nanotechnology CRC Press
3. T. Pradeep, Nano: The Essentials McGraw Hill
4. G. W. Hanson, Fundamentals of Nanoelectronics, Pearson
5. D. Maclurcan and N. Radywyl (Eds.) Nanotechnology and Global Sustainability CRC Press
6. E. Lichtfouse, J. Shwarzbauer, D. Robert, Environmental Chemistry for a Sustainable World, Vol.2 Springer Verlag

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	M	L	L
CO 2		M	H		
CO 3		L	M	H	
CO 4		M	H	M	
CO 5	L	M	H		H
CO 6			M	M	H

ECSD0100 SOC DESIGN (L-T-P: 3-0-0)
(3 credits- 45 hours)

Objective
This course will cover the basics of system-on-chip (SoC) design, hardware-software co-specification, co-synthesis, network-on-chip (NoC) systems and system-on-programmable-chip technologies. It provides the advanced knowledge required for system-on-chip design and development, multi-core architectures and embedded systems on a chip. It also involves projects based on FPGA prototyping platform using state-of- the-art synthesis and verification tools and design flows.

Course Outcomes
1. Define System on Chip (SoC) and SoC design methodologies. Also Relate the algorithms used for ASIC construction. (Remembering)
2. Explain the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design. (Understanding)
3. Model and specify embedded systems at high levels of abstraction. (Applying)
4. Develop HDL coding techniques for minimization of power consumption, Fault tolerant designs. (Applying)
5. Examine high performance algorithms available for ASICs. (Analysing)
6. Develop examples of applications and systems developed using a co-design approach. (Creating)

Module I (7 Hours)
ASIC: Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.

Module II (8 Hours)
NISC: NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.

Module III (8 Hours)
Simulation: Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.

Module IV (7 Hours)
Low power SoC design / Digital system: Design synergy, Low power system perspective- power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.

Module V (10 Hours)
Synthesis: Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysis Single core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs

Module VI (5 Hours)
Case study for overview of cellular phone design with emphasis on area optimization, speed improvement and power minimization.

Suggested Readings
1. Hubert Kaeslin, “Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication”, Cambridge University Press, 2008.
2. B. Al Hashimi, “System on chip-Next generation electronics”, The IET, 2006
3. RochitRajsuman, “System-on- a-chip: Design and test”, Advantest America R & D Center, 2000
4. P Mishra and N Dutt, “Processor Description Languages”, Morgan Kaufmann, 2008
5. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”, Wiley, 2011

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		H	M	L	

CO 2	H	M		L		
CO 3		M		H	L	H
CO 4		H	M		H	
CO 5	H		M	L		H
CO 6	M	H		M		H

ECWP0102: ANTENNAS and WAVE PROPAGATION (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This subject is aimed at providing basic knowledge on the theory of radiation of antenna, types of antenna and propagation characteristics and their applications in communication engineering.

Course Outcomes

1. Define various antenna functions and parameters. (Remembering)
2. Identify different types of antennas and arrays along with their application (Understanding)
3. Develop various antennas and arrays using specific design principles (Applying)
4. Analyse the properties of different types of antennas and their design. (Analysing)
5. Design antennas of required specifications in antenna design software tools. (Creating)

Module I (10 hours)

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Module II (13 Hours)

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Module III (12 Hours)

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Module IV (10 Hours)

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed-weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Suggested Readings

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			M
CO 2		H	H	H
CO 3		H	H	L
CO 4		H	M	
CO 5	H	M	M	

ECES0103: EMBEDDED SYSTEM (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective
To provide students with basic knowledge and skills in embedded systems design.

Course Outcomes
1. Select design approach using advanced controllers to real-life situations. (Remembering)
2. Develop systems using interfacing with other data handling / processing systems. (Applying)
3. Assess engineering constraints like energy dissipation, data exchange speeds etc. (Evaluating)

Module I (10 hours)
Concept of embedded systems design, embedded microcontroller cores, embedded memories. Examples of embedded systems

Module II (20 hours)
Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. Sub-system interfacing, interfacing with external systems, user interfacing.

Module III (15 hours)
Design trade-offs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Suggested Readings
1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole,
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	M	
CO 2		H	L
CO 3		L	H

ECMN0104: MOBILE COMMUNICATION and NETWORKS (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective
The course introduces the principles of mobile systems and its most important technical aspects and services and emphasizes on both public and professional mobile telephony standards, spread spectrum technology, wireless networks while migrating from wired to wireless applications.

Course Outcomes
1. Define the working principles of the cellular communication systems. (Remembering)
2. Explain the features and underlying technology. (Understanding)
3. Compare different techniques used to in mobile communication system. (Analysing)

Module I (12 hours)
Cellular concepts-Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, improving the capacity in cellular system- cell splitting, sectoring, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Module II (15 Hours)
Signal propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate. Capacity of flat and frequency selective channels.

Module III (10 Hours)
Antennas-Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays.

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM. Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Module IV (8 Hours)
MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing trade off. Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Suggested Readings
1. T. S. Rappaport, Wireless Communication, Pearson, 2001.
2. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
3. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
4. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	H	M	L
CO 2		H	M	
CO 3			M	H

ECWN105: WIRELESS SENSOR NETWORK (L-T-P: 3-0-0)
(3 credits – 45 hours)

Objective
This course introduces the different modules in a wireless sensor node and design of wireless sensor networks for different applications

Course Outcomes
1. Recall the Concepts, Network Architecture and Applications of Wireless Sensor Networks (Remembering).
2. Outline emerging research areas in the field of sensor networks (Understanding).
3. Develop the Concepts and Architecture of ad-hoc and sensor networks and MAC layer protocols (Applying).
4. Interpret and Analyze the protocol design issues for different communication standards used in WSN (Understanding, Analyzing).
5. Evaluate the QOS related performance measurements of ad-hoc and sensor networks (Evaluating).

Module I (5 Hours)
Introduction: Introduction to Sensor Networks and its architecture; Unique constraints and challenges of Sensor Networks; Advantage of Sensor Networks; Applications of Sensor Networks; Types of wireless sensor networks; Sensor node architecture with hardware and software details.

Module II (5 Hours)
Mobile Ad-hoc Networks: Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Network; Enabling technologies for Wireless Sensor Networks.

Module III (12 Hours)
Overview of Sensor Network Protocols: Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee; Dissemination protocol for large sensor network: Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Module IV (5 Hours)
Design Principles: Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Module V (12 Hours)
Hardware and Software: Single-node architecture, Hardware components & design constraints, Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT.
Operating systems and execution environments, introduction to TinyOS, nesC, MANTIS, Contiki, and RetOS.

Module VI (6 Hours)
Specialized features: Energy preservation and efficiency; Security challenges; Fault tolerance, Issues related to Localization, connectivity and topology; Sensor deployment mechanisms; Coverage issues; sensor Web; Sensor Grid.

Suggested Readings

1. Waltenegus Dargie, Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011
2. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
3. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 200
4. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
5. KazemSohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
6. SabrieSoloman, “Sensors Handbook" by McGraw Hill publication. 2009

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				L
CO 2		L	M	M	H	H
CO 3		H	L	M	M	M
CO 4	L		H	H		M
CO 5			M	L	M	H

ECSC0106: SATELLITE COMMUNICATION (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course introduces the basic satellite system, Geostationary satellite, satellite link budget, Multiple access, satellite Earth station etc.

Course Outcomes

1. Relate the architecture of satellite systems as a means of high speed, high range communication system. (Remembering)
2. Infer the basic laws, terminologies and orbital parameters related to satellite communication. (Understanding)
3. Explain various aspects related to satellite systems such as types of satellites, satellite orbits, orbital parameters and the process of launching them in orbits. (Applying)
4. Analyze the subsystems of satellite communication. (Analysing)
5. Compare the various multiple access techniques and assess their importance in satellite communication. (Evaluating)

Module I (6 hours)

Introduction to Satellite Communication: Principles and architecture of satellite communication, Brief history of satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Module II (8 hours)

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Module III (8 hours)

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Module IV (8 hours)

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Module V (8 hours)

Power Calculations: Satellite link budget. Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Module VI (7 hours)

Modulation and Multiple Access Schemes: Modulation schemes used in satellite communication, Multiple access schemes - TDMA, FDMA and CDMA.

Suggested Readings

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002.
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009.
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module5	Module6
CO 1	H	M	L			
CO 2	M	H	L			
CO 3		M	H	L		
CO 4	L	L	M	H		
CO 5	L	L	L	M	H	L

ECAM0107: INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course will help students to acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level

Course Outcomes

1. Interpret mathematical principles used in learning algorithms and relate them to learning principles. (Understanding)
2. Demonstrate fundamental understanding of artificial intelligence (AI) and its foundations. (Applying)
3. Construct and classify learning algorithms used in different problems (Applying)
4. Contrast what and how to perform pre-processing to make dataset ready for learning algorithms. (Analysing)
5. Choose and compare the different approaches To Knowledge Representation. (Evaluate)

Module I (10 Hours)

Artificial Intelligence: What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate- And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Module II (10 Hours)

Mathematical Foundations: Linear Algebra-Linear equations & vector spaces, matrix decomposition: determinant, Eigen values, singular value decomposition, matrix approximation, Calculus: Differentiation & partial differentiation, gradientvector, Probability & Distributions: Discrete and Continuous random variables, Gaussian distribution, Continuous optimization: Gradient descent, Lagrange Multiplier.

Module III (8 Hours)

Knowledge Representation Issues: Representations and Mappings, approaches to knowledge Representation; Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution; Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Module IV (7 Hours)

Learning: Supervised, unsupervised and reinforcement learning, types of unsupervised learning, KNN, regression models, Naive Bayes' classifier, decision trees, random forest classifier, SVM: linear, non-linear.

Module V (5Hours)

Data pre-processing& Scaling: Different kinds of pre-processing, Data transformations, Scaling: training data & testing data, dimensionality reduction, clustering: k-Means, Fuzzy C -Means, DBSCAN.

Module VI (5 Hours)

Deep learning: Introduction to neural Network: Perceptron model, Multilayer feed forward neural networkand back propagation, Convolutional Neural Network(CNN): Basic architecture and training of CNN. Introduction to Deep learning, RNN: Training a RNN, deep RNN, LSTM cell, Autoencoders: stacked autoencoders, sparse autoencoder.

Suggested Readings

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer (India) Private Limited, 2013
4. AurelienGeron, Hands-On Machine Learning with Scikit-Learn &TensorFLow. Second edition, 2017, O' Reilly Media.
5. Stephen Marshland,Machine Learning-An Algorithmic Perspective, second edition, ,2015, CRC Press.
6. John D. Kelleher, Deep Learning,2019, Massachusetts Institute of Technology(MIT).

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1		H		M	L	
CO 2	H		M	L		L
CO 3		L		H	M	H
CO 4			L	M	H	M
CO 5			H	L	M	

ECOC0108: FIBER OPTIC COMMUNICATION (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course aims at providing a comprehensive introduction to communication systems which include fiber-optic communication technology, satellite communication and multiple access. The course is designed for the students to develop a good understanding of the physical aspect of the technology necessary for them to evaluate and design communication systems.

Course Outcomes

1. Define the fundamental concepts of light transmission. (*Remembering*)
2. Define different types of optical fibers and other components of Fiber Optic Communication such as optical sources, detectors amplifiers and connectors etc. (*Remembering*)
3. Explain various components of optical networking and networking systems. (Understanding)
4. Solve for various parameters related to optical fibre and fibre optic link design. (*Applicatio*n)
5. Analyze optical fibers in terms of various nonlinear effects. (*Analysis*)

Module I (10 Hours)

Introduction: Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

Module II (7 Hours)

Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Module III (6 Hours)

Optical sources and receivers: LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers.

Module IV (7 Hours)

Optical Networking: Optical switches, Couplers, coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers - EDFA, Raman amplifier. WDM and DWDM systems. Principles of WDM networks.

Module V (5 Hours)

Optical link design - BER calculation, quantum limit, power penalties.

Module VI (10 Hours)

Nonlinear Effects: Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and soliton based communication.

Suggested Readings

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.

5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997.
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module5	Module6
CO 1	H	M	L			
CO 2	M	H	L			M
CO 3	L	M	H			
CO 4	L	L	M	H		H
CO 5	L	L	L	M	H	L

ECAS0109: ADAPTIVE SIGNAL PROCESSING (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course introduces some practical aspects of signal processing, and in particular adaptive systems.

Course Outcomes

1. Identify various algorithms to design filters and adaptive filters. (Remembering)
2. Explain the characteristics and properties of Adaptive systems. (Understanding)
3. Inspect concepts of signal and vector space and its applicability in various systems. (Analysing)
4. Discuss application of recursive least squares in filters and adaptive filters. (Creating)

Module I (10 Hrs)

Adaptive Systems - Definition and characteristics – Properties - Applications and examples of an adaptive system. Stochastic Processes and Models: Characterization - Mean ergodic theorem - Correlation matrix - Power spectral density, Properties of power spectral Density, Response of a linear system to random signals; Stochastic models

Module II (10 Hrs)

Wiener filters - Linear optimum filtering - Minimum mean-square error - Wiener- Hopf equations - Multiple linear regression model - Linear prediction - Forward linear prediction, Levinson-Durbin algorithm. Recursive updating of forward and backward prediction errors, Stochastic lattice filters, joint process estimator, gradient adaptive lattice.Kalman filter - Extended Kalman filter

Module III (7 Hrs)

Steepest-descent algorithm, Least-Mean-Square (LMS) adaptive filters - LMS algorithm, LMS adaptation algorithm - applications. Method of Least Squares - Data windowing, Normal equations and linear least square filters, Recursive least squares algorithm.

Module IV (8 Hrs)

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters.

Suggested Readings

1. Todd K. Moon, Wynn C. Stirling, “Mathematical Methods and Algorithms for Signal Processing” Prentice Hall, First edition, 1999.
2. John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, “Theory and Design of Adaptive Filters”, Prentice Hall India Private Limited, 2004
3. Bernard Widrow and Samuel. D. Stearns, “Adaptive Signal Processing”, Pearson Education, 2001.
4. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
5. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	L	H	H			
CO 3				H	H	
CO 4						H

ECMT0110: MICROWAVE THEORY & TECHNIQUE (L-T-P: 3-0-0)
(3 credits – 45 hours)

Objective
The course provides an introduction to microwave theory and techniques, including network theory, transmission lines, passive devices and active devices. The course also describes the microwave sources, propagation and measurement.

Course Outcomes
1. Define the fundamentals of microwave systems, components and their properties (Remembering)
2. Illustrate the mathematical concepts during analysis/ synthesis of microwave systems, and circuit parameters (Understanding)
3. To apply the knowledge of transmission line theory and design principles to compute measurement parameters and solve related problems (Applying)
4. Design microwave systems for different practical application (Creating)

Module I (5 hours)
Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Module II (11 hours)
Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Microstrip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

Module III (9 hours)
Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

Module IV (12 hours)
Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

Module V (4 hours)
Microwave Measurements- Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Module VI (4 hours)
Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RF MEMS for microwave components, Microwave Imaging.

Suggested Readings
1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech
3. Samual Y. Liao, Microwave Devices & circuits, Pearson

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		H	L		H
CO 2	H	H	L	M		
CO 3	M	H		L	H	
CO 4		L		H		

ECDV0111: DIGITAL IMAGE and VIDEO PROCESSING (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course's objectives are to introduce the fundamentals of digital image and video processing, analyze operations on images and videos such as image enhancement, image restoration, Image Segmentation, image compression, colour Image Processing etc.

Course Outcomes

1. Define key stages of image processing (Remembering)
2. Explain key stages of image processing (Understanding)
3. Implement image enhancement, restoration, data compression techniques (Apply)
4. Choose image enhancement technique and object recognition tool for specific image and video application (Evaluate)

Module I (15hours)

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Module II (15hours)

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Image Segmentation-Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation. Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub band filter banks, wavelet packets.

Module III (15hours)

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000. Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder. Video Segmentation.

Suggested Readings

1. Digital Image Processing, 3rd edition, R.C. Gonzalez and R.E. Woods, 2008, Pearson Education.
2. Fundamentals of Digital Image Processing, 2nd edition, Anil Kumar Jain, 2004, Prentice Hall of India.
3. Digital Video Processing, 2nd edition, Murat Tekalp , 2015,Prentice Hall.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	M	M	M
CO 2	M	M	M
CO 3	H	L	H
CO 4	L	H	H

ECIT0112: INTERNET OF THINGS (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

This course introduces the definition and significance of the Internet of Things and discusses the architecture, operation, and benefits of IoT.

Course Outcomes

1. Recall the fundamental concepts of Internet of Things (IoT) (Remembering)
2. Explain the transition from M2Mto IoT (Understanding)
3. Evaluate the various applications of IoT (Evaluating)
4. Describe the importance of privacy and security in IoT (Understanding)

Module I (12 hours)

Introduction to IoT: History and evolution of IoT, Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT.

Module II (8 Hours)
M2M to IoT: Introduction, From M2M to IoT, M2M towards IoT-the global context, Role of M2M in IoT, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.

Module III (8 Hours)
Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT application.

Module IV (7 Hours)
Privacy and Security in IoT: Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues.

Suggested Readings
1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014.
2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on Approach)", 1 st Edition, VPT, 2014.
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, Apress Publications, 2013.
5. E- Resource: http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L		
CO 2		H	L	
CO 3		M	H	M
CO 4				H

ECBI0113: BIOINFORMATICS (L-T-P: 3-0-0)
(3 credits – 45 hours)

Objective
The objective of the course is to introduce students to the rapidly evolving field of bioinformatics and to analyze and evaluate bioinformatics data to discover patterns, critically evaluate conclusions and generate predictions for subsequent experiments

Course Outcomes
1. Recall the biological concepts. (Remembering)
2. Explain the fundamentals of bioinformatics. (Understanding)
3. Apply various techniques used in bioinformatics. (Applying)
4. Analyse and compare various aspects of bioinformatics. (Analysing)
5. Predict protein structure that helps in drug discovery. (Creating)

Module I (10 hours)
Introduction to bioinformatics and computational biology, Scope of bioinformatics, relation of bioinformatics with molecular biology, Fundamental concepts of biology such as nucleotide, amino acids, proteins, different structure of proteins, DNA, DNA Sequences, Cell, Chromosomes, Gene, Mutation, Genetic Polymorphism

Module II (15 hours)
The form of biological information, Introduction to Biological Databases: Nucleic Acid Databases (NCBI, EMBL, DDBJ,), Protein databases (Primary, Composite and Secondary), Specialized Genome Databases (SGD, TIGR), Structure Databases (CATH, SCOPE and PDBsum), Tools: FASTA, BLAST, BLAT, RASMOL

Module III (10 hours)
DNA sequence analysis, Sequence Based Parameters, DNA sequencing as a diagnostic tool

Module IV (10 hours)
Protein Structure and Function, Sequence Alignment, Protein Sequence Analysis, Protein Secondary Structure Prediction, Recent advancement in bioinformatics

Suggested Readings:
1. Arthur M. Lesk, Introduction to Bioinformatics, Oxford
2. JinXiong, Essential Bioinformatics, Cambridge
3. David W. Mount, Bioinformatics: Sequence and Genome Analysis, CBS Relevant e resources

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L		
CO 2		H		
CO 3		M	H	
CO 4			M	H
CO 5			L	H

ECST0114: SENSOR TECHNOLOGY (L-T-P: 3-1-0)
(4 credit – 60 hours)

Objective
This course introduces the concepts of Sensors. The course provides different measurement techniques of physical parameters and to convert it into convenient form and transmit the signals to the control room to have a reliable product.

Course Outcomes
1. Recall the fundamental characteristics of sensors (Remembering)
2. Explain the working of different types of sensors (Understanding)
3. Apply the sensors/transducers to measure the physical quantities in the field of science, engineering and technology (Applying)
4. Analyse the different signal conditioning techniques (Analysing)

Module I (10 hours)
Basics of Sensors, Sensor Classification; Units of Measurements; Performance and Types, Sensor Characteristics, Error Analysis characteristics

Module II (18 hours)
Displacement, position and proximity sensors, Velocity and motion sensors, Strain gauge, load cell, Fluid pressure sensors, Piezoelectric sensors, Liquid flow and level sensors, Ultrasonic sensors, Temperature sensors, Smart sensors

Module III (17 hours)
Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, photoconductive detectors, Photo diodes, Avalanche photodiodes, Basics of biomedical sensors: ECG sensor, EEG sensor, PPG sensor, GSR sensor

Module IV (15 hours)
Signal conditioning and processing, Data acquisition systems, block diagram of DAQ, signal conditioning, Digital to Analog converters, Analog to digital converters

Suggested Readings
1. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi, 2013
2. Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.
4. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
5. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999.
6. Leslie Cromwell, Biomedical Instrumentation and measurement, 2nd edition, Prentice hall of India, New Delhi, 2015.

E- Resource

7. https://nptel.ac.in/courses/108/108/108108147/
8. https://nptel.ac.in/courses/108/105/108105064/
9. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M		
CO 2		H	H	
CO 3		H	H	M
CO 4		L	L	H

ECBA0115: IOT Basics and Architecture (L-T-P: 4-0-0)

(4 credits – 60 hours)

Objective

This course introduces the definition and significance of the Internet of Things and discusses the architecture, operation, and benefits of IoT.

Course Outcomes:

1. Recall the fundamental concepts of Internet of Things (IoT) (Understanding/ Remembering)
2. Explain the transition from M2M IoT (Understanding)
3. Analyze various M2M and IoT architectures (Analysing)
4. Evaluate design issues related to IoT architecture (Evaluating)

Module I (15 hours)

Introduction to IoT: History and evolution of IoT, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT. Applications of IoT and IoT privacy and security.

Module II (10 Hours)

M2M to IoT: Introduction, From M2M to IoT, M2M towards IoT-the global context, Role of M2M in IoT, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.

Module III (10 Hours)

Overview of Architecture: An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking.

Module IV (15 hours)

Reference Architecture: IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Introduction to protocols.

Suggested Readings

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on Approach)”, 1 st Edition, VPT, 2014.
3. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1stEdition, Apress Publications, 2013.
5. E- Resource: http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L		
CO 2		H	L	
CO 3		M	H	M
CO 4		L	L	H

ECWT0116: WEB TECHNOLOGY (L-T-P: 4-0-0)

(4 credits – 60 hours)

Objective

The main objective of the course is to focus on fundamental key concepts required for developing web applications. The course will encompass key components like HTTP communication protocol, the markup languages HTML, XHTML, PHP and XML, the CSS XSLT standards for formatting and transforming web content, interactive graphics and multimedia content on the web, client-side programming using Javascript, JSP and AJAX.

Course Outcomes

1. Define basics terminologies like HTML, PHP, JAVA, XML, AJAX etc. necessary in web technology. (Remembering)
2. Explain the HTML and CSS syntaxes and semantics required to build web pages. (Understanding)
3. Apply different tags, tables, forms, frames and style sheets supported by HTML to design web pages. (Applying)
4. Evaluate particular software problem using Java programs, comprising more than one class. (Evaluating)
5. Design applets as per the requirements with event handling facility. (Creating)

Module I (12 hrs)

Web Basics: Introduction, History and Protocols of Internet, World Wide Web, Web Server and Browser, HTML, Structure of HTML document, Dynamic HTML.

PHP: Introduction to PHP, Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, etc. File Handling in PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.

Module II (10 hrs)

JAVA: Introduction to JAVA, Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms.

Module III (13 hrs)

XML: Introduction to XML, uses of XML, simple XML, Defining XML tags, their attributes and values, Document type definition, XML Schemas, XML key components, DTD and Schemas, Using XML with application, XHTML Parsing XML Data - DOM and SAX parsers in java, Transforming XML using XSL and XSLT.

Module IV (15 hrs)

Servlets: Introduction to Servlets, Common Gateway Interface (CGI), Lifecycle of a Servlets, deploying a Servlets, The Servlets API, Reading Servlets parameters, Reading initialization parameters, Handling Http Request & Responses.

JSP: Introduction to JSP, The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session tracking, connecting to database in JSP.

Module V (10 hrs)

AJAX: Introduction AJAX, AJAX Components, Handling Dynamic HTML with AJAX, AJAX using PHP, AJAX PHP Database form, AJAX PHP MySQL select Query, AJAX using XML.

Suggested Readings

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1 st Edition, Pearson Education India. (ISBN:978-9332575271)
2. Ralph Moseley and M.T Savaliya, "Developing Web Applications", 2nd edition, Wiley-India, 2015 (ISBN: 9788126538676)
3. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", 4 thEdition, O'Reilly Publications, 2015. (ISBN:978-9352130153)
4. Nicholas C Zakas, "Professional JavaScript for Web Developers", 3rd Edition, Wrox/Wiley India, 2012. (ISBN:978-8126535088)
5. Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", 3rdEdition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016. (ISBN: 978-9352133246)
6. B. M Harwani, "Developing Web Applications in PHP and AJAX", 1st Edition, McGraw Hill India, 2010 (ISBN: 978-0070144521)

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	L		
CO 2		H	M	L	

CO 3	M	L	H		
CO 4		M	H		L
CO 5	L	M		M	H

ECML0117: Machine Learning (L-T-P: 4-0-0)

(4 credits – 60 hours)

Objective

The main objective of this course is to introduce the students with the concept of artificial intelligence and machine learning.

Course Outcomes

1. Define various terminologies used in probability theory and statistics, function approximation and models of classification (Remembering)
2. Explain various terminologies used in probability theory and statistics, function approximation and models of classification (Understanding)
3. Implement various function approximation techniques and models of classification (Applying)
4. Compare various function approximation techniques and models of classification (Analyzing)
5. Choose models of classification for specific application (Evaluating)

Module I (20 hours)

Basics of Linear Algebra and Probability Theory: Vector space, Inner product, Inverse of a matrix, Eigen analysis, Singular value decomposition, Probability distributions – Discrete distributions and Continuous distributions; Independence of events, Conditional probability distribution and Joint probability distribution, Bayes theorem, Normal (Gaussian) distribution.

Methods for Function Approximation: Linear models for regression, Parameter estimation methods - Maximum likelihood method and Maximum *aposteriori* probability method; Regularization, Ridge regression, Lasso, Bias-Variance decomposition, Bayesian linear regression.

Module II (20 hours)

Classification: Bayesian decision theory, Bayes classifier, Minimum error-rate classification,– Discriminant functions, Decision surfaces, Maximum-Likelihood, maximum a posteriori probability decision; Gaussian mixture models -- Expectation-Maximization method for classification; Naive Bayes classifier: Non-parametric techniques for density estimation -- Parzen-window method, K-nearest neighbors method, Hidden Markov models (HMMs)

Module III (20hours)

Dimensionality Reduction Techniques: Principal component analysis, Fisher discriminant analysis, Multiple discriminant analysis.

Discriminative Learning based Models for Classification: Logistic regression, Perceptron, Multilayer feed forward neural network – Gradient descent method, Error back propagation method; Support vector machine.

Swap Pattern Recognition with Intro to AI

Suggested Readings

1. Pattern Recognition and Machine Learning, C.M.Bishop, , 2006, Springer.
2. Pattern Classification ,2nd Edition, R.O.Duda, P.E.Hart and D.G.Stork, 2001, John Wiley.
3. Pattern Recognition , 3rd Edition, S. Theodoridis and K. Koutroumbas, 2009 , Academic Press.
4. Introduction to Machine Learning, 4thEdition , E. Alpaydin, 2010 , Prentice-Hall of India.
5. Introduction to Statistical Learning, G. James, D. Witten, T. Hastie and R. Tibshirani, 2013.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H	H	L
CO 2	H	H	L
CO 3	L	M	M
CO 4	L	M	M
CO 5	L	M	H

ECET0118: EMBEDDED SYSTEMS & IOT (L-T-P: 4-0-0)

(4 credits – 60 hours)

Objective

The main objective of this course is to introduce the students with the concept of embedded system and IoT and its applications in various fields. In this course they will study IoT architecture designing of IoT based embedded system with the security and privacy issues.

Course Outcomes

1. Define various terminologies related to embedded system and IoT. (Remembering)
2. Illustrate the concept of IoT. (Understanding)
3. Apply the concept of IOT architecture to design embedded systems in various domains. (Applying)
4. Analyze IOT architecture and applications in various fields. (Analyzing)
5. Create IoT based embedded systems. (Evaluating-Creating)

Module I (10 Hours)

Embedded System Basics: Introduction to Embedded Systems, Components of Embedded Systems, Features of Embedded System, Challenges in designing Embedded Systems, Categories of Embedded Systems, Importance of Microcontroller in Embedded System based system design

Module II (15 Hours)

IoT Basics: Definition, History, Features, Working, Applications, Challenges, Advantages and Disadvantages, Best Practices of IoT, Embedded devices and system using IoT, IoT decision framework, IoT Ecosystem

Module III (10 Hours)

a. Architecture: Components of IoT Architecture, Stages of IoT Architecture, IoT Platform
b. IoT Communication Protocols: Data Link, Network Layer, Session Layer

Module IV (15 Hours)

a. Applications of IoT: Smart Objects, IoT Devices, Basic and Advance IoT Boards
b. Domain of IoT: Energy, Biometric, Security and Surveillance, Smart City, Healthcare, Agriculture, Transportation, Transforming Businesses

Module V (10 Hours)

IoT based System Design: IoT based Home Light Control, IoT based Ultra Sonic Sensor Distance Calculation, Temperature, Pressure and Altitude Measurement System using IoT

Suggested Readings

1. Arsheep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach Book, R.K. Books.
2. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media.
3. Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri, Internet of Things: Architectures, Protocols and Standards, Willey.
4. Samuel Greengard, The Internet of Things, MIT Press.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M			
CO 2		H	M		
CO 3		L	H	M	
CO 4			M	H	L
CO 5				M	H

ECSV0119: SIGNAL PROCESSING FOR VLSI (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

This course aims at providing a comprehensive coverage of some of the important techniques for designing efficient VLSI architectures for DSP.

Course Outcomes

1. Explain pipelining and parallel processing concepts. (Understanding)
2. Inspect various algorithms and architecture for designing FIR and IIR filters. (Applying)
3. Inspect concepts of scaling and round off noise in digital filters (Analyzing)
4. Discuss various bit level arithmetic architectures. (Creating)

Module I (8 Hrs)
Introduction to DSP Systems: Introduction to DSP systems, Typical DSP algorithms, Data flow and Dependence graphs, critical path, Loop bound, iteration bound, longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

Module II (8 Hrs)
Retiming: Retiming and Unfolding: Retiming, definitions and properties, Unfolding, an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application.

Module III (7 Hrs)
Algorithmic Strength Reduction: Algorithmic strength reduction in filters and transforms, 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank order filters.

Module IV (7 Hrs)
Fast Convolution & Pipelining and Parallel Processing Of IIR Filters: Fast Convolution - Fast convolution, Cook-Toom algorithm, modified Cook-Toom algorithm.
Pipelining and Parallel Processing of IIR Filters - Pipelined and parallel recursive filters, Look-Ahead pipelining in first-order IIRfilters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

Module V (7 Hrs)
Scaling and Round-Off Noise: Scaling and round-off noise, scaling operation, round-off noise, state variable description of digital filters, scaling and round-off noise computation, round-off noise in pipelined IIR filters.

Module VI (8 Hrs)
Bit-Level Arithmetic Architectures: Bit-level arithmetic architectures, parallel multipliers with sign extension, parallel carry ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters

Suggested Readings
1. Keshab K.Parhi, "VLSI Digital Signal Processing systems, Design and implementation", Wiley, Inter Science, 1999.
2. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
3. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Publishers, 1998.
4. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", Mc Graw-Hill, 1994.
5. S.Y. Kung, H.J. White House, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985. 5. Jose E. France, Yannis Tsividis, "Design of Analog & Digital VLSI Circuits for Telecommunication and Signal Processing ", Prentice Hall, 1994.
6. U.Meyer, Baese, Digital Signal Processing with Field Programmable Gate Arrays, Springer, Second Edition, 2004.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H					
CO 2	L	H	H	H		
CO 3	L			M	H	
CO 4					L	H

EDDS0120: ADVANCED DIGITAL SIGNAL PROCESSING (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective
This course is intended to make the students learn the essential advanced topics in digital signal processing. The course includes linear constant-coefficient system properties which will be required for study of any further advance courses. The course also introduces the students to adaptive signal processing and applications of DSP and multirate DSP.

Course Outcomes
1. Recall, illustrate and summarize the theories DSAP and multirate DSP for different filters and algorithms. (Remembering - Understanding)
2. Choose best algorithm for adaptive filter design. (Applying)
3. Solve different problems related to finite word length effect. (Applying - Creating)

4. Analyze the theory of prediction and solution of normal equations. (Analyzing)
5. Examine applications of DSP at block level. (Analyzing)
6. Interpret the utilization of advanced algorithms like LMS, MMSE etc., for designing of adaptive filters. (Evaluating)

Module I (9 Hours)
DSP: Discrete time signals and Systems and its classifications; Time and frequency domain analysis of LTI System; Z-transform, DTFT, DFT, FFT Algorithms; IIR and FIR digital filter design and structural realization; Butterworth, Chebyshev and Eliptic Approximations; All pass filter.

Module II (9 Hours)
Multirate DSP: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.Introduction to wavelets, Multi-resolution analysis.

Module III (8 hours)
Introduction; Representation of numbers- fixed point, floating point; Rounding and Truncation Errors; Quantization Effects in ADC and DAC processes; Noise power from a digital system; Coefficient quantization effects in direct form realization of IIR and FIR systems; Round off effects in Digital filter structures.

Module IV (8 Hours)
Stationary random processes, Minimum mean square error and linear minimum mean square error criteria, forward-backward linear prediction filters, solution of normal equations – Levinson Durbin Algorithm, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Module V (10 Hours)
Adaptive Filters, FIR adaptive filters: steepest descent algorithm, LMS algorithmand variance, Gradient Adaptive Lattice, Recursive Least Square algorithm, Applications: noise cancellation, channel equalization.
Introduction to Kalman Filter.

Module VI (10 Hours)
Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis, Algorithms for Spectrum Estimation.

Module VII: Applications (6 Hours)
Application to Radar signal processing, image processing and speech processing.

Suggested Readings
1. J. G. Proakis and D. G. Manolakis “Digital signal processing: Principles, Algorithm and Applications”, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems-Filter Banks– Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, “Multirate and Wavelet Signal Processing”, 1st Edition, Academic Press, 1997.
4. M. H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons Inc., 2002.
5. S. Haykin, “Adaptive Filter Theory”, 4th Edition, Prentice Hall, 2001.
6. D. G. Manolakis, V.K. Ingle an and S. M. Kogon, “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H		M	L		
CO 2			M	H	L	
CO 3		H		L	M	L
CO 4			H	M	L	
CO 5	M		L			H
CO 6			M	L	H	

ECCV0121: FUNDAMENTALS OF COMPUTER VISION (L-T-P: 3-1-0)
(4 credits – 60 hours)

Objective

The course is intended to make an insight into different aspects of Computer Vision and Machine learning, working principles, systems associated and applications.

Course Outcomes

1. Recall the working of camera and explain behavior of various sources, surfaces, shadows, human visual systems etc. (Remembering - Understanding)
2. Illustrate the image formation models and feature extraction for computer vision. (Understanding)
3. Apply various image analysis operations on the images and videos such as segmentation, counting objects, shape determination, feature extraction etc. (Applying)
4. Analyze algorithms for high level vision analysis such as object detection and classifications using input features and classifiers. (Analyzing)
5. Evaluate the segmentation and motion detection and estimation techniques. (Evaluating)
6. Develop small applications and detect the objects in various applications. (Creating)

Module I (12 Hours)

Human Visual system, Colour representation and colour Models; Camera: Pinhole and Lens Types, geometric Camera model and Camera calibration; Monocular imaging system, Orthographic & Perspective Projection, Binocular imaging systems, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Radiometry, Projections.

Transforms: 2 dimensional discrete Fourier transform, Hough transforms for line detection and Radon transform and tomographic reconstruction.

Module II: Feature Extraction (10 Hours)

Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection,

Module III (5 Hours)

Surface Illumination; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo, Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Module IV (20 Hours)

Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation. Deformable curves and surfaces, active contours, Level set representations, Fourier and wavelet descriptors, B-Splines, Least Squares and Eigen Vector Line Fitting

Statistical Decision Theory; Pattern Recognition Principles; Clustering Approach- K- Means Clustering; Parametric Approach- Bayes' Classifier; Relaxation Approach; Shape Similarity Based Recognition; Expert System and applications;

Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition, Geometric templates from spatial relations, Probabilistic and inferential methods- neural networks, support vector machines; Introduction to convolutional neural network

Module V (8 Hours)

Regularization theory, Optical computation, Stereo Vision, Motion estimation, Background Subtraction and Modeling, Optical Flow, Spatio Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Structure from motion, Motion Tracking in Video.

Module VI (5 Hours)

Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing.

Suggested Readings

1. Ballard and Brown, "Computer Vision",PRENTICEHALL, INC., 1982.
2. D. Forsyth and J. Ponce, "Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
3. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, SpringerVerlag London Limited, 2011.
4. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
5. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
6. K. Fukunaga,"Introduction to Statistical Pattern Recognition",2nd Edition, Morgan Kaufmann, 1990.
7. B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
8. E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc, 2012.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H			L	M	M
CO 2		H	L			M
CO 3		M	H		L	L
CO 4	L			M	H	M
CO 5				H	M	L
CO 6	M	L	M	M	M	H

ECDC0122: DIGITAL CIRCUITS (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

The objectives of this course are to introduce the concept of digital and binary systems and give students the concept of digital electronics. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits and systems.

Course Outcomes

1. Define the fundamentals of digital systems, logic gates, Boolean algebra, logic families and memories (Remembering)
2. Classify and compare between different types of number systems, their conversions and different types of combinational and sequential circuits (Understanding)
3. Apply Boolean formulas, K-map and Quine-McClusky methods for minimizing logic functions (Applying)
4. Analyse various combinational, sequential and other digital circuits and systems. (Analyzing)
5. Design various combinational and sequential circuits and determine their outputs (Creating)

Module I (10 Hours)

Introduction to Digital Systems-Difference between analog and digital systems, advantages of digital systems, Number System-Decimal, Binary, Octal and Hexadecimal number system, addition, subtraction, multiplication and division of different number systems, conversion from one number system to another, Codes-Binary codes, BCD codes, Excess-3, Gray codes, Parity and Hamming codes. Logic Gates-NOT, AND, OR, NAND, NOR, XOR, XNOR, Universal gates, realization of basic gates using universal gates, Difference between Positive and negative logic systems, TTL 74XX series.

Module II (8 Hours)

Boolean Algebra-Boolean rules, laws and axioms, SOP, POS forms, standard SOP and standard POS forms, conversion from SOP to POS forms, minimization of Boolean expressions, Karnaugh Map, Quine Mc-Clusky method.

Module III (10 Hours)

Combinational Circuits-Difference between combinational and sequential circuits, half adder, full adder, half subtractor, full subtractor, Parallel adder, Look-Ahead Carry adder, Serial adder, BCD adder, encoder, decoder, multiplexers and demultiplexers, comparator, parity generator and checker, priority encoder, code converters.

Module IV (13 Hours)

Sequential Circuits-Latches, concept of clock, level-triggered and edge-triggered clocks, flip-flops-S-R, J-K, D and T flip-flop, conversion from one flip-flop to another, Race-around condition, Master-Slave J-K flip-flop, Registers-Shift registers- right shift and left shift registers, SISO, SIPO, PISO and PIPO, bi-directional shift registers, universal shift registers, ring and twisted-ring counters, Counters-Difference between synchronous and asynchronous counters, ripple counter design, synchronous counter design, decade counter

Module V (8 Hours)

Introduction to Analog-to-Digital Converters-Successive Approximation type ADC, Dual-Slope type ADC, Flash type ADC, Counter type ADC, Introduction to Digital-to-Analog Converters- Parameters of DAC, R-2R Ladder type DAC, Weighted Resistor DAC, Switched Current –Source type DAC, Switched –Capacitor type DAC

Module VI (11 Hours)

Introduction to different Logic Families- RTL, DCTL, DTL, HTL, TTL, ECL, CMOS, BiCMOS, IC specification Terminology-Threshold voltage, Propagation Delay, Fan-in, Fan-out, Noise margin, power dissipation, characteristics of different logic families, CMOS inverter, CMOS NAND and NOR gates, design of basic gates using CMOS. Introduction to memories-memory types and

terminology, RAMs, ROMs and PROMs, DRAMs and SRAMs, Volatile and Non-Volatile memory, magnetic memories, optical disk memory, charged coupled devices.

Suggested Readings

1. William Gothmann, "Digital Electronics: An Introduction to Theory and Practice", 2nd Edition, Prentice Hall
2. John Morris, "Digital Electronics" 1st Edition, Butterworth-Heinemann
3. Anand Kumar, "Fundamentals of Digital Circuits", 2nd Revised Edition, Motilal UK Books of India.
4. R. P. Jain, "Modern Digital Electronics", 4th Edition, Mc-Graw Hill.
5. M. Morris Mano, "Digital Design", 3rd Edition, Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L	M	M	M	H
CO 2	H		H	H	M	
CO 3		H	L	L		
CO 4			H	H	M	
CO 5			H	H	L	L

ECSC0123: SEMICONDUCTOR DEVICES AND CIRCUITS (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

The objective of the course is to introduce basic semiconductor devices, their characteristics and application. The course will also help in analysis and design of circuits using simple devices such as p-n junctions and also more complex devices such as Bipolar Junction Transistors (BJTs) and Field Effect Transistors (FETs).

Course Outcomes

1. Define semiconductors and their applications (Remembering)
2. Identify the behavior PN junctions and special purpose diodes (Applying)
3. Design and analyze simple BJT and MOSFET circuits (Analysing, Creating)
4. Illustrate the advantages of feedback in amplifiers (Understanding)

Module I (15 Hours)

a. Semiconductors: Energy band theory of Solids, Conductors, Semiconductors and Insulators. Types of semiconductors, mobility, conductivity, concept of holes, majority and minority carriers, drift current and diffusion current
b. PN Junction diodes: PN junction as a diode, drift and diffusion currents in PN junction diode, V-I characteristics, Diode equation. Diode resistance, Transition capacitance and diffusion capacitance, loadline analysis. Applications of Diode: Half-wave and full-wave rectifiers, voltage multipliers, clipper, clamper; Special purpose diodes: Construction, Principle of operation, application and characteristics of Zener diode, Schottky diode, Varactor diode, Tunnel diode, PIN diode, LED, photo diode, Photo diode.

Module II (20 Hours)

Bipolar Junction Transistors: Transistor– construction, operation and configuration, V-I characteristics, Q- point and Biasing in BJTs: Fixed bias, Potential-divider bias. Collector feedback Bias etc., loadline analysis, Transistor as an inverter and amplifier, Small signal modeling and analysis: Hybrid model and analysis. Parameter conversion for three transistor configurations. Compound configurations: Darlington pair, cascade and cascode connection; Frequency Response of an amplifier, Phototransitors: construction and application of phototransistors

Module III (15 Hours)

Field Effect Transistors (FET): Construction and V-I characteristics of JFET, differnt types of Biasing in JFETs, Application of JFET as an amplifier, Small signal modeling and analysis of JFETs, Types of MOSFETS: EMOSFET and DMOSFET, construction and V-I characteristics, Biasing in MOSFETs, MOSFETs as an amplifier and small signal modelling and analysis of MOSFETs, CMOS: Construction and advantages of CMOS, application of CMOS as an inverter

Module IV (10 Hours)

Feedback amplifiers: Concept of feedback, advantages of negative feedback; Topological classification (Voltage series; Voltage shunt, Current series, Current shunt), Effect of feedback on input and output resistances, Bandwidth of amplifier.

Suggested Readings

1. S Salivahanan, N Suresh Kumar and A Vallavaraj, Electronic Devices and Circuits, 2 ed., Tata McGraw-Hill, 2008
2. Robert L. Boylestad and Lowis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, New Delhi
3. David A. Bell, Electronic Devices and Circuits, 4th Edition, Oxford University Press
4. Streetman and Banerjee, Solid State Electronic Devices, Prentice Hall, New Delhi
5. Jacob Millman, Christos C Halkias, Integrated Electronics, McGraw Hill Int. students Edition.
6. R. S. Sedha, Applied Electronics, Multicolor Illustrative Edition, SChand, New Delhi.
7. Donald A. Neamen, Semiconductor Physics and Devices, 3rd Edition, Tata McGraw Hill
8. P. Ramesh Babu, Electronic Devices and Circuits, Scitech Publications Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L	L	
CO 2	H	L	L	
CO 3		H	H	M

ECFC0124: FUNDAMENTALS OF ANALOG ELECTRONIC CIRCUIT (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

The course introduces to basic analog electronic circuit design. The student will develop the ability to apply basic engineering sciences to the design, analysis and operation of electronics devices and circuits and problem solving skills of electronic circuits.

Course Outcomes

1. Define the fundamental concepts of semiconductor devices. (Remembering)
2. Explain the working principle of different circuits based on BJT and Op-amp. (Understanding)
3. Apply the methods learned in class to design and implement practical projects. (Applying)
4. Analyse modern analog circuits using integrated circuits. (Analyzing)
5. Evaluate the operation and behaviour of various analog integrated circuits by using the analog circuit analysis techniques. (Evaluating)
6. Design analog circuits. (Creating)

Module I (10 Hours)

Amplifiers: Introduction and classification of Power Amplifiers, Class A, Class B, Complementary symmetry push pull amplifier, Class C, Distortion in power amplifiers.

Introduction and classification of Tuned Amplifiers, Capacitance coupled tuned amplifier, stagger tuned amplifier.

Module II (15 Hours)

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

Module III (20 Hours)

Op-Amp: Internal structure of an Op-amp, Ideal op-amp, Non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product).

Op-amp as inverting and non-inverting amplifier, Differential amplifier, Instrumentation amplifier, Integrator, P, PI and PID controllers and lead/lag compensator using an op-amp, Voltage regulator, Zero crossing detector, Square wave and triangular wave generators, Precision rectifier.

Module IV (15 Hours)

Active filters: Transfer functions- LPF, HPF, BPF, BRF and All Pass Filter, Approximation methods- Butterworth, Chebyshev filter, I and II filter orders.

555 Timer: Block diagram, Monostable operation, Astable operation, Voltage controlled oscillator, Ramp generator.

A/D and D/A Converter: DAC- Weighted resistor, R-2R ladder, ADC- Single slope, dual slope, successive approximation and flash type.

Suggested Readings:

1. R.S Sedha, A Textbook of Applied Electronics, S. Chand & Company Ltd.

2. T.R. Ganesh Babu and B. Suseela, Linear Integrated Circuits, Scitech Publications (India) Pvt. Ltd.
3. S. Salivahanan, V.S.K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill.
4. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational, Amplifier theory and applications, McGraw Hill,1992.
5. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill,1988.
6. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.
7. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder'sCollege11 Publishing, EditionIV.
8. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	M	L
CO 2	L	H	H	M
CO 3		L	M	H
CO 4	L	M	H	H
CO 5		L	M	H
CO 6			M	H

ECIM0125: INTRODUCTION TO MICROPROCESSOR AND MICROCONTROLLER (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

This course provides an in-depth understanding of the architecture and operation of microprocessors and microcontroller, assembly language programming and microcontroller interfacing techniques. The students will be able to design and implement microcontroller-based systems in both hardware and software and can apply this knowledge to more advanced structures.

Course Outcomes

1. Develop an ALP in 8085 microprocessor using the internal organization for the given specification. (Creating)
2. Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller. (Analysing)
3. Demonstrate the architecture and functional block of 8085 and 8086 microprocessor and 8051 Microcontroller. (Understanding)
4. Develop an embedded C and ALP in 8051 microcontroller using the internal functional blocks for the given specification. (Creating)
5. Explain various peripherals devices such as 8255, 8279, 8251, 8253, 8259 and 8237. (Understanding)
6. Design electrical circuitry to the Microprocessor I/O ports in order to interface the Processor to external devices. (Creating)

Module I (5 Hours)

Microprocessor Architecture: Introduction to microprocessor and microcomputer architecture; History and Evolution; Pins and signals; Register organization, ALU, control unit, Timing and control module; Architecture of 8085 Microprocessor, pin out configuration of 8085 microprocessor.

Module II (15 Hours)

Instruction set and assembly language programming of 8085: Instruction Fetch, Instruction cycle, machine cycles, T-states; Programming model of 8085 microprocessor; instruction and data formats; Memory and I/O Addressing; Addressing modes of 8085; Instruction set of 8085 Microprocessor; Assembly language programming using 8085 microprocessor; State transition diagram, use of stack and subroutine.

Module III (12 Hours)

Interfacing: Memory and their interfacing; I/O Interfacing, Addressing the I/O devices, I/O data transfer schemes; I/O interfacing devices and special purpose supporting chips like 8255, 8279, 8259, 8257; Interfacing a keyboard, interfacing a LED and seven segment displays, interfacing A/D converter, D/A converter; Serial I/O techniques.

Module IV (6 Hours)

Interrupts: Interrupt in 8085; RST Instructions; Issues in implementing interrupt, multiple interrupts and priorities, Daisy Chaining, Interrupt handling in 8085, Enabling, Disabling and masking of interrupts.

Module V (7 Hours)

16-bit Microprocessor: Functional block diagram of 8086 microprocessor; Addressing modes of 8086 microprocessor; Software model of 8086 microprocessor; Instruction sets of 8086 microprocessor; Interrupts of 8086 microprocessor.

Module VI (15 hours)
Microcontroller (Architecture and Programming): Introduction to 8051 Microcontrollers, Assembly level language programming on 8051; I/O port programming; 8051 interrupt; Interfacing to 8255, 80851 interfacing examples; 16-bit microcontroller-MCS-96 series; Trends and development in Microcontroller.

Suggested Readings
1. R.S. Goankar, Microprocessor Architecture, Programming and Application with 8085, Pengram
2. Mazidi J Gillispie and Mazidi M Ali, The 8051 Microcontroller and Embedded Systems, Pearson/ PHI
3. P.K. Ghosh and P.R. Sridhar, 0000 to 8085 - Introduction to Microprocessor for Scientists and Engineers, PHI
4. A.V. Deshmukh, Microcontroller, TMH
5. YU-Cheng Liu and Glenn A Gibson, Microprocessor System, Architecture, Programming and Design
6. Barry B Brey, The Intel Microprocessor, Architecture, Programming and interfacing

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	M	H	M	L	L	
CO 2		H	H	M	L	M
CO 3	H		M	L	H	
CO 4	L	M		M		H
CO 5		L	H	M	M	
CO 6	L		M	H	M	L

ECIC0126: SEMICONDUCTOR IC TECHNOLOGY (L-T-P: 3-1-0)
(4 credits – 60 hours)

Objective
This course is intended to make the Students learn the essential concepts of advanced semiconducting materials and IC Technology. The course includes a review of the CMOS logic design, IC fabrication steps as well as study of various advanced semiconducting materials, analog VLSI circuit design and MEMS technology.

Course Outcomes
1. Illustrate and summarize the fabrication techniques and design of digital circuits using CMOS, advanced semiconducting materials, analog VLSI circuits, MEMS (Remembering - Understanding)
2. Understand and analyze MEMS technology, advanced semiconducting materials and various analog VLSI circuit design. Understanding - Analyzing)
3. Develop various CMOS logic circuit, analog VLSI circuits, MEMS. (Applying)
4. Inspect CMOS logic circuits, analog VLSI circuits, MEMS (Analyzing)
5. Evaluate the performance of CMOS logic circuits, analog VLSI circuits, MEMS. (Evaluating)

Module I (16 hours)
Review of IC Fabrication Techniques: Crystal growth, Oxidation, Diffusion and Ion-implantation, Epitaxy, Etching, Lithography, Metallization.
Review of digital circuits using CMOS: Logic gates, Combinational MOS logic circuits, CMOS logic circuits.

Module II (12 hours)
Advanced semiconducting materials:
Gallium Nitride: Band structure, Carrier concentration, Temperature dependencies, Effective masses, Donors and acceptors.
Aluminum Nitride: Band structure, Carrier concentration, Temperature dependencies, Effective masses, Donors and acceptors.
Boron Nitride: Band structure, Carrier concentration, Temperature dependencies, Effective masses, Donors and acceptors.

Module III (12 hours)
Analog VLSI Circuit Design: Single stage amplifier, Differential amplifier, Current mirror, Operational amplifiers.

Module IV (20 hours)

MEMS Technology: An overview of micro-electromechanical devices and technologies, Physics in microscopic world, scaling issues, Micromachining technologies, Basics of micro-fabrication technologies, Bulk micromachining, Surface micromachining, Materials encountered in micromachining processes and their properties.

Suggested Readings

1. S. K Gandhi, VLSI Fabrication Principles: Silicon and Gallium Arsenide, John Wiley and Sons.
2. S. M. Kang and Y. Leblebici, CMOS Digital integrated Circuits: Analysis and Design, TMH.
3. E. M. Levinshtein, S. L. Rumyantsev and M. S. Shur, Properties of Advanced Semiconductor Materials: GaN, AIN, InN, BN, SiC, SiGe. John Wiley & Sons.
4. B. Razavi, Design of Analog CMOS Integrated Circuits, Mc Graw Hill.
5. T. R. Hsu, MEMS & Microsystems, Design and Manufacturing, TMH.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	M	M	M	M	M
CO 2	L	M	M	M	M
CO 3	L		M	M	M
CO 4	L		M	M	M
CO 5	L	L	M	M	M

ECMC0127: MICROELECTRONICS: DEVICES TO CIRCUITS (L-T-P: 3-1-0)

(4 credits – 60 hours)

Objective

The objective of this course is to develop the ability to understand, analyse and design microelectronic circuits. The course starts with the basics of the devices mostly used for various designs and applications like BJT, FET, MOS transistors and then goes on to do various circuit analysis. The course also includes complex electronic circuits like the differential amplifier and introduction of feedback for various operations and applications. It also introduces students to designing concepts for analog and digital microelectronic circuits.

Course Outcomes

1. Define and explain the basic principles of various electronic devices and their operation. (Remembering)
2. Understand and explain how various electronic devices are used as electronic circuit components and their behavior. (Understanding)
3. Apply certain electronic devices, components and circuits for various applications. (Applying)
4. Analyze how electronic circuits work under various conditions. (Analyzing)
5. Evaluate and/or design electronic circuits for specific performance/applications. (Evaluating)

Module I (13 Hours)

Device Basics: *Bipolar Junction Transistor*: physical structure, modes of operation, circuit symbols and conventions, operation in active mode, BJT as an Amplifier, BJT as a switch.

Field Effect Transistor: JFET, structure and operation, MOS Transistor, types; I-V characteristics, CMOS inverter.

Module II (12 Hours)

Circuit Basics: Ebers Moll Model, BJT biasing; bias stability, Biasing of MOS Amplifier, CMOS Amplifier.General Feedback structure and properties of negative feedback, feedback topologies,.

Operational Amplifer: Basic structure and principle of operation, Open loop and closed loop concept, virtual ground, equivalent circuit, characteristics, transfer curve.

Module III (10 Hours)

Op amp applications: Inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, difference amplifier, precision rectifier, comparator, zero crossing detector, Schmitt trigger, active filters, DAC and ADC.

Module IV (10 Hours)

Circuit Analysis: Small signal analysis, frequency response of amplifiers, low frequency transistor models and analysis, High frequency transistor models and analysis, multistage amplifiers, differential amplifier.

MOS differential amplifier, power analysis, high frequency modelling.

Module V (15 Hours)

Circuit Design: Design of feedback amplifier, 1st and 2nd order filters: Low pass, High pass, Band Pass and Band Stop, design considerations, practical filter design.
Logic Design: Sequential logic design, combinational logic design.

Suggested Readings

1. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11 Publishing, Edition IV.
2. David A. Bell, "Electronic Devices and Circuits", Oxford.
3. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Pearson.
4. Jacob Millman, Christos C Halkias and Satyabrata Jit, Millman's Electronic Devices and Circuits, Tata McGraw Hill.
5. P. Ramesh Babu, Electronic Devices and Circuits, Scitech Publications Pvt. Ltd.
6. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M	L	M	L
CO 2	M	H	L	M	L
CO 3	L	L	H	L	M
CO 4	M	L	M	H	L
CO 5	L	M	M	M	H

ECES0128 EMBEDDED SYSTEMS (L-T-P: 3-0-0)

(3 credits – 45 hours)

Objective

To provide students with basic knowledge and skills in embedded systems design.

Course Outcomes

1. Define the fundamental concepts related to embedded systems. (Remembering)
2. Explain the internal organization of various microcontrollers. (Understanding)
3. Select various microcontrollers for different applications. (Applying)
4. Design and develop embedded systems. (Creating)

Module I (8 hours)

Introduction to Embedded Systems, Components of Embedded Systems, Features of Embedded System, Challenges in designing Embedded Systems, Categories of Embedded Systems, Importance of Microcontroller in Embedded System based system design

Module II (20 hours)

Fundamentals of Microcontrollers, Ingredients of microcontroller, Criteria for choosing microcontrollers, History of MCS51 family, Various versions of 8051 microcontroller, Architecture of 8051 microcontroller, Instruction Set of 8051 microcontroller, Programming of 8051 microcontroller, Interfacing of 8051 microcontroller with various peripheral devices, Timers, Serial Communication and Interrupt of 8051 microcontroller

Module III (12 hours)

Introduction to PIC Microcontroller, Comparison of various PIC families, Internal Organization of PIC16C61 microcontroller, Introduction to AVR Microcontrollers, Internal Organization of ATMega8 Microcontroller

Module IV (5 hours)

Introduction to advanced microcontrollers, recent technologies related to embedded system design, Design of embedded system

Suggested Readings

1. Shibu K V, Introduction to Embedded Systems, McGraw Hill
2. Muhammad Ali Mazidi. Janice Gillispie Mazidi. Rolin D. McKinlay., The 8051 Microcontroller And Embedded Systems Using Assembly And C, Pearson
3. A V Deshmukh, Microcontrollers : Theory and Applications, Tata McGraw-Hill Education
4. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, PIC Microcontroller And Embedded Systems Using Assembly And C, Pearson
5. Steven F Barett, Daniel J. Pack, Atmel AVR Microcontroller Primer: Programming and Interfacing, Morgan and Claypool

6. E resources and relevant datasheets

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	L	L	L
CO 2	L	H	H	H
CO 3	L	H	H	H
CO 4	L	M	M	H

ECBI0129 BIOINFORMATICS

(L:T:P: 3:0:0) (3 credit – 45 hours)

Objective

The objective of the course is to introduce students to the rapidly evolving field of bioinformatics. It will help the students to gain knowledge about various biological databases that provides information about biomolecules. It will also give in depth understanding of various techniques used in bioinformatics.

Course Outcomes

1. Recall the biological concepts. (Remembering)
2. Explain the fundamentals of bioinformatics. (Understanding)
3. Apply various techniques used in bioinformatics. (Applying)
4. Analyse and compare various aspects of bioinformatics. (Analysing)
5. Predict protein structure that helps in drug discovery. (Creating)

Module I (10 hours)

Introduction to bioinformatics and computational biology, Scope of bioinformatics, relation of bioinformatics with molecular biology, Fundamental concepts of biology such as nucleotide, amino acids, proteins, different structure of proteins, DNA, DNA Sequences, Cell, Chromosomes, Gene, Mutation, Genetic Polymorphism

Module II (15 hours)

The form of biological information, Introduction to Biological Databases: Nucleic Acid Databases (NCBI, EMBL, DDBJ,), Protein databases (Primary, Composite and Secondary), Specialized Genome Databases (SGD, TIGR), Structure Databases (CATH, SCOPE and PDBsum), Tools: FASTA, BLAST, BLAT, RASMOL

Module III (10 hours)

DNA sequence analysis, Sequence Based Parameters, DNA sequencing as a diagnostic tool

Module IV (10 hours)

a. Protein Structure and Function, Sequence Alignment, Protein Sequence Analysis, Protein Secondary Structure Prediction, Recent advancement in bioinformatics
b. Introduction to various bioinformatics Softwares: Acua, INCA, Anaconda, PAST3, CodonW
c. DNA Computing

Suggested Readings

1. Arthur M. Lesk, Introduction to Bioinformatics, Fifth Edition, Oxford
2. Jin Xiong, Essential Bioinformatics, First Edition, Cambridge University Press
3. David W. Mount, Bioinformatics: Sequence and Genome Analysis, First Edition, CBS
4. Relevant e resources

Mapping of COs to Syllabus

Course Outcomes	**Module 1**	**Module 2**	**Module 3**	**Module 4**
CO 1	H	L		
CO 2		H		
CO 3		M	H	
CO 4			M	H
CO 5			L	H

LABORATORY COURSES

ECED6034: ELECTRONIC DEVICES LAB

(L-T-P: 0-0-2) (1 Credit)

Course Outcomes

1. Label and demonstrate the working of electronic devices and tools used in the lab. (Remembering - Understanding)
2. Build simple electronic circuits and analyze their outputs. (Applying - Analysing)
3. Construct electronic circuits using different devices and components to assess certain operations. (Evaluating - Creating)

List of Experiments:

1. Study the Characteristics of PN junction Diodes.
2. Study the Characteristics of Zener Diodes.
3. Design half wave and full wave rectifiers using diodes and study various parameters.
4. Design various multiplier circuits using diodes and capacitors.
5. Design wave forming circuits or clippers using diodes.
6. Study Static Characteristics of a Bipolar Junction Transistor (CE Mode)
7. Study the Characteristics of JFET.
8. Series voltage Regulator.
9. Study of BJT as a switch.
10. Design of CE amplifiers using voltage divider biasing and plot and understand its response curve.

ECDS6035: DIGITAL SYSTEM DESIGN LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. List and recognize the various logic gate ICs and other components and instruments used in DLD lab. (Remembering)
2. Demonstrate the working and operation of hardware involved in designing and building of digital circuits. (Understanding)
3. Analyze practically different types of combinational and sequential circuits. (Analyzing)
4. Construct digital electronic circuits using different devices and components to assess certain operations. (Evaluating - Creating)

List of Experiments:

1. To study and verify the truth table of logic gates.
2. To realize half/full adder and half/full subtractor.
3. To convert a given binary number to gray code and given gray code to its equivalent binary number.
4. To verify the truth table of MUX and DEMUX.
5. To verify the truth table of one bit and four bit comparator using logic gates.
6. To study shift register in all its modes i.e. SIPO/SISO, PISO/PIPO.
7. Realization of 3-bit asynchronous counter and Mod-N counter design.
8. Realization of 3-bit synchronous counter design.
9. Truth table verification of flip-flops: (i) RS-Type, (ii) D-Type, (iii) T-Type, (iv) JK-Type.
10. Realization of 2:4 decoder and 4:2 encoder design.
11. Design and testing of Ring counter/ Johnson counter.

ECAC6036: ANALOG CIRCUITS LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Define the various terminologies and parameters related to operational amplifiers (741) and IC555. (Remembering))
2. Extend the theoretical knowledge to practical one. (Understanding)
3. Experiment with different types of circuits based on operational amplifiers and some specialized ICs. (Applying)

List of Experiments:

Any ten or more experiments from the following are to be performed depending on the no of laboratory classes.

1. Inverting, Non-Inverting amplifier using op-amp
2. Adder – Subtractor using op-amp

3. Integrator – Differentiator using op-amp
4. Comparator – Zero crossing detector using op-amp
5. Schmitt trigger using op-amp
6. Triangular wave generator using op-amp
7. Monostable or Astable multivibrator using op-amp
8. Active Filters– LPF 1st and 2nd order using op-amp
9. Active Filters- HPF 1st and 2nd order using op-amp
10. Digital to analog converter using op-amp
11. Analog to Digital converter using op-amp.
12. 555 Timer application as monostable or astable multivibrator
13. Instrumentation amplifier
14. RC phase shift oscillator using op-amp
15. Wein Bridge oscillator using op-amp

ECEL6037: ELECTRONIC MEASUREMENTS LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. List various measuring instruments used for measurement of electrical quantities. (Remembering)
2. Explain the correct procedure of using a C.R.O. (Understanding)
3. Apply different electronic measuring instruments for different measurement Applications. (Applying)
4. Compare performances of different type of measuring instruments to be applied for measurement of electrical quantities. (Analysing)
5. Choose and justify the proper measurement devices. (Evaluating)
6. Elaborate the different components involved in measurement. (Creating)

List of Experiments:

1. Extension of range of Ammeter.
2. Extension of range of Voltmeter.
3. Measurement of frequency using Lissajous Pattern.
4. Measurement of phase-angle using Lissajous Pattern.
5. Measurement of resistance by Wheatstone bridge method.
6. Study of Maxwell bridge circuit.
7. Measurement of frequency by Wien Bridge using Oscilloscope.
8. Measurement of Inductance by Anderson Bridge.
9. Study of Schering bridge circuit.
10. Study of LCR meter.
11. Study of Spectrum Analyser
12. Study the characteristics of transducers (RTD/Thermistor/Thermocouple).
13. Study the characteristics of (a) LDR and (b) Photodiode

ECDP6038: DIGITAL SIGNAL PROCESSING LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Identify the different MATLAB functions useful for DSP. (Remembering)
2. Classify a system design problem in various parts to be solved/ simulated in MATLAB. (Understanding)
3. Describe the various components/modules of the MATLAB program of a particular problem. (Understanding)
4. Apply mathematical skills and how these skills are important in writing MATLAB programs for DSP. (Applying)
5. Improve skill to simulate, design and analysis of different discrete time signals and signal processing techniques. (Creating)
6. Evaluate the simulated results. (Evaluating) CO 16: Justify the results with proper mathematical relationships. (Evaluating)

List of Experiments:

1. MATLAB code to generate different unitary discrete time signals.
2. MATLAB code for verification of sampling theorem, Demonstrate the effects of aliasing arising from improper sampling

3. MATLAB code to demonstrate the folding , time scaling and shifting with any k samples towards the right or left of any signal x[n].
4. MATLAB code to determine the Linear Convolution of any input signal x[n] with the impulse response h[n] i.e, y[n]=x[n]*h[n].
5. MATLAB code to determine the N-point DFT X(k) for any signal x[n] for N=L, N<L, and N>L, where L is the length of the signal also demonstrates the effect of the three different cases.
6. MATLAB code to determine the IDFT of complex DFT X(k).
7. MATLAB code to determine the Circular Convolution of any two signals x1[n] and x2[n] using matrix method and also using DFT and IDFT.
8. MATLAB program to determine the linear convolution using circular convolution of any two signals.
9. MATLAB program to demonstrate a simple FIR (Butterworth LPF, HPF, BPF and BSF) filter using different windows.
10. MATLAB program to demonstrate a simple FIR low-pass and high-pass filter using frequency sampling method.
11. MATLAB program to demonstrate a simple IIR (Butterworth LPF, HPF, BPF and BSF) filter.
12. MATLAB program to determine the autocorrelation of x[n] then the power spectral density (PSD) using DFT.
13. MATLAB program to determine the time response (unit impulse and unit step response) and frequency response of any recursive system.
14. Introduction to DSP (TMS3207613) board

ECEC6039: ANALOG ELECTRONIC CIRCUITS LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Define PN junction diode and their properties and uses. (Remembering)
2. Explain the working of basic electronic circuits such as transistors, diodes and amplifiers. (Understanding)
3. Build different circuits using diodes, transistors and OPAMPs. (Applying)
4. Analyse various amplifier and filter circuits. (Analysing)
5. Evaluate the performance of the 555 timer as a monostable and astable vibrator. (Evaluating)
6. Design amplifiers, integrators, oscillators and filter circuits using OPAMPs. (Creating)

List of Experiments:

1. To Study the Characteristics of Zener Diodes.
2. Study of the Half-wave and Full-wave rectifier circuits with and without capacitor filter
3. To Study the characteristics of a Bipolar Junction Transistor (CE Mode)
4. To design of CE amplifier and analyse the frequency response of the amplifier
5. To Study the Characteristics of JFET
6. Inverting and non-inverting op-amp amplifiers
7. Op-amp linear applications: adders, sub-tractors
8. Op-amp based active filters: Low Pass and High Pass
9. Instrumentation Amplifier
10. 555 timer applications: Monostable and Astable

ECBE6040: BASIC ELECTRONICS LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Classify and compare different passive and active electronic components and devices. (Understanding)
2. Apply the theoretical knowledge in developing different electronic circuits. (Applying)
3. Analyse the characteristics of different components like diodes, transistors, amplifiers and oscillators. (Analysing)
4. Evaluate and estimate the behavior of logic gates. (Evaluating)
5. Create and test electronic circuits using the components and devices studied in the course. (Creating)

List of Experiments:

1. Identification, Specifications, Testing of R, L, C Components; Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, LEDs; Study and Operation of Digital MultiMeter, Function / Signal Generator, Regulated Power Supply (RPS)

2. Study of Cathode Ray Oscilloscopes – Displaying and Determining Amplitude, Phase and Frequency of Sinusoidal Signals in CRO
3. To study the characteristics of a P-N Junction diode
4. To design a full wave bridge rectifier circuit with and without filter
5. To study the static characteristics of a BJT in CE mode
6. To study the static characteristics of a BJT in CB mode
7. To design an Inverting and Non Inverting amplifier using op-amp
8. To design a monostable and an astable multivibrator using 555 timer IC
9. To verify different logic gates
10. Realisation of simple logical expression using logic gates

ECAP6041: ADVANCED DIGITAL SIGNAL PROCESSING LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Find and demonstrate the particular methodology to be adopted for writing the various programs in MATLAB. (Remembering - Understanding)
2. Apply important mathematical skills in writing MATLAB programs for DSP. (Applying)
3. Examine the advance topics of digital signal processing in MATLAB. (Analyzing)

List of Experiments:

1. Basic Signal Representation
2. Different operations on discrete time signals
3. Linear and Circular convolution
4. Correlation Auto And Cross
5. Stability Using Hurwitz Routh Criteria
6. Sampling FFT Of Input Sequence
7. Butterworth Low pass And High pass Filter Design
8. Chebychev Type I, II Filter
9. State Space Matrix from Differential Equation
10. Normal Equation Using Levinson Durbin
11. Decimation And Interpolation Using Rational Factors
12. Maximally Decimated Analysis DFT Filter
13. Cascade Digital IIR Filter Realization
14. Convolution And M Fold Decimation & PSD Estimator
15. Estimation Of PSD
16. Inverse Z Transform
17. Group Delay Calculation
18. Separation Of T/F
19. Parallel Realization of IIR filter

ECDV6042: DIGITAL IMAGE AND VIDEO PROCESSING LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Perform basic gray and colour image processing operations as well as various image procession algorithms. (Applying)
2. Perform basic video processing algorithm and to calculate various features of image. (Applying)

List of Experiments:

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique

8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

ECWM6043: WIRELESS AND MOBILE COMMUNICATION LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Define the fundamental concepts of cellular communication like frequency reuse, cell splitting etc. (Remembering)
2. Outline concepts of GSM and CDMA architecture, network concepts etc. (Understanding)
3. Utilize GSM handset for various signalling techniques. (Applying)
4. Analyse transmitter and receiver sections in mobile handset, different modulation techniques etc. (Analysing)
5. Evaluate AT commands in 3G network. (Evaluating)
6. Discuss features of 3G communication systems such as transmission of voice and video calls, SMS etc. (Creating)

List of Experiments:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multipath environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.
3. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver sections in mobile handsets and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new applications using it.
6. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.
7. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
8. To learn and develop concepts of Software Radio in a real time environment by studying the building blocks like Baseband and RF section, convolution encoder, Interleaver and De- Interleaver.
9. To study and Analyse different modulation techniques in time and frequency domain using SDR kit.

ECMA6044: MICROCONTROLLER AND APPLICATIONS LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Apply the concept of 8051 microcontroller to write program using assembly language and embedded C language. (Applying)
2. Design systems using 8051 microcontroller. (Creating)

List of Experiments:

1. Introduction to various simulators used for 8051 microcontroller
2. Assembly language programming of 8051 microcontroller for arithmetic operations
3. Assembly language programming of 8051 microcontroller for logical operations
4. Introduction to development board of 8051 microcontroller
5. Interfacing of LED with 8051 microcontroller
6. Interfacing of Seven segment display with 8051 microcontroller
7. Interfacing of LCD interfacing with 8051 microcontroller
8. Interfacing of Keyboard with 8051 microcontroller
9. Interfacing of ADC with 8051 microcontroller
10. Assignment based on above mentioned experiments.

ECPM6045: PATTERN RECOGNITION & MACHINE LEARNING LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcome

1. Implement various tools such as maximum likelihood algorithm, Bayes classifier, linear regression, deep learning algorithm, linear discriminant algorithm,unsupervised learning. (Applying)
2. Design classifier using perceptron rule, feed forward back-propagation and delta rule, SVM. (Creating)

List of Experiments:

1. Implement maximum likelihood algorithm
2. Implement Bayes classifier
3. Implement linear regression
4. Design a classifier using perceptron rule
5. Design a classifier using feed-forward back-propagation and delta rule algorithms
6. Implement deep learning algorithm
7. Implement linear discriminant algorithm
8. Design a two class classifier using SVM
9. Design a multiclass classifier using SVM
10. Perform unsupervised learning

ECDE6046: DETECTION AND ESTIMATION THEORY LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Identify methods for detection and estimation of signals in white and non-white Gaussian noise. (Applying)
2. Analyse Signals and noise models. (Analysing)
3. Design optimal and suboptimal detection and estimation algorithms under realistic conditions. (Creating)

List of Experiments:

1. Simulate signal and noise models models.
2. Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3. Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4. Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5. Detect Constant amplitude Signal in AWGN
6. Detect Time varying Known Signals in AWGN
7. Detect Unknown Signals in AWGN
8. Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9. Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques

ECRS6047: ANTENNAS AND RADIATING SYSTEMS LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcome

1. Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
2. Understand and build the skills of subnetting and routing mechanisms. (Understanding)
3. Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation. (Understanding)
4. Apply mathematical foundations to solve computational problems in computer networking. (Applying)
5. Analyse performance of various communication protocols. (Analysing)
6. Compare routing algorithms. (Evaluating)
7. Design and develop protocols for Communication Networks and practice packet/file transmission between nodes. (Creating)

List of Experiments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.

5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.
9. Case study.

ECCN6048: ADVANCED COMMUNICATION NETWORKS LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
2. Understand and build the skills of subnetting and routing mechanisms. (Understanding)
3. Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation. (Understanding)
4. Apply mathematical foundations to solve computational problems in computer networking. (Applying)
5. Analyse performance of various communication protocols. (Analysing)
6. Compare routing algorithms. (Evaluating)
7. Design and develop protocols for Communication Networks and practice packet/file transmission between nodes. (Creating)

List of Experiments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
3. Configuring NIC's IP Address.
4. Determining IP Address and MAC Address using if-config command.
5. Changing IP Address using if-config.
6. Static IP Address and Configuration by Editing.
7. Determining IP Address using DHCP.
8. Configuring Hostname in /etc/hosts file.
9. Design TCP iterative Client and Server application to reverse the given input sentence.
10. Design a TCP concurrent Server to convert a given text into upper case using a multiplexing system called "select".
11. Design UDP Client Server to transfer a file.
12. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
13. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
14. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
15. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
16. Signaling and QoS of labeled paths using RSVP in MPLS.
17. Find shortest paths through the provider network for RSVP and BGP.
18. Understand configuration, forwarding tables, and debugging of MPLS.

ECDS6049: DSP ARCHITECTURE LAB

(L-T-P:0-0-4) (2 credits)

Course Outcomes

1. Recall and demonstrate the Code Composer Studio. (1-Remembering, 2-Understanding)
2. Develop the interfacing between MATLAB and Code Composer Studio (3-Applying, 6-Creating)
3. Simplify and explain the real time DSP problems with the help of DSP processor. (4-Analyzing, 5-Evaluating)

List of Experiments:

1. Introduction to Code Composer Studio-I

2. Introduction to Code Composer Studio-II
3. Introduction to the Addressing Modes
4. FFT and Bit Reversal Operation
5. FFT and its Applications
6. Audio Codec and its Applications
7. Real Time Data Exchange
8. FIR filtering by interfacing Matlab with Code Composer Studio
9. Introduction to Interrupts
10. Digital communication using Binary Phase Shift Keying

ECSA6050: EMBEDDED SYSTEMS AND APPLICATIONS LAB

(L-T-P: 0-0-4) (2 credits)

Course Outcomes

1. Perform various experiments using PIC and AVR microcontroller. (Applying)
2. Relate different peripheral devices with PIC and AVR microcontroller. (Analysing)
3. Evaluate the performance of various microcontroller based embedded systems (Evaluating)

List of Experiments:

1. Introduction to MPLAB and Embedded C.
2. LED interfacing with PIC Microcontroller
3. 7 Segment display interfacing with PIC Microcontroller
4. LCD interfacing with PIC Microcontroller
5. Keyboard interfacing with PIC Microcontroller
6. ADC and DAC interfacing with PIC Microcontroller
7. Serial Communication using PIC Microcontroller
8. Timer using PIC Microcontroller
9. Interrupt using PIC Microcontroller
10. Basic programming using AVR Microcontroller
11. Data Acquisition using LabView
12. Interfacing of Microcontroller with LabVIEW

ECMI6051: MINI PROJECT

(L-T-P: 0-0-4) (2 credits)

Objective

The Mini Project work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminars should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of a report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by the Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Course Outcomes

1. Choose various topics for self-learning (Remembering)
2. Explain different problems and recent trends related to the topic (Understanding)
3. Apply the knowledge to find out the solution of the problems related to the topic (Applying)
4. Compare various real life problems related to the topic (Analysing)
5. Evaluate various design problems related to the topic (Evaluating)
6. Develop oral and written communication skills to present and defend their work in front of technically qualified audience (Creating)

ECAC6052: ANALOG AND DIGITAL COMMUNICATION LAB

(L-T-P: 0-0-2) (1 Credit)

Course Outcomes

1. Design various carrier generation circuits as well as pulse modulation circuits. (Applying - Creating)
2. Design various analog modulation circuits and measure noise figure. (Applying - Creating)
3. Design various digital modulation circuits and PN Sequence Generator. (Applying - Creating)

List of Experiments:

1. Realization of Colpitt Oscillator using BJT.
2. Realization of Hartley Oscillator using BJT.
3. Realization of Amplitude Modulation Circuit.
4. Realization of Envelope Detector Circuit for AM demodulation.
5. Design and study of a sample and hold circuit.
6. To study and implement PPM using IC555 Timer.
7. Generation of ASK Modulation and Demodulation.
8. Generation of FSK Modulation and Demodulation.
9. Generation of PSK and DPSK Signals.
10. Study of QPSK Modulation and Demodulation.
11. Design of a PN Sequence Generator.
12. To Study the Measurement of Noise Figure.

ECMM6053: MICROPROCESSORS AND MICROCONTROLLERS LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Explain the concepts of microprocessor-kits, development boards and assemblers of 8085, 8086 microprocessors and 8051 microcontroller. (Understanding)
2. Apply the knowledge of programming to develop various systems. (Applying)
3. Compare programming techniques of various microprocessors and microcontrollers. (Analysing)
4. Assess various I/O devices for interfacing with microprocessors and microcontrollers. (Evaluating)
5. Elaborate the performance of 8085, 8086 microprocessors and 8051 microcontroller. (Creating)

List of Experiments:

1. Perform Arithmetic (Addition, Subtraction, Multiplication and Division) and Logical (AND, OR, XOR and Complement) operation using 8085.
2. Perform Data sorting in an Array of numbers using 8085.
3. Binary to Gray and Gray to Binary Conversion using 8085.
4. ALP based on 8085 for delay subroutine.
5. ALP to add, subtracts, multiply and divide of one byte and two byte nos. using 8086.
6. ALP to perform AND, OR, NOT of one byte and two byte numbers using 8086.
7. Find two's complement of a number using 8086.
8. ALP to display a message without an array and using an array using 8086.
9. ALP to read a character and display the character using 8086.
10. ALP to find some mathematical expression using 8051.
11. ALP to find some logical expression using 8051.
12. Interfacing with Traffic Light controller and Stepper motor Controller using 8085.
13. ALP to interface LEDs, 7 Segment display and LCD using 8051/ AVR microcontroller.

ECMI6054: MINI PROJECT

(L-T-P: 0-0-2) (1 Credit)

Objective

The objective of this course is to train the students to design, simulate or study mini electronic systems which will give them hands on experience in re-creating the principles they have studied in their engineering classes. This is electronic product design work with a focus on electronic circuit design.

Guideline:

1. The mini-project is a team activity having 3-4 students in a team.

2. After interactions with the course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of the mini-project.
3. Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within the first week of the semester.
4. Mini Project should cater to a small system required in laboratory or real life.
5. The mini project may be a complete hardware or a combination of hardware and software. The software part in the mini project should be less than 50% of the total work.
6. It should encompass components, devices, analog or digital ICs, micro controllers with which functional familiarity is introduced.
7. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Course Outcomes

1. Choose a problem statement either from rigorous literature survey or from the requirements raised from need analysis. (Remembering)
2. Construct the prototype/algorithm in order to solve the conceived problem. (Applying)
3. Analyse the performance of the electronic system. (Analysing)
4. Evaluate the prototype/algorithm. (Evaluating)
5. Compile report on mini project work. (Creating)

ECEW6057: ELECTROMAGNETICS WAVES LAB

(L-T-P: 0-0-2) (1 credit)

Course Outcomes

1. Apply the theoretical knowledge for measuring different parameters experimentally. (Applying)
2. Analyze and test the characteristics and performances of different components, devices and circuits using standard test bench. (Analysing)
3. Model electromagnetic structures, waveguides and antennas in associated software. (Creating)

List of Experiments:

1. To determine an unknown impedance using VSWR/Smith chart.
2. Determine the frequency and wavelength in a rectangular waveguide working on TE10 mode
3. To study the characteristics of wave propagation in a waveguide by studying standing wave patterns for (a) Short circuit, (b) Open circuit and (c) Matched termination.
4. Determine the SWR and reflection co-efficient in a rectangular waveguide
5. Study of the reciprocity theorem for antennas, the variation in the radiation strength at a given distance from the antenna and to perform polarization test
6. Write a MATLAB code to find the following: (a) Vector R_{MN}, (b) Dot product of R_{MN} and R_{PM}, (c) projection of R_{MN} on R_{PM}, (d) angle between R_{MN} and $R_{PM.}$ Given the points M(0.1, -0.2, -0.1), N(-0.2, 0.1, 0.3), P(0.4, 0, 0.1).
7. Two perfect dielectrics have relative permittivities ε_{r1}=3 and ε_{r2}=6. The planar interface between them is the surface x+y+2z =1. The origin lies in region 1. If E1=24.0a_x + 36.0a_y + 42.0a_z V/m, write a MATLAB code to find field E_2.
8. A point charge Q=0.1μC is located at the origin. Write a MATLAB program to plot the electric flux lines in the three dimensional space.
9. Create a default open ended rectangular waveguide. Vary its properties and display it. Plot the E and H field distribution of this waveguide at 2.1GHz.
10. Create and view a default circular waveguide. Plot the s-parameters and impedance of the waveguide.
11. Create a dipole antenna of length 3m and width 0.5m and then plot its radiation pattern in both polar and rectangular coordinate systems. Visualize 2D slices from 3D data. Also calculate the HPBW and FNBW from the plot.
12. Create and view a monopole of 1 m length, 0.02 m width and ground plane of dimensions 2.8m x 2.8m. Plot the radiation pattern for a frequency of 75MHz.

ECDI6059: DISSERTATION PHASE–I

(L-T-P: 0-0-20) (10 credits)

Objectives

During this phase the student will start a research project applying the knowledge acquired during the first two semesters and also incorporating the recent trends in the chosen area. It should include phases of design, implementation and reporting. This

project is to be executed individually within or outside the campus. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester

Course Outcomes

1. Select a project of interest. (Remembering)
2. Defend the topic of interest for continuing work, by doing initial studies on it. (Understanding)
3. Prepare a working methodology for the project for its successful completion.(Applying)
4. Design and experiment on the selected project. (Analysing)
5. Devise tools and methods for experimenting and troubleshooting for getting expected outcomes. (Evaluating)
6. Explain, justify and defend the project work by presenting the work and writing a report. (Creating)

ECDI6060: DISSERTATION PHASE–II

(L-T-P: 0-0-32) (16 credits)

Objective

During this phase the student will carry forward and complete the work that they have started in Phase I. It is expected that the student will publish at least one research paper in a well-known journal to augment their work during this phase. Published papers will carry extra weightage during evaluation. The mode and components of evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

Course Outcomes

1. Define the problem encountered in Phase-I. (Remembering)
2. Explain the working model of the proposed work. (Understanding)
3. Apply mathematical skills and how these skills are important in engineering. (Applying)
4. Contrast different problems encountered in designing a system. (Analysing)
5. Interpret knowhow on the topic selected for the project. (Evaluating)
6. Contrast on limitations of the system designed. (Creating)

ECPR6061: PROJECT-I

(L-T-P: 0-0-2) (1 credits)

Objective

During the last year of their study, B. Tech. students are required to take up a major project. This may be an individual project or a group project. The Major Project is an integral learning experience that encourages students to break away from the compartmentalization of the different courses they have studied during the three years of their study and aims to provide opportunities to explore the inter-relationships and interconnectedness of the various courses and gather them together into a single learning experience.

The major project focuses upon the following:

- Interdisciplinary: The major project provides a platform for students to apply the knowledge and skills acquired from different courses.
- Collaboration: It encourages students to work in groups over an extended period of time. They clarify the task, plan their work, share the responsibilities and work towards the successful completion of the project.
- Process and Product: Project work focuses on both process and product. The process would include collaboration, gathering and processing of information. The product may take the form of a working model, a complete software package, etc.
- Written and Oral presentation: Project work provides students with opportunities to present their findings as a written thesis in a prescribed format and orally with an intended audience and purpose in mind.

During the first phase in the seventh semester, students are expected to choose the project, prepare a synopsis under the guidance of a project supervisor appointed by the department, present the synopsis to the committee set up for the purpose, get approval for the synopsis and start the project work. Students are expected to submit weekly activity reports and present a progress seminar during this phase. They will also undergo a viva voce examination, in which they will be examined on all the basic areas of the discipline in which they have chosen their project.

Course Outcomes

1. Define the problem statement for the project work. (Remembering)

2. Classify the whole project work in various modules. (Understanding)
3. Construct software implementation skills and design skills. (Applying)
4. Simplify different problems encountered in designing a system. (Analysing)
5. Recommend a model for the second phase of the project. (Evaluating)
6. Test for the results with proper mathematical modelling. (Creating)

ECTS6062: TRAINING SEMINAR
(0-0-4)

ECPR6063: PROJECT-II
(L-T-P: 0-0-9) (3 credits)

During the second phase students are expected to focus on the process and completion of the projects and prepare project reports under the guidance of the Supervisors. The internal assessments shall be evaluated by the Departmental Project Evaluation Committee (DPEC) and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester. The External assessment shall have the following components:

- Project Implementation: 40 marks
- Seminar presentation: 20 marks
- Viva voce examination: 20 marks
- Project documentation: 20 marks

Course Outcomes

1. Define the problem encountered in Phase-I. (Remembering)
2. Demonstrate the various components/modules of the project. (Understanding)
3. Analyse different problems encountered in designing a system (Analysing)
4. Develop technical writing and communication skills. (Applying)
5. Design and evaluate the performance of electronic system (Evaluating - Creating)

ECNT6064: COMPUTER NETWORKS LAB
(L-T-P: 0-0-2)(1 credit)

Course Outcomes

1. Choose suitable tools to model a network and understand the protocols at various OSI reference levels.(Applying)
2. Design a suitable network and simulate using a Network simulator tool.(Creating)
3. Model the networks for different configurations and analyze the results.(Evaluating - Creating)

List of Experiments:

1. Study of Network Devices in detail.
2. Familiarization of network environment, understanding and using network utilities: ipconfig, ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute.
3. Connect the computers in local area network.
4. Configure a network topology using packet tracer software.
5. Implementation of concurrent server using connection-oriented socket system calls.
6. Implementation of concurrent server using connection less socket system calls.
7. Implementation of iterative server using connection-oriented socket system calls.
8. Implementation of iterative server using connection less socket system calls.
9. Implementation of Linked State Routing Algorithm.
10. Implementation of Distance Vector Routing Algorithm.
11. Introduction to Wireshark.
12. Wireshark as a network protocol analyser.

ECSL0200 SERVICE LEARNING
(2 credits – 30 hours)

Objective

Service Learning is an experience-based approach to education. It is a course-based service experience that produces the best outcomes when meaningful service activities are related to the course material through reflection and critical inquiry. It deepens and enriches the theoretical and conceptual side of learning. Service Learning combines – Academic Instruction, Meaningful Service and Critical and Reflective thinking.

Module I (15 Hours)

Introduction to service learning-Its philosophy, historical background, purpose, value& theoretical framework; Locating Service Learning within the University context, elements of service learning, Historical context of University Community Partnership; Understanding Community &Community Partnership; Ethical understanding of partnership; Understanding the agency of the Community – as co-educators; Community barriers; Understanding of society & social issues; Culture and Power Dynamics; Power & Privilege; social responsibility and community engagement

Module II (15 Hours)

Introduction to applicability of Electronics & Communication in various fields; Identification and use of electronic components, concepts of voltage and currents, use of different instruments: digital multimeter, soldering iron, PCB, tester, etc., designing electronic circuits: power supply, Solar-LED lamps, water level indicator system, smoke detector, agricultural monitoring and controlling circuit, experiments using drones, IoT, Utility of Nanotechnology etc.

VALUE ADDED COURSES

ECES6064: ELECTRONIC DISPLAY SYSTEM

(L-T-P: 2-0-0) (2 credits – 30 hours)

Objective

The objective of this course is to introduce the students to opto-electronic devices that are used to make advance display units. This course will also provide an exposure to interfacing of these display devices based on LED.

Course Outcomes

1. Explain and experiment with LED based display system. (Understanding - Applying)
2. Make use of Embedded Systems and its related applications. (Applying)
3. Design electronic displays. (Creating)

Module I (10 hours)

Fundamentals of LED: Introduction to PN Junction Diode, Construction and working of LED, Types of LED, Advantage, Disadvantage and Applications, 7 segment display, LED Dot Matrix Display, Tricolor LED – Construction and Working, LCD. Fundamentals of Microcontroller: 8051 Microcontroller, Basic and Advanced Microcontroller Boards.

Module II (20 hours)

Glowing of various patterns in LED using microcontroller, Microcontroller based up counter and down counter design using LED and 7 segment displays, Displaying of Names in different format using LCD, designing of rolling display using LED and LCD. Implementation of display devices in projects.

Suggested Readings

1. Electronic Devices and Circuits Theory, Boylestead and Nashelsky, 9th Edition, Prentice Hall India, 2007.
2. Electronic Devices and Circuits, Salivahanan et al., 2nd Edition, Tata McGraw Hill, New Delhi, 2008.
3. The 8051 Microcontroller And Embedded Systems Using Assembly And C, Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay,Pearson
4. Microcontrollers : Theory and Applications, A V Deshmukh, Tata McGraw-Hill Education

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2
CO 1	H	M
CO 2	H	H
CO 3	H	H

ECNA6065: NANOTECHNOLOGY and APPLICATIONS

(L-T-P: 2-0-0) (2 credits – 30 hours)

Objective

This course will introduce the students to Nanotechnology. The course is designed to build up a basic understanding of the nano concepts. It will provide the students the knowledge of synthesis of nanomaterials, their characterization techniques as well as touch upon some applications of nanotechnology.

Course Outcomes

1. Define various terms such as nanotechnology, nanoelectronics, nanoscience etc. (Remembering)
2. Explain the operations of various characterization tools. (Understanding)
3. Apply the synthesis process to fabricate various nanostructures. (Applying)
4. Analyze various nanostructures. (Analysing)
5. Evaluate nanomaterials using characterization techniques. (Evaluating)

Module I (17 hours)

Introduction to Nanotechnology, Basics of Material science and Nanoscience, Poor Man's Nanotechnology, Introduction to Characterization Techniques-I, Synthesis of nanomaterials, ImageJ, Origin and Lab Rules, Nano electronics: Novel device fabrication and characterization.

Module II (13 hours)

Introduction to Characterization Techniques – II, Optical properties of nanomaterials, Nano Bioscience, Issues of Nanotechnology, Characterization results, Applications of Nanotechnology.

Suggested Readings

1. G. L. Hornyak, J. Dutta, H. F. Tibbals, A. Rao Introduction to nanoscience, CRC Press

2. G. L. Hornyak, J. Dutta, H. F. Tibbals, A.Rao Introduction to nanotechnology CRC Press
3. T. Pradeep, Nano: The Essentials McGraw Hill
4. G. W. Hanson, Fundamentals of Nanoelectronics, Pearson
5. D. Maclurcan and N. Radywyl (Eds.) Nanotechnology and Global Sustainability CRC Press
6. E. Lichtfouse, J. Shwarzbauer, D. Robert, Environmental Chemistry for a Sustainable World, Vol.2 Springer Verlag

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2
CO 1	H	M
CO 2	H	M
CO 3	H	M
CO 4	M	H
CO 5	M	H

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To establish the department as a hub of quality technical education and research for aiding the industry and to strive for the upliftment of the North East Region and nation as a whole.

MISSION

- To train the youth to be intellectually competent with strong fundamentals in Mechanical engineering.
- To create an environment for carrying out fundamentals and interdisciplinary research to address the future needs and challenges of a society and the industry.
- To cultivate strong moral values and professional ethics to build them as responsible and environmentally conscious citizens.
- To motivate, nourish and mould the students to be dynamic leaders and entrepreneurs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

1. To develop the ability to design a system, component or process to meet the social and industrial requirements within realistic constraints.
2. To achieve a high level of technical expertise through extensive project work, experiments, industrial visits and regular symposiums.
3. To inculcate professional ethics, leadership qualities and inherent creative instincts in students.
4. To encourage lifelong learning and to foster the ability to function on multi-disciplinary teams.

PROGRAM SPECIFIC OUTCOMES (PSOS)

1. To develop the ability to apply the concept of Mechanical engineering for design, development, manufacturing, analysis and maintenance of mechanical systems and processes.
2. To understand and demonstrate the key concepts related to entrepreneurship, professionalism, effective communication, shop floor management, project management and economics.

MAPPING OF PO, PSO'S VS COURSES

Course	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CHCE0027	M	L		L		M	M		M	M		L	H	M
MACL0012	L	H	M		M	M		M	H	M	M	M		M
EEBE0038	M	M	L						M				M	
MNWM6023					H				M			H	L	H
PSPT0040	H	M	L										M	
MAIN0013	L	H	M		M	M		M	H	M	M	M		M
LSEH0017								L		H		L		
CSPS0079	M	H	M							M	L	L	M	
CSPL6069	M	M	M		M				L	M	L	M	M	
PSEG6017	H	M	M									L	M	L
CVED6024	M		L	L	L				L	H	L		M	L
LSOC6004								L		M		L		
PSW00052	H	M	L							L			M	
MACP0029	L	H	M		M	M		M	H	M	M	M		M
BOBE0002	L		M	M	L	M	H	L	M		H	M		M
ECEE0052	H	M	M		L							H	M	
MNEM0034	H	M										L	H	
MNBT0035	M	M	L									M	M	

MNMD6024	M					M				M		M		M
BTIA8		L	L			M	L	L	M					
MNAP0036	H	M	M				M					L	H	L
MNFM0037	M	L	L										H	
MNSM0038	M	L	L									L	H	
MNSE0039	H	M	L			L						M	L	L
MNIC0040	H	M	M			L	L					L	H	M
CHES0029		M	H	L		M	H	L	L		H			M
MNMF6025	H	M	L						M				M	
MNHT0041	H	M	L									M	M	
MNDM0042	H	M	H	H					M		H		H	
MNMP0043	M	M	M		M	L							M	M
MNKT0044	H	M	M									M	M	M
MTEC0074			L	H			L				M			
MNFT6026	H	M					M						M	
MNMI6027	H	H	M	M	M	L	L	H	H	H	M	L	H	M
MNMT0045	H	H	H	M	M								M	M
MNDD0046	H	H	H				M		M			L	H	L
MNHM0047	M	M	M		M	L	L						M	M
MNMP0048	M						M					H	M	M
MNCM0049	M		M			M	L						M	
MNIC0050	M		L			L	M						M	
MTFP0070			L	H			L				M			
MNDS6028	H	L	L				M		L				M	
MNAM0051	M	M	H		H		L						M	M
MNRC0052	M	L	L				L						M	
MNSE0053	M	L				M	M						M	
MNSN0054	H	M	L	L									H	M
MNER0055	H	L	M				M						M	
MNAE0056	H	M	M		M	L	M						M	M
MNPE0057	H	L	M				L						M	
MNQM0058	L	L	L	M							L		M	
MNCA0059	H				M							H	M	H
MNSG0060	H	M	L									M	M	
MNWT0061	M	L	L										M	L
MNGT0062	L	L	M			M							M	L
MNMO0063	H	H	H	M		L								M
MNRA0064	M	M	M				L						M	
MNMP6029 & MNMP6031	H	H	M	H	M	L	M	H	H	H	M	M	H	H

DETAILED SYLLABUS

MNEM0034: ENGINEERING MECHANICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objective

To develop the ability of the engineering students to Analyse physical engineering problems in a simple and logical manner; to apply the basic principles and concepts of mechanics to obtain a feasible solution and reach a conclusion. To understand the kinetics and dynamics of motion and concept of vibration and its effect on a system.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define various principles, definitions, theorems related to mechanics.
2. Compare and identify the various types of beams, frames and the effect of different loading on them
3. Apply the concept of virtual work for relevant problem solving
4. Analyse the different truss and frames for its suitability considering various given constraints.
5. Appreciate the importance of the knowledge of vibration and its effect on a system
6. Solve various simple day to day life problems within the applicable constraints and communicate the solution effectively.

Module I (9 hours)

a. Force Systems Basic concepts, Particle equilibrium in 2-D and 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.
b. Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack and differential screw jack.

Module II (8 hours)

Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams and types of beams; Frames and Machines.

Module III (8 hours)

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module IV (8 hours)

Virtual displacements, principle of virtual work for particles and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy(elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module V (9 hours)

a. Particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).
b. Introduction to Kinetics of Rigid Bodies- Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Module VI (8 hours)

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums

Suggested Readings

1. Mariam and Craig, Engineering Mechanics, Wiley.
2. S. Timoshenko and D.H. Young, Engineering Mechanics McGraw Hill Int

3. R.K. Bansal, Engineering Mechanics, Laxmi Publication (P) Ltd.
4. K.L. Kumar, Engineering Mechanics, McGraw Publishing Co.
5. Irving H. Shames , Engineering Mechanics, 4th Edition, Prentice Hall (2006)
6. F. P. Beer and E. R. Johnston , Vector Mechanics for Engineers, Vol I - Statics, Vol II, Dynamics, 9th Ed, Tata McGraw Hill (2011).
7. Shanes and Rao , Engineering Mechanics, Pearson Education (2006).
8. Hibler and Gupta , Engineering Mechanics (Statics, Dynamics) by Pearson Education (2010).
9. Khurmi R.S. , Engineering Mechanics, S. Chand and Co (2010).
10. NPTEL LINK: https://nptel.ac.in/courses/112/105/112105164/
11. NPTEL LINK: https://nptel.ac.in/courses/112/106/112106286/
12. NPTEL LINK: https://nptel.ac.in/courses/112/103/112103109/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO1	H		M		L	
CO2		H				
CO3				H		
CO4		H				
CO5						H
CO6	L	M	H		M	

MNBT0035: BASIC THERMODYNAMICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the working of petrol and diesel engines.

Course /Learning Outcomes:

After completing the course successfully the students will be able to

1. define thermodynamic system, properties, processes and various terms related to properties of pure substances
2. apply the concept of 1st and 2nd law to a wide range of systems.
3. evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations
4. classify and compare various types of IC engines

Module I (15 hours)

Fundamentals - System and Control volume; Property, State and Process; Exact and Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers. Definition of heat; examples of heat/work interaction in systems. First Law for Cyclic and Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; various modes of energy, Internal energy and Enthalpy.

Module II (15 hours)

a. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.
b. Second law : Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Carnot's theorem, Corollary of Carnot theorem, Absolute thermodynamic temperature scale, Clausius theorem; Definition of entropy S ; Demonstration that entropy S is a property; Inequality of Clausius, Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles. Irreversibility and

Availability, Availability functions for systems and Control volumes undergoing different processes, Lost work. Second law efficiency.

Module III (10 hours)

Definition of Pure substance, p-v diagram, p-T diagram, p-v-T diagram, T-s diagram for a Pure Substance, h-s diagram or Mollier diagram, Dryness Fraction, Charts of Thermodynamic Properties. Equation of State of a Gas, Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy of an Ideal Gas, Equations of State, Compressibility Charts, Properties of Mixtures of Gases-Dalton's law of Partial Pressures, Internal Energy, Enthalpy and Specific Heats of Gas Mixtures.

Module IV (10 hours)

Definition of Engine, classification of IC Engines, Performance Parameters, Working principle of 4-stroke and 2-stroke engine, Petrol Engine, Diesel Engine, Comparison between Petrol and Diesel Engine.

Suggested Readings

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, John Wiley and Sons, 6th Edition, 2003.
2. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India,1996.
3. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons, 1999.
4. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd, 1995.
5. https://nptel.ac.in/courses/112/105/112105266/ Concepts of thermodynamics [IIT KGP}
6. https://nptel.ac.in/courses/112/105/112105220/ Laws of Thermodynamics [IIT KGP}
7. https://nptel.ac.in/courses/112/105/112105123/ Basics Thermodynamics {IIT KGP}

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	M	H	L
CO2	H	H	M	
CO3		H		
CO4				H

MNAP0036: APPLIED THERMODYNAMICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:

- To learn about the operating parameters of vapour power cycles.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn about reciprocating compressors with and without intercooling.
- To Analyse the performance of steam turbines.

COURSE/ LEARNING OUTCOMES

After completing the course successfully the students will be able to-

1. Define the thermodynamic processes of Rankine cycle.
2. Illustrate the mathematical equations to solve thermodynamics problems.
3. Compute the performance and characteristics of reversible thermodynamic cycles.
4. Analyze thermodynamic problems with application to steam power plant and refrigeration systems.

Module I (10 hours)

a. Simple Steam Power Cycle, Rankine Cycle, Actual Vapour Cycle Processes, Comparison of Rankine and Carnot Cycles, Mean Temperature of Heat Addition, Reheat Cycle, Regeneration- Open Feedwater Heater, Reheat-Regenerative Cycle, Characteristics of an Ideal Working Fluid, Binary Vapour Cycles.
b. Gas power cycles, Air standard Cycles- Otto, Diesel and Dual cycles, Comparison of Otto, Diesel and Dual Cycles, Brayton cycle, effect of reheat, regeneration and intercooling.

Module II (10 hours)

Reversed Carnot Cycle, Unit of Refrigeration, Limitation of Reversed Carnot Cycle, Gas Refrigeration Cycle, Vapor compression refrigeration cycles, p-h diagram. Properties of Atmospheric Air, Psychrometric Properties of Air, Pyschrometric Chart.

Module III (10 hours)

Velocity of Pressure Pulse in Fluid, Stagnation properties, Mach Number, Property Relations for Isentropic Flow through a Duct, One Dimensional Steady Isentropic Flow, Critical Properties- Choking in Isentropic Flow, Normal Shocks, use of ideal gas tables for isentropic flow and normal shock flow, Flow through Actual Nozzles and Diffusers, Effect of Irreversibilities on Nozzle Efficiency.

Module IV (10 hours)

a. Classification, Reciprocating Compressor Terminology, Work of Compression, Single stage Reciprocating Air Compressor, Volumetric Efficiency, Limitations of Single Stage Compression, Multistage Compression.
b. Classification of Steam Turbines, Simple Impulse Turbine, Optimum Operating Conditions from Blade-Velocity Diagram, Effect of Blade Friction on Velocity Diagram, Compounding of Impulse Turbine, Reaction Turbine, Comparison between Impulse and Reaction Turbines, Losses in Steam Turbines.

Module V (10 hours)

Characteristics of an Ideal Fuel, Liquid Fuel, Gaseous Fuel, Combustion, Amount of Air Required for Combustion, Air-Fuel Ratio, Air-Fuel Ratio from Analysis of Flue Gases, Heat Generated by Combustion, Standard Reference State, Enthalpy of Formation, Enthalpy of Reaction, Calorific value of Fuel.

Suggested Readings

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., Fundamentals of Thermodynamics, John Wiley and Sons,6th Edition, 2003..
2. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India, 1996.
3. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons,1999.
4. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd., 1995.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1	H			L	
CO2	H	H	M	H	L
CO3	H	H	L		
CO4		H		H	

MNFM0037: FLUID MECHANICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objective

This is an introduction in mechanics of fluid motion. It is designed to establish fundamental knowledge of basic fluids mechanics and hydraulic machines. It addresses specific topics relevant to simple applications in the field of fluids as well hydraulics machines.

Course/Learning Outcomes

At the end of the course students will be able to:

1. CO1: Define types of fluid and flow, the properties of fluids, basic law of fluid mechanics, basic fundamental theories of fluid mechanics, types of turbines, pumps and various hydraulic equipment, function and characteristic of hydraulics machines. (Remembering)
2. CO2: Explain different types of fluids, types of fluid flow, fundamental law of fluid mechanics, basic fundamental theories of fluid mechanics, various fluid mechanic equipment and hydraulics machines (Understanding)
3. CO3: Apply fundamental concepts of fluid mechanics and hydraulic system to engineering application. (Applying)
4. CO4: Solve problems of fundamental law of fluid mechanics and work done and various efficiencies of turbines, pumps and hydraulic machines. (Applying)
5. CO5: Analyze fluid flow problems by fundamental fluid mechanics laws, dimensional analysis and model analysis. (Analyzing)

Module I (6 hours)

Definition of fluid, Units and dimensions-Properties of fluids, Pascal law, Pressure measurement manometer, types of manometer and its application, Newton's law of viscosity, Forces on submerged plane and curved surfaces, buoyant force, metacentre, centre of buoyancy, equilibrium of floating and submerged body.

Module II (11 hours)

Types of fluid flow: steady, unsteady, uniform, non uniform, laminar, turbulent, compressible, incompressible, rotational, irrotational, one, two, three dimensional flows, velocity, acceleration, Velocity potential function, Stream function. Control volume- application of continuity equation and momentum equation, flow net, Vortex flow Bernoulli's equation and its applications to Venturimeter, Orificemeter and Pitot tube and Notches.

Module III (15 hours)
Exact flow solutions in channels and ducts, Laminar flow, Velocity distribution, mean velocity, velocity profile Kinetic energy factor and momentum Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli. Turbulent flow: Reynold's experiment, laws of fluid friction, shear stress, types of boundary, Prandtl length concept, velocity distribution, mean velocity, velocity profile, resistance to flow in smooth and rough pipes, Darcy Weisbach equation, friction factor, Moody's diagram.

Module IV (7 hours)
Concept of boundary layer, laminar boundary layer, turbulent boundary layer, Laminar sub layer, Boundary layer thickness, displacement thickness, momentum thickness, energy thickness. Flow around submerged bodies- Introduction to concept and expression of drag and lift, pressure drag and friction drag, Streamlined and Bluff bodies.

Module V (4 hours)
Need for dimensional analysis, Buckingham's pi theorem and its application. Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

Module VI (9 hours)
Euler's equation – theory of Rotodymanic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.

Module VII (8 hours)
Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines.

Suggested Readings
1. Sukumar Pati, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill.
2. Dr. R.K. Bansal, Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.
3. R.K Rajput, Textbook on Fluid Mechanics and Hydraulic Machines, S. Chand.
4. Y. A. Cengel, Fluid Mechanics Fundamentals and Applications, Tata McGraw Hill.
5. P.N. Modi and S.M. Seth, Hydraulics and fluid Mechanics including hydraulics machines, Standard Book House.
6. NPTEL course: Introduction to Fluid Mechanics By Prof. Suman Chakraborty https://nptel.ac.in/courses/112/105/112105269/
7. NPTEL course: Fluid Mechanics By Prof. S.K. Som https://nptel.ac.in/courses/112/105/112105171/

Mapping of COs to Syllabus

Course Outcomes	Module1	Module2	Module3	Module4	Module5	Module6	Module7
CO1	H	M	L	H	M	M	M
CO2	M	H	M	L	L	M	M
CO3	M	M	L	L	M	H	H
CO4	L	L	M	M	H	M	M
CO5	L	H	H	M	M	H	H

MNSM0038: STRENGTH OF MATERIALS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:
- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

Course/Learning Outcomes
1. Define and relate basic definitions of important terminologies used to characterize solid mechanics problems. (Remembering)

2. Explain various loading conditions and stress regimes prevalent under various loading and boundary conditions. (Understanding)
3. Solve various problems related to stresses in beams, cylinders, columns and prismatic bodies subjected to combinations loading. (Applying)
4. Analyse various stress states using both analytical and graphical techniques. (Analysing)

Module I (8 Hours)
Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

Module II (8 Hours)
Beams and types transverse loading on beams- shear force and bend moment diagrams-Types of beam supports, simply supported and overhanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Module III (8 Hours)
Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Module IV (8 Hours)
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Module V (8 Hours)
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Suggested Readings
1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1	H	M	L		L
CO2		H	M	L	M
CO3		H	H	M	H
CO4		H	L	H	H

MNSE0039: MATERIAL SCIENCE AND ENGINEERING

(3 Credits-45 hours)(L-T-P: 3-0-0)

Objectives:
- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course/ Learning Outcomes
At the end of the course students will be able to:
1. Understand the basic concepts and crystal properties of material.
2. Evaluate the different properties of material by studying different tests.
3. To quantify mechanical integrity and failure in materials.
4. To understand variation in structure of different metallic System with variation in composition and heat treatment procedures.
5. Study the alloying and high temperature behaviour of superalloys.

Module I (6 hours)

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Module II (6 hours)
Mechanical Property measurement: Tensile, Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Module III (8 hours)
Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress- life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT)

Module IV (6 hours)
Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Module V (6 hours)
Heat treatment of Steel: Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Module VI (8 hours)
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro- nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Suggested Readings
1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.
5. NPTEL LINK: https://nptel.ac.in/courses/113/106/113106032/
6. NPTEL LINK: https://nptel.ac.in/courses/113/107/113107078/
7. NPTEL LINK: https://nptel.ac.in/courses/112/108/112108150/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO1	H	M	L			
CO2	M	H				
CO3			H			
CO4				H	H	
CO5					M	H

MNIC0040: INSTRUMENTATION AND CONTROL

(3 Credits-45 hours)(L-T-P: 3-0-0)

Objectives
This course aims provide a basic knowledge about measurement systems and their components. The course would also help students to learn about various sensors used for measurement of mechanical quantities, system stability and control. Integration of the measurement systems with the process for process monitoring and control is also introduced in this course.

Module I (10 hours)

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements. Mechanical and Electromechanical sensor: Resistive (potentiometric type), Strain gauge, Inductive sensor, LVDT, Proximity sensor, Capacitive sensors, Stretched diaphragm type, Piezoelectric, Thermal sensors: Material expansion type: solid, liquid, gas and vapor, Resistance change type: RTD materials, tip sensitive and stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermoemf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type, Magnetic sensors, Introduction to smart sensors.

Module II (12 hours)

Signal Processing and conditioning: Processing of the analogue measurement signals- Signal conditioning, filtering, amplification. Digital processing of the measurement signals-A/D and D/A conversion, DFT and FFT, Digital filters. Final control elements: Actuators-Solenoid, motors as actuators, spring and diaphragm actuator, direct action pneumatic actuator and hydraulic actuators. Control system basic elements: Basic block diagram of a control system. Conversion of an electrical circuit into a block diagram. Types of control systems: Automatic process control, Batch and Continuous process, Self regulation, Servo and Regulator operation. Examples of feedback control systems: OpAmp with positive and negative feedbacks.

Module III (8 hours)

Control method – Performance criteria-ISE, IAE, ITAE, selection of controllers-P, PI, PID. Mathematical models-Transfer Function. Time-domain response- step response of 1st and 2nd order systems. Frequency response- Nyquist diagrams gain and phase margins.

Module IV (6 hours)

Any one implementation of the following in groups:
Temperature control using ON/OFF controller using Arduino.
Analogue signal conditioning using simple filter circuits such as RC high/low pass filters.
Analogue signal conditioning using active filters.
Implementation of OpAmp based PI controller.

Course Outcomes

At the end of the course, students will be able to:

1. Understand the measurement of various quantities using instruments, their accuracy and range, and the techniques for controlling devices automatically. (Understanding)
2. Understand and analyze Instrumentation systems and their applications to various industries. (Understanding)
3. Model and analyze transducers. (Applying)
4. Select proper control scheme for a given condition (Applying)

Suggested Readings

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2009.
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw- Hill: New York, 1999.
4. S. Tumanski, Principles of Electrical Measurement (Series in Sensors), First edition, CRC press,, 2006.
5. K. Krishnaswamy, Process Control, Second edition, New Age International, 2011.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H		H
CO 2	L	H		M
CO 3				H
CO 4			H	H

MNME0041: ELEMENTS OF MECHANICAL ENGINEERING

(3 Credits-40 hours)(L-T-P: 2-1-0)

Objectives:

- To learn about the 1st and 2nd law of thermodynamics.
- To understand the working of petrol and diesel engines.

- To interpret the different types of manufacturing processes and their applicability.
- To familiarize with the belt drive and gear drive.

Course/ Learning Outcomes

After the completion of the course the students will be able to:

1. CO1: Define basic terminologies of 1st and 2nd law of thermodynamics, IC engine, Boilers, types mechanical materials, casting, welding, metal forming processes, types of link, types of Belts and Gears(Remembering)
2. CO2: Explain Zeroth, 1st, and 2nd law of thermodynamics, S.F.E.E, temperature and pressure measuring instruments, Otto cycle and diesel cycle, two stroke and four stroke engines, petrol and diesel engine, boilers- mounting and accessories. (Understanding)
3. CO3: Describe various types of mechanical materials, sand casting, types of patterns, casting defects, Arc welding, gas welding, various metal forming techniques, types of kinematic link, transmission of Power by Belts and Gear Trains.(Understanding)
4. CO4: Solve problems on Zeroth, 1st and 2nd law of thermodynamic, Otto and diesel cycle, performance of IC engine, simple problems on rolling, belt and gear drive.(Applying)

Module I (10 Hours)

Thermodynamics system, surrounding and boundary, thermodynamic properties, path,processes and cycle, Macroscopic and Microscopic approach, Thermodynamic equilibrium, Pressure and Temperature, Zeroth Law of Thermodynamic. Displacement work, path function, point function, Work done for constant volume, constant pressure, isothermal, adiabatic and polytropic processes, Internal energy, enthalpy specific heat at constant pressure and volume. First Law of Thermodynamic and its application to non-steady flow systems, Steady flow energy equation, Limitation of First Law of Thermodynamic, Second Law of Thermodynamic, Clausius and Kelvin Planck Statements, concept of Entropy.

Module II (10 Hours)

Engine, Classification, Definition of Brake power, indicated power, friction power, BTE, ITE,calorific value of fuel, Stoichiometric air-fuel ratio, Engine Terminology- bore, compression ratio, swept volume, clearance volume etc. Difference between 4-stroke and 2-stroke engine, comparison of petrol and diesel engine, simple problems related to performance parameters of IC engine, Classification of boilers, Fire Tube boiler- Cochran and Lancashire boiler, Watertube boiler- Babcock wilcox boiler, Advantages and disadvantages of firetube and water tube boilers.

Module III (10 hours)

Types of materials: Ferrous metals, Non-Ferrous Metals, Alloys and Composites, Casting- Sand casting, Types of Pattern, Pattern Materials, Solidification time, Casting Defects. Metal Forming Techniques- Rolling, Forging, Extrusion, Deep Drawing. Simple Problems on Rolling, Welding- Classification, Arc Welding, Problems related to Open Circuit Voltage-Short Circuit Current characteristics, Welding speed, Gas Welding, Types of Flame, Flux, Slag, working of oxy-acetylene welding.

Module IV (10 Hours)

Resistant Body, Link, Difference between machine and structure, types of link, Kinematic pair, constrained motions, kinematic chain, mechanism, degree of freedom, types of joints, simple problems.Types of Belts and Gears, Transmission of Power by Belts and Gear Trains, Simple Belt Drive and Simple Gear Drive, Velocity Ratio, simple problems.

Suggested Readings

1. Nag P. K., “Engineering Thermodynamics”, 4th Edition, Tata McGraw Hill.
2. Chattopadhyay, P., “Engineering Thermodynamics”, 2nd Edition, Oxford.
3. Domkundwar S., Kothandaraman C.P., “A Course in Thermal Engineering”, 6th Edition, Dhanpat Rai & Co (p) Ltd.
4. Sharma P.C. “Production Technology” S. Chand.
5. Singh V.P. “Theory of Machines” Dhanpat Rai & Co.

Mapping of COs to Syllabus

Course Outcomes	Module1	Module2	Module3	Module4
CO1	H	H		H
CO2	M	H		M
CO3	L		H	L
CO4	L		H	M

MNEE0042: ENGINEERING MECHANICS FOR ELECTRONICS AND ELECTRICAL

(4 credits-60 hours)(L-T-P: 3-1-0)

Objective

At the end of this course, students will demonstrate the ability to

- Understand the concepts of co-ordinate systems.
- Analyse the three-dimensional motion.
- Understand the concepts of rigid bodies.
- Analyse the free-body diagrams of different arrangements.
- Analyse torsional motion and bending moment.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define the various principles, definitions, theorems related to mechanics, relate the different coordinate systems and their transformations. (Remembering)
2. Illustrate the various types of motions and their effects on a body. (Understanding)
3. Construct free body diagrams for various situations. (Applying)
4. Analyze the concept of virtual work for relevant problem solving. (Analyzing)
5. Assess various simple day to day life problems within the applicable constraints and communicate the solution effectively. (Evaluating)

Module I (9 hours)

a. Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indicial notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.
b. Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module II (11 hours)

a. Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.
b. Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module III (6 hour)

a. Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.
b. Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module IV (11 hours)

a. Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.
b. Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module V (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Suggested Readings

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.
3. NPTEL LINK: https://nptel.ac.in/courses/112/105/112105164/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
1	H	M	L		
2	M	H	L		

3	M	L	H		
4	M	L	L	H	
5	M	L			H

MNHT0041: HEAT TRANSFER

(4 credits-60 hours) (L-T-P: 3-1-0)

Objectives:

- To build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solutions of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. define heat conduction equation for different coordinate systems.
2. apply various empirical correlations of forced convection and free convection under different boundary conditions.
3. evaluate the parameters to design heat exchangers by using LMTD method and NTU method.
4. estimate the radiative heat transfer rate and the shape factors for different geometries.

Module I: Conduction (15 hours)

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, Fins, Mathematical Equation of a Rectangular Fin of Uniform Cross section, Temperature and Heat Transfer Calculation of Fin with different boundary Conditions, Fin Efficiency and Fin Effectiveness.

Module II: Convection (15 hours)

a. Heat convection, Mechanism of Convection, Concept of Velocity Boundary Layer, Thermal Boundary Layer, Laminar and Turbulent Flow, Forced and Free Convection, Conservation of Mass Equation for the Boundary Layer, Conservation of Continuity Equation for the Boundary Layer, Conservation of Energy Equation for the Boundary Layer.
b. Forced Convection: Flat Plate in Parallel Flow, Exact Solution of Laminar Boundary Layer Over a Flat Plate, Integral Method: Laminar Forced Convection on a Flat Plate, Turbulent Boundary Layer Condition for Flow over an Isothermal Flat Plate, Methodology for Calculation of Convection Coefficient, Analogy Between Heat and Momentum Transfer. Internal Flow: Hydrodynamic Considerations, Thermal Considerations, Laminar Flow Heat Transfer in a Circular Pipe: Fully Developed Flow, Turbulent Flow Convection in Pipes: Empirical Correlations, Heat Transfer Considerations: Constant Wall Temperature and Constant Heat Flux.
c. Natural Convection: Analytical Solution of Laminar Free Convection over a Vertical Flat Plate, Integral Method for Natural Convection Heat Transfer on a Vertical Flat Plate, Correlation from Experimental Results.

Module III: Radiation (10 hours)

Prevost's theory, Absorptivity, Reflectivity and Transmissivity, Black Body, Emissive Power, Emissivity, Kirchhoff's Law, Spectral Energy Distribution of a Black Body, Radiation from Real Surfaces, Intensity of Radiation, Radiant Heat Exchange between Two Black Bodies Separated by a Non Absorbing Medium, Shape Factor, Electrical Analogy, Evaluation of Shape Factor, Radiation Heat Transfer Between Gray Bodies, Radiosity and Irradiation, Radiation Shields.

Module IV: Heat Exchanger, Phase Change and Mass Transfer (10 hours)

Types of heat exchangers, Compact, Shell and Tube and Plate Heat Exchangers, Overall Heat Transfer Coefficient, Fouling Factor, Use of LMTD, Cross Flow Heat Exchanger, Effectiveness-NTU Method, Heat Exchange Design Considerations. Condensation Heat Transfer, Dropwise Condensation, Laminar Film Condensation on a Vertical Plate, Boiling Heat Transfer, Regimes of Boiling, Nucleate Boiling, Correlations of Boiling Heat Transfer Data. Introduction to mass transfer, Diffusion Mass Transfer, Fick's law of Diffusion, Analogy between Momentum, Heat and Mass Transfer.

Suggested Readings

1. A. Bejan, Heat Transfer John Wiley, 1993.
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002.
5. https://nptel.ac.in/courses/112/105/112105271/
6. https://nptel.ac.in/courses/112/105/112105271/
7. https://nptel.ac.in/courses/112/103/112103276/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H		L	M
CO 2	L	H		M
CO 3	L	L		H
CO 4			H	L

MNDM0042: DESIGN OF MACHINE ELEMENTS

(4 credits-60 hours)(L-T-P: 3-1-0)

Objectives

To make students learn about various aspects of mechanical component design and understand the origin, nature and applicability of empirical design principles, based on safety considerations. Afterwards, students will have proper conceptualization of available design data and will be able to determine safe dimensions for machine elements under various loading conditions.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define basic design concepts and procedures.
2. Apply the theories of failure in designing mechanical components.
3. Compute safety parameters by making use of design data hand book.
4. Classify different springs, shafts, bearings and gears and analyze their required design standards to withstand failure.

Module I: Design against Static Load (15 hours)

Overview and need of design, Design procedures, Limits, Fits and Tolerances, BIS standards. Design against Static Loading: Modes of failure, Factor of safety, Stress-strain, Design of cotter and knuckle joints, Theories of failure: Maximum normal-stress theory, Maximum shear-stress theory and Distortion-energy theory.

Module II: Design against Dynamic Load (15 hours)

Stress concentration, Modes of failure, Fluctuating stresses, Fatigue failure and S-N diagram, Notch sensitivity, Soderberg, Goodman and Gerber diagrams, modified Goodman diagrams, Fatigue design under combined stresses.

Module III: Design of shafts and springs (10 hours)

a. Shafts: Design of shaft subjected static and dynamic loading against failure due to bending, torsion and combined bending and torsion.
b. Springs: Design of helical tension and compression springs, leaf springs and helical torsion springs, surge in spring

Module IV: Design of bearings and gears (20 hours)

a. Bearings: Design of rolling contact bearings, Static and dynamic load carrying capacity, Load life relationship, Analysis and design of sliding contact bearings, Reynold's equation.
b. Gears: Design of spur gears, force analysis, beam strength and wear strength of spur gear tooth, design of helical gears, virtual teeth and tooth proportions, force analysis and effective load, design of bevel gears, design of worm gears, strength and wear rating of worm gears.

Suggested Readings

1. J.E. Shigley et al., Mechanical Engineering Design, Tata McGraw-Hill Publications
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan.
3. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publications.
4. U. C. Jindal, Machine Design, Pearson Education.
5. K Mahadevan et. al., Design Data Handbook, CBS Publishers and Distributors Pvt. Ltd.
6. V. B. Bhandari, Machine Design: Data book, Tata McGraw Hill Publications.
7. https://nptel.ac.in/courses/112/105/112105124/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	H	M	M
CO2	H	H	M	M
CO3	L	M	M	M
CO4			H	H

MNMP0043: MANUFACTURING PROCESSES

(4 credits-60 hours)(L-T-P:3-1-0)

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

1. Define various conventional and unconventional manufacturing methods.
2. Classify various manufacturing methods for its applications in industries.
3. Analyze the various causes of tool wear and examine the various ways of preventing it.
4. Select the appropriate manufacturing process to manufacture any components.

Module I (9 hours)

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses, Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Module II (8 hours)

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components:
Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Module III (7 hours)

Additive manufacturing: Rapid prototyping and rapid tooling, Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Module IV (16 hours)

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), process parameters, MRR and surface finish, Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Suggested Readings

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Ed.),Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black and Kohser, Materials and Processes in Manufacturing
4. OP Khanna, Foundry technology, Dhanpat Rai
5. Manufacturing Processes by B.H. Amsteal, Philip F. Ostwald and Myron L. Begeman, John Wiley & Sons.
6. P.K. Mishra, Non-Conventional Machining, Narosa Publishing House.
7. A.B.Chattopadhyay, Machining and Machine Tools, Wiley India Pvt Ltd
8. https://nptel.ac.in/courses/112/107/112107258/
9. https://nptel.ac.in/courses/112/103/112103248/
10. https://nptel.ac.in/courses/112/105/112105233/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M	M	H
CO 2	M	H	H	H
CO 3		H		
CO 4	H	M	M	H

MNKT0044: KINEMATICS & THEORY OF MACHINE

(4 credits-60 hours)(L-T-P:3-1-0)

Objectives:

- To deepen understanding of kinematic analysis as an essential element of the design and synthesize process of different mechanisms.
- To develop skills in analytical, graphical methods for understanding the kinematics and dynamics of different mechanisms.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define various basic terms related to machine and mechanisms; examine the degree of freedom of a given mechanism; state law of gearing, law of belting; list different types of cam & follower classify various types of gears and gear trains; state the working of bearing, friction clutches and brakes.
2. Construct velocity and/or acceleration analysis diagrams of simple mechanisms.
3. Design suitable cam profile with roller/knife-edge/flat faced follower for simple applications.
4. Solve problems related to gear/gear train; and belting.

Module I (12 hours)

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains, Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.

Module II (14 hours)

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis, three position graphical synthesis for motion and path generation.

Module III (14 hours)

Classification of cams and followers- Terminology and definitions- Displacement diagrams: Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, disc cam profile synthesis for roller and flat face followers.

Module IV (10 hours)

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack and pinion gears, epicyclic and regular gear train kinematics.

Module V (10 hours)

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication, friction clutches- belt and rope drives- friction in brakes.

Suggested Readings

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers and Distributors, 2005.
2. CleghornW. L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated EastWest Pvt. Ltd.
5. S. S. Rattan, Theory of Machines, McGrawHill.
6. V. P. Singh, Theory of Machines, Dhanpat Rai and Co.
7. https://nptel.ac.in/courses/112/105/112105268/
8. https://nptel.ac.in/courses/112/104/112104121/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H		L	L	M
CO 2	L	H			
CO 3			H		
CO 4				H	H

MNMT0045: MANUFACTURING TECHNOLOGY

(4 credits-60 hours)(L-T-P: 4-0-0)

Objectives:

- To provide knowledge on machines and related tools for manufacturing various components
- To understand the relationship between process and system in the manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Illustrate various tool holding mechanisms, die design and press work operations.
2. Examine dimensional accuracy and tolerances of products to design solutions and to design system components
3. Illustrate various assembly practices.
4. Evaluate optimization methods in manufacturing

Module I (12 hours)

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

Module II (16 hours)

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, inspection and workpiece quality

Module III (6 hours)

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

Module IV (16 hours)

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model-Project networks: CPM and PERT, critical path scheduling; Production planning and control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT, Simple queuing theory models.

Suggested Readings

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. P.H. Joshi, Jigs and Fixtures, Tata McGraw Hill.
3. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
4. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
5. P. C. Sarma, A Textbook of Production Engineering, S Chand.
6. https://nptel.ac.in/courses/112/103/112103263/
7. https://nptel.ac.in/courses/112/104/112104250/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	M	L	
CO2	M	H	M	

CO3			H	
CO4				H

MNDD0046: MACHINE DESIGN AND DYNAMICS

(4 credits-60 hours)(L-T-P:3-1-0)

Objectives

This course seeks to provide an introduction to the design of machine elements and introduction to dynamics of machinery, students will learn various design aspects of components like screws, couplings, belt, chain, flywheel etc. and the applicability of available design data during designing. The course involves introduction to gyroscope and governor and aims at developing skills to understand the dynamics of the mechanisms.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

1. Define the basic concepts related to design process.
2. Illustrate the idea of working and design of different types of brakes and clutches based on established theories.
3. Evaluate suitable dimensions for belt drive, chain drive and flywheel based on failure criterion.
4. Compute required balancing weight in machines in static and dynamic balancing cases.
5. Illustrate the use and working principles of governors and gyroscopes.

Module I (20 hours)

a. Power Screw: Analysis and applications of power screws, forms of threads, self-locking, efficiency of screw.
b. Threaded fasteners: ISO Metric screw threads, bolted joint analysis under eccentric load, torque required for bolt tightening.
c. Permanent Joints: Design of Riveted and welded joints and their strength.
d. Keys: Introduction to different types of keys, Force analysis.
e. Couplings: Analysis and design of rigid flange couplings.

Module II (10 hours)

a. Brakes: Analysis of Block, band and disc brakes.
b. Clutches: Classification, Analysis of friction clutches

Module III (15 hours)

a. Design of belt drive: geometrical relationships, analysis, condition for maximum power, V belts.
b. Design of chain drive: geometrical relationships, sprocket wheels, design of chain drive.
c. Design of Flywheels: Introduction, Turning moment diagram, solid disk flywheel, rimmed flywheel.

Module IV (8 hours)

a. Balancing of rotational mass: Static and dynamic balancing.
b. Balancing of reciprocating mass: Partial balancing, Different balancing approaches.

Module V (7 hours)

a. Governor: Introduction, types, principle, working and need.
b. Gyroscope: Introduction, principle and application.

Suggested Readings

1. J.E. Shigley et al., Mechanical Engineering Design, Tata McGraw-Hill Publications.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan.
3. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publications.
4. U. C. Jindal, Machine Design, Pearson Education.
5. K Mahadevan et. al., Design Data Handbook, CBS Publishers and Distributors Pvt. Ltd.
6. V. B. Bhandari, Machine Design: Data book, Tata McGraw Hill Publications

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1	H	L	H		
CO2	M	H			
CO3			H		

CO4				H	
CO5					H

MNHM0047: HYDRAULICS MACHINES

(3 credits-45 hours) (L-T-P: 3-0-0)

Objective

The course familiarizes students with basic facts relating to working principles of hydraulic machines and equipment used in all industrial fields. It deals with pumps, hydraulic turbines and fluid mechanisms such as hydraulic elements, hydraulic transmissions and couplings.

Course/Learning Outcomes

At the end of the course students will be able to:

1. CO1: Define governing principle of impulse momentum, various hydraulic turbines and pumps. (Remembering)
2. CO2: Classify and identify the various types of pumps and turbines, their performance characteristics, blade triangles and various efficiency studies. (Understanding)
3. CO3: Solve various numerical problems based on the application of impulse momentum theory in impact of jet problems and performance characteristics of turbines and pumps based on velocity triangle approach. (Applying)
4. CO4: Analyze various results to estimate the performance of turbines and pumps. (Analyzing)

Module I (8 hours)

Force exerted on stationary flat plate held normal to jet and inclined to jet, force exerted on curved plate, force exerted on moving flat plate normal to jet and moving inclined to the direction of the jet, jet propulsion of jet.

Module II (12 hours)

Definition of fluid machine and energy transfer machines, Review of classification of hydraulic turbines, Impulse and reaction turbines, work done and efficiency of Pelton wheel, Francis turbine, propeller turbine and Kaplan turbine, theory of draft tube , Concept of specific speed, unit quantities of hydraulics turbine, performance characteristics of hydraulic turbines, cavitation in the turbine, governing of turbines.

Module III (10 hours)

Introduction to Rotodynamic pump, Review of classification of centrifugal pumps, working principles and head of centrifugal pumps, losses and efficiencies of centrifugal pumps, effect of variation of discharge on efficiency, multi stage centrifugal pumps, Concept of specific speed, characteristics performance of centrifugal pumps, Net Positive Suction Head, cavitation and priming of centrifugal pumps.

Module IV (10 hours)

Introduction to positive displacement pump, Review of classification of reciprocating pumps, working principles of reciprocating pumps, discharge, work done, power for reciprocating pumps, single acting and double acting reciprocating pumps, slip of reciprocating pump, effect of acceleration of piston on velocity and pressure in the suction and delivery pipes, indicator diagram and their effect on acceleration and friction of suction and delivery pipes , air vessels and its effect on work done for reciprocating pump

Module V (5 hours)

Working principle of hydraulic accumulator, hydraulic intensifier, hydraulic press, hydraulic crane, hydraulic lift, hydraulic ram, hydraulic coupling, hydraulic torque converter, jet pump, submergible pump, gear pump.

Suggested Readings

1. R.K. Rajput, Text book on hydraulic machines, S. Chand.
2. Dr.R.K. Bansal, Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi publication.
3. P.N Modi and S.M Seth, Hydraulics and Fluid Mechanics, Standard Book House.
4. Jagadish Lal, Fluid machines Including Fluid mechanics, Metropolitan Book Co.
5. Sadhu Singh, Fluid Machinery, Khanna Publishing House, Delhi
6. NPTEL course: Fluid Machine By Prof. S.K. Som, https://nptel.ac.in/courses/112/105/112105206/
7. NPTEL course: Principle of Hydraulics Machine and System Design By Prof. Pranab K. Mondal, https://nptel.ac.in/courses/112/103/112103249/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1	M	H	H	H	L
CO2		H	H	H	L
CO3	L	M	H	M	M
CO4		H	M	M	

MNMP0048: ADVANCED MANUFACTURING PROCESSES

(3 credits-45 hours)(L-T-P:3-0-0)

Objective:

- To make the learner familiar with various advanced manufacturing processes; their need and capabilities.
- To make them aware about the modern trends in the field of manufacturing.

Module I (3 hours)

Introduction to Modern Manufacturing Methods, their needs in today's manufacturing scenario, identification and characteristics of these processes, conventional versus modern manufacturing methods.

Module II (8 hours)

Abrasive jet machining, Water jet machining, Abrasive water jet machining, Abrasive flow machining, Ultrasonic machining, Ultrasonic welding, their working principles, equipments, process capabilities, applications, advantages and limitations.

Module III (8 hours)

Chemical machining, Photo chemical machining, Electrochemical machining, drilling, grinding, deburring, their working principles, equipments, process capabilities, applications, advantages and limitations.

Module IV (8 hours)

Electrodischarge machining (EDM), Electrodischarge wire cutting or wire EDM, Electrodischarge grinding, Electrochemical discharge grinding, their working principles, equipment, process capabilities, applications, advantages and limitations. Electron Beam Machining, Electron Beam welding, Plasma arc cutting, Ion beam machining.

Module V (8 hours)

Process principle, type of laser, equipment, and laser processes: drilling, cutting, machining, welding, heat treating, cladding; applications, advantages and limitations.

Module VI (5 hours)

Micromanufacturing, manufacturing processes lead towards micro-manufacturing, micro electro mechanical systems (MEMS), LIGA, Rapid prototyping, 3D printing, concept of nanotechnology and nano-processing techniques.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define and characterise advanced manufacturing and machining processes, their evolution and usefulness of them & compare with conventional manufacturing. Acquire fundamental knowledge about some emerging trends like rapid prototyping, 3D printing, micro-manufacturing etc.
2. Know the working and process capabilities of Mechanical processes like Abrasive jet machining, Water jet machining, Abrasive water jet machining, Abrasive flow machining, Ultrasonic machining etc.
3. Know the working and process capabilities of Chemical and Electrochemical Processes like chemical machining, Photo chemical machining, Electro-chemical machining etc.
4. Know the working and process capabilities of Electro-thermal Processes like

Suggested Readings

1. V.K. Jain, Advanced Machining processes, Allied publishing pvt. Ltd.
2. G. F. Benedict, Nontraditional manufacturing processes, Marcel Dekker Inc.
3. J.A McGeogh, Advanced Methods of Machining, Chapman and Hall.
4. PK. Mishra, Nonconventional Machining, Narosa Publishing House.
5. G.Boothroyd and W.A. Knight, Fundamentals of Machining and Machine Tools, CRC Press T&F Group.
6. NPTEL LINK: https://nptel.ac.in/courses/112/103/112103202/
7. NPTEL LINK: https://nptel.ac.in/courses/112/104/112104028/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				H
CO 2		H			
CO 3			H		
CO 4				H	M

MNCM0049: COMPOSITE MATERIALS

(3 credits-45 hours) (L-T-P:3-0-0)

Objectives:

- To understand the mechanical behavior of composite materials.
- To get an overview of the methods of manufacturing composite materials

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. CO1: Define composite materials and their properties.
2. CO2: Classify various types of composite materials based on various attributes.
3. CO3: have a pure contrast of the mechanical behaviour and application of composite materials.
4. CO4: Interpret the failure behavior in different composites

Module1 (12 hours)

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Module II (16 hours)

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes. Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.

Module III (12 hours)

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Suggested Readings

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.
3. https://nptel.ac.in/courses/112/104/112104229/
4. https://nptel.ac.in/courses/112/104/112104168/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H	M	
CO 2	M	H	
CO 3		H	M
CO 4			H

MNIC0050: INTERNAL COMBUSTION ENGINES

(3 credits-45 hours) (L-T-P:3-0-0)

Objectives:

- To familiarize with the terminology associated with IC engines.
- To understand the basics of IC engines.

- To understand combustion, and various parameters and variables affecting it in various types of IC engines.
- To learn about various systems used in IC engines and the type of IC engine required for various applications.

Course/Learning Outcomes

After completing the course the students will be able to

1. C01: define the relevant performance parameters of an engine.
2. C02: compare the difference between combustion in SI and CI engines.
3. CO3: illustrate the effect of exhaust emissions on the environment.
4. CO4: elaborate the working of the lubrication system of the IC engine.

Module I (10 hours)

Review of Petrol and Diesel engines, Revision of Air standard cycle-assumptions, Otto cycle, Diesel cycle and dual cycle. Fuel-air cycle, effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation, actual cycle, losses in actual cycle.

Module II (10 hours)

a. Elementary carburetor, complete carburetor, air fuel ratio, stoichiometric ratio, Spark plug,Magneto and battery ignition system, fuel pump, drawbacks of carburettor and introduction of multipoint fuel injection.
b. Diesel injection system, fuel pump, injectors and nozzles.
c. Firing order, Ignition timing, and valve timing diagram.

Module III (10 hours)

a. Combustion in S.I and C.I engines, Parameters influencing combustion, Detonation and knocking in S.I. and C.I. engines and their prevention, Combustion chamber types, Basic principles of combustion chamber in I.C.engines,
b. Supercharging, Thermodynamic cycle with supercharging, Supercharging power, Supercharging of I.C. engines, Effect of supercharging on performance of the engine, Turbocharging.

Module IV (10 hours)

a. Lubrication of I.C. engines, properties of lubricating oils, lubricating systems,
b. Cooling of I.C engines, air and water cooling systems.
c. Classification and desirable characteristics of I.C. engine fuels, Rating of S.I. and C.I. engine fuels: Octane number (RON and MON), Cetane number, CFR engine, Alternative fuels (liquid, gaseous etc).
d. Greenhouse Gases and Exhaust emissions from I.C. engines (Pollutants: CO, HC, NO_X and PM)
e. Environmental effects of I.C. Engine exhaust pollutants, Introduction to Catalytic converters and other technological changes in IC engines for control.

Suggested Readings

1. Heywood J. B, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co. NY, 1989.
2. Mathur M.L., “Internal Combustion Engine”, Dhanpat Rai Company Ltd.
3. Ganesan V., “Internal Combustion Engine”, Tata McGraw Hill.
4. https://nptel.ac.in/courses/112/104/112104033/ Engine combustion
5. https://nptel.ac.in/courses/101/104/101104070/ Fundamentals of Combustion (Part1) https://nptel.ac.in/courses/101/104/101104072/ Fundamentals of Combustion (Part2) https://nptel.ac.in/courses/103/105/103105110/ (Fuels & Combustion Technology) [PDF Notes]

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M	M	M
CO 2		L	H	M
CO 3			M	H
CO 4				H

MNAM0051: AUTOMATION IN MANUFACTURING

(L-T-P: 3-0-0)

Objectives:

- To understand the importance of automation in the field of machine tool based manufacturing.

- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC.
- To understand the basics of product design and the role of manufacturing automation.

Course Outcomes:

After completing the course successfully, the students will be able to-

1. Define and recall automation in manufacturing, modeling and product design.
2. Classify different automation assisting technological aids in different manufacturing processes.
3. Apply the knowledge of computer based automation of manufacturing operations.

Module I

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Module II

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control

Module III

Low cost automation: Mechanical and Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

Module IV

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies and industrial applications.

Suggested Readings

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition, Pearson.
3. YoramKoren, Computer control of manufacturing system, 1st edition
4. Ibrahim Zeid , CAD/CAM : Theory and Practice, 2nd edition.
5. https://nptel.ac.in/courses/112/103/112103174/ Mechatronics And Manufacturing Automation

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	M	M	L	M
CO2	L	H	M	L
CO3	M	M	L	H

MNRC0052: REFRIGERATION AND AIR-CONDITIONING

(L-T-P: 3-0-0)

Objectives

- To familiarize with the terminology associated with refrigeration systems and air conditioning.
- To understand basic refrigeration processes.
- To understand the basics of psychrometry and practice of applied psychrometrics.
- To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.

Course Outcomes:

After completing the course successfully the students will be able to-

1. define the different types of aircraft refrigeration systems.
2. explain the working principle of vapour compression and vapour absorption systems.
3. examine the effect of operating parameters on the performance of a vapour compression system.
4. estimate cooling load, sensible heat and latent heat in air conditioning systems.

Module I (10 hours)

Concept of throttling, Joule-thomson effect, Concepts of Refrigeration and Air-conditioning. Difference between engine, refrigerator and heat pump. COP, power consumption of a refrigerating machine, Heat pump v/s electric resistance heater.

Module II (12 hours)

a. Simple cycles – Carnot and Bell-Coleman; Air-craft refrigerating system – simple, boot-strap, regeneration, reduced ambient; Actual cycles, DART.
b. Analysis of simple cycles, representation of T-s, p-h charts; methods of improving COP;
c. Deviations of actual cycles from theoretical cycles. Compound compression with liquid flash cooler, flash inter-cooler multiple systems – COP, power required.

Module III (8 hours)

a. Vapour Absorption Refrigeration System (VARS): Advantages of VARS over VCRS. Working principle of simple VARS, practical VARS. Limitations of VARS, maximum COP of a VARS, Lithium bromide-water System; Aqua-ammonia systems.
b. Nomenclature, classification, desirable properties. Important refrigerants and their comparisons, selection of refrigerants.

Module IV (10 hours)

Basic definitions and principles related to Psychometric; Psychometric Charts and Their Uses; adiabatic saturation and enthalpy deviation. Adiabatic mixing of air stream. Constant sensible heat and latent heat processes, Total heat process, sensible heat factors, grand sensible heat ratio lines, apparatus dew points, Bypass factors, Air washer-humidifying efficiency, Summer Air-conditioning, Winter Air-conditioning.

Suggested Readings

1. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
2. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
3. Prasad, M, "Refrigeration and Air Conditioning", New Age International Publishers.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	L	H		
CO2	L	H	H	M
CO3		H	L	
CO4			L	H

MNSE0053: NON-CONVENTIONAL ENERGY SYSTEMS

(L-T-P: 3-0-0)

Objective

To convey the knowledge of basics of different non-conventional energy systems in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are meager in nature.

Course outcomes: After completing the course successfully the students will be able to-

- Compare the various fossil fuel sources with respect to their impact on the environment.
- Analyze harnessing of solar energy.
- Analyze harnessing of microhydel and wind energy
- Analyze harnessing of Biomass and wave energy
- To study and compare energy storage systems.

Module I (5 hours)

a. Fossil fuel based systems: Impact of fossil fuel based systems. Non-conventional energy – Seasonal variations and availability. Renewable energy – sources and features. Hybrid energy systems Distributed energy systems and dispersed generation (DG)
b. Traditional Energy Systems: Sources. Features and characteristics. Applications: Transport – bullock cart, horse carriage, camels; Agriculture – ox plough, water lifting devices; Human power – bicycle, cycle rickshaw etc.; House hold – cooking (bio mass), lighting etc.

Module II (11 hours)

a. Solar Thermal Systems: Solar radiation spectrum. Radiation measurement. Technologies. Applications: Heating, Cooling, Drying, Distillation, Power generation
b. Solar Photovoltaic System: Operating principles. Photovoltaic cell concepts. Cell, module, array. Series and parallel connections. Maximum power point tracking. Applications: Battery charging, Pumping, Lighting, and Peltier cooling.

Module III (7 hours)

a. Microhydel: Operating principles. Components of a microhydel power plant. Types and characteristics of turbines. Selection and modification. Load balancing.
b. Wind: Wind patterns and wind data. Site selection. Types of windmills. Characteristics of wind generators. Load matching.

Module IV (6 hours)

a. Biomass: Operating principles. Combustion and fermentation. Anaerobic digester. Wood gassifier. Pyrolysis. Applications: Biogas, Wood stoves, Bio diesel, Combustion engine.
b. Wave Energy Systems: Shoreline systems. Near shore systems. Off shore systems.

Module V (7 hours)

a. Costing: Life cycle costing (LCC). Solar thermal system LCC. Solar PV system LCC. Microhydel LCC. Wind system LCC. Biomass system LCC
b. Hybrid Systems: Need for Hybrid Systems. Range and type of Hybrid systems. Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

Suggested Readings:

1. Rai.G.D, “Non-Conventional Energy Sources”, Khanna Publishers, 4th edition, New Delhi, 2009.
2. Roland Wengenmayr, Thomas Buhrke,” Renewable energy: Sustainable energy concepts for the future”, Wiley-VCH, 1st edition, 2008.
3. B H Khan, “Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011
4. S. Hasan Saeed and D. K. Sharma, “Non-Conventional Energy Resources”, 3rd Edition, S. K. Kataria and Sons, 2012
5. G.N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles And Applications”, Narosa Publishing House, 2004 Godfrey Boyle, “Renewable energy”, Oxford University Press, 2nd edition, 2010
6. Hans-Josef Fell, “Global cooling strategies for climate protection”, CRC Press, 2012.
7. Ottmar Edenhofen, “Renewable energy sources and climate change mitigation”, Cambridge University Press, 2011.
8. B.K. Hodge, “Alternative energy systems and applications”, John Wiley and Sons, 2009.
9. Mark Diesendorf, “Greenhouse solutions with sustainable energy”, University of New South Wales Press, 2007.
10. https://nptel.ac.in/courses/108/108/108108078/
11. https://nptel.ac.in/courses/121/106/121106014/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5	L	L	M	M	H

MNSN0054: SOLID MECHANICS

(L-T-P: 3:0:0)

Objective

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Module I (10 hours)

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions.

Module II (11 hours)

Constitutive equations: Generalized Hooke’s law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

Module III (15 hours)

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems. Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems. Solutions using potentials, Energy methods. Introduction to plasticity.

Suggested Readings:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.
4. S.M.A. Kazimi, Solid mechanics, MGH
5. https://nptel.ac.in/courses/112/102/112102284/

Course Outcomes:

After completing the course successfully the students will be able to-

1. Know the basics including various laws related to solid mechanics and concept of stress and strain
2. Demonstrate the deformation behaviour of solids under different types of loading, use of Hooke's law and solve boundary value problems
3. Solve and obtain mathematical solutions for simple geometries under loading, plane stress & strain problems and use of potential & energy methods

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO 1	H	M	
CO 2		H	
CO 3			H

MNER0055: ENERGY CONSERVATION AND WASTE HEAT RECOVERY

(L-T-P: 3-0-0)

Objectives

To provide the understanding on basic principles and available technologies for energy conservation as well as waste heat recovery. To provide a comprehensive understanding on industrial waste heat recovery systems and how to use those waste heat for batter engineering purpose.

Module I (10 hours)

Introduction to energy conservation and Importance of Waste Heat Recovery, Review of Thermodynamics, Introduction to First and Second Laws Entropy Generation, Rankine Cycle, modification of Rankine cycle, Lenior cycle, Atkinson cycle, Brayton cycle, Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Thermodynamic cycles for low temperature application. Heat Recovery Steam Generators**.**

Module II (8 hours)

Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycle cogeneration system.

Module III (10 hours)

Utilization of industrial waste heat; Properties of exhaust gas; Gas-to- gas, gas-to-liquid heat recovery systems, Recuperators and regenerators , Shell and tube heat exchangers, Spiral tube and plate heat exchangers. Special Heat Exchangers for Waste Heat Recovery.

Module IV (10 hours)

Waste heat boilers: various types and design aspects. Heat pipes: theory and applications in waste heat recovery. Prime movers: sources and uses of waste heat; Fluidized bed heat recovery systems; Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems; Thermoelectric system to recover waste heat; Heat pump for energy recovery; Heat recovery from incineration plants.

Module V (7 hours)

Energy storage technique: Thermal, electrical, magnetic and chemical storage systems. Investment cost – economic concepts – measures of economic performance – procedure for economic analysis.

Course Outcomes:

At the end of the course students will be able to:

1. Define energy conservation and waste heat recovery system. (Remembering)
2. Compare the performance of various waste recovery systems. (Understanding)
3. Categorize various waste recovery systems and sources. (Applying)

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H	M	M	L	L
CO2	L	H	L	L	H
CO3	L	M	H	H	L

MNAE0056: AUTOMOBILE ENGINEERING

(L-T-P: 3-0-0)

Objective

This course is an introduction to the description and working of various mechanical parts of an automotive vehicle. After learning the course students will be able to understand the usage of mechanical components and their assembly. As there is a growing demand for design and development of modern environment friendly vehicles, this course serves as an introduction to enable students to develop better technologies.

Course Outcome:

1. Relate different aspects of mechanical design to automobile engineering. (Remembering)
2. Classify various assemblies of an automobile. (Understanding)
3. Apply the knowledge of cooling, lubrication system, exhaust system and emission control system in automobiles. (Applying)
4. Examine the performance of transmission, suspension, steering and braking systems. (Analysing)

Module I (9 hours)

a. History and development of Automobiles, classification, layout of various components in an automobile, design considerations and materials.
b. Various parts: chassis, frame and body, aerodynamic considerations,
c. Various types of engines: Identification of petrol, diesel, gas and hybrid engines, Inline, Radial and V engines, Overhead Camshaft (OHC) engine, CRDI engine, Introduction to Single point injection or Throttle Body injection (TBI) engine and Multi point Injection (MPI) engine.
d. Tyres (with tube and tubeless, radial) and spark plugs (heat range, hot and cold).

Module II (9 hours)

a. Clutch: types and working.
b. Gearbox: classification, sliding mesh, constant mesh and synchro-mesh gear boxes, Gear shifting mechanism.
c. Manual transmission, Automatic transmission: torque converters, epicyclic gear train, freewheeling mechanism, propeller shaft and universal joint. Final drive: rear axle, mounting methods, differential mechanism.

Module III (9 hours)

a. History, functions and requirements, elements of a suspension system, loads and characteristics.
b. Springs: leaf, coil and torsion bar, air springs.
c. Shock absorbers: dampers. Different types of suspension systems. Wheels and tyres.

Module IV (14 hours)

a. Steering mechanism: function and requirements, layout of steering system, front axle and stub axles, steering linkages, cornering force and self righting torque, power steering.
b. Braking mechanism: function and requirements, classification, mechanical and hydraulic brakes, air brake, brake efficiency. Antilock braking systems (ABS).
c. Four wheel drive mechanism, variable valve timing (VVT) technology,
d. Cooling and Lubrication systems, SAE grades for lubricant oils used.
e. Exhaust system and Emission control system.
f. Vehicle safety systems.

Module V

a. Electric and hybrid vehicles
b. Fuel cell operated vehicles

Suggested Readings

1. P. S. Gill, Automobile Engineering I and II, S. K. Kataria and sons.
2. D. S. Kumar, Automobile Engineering, S. K. Kataria and sons.
3. K. K. Jain, R. B. Asthana, Automobile Engineering, Tata McGraw Hill publishing co. Ltd.
4. R K. Rajput, A Textbook of Automobile Engineering, Laxmi Publications (P) Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1		M	M	M	
CO2	H				L
CO3				H	
CO4		H	H	H	L

MNPE0057: POWER PLANT ENGINEERING

(L-T-P: 3-0-0)

Objective

This course will enable students to study the preliminary design of the major systems of conventional fossil-fuel steam-cycle, nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants. It will also make the students aware regarding the economic, environmental, and regulatory issues related to power generation.

Module I (5 hours)

Introduction to different power plants, Load duration curves, Location of power Plants, Power plant economics and Indian energy scenario.

Module II (15 hours)

Introduction to Rankine cycle, Typical layout of steam power plant, Efficiencies in steam power plant, Cogeneration of power and process heat, Combined cycle power generation, Different types of fuel and their properties, coal handling, ash handling of steam generation, Draught system, Natural Draught, Mechanical Draught. Pollution control technologies for coal.

Module III (10 hours)

a. Introduction, Classification of different gas turbine power plants, Analysis of closed cycle and open cycle constant pressure gas turbine plant, Reheat, Intercooling and regeneration cycle, components of gas turbine plants, combined cycle power plants, gas turbine fuels and gas turbine materials.
b. Introduction, Application of diesel engines in power field, Advantages and disadvantages of diesel engine power plant, General layout, Performance characteristics, Supercharging.

Module IV (10 hours)

a. Introduction, Classification of hydro-electric power plant, Site selection, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and its selection, Hydrographs, Flow duration curves.
b. Introduction to nuclear engineering, Types of nuclear reactors, Pressurized water reactor, Boiling water reactor, CANDU reactor, Gas-cooled reactor, Liquid metal fast breeder reactor, India‘s nuclear power programme. Waste disposal for nuclear materials.

Module V (5 hours)

Prospect of renewable energy source, Types of non-conventional power plants, solar plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal power plant.

Course Outcomes

At the end of the course students will be able to:

a. CO1: Recall the basic of power plant engineering terminologies and economics of power plant.. (Remembering)
b. CO2: Classify conventional and Non-conventional power plants along with various equipment of power plant engineering. (Understanding)

c. CO3: Explain the design parameters of conventional and non-conventional power plant. (Understanding)
d. CO4: Identify and solve power plant engineering problems. (Applying)

Suggested Readings

1. P. K. Nag, Power Plant Engineering, Tata McGraw-Hill.
2. S.C. Arora and S. Domkundwar, A course in Power Plant Engineering, Dhanpat Rai and Co.
3. R.K.Rajput, Power Plant Engineering, Laxmi Publishers.
4. Black and Veatch, Power plant Engineering, McGraw-Hill.
5. S. Domkundwar, Solar energy and Non –conventional energy.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO1	H	M	M	M	H
CO2		H	H	H	M
CO3		M	H	L	
CO4	M	H	L	H	

MNQM0058: TOTAL QUALITY MANAGEMENT

(L-T-P: 3-0-0)

Objectives

This Course is introduced with the objective of analyzing the relevance of total quality management system in the engineering profession in the light of its increased involvement in company practices.

Course Outcomes

At the end of the course students will be able to:
1. Define quality and its various dimensions. (Remembering)
2. Interpret various principles of TQM. (Understanding)
3. Apply the tools of quality control in various engineering application. (Applying)

Module I (8 hours)

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation and satisfaction, customer complaints, customer retention; costs to quality.

Module II (11 hours)

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating and selection.

Module III (18 hours)

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types. TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM-concepts, improvement needs, performance measures.

Module IV (8 hours)

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Suggested Readings

1. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India
2. Besterfield D.H. et al., Total Quality Management, Pearson Education Asia
3. Arora, K.C., Total Quality Management, Kaston Books.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H	M	M	M

CO2		H	M	H
CO3	L	M	H	H

MNCA0059: COMPUTER AIDED DESIGN AND MANUFACTURING
(L-T-P: 3-0-0)

Objective
To provide the learner with involving fundamental concepts and state-of-the-art techniques in the field of CAD/CAM. To equip students, with knowledge and skill to undertakes, design, analysis, evaluation of system, processes and components.

Course Outcomes
After completing the course successfully the students will be able to-
1. Name various hardware, software components and system requirements for implementing CAD/CAM; Illustrate the product design and manufacturing process ; state the different laws governing robotics & understand the use of robotics and automation in different environment; summarize the concepts of group technology, FMS and their applications
2. Solve transformation operation related problems to manipulate an object under consideration as per the need of the design/manufacturing process
3. Understand and compare various types of geometric modelling techniques, know different geometric primitives, curves, surfaces, product data exchange in CAD
4. Synthesize a CNC manual or computer assisted part program to use it for machining of different parts by various manufacturing operations.

Module I (7 hours)
Introduction to CAD/CAM, need, advantages, Fundamentals of design process, stages in design process and product development cycle, Computers in design applications, role of computers in industrial manufacturing, components of CAD/CAM/CAE systems, system software and application software, CAD database and structure, coordinate systems in CAD, Typical Product Life Cycle

Module II (10 hours)
Intro to Rigid body transformation, affine transformation and general transformations; Basic transformations: Translation, Rotation, Scaling, Reflection and Shear; Introduction to Homogeneous coordinate representation: 2D and 3D; Concatenated transformation.

Module III (10 hours)
a. 3D wire frame modeling, wire frame entities- definitions interpolation and approximation curves, concept of parametric and nonparametric representation of curves, curve fitting techniques, definitions of cubic spline and Bezier, B-spline.
b. Surface modeling: Algebraic and geometric form, parametric space of surface, blending functions, Reparametrization of a surface patch, subdividing, cylindrical surface, ruled surface, surface of revolution, spherical surface, Composite surface, Bezier surface, B-spline surface.
c. Solid modeling: Definition of cell composition and spatial occupancy enumeration, sweep representation, constructive solid geometry, boundary representations.
d. Product data exchange: Need, advantage, IGES, STEP

Module IV: NC Part Programming and Robotics (9 hours)
a. Introduction to NC, CNC, DNC; NC coordinate system; Introduction to NC part programming: manual part programming, computer assisted part programming (APT language), advantages and limitations of programming methods.
b. Introduction to Robotics: Robot definition, origin and characteristics; History of robotics; Asimov's laws of robotics, types of robots, specifications and applications, advantages and limitations, Introduction to robot anatomy.

Module V: Group Technology and Flexible Manufacturing System (4 hours)
Group technology and flexible manufacturing system: Part families, parts classification and coding, production flow analysis, machine cell design, FMS workstations, Material handling and storage system, Application of Group technology and FMS.

Suggested Readings
1. MickelP.Groover, "Automation, production systems and computer Integrated manufacturing", 3rd edition, PHI, 2009.
2. Ibrahim Zeid., "CAD/CAM Theory and practice" Tata Mcgraw Hill education private limited, 2009
3. David D Bedworth, "Computer Integrated design and Manufacturing," McGraw Hill International 1991
4. P. N. Rao, "CAD/CAM Principles and Applications," 3rd edition, Tata McGraw Hill, 2010

5. Dr. K. C.Jain, Sanjay Jain, "Principles of Automation and Advanced Manufacturing Systems," 1 st Edition, Khanna Publishers.
6. K. Lalit Narayan, K. Mallikajurna Rao, M.M.Sarcar "Computer aided design and manufacturing." PHI.
7. https://nptel.ac.in/courses/112/102/112102102/
8. https://nptel.ac.in/courses/112/102/112102103/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H			M	H
CO 2		H			
CO 3			H		
CO 4				H	

MNSG0060: SURFACE ENGINEERING

(L-T-P: 3-0-0)

Objective

The course is designed to have systematic and comprehensive understanding on various aspects related with surface engineering of metallic components for enhanced tribological life.

Course outcomes:

After completing the course successfully the students will be able to-

1. Define and the different types of surface engineering, and wear mechanism. .
2. Classify and compare the surface engineering methodologies.
3. Analyze the processes for controlling wear.
4. Identify the suitable surface engineering technique as per the requirement.
5. Find methods to improve the surface characteristics.

Module I (9 hours)

Purpose and need of surface engineering, Surface sub-surface regions, Classification of surface modification techniques, Scope of surface engineering, Role of surface properties on friction and wear

Module II (10 hours)

a. Advantages and limitations of surface engineering, Materials properties and its effect on performance of components, Fundamentals of wear mechanism: Adhesive wear, Fundamentals of wear mechanism: Abrasive wear, Fundamentals of wear mechanism: Surface fatigue wear.
b. Fundamentals of wear mechanism: Corrosion wear, Fundamentals of wear mechanism: Cavitation wear, Fundamentals of wear mechanism: Erosion wear and Fretting wear, Fundamentals of wear mechanism: Diffusive wear and Seizure, Evaluation of damage on wear surfaces

Module III (9 hours)

Material properties for controlling wear: Material properties for specific type of wear, Structure and wear relationship for materials of commercial importance, New coating system: Functionally Graded Thermal Barrier Coatings (FGM), Thermal Barrier Coatings (TBCs), Guidelines for selection of materials for engineering the surface.

Module IV (11 hours)

b. Fundamental approaches of structural modification, Candidate materials for structural modification, Processes: Localised plastic deformation Processes: Localised plastic deformation, Shot peening, Burnishing
c. Transformation hardening, Laser Hardening Processes, Induction hardening. Advantages, limitations and application, Fundamental approach of changing chemical composition, Candidate material for controlling wear.
d. Carburizing and plasma carburizing, Carbo-nitriding and Cyaniding, Nitriding and plasma nitriding, Chromizing and Aluminizing V. Boronizing
e. Laser Plasma TIG alloying, Vapor deposition and Ion implantation, Chemical vapour deposition (CVD) and Ion bean assisted CVD, Physical vapour deposition, Advantages, limitations and application

Module V: Processes for Controlling Wear (8 hours)

a. Coatings and Overlays: Fundamentals of approach, Heat input, and dilution, Welding based methods, Laser cladding Thermal spray based methods.

b. Coatings and Characterization: Electrolysis based methods, Advantages, limitations and application Purpose, Characterization of soundness, Thickness measurement, Surface roughness measurement
c. Characterization of Engineered Surfaces: Mechanical properties, Chemical properties, Metallurgical properties, Wear properties.

Suggested Readings

1. ASM Handbook, Surface Engineering, ASM, (1995) Ohio.
2. D K Dwivedi, Surface Engineering: Enhancing life of tribological component, Springer (2017) New Delhi.
3. Materials and Surface Engineering in Tribology, Willey (2007).
4. Materials Degradation and its control by surface engineering, Imperial College Press, (2006),
5. Surface engineering in metals, CRC Press (1999) London.
6. https://nptel.ac.in/courses/112/107/112107248/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	L	H	M	L	
CO 3			L	M	H
CO 4			M	H	L
CO 5			L	M	H

MNWT0061: WELDING TECHNOLOGY

(L-T-P: 3-0-0)

Objectives

- To familiarize the students with the fundamentals of arc welding processes, weld joint design, metallurgical aspects in welding of steel, and assessing the quality and suitability of weld joints.
- To equip the students technological input for handling the problems in welding of selected metals and alloys.

Course Outcomes:

After completing the course the student will be able

1. CO1: To define the welding process.
2. CO2: To classify the different types of welding.
3. CO3: To identify suitable processes for producing quality weldments based on materials and applications.
4. CO4: To inspect the quality of weldments and suggest methods of producing quality joints.
5. CO5: To compare the selection and design of appropriate consumables for welding involving different types of materials.
6. CO6: To an environment for developing and adopting in energy saving and eco-friendly techniques in welding industries.

Module I (6 Hours)

a. Introduction:
Evolution of welding; classification of welding processes; heat sources and shielding methods.
b. Physics of Welding Arc
Welding arc; voltage distribution along the arc; thermionic and non-thermionic cathodes; theories of cathode and anode mechanism; arc characteristics and its relationship with power source; arc efficiency; heat generation; effect of type of shielding gas on arc; isotherms of arcs.
c. Welding Power Sources
Conventional welding power sources; constructional features; static and dynamic characteristics; duty cycle; influence of inductance on arc and power source characteristics; internal and external regulation; specific power source requirements; special welding power sources.

Module II (6 Hours)

Consumable electrode welding processes. Manual metal arc (MMA) welding; Gas metal arc welding; pulsed MIG welding; Submerged arc welding, Significance of flux-metal combination; Electroslag welding: heat generation; principle; Gas tungsten arc welding; selection of polarity, Plasma arc welding; transferred and nontransferred plasma arc welding; selection of gases; welding parameters; keyhole technique.

Module III (8 Hours)
Effect of welding parameter on heat distribution; calculation of peak temperatures; thermal cycles; cooling rate and solidification; Residual stresses and their distribution in welds; influence of residual stresses in static and dynamic loading, distortion.

Module IV (8 Hours)
Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading, Weld Calculations in lap, butt and fillet welds; design for fatigue loading, Introduction to Fatigue; nature of the fatigue process; fatigue strength; factors affecting fatigue life; improvement methods for fatigue strength; reliability analysis and safety factors applied to fatigue design.

Module V (6 Hours)
Chemical tests; Metallographic tests; Hardness tests; Mechanical test for groove and fillet welds-full section, reduced section and all-weld- metal tensile tests, root, face and side bend tests, fillet weld break tests, creep and fatigue testing. Non-Destructive Testing of Weldments; Visual inspection; Dye-penetrant inspection; Magnetic particle inspection; Ultrasonic inspection principle of ultrasonic testing, Radiographic inspection –principle of radiography, X-ray tubes, gamma-ray sources, defect discernibility; Eddy current inspection; Leak tests: N.D.T. Standard procedure for specification and qualification of welding procedure.

Module VI (8 Hours)
Solidification of weld metal; heat affected zone (HAZ), factors affecting properties of HAZ; gas-metal, slag-metal and solid state reactions in welding and their influence on soundness of weld joint; lamellar tearing and hydrogen damage; weldability; definition, factor affecting the weldability of steel Carbon equivalent. weldablity of steel, cast iron and aluminium alloys of commercial importance, failure analysis of welded joints.

Suggested Readings
1. The Metallurgy of Welding, 6th Edition, Lancaster, William Andrew Publishing, NY.
2. Principles of Welding (Processes, Physics, Chemistry and Metallurgy), Robert and Messler, Wiley Interscience Publishers.
3. Welding Hand Book Vol. 5; 7th edition, AWS, 1984.
4. Welding METALLURGY, S Kou, John Wiley, USA, 2003.
5. NPTEL LINK: https://nptel.ac.in/courses/112/107/112107090/
6. NPTEL LINK: https://nptel.ac.in/courses/112/103/112103263/
7. NPTEL LINK: https://nptel.ac.in/courses/112/107/112107090/

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2		H				
CO 3		M	H	H		
CO 4				M	H	
CO 5			M	H		
CO 6					M	H

MNGT0062: GAS TURBINES AND JET PROPULSION

(L-T-P: 3-0-0)

Objectives:
- To understand the major components and the working principle of a gas turbine power plant.
- To acquire the skills required to determine the performance of a combined cycle power plant.
- To learn about the various design of a combustion chamber and their modifications.
- To familiarize the classification of jet propulsion cycles and their working principles.

Module I (10 hours)
Open cycle Arrangements, Closed cycle, Basic requirements of the Working Medium, Applications, Comparison of Gas Turbines with Reciprocating Engines, Assumptions in Ideal Cycle Analysis, Simple Gas Turbine Cycle, Reheat Cycle, Intercooled Cycle, Regeneration Cycle, Comparison of various cycles, Combined Steam-Gas Turbine Plant, Blade Materials, Manufacturing Techniques, Blade Fixing.

Module II (10 hours)

Centrifugal Compressors: Essential Parts, Principle of Operation, Ideal Energy Transfer, Blade Shapes and Velocity Triangles, Analysis of Flow through the Compressor, Diffuser, Volute Casing, Performance Parameter, Losses in Centrifugal Compressor, Compressor Characteristics, Surging and Choking.

Axial Compressors: Geometry and Working Principle, Stage Velocity Triangles, Work Done Factor, Enthalpy-Entropy Diagram, Compressor Stage Efficiency, Performance Coefficients, Degree of Reaction, Flow through Blade Rows, Flow Losses, Stage Losses, Performance Characteristics, Comparison of Axial and Centrifugal Compressor.

Module III (8 hours)

Combustion Theory Applied to Gas Turbine Combustor, Factors affecting Combustion Chamber Design, Factors affecting Combustion Chamber Performance, Form of Combustion System, Requirements of the Combustion Chamber, Process of Combustion in a Gas Turbine, Combustion Chamber Geometry. Ignition and Pollution.

Module IV (12 hours)

Reciprocating or Propeller Engines, Gas Turbine Engines, Ramjet engine, Pulse Jet engine, Turbo prop engine, Turbo jet engine, Thrust and Thrust equation, Specific thrust of the Turbojet engine, Efficiencies, Parameters affecting Flight Performance, Thrust Augmentation.

Classification of Rockets, Principle of Rocket Propulsion, Analysis of an Ideal Chemical Rocket, Classification of Chemical Rocket-Solid Propellant, Liquid Propellant and Free radial rockets.

Course Outcomes

After completing the course the student will be able to

1. define the open cycle gas turbine plants with modifications.
2. analyze the performance of open cycle gas turbines with modifications.
3. compare the difference between the working of centrifugal and axial flow compressors.
4. formulate the different types of combustion chamber design and modifications.

Suggested Readings

1. Ganesan, V. “Gas Turbines”, Mc Graw Hills.
2. Kharuja and Dubey, “Gas Turbines and Propulsive Systems''. Dhanpat Rai Publications.
3. Mattingly, J. “Element Gas Turbine Propulsion”, Mc Graw Hill Education.
4. Cohen and Rogers, “Gas Turbine Theory”, Pearson Education.

Mapping of COs to Syllabus

Course Outcomes	Module1	Module2	Module3	Module4
CO1	H		L	M
CO2	H			L
CO3	L	H		M
CO4	L		H	M

MNRA0064: ROBOTICS AND AUTOMATION

(L-T-P: 3-0-0)

Objectives

- To develop the student’s knowledge in various robot structures and their workspace
- To develop student’s skills in perform kinematics analysis of robot systems
- To provide the student with some knowledge and skills associated with robot control

Course Outcomes:

After completing the course successfully the students will be

CO 1: describe various types of robots, robotic sensors and their manipulators used in industries

CO 2: explain the mechanical structure of robot, motion of rigid bodies, kinematics of mechanisms and dynamics of robotics

CO 3: discuss various uses of industrial robots

CO 4: solve forward kinematics, inverse kinematics of simple robot manipulators

Module I: (8 hours)

Evolution of Robots and Robotics, Laws of Robotics, What is and what is not a Robot, Progressive Advancement in Robots. Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Programming Robots

Module II: (8 hours)

a. Robot End Effectors: Classification of end effectors, drive system for grippers, Mechanical, Magnetic, Vacuum, Adhesive grippers, Hooks Scoops, Miscellaneous devices, Gripper force analysis and Design, Active and Passive Grippers
b. Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices.

Module III: (8 hours)

Symbolic Modelling of Robots: Direct Kinematic Model, Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modelling of the Manipulator, Denavit –Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model

Module IV: (8 hours)

a. Robotic Sensors: The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Choosing the right sensors
b. Robotic vision: Introduction to Robotic Vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems

Module V: (8 hours)

a. Robot Applications: Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-industrial Applications.
b. Robot Programming: Robot languages, Classification of Robot language, Computer control and robot software

Suggested Readings

1. Saeed B. Niku, Introduction to Robotics, Wiley.
2. Mittal R.K., Nagarath, I.K., Robotics and Control, Tata Mc Graw Hill.
3. Deb S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill.
4. Groover, M. P., Wiess, M., Nagel, R. N. and Odery, N. G. Industrial Robotics- Technology, Programming and Applications, McGraw Hill Inc. Singapore
5. Ghoshal, A., Robotics Fundamental Concepts and Analysis, Oxford University Press.
6. Craig JJ, Introduction to Robotics, Mechanics and Control, Addison-Wesley, 2nd Ed.
7. Fu, K.S., Gonzales, R.C. and Lee, C.S.G., Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill.
8. https://nptel.ac.in/courses/112/101/112101098/

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H			H	
CO 2		H	M		
CO 3				M	H
CO 4		L	H		

MNRA0064: ROBOTICS AND AUTOMATION

(L-3: T-0: P-0)

Objectives:

- 1. To develop the student's knowledge in various robot structures and their workspace
- 2. To develop student's skills in perform kinematics analysis of robot systems
- 3. To provide the student with some knowledge and skills associated with robot control

Course Outcomes:

After completing the course successfully the students will be

CO 1: describe various types of robots, robotic sensors and their manipulators used in industries

CO 2: explain the mechanical structure of robot, motion of rigid bodies, kinematics of mechanisms and dynamics of robotics

CO 3: discuss various uses of industrial robots

CO 4: solve forward kinematics, inverse kinematics of simple robot manipulators

Module I: (12 hours)

a. Introduction: Evolution of Robots and Robotics, Laws of Robotics, what is and what is not a Robot, Progressive Advancement in Robots. Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Programming Robots
b. Robot End Effectors: Classification of end effectors, drive system for grippers, Mechanical, Magnetic, Vacuum, Adhesive grippers, Hooks Scoops, Miscellaneous devices, Gripper force analysis and Design, Active and Passive Grippers

Module II: (16 hours)

a. Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices.
b. Symbolic Modelling of Robots: Direct Kinematic Model, Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modelling of the Manipulator, Denavit –Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model

Module III: (12 hours)

a. Robotic Sensors: The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Choosing the right sensors
b. Robotic vision: Introduction to Robotic Vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems
c. Robot Applications: Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-industrial Applications.
d. Robot Programming: Robot languages, Classification of Robot language, Computer control and robot software

Suggested Readings

1. Saeed B. Niku, Introduction to Robotics, Wiley.
2. Mittal R.K., Nagarath, I.K., Robotics and Control, Tata Mc Graw Hill.
3. Deb S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill.
4. Groover, M. P., Wiess, M., Nagel, R. N. and Odery, N. G. Industrial Robotics- Technology, Programming and Applications, McGraw Hill Inc. Singapore
5. Ghoshal, A., Robotics Fundamental Concepts and Analysis, Oxford University Press.
6. Craig JJ, Introduction to Robotics, Mechanics and Control, Addison-Wesley, 2nd Ed.
7. Fu, K.S., Gonzales, R.C. and Lee, C.S.G., Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill.
8. https://nptel.ac.in/courses/112/101/112101098/

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3
CO 1	H		M
CO 2	M	H	
CO 3	L		H
CO 4		H	

MNOR0065: OPERATIONS RESEARCH (Open Elective for all branches)

(L-3;T-0;P-0) **(3 credits - 45 hours)**

Objective: Operations Research can be described as a scientific approach to the solution of problems in the management of complex systems. In a rapidly changing environment an understanding is sought which will facilitate the choice and the implementation of more effective solutions which, typically, may involve complex interactions among people, materials and money.

Course Outcomes

At the end of the course students will be able to:

CO1: Recall the basic of operation research and classification of optimization techniques. (Remembering)

CO2: Express the characteristics of different types of decision-making environments and the appropriate decision making approaches. (Understanding)

CO3: Build and solve linear programming, graphical method, simplex method transportation model, assignment model, sequencing model, Bracketing method, Region elimination method and Gradient based method, . (Applying)

Module I: Introduction to Linear Programming (12 hours)
Introduction to operation research, advantages and disadvantages of operation research along with applications Introduction to linear programming - formulation, graphical method, Simplex method and its applications, initial basic feasible solution, optimality test, Big M method

Module II: Special topics in Linear Programming (8 hours)

Duality in linear programming, the dual simplex method.

Module III: The Transportation Model and The Assignment Model (8 hours)
a. Formulation and solution of Transportation Model, North-west Corner method, Vogel's approximation method, modified distribution method, degeneracy in Transportation problem,
b. Mathematical representation and solution of assignment model, Hungarian method.

Module IV: Sequencing Model (6 hours)
Assumptions in sequencing problem, processing of n jobs through: one machine, two machines and three machines, processing of two jobs through m machines.

Module V: Nonlinear programming: single variable optimization algorithms (11 hours)
Introduction to nonlinear programming, Local and global optimum, Concave and convex function, Bracketing method: Exhaustive search method, Bounding phase method, Region elimination method: Fibonacci search method, Golden section search method, Gradient based method: Newton Raphson method, Secant method.

Suggested Readings
1. D. S. Hira and P.K. Gupta, "Operations Research"S. Chand
2. J.K. Sarma"Operations Research "Macmillan
3. Taha " Operation Research an introduction"Pearson
4. Kalyanmoy Deb "Optimization for Engineering design Algorithms and examples " PHI

Mapping of COs to Syllabus

COs	Module1	Module2	Module3	Module4	Module5
CO1	M				H
CO2	M	L	L	L	M
CO3	H	H	H	H	H

MNOR0065: NUMERICAL METHODS IN MECHANICAL ENGINEERING

(L-3;T-0;P-0) (3 Credits- 45 Hours)
Objective: To learn and understand the various numerical approximation methods used to solve different types of equations, which are used to model mechanical engineering phenomena. The subject gives an insight into how real life problems in the field of mechanical engineering are solved.
Module I (15 Hours)
Taylor Series; Roots of equations: The Bisection Method, The False Position Method, Simple Fixed Point Iteration, Newton Raphson method, Secant method. Roots of polynomials: Muller's and Bairstow's Method. Sets of Linear algebraic equations: Gauss Elimination method, Gauss Jordan elimination method, LU Decomposition method, Matrix Inversion method, Gauss Siedel iteration method. Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Ordinary Differential Equations: Euler's method, RungeKutta Methods.

Module II (15 Hours)
Numerical solutions to Partial Differential Equations using Finite Difference Method (FDM): Elliptic Equations, Parabolic equations. Curve Fitting: Least Squares Regression, Interpolation.

Module III (15 Hours)

Basic finite element concepts-Basic ideas in a finite element solution, General finite element solution procedure, Application of Finite element concepts to 1D and 2D problems. Finite volume method:Conceptual Basics and Illustrations through 1-D Steady State Problems.

Course Outcomes:

After completing the course successfully, the students will be able to-

CO1: Classify the different approaches used to solve partial differential equation numerically.

CO2: Apply the numerical method which can optimize the solution for specific problems in terms of computation effort and accuracy.

CO3: Analyse data sets through applications of curve fitting methods.

CO4: Develop Finite Element, Finite Difference and Finite Volume formulations of mechanical engineering problems.

Suggested Readings

1. Steven C. Chapra et al., "Numerical Methods for Engineers", Tata McGraw Hills Publication.
2. Dr. B. S. Grewal, "Numerical Methods in Engineering and Science with Programs in C and C++", Khanna Publications.
3. Bhatti, M.A., "Fundamental Finite Element Analysis and Applications: with Mathematical and MATLAB Computations", Wiley, 2005.
4. https://nptel.ac.in/courses/127/106/127106019/ (IIT Madras)
5. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ge20/ (IIT Madras)
6. https://nptel.ac.in/courses/122/102/122102009/ (IIT Delhi)
7. https://nptel.ac.in/courses/111/106/111106101/ (IIT Madras)
8. https://onlinecourses.nptel.ac.in/noc19_ge30/preview (Swayam Portal)

Mapping of COs to syllabus

COs	Module1	Module2	Module3
CO1	L	H	M
CO2	H	M	M
CO3		H	L
CO4			H

LAB COURSES

MNWM6023: WORKSHOP/MANUFACTURING PRACTICES

(3 Credits) (L-T-P: 1-0-4)

Objective

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Course/Learning Outcomes

At the end of the experiments students will be able to

1. Recognize different fabrication techniques. (Remembering)
2. Identify the tools and machinery involved in the various experiments related to material processing. (Understanding)
3. Demonstrate some of the advanced and latest manufacturing techniques being employed in the industry. (Applying)
4. Recognize the different manufacturing processes which are commonly employed in the industry. (Understanding)
5. Fabricate simple components using different materials and fabrication techniques. (Applying)

Manufacturing Practice

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 hours)
2. CNC machining, Additive manufacturing (1 hour)
3. Fitting operations and power tools (1 hour)
4. Electrical and Electronics (1 hour)
5. Carpentry (1 hour)
6. Plastic moulding, glass cutting (1 hour)
7. Metal casting (1 hour)
8. Welding (arc welding and gas welding), brazing (1 hour)

Workshop Practice

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical and Electronics (8 hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding and Glass Cutting (6 hours)

Suggested Readings

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol I and Vol II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu, “Manufacturing Technology – I” , Pearson Education, 2008.
4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
5. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw Hill House, 2017.

MNMD6024: MACHINE DRAWING LAB

(0 credits) (L-T-P: 0-0-2)

Objectives:

- To develop basic understanding of projections and sectional views of various mechanical parts.
- To get an idea about the assembly drawing of machines.

Course Outcomes

At the end of the course students will be able to:

1. Explain the concepts of different types of projections. (Explaining)
2. Identify the full and half sectional views of machine parts based on requirements. (Applying)

3. Construct different types of assembly drawings of machine units based on their uses. (Creating)

Orthographic projections and Perspective projections

1. Principle of projections.
2. First and third angle projections.
3. Orthographic projections in first and third angle.
4. Perspective projections.

Sectional views

1. Introduction and types of sectional views
2. Full section
3. Half section
4. Full and half sectional views of different machine parts.

Assembly drawings

1. Procedure and types of assembly drawings.
2. Assembly drawings of machine units like stuffing box, connecting rod, foot step bearing, tool-post, flanged coupling etc.

Text Books/ References:

1. N. D. Bhatt, V. M. Panchal, Machine Drawing, Charotar Publishing House.

MNMF6025: MECHANICAL ENGINEERING LAB 1: MATERIALS AND MANUFACTURING LAB

(2 Credits) (L-T-P: 0-0-4)

Objectives:

- To provide an understanding of various manufacturing processes.
- To get an idea of the dimensional and form accuracy of products.

A:

1. Facing, Turning: Step turning, taper turning.
2. Thread Cutting- Internal and external thread cutting using a single point cutting tool.
3. Contour milling using a vertical milling machine.
4. Spur gear cutting in milling machine.
5. Study of CNC part programming.
6. Use of CNC machine tools: Lathe (2 Axis)
7. Use of CNC machine tools: Milling (3 Axis)
8. Use of CNC machine tools: Milling (4 Axis)
9. Study and use of Universal Robot Arm.

B:

1. Use of slip gauges and sine bar.
2. To study the Brinell hardness testing machine and perform the Brinell hardness test.
3. To study the Rockwell hardness testing machine and perform the Rockwell hardness test.
4. To study the Vickers hardness testing machine and perform the Vicker hardness test.
5. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
6. To study the Impact testing machine and perform the Izod Impact tests.
7. To study the Impact testing machine and perform the Charpy Impact tests.
8. To study the Universal testing machine and perform the tensile test.
9. Use of Vernier caliper and height gauge.
10. Use of micrometer, depth gauge.

Course/Learning Outcomes

After completion of this course, students will be able to

1. Label various engineering measurement devices with its characteristics and to perform some advanced manufacturing operations. (Remembering)
2. Relate the theoretical learning into applications with various engineering measurement devices and tools. (Understanding)

3. Make use of various measuring devices for taking different measurements and to evaluate the accuracy and tolerance of components produced. (Applying)
4. Distinguish the implementations and critical use of various devices for precise measurement. (Analysing)
5. Justify theoretical and practical knowledge into the actual working environment for various measurements. (Evaluating)
6. Elaborate the processes related to measurement in engineering and determine the use of various tools. (Creating)

MNFT6026: Mechanical Engineering Lab2: Fluid and Thermal

(2 Credits) (L-T-P: 0-0-4)

Objective

Introduce the student the fundamental theories and laws along with the industrial applications of thermodynamics, heat transfer, fluid mechanics and hydraulic machines

A. Thermal Engineering

1. Determination of dryness fraction of combined separating and throttling calorimeter.
2. Determination of Coefficient of Performance of Vapour Compression Refrigeration System.
3. Study and Performance test of Single Acting Reciprocating Air Compressor.
4. Determination of Thermal Conductivity of Metal Rod and Composite Wall
5. Determination of Heat Transfer Coefficient in Natural Convection and Forced Convection.
6. Determination of Temperature Distribution and Fin Efficiency in both Natural and Forced Convection.
7. Determination of Stefan Boltzmann Constant.
8. Determination of LMTD of both parallel flow and counter flow heat exchanger.
9. Study and Performance test on a Petrol Engine.
10. Study and Performance test on a Diesel Engine.

B. Fluid and Hydraulics Machines.

1. Determination of metacentric height.
2. Study of fluid pressure distribution on immersed bodies.
3. Experimental verification of Bernoulli's theorem.
4. Study of discharge through orifice meter and venturimeter.
5. Study of discharge through Triangular and Rectangular notches.
6. Study of different types of pipe flow.
7. Determination of vorticity of free and forced vortex.
8. Determination of velocity through Pitot tube.
9. Determination of performance of Pelton Wheel & Francis turbine.
10. Determination of performance of Reciprocating pump, Centrifugal pump and Submersible pump.

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define various studies for understanding the practical concepts of laws of fluid mechanics, hydraulic machine and thermal engineering system. (Remembering)
2. Explain various basic concepts used for performing experiments in I.C engine, Refrigeration system, Air conditioning system, Hydraulics machines and equipment. (Explaining)
3. Apply basic formulae of heat transfer to perform experiment in conduction, convection and radiation and study of discharge over notches, orifice, hydrostatic force, experimental verification on Bernoulli theorem, laminar flow apparatus, hydraulics turbine and hydraulic pumps (Applying)
4. Analyse the characteristics parameter of various heat transfer equipment, I. C engine, Refrigeration system, Air conditioning system, Hydraulics machines. (Analysing)
5. Evaluate the characteristics parameter of various heat transfer equipment, I. C engine, Refrigeration system, Air conditioning system, Hydraulics machines. (Evaluating)
6. Elaborate the characteristics parameter of various heat transfer equipment, I. C engine, Refrigeration system, Air conditioning system, Hydraulics machines and equipment. (Creating)

MNMI6027: MINI PROJECT (30 HOURS)

Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

MNDS6028: Mechanical Engineering Lab3: Design

(2 Credits) (L-T-P: 0-0-4)

Objectives:

- To understand the measurement of mechanical properties of materials
- To understand the deformation behaviour of materials
- To understand the kinematic and dynamic characteristics of mechanical devices Contents

Course/Learning Outcomes

After completing the course successfully the students will be able to-

1. Define laws of Engineering mechanics, Theory of machine and vibration of mechanical system. (Remembering)
2. Explain various basic concepts for performing experiments in Governors, cam follower, gyroscope, brakes and dynamometers and equipment. (Explaining)
3. Identify the study of frequency of undamped single and two degree freedom systems. (Applying)
4. Distinguish the implementations and critical use of various devices for precise measurement.
5. Analyse numerical solutions to vibration problems by simple algorithms, and display the findings in graphical form. (Analysing)
6. To evaluate the motion and the natural frequency for forced vibration of a single degree of freedom damped or undamped system. (Evaluating)
7. Construct a cam profile for a particular application. (Creating)

A.

1. Determination of Coefficient of Friction between two given surfaces.
2. Determination of Moment of Inertia of the Fly Wheel.
3. Verification of Triangle Law and Polygon Law of Forces.
4. Determination of efficiency of Screw Jack.
5. Worm and Worm wheel experiment
6. To verify the law of moment of force and to determine the Bending Moment for a simply supported beam.
7. Study of gyroscope and gyroscopic effect/couple.
8. Study of different types of brakes and dynamometers.

B.

1. Determination of the sleeve lift for various speeds of a Hartnell governor.
2. To plot follower displacement vs Cam rotation for various cam follower systems.
3. Velocity ratios of simple, compound, epicyclic and differential gear trains.
4. Study of four bar mechanism, slider crank mechanism and their inversions.
5. Cam and follower and motion studies.
6. Determination of natural frequency of an undamped single and two degree freedom system.
7. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient.
8. To study the free vibration and to determine the natural frequency of vibration of the Two-Rotor system.
9. To study the torsional vibration and to determine the natural frequency vibration of a single rotor system.

MNMP6029: MAJOR PROJECT (PHASE I)

(2 credits)

The major project phase I requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, etc. students will learn to use these core principles along with tools like computer-aided design, ABAQUS, ANSYS to design and Analyse manufacturing plants, industrial equipment and machinery, refrigeration and air conditioning systems, transport systems, aircraft, watercraft, robotics, medical devices, and others under the guidance of faculty members.

Course/Learning Outcomes

At the end of Project Phase I students will be able to

1. Find potential gaps and needs related to mechanical engineering through study of existing literature. (Remembering)
2. Interpret the potential gaps in mechanical engineering through literature review. (Understanding)
3. Develop a feasibility study on the proposed topic. (Applying)
4. Discover the problem statement. (Analysing)
5. Assess the proposed topic by application of basic principles of mechanical engineering. (Evaluating)
6. Evaluate and validate their respective results and propose further scope for advancement in that particular domain. (Evaluating)
7. Compile their results using various engineering application tools. (Creating)
8. Construct the mechanical engineering component using resources available. (Wherever applicable). (Creating)
9. Build reports of the work. (Creating)

MNMP6031: MAJOR PROJECT (PHASE II) AND VIVA VOCE
(4 credits)

The major project phase II involves the students in realising their goal towards fulfilling the identified problem from the first phase of the major project. Accordingly students will design/ fabricate/analyse whichever is/are needed. The complete report of the work in proper format is prepared and finally the work is evaluated. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester.

Course/Learning Outcomes
At the end of Project Phase II students will be able to
1. Find potential gaps and needs related to mechanical engineering through study of existing literature. (Remembering)
2. Interpret the potential gaps in mechanical engineering through literature review. (Understanding)
3. Develop a feasibility study on the proposed topic. (Applying)
4. Discover the problem statement. (Analysing)
5. Assess the proposed topic by application of basic principles of mechanical engineering. (Evaluating)
6. Evaluate and validate their respective results and propose further scope for advancement in that particular domain. (Evaluating)
7. Compile their results using various engineering application tools. (Creating)
8. Construct the mechanical engineering component using resources available. (Wherever applicable). (Creating)
9. Build reports of the work. (Creating).

MNSL0200: SERVICE-LEARNING
(2 Credits)

Module I: Theory (15 hours)
a. Understanding Service Learning – Its philosophy, historical background, purpose, value & theoretical framework; Locating Service-Learning within the University context
b. Principles of Service Learning; Classification of Service-Learning Models; Experiential Learning; Reflective Learning; Journaling; Service-Learning Pedagogy; Difference between Service Learning and other community experiences;
c. The historical context of University-Community Partnership; Understanding Community & Community Partnership; Ethical understanding of partnership;
d. Understanding the agency of the Community – as co-educators; Community barriers; Understanding of society & social issues; Effective communication skills
e. Culture and Power Dynamics; Power & Privilege; Social Justice; Human Solidarity & Diversity; Need & Asset based assessment. Theory of efficient team building & execution of the task in a team.

Understanding of Professional and Ethical Responsibility
a. The context in which service-learning projects are situated provides a natural opportunity for students to examine the professional and ethical responsibilities of their profession. The multidimensional reflection and analysis embedded in the service-learning process ensure that students will explore these issues in a guided manner to deepen their overall understanding of their roles as engineering professionals.
b. Design thinking in context to Service Learning
c. Social Activity value addition and procedure to identify the technological gaps & finding out solutions to rectify the same

d. Understanding Community-Based Participatory Research (CBPR) and Basic knowledge on preparation of detailed project reports related to social development projects
e. Technological intervention towards traditional activities in the society, for example, effective project monitoring, health monitoring system
f. Internal Assessment -1: Report writing of fieldwork
g. Internal Assessment -2: Report writing of fieldwork

Module II: Practical (15 Hours)

a. Hands-on training in Design Thinking
b. Field Visit and communication skill development
c. Field Visit and identification of the scope of technological intervention in various social areas
d. Data Collection techniques and interpretation of collected data
e. Workshop on effective report writing
f. Training on Grant writing
g. Training on IPR

VALUE ADDED COURSE

MNRF6032: ROYAL ENFIELD FRESHERS COURSE

Objective

To make the learners familiar with the state of the art of Royal Enfield two wheelers' working, troubleshooting and servicing and technical knowhow of different parts.

Course/Learning Outcomes

After completing the course successfully, the students will be able to-

1. Identify and locate different parts of Royal Enfield two wheelers, understand their working & troubleshooting and perform basic maintenance work.

Pre-requisite

Basic knowledge of IC engines, Kinematics & Theory of Machines

Module I: Technical theory Sessions (6 hrs)

History, 4 stroke/2 stroke engines and their working, bore, stroke, cubic capacity, technical specifications of engine & components, valve overlapping, Electrical Connections, parts locations, different sensors- their working & troubleshooting, clutch, brake, chain, suspension, steering, BS IV and BS VI

Module II: Practical Sessions (24 hrs)

Hands on training Practical on **UCE, Himalayan, 650, meteor.** Dos and Don'ts at training center, engine dismantling, engine & gearbox assembly, wheel removal, refit, freeplay, clutch, suspension, steering, brake, air filter, use of multimeter & special tools, Electrical systems: inspection of components and troubleshooting.

Suggested Readings

a) Engineering Fundamentals of the Internal Combustion Engine – Willard W. Pulkrabek
b) Clutch and Brakes: Design and Selection – William C. Orthwein
c) Internal Combustion Engines- V. Ganesan
d) Theory Of Machine And Mechanisms– Gordon R. Pennock & Joseph E. Shigley John J. Uicker

MNQC6033: QUANTITATIVE APTITUDE FOR COMPETITIVE EXAMINATION

Objective: This course is aimed to provide the learners a platform to have an insight about the various quantitative aptitude problems

Pre-requisite: Fundamental of mathematics

Module I: Simplification, HCF and LCM, Ratio and Proportion, Percentage, Partnership, Average, Profit and Losses, Areas and Volumes, Simple Interest and Compound Interest.

Module II: Time and work, Time and distance, Problems on ages, Pipes and cisterns, Boats and streams, Visualization of space, Probability.

COURSE/LEARNING OUTCOMES

After completing the course successfully, the students will be able to-

CO1: Solve different numerical problem related to quantitative aptitude.

Suggested Readings

1. Dr. R.S. Aggarwal , Quantitative Aptitude for Competitive Examinations

MNIA6034: INTRODUCTION TO AUTOCAD

Objectives: To learn the basics of technical drawing thoroughly by using AUTOCAD software.

Course outcomes

1. Demonstrate basic concepts of the AutoCAD software.
2. Apply basic concepts to develop Geometric construction (drawing) techniques.
3. Analyze technical drawings using CAD.

Module 1 (8 hours)

Interface of AutoCAD, Cartesian coordinate system: absolute coordinate system, relative coordinate system, AutoCAD basics: Function keys, Draw Commands, Modify commands, Annotate dimension style manager, Single line text, Multiline text, Layer properties, Insert blocks, Parametric, Isometric views

Module 2 (8 hours)

Isometric and Perspective projections, Isometric diagram's exercise, 2D Fundamentals in Auto CAD, Drawing units. Interactive Input method: grid snap mode, introduction to 3d interface of Auto CAD.

Module 3 (8 hours)

a) Mechanical diagrams: nut and bolt, rivets, types of threads, keys, knuckle joint, Idler plate, Hook Joint, mechanical tools etc.
b) Civil engineering drawing: Brief history of building drawing Introduction to building drawing, simple building drawing plan.
c) Electrical and Electronic drawings: Circuit, transistor symbols, electrical plans etc.

Group Assignment/ Activity (6 hours)

SCHOOL OF TECHNOLOGY
DEPARTMENT OF COMPUTER APPLICATIONS
BACHELOR OF COMPUTER APPLICATIONS (BCA)

VISION

Imparting knowledge of Computer Applications, to mould individuals into IT professionals, researchers and entrepreneurs who are innovative, versatile and committed to society.

MISSION

To prepare students for professional career and higher studies by providing conducive teaching, learning and research environment.

- To produce skilled individuals and entrepreneurs in emerging areas of technologies by academia-industry collaboration.
- To instill in individuals a sense of commitment to work for the betterment of society using technology.

PROGRAMME – BACHELOR OF COMPUTER APPLICATIONS (BCA)

PROGRAM OUTCOME-BCA

PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PO 8: Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PROGRAM SPECIFIC OUTCOME – BCA

PSO 1: Knowledge of Computing Systems: An ability to understand the principles and working of computer systems.

PSO 2: Project Development Skills: An ability to understand the structure and development methodologies of software systems.

PSO 3: Software Development Skills: Familiarity and practical competence with a broad range of programming language and open-source platforms.

PSO 4: Mathematical Skills: An ability to apply mathematical methodologies to solve computation task, model real world problem using appropriate data structure and suitable algorithm.

PROGRAMME – MASTER OF COMPUTER APPLICATIONS (MCA)

PROGRAM OUTCOMES – MCA

PO 1: Computational Knowledge: Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO 2: Problem Analysis: Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO 3: Design /Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex Computing problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5: Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO 6: Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO 7: Life-long Learning: Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO 8: Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 9: Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
PO 10: Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.
PO 11: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
PO 12: Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PROGRAM SPECIFIC OUTCOMES – MCA

PSO 1: Ability to understand and apply knowledge on analysis, design and development of software applications.
PSO 2: Utilize skills and knowledge for computing practice with commitment on social, ethical and legal values.
PSO 3: Ability to work with latest computing technologies and pursue careers in IT industry/ consultancy/ research and development, teaching and allied areas.

LIST OF COURSES –BCA

Code	Course Name
1.1	Computer Programming in C Language
1.2	Computer Programming in C Language Lab
1.3	Digital Logic Design
1.4	Digital Logic Design Lab
1.5	English Communication/MIL
1.6	Computer Fundamentals
1.7	Computer Fundamentals Lab
2.1	Data Structures Using C
2.2	Data Structures Using C Lab
2.3	Computer Organization and Architecture
2.4	Computer Organization and Architecture Lab
2.5	Environmental Studies
2.6	IT Tools for Business
2.7	Service Learning
2.8	Constitution of India
3.1	Introduction to Operating Systems
3.2	Introduction to Operating Systems Lab
3.3	Computer Networks Fundamentals
3.4	Computer Networks Fundamentals Lab
3.5	Web Technologies
3.6	Web Technologies Lab
3.7	MEAN Stack Web Development
3.8	E-Commerce
4.1	Relational Database Management Systems

4.2	Relational Database Management Systems Lab
4.3	Basic Software Engineering
4.4	Basic Software Engineering Lab
4.5	Introduction to Java Programming
4.6	Introduction to Java Programming Lab
4.7	Managerial Competencies For Professionals
4.8	Computer Applications in Business
5.1	Data Communication
5.2	Data Communication Lab
5.3	Design and Analysis of Algorithm
5.4	Design and Analysis of Algorithm Lab
5.5	Introduction to Data Analytics
5.6	Internet of Things
5.7	Computer Oriented Numerical Methods
5.8	Introduction to Data Analytics Lab
5.9	Computer Oriented Numerical Methods Lab
5.10	Compiler Design
5.11	Theory of Computation
5.12	Computer Graphics
5.13	Mini Project
6.1	Python and Machine Learning
6.2	Python and Machine Learning lab
6.3	Data Warehousing and Data Mining
6.4	Network Security
6.5	Android Application Development Fundamentals
6.6	Digital Image Processing
6.7	Android Application Development Fundamentals Lab
6.8	Digital Image Processing Lab
6.9	Cloud Computing
6.10	Mobile Communication
6.11	Operation Research
6.12	Major Project

LIST OF COURSES -MCA

Mapping Code	Course Name
1.1	Mathematical Foundation for Computer Science
1.2	Theory of Computation
1.3	Operating Systems
1.4	Data Structures and Algorithms
1.5	Programming Through Java
1.6	Operating Systems Lab
1.7	Data Structures and Algorithms Lab
1.8	Programming Through Java Lab
2.1	Software Engineering
2.2	Data Communication and Computer Networks
2.3	Advanced Database Management Systems
2.4	Internet Technology and Applications
2.5	Sensor Networks and Internet of Things
2.6	Data Communication and Computer Networks Lab
2.7	Internet Technology and Applications Lab
2.8	Advanced Database Management Systems Lab
2.9	Constitution of India
3.1	Cyber Law and IT Security

3.2	Machine Learning
3.3	Enterprise Resource Planning
3.4	Research Methodology and IPR
3.5	Elective I *Specialization I: Artificial Intelligence* OR *Specialization II: Data Science*
3.6	Elective II *Specialization I: Artificial Intelligence* OR *Specialization II: Data Science*
3.7	Machine Learning Lab
3.8	Minor Project - MCA
3.9	Communication Skills
3.10	Entrepreneurship
4.1	Major Project - MCA
4.2	Elective III

MAPPING of COURSES to PO/PSOs –BCA

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
1.1	H							L		M	H	
1.2	H							L		M	H	
1.3	M								H			
1.4	M								H			
1.5		H		M				L		M		
1.6	M								H			
1.7	M								H			
2.1	H							L		M	M	
2.2	H							L		M	M	
2.3	L								H	L		
2.4	L								H	L		
2.5						H						
2.6								M	L	L	H	
2.7			H	M								
2.8				H								
3.1	L								H	L	M	
3.2	L								H	L	M	
3.3	L							L	H			
3.4	L							L	H			
3.5		M		M				H		M	M	
3.6		M		M				H		M	M	
3.7		M		M				H		M	M	
3.8	L						M	H	L	M	M	
4.1	L							L		H	M	
4.2	L							L		H	M	
4.3	M									H	M	
4.4	M									H	M	
4.5	H							M		M	H	
4.6	H							M		M	H	
4.7	M	H	M		L			M		M		L
4.8	L						M	H	L	M	M	
5.1	M								H	L		
5.2	M								H	L		
5.3	H								L	M	M	H
5.4	H								L	M	M	H
5.5	H								M	M	M	L
5.6	M							L	M	H	H	L
5.7	M								L			H
5.8	H								M	M	M	L
5.9	M								L			H

5.10	M							L	H	M	M	
5.11	M											H
5.12											H	M
5.13	H	M	L				M	H		H	H	L
6.1	M							H		H	H	M
6.2	M							H		H	H	M
6.3	M								L	M	H	
6.4								M	H	M	H	M
6.5	M						L	H	M	M	M	
6.6							L	M	M	H	M	M
6.7	M						L	H	M	M	M	
6.8							L	M	M	H	M	M
6.9									H	H	M	
6.10									H	M		M
6.11	H								M			H
6.12	H	M	L				M	H		H	H	L

MAPPING of COURSES to PO/PSOs –MCA

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.1	H	M		L											L
1.2	H	M		L									M		L
1.3		L	H		M								H		
1.4	M	H	M										H		L
1.5	M		H		H								H		M
1.6		L	H		M								H		
1.7	M	H	M										H		L
1.8	M		H		H								H		M
2.1			H					M					H		M
2.2	H		M		M							L		L	M
2.3	H		M		M							L		L	M
2.4			H						L			M		L	H
2.5	M		H		H					M		M			H
2.6	H		M		M							L		L	M
2.7			H						L			M		L	H
2.8	H		M		M							L		L	M
2.9										M				M	
3.1						H	M			L				H	
3.2	H		M		M							L	M		H
3.3					H			M				L	M		
3.4					M		L					H			H
3.5	H	M		M	L									M	H
3.6	H	M		M	L									M	H
3.7	H		M		M							L	M		H
3.8	M	L	H		H		M	M			M	H	H	M	M
3.9									H	M	L			M	
3.10										M	L	H			
4.1	M	L	H		H		M	M			M	H	H	M	M
4.2	L		M			M		H	L						M

DETAILED SYLLABUS
THEORY COURSES

CALD0001: DIGITAL LOGIC DESIGN

(4 credits–60 hours)

Objectives

The topics below cover some of the basic understanding of a digital computer. The aim is to give an overview of the computer and its functions, with specific references to some of its parts. The student will also get an understanding of the application of Boolean Algebra in computer science and applications.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. List the various components of a computer, define various concepts like normalization, fixed point representation etc. (Remembering)
2. Explain the memory hierarchy and working principle of different types of memory such as -semiconductor, optical and magnetic memory. Students will also be able to understand conversion from one number system to another number system, floating point representation, and error detection/correction codes. (Understanding)
3. Apply the knowledge of boolean algebra, Karnaugh-map or tabulation method to minimise boolean expressions. (Applying)
4. Design and analyse a given combinational/ sequential circuit and determine the corresponding truth table/ state table. (Analysing)
5. Evaluate and compare various logic families based on characteristics such as- propagation delay, noise margin, fan-in, fan-out etc. (Evaluate)
6. Design prototype of a digital logic circuit and demonstrate that it meets requirement and performance specifications. (Creating)

Module I: Introduction to organization of digital computer (12 Hours)

Block diagram of a computer: Input Unit, Output Unit, Storage Unit, CPU. Control Unit, Arithmetic Logic Unit. System bus. Stored program concept. Number systems. Binary Arithmetic, Floating point number representation, Normalization of point number representation, Fixed point number representation, Signed-magnitude representation, overflow, underflow, Computer codes; Error detection and correction codes, parity, parity generator, parity checker.

Module II: Memory Unit (12 Hours)

Memory Hierarchy, Main Memory, Memory Address Map. Semiconductor Memory; Different types Cache Memory: Levels of Cache, Locality of reference, hit and miss; Magnetic Memory; Optical Memory

Module III: Boolean Algebra, Simplification of Boolean Functions (12 Hours)

Boolean Algebra: Various Boolean operations; Postulates, Theorems, Duality, Boolean functions, Canonical forms, Representation of Boolean expressions using truth tables, logic gates. Boolean expressions minimization using Karnaugh map, Realization of canonical forms from Karnaugh map, Don't Care Conditions - problems using Don't care conditions, benefit of using Don't care conditions. Tabulation method/Quine-Mc Kluskey method, prime implicants.

Module IV: Combinational Logic and Sequential Logic (24 Hours)

a. Brief introduction to Microprocessor, Integrated circuits, SSI, MSI, LSI, VLSI, IC Digital logic families- TTL, ECL, MOS, CMOS and I2L.
b. Positive and negative logic. Characteristic of IC logic families - fanout, power dissipa-tion, propagation delay, noise margin.
c. Digital devices: Logic gates, wired-logic, 8 non-degenerate forms of NOR and NAND, multilevel NAND and NOR gates (Boolean function implementation using block dia-gram method, analysis procedure, deviation of Boolean function by algebraic ma-nipulation, derivation of truth table, block diagram transformation), buffer, 3-state buffer, high impedance state, Realization of other logic functions using NAND/NOR gates. Drawing logic diagrams for different types of Boolean expression derived from truth tables; A brief introduction to Combinational and sequential circuits. Differ-ence between Combinational and sequential circuits; Arithmetic circuits: Half-adder, Full-adder, Binary Adder, Binary Parallel Adder, BCD Adder, Binary Adder-Subtractor, Half-subtractor, Half- subtractor , Binary Incrementer, carry propagation, look ahead carry, carry generator, magnitude comparator.; Encoders, Decoders, Multiplexers, Demultiplexers
d. Code conversion, BCD-to-Excess3 Code converter. Analysis of Combinational circuits.
e. Flip-flops: Different types of flip-flops, Flip-flop excitation tables, characteristic equa-tions, truth tables, Triggering of Flip-flops.
f. Registers: Registers (Register with Parallel Load), Shift registers(serial transfer, Bi- directional Shift Registers With Parallel

Load, serial adder, Serial Register);

g. Counters: Asynchronous counters, Synchronous counters; Binary Counter with Par-allel Load, binary Ripple Counter, BCD ripple counter, synchronous binary counter, binary count-up-down counter, BCD synchronous counter, Decade Counter, Mod 6 counter. Timing sequences- word- time generation, timing signals, Johnson counter. Designing of counters using excitation tables of flip flops. Designing of counters using state equations.

Suggested Readings

1. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., New Delhi, 1994
2. Thomas L. Floyd, Digital Fundamentals, Fifth Edition, Pearson Education, 2002
3. V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	M		
CO2	H	H		
CO3	M		H	
CO4	L		M	H
CO5				H
CO6	M	L	H	H

CATC0003: THEORY OF COMPUTATION

(3 credits – 45 hours)

Objective

The objective of the Theory of Computation is to introduce and study abstract, mathematical models of computation (such as finite state, pushdown and Turing machines), and to use the abstract machine models to study the ability to solve computational problems. At the complete course students will be able to use regular expression effectively and appropriately, construct derivations and parse trees, write simple programs for a Turing machine, understand the equivalence of grammars, languages and automata and translate between grammars, languages and automata.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define basic terminology like Deterministic and Non deterministic automata, Pushdown Automata, Parse Tree, Regular Languages, Turing Machines etc. (Remembering)
2. Make use of techniques, components and tools of a typical automated machine and apply it in designing new machines (Applying)
3. Design deterministic and non-deterministic context-free grammars and understand their capabilities and limits. (Creating)
4. Design deterministic and non-deterministic pushdown automata and Turing Machine. (Creating)
5. Demonstrate the understanding of complexity classes and current unsolved problems in theoretical computer science. (Understanding).

Module I Theory of Automata (12 Hours)

Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NDFA, Mealy and Moore Models, Minimization of Finite Automata.

Module II Formal Languages, Regular Sets and Regular Grammars (10 Hours)

Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars Exercises.

Module III Context-free Languages (11 Hours)

Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context- free Languages, Decision Algorithms for Context-free Languages Exercises

Module IV Pushdown Automata Turing Machines and Linear Bounded Automata (12 Hours)

Basic Definitions, Acceptance by pda, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

Suggested Readings

1. K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science, BPB Publication, Prentice-Hall of India, Second Edition.
2. H.R. Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India.
3. H.E. Hopcraft and J.D. Ullamn, Introduction to Automata Theory, Languages and Computation, Narosa Publications.
4. J.C. Martin, Introduction to Languages and the Theory of Automata, Tata McGraw-Hill.
5. C.H. Papadimitriou, Computation Complexity, Addison-Wesley.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	M	M	M	M
CO2	M	M	M	M
CO3			H	
CO4				H
CO5			M	H

CAOP0005: OBJECT ORIENTED PROGRAMMING AND DESIGN

(4 credits – 60 hours)

Objective

The Main aim of this paper is to give the students a broad understanding of the object oriented approach to problem solving through C++. It provides a practical, productive way to develop software for most applications. It also includes an introduction to object- oriented design, which can promote a better understanding of the requirements, cleaner designs, and more maintainable systems.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Describe the various features of Object Oriented programming by utilizing the C++ language construct. (Remembering)
2. Explain the standard library, scope and lifetime of a variable and various control statements used in C++ program. (Understanding)
3. Interpret the concept of classes and object in C++ and apply exception handling to solve various exceptions (Analysing, Applying)
4. Evaluate the different type of inheritance and polymorphism and Analyse it in resolving various problems (Analysing, Evaluating)

Module I Introduction To Object-Orientation Concepts And OOP (16 Hours)

a. Introduction to Object-Oriented Programming: Basic concepts of OOP (Abstraction, Encapsulation, Inheritance, Polymorphism), comparison of procedural programming and OOP; code reusability, creating new data types. C++ Language basics, cin and cout, << and >> operators, setw and endl, Control statements, differences between C and C++.
b. Classes and Objects: C++ extension to structures, member access operators static members, arrays of objects, returning objects from functions, Friend functions, Pointers to members, Friend classes, stack class.
c. Constructors: Default constructors, overloaded constructors, constructors with default arguments default constructor, copy constructor, dynamic constructor, destructors.

Module II Templates and Exception Handling (12 Hours)

a. Templates: string template, instantiation, template parameters, type-checking, function templates, template argument deduction, specifying template arguments, function template overloading, default template arguments, specialisation, conversions.
b. Exception handling: Error handling, grouping of exceptions, catching exceptions, catch all, re- throw, resource management, auto ptr, exceptions and new, resource exhaustion, exceptions in constructors, exceptions in destructors, uncaught exception, standard exceptions.

Module III Inheritance, Virtual Functions and Polymorphism (16 Hours)

a. Overloading: Defining operator overloading, operator function as member function and friend function, overloading unary and binary operators, type conversions, function overloading.
b. Inheritance: Types of inheritance, Defining derived class, Access specifiers: public, private and protected; public and private inheritance, accessing base class members, ambiguity in multiple inheritance, virtual base classes, abstract classes, Derived class constructor with arguments, Initialization lists in constructors, classes within classes.
c. Virtual functions and polymorphism: Virtual functions, pure virtual functions, abstract classes, implementation of virtual functions (virtual pointers and virtual tables in classes with virtual functions), this pointer, static and dynamic binding, virtual functions in derived classes, object slicing, virtual functions and constructors, calling virtual functions from constructors, destructors and virtual destructors, calling virtual functions from destructors, virtual base classes, Rules for

virtual functions.

d. File handling and streams.

e. Basics of file handling in C++, classes for stream operations, operations on files, file opening modes, file pointer, error handling during file operations

Module IV Object Oriented Design (16 Hours)

Overview of object oriented designing (concepts), steps involved in object oriented designing, advantages of OOD, what is modeling, why modeling is required, UML, different views captured by UML diagrams, Use Case diagram(actors, generalization, association, include dependency, extend dependency etc.),organization of use cases, Use Case Packaging, constraints in use case models, how to find out actors, use cases and use case relationships, Class diagrams, representations, association and links, aggregation, composition, dependency, constraints, interaction diagrams(sequence diagrams and collaboration diagrams), representation, boundary objects, controller objects, entity objects, Booch's object identification method, CRC cards, equivalence of sequence diagram and collaboration diagrams, activity diagrams, representation(action states, action flow, object flow, initial state , final state etc..), swim lanes, branching, fork, join etc, OOD goodness criteria.

Suggested Readings

1. E. Balagurusamy, Object-Oriented Programming with C++, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Nabajyoti Barkakati, Object-Oriented programming in C++, Prentice hall of India private Limited, New Delhi, 2005.
3. James Rumbaugh, Micheal Blaha, William Premerlani, Frederick Eddy, William Loorenson, Object- Oriented Modeling and Design, Prentice hall of India private Limited, New Delhi, 2005.
4. Bjarne Stroustrup, The C++ Programming Language, Special edition, Pearson Education Publication.
5. David Parsons, Object-Oriented Programming with C++, BPB Publications, B-14 Cannaught Place, New Delhi.
6. Grady Booch, Object-Oriented Analysis and Design with Applications, Second Edition, Addison- Wesley Publishing Company.
7. Steve Qualline, Practical C++ Programming, Second Edition, Shroff publishers and Distributors Private limited.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H			M
CO2	H			
CO3		H		
CO4			H	

CAOA0007: COMPUTER ORGANIZATION AND ARCHITECTURE

(4 credits – 60 hours)

Objective

This course aims to provide the student with the concepts and basic knowledge necessary to understand the organisation and architecture of computing systems.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recognize, and define the basic components and design of a computer, including CPU, memories, and input/output units. (Remembering)
2. Identify and classify the major components of a CPU and discuss, review the operations intrinsic to it. (Understanding)
3. Discover the parameters of performance improvement and use them in predicting the issues in instruction cycle. (Applying)
4. Analyse the mapping techniques of different memory units; instruction sets interpret the different performance trade-offs between them. (Analysing)
5. Summarize the concepts adhered to the principles and architectures of a digital computer system to design and develop new improvised systems. (Create)

Module I: Arithmetic Logic Unit (10 Hours)

Addition and Subtraction (Addition and Subtraction with Signed-Magnitude Data, Hardware Implementation, Addition and Subtraction with Signed-2's Complement Data); Booth's Multiplication Algorithm; Division Algorithm; Floating-Point Arithmetic Operations (Addition, Subtraction, Multiplication, Division).

Module II: Control Unit (12 Hours)

a. Major Components of a CPU; General Register Organization; Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation); Subroutine Call and Return; Fetch Routine; Types of Interrupts; Characteristics of Complex Instruction Set Computer (CISC) and Reduced Instruction Set Computer(RISC)

b. Micro operations, Control Function, Role of Three-State Bus Buffers in Memory Transfers; Arithmetic Microoperations,

Logic Microoperations, Shift Microoperations; Microprogrammed Control and Hardwired Control; Control Memory, Control Word, Microinstruction, Microprogram, Mapping of Instructions; Instruction Formats(Three- Address Instructions, Two-Address Instructions and Zero-Address Instructions); Addressing modes.

Module III: Parallel Processing and Multiprocessors (14 Hours)

a. Parallel Processing: Flynn's Classification of computers; Pipelining, Data Dependency,Handling of Branch Instructions, Delayed Load, Delayed Branch; Vector Processing, Supercomputers; Array Processors.
b. b) Multiprocessors: Tightly Coupled, Loosely Coupled; Interconnection Structures (Time- Shared Common Bus, Multiport Memory, Crossbar Switch, Multistage Switching Network, Hypercube Interconnection); Interprocessor Arbitration (Serial Arbitration Procedure, Parallel Arbitration Logic, Rotating Daisy-Chain); Interprocessor Communication and Synchronization, Mutual Exclusion with a Semaphore.

Module IV: Memory Organization (14 Hours)

Hardware Organization for Associative Memory; Mapping methods for Cache Memory (Associative Mapping, Direct Mapping, Set-Associative Mapping), Write Through, Write Back, Cache Initialization, Cache Coherence; Virtual Memory, Memory management hardware.

Module V: Input-Output Organization (10 Hours)

Input Output Interface, I/O Bus, Memory Bus, Isolated I/O, Memory-Mapped I/O; Asynchronous Data Transfer, Strobe Control, Handshaking; Modes of Transfer- viz. Direct Memory Access, Programmed I/O, and Interrupt-Initiated I/O; Priority Interrupt (Daisy-Chain Priority, Parallel Priority Interrupt, Priority Encoder); Input-Output Processor; Serial Communication(Character-Oriented Protocol and Bit-Oriented Protocol).

Suggested Readings

1. M. Morris Mano, Computer System Architecture, Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2. V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996
3. William Stallings, Computer Organization and Architecture, Sixth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002

Mapping of COs to syllabus:

Course Outcomes	Module1	Module1	Module1	Module1	Module1
CO1	H	M	M	L	L
CO2	H	M	L		
CO3		H	M	M	L
CO4	H	L	M		L
CO5		H	H	M	

CACF0008: COMPUTER FUNDAMENTALS

(4 credits - 60 hours)

Objectives

This course provides an introduction to the fundamentals and basic requirements of computer science. This course will enable the student to gain an understanding of the core concepts and technologies which constitute Information Technology and to articulate and demonstrate these basic fundamental concepts.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall the fundamental concepts of computers that includes understanding the hardware and software components as well as the role of each of these components. (Remembering)
2. Demonstrate an understanding of the various number systems as well as conversion from one number system to another and basic arithmetic binary operations. (Understanding)
3. Analyse problems and develop a flowchart and/or an algorithmic solution for the same.(Analysing)
4. Work with files, folders, and applications.(Applying)
5. Assess the use of Windows and Unix Operating Systems efficiently to Analyse the structure and design of each of these two operating Systems. (Evaluating)

Module I: Introduction to Computers (12 hours)

Introduction, brief history of development of computers, characteristics of computers, block diagram of computer; types of computers and features, analog, digital, hybrid, general, special purpose, micro, mini, mainframe supercomputers. Types of personal computers – desktop, laptop, palmtop etc. , types of programming languages (machine languages, assembly languages, high level languages, 4GL), data organization, drives, files, directories., basic components of computer system; Von Neumann architecture.; types of memory (primary and secondary) RAM, ROM, PROM, EPROM; secondary storage devices (FD, CD, HD, Pen drive) I/O devices (Scanners, Plotters, LCD, Plasma Display).

Module II: Data representation and operations (8 hours)
Simple model of memory, bits and bytes, introduction to binary, Hexadecimal, Octal, Decimal systems, conversion from one system to another, simple addition, subtraction, multiplication.

Module III: Algorithm and Flowcharts (10 hours)
Algorithm: Definition, Characteristics, Advantages and disadvantages, Examples Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages, examples.

Module IV: Operating System and Computer Software (12 hours)
a. Introduction to O.S., historical evolution - first generations, second generations, third generations, fourth generation, phases of evolution-serial processing, simple batch systems, multi-programmed batch systems, time-sharing systems, personal-computer systems (PCs), parallel systems, multi processing system – symmetric, asymmetric, distributed system, real- time systems, need of Operating system, comparative study of popular operating systems. DOS – history, files and directories, internal and external commands, batch files, types of Operating systems, introduction to Windows, Linux, UNIX operating systems.
b. Need of software, types of software, system software and application software, Application software-word processing, spreadsheet, presentation graphics, database management software.Introduction to Computer virus.Introduction to Internet and E-mail; searching information through a search engines (google, altavista, sulekha, khoj etc)

Module V: Windows Operating System (8 hours)
Introduction to microsoft windows; features of windows; Various versions of windows and its use; working with windows; my Computer and Recycle bin ; Desktop, Icons and Windows Explorer; working with files and folders; simple operations like copy, delete ,moving of files and folders from one drive to another, installing and uninstalling new hardware and software programs on computer.

Module VI: Unix Operating System (10 hours)
Introduction to UNIX OS, Salient features of UNIX, UNIX system architecture, shells and types of shells, file management, directories, file permissions, pipes and filters, various processes- foreground, background, parent, child, zombie, daemon; basic UNIX commands (log in, create/ delete files/directories, listing files/directories, changing permission of files/directories etc), advanced UNIX commands (creating, listing and stopping process, printing files, sending E-mails etc), Built-in Functions (abs, log, sin, cos etc), signals and traps, system calls-basic idea,the UNIX file system.

Suggested Readings
1. Rajaraman, V. Fundamentals of Computers, PHI Publications
2. Sinha P.K. Fundamental of Computers
4. Suresh Basandra, Computers Today
5. Kanetkar Y, UNIX Shell Programming
6. Manuals of Office Software

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO1	H					
CO2		H				
CO3			H			
CO4				H		
CO5					H	H

CADS0011: DATA STRUCTURES USING C
(4 credits - 60 hours)

Objective
The objective of the course is to learn how to create data structures to represent a collection of similar data and solve problems using C language. After completion of this course, a student will be able to
- Understand and use the process of abstraction using a C programming language
- Implement various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs
- Understand various searching and sorting techniques.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall the basic C constructs and familiarize with basic C syntax, also define and outline the relationship between data and operations on these data using different data structures like arrays, linked list, stacks and queues, graph and trees.

(Remembering)
2. Define C constructs for explaining and generalizing these data structures and choosing appropriate algorithm for efficient program design using C syntax. (Understanding)
3. Compute and demonstrate these data structures and algorithms in different real world problem domain(Applying)
4. Compare and analyse the performance of algorithms based on problem domain. (Analysing)
5. Review the choice of data structure and algorithms based on problem domain, also would be able to judge and assess the algorithm efficiency based on space and time complexity which forms the fundamental step in the design of an efficient program. (Evaluating).
6. Design and create efficient algorithm for application development related to academia and industry. (Creating)

Module I: Arrays and Lists (16 Hours)

a. Data Type, Abstract Data Type, Data Structure, Fundamental and Derived Data Types, Array as a data structure, Representation of arrays: single and multidimensional, Address calculation using column and row major ordering; insertion and deletion in arrays; use of arrays for matrix representation and manipulation (addition, multiplication).
b. Linked List as a data structure; operations on lists; singly linked list (with one or two external pointers), doubly linked list, circular list; use of linked lists for polynomial representation and manipulation (addition and multiplication), and sparse matrix representation and manipulation (inputting, adding, and displaying in matrix form) .

Module II: Stacks and Queues (14 Hours)

Stacks and Queues as data structures; implementation of stacks and queues using arrays and linked lists; Circular Queue, Priority Queue; Application of stacks: Conversion of infix (containing arithmetic operators including exponential operator, and parenthesis) to postfix and prefix expressions; evaluation of postfix expression.

Module III: Trees and Graphs (18 Hours)

a. Binary Trees and General Trees, Representation of trees using linked lists, Binary tree traversal methods, recursive and non-recursive algorithms for traversal methods, Binary search trees (creation, insertion and deletion of a node), Height balanced (AVL) binary trees (construct and traverse an AVL tree), multi-way search trees (construction and traversal); B-tree (construction and traversal of a B-tree of given order)
b. Introducing Graphs; Graph representation: Adjacency matrix, adjacency lists, incidence matrix; Traversal schemes: Depth first search, Breadth first search

Module IV: Searching and Sorting (12 Hours)

Linear and binary search, Indexed search; Hashing, Hash Functions (division method, mid square method, folding), Sorting algorithms: Insertion, Selection, Bubble, Quick, Merge, Radix.

Suggested Readings

1. Lipschutz, S., Theory and Problems of Data Structures (International Edition), Schaum's Outline Series, New Delhi: Tata McGraw-Hill.
2. Kanetkar, Y. P., Data Structures Through C Language, New Delhi: BPB Publications.
3. Chattopadhyay, S.; D. G. Dastidar; M. Chattopdhyay, Data Structures Through C Language, New Delhi: BPB Publications.

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	L	L	
CO2	H	L	L	L
CO3	M	M	M	M
CO4	L	L	L	L
CO5	M	M	M	M
CO6	M	M	M	M

CANW0012: COMPUTER NETWORK FUNDAMENTALS

(4 Credits - 60 Hours)

Objective

The objective of this course is to make the students understand basic terminologies of computer networks along with their types, mode of communication, models, transmission media, connecting devices. It also emphasizes to make the students aware about network security and basic conception of the World Wide Web.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:
1. Define the basic concepts of Computer Networks, its goals and network related terminologies. (Remembering)
2. Explain the concepts of Analog and Digital signals, Electromagnetic spectrum and related concepts on various architecture

used in computer networks (Understanding)
3. Experiment with various Networks concepts such as Types of networks, Topologies, Transmission media and implement these concepts in setting up a lab in a real time scenario. (Applying)
4. Comprehend on Network Security Devices, Digital Signature and Internet Basics. (Understanding)
5. Evaluate the performance of the network based on the network criteria. (Evaluating)
6. Design the network with a suitable topology and network types.(Creating)

Module I (15 Hours)
Computer Network: Definition, Goals, Applications, Structure, Components, Topology, Types of Topology, Types of Networks (LAN, MAN, WAN, Internet), Broadcast and Point-To-Point Networks, Communications Types (Synchronous, Asynchronous), Modes of Communication, Topology, Client/Server architecture, Network Models, Design issues of the layer, Protocol Hierarchy, ISO-OSI Reference Model (Functions of each layer),Terminology, SAP, Connection Oriented and connectionless services, Peer Entities, TCP/IP model, Layers, Ports, Protocol Stack, Comparison of ISO-OSI and TCP/IP Model

Module II (15 Hours)
Transmission Media, Classes of Transmission Media, Guided Media: Coaxial Cable, Twisted Pair, Fiber Optics Cable, Connectors. Unguided Media (Wireless) Electromagnetic Spectrum for Wireless Communication, Propagation Methods (Ground, Sky, Line-of-Sight), Wireless Transmission, Radio Waves, Infrared, Microwave, Wireless LANs Architecture, MAC Sublayer, Frame Format, Frame Types, Bluetooth Architecture.

Module III (15 Hours)
Analog and Digital Signals, Data Encoding, Parallel and Serial Transmission, Network Connectivity Devices, Categories of Connectivity Devices, Passive and Active Hubs, Repeaters, Bridges, Switches (2-Layer Switch, 3-Layer Switch (Router)), Gateways, Network Interface Cards (NIC), Internetworking Principles.

Module IV (15 Hours)
Network Security : Definition, Network Security Requirements and Attacks, Network Security Devices (firewalls, Proxy Server), Encryption and Digital Signatures, Internet Basics, Concept of Intranet and Extranet, Web Server, World Wide Web (WWW) Architecture, Web Documents, Search Engines, Internet Service Providers (ISP).

Suggested Readings
1. Andrew S. Tannenbaum, "Computer Networks", Tata McGraw-Hill Publishing Company Limited New Delhi.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill Publishing Company Limited New Delhi.
3. William Stallings, "Data and Computer Communications", Pearson Education Asia.

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	M	M	M
CO2			H	
CO3	H			
CO4				H
CO5		H		
CO6	H	L	L	

CAWT0013: WEB TECHNOLOGIES

(4 credits-60 Hours)

Objective
The course provides an introduction to the fundamentals and basic requirements of web technologies. After completion of this course, students should be able to design and implement a website on their own by including client-side and server-side technologies. Finally, the course also provides a basic knowledge of querying web databases to support a website having back-end information.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Examining the growth of the Internet and recalling the history behind it. (Remembering)
2. Illustrate and differentiate the various services provided by the internet. (Understanding)
3. Experiment with various mark-up languages, style sheets and scripting languages. (Applying)
4. Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
5. Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)

6. Develop and create a website of their own. (Creating)

Module I: Basic Internet-related Terms and Static Web Development (18 Hours)

a. Basic Terms: History of the Internet and the World Wide Web; W3C (World Wide Web Consortium); Levels of Internet Connectivity (Dial-up, Leased Line, DSL, VSAT); Requirements for Internet Connectivity; Search Engines, News-group, voice and video conferencing, E-mail and its Protocols; Web Portal; Different types of browsers (IE, Firefox, Chrome); URLs, Domain names

b. Static Web Development: Introduction to XHTML; HTML vs. XHTML, XHTML comments; Basic Tags-XHTML, HEAD, TITLE, BODY; Paragraph Tag, Horizontal Rule Tag, Headings Tags, Blockquote Tag, Lists, Linking, Images, Tables, FONT Tag, PRE, DIV and SPAN tags; other different formatting tags; Forms; Frames

Module II: CSS, DHTML and JavaScript (18 Hours)

a. Cascading Style Sheets: Types of Style Sheets-Inline, Embedded, and External; Conflicting Styles; Use of CSS for positioning elements, Background, and Text flow, CSS Box Model, CSS Borders and Outlines, Style class and Pseudo-class, CSS Image Gallery

b. DHTML: Introduction to DHTML and JavaScript, JavaScript vs. VBScript, Adding script to documents, Data types, operators, variables, input and output statements, Built in functions, Arrays, If statement, Switch statement, Looping statements, Loops, JavaScript Form Validation, Events in JavaScript

Module III: Website Design Considerations and XML (10 Hours)

a. Website Design Considerations: Planning to design a website, sitemaps, top-down vs. bottom up approach, Creating a Compatible website for different color depths, resolutions, and browser considerations, validating a website) XML: Introduction to XML; Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Parser; Document Object Model; Extensible Stylesheet Language (XSL)

Module IV: Web Servers and PHP (14 Hours)

a. Web servers: Need of a web server; System Architecture of a Web server; HTTP Request Types; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Various web servers- Microsoft IIS, Apache, NGINX, LAMP, WAMP

b. PHP: Introduction to PHP; PHP Data Types; Control Structures; Functions; Strings; Arrays

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 4th Edition, Prentice Hall of India Pvt. Ltd. , New Delhi, 2009.
2. E. A. Meyer, CSS The Definite Guide, 3rd Edition, O'Reily.
3. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi
4. R. Lerdorf, K. Tatroe, P. MacIntyre, Programming PHP, 3rd Edition, O'Reily.
5. T. McNavage, JavaScript for Absolute Beginners, Apress, 2010.

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H			
CO2		H		
CO3		H	M	
CO4			H	H
CO5			H	L
CO6			H	H

CAOS0016: OPERATING SYSTEMS

(4 credits – 60 hours)

Objective

The main objective of this course is to introduce the students to a layer of software called Operating Systems, whose job is to manage all the devices of a computer system and provide user programs with a simple interface to the hardware. This course will familiarize the students with the concepts of processes, memory management, file management, Input/Output management and the potential problem of deadlocks. The students will also learn about the Linux operating system, which is a full-blown Unix clone and is fast gaining popularity worldwide.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Elaborate what operating systems are, what they do and how they are designed and constructed. (Creating)

2. Define process concepts like process scheduling, inter-process communication, process synchronization and concurrency. (Remembering)
3. Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm. (Understanding)
4. Identify different page replacement algorithms to solve problems. (Applying)
5. Determine the concepts learned with case studies of Linux and Windows. (Evaluating)

Module I: Concepts, Processes and Threads (14 Hours)

Operating system as an Extended Machine and as a Resource Manager, Operating system concepts (Files, Deadlocks, Memory Management, Input/Output, Processes, The Shell, Security), The evolution of Operating Systems (Serial Processing, Simple Batch Systems, Multiprogrammed Batch Systems, Mainframe Operating Systems, Server Operating Systems, Time Sharing Systems, Multiprocessor Operating Systems, Real-Time Systems, Embedded Operating Systems, Smart Card Operating), System Calls (Process Management, File Management, Directory management), Introduction to Processes (The Process Model, Process Creation, Process Termination, Process Hierarchies, Process States, Implementation of Processes, Process Control Block), Threads (The Thread Model, Thread Usage, Implementing Threads(In User Space and Kernel), Scheduler Activation, Pop Up Threads, Interprocess Communication (Race conditions, Critical Sections, Mutual Exclusion with Busy Waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message Passing), Classical IPC problems (The Dining Philosophers Problem, The Sleeping Barber Problem), Process Scheduling (Scheduling in Batch Systems, Scheduling in Batch Systems, Scheduling in Interactive Systems, Scheduling in Real-Time Systems, Thread Scheduling)

Module II: Deadlocks and Memory Management (14 Hours)

a. Resources, Deadlock (Conditions for Deadlock, Deadlock modeling), Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention
b. Memory management without swapping or paging (Monoprogramming without swapping or paging, Multiprogramming with fixed partitions, Relocation and Protection), Swapping, Virtual Memory (Paging, Page Tables), Page Replacement Algorithms (Not-recently-used, First in first out, Second Chance page replacement algorithm, The Clock Page Replacement Algorithm, Least Recently used page replacement algorithm, The Working Set Page Replacement Algorithm, Modeling Paging Algorithms (Belady's Anomaly, Stack Algorithms, Predicting page fault rates), Design issues for Paging Systems, Implementation issues, Segmentation (Implementation of pure segmentation, Segmentation with Paging: MULTICS)

Module III: Input/output and File Systems (16 Hours)

a. Principles of I/O hardware (I/O devices, Device Controllers, Direct memory access), Principles of I/O software, I/O Software Layers, Disks (Disk hardware, disk formatting, disk arm scheduling algorithms, Error handling, Track-at-a-time caching, RAM disks) Clocks (Clock hardware, Clock software), Terminals (Terminal hardware, Input software, Output software)
b. Files (File Naming, File structure, File types, File access, File attributes, File operations, Memory mapped files), Directories, File System layout (Implementing files, Implementing directories, Shared files), Security (The security environment, Generic Security Attacks, Design Principles For Security, User Authentication), Protection mechanisms (Protection Domains, Access Control Lists, Capabilities, Multilevel Security, Covert Channels), Type of File Systems (FAT, VFAT, FAT32, NTFS)

Module IV: Introduction to Linux OS design – Case study (16 Hours)

Overview of Unix, Processes in Unix (Fundamental Concepts, Process Management System Calls in Unix, Implementation of Processes in Unix), Memory Management in Unix, Input/Output in Unix, The Unix File System, Security in Unix

Suggested Readings

1. Andrew S Tanenbaum, Modern Operating Systems , (Second Ed.), Prentice Hall of India, New Delhi,
2. William Stallings, Operating Systems, Fourth Edition, Prentice Hall of India, New Delhi.
3. Silberschatz, Galvin, Operating System Concepts, Fifth Edition, John Wiley and Sons (Asia) Pte.
4. HM Deitel, Operating Systems, Second Edition, Pearson Education.
5. Pramod Chandra P. Bhatt, An Introduction to Operating Systems Concept, Prentice Hall of India.
6. Maurice J. Bach, The Design of the Unix Operating System, Prentice Hall of India, New Delhi.
7. Kernighan and Pike, The Unix Programming Environment, Prentice Hall of India, New Delhi.

Mapping of COs with Syllabus

Course Outcomes	Module1	Module2	Module3	Module4
CO1	H	M	L	
CO2	M	H	L	
CO3	M	H	M	
CO4		M	H	
CO5		L	H	M

CAPJ0018: PROGRAMMING THROUGH JAVA

(4 credits–60 hours)

Objective

The course is designed to impart the knowledge and skill required to solve real world problems using an object-oriented approach utilizing Java language constructs. This course covers the two main parts of Java i.e. Java Language and Java Library (JDK 5). After completion of the course, a student is expected to be able to

- Do Object Oriented Programming using Java
- Implement Exception handling and Multithreading in Java.
- Create Java I/O Applications and Applets.
- Set up a GUI using Swing components
- Do Network Programming in Java.
- Access relational databases from the Java program and use Java Beans and Servlets.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall the various features of Object Oriented programming by utilizing the JAVA language construct. (Remembering)
2. Explain the standard library, scope and lifetime of a variable and various control statements used in JAVA programs. (Understanding)
3. Interpret the concept of classes and object in JAVA and apply exception handling to solve various exceptions (Applying)
4. Contrast the different type of inheritance and polymorphism and Analyse it in resolving various problems (Analysing)
5. Select the appropriate GUI and will be able to justify their decision to use a particular GUI by evaluating the required parameters depending on the domain and requirement. (Evaluating)
6. Develop algorithms based on the knowledge they have gained to design cost effective and user friendly applications. (Creating)

Module I: Core Java Programming (14 Hours)

a. Java Overview: Genesis, Java Philosophy, Java and Internet, Object-Oriented Programming features, Java Applet and Application, Java Environment and Java Development Kit (JDK) and Java Standard Library (JSL),
b. Java language fundamentals: The scope and lifetime of variable, Type conversion and casting, Control statements, Arrays
c. Classes and objects: The this keyword, Garbage collection, Overloading constructor, Using object as parameters, Argument passing, Returning objects, Recursion, Introducing Access control (public, private and protected), static, final, nested classes, String class, Command- line argument

Module II: Inheritance, Exception handling, Multithread and Applets (12 Hours)

a. Inheritance: Member access and inheritance, method overriding, dynamic method dispatch, using abstract classes, using final with inheritance, the Object class; Packages, Interface, classpath
b. Exception handling: Fundamentals, Exception types, Java's built-in exceptions, user defined exceptions.
c. Multithreaded Programming: The Java thread model (thread priorities, synchronization and inter-thread communication); Deadlock, Thread Group
d. I/O Basics: Streams, the stream classes, the predefined streams, Reading console input, writing console output, the transient and volatile modifiers, using instance of native methods

Module III String handling, Utility classes, java.lang and java.io (12 Hours)

a. String handling: String constructors, methods for character extraction, string searching and comparison, data conversion using valueof (), String Buffer.
b. Exploring java. lang: Simple type wrappers, System class, class Class, Math functions
c. The utility classes: Vector, Stack, Hash Table, String Tokenizer, Bit set, Date, Calendar, Gregorian Calendar, Random, Observable
d. Input/Output - Exploring java.io: The java.io classes and interface, File class and methods for creating, renaming, listing and deleting files and directories, I/O stream classes (File Input Sream, File Output Stream, Buffered Input Stream, Buffered Output Stream, Push Back Input Stream, Input Stream Reader, Buffered Reader, Buffered Writer, Print Stream, Random Access File)

Module IV: Networking, Images, Applet class and Swing (12 Hours)

a. Networking: Socket overview, Stream Sockets, Datagram sockets, Manipulating URLs, Establishing a simple Server/Client using Stream Sockets, Connectionless Client/Server Interaction with Datagrams
b. Images: File formats, image fundamentals, creating, loading and displaying images, ImageObserver, MediaTracker
c. The Applet class: applet architecture, passing parameters to applets, getDocumentBase, getCodeBase, and

showDocument, AppletContext and AudioClip interfaces, Graphics class and methods for drawing lines, rectangles, polygons and ovals

I. Swing: Component and Container classes, Layout managers (Flow Layout, Grid Layout, Border Layout), Handling events, Adapter classes, Anonymous inner classes

II. Swing GUI components: JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JList, JComboBox, JScrollBar, JScrollPane, JToolTip, JPanel, JFrame

III. Menus: JmenuBar, JMenu, JMenuItem, JSeparator

Module V: Java Beans, JDBC, Java Servlets (10 Hours)

a. Java Beans: Introducing JavaBeans Concepts and Bean Development Kit (BDK), Using the Bean Box, Writing a simple Bean, Bean Properties (simple properties), Manipulating events in the Bean Box

b. Java database connectivity (JDBC): Introduction to JDBC, type of JDBC connectivity, Establishing database connections, Accessing relational database from Java programs

Suggested Readings

1. Deitel, H. M.; P. J. Deitel, Java : How To Program (Sixth Edition), New Delhi: Prentice-Hall India, 2005
2. Schildt, H., The Complete Reference Java 2 (Fifth Edition), New Delhi: Tata McGraw-Hill, 2005
3. Moss, K., Java Servlets (Second Edition), New Delhi: Tata McGraw-Hill
4. Russel, Java Programming for the absolute Beginner , New Delhi: Prentice-Hall India
5. Hanagan D., Java Examples in a Nutshell (Third Edition), New Delhi: O' Reilly, 2001

Mapping of COs with Syllabus

Course Outcome	Module I	Module II	Module III	Module IV	Module V
CO1	H	H	M		
CO2	H	H	M		
CO3	H				
CO4		H			
CO5				H	H
CO6			M	M	M

CASE0019: SOFTWARE ENGINEERING

(4 credits–60 hours)

Objective

The field of software engineering aims to find answers to the many problems that software development projects are likely to meet when constructing large software systems. The objective of this paper is to make students aware of the problems incurred by large-scale software development and the solutions proposed. It covers a framework for studying and evaluating software tools, and stresses the importance of theory in the development of software.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define the life cycle models of software. (Remembering)
2. Explain, identify and differentiate various software life cycle models (Understanding)
3. Analyse and design the software requirement specification and perform risk management and testing. (Analysing)
4. Develop and create various design diagrams and find solutions to problems. (Creating)

Module I (10 Hours)

a. The Product and The Process: The Product - Evolving Role of Software, Software (Characteristics, Components and Applications;

b. The Process – Software Engineering A Layered Technology, The Software Process, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models (The Incremental Model, The Spiral Model, The Component Assembly Model, The Concurrent Development Model), The Formal Methods Model, Fourth Generation Techniques;

c. Project Management Concepts – The Management Spectrum (People, the Problem, the Process and the Project);

d. Software Process and Project Metrics – Measures, Metrics and Indicators, Metrics in the Process and Project Domains, Software Measurement, Reconciling Different Metrics Approaches, Metrics for Software Quality;

e. Software Project Planning – Observation on Estimating, Project Planning Objectives, Software Scope, Resources, Project Estimation Technique – Empirical estimation techniques (Expert Judgement Technique, Delphi Cost Estimation), Heuristic estimation techniques (COCOMO Model), Halstead Software Science (An Analytical Technique), The Make-Buy Decision;

Module II (10 Hours)

a. Project Scheduling and Tracking - Basic Concepts, The Relationship between People and Effort, Defining a Task set for the Software Project, Selecting Software Engineering Tasks, Defining a Task Network, Scheduling, The Project Plan;
b. Software Projects Risks, Quality Assurance and Configuration Management: RiskManagement- Reactive Vs. Proactive Risk Strategies, Software Risk, Risk Identification, Risk Projection, Risk (Mitigation, Monitoring and Management), Safety Risks and Hazards, The RMMM Plan;
c. Software Quality Assurance - Quality Concepts, The Quality Movement, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Quality Assurance, Software Reliability, The SQA Plan, The ISO 9000 Quality Standards;
d. Software Configuration Management - Software Configuration Management, The SCM Process, Identification of Objects in the Software Configuration, Version Control, Change Control, Configuration Audit, Status Reporting;
e. System Engineering - Computer Based Systems, Product Engineering

Module III (20 Hours)

a. Analysis and Design: Analysis Concepts and Principles - Requirements Analysis, Communication Techniques, Analysis Principles, Software Prototyping, Specification, Specification Review;
b. Analysis Modeling- The Elements of the Analysis Model, Data Modeling, Functional Modeling and Information Flow, Behavioral Modeling, the Mechanics of Structured Analysis, the Data Dictionary;
c. Design Concepts and Principles - Software Design and Software Engineering, the Design Process, Design Principles, Design Concepts, Effective Modular Design, Design Heuristic for Effective Modularity, the Design Model, Design Documentation;
d. Design Methods - Data Design, Architectural Design, the Architectural Design Process, Architectural Design Optimization, Interface Design, Human-Computer Interface Design, Interface Design Guidelines, Procedural Design;
e. Design For Real Time systems - Real Time Systems;
f. Case studies on diagram - Use case, Class, Activity, Sequence

Module IV (10 Hours)

a. Software Testing: Software Testing Methods - Software Testing Fundamentals, Test Case Design, White Box Testing, Basis Path Testing, Control Structure Testing, Black Box Testing, Testing for Specialized Environments;
b. Software Testing Strategies - A Strategic Approach to Software Testing, Strategic Issues, Unit Testing, Integration Testing, Validation Testing, System Testing, The Art of Debugging;
c. Technical Metrics For Software - Software Quality, A Framework For Technical Software Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance

Module V (10 Hours)

a. Object Oriented Software Engineering: Object Oriented Concepts and Principles - The Object Oriented Paradigm, Object Oriented Concepts, Identifying the Elements of an Object Model, Management of Object Oriented Software Projects
b. Object Oriented Analysis - Object Oriented Analysis, Domain Analysis, Generic Components of the Object Oriented Analysis Model, the OOA Process, the Object Relationship Model, the Object Behavior Model
c. Object Oriented Design - Design for Object Oriented Systems, The Generic Components of the OO Design Model, The Systems Design Process, The Object Design Process, Design Patterns, Object Oriented Programming
d. Advanced Topics in Software Engineering: Cleanroom Software Engineering- The Cleanroom Approach, Functional Specification, Design Refinement and Verification, Cleanroom Testing
e. Software Reuse - Management Issues, the Reuse Process, Domain Engineering, Building Reusable Components, Classifying and Retrieving Components, Economics of Software Reuse
f. Reengineering - Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, Economics of Reengineering
g. Computer Aided Software Engineering - Case Definition, Building Blocks of Case, Taxonomy of Case Tools, Integrated Case Environments, the Integration Architecture, the Case Repository

Suggested Readings

1. Roger S. Pressman, Software Engineering A Practitioner's Approach, Fourth Edition, Tata McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, Second Edition, Prentice Hall of India Private Limited.
3. Ian Sommerville, Software Engineering, Sixth Edition, Addison Wesley, Pearson Education.
4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals Of Software Engineering, Second Edition, Prentice Hall of India Private Limited, New Delhi, 2002.
5. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, Modern Systems Analysis and Design, Second Edition, Pearson Education.
6. Richard E Fairley, Software Engineering Concepts, Tata McGraw Hill Publishing Company Limited, New Delhi, 1997.
7. Hans Van Vilet, Software Engineering Principles and Practice, Second Edition, John Wiley and Sons, Ltd.

Mapping of COs with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5

CO1	H	L			
CO2	H	M	H		
CO3		H	M	H	
CO4			H		M

CAIT0022: INTERNET TECHNOLOGY AND APPLICATIONS

(4 credits – 60 hours)

Objective

The objective of the course is to familiarize the students with a discussion on Internet and its growth. It also provides the students a study on the basic services provided by the Internet. A familiarization on the markup languages, scripting languages and web application development are also being discussed to make the student competent to design websites. It has been taken into consideration that this paper assumes that the students must know well in advance about the various protocols of the Internet and the knowledge of HTML and databases.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall and examine the growth of Internet and identify the history behind it. (Remembering)
2. Identify and differentiate the various services provided by the internet. (Understanding)
3. Experiment with various mark-up languages and scripting languages. (Applying)
4. Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
5. Develop and create a website of their own. (Creating)
6. Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)

Module I: Introduction to Internet (10 Hours)

History of the Internet; History of the World Wide Web; W3C (World Wide Web Consortium); Levels of Internet Connectivity (Dial-up, Leased Line, DSL, VSAT); Requirements for Internet connectivity; Use of Browsers; Different types of browsers (IE, Opera, Netscape, Firefox); Search engines; FTP; Electronic Mail; Instant Messaging; DHCP; DNS; HTTP; URL; Proxy Servers.

Module II: Internet Markup Languages (12 Hours)

a. XHTML: What is XHTML? Components of XHTML; Elements of XHTML (Headers, Paragraphs,
b. Linking, Images, Special Characters, Lists, Tables, Forms, Framesets)
c. Cascading Style Sheets: Inline Styles; Embedded Style; Conflicting Style; Linking External Styles; W3C CSS Validation Service; Use of CSS (Positioning Elements, Backgrounds, Text flow)
d. XML: What is XML? Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Vocabularies; Document Object Model (DOM and its methods); Extensible Style Sheet Language (XSL)

Module III: Web servers, Databases and Scripting Languages (18 Hours)

a. Web servers: What is a web server; HTTP Request Types; System Architecture of a Web server; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Apache Web Server.
b. Databases: Introduction to each one of the following: SQL, MYSQL, DBI
c. Scripting Languages: Javascript: Operators, Data Types, Control Structures, Functions, Arrays, String Manipulation. JQuery, ASP.NET. Introduction to Perl and CGI (Common Gateway Interface). JSP: Introduction; JSP Overview; Scripting; Standard Actions; Directives
d. Java Servlets: Servlet overview and architecture, Servlet Interface and Servlet life cycle, HttpServlet Class, HttpServletRequest Interface, HttpServletResponse Interface, Handling HTTP get Requests, deploying a web application, Handling HTTP get requests containing data, Handling HTTP post requests.

Module IV: Web Application Development Using PHP (20 Hours)

a. Web Site Design Considerations: Using Logical Design: Planning your website, drawing a map, using a top-down approach, flexibility, other web design metaphors. Creating templates. Creating a Compatible Design: Designing for different color depths, resolutions, different browser considerations, accommodating limited bandwidth. Validating your work.
b. PHP: Introduction to PHP; Data Types; Control Structures; Functions; Strings; Arrays; Querying Web Databases using PHP; Writing to Web Databases; Errors, Debugging and Deployment; Reporting in PHP; Validation Techniques in PHP.

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi
2. Hugh E. Williams and David Lane, PHP and MySQL, 2nd Edition, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd.
3. Moss, K., Java Servlets (Second Edition), New Delhi: Tata McGraw-Hill
4. Internet Complete, 2nd Edition, BPB Publications, New Delhi

5. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2	H			
CO 3			H	
CO 4		M		H
CO 5		M		H
CO 6		M		H

CAEP0024: ENTERPRISE RESOURCE PLANNING

(4 credits–60 hours)

Objective

To help the student understand the conceptual elements of ERP and its theory and implementation. This is especially poignant in view of large number of organizations implementing ERP applications in recent years. The student will appreciate the impact that ERP brings into the daily operations of firms with respect to their productivity, integration, communication, etc.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall the conceptual elements of ERP. (Remembering)
2. Demonstrate the Influence of ERP in Large Organizations. (Understanding)
3. Identify the impact of ERP into the daily operations of firms with respect to their productivity, integration, communication etc. (Applying)
4. Analyse the practical side of ERP implementation with different vendors. (Analysing)
5. Discuss and evaluate the best practices of ERP with various case studies and real time examples. (Creating, Evaluating)

Module I: ERP Basics (15 hours)

a. Evolution and structure of ERP, ERP concepts, growth of the ERP market, conceptual model of ERP, 2-tier and 3-tier architecture, elements in ERP architecture, advantages/benefits of ERP, overview of an enterprise, integrated management information, business modeling, integrated data model
b. ERP and related technologies: Business Process Reengineering (BPR), Management Information Systems (MIS), Decision Support Systems (DSS), Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Supply Chain Management.

Module II: ERP Modules (15 hours)

Item types in ERP, Manufacturing, distribution and Financial requirements, item control module in ERP, Finance module, Manufacturing and Production Planning module, Sales and Distribution module, Plant Maintenance module, Quality Management module, Materials Management module, Capital Requirement Planning module, Purchase Control module, Human Resources modules; concept of Bill of materials, concept of formula management.

Module III: Profiling ERP Vendors (10 hours)

a. SAP AG: R/3 –, overview of R/3 system, R/3 modules, R/3 and the internet
b. BAAN: Baan ERP modules, Baan ERP Tools
c. Oracle: Oracle modules – Financials, Human Resources, Projects, Manufacturing, Supply chain.
d. PeopleSoft: Accounting and control, Treasury Management, Performance Management, Sales and Logistics, Procurement.

Module IV: ERP Implementation Lifecycle (10 hours)

Elements of implementation methodology, Pre-evaluation Screening, Package evaluation, project planning phase, Gap Analysis, Business Process Re-engineering, configuration, Implementation team training, testing, product migration and support, Problems in ERP implementation, cost of ERP.

Module V Best Practices in ERP (10 hours)

a. Concept of Best Practices, concept of Customer Order Decoupling Point(CODP), Demand Management – Sales and Operations Planning, ERP scenario in India, future directions in ERP.
b. Case studies should also be introduced to highlight situations where ERP projects are implemented, and the success stories/benefits/difficulties of these implementations.

Suggested Readings

1. O'Leary, Daniel E, Enterprise Resource Planning Systems: systems, life cycle, electronic commerce and risk, Cambridge University Press.
2. Alexis Leon, Enterprise Resource Planning, 14th reprint, Tata McGraw Hill, New Delhi 2005
3. Rahul V Altekar, Enterprise Resource Planning (Theory and Practice), Prentice Hall India, New Delhi 2004
4. Alexis Leon, ERP Demystified, Tata McGraw Hill Pub. Co. Ltd, 2000
5. Kent Sandoe, Enterprise Integration, John Wiley and Sons
6. Garg and Venkitakrishnan, Enterprise Resource Planning : Concepts and Practice, 2nd edition, Prentice Hall India
7. Garg and Venkitakrishnan, ERPWARE: ERP Implementation Framework, Prentice Hall India
8. ERP – Concepts and Cases, ICFAI University Press, 2004

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		M	H		
CO 3		H	M		
CO 4		L		H	
CO5					H

CAOS0025: INTRODUCTION TO OPERATING SYSTEMS

(4 credits -60 hours)

Objective

To provide the basic functionalities and services provided by an operating system. This subject provides an overview of process management, memory management, deadlock, file system, input-output systems and protection and security. It give knowledge on existing common operating system like UNIX, Linux and Windows.

Module I: Introduction to Operating systems (8 Hours)

Definition of Operating Systems, Functions of Operating Systems, Types of Operating Systems: Batch, Multiprogrammed, Time sharing, Multi-Processor, Real-time and Distributed Operating Systems, Operating System Structures, Components and Services, System calls.

Module II: Process Management (10 Hours)

Process Concept-Definition, Process States, Process Control Block, Process Schedulers- Short term, Medium term and Long term schedulers, Scheduling Algorithms - Preemptive and Non- Preemptive, Co-operating process, Threads, Inter-process communication.

Module III: Process Synchronization and Deadlock (12 Hours)

Process Synchronization-the Critical Section Problem, Classical Problems of Synchronization, Semaphores. Deadlocks - Definition of a Deadlock, System model, Characterization, Deadlock Handling-Prevention, Avoidance, Detection and Recovery (Banker's Algorithms and Resource Request Algorithm

Module IV: Memory Management (10 Hours)

Memory Management- Logical and Physical Address Space, Address Mapping, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with Paging. Virtual memory- Demand paging and its performance, Page replacement algorithms- FIFO and LRU, Thrashing.

Module V: File and I/O System Management (12 Hours)

a. File management (Systems, Secondary Storage Structure)-File Concepts, Access methods, Directory Structure, Protection and consistency, Recovery.
b. I/O System Management- Overview of I/O Systems, I/O Interface, Secondary Storage Structure-Disk Structure and Scheduling methods, Disk management, Swap – Space management.

Module VI: Protection and Security (8 Hours)

Goals of protection, Domain Protection, Access matrix, Security Problem, Authentication, Case Study of Windows and Linux Operating System.

Suggested Readings

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", 7th Edition, Pearson Education, 2002.
2. Tannenbaum ,"Modern Operating Systems", PHI
3. William Stallings, "Operating Systems", 6th Edition, Pearson Education, 2010.
4. Harvey M. Deitel, Operating Systems, Second Edition, Pearson Education Pvt. Ltd.
5. Mandik and Donovan, Operating Systems, Mcgraw Hill.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define the basic concepts of operating systems and terminology related to operating systems such as processes, threads, files, semaphores, IPC abstractions, shared memory regions. (Remembering)
2. Analyze important algorithms such as Process scheduling and memory management algorithms. (Analysing)
3. Categorize the operating system's resource management techniques, dead lock management techniques, memory management techniques. (Analysing)
4. Discuss and examine the importance of File and I/O system management in operating systems. (Evaluating)
5. Description of protection and security and also the Comparison of UNIX and Windows OS. (Understanding).

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M	M	M	M	M	M
CO 2		H		H		
CO 3			H	H		
CO 4					H	
CO5						H

CADB0028: RELATIONAL DATABASE MANAGEMENT SYSTEMS

(4 credits – 60 hours)

Objective

The objectives for this course are to give students an in-depth understanding of the relational model for establishing fundamental skills with SQL and the operation of an RDBMS. The course also provides concepts of data modelling, design and management for solving realistic problems.

Module I (15 hours)

a. Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
b. Data models - Entity Relationship(ER), Enhanced Entity Relationship (EER): specialization, Aggregation, Mapping ER Model to Relational Model, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II (22 hours)

Relation Query Languages, SQL queries for retrieval and data changing commands, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Module III (8 hours)

Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV (15 hours)

a. Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
b. Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define the terminology, features, classifications, and characteristics embodied in database systems. (Remembering)
2. Master sound design principles for the logical design of databases, including the ER and EER diagrams and mapping of these diagrams to Schema diagrams (Evaluating)
3. Use the various types of SQL queries that can be used for building a relational database. (Creating)
4. Transform an unnormalized database to a normalized database by using the concept of normalization. (Applying)
5. Experiment the various optimization techniques that are used in Query processing. (Evaluating)
6. Compare and contrast the various types of advanced databases used in recent days and also summarize the underlying storage hierarchy for such databases. (Understanding)

Suggested Readings

1. Ramez Elmasri and Shamkant B Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
2. Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, 5th Edition, Mc-Graw Hill.

3. C.J. Date, Introduction to Database Systems, 8th ed.,Pearson Education.
4. Bipin Desai, An introduction to Database System, Galgotia Publication.

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H	M		L
CO2	H	L		
CO3		H	M	
CO4		H		
CO5			H	
CO6	L			H

CASE0029: BASIC SOFTWARE ENGINEERING

(4 credits - 60 hours)

Objective

To provide ability analyse a scenario and produce a problem statement. The learners will be able to produce a conceptual solution which includes sample prototypes, domain models, and user stories. The learners will be able to describe the attributes and activities involved in software development process models and testing.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Relate and examine the life cycle models of software. (Remembering)
2. Interpret and differentiate various software life cycle models(Understanding)
3. Experiment with different software architectures and identify the best feasible one (Applying)
4. Analyse and design the software requirement specification(Analysing)
5. Develop and create various design diagrams and find solutions to problems. (Creating)

Module I: Introduction (10 Hours)

Problems and solutions: Why software is developed. Problem and vision statements. Goals and objectives. Definitions and paradigms, A generic view of software engineering. Software development life cycle, Role of quality, metrics and measurement.

Module II: Requirements Analysis (15 Hours)

The feasibility study, Software Requirement Analysis and Specifications, work breakdown structure (WBS), Problem Analysis, Creating software requirement specification document (SRS).

Module III: Designing Software applications (15 Hours)

Process Models: How software is built. The fundamental design concept for data, architectural and procedural designs. Conceptual solutions. Agile concept and User stories. Domain modeling with UML diagrams-Class diagram, Use cases etc, Object oriented design paradigm; Creation of technical design document.

Module IV: Software Implementation (10 Hours)

The relationship between design and implementation, Implementation, Coding the procedural design, Good coding style and review of correctness and readability.

Module V: Software Testing and Maintenance (10 Hours)

Strategies of software testing. Types of testing, functional testing, validation and verifications. Test Case Design. Maintenance as part of software evaluation, techniques and procedures for maintenance. Introduction to configuration Management. The concept of CASE, green engineering.

Suggested Readings

1. Sommerville, “Software Engineering”, Addison Wesley.
2. Roger S.Pressman, “Software Engineering–A Practitioner’s Approach”, McGraw Hill Companies.
3. Rajib Mall, Fundamentals of Software Engineering, PHI.

Mapping of COs with Syllabus

Course Outcomes	Module1	Module2	Module3	Module4	Module5
CO1	H	M	L		
CO2		H	L		
CO3	H	M	L	L	
CO4		H	H	M	L
CO5			H	M	

CAPA0030: PRINCIPLES OF ARTIFICIAL INTELLIGENCE

(4 credits – 60 hours)

Objective

Artificial Intelligence has embraced the larger scientific goal of constructing information- processing theory of intelligence. If such a science of intelligence could be developed, it could guide the design of intelligent machines as well as explicate intelligent behaviour as it occurs in humans and other animals. This paper describes the fundamental AI ideas that underlie many of the AI applications and provides a base for understanding natural intelligence.

Module I: General Issues and Overview of AI (12 Hours)

Introduction to AI: The AI problems, the underlying assumption, AI techniques, the level of the model, criteria for success, AI applications. Problem solving, search and control strategies: defining the problem as a state space search, production systems, control strategies, breadth-first search, depth-first search, problem characteristics, production system characteristics, issues in the design of search programs.

Module II: Search Strategies for AI Production Systems (16 Hours)

Heuristic search techniques: generate-and-test, hill climbing, simple hill climbing, steepest- ascent hill climbing simulated annealing, best-first search, OR-graphs, the A* algorithm, problem reduction, AND-OR graphs, the AO* algorithm, constraint satisfaction, means-end analysis. game playing: overview, the minimax search procedure, adding alpha-beta cutoffs, additional refinements, iterative deepening.

Module III: Knowledge Representation (16 Hours)

Knowledge representation issues: representations and mappings, representing simple facts in logic, knowledge representation attributes, computable functions and predicates, resolution, conversion to clause form, the basics of resolution, resolution in propositional logic, procedural vs. declarative knowledge, logic programming, forward vs. backward reasoning, matching, control knowledge. statistical reasoning: probability and Bayes' theorem, certainty factors and rule-based systems, Bayesian networks, Dempster-Shafer theory, basic notions and concepts of fuzzy sets, fuzzy set operations, information - based characterization of fuzzy sets, fuzzy relations and their calculus.

Module IV: Advanced AI (16 Hours)

Natural language processing: overview, morphological analysis, syntactic analysis, semantic analysis, discourse integration, pragmatic analysis, parsing techniques, top-down parsing, bottom- up parsing, augmented transition networks (ATN). Learning: rote learning, learning by taking advice, learning by induction, explanation-based learning. Expert system: representing and using domain knowledge, expert system shells, explanation, knowledge acquisition.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall and identify the need of incorporating human intelligence into machine and define the basic terms related to the concept of knowledge and representation, learning and reasoning, communication and language processing. (Remembering)
2. Define problem state space, design algorithms to solve problems, generalized schema for knowledge interpretation and planning and language processing. (Understanding)
3. Compute and demonstrate the problem in terms of state space and apply different AI algorithms to solve problems and construct logic to represent knowledge in the computational domain and also to interpret the natural language. (Applying)
4. Compare and analyse the performance of algorithms based on problem domain. (Analysing)
5. design and create new intelligent algorithms for application development by integrating experience based learning. (Creating)
6. Judge and assess the algorithms based on completeness, optimality, and space and time complexity for solving a problem in an intelligent manner. (Evaluating)

Suggested Readings

1. Rich, E.; K. Knight, Artificial Intelligence, (Second Edition), New Delhi: Tata McGraw-Hill, 1997
2. Nilson, N. J., Principles of Artificial Intelligence, New Delhi: Narosa Publishing House, 2002
3. Pedrycz, W.; F. Gomide, An Introduction to Fuzzy Sets: Analysis and Design, New Delhi: Prentice- Hall India, 2004.
5. Winston, P. H., Artificial Intelligence, New Delhi: Pearson Education Asia, 2002
6. Charniak, E.; D. McDermott, Introduction to Artificial Intelligence, New Delhi: Pearson Education, 2002
7. Russell, S.; P. Norvig, Artificial Intelligence: A Modern Approach (Second Edition), New Jersey: Prentice-Hall, 2003

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4

CO 1	H		M	L
CO 2	M	H	L	
CO 3	L	M	H	
CO 4		H	M	M
CO 5			H	M
CO 6		M	M	H

CACL0033: CYBERLAW and IT SECURITY (4-0-0)
(4 credits – 60 hours)

COURSE/LEARNING OUTCOMES:
1. Apply fundamental concepts of Information Security threats and vulnerabilities to adopt right security measures and design real time scenarios. (Applying)
2. Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation. (Analyzing)
3. Analyze and evaluate the cyber security needs of an individual/organization. (Analyzing, Evaluating)
4. Design operational and strategic cyber security strategies and policies. (Creating)
5. Analyze various types of cybercrime and formulate procedures for real world cybercrime Investigations. (Analyzing)

Module I: (12 hours)
Object and Scope of the IT Act - Genesis, Object, Scope of the Act. Encryption -Symmetric Cryptography, Asymmetric Cryptography, RSA Algorithm, Public Key Encryption

Module II: (14 hours)
Digital Signature- Technology behind Digital Signature, creating a Digital Signature, Verifying a Digital Signature, Digital Signature and PKI, Digital Signature and the Law. E-Governance and IT Act 2000- Legal recognition of electronic records, Legal recognition of digital signature, Use of electronic records and digital signatures in Government and its agencies, Certifying Authorities. Need of Certifying Authority and Power. Appointment, function of Controller. Who can be a Certifying Authority? Digital Signature Certifications. Generation, Suspension and Revocation of Digital Signature Certificate.

Module III: (12 hours)
Domain Name Disputes and Trademark Law: Concept of Domain Names, New Concepts in Trademark, Jurisprudence, Cyber-squatting, Reverse Hijacking, Meta tags, Framing, Spamming, Jurisdiction in Trademark Dispute

Module IV: (12 hours)
Cyber Regulations Appellate Tribunal: Establishment & Composition of Appellate Tribunal, Powers of Adjudicating officer to Award Compensation, Powers of Adjudicating officer to impose Penalty.

Module V: (10 hours)
The Cyber Crimes (S-65 to S-74): Tampering with Computer Source Documents(S-65), Hacking with Computer System(S-66), Publishing of Information Which is Obscene in Electronic Form(s-67), Offences: Breach of Confidentiality & Privacy (S-72), Offences: Related to Digital Signature Certificate (S-73 & S-74)

Suggested Readings
1. Farooq Ahmad, Cyber Law in India, Pioneer Books
2. Vakul Sharma, Information Technology Law and Practice, Universal Law Publishing Co. Pvt. Ltd.
3. Suresh T Vishwanathan, The Indian Cyber Law, Bharat Law house New Delhi.
4. P.M. Bakshi and R.K.Suri, Hand book of Cyber and E-commerce Laws, Bharat Law house New Delhi.
5. Rodney D. Ryder, Guide to Cyber Laws, Wadhwa and Company Nagpur.
6. The Information Technology Act, 2000, Bare Act, Professional Book Publishers, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		M
CO 4				H	M
CO 5				M	H

CAAD0036: ANDROID APPLICATION DEVELOPMENT FUNDAMENTALS
(4 credits – 60 hours)

Objective

This course is designed to enable students to get a complete understanding of the android applications development. On completion of this course, students will be able to design, develop, debug and deploy various real-time android apps.

Module I: Get started with Kotlin (5 hours)

Kotlin basics: data types, operators, variables, control structures, and nullable versus non-nullable variables.
Functions: functions in Kotlin, including default values for parameters, filters, lambdas, and compact functions.
Classes and Objects: classes, objects, and inheritance in Kotlin. Create small programs as you learn about abstract classes, interfaces, and interface delegation.

Module II: Introduction to Android (10 hours)

Build your first Android app: create your first Android apps using Android Studio.
Layouts: Build a tip calculator app by building the layout first, and then implement the logic to calculate the tip from the user input. Next, create an app that displays a scrollable list using the Recycler View widget in Android.
App navigation: Create a fragment, define navigation paths, and start an external activity. Complete the Android Trivia app, which is a game in which users answer trivia questions about Android development and can share their results if they win.

Module III: Android app architecture (35 hours)

Activity and fragment lifecycles: Learn about Activity and Fragment lifecycles, how to handle complex lifecycle situations, and use logging to help debug and track the state of the app.
App architecture (UI layer): Learn how to use Android Jetpack Architecture components, a collection of libraries that help you design robust, testable, and maintainable apps.
App architecture (persistence): Create a database using the Room library and use coroutines to simplify asynchronous programming.
Advanced Recycler View use cases: Learn advanced binding and layouts with Recycler View, and how to handle multiple types in a Recycler View.
Connect to the internet: Learn about Android permissions, how to connect to and use network resources, and how to define a Retrofit service and display images.
Repository pattern and Work Manager: Learn about the repository pattern, and how to use Work Manager.

Module IV: Android app design and Play store publishing (10 hours)

App UI design: Learn UI best practices and how to make your app follow the Material Design guidelines.
Play store publishing.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall the programming structure of Kotlin and OOPS concepts and android basic concept (Remembering)
2. Illustrate the various methods of the Android development framework. (Understanding)
3. Incorporate different features to design user friendly and interactive Android Applications. (Applying)
4. Analyse various aspects of commercializing an application. (Analysing)
5. Evaluate effectiveness of different products for real time problems. (Evaluation)
6. Design Android application for different requirements. (Creating)

Suggested Readings

Complete Study Material provide by Google:

1. https://docs.google.com/presentation/d/1EXRoxyZxMdy4UEJ7YvWgZLEHwOGDE_QmbXkQ543JwnA/edit#slide=id.g8ef83c870c_0_70

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4	CO5	CO6
Module I	H					
Module II	H	M	L			
Module III		H			M	
Module IV				M		H

CADC0037: DATA COMMUNICATION

(4 credits – 60 hours)

Objective

The main objective of this course is to make the students understand the characteristics of signals propagated through different

transmission media, including concepts of attenuation and noise, error-detection, and error-correction techniques and interfacing and synchronization issues.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define the fundamentals of data communication and various techniques of communications. They will also be able to recall the layered structure of computer networks. (Remembering)
2. Explain about different network topology and the type of protocol required for different communication techniques. (Understanding)
3. Understand the requirements of various networking devices and make use of the network accordingly. (Applying)
4. Compare different networking devices. They will also be able to analyse different network behaviour depending on performance parameters. (Analysing)
5. Compose a type of network required for an organization, Depending on availability of hardwares and softwares (Creating)
6. Establish and determine a computer network either Wired or Wireless, (Applying, Evaluating)

Module I (16 hours)

a. Introduction to data communications: A communications model, Data communications, Networking, Protocols and Protocol architecture, Characteristics of data transmission: Concepts and Terminology, Analog and digital data transmission, Transmission impairments.
b. Transmission media: Guided transmission media, Wireless transmission data encoding, Digital data-Digital signals, Digital data- Analog signals, Analog data-Digital signals, and Analog data-Analog signals.

Module II (13 hours)

Data communication interface: Asynchronous and Synchronous transmission, Line configurations, Interfacing. Data link control, Flow control, Error detection, Error control, High-level data link control (HDLC), Other data link control protocols.

Module III (16 hours)

Data communications hardware: Terminals- Introduction, Basic terminal components, Enhanced terminal components, General-purpose terminals, Remote job entry terminals, Transaction terminals, Clustering of terminal devices. Communications processing hardware introduction, Switching processors, Multidrop lines, Multiplexers, Concentrators, Front-end processors.

Module IV (15 hours)

Modems: Network attachment and regulations, Line conditioning and leased lines, Modems and modem circuits. Multiplexing: Frequency-division multiplexing, Synchronous time- division multiplexing: Characteristics, TDM Link control, Digital carrier systems statistical time-division multiplexing: Characteristics.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2	M			
CO 3			H	M
CO 4			H	M
CO 5				H
CO 6			M	H

CAIJ0038: INTRODUCTION TO JAVA PROGRAMMING

(4 Credits–60 hours)

Objective

The course is designed to impart the knowledge and skill required to solve real world problems using an object-oriented approach utilizing Java language constructs. This course covers the two main parts of Java i.e. Java Language and Java Library (JDK 5). After completion of the course, a student is expected to be able to

- Do Object Oriented Programming using Java
- Implement Exception handling and Multithreading in Java.
- Create Java Applets.
- Set up a GUI using Swing components
- Do Network Programming in Java.

Module I: Java Fundamentals (16 hours)

Genesis, Java Philosophy, Java & Internet, Object-Oriented Programming features, Java Applet and Application, Java Environment and Java Development Kit (JDK) and Java Standard Library (JSL), Tokens, Expressions, Using Data Types,

Declarations, Control Flow

Module II: Java Classes, Packages and Interfaces, Java Streams (14 hours)
a. Introduction, Classes, Working with Objects, Packages, Inheritance, Interfaces
b. Data Flow with Java Streams, Input Streams, Output Streams

Module III: Exception Handling in Java and Java threads (10 hours)
a. Introduction, Exception Methods, java.lang Exceptions
b. Introduction, Creating Threads, the Life Cycle of a Thread, Thread Methods, Using Threads, Synchronization of Threads

Module IV: Java Applets (10 hours)
Introduction, Applet Examples, The java.applet.Applet Class, The Five Stages of an Applet's Life Cycle, Methods for Adding UI Components, Methods for Drawing and Event Handling

Module V: Java AWT (10 hours)
Introduction, Swing Component and Container classes, Layout managers (Flow Layout, Grid Layout, Border Layout), Handling events, Adapter classes, Anonymous inner classes, Swing GUI components :JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JList, JComboBox, JScrollBar, JScrollPane, JToolTip, JPanel, JFrame, introduction to database connectivity with JDBC.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall the knowledge of the structure and model of the Java programming language, (Remembering)
2. Explain the use of Java programming language for various programming technologies (Understanding)
3. Develop software in the Java programming language. (Applying)
4. Analyse user requirements for software functionality required to decide whether the Java programming language can meet user requirements (Analysing)
5. Choose an engineering approach to solving problems, starting from the acquired knowledge of programming and knowledge of operating systems. (Evaluating)
6. Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem (Creating)

Suggested Readings
1. Deitel, H. M.; P. J. Deitel, Java: How to Program, New Delhi: Prentice Hall India
2. Schildt, H., The Complete Reference Java 2, New Delhi: Tata McGrawHill
3. Moss, K., Java Servlets, New Delhi Tata McGraw-Hill
4. Russell, Java Programming for the absolute Beginner, New Delhi: Prentice-Hall India
5. Hanagan D., Java Examples in a Nutshell, New Delhi: O' Reilly

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	H	M			
CO 3		M	M	M	M
CO 4		M	M	M	M
CO 5		M	M	M	M
CO 6		M	M	M	M

CACL0039: CLOUD COMPUTING

(4 Credits–60 hours)

Objective
This course is designed to enable students
- To get acquainted with the latest computational model, i.e. cloud computing
- To understand the basic foundational elements of cloud computing
- To study details of Data storage in cloud, big data file handling and parallel computing basics
- To get familiarized with popular cloud platforms and applications

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall and recognize the differences in cloud services and deployment models. (Remembering)

2. Describe the behaviors of Big Data and the components of Hadoop. (Understanding)
3. Describe and compute Map Reduce programs. (Understanding/Applying)
4. Illustrate the security principles in cloud computing and predict the vulnerabilities. (Applying/ Analysing)
5. Demonstrate the application of HDFS by transferring a file from the local file system to HDFS or vice versa and justify the transactions using HDFS commands. (Applying/ Evaluating)
6. Analyse the hosting of real time applications on cloud platforms. (Analysing)
7. Design and build a cloud network using OpenStack. (Creating)

Module I (15 hours)
Introduction to cloud computing, the evolution of cloud computing, hardware evolution, internet software evolution, server virtualization, web services deliver from the cloud, communication-as- a-service, infrastructure-as-a-service, monitoring-as-a-service, platform- as-a- service, software-as- a-service, building cloud network

Module II (18 hours)
Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module III (15 hours)
Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Cloud computing security challenges: Virtualization security management virtual threats, VM Security Recommendations, Secure Execution Environments and Communications in cloud.

Module IV (12 hours)
Issues in cloud computing, implementing real time application over cloud platform, Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment.

Suggested Readings
1. Enterprise Cloud Computing by Gautam Shroff,Cambridge
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
3. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, (Wiley India Edition)
4. Google Apps by Scott Granneman, Pearson
5. Cloud Security and Privacy by Tim Malhar, S. Kumaraswamy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Anthony T Velte, et.al McGraw Hill
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3		H		
CO 4			H	
CO 5		H		
CO 6				H
CO 7				H

CANS0040: NETWORK SECURITY

(4 Credits–60 hours)

Objective
This course provides a beginners approach to understanding the basic security concepts in a Network along with different mitigation techniques of several attacks. After the completion of the course students will be able to understand security measures to be adopted in different devices and network applications used to interface with the inter network.

Module I (18 hours)
Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP

hijacking, and man-in-the-middle attacks.

Module II (18 hours)
Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC, Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

Module III (12 hours)
Email privacy: Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

Module IV (12 hours)
Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats. Firewall Design principles, Trusted Systems, Intrusion Detection Systems, Ransomware and different types of Ransomware, Methodology of execution of Ransomware.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall and identify the different security attacks, requirements, mechanisms and services in the practical field. (Remembering)
2. Recognize and summarize the core principles of cryptography and cryptanalysis available today, including symmetric and asymmetric encryption, hashing, and digital signatures. (Understanding)
3. Discover and relate themselves with the different vulnerabilities, a system in a network can have. (Applying)
4. Interpret and predict the issues of securing computer and information systems. (Analysing)
5. Assess and critique references to computer security appearing in other academic and non-academic curriculum. (Evaluating)
6. Reconstruct how malicious code functions, relate the vulnerabilities that make proliferation possible and rewrite methods and practices are available for alleviation. (Creating)

Suggested Readings
1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech.
3. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
4. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
5. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
6. Principles of Information Security, Whitman, Cengage Learning.
7. Cryptography and Network Security, S.Bose , Pearson

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2	M	H		
CO 3	H			
CO 4			H	
CO 5				H
CO 6			M	H

CAMC0041: MOBILE COMMUNICATION
(4 Credits–60 hours)

Objective
The course on mobile communications introduces the principles of mobile systems and its technical aspects and services. The evolution of services related to technical aspects is emphasized for both public and professional mobile telephony standards. Indoor access standards such as Wireless LAN and ad hoc networks based on Bluetooth are also considered in the frame of the migration to wireless of wired applications. The course also emphasizes cellular networks.

Module I: Introduction to Personal Communications Services (PCS) (12 hours)

Personal Communications Services (PCS): Architecture, Cellular Telephony, Coreless Telephony; Overview of AMPS, GSM, DAMPS, CDMA; 3G Wireless Systems

Module II: Wireless LANs (15 hours)
Infra-red vs. Radio Transmission, Infrastructure and Ad-hoc Network; IEEE 802.11: Architecture, Medium Access Control Layer, MAC Management, 802.11a, 802.11b; HIPERLAN: HIPERLAN 1, WATM, BRAN, HIPERLAN 2; Bluetooth

Module III: Mobile Transport and Network Layer (18 hours)
a. Mobile Transport Layer: Traditional TCP: Congestion Control, Slow Start, Fast Retransmission, Fast Recovery; Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmission, Fast Recovery
b. Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile ad-hoc networks

Module IV: Cellular Networks (15 hours)
Cellular Concept: Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Capacity in Cellular Systems, Cell Splitting, Sectoring, Microcell Zone Concept

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall the concepts of different mobile communication technology including AMPS, GSM, GPRS etc (Remembering)
2. Illustrate about wireless communication, relevant protocols, layer structure, function of different layers etc. (Understanding)
3. Work in mobile environment, creation of mobile network and understanding their functions (Applying)
4. Analyse packet structure and functions of packet header with respect to different fields (Analysing)
5. Evaluate network performance and also be able to know how to get mobile communication in the best possible way. (Evaluate)
6. Synthesize mobile protocols, data communications and variation with respect to different network parameters. (Creating)

Suggested Readings
1. J. Schiller, Mobile Communications, Addison-Wesley.
2. T. S. Rappaport, Wireless Communications: Principle and Practices, Pearson.
3. R. Pandya, Mobile and Personal Communication Systems and Services, PHI.
4. J.Burkhardt, Pervasive Computing: Technology and Architecture, Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3				H
CO 4			H	H
CO 5			H	M
CO 6			H	M

CAPM0042: PYTHON AND MACHINE LEARNING

(4 credits- 60 hours)

Objective
The course is intended to give the students an insight into python programming language and its application extended to machine learning techniques in different problems of applications.

Module I (14 hours)
Introduction to python, Python basics: Data types and variables, data type conversions, command line argument, data input, Flow control: if, if_elif_else statement, while loop, for loop, break & continue, Python sequences: Range, String, List, Tuple, Dictionary, Set, Shallow and deep copy, Introduction to PyCharm & Jupyter, Functions and modules: Function, Pass arguments, Arguments with default values and arbitrary arguments, local and global variables, returning single and multiple values from functions, Mathematical functions, Random number functions, python modules, import statement for importing modules.

Module II (16 hours)
File operations handling: Reading, writing, manipulations, Exception handling: try, except, finally, raise exception, user defined exception, Python class & objects: Constructors, creating objects, Destructors, Inheritance, Overriding, Overloading, Data hiding, Functional programming: Iterators, Generators, lambda construct, Comprehensions, Map reduce and filter. NumPy: selecting data using slicing, numerical processing with multidimensional array, 2D plotting with matplotlib Pandas: Loading from

CSV and other structured formats, 1D and 2D data structures-Series and DataFrame, Normalizing data, dealing with missing data.

Module III (18 hours)
Introduction to Machine learning: Basic definition, types of learning, hypothesis space and inductive bias, Cost functions, transforms: logarithmic and curvilinear, Linear regression, l1 and l2 normalization, Decision trees, Probability and Bayes learning, Logistic regression, SVM (Support Vector Machine), Instance Based Learning: K-Nearest Neighbours Algorithm, K-Means Algorithm

Module IV (12 hours)
Soft computing techniques: Fuzzy Computing: Fuzzy set, Fuzzy logic, Fuzzy theory, Neural Network: Artificial Neural Network (ANN).

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
1. Understand python and its usage with respect to different machine learning algorithms. (Remembering)
2. Differentiate learning algorithms for different classification problems together in combination with soft computing techniques. (Understanding)
3. Build machine learning programs for designing self-learning solutions to different problems in the real world. (Applying)
4. Experiment with different learning techniques & parameters and conclude the pros and cons of each with respect to different problem domain. (Analysing)
5. Evaluate results of the learning algorithms using different representations.(Evaluating)
6. Create new solutions that may be ensemble of learning techniques or create new learning algorithm for different problem domain. (Creating)

Suggested Readings:
1. Python Cookbook-by Alex Martelli, Anna Martelli Ravenscroft, and David Ascher
2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
3. Introduction to Machine Learning Edition 2, by Ethem Alpaydin.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	H		
CO 2			H	
CO 3			H	H
CO 4			H	H
CO 5	M	M	H	H
CO 6	M	M	H	H

CAMF0043: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE
(4 Credits)

Objective
- To introduce the concepts of mathematical logic.
- To introduce the concepts of sets, relations, and functions and relate practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context.
- To perform the operations associated with sets, functions, and relations.
- To understand combinatorics and apply in solving problems.
- To use Graph Theory for solving problems

COURSE/LEARNING OUTCOMES
1. Ability to apply mathematical logic to solve problems (Remembering, Understand)
2. Recall some basic concept of set theory and understand the concept of graph theory and Group theory. (Remembering)
3. Interpret logic sentence in terms of predicates, quantifiers, and logical Connectives (Understanding)
4. For a given a discrete problem, classify its algebraic structure (Analyzing)
5. Derive the solution of a problem using deductive logic and prove the solution based on logical inference (Applying)
6. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
7. Develop the given problem as graph networks and solve with techniques of graph theory. (Creating)

Module I (13 hours)
Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, Logical

equivalence: The Laws of logic, Logical Implication, Normal forms, Quantifiers, universal quantifiers. Predicates: Predicative logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction.

Module II (20 hours)

Set theory: Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Matrix representation of relations and partial ordered sets, representation of relations by Graphs; Lattices as Partially Ordered Sets, Boolean algebra; Functions. Algebraic Structures: Introduction, Algebraic Systems, Semi groups and Monoids; Groups, Congruence Relation and Quotient Structures, permutation groups, Lagrange's Theorem; Normal subgroups. Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. (Definition, basic properties and examples)

Module III (12 hours)

Elementary Combinatorics: Basics of counting, Combinations & Permutations with repetitions, Constrained repetitions, Binomial Coefficients, Binomial and Multinomial theorem, Pigeonhole Principle, principles of Inclusion – Exclusion.

Module IV (15 hours)

Graph Theory: Basic Concepts, Sub graphs, Multi graphs Representation of Graphs, Isomorphism, Paths and Circuits, Traversing a Graph, DFS, BFS, Eulerian and Hamiltonian graphs, Shortest path algorithms, Planar Graphs, Chromatic Numbers. Tree and Spanning Trees. Applications of Graph Theory.

Suggested Readings

1. Discrete Mathematical Structures with Applications to Computer Science by J. P. Tremblay and R Manohar, Tata McGraw-Hill Publications, 1997.
2. Graph Theory by Narsingh Deo, Prentice-Hall of India publications, 2004.
3. Discrete Mathematical Structures, Theory and Applications. D.S. Malik, Thomson Learning, I Edn
4. Discrete Mathematics for Computer Science, Haggard, Thomson Learning, I Edn
5. Discrete Mathematics and Its Applications by Kenneth H Rosen. Tata McGraw-Hill Publications
6. Mathematical foundation of Computer Science by Y. N Sings. New Age international Publishers
7. Bernard Kolman, Robert. C.Busby & Sharon Ross, "Discrete Mathematical structures" Prentice Hall of India,2001.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2		H		
CO 3	H			
CO 4		H		
CO 5		H		
CO 6		H	M	
CO 7				H

CADA0044: DATA STRUCTURES AND ALGORITHMS

(4 Credits – 60 Hours)

Objectives

- To introduce first level topics covering basics in algorithms and data structures.
- To enable students to choose appropriate data structures, understand the ADT/libraries, and use of it to design algorithms for a specific problem.
- To understand the necessary mathematical abstraction to solve problems.
- To apply important algorithmic design paradigms and methods of analysis.

COURSE/LEARNING OUTCOMES

At the end of the course, students would be able to:

1. Know the formal definition of algorithms, importance of analysis of an algorithm and get familiar with different types of problem and their solutions. (Remembering and Understanding)
2. Choose appropriate data structure as applied to specified problem definition. (Applying)
3. Understand different design strategies such as brute force, divide-and-conquer, dynamic programming, greedy technique and backtracking used for the design of algorithms. (Understanding)
4. To design and analyse algorithms for given problems. (Applying)
5. Compare and analyse different design strategies and assess an algorithm in terms of correctness, computation cost and memory space used. (Analysing and Evaluating) .
6. Design new algorithms for given problems by using most appropriate algorithmic strategy considering the problem

domain. (Creating)

Module I (14 Hours)
Introduction to Algorithms, Fundamentals Stages of Problem Solving, and Classification of Algorithms - Based on Implementation, Based on Design, Based on Area of Specialization, Based on Tractability, Basics of Algorithms Analysis, Asymptotic Analysis, Mathematical Analysis of Iterative and Recursive Algorithms, Empirical Analysis of Algorithms, Models of Computations - RAM model, Turing Machine.

Module II (12 Hours)
Data Structures: Abstract Data Types (ADTs), Stacks, Queues, Circular Queues, Implementation of Stacks using Queues, Implementation of Queues using Stacks, Priority Queues, Heaps, Linked Lists, Search and Update Operations on Varieties of Linked Lists, Graphs, Binary Trees, Tree Traversals, Binary Search Trees (BSTs), AVL Trees, Red Black Trees, Splay Trees, B-Trees, Disjoint Sets.

Module III (12 Hours)
Analysis of Sorting and Searching Algorithms: The sorting problem, Brute Force Approach - Sequential Search, Bubble Sort, Selection Sort, Decrease-and-Conquer Approach - Insertion Sort, Binary Search, Divide-and-Conquer Approach - Quick Sort, Merge Sort, Transform-and-Conquer Approach - Heap Sort, Linear Sorting Algorithms - Counting Sort, Radix Sort, Bucket Sort, Hashing - Hash Function, Collisions in Hashing, Separate Chaining, Open Addressing, Analysis of Search Operations.

Module IV (14 Hours)
Graph Algorithms: Graphs and their Representations, Graph Traversal Techniques - Breadth First Search (BFS) and Depth First Search (DFS), Minimum Spanning Trees (MST), Greedy Techniques - Prim's and Kruskal's algorithms for MST, Dijkstra's Algorithm for Single Source Shortest Paths, Dynamic Programming - Warshall's Algorithm for finding Transitive Closure of a Graph, Floydd's Algorithm for All-Pairs Shortest Paths Problem.
Algorithmic Design Techniques: Greedy Algorithms - Coin Change Problem, Scheduling Problem, Knapsack Problem, Huffman Trees, Divide-and-Conquer Approach - Strassen Matrix Multiplication, Closest-pair Problem, Tiling Problem, Dynamic Programming – Longest Common Subsequence (LCS) problem, Optimal Binary Search Trees, Travelling Salesperson Problem, Chain matrix multiplication.

Module V (8 Hours)
Tractable and Intractable Problems: Computability of Algorithms, Computability Classes – P, NP, NP-Complete, NP-Hard.
Basics of Backtracking, Branch-and-bound methodologies for Algorithm design, Approximation algorithms, Randomized algorithms.

Suggested Readings
1. Mark Allen Weiss, Data Structure and Algorithm Analysis in C++, Fourth Edition, Pearson, 2014.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2014.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, The MIT Press, 2009.
4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, 2008.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4			H	H	
CO 5		M	M	H	
CO 6					H

CACC0045: DATA COMMUNICATION AND COMPUTER NETWORKS
(4 credits)

Objective
This course introduces students to computer networks and concentrates on building a firm foundation for understanding Data Communications and Computer Networks. It deals with the Data link layer, the Network layer, the Transport layer and the Application Layer. This course also introduces the concepts of network security and cryptography.

Module I: Digital Communications
Signals, noise, Nyquist rate, Shannon capacity; Analog transmission: modulation techniques, FDM; Digital transmission: PCM,

TDM, line coding, xDSL,; Transmission media: Guided (twisted pair, coaxial, fiber optic) and unguided media; Local area networks: Ethernet, Fast Ethernet, introduction to Gigabit Ethernet and WLANs; Repeater, Hubs, Bridges, Switches, Router and Gateway.

Module II: Media Access Control and Data Link Layer
Data Link Layer Fundamentals: Framing, Error Control, Flow Control, Error Detection and Correction; Data link protocols: Stop-&-Wait ARQ, Go-Back-NARQ, Selective Repeat ARQ, Piggybacking
Multiple Access Protocols: Advantages of Multiple-Access Sharing of Channel Resource, Pure ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA), CSMA with Collision Detection (CSMA/CD), Asynchronous Transfer Mode (ATM)

Module III: Network Layer
IPv4 Addresses: Address space, Notations, Classful addressing, classless addressing, NAT; IPv6 Addresses: advantages, structure, address space, packet format, extension header; Transition from IPv4 to IPv6; Address Mapping, Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols.

Module IV: Transport Layer and Application Layer
Process to Process Delivery: Client Server paradigm, Connectionless vs Connection Oriented Service, Services provided to upper layers, Transport Service primitives. UDP: Introduction, User Datagram, Checksum, UDP operations, use of UDP, Remote Procedure call TCP: Introduction, TCP Service Model, TCP Protocol, segment header, Connection Establishment and release, Transmission Policy, Congestion Control, Timer Management, Wireless TCP and UDP . Application Layer: Domain Name System, Simple Mail Transfer Protocol (SMTP), POP3, IMAP, File Transfer Protocol (FTP) Network Security: Cryptography, Symmetric Key Algorithms, Public Key Algorithms, Digital Signatures, Communication Security, Web Security

COURSE/LEARNING OUTCOMES:
At the end of the course the students will be able to:
1. Understand and explain Data Communications System and its components (Understand, Explain)
2. Understand and identify different networking terminologies and network architecture. Design issues in network and network transition. (understand)
3. Students would be able to distinguish between IPV4 and IPV6 network together with MAC layer transmission and modulation schemes. (Analyze)
4. Students would be able to understand and analyze what type of network to implement and decide what protocols to configure(Analyze)
5. Students would be able to know why different layers are embodied with different protocols and different network architecture for different network needs. (Evaluate)
6. Have a basic knowledge of the use of cryptography and network security; (Apply)

Suggested Readings
1. Andrew S. Tenenbaum, Computer Networks (Fourth Ed.), Prentice Hall of India, 2002
2. W Richard Stevens, UNIX Network Programming – Volume I (2nd Ed.), Prentice Hall of India, 2002
3. William Stallings, Data and Computer Communications (Sixth Ed.), Prentice Hall of India, 2000
4. Fred Halsall, Data Communication, Computer Networks and Opens Systems, (4th Ed.), Pearson Education, 2000
5. William Stallings, Cryptography and Networking Security - Principles and Practice, Pearson

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3			H	
CO 4		M	M	M
CO 5			H	M
CO 6				H

CADM0046: ADVANCED DATABASE MANAGEMENT SYSTEMS
(4 Credits - 60 hours)

Objective
The objective of this course is to introduce the basic conceptual background necessary to design and develop simple database systems. The course stresses on database modeling and design, physical file storage techniques and SQL query language facilities provided by database management systems. The course also presents some advanced database management concepts like query processing and optimization, transaction processing, concurrency control, recovery and security issues in database

management systems.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Explain the core terms, concepts, and tools of relational database management systems (Understanding)
2. Understand Normalization and Design ER-diagrams and corresponding schema diagrams for handling database projects (Creating)
3. Recall and identify the techniques used by a DBMS to process, optimize and execute high level queries. (Remembering)
4. Describe fundamentals of transaction processing system, including ACID properties of a transaction. (Understanding)
5. Illustrate concurrency control & analyze several concurrency control techniques for ensuring serializability, locking, timestamping. (Analysing)
6. Discuss some of the techniques that can be used for database recovery from failures and summarize the control measure for securing databases against a variety of threats. (Understanding)

Module I: Introduction (3 Hours)

Introduction: Introduction to databases, characteristics of the database approach, database users and designers, role of a DBA, advantages of using a DBMS, data models, schemas, instances, DBMS architecture (Three-Schema Architecture), Database systems- Network, Hierarchical, Relational, Data Independence

Module II: Relational Data Model and ER Models (12 Hours)

Relational Model: Domains, Attributes, Tuple and Relation; Super keys Candidate keys and Primary keys for the Relations. Relational Constraints: Domain Constraint, Key Constraint, Integrity Constraint.

Relational Algebra: basic relational algebra operations-SELECT, PROJECT, UNION, INTERSECTION, SET DIFFERENCE, Cartesian PRODUCT, JOIN, Aggregate functions.

Entity Relationship (ER) Model: Entities, Attributes, Relationships. More about Entities and Relationships, E-R Diagram, Conversion of E-R Diagram to Relational Database, Case Study.

Module III: Functional Dependencies and Normalization (10 Hours)

Functional Dependencies, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Multivalued Dependencies.

Module IV: Data Storage, Indexing, Query Processing and Query Optimization (11 Hours)

Overview of physical storage media, Magnetic Disks, RAID, File Organization: Fixed-length records, variable-length records. Organization of records in Files - Heap Files, Sequential File, Hashed Files. Indexing: Types of Single-level Ordered Indexes (Primary Indexes, Clustering Indexes, Secondary Indexes), Multilevel Indexes, Multilevel indexing using B tree and B+ tree, Indexing on multiple keys. Query Processing: Overview of query processing, Algorithms for query processing, Query Optimization

Module V: Transaction Processing and Concurrency Control (14 Hours)

Transaction Processing: Transaction, ACID properties of transaction, transaction states, schedules, serializability, tests for serializability, recoverability, transaction definition in SQL. Concurrency Control: Concurrent execution of transaction, Lock-based techniques for concurrency control, Graph-based protocol, Timestamp based protocol, Deadlock, Deadlock prevention methods, Deadlock detection Deadlock recovery.

Module VI: Recovery and Security (10 Hours)

Recovery system: Types of failure, types of storage, recovery and Atomicity, Log-based recovery, shadow paging, recovery with concurrent transactions, buffer management, logical undo logging, transaction rollback, checkpoints, restart recovery, fuzzy checkpointing.

Security: Security and Integrity-security violations, authorization and views, granting of privileges, security specifications in SQL, encryption, and statistical databases.

Suggested Readings

1. Silberschatz, HF Korth, S Sudarshan, Database System Concepts, Tata- McGraw Hill, 1997.
2. R Elmasri, SB Navathe, Fundamentals of Database Systems, Addisson, Wesley (Third Edition) 2000
3. DM Kroenke, Database Processing: Fundamentals, Design and Implementation, Prentice-Hall of India, (Eighth Edition) 2002.
4. GW Hansen, JV Hansen, Database Management and Design, Prentice-Hall of India, (2nd Edition) 2001.
5. Thomas M Connolly, Carolyn E Begg, Database Systems, A Practical Approach to Design, Implementation and Management, Addison Wesley Longman Ltd. 1999.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M	M	M	M	M
CO 2		H	H			
CO 3				H		
CO 4					H	
CO 5					H	
CO 6						H

CASI0047: SENSOR NETWORK AND INTERNET AND INTERNET OF THINGS
(3 Credits – 45 Hours)

Objective
This course will introduce the students to the Internet of Things(IoT) and basic structure of communication protocols in sensor networks. The course is designed to build up basic understanding of how to set up an application specific IoT network with better orientation and representation of sensor nodes.

Module I (8 hours)
Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics; IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

Module II (12 hours)
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, a use case example, Differing Characteristics. Definitions, M2M Value Chains, IoTValue Chains, An emerging industrial structure for IoT
M2M vs IoT An Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.

Module III (18 hours)
IoT Architecture: Introduction, Reference Model, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
IoT with Arduino: Hands on Experience with Arduino (Firmware development & RTOS) - General Purpose I/O(GPIO), Serial Communication Interfaces: RS-232/485, Synchronous Peripheral Interfaces: I2C, SPI Sensors interfacing with Arduino.
IoT with Raspberry PI: Hands on Experience with Raspberry PI (Firmware development) - Setting up Raspberry PI SD Card, Raspberry PI booting up & Initialization; General Purpose I/O(GPIO), Serial Communication Interfaces: RS-232/485, Synchronous Peripheral Interfaces: I2C, SPI; Sensors Interfacing with Raspberry PI
Domain specific applications of IoT:Home automation, Industry applications, Surveillance, applications, Other IoT applications.

Module IV (7 hours)
Wireless Sensor Networks & Protocols: Wireless Sensor Networks (WSNs), Introduction to WSNs Topologies in WSNs; Wired Communication Protocols – Ethernet, Serial Communications; Wireless Communication protocols Wifi, RF, IPV4/V6, 6LOWPAN, ZigBee(IEEE802.15.4), BLE, GSM(2G/3G/LTE).

COURSE/LEARNING OUTCOMES
1. Explain the definition and usage of the term “Internet of Things” in different contexts and understand the key components that make up an IoT system (Remembering)
2. Understand why it is necessary to build a separate model for IoT and what parameters influences the operation of IoT network. (Understanding)
3. Apply the knowledge in designing IoT network for addressing real life issues for easing the day to day life activities. (Applying))
4. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis. (Applying)
5. Know what type of sensor protocols and architecture to adopt for efficient communication and what services offline and online to be used for problem solving. (Analyzing)

Suggested Readings
1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, 2013.
2. Qusay F. Hassan, Internet of Things A to Z: Technologies and Applications, Wiley-Blackwell, 2018.
3. Peter Waher, Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3, Packt Publishing, 2018.
4. Kazem Sohraby, Minoli Daniel and Znati Taieb, Wireless sensor networks: technology, protocols, and applications. John

Wiley & Sons, 2007.
5. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice (Wireless Communications and Mobile Computing), Wiley-Blackwell, 2010.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3			H	M
CO 4			H	
CO 5				H

CATC0048: THEORY OF COMPUTATION

(4 credits – 60 hours)

Objective

The objective of the Theory of Computation is to introduce and study abstract, mathematical models of computation (such as finite state, pushdown and Turing machines), and to use the abstract machine models to study the ability to solve computational problems. At the complete course students will be able to use regular expressions effectively and appropriately, construct derivations and parse trees, write simple programs for a Turing machine, understand the equivalence of grammars, languages and automata and translate between grammars, languages and automata.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define basic terminology like Deterministic and Non deterministic automata, Pushdown Automata, Parse Tree, Regular Languages, Turing Machines etc. (Remembering)
2. Make use of techniques, components and tools of a typical automated machine and apply it in designing new machines (Applying)
3. Design deterministic and non-deterministic context-free grammars and understand their capabilities and limits. (Creating)
4. Design deterministic and non-deterministic pushdown automata and Turing Machine. (Creating)
5. Demonstrate the understanding of complexity classes and current unsolved problems in theoretical computer science. (Understanding).

Module I Theory of Automata (15 Hours)

Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NDFA, Mealy and Moore Models, Minimization of Finite Automata.

Module II Formal Languages, Regular Sets and Regular Grammars (15 Hours)

Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars.

Module III Context-free Languages (15 Hours)

Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages.

Module IV Pushdown Automata Turing Machines and Linear Bounded Automata (15 Hours)

Basic Definitions, Acceptance by PDA, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

Suggested Readings

1. K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science, BPB Publication, Prentice-Hall of India, Second Edition.
2. H.R. Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India.
3. H.E. Hopcraft and J.D. Ullamn, Introduction to Automata Theory, Languages and Computation, Narosa Publications.
4. J.C. Martin, Introduction to Languages and the Theory of Automata, Tata McGraw-Hill.
6. C.H. Papadimitriou, Computation Complexity, Addison-Wesley.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	M	M	M	M
CO2	M	M	M	M
CO3			H	
CO4				H
CO5			M	H

CAML0049: MACHINE LEARNING

(4-0-0) (4 Credits – 60 Hours)

COURSE/LEARNING OUTCOMES:

1. Learn mathematical principles used in learning algorithms and relate them to learning principles. (Understanding)
2. Construct and classify learning algorithms used in different problems. (Applying)
3. Know what and how to perform pre-processing to make dataset ready for learning algorithms(Analysing)
4. Create learning models and evaluate the effect of it in a given problem domain. (Evaluation)

Module I: (15 hours)

Mathematical Foundations of Machine Learning: Linear Algebra-Linear equations & vector spaces,matrix decomposition: determinant, Eigen values, singular value decomposition, matrix approximation, Calculus: Differentiation & partial differentiation, gradient of matrices, Probability & Distributions: Discrete and Continous probabilities, Gaussian distribution, Continous optimization:Gradient descent, Lagrange Multiplier.

Module II: (10 hours)

Learning: supervised and unsupervised learning,necessary of supervised learning, KNN,regression models,Naive Bayes' classifier, decision trees,random forest classifier, SVM:linear, non-linear.

Module III: (11 hours)

Data preprocessing & Scaling: Different kinds of preprocessing, Data transformations, Scaling: training data & testing data, Types of unsupervised learning, dimensionality reduction, clustering: k-Means, Fuzzy C -Means, DBSCAN, Comparing and evaluating clustering.

Module IV: (13 hours)

Neural Network: Biological to Artificial neurons, Logical computations with neurons, perceptron, MLP & backpropagation, Tuning neural network hyperparameters, vanishing and exploding gradient problems,momentum optimization:AdaGrad, Adam optimization, Regularization: L1 & L2, Convolutional property of neural network.

Module V: (11 hours)

Deep learning: Convolutional Neural Network: AlexNet, GoogleNet, ResNet, RNN: Training a RNN, deep RNN, LSTM cell, Auto encoders: stacked auto encoders, sparse auto encoder.

Suggested readings:

1. Hands-On Machine Learning with Scikit-Learn & TensorFLow. Second edition, Aurelien Geron,2017, O' Reilly Media.
2. Machine Learning-An Algorithmic Perspective, second edition, Stephen marshland,2015, CRC Press.
3. Deep Learning, John D. Kelleher,2019, Massachusetts Institute of Technology(MIT).

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H	M		
CO 3			H	M	
CO 4				H	H

CAHC0050: HUMAN COMPUTER INTERACTION (HCI)

(4-0-0) (4 Credits – 60 Hours)

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

1. Learn the basic physiological, perceptual, and cognitive components of human learning and memory and gain theoretical knowledge of the fundamental aspects of designing and implementing user interfaces (Remembering)

2. Explain the HCI implications for designing various applications such as multimedia/apps/ ecommerce/ e-learning Web sites. (Understanding)
3. Design effective HCI for individuals. (Applying)
4. Analyze the quality of user interface (Analyzing)
5. Assess the importance of user feedback. (Evaluating)
6. Develop meaningful user interface. (Creating)

Module I: Introduction to HCI And History (10 Hours)
What is HCI? Historical evolution of the field. Human brain and computer: The Human sensation and perception–Human Memory – Reasoning and problem solving; The computer and its I/O Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms- Problems and challenges.

Module II: Design and Software Process (22 Hours)
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Design Evaluation Techniques – Experimental evaluation and Empirical Methods: Hypothesis testing, Choosing participants and sample size, Variables: independent and dependent measures, Types of experimental designs, Data analysis.

Module III: Models and Theories (9 Hours)
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and Collaboration models-Hypertext, Multimedia and WWW. Design Case studies: Multi-Key press Hindi Text Input Method on a Mobile Phone, Employment Information System for unorganized construction workers on a Mobile Phone.

Module IV: Mobile HCI (7 Hours)
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile
Design, Tools.

Module V: Brain-Computer Interaction (BCI) and Neuroprosthetics/Sensory substitution (12 HOURS)
What is BCI? BCI and brain plasticity-Neuroergonomics and Neurocognitive Engineering-Medical applications of BCI: Neuroprosthetics, Commercial Applications of BCI, Ethical implications of these interfaces, Neuroprosthetics vs. sensory substitution, Most sensory substitution devices compensate for loss of vision: discussion of visual to tactile and visual to auditory devices, Components of sensory substitution devices, Underlying theories and why it works?

Suggested Readings:
1. "Human Computer Interaction", 3rd Edition , Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, 2004, Pearson Education.
2. "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition, Shneiderman, Plaisant, Cohen, and Jacobs, 2009, Addison Wesley.
3. "Introduction to Human Factors Engineering", 2nd Edition, Wickens, Lee, Liu, and Gordon-Becker, 2004, Pearson.
4. "Human Computer Interaction", Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T., 1994, Addison-Wesley.
5. "Designing the User Interface", B. Shneiderman; 2000, Addison Wesley(Indian Reprint).
6. "Mobile Design and Development", First Edition, Brian Fling, 2009, O'Reilly Media Inc.
7. "Designing Web Interfaces", First Edition, Bill Scott and Theresa Neil, 2009, O'Reilly.

Mapping of Course outcomes

Course outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	L			H
CO 2	L	H	M	M	L
CO 3		H	H	M	
CO 4		H	H	L	
CO 5		M	H	H	
CO 6			H	H	M

CABI0051: BIOINFORMATICS
(4-0-0) (4 Credits – 60 Hours)

Course Outcomes:
1. Relate the different mathematical principles that are necessary in sequence analysis and searching. (Remembering).
2. Explain the different protein structure and use algorithm models for alignment analysis. (Understanding)

3. Design phylogenetic tree for discovering pattern in sequence analysis. (Creating)
4. Analyze , predict and model protein structure and assess the structures.(Evaluating)

Module I: (16 hours)
Introduction to bioinformatics, opportunity and challenges in bioinformatics, protein sequence, analyzing protein sequences, analyzing DNA sequences, palindromes in DNA sequences, coding DNA sequences, RNA structures and sticky strands, pubmed, Expasy, Assessment of structure prediction, protein engineering.

Module II: (15 hours)
Genome organization, picking out genes in genomes, genome of homosapiens, database indexing, nucleic acid sequence database,genome database, protein sequence database, database of protein families, structures, protein identification resource, sequence alignments and dotplots, sequence similarity quantification, scoring schemes, dynamic programming for optimal pairwise alignment, multiple sequence alignment, editing and publishing alignments.

Module III: (14 hours)
phylogenetic tree, taxonomic relationships, clustering and cladistic methods, ancestral sequences and its reconstruction, evolution and varying rates of evolution, preparing data for phylogenetic tree, BLAST search, building the tree specific to a problem, phylip and open source tools for generating tree, maximum likelihood tree.

Module IV: (15 hours)
Folding and protein stability, sidechains, denaturation in relation to protein stability, coiled-coiled proteins, helical model, structural elements and superposition, mustang, dali, protein structure evolution, SCOP classification, prediction of protein structure and modeling, assessment of structure prediction, secondary structure and prediction, homology modeling and fold recognition. Three dimensional profiles to assess quality of structures.

Suggested readings:
1. Bioinformatics for dummies, second edition, Jean-Michel, Cedric Notredame, 2007, Wiley publishing
2. Introduction to bioinformatics, fourth edition, Arthur M. Lesk,2014, Oxford University Press.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		M
CO 3			H	
CO 4				H

CADL0052: DEEP LEARNING
(4-0-0) (4 Credits – 60 Hours)

Course Outcomes:
1. Recall the various deep learning related terms, tools, and technologies (Remembering)
2. Compare and contrast the various types of neural networks (Analysing)
3. Test, explore and estimate all the parameters for neural networks. (Evaluating)
4. Illustrate the various deep unsupervised learning techniques for solving specific real-world problems. (Understanding)
5. Experiment how to deploy neural network algorithm to solve real-world problems. (Applying)

Module I: Basics of Deep Learning (14 Hours)
Introduction: Basics of Artificial Intelligence, Machine learning, and Deep learning; History and Capabilities of Deep Learning, Deep Learning primitives – Soft Max Function, Sigmoid, Tanh and ReLU Neurons, Functions and Gradient Descent, Linear/Logistic regression, Vectorizing Logistic regression,
Neural Network: Basic concepts of artificial neurons, single and multi-layer perceptrons, perceptron learning algorithm, perceptron convergence theorem, gradient descent and backpropagation algorithm, the vanishing gradient problem, gradient descent, regularization, dropout

Module II: Types of Neural Networks (18 Hours)
Convolutional Neural Networks (CNN): Introduction to CNN, CNN Architectures, Convolution / pooling layers, Correlation, Filtering, CNN architectures, Detection and Segmentation, Advanced CNNs for computer vision
Advanced Deep Architectures: Recurrent Neural Networks, Long Short-Term Memory Units (LSTM), Gated Recurrent Unit (GRU), Encoder Decoder architectures, Generative Adversarial Networks (GANs)

Module III: (10 Hours)

Deep Unsupervised Learning: Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, clustering learning, Adversarial Generative Networks, Learn-from-data model, Autoencoder and DBM Attention and memory models, Maximum Entropy Distributions, Unsupervised learning of visual representations from image patches and locality, Unsupervised Learning of Visual Representations using Videos

Module IV: Deep Learning in Practice (18 Hours)
Deep Learning for Computer Vision: Introduction to convnets, training a convnet on small datasets, using a pretrained convnet, Applying Deep Learning for Object detection, face recognition, and automatic image classification
Deep Learning for Natural Language Processing (NLP): Introduction to NLP, Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning, Named Entity Recognition, Opinion Mining using Recurrent Neural Networks, Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks

Suggested Readings

1. Nielsen, Michael A. *Neural networks and deep learning*. Vol. 25. San Francisco, CA: Determination press, 2015.
2. Goodfellow, Ian, et al. *Deep learning*. Vol. 1. No. 2. Cambridge: MIT press, 2016.
3. Deng, Li, and Yang Liu, eds. *Deep learning in natural language processing*. Springer, 2018.
4. Wani, M. Arif, et al. *Advances in deep learning*. Springer, 2020.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3	L	H		M
CO 4			H	
CO 5		M		H

CASC0053: SOFT COMPUTING

(4-0-0) (4 Credits – 60 Hours)

Course/Learning Outcomes

At the end of the course, students would be able to:

1. Identify and describe soft computing techniques and their roles in the development of smart machines. (Remembering and Understanding)
2. Apply fuzzy logic and reasoning to deal with uncertainty and solve various problems. (Applying)
3. Analyze the architecture and algorithms of Neural networks to meet the challenges of soft computing problems. (Analyzing)
4. Analyze genetic algorithms to combinatorial optimization problems. (Analyzing)
5. Evaluate and compare solutions to a given problem using various soft computing approaches. (Evaluating and Creating)
6. Effectively use existing software tools to solve real problems using a soft computing approach. (Applying)

Module I (6 Hours)

Introduction to Soft Computing, Characteristics of Soft Computing, Soft Computing Versus Hard Computing, Soft Computing Constituents, Applications of Soft Computing techniques, Evolutionary Computing, Machine Learning Basics.

Module II (11 Hours)

Fuzzy Logic: Introduction to Fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, Rules, Propositions, Implications and Inferences, Fuzzification and Defuzzification, Fuzzy ogic controller, Fuzzy Expert Systems, Fuzzy Decision Making, Applications of Fuzzy logic.

Module III (15 Hours)

Neural Networks: Biological neurons and its working, Introduction to Artificial Neural Network, Artificial Neural Networks Versus Biological Neural Networks, Activation functions, ANN architectures : McCulloch & Pitts model, Perceptron, ADALINE, MADALINE, Activation functions, Supervised Learning: Introduction, Neuron as a simple computing element, The perceptron, Backpropagation Networks: Architecture, Multilayer Perceptron, Back propagation learning-input layer, Radial Basis Function Networks. The Hopfield Network, Unsupervised Learning Neural Networks: Hebbian Learning, Self-Organizing Computational Maps: Kohonen Network, Applications of ANNs.

Module IV (13 Hours)

Genetic Algorithms: Introduction to Genetic Algorithm (GA), Working Principle, Difference between traditional algorithms and GA, Phases of Genetic Algorithm, Basic GA framework and different GA Architectures, Convergence of GA, Applications of GA

case studies. Introduction to genetic programming-basic concepts.

Module V (15 Hours)
Deep Learning: Basics of Deep Learning, Convolutional Neural Network, Recurrent Neural Network. Matlab/Python Lib: Study of Neural Network Toolbox and fuzzy logic toolbox, Simple implementation of ANN and fuzzy logic.

Suggested Readings
1. R. Rajasekaran and G. A Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India. 2003.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley, 2011.
3. N.P.Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press. 2005.
4. Simon O. Haykin, Neural Networks and Learning Machines, Pearson, 2009.
5. MATLAB Toolkit Manual.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5	M		M		M
CO 6					M

CADS0054: DATA SCIENCE
(4-0-0) (4 Credits – 60 Hours)

Course/Learning Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the basic concepts and technologies related to Data Science. (Understanding)
2. Obtain, clean/process, and transform data and analyze the transformed data using an ethically responsible approach (Applying and Analyzing)
3. Relate which tools and methodologies can be applied to solve data science tasks. (Remembering)
4. Integrate Data Science capabilities into the formation of a situation analysis (Evaluating)
5. Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges (Creating)
6. Interpret data findings effectively to any audience, orally, visually, and in written formats. (Understanding)

Module I: Introduction to Data Science, Preprocessing, and Data Visualization (14 Hours)
Introduction to Data Science: Why Learn Data Science, Data Analytics Life Cycle, Types of Data Analysis, Types of Jobs in Data Analytics, Data Science Tools, Fundamentals Areas of Study in Data Science
Data Preprocessing: Introduction to Data Preprocessing, Data Types and Forms, Possible Data Error Types, Various Data Preprocessing Operations - Data Cleaning, Data Integration, Data Transformation, Data Reduction, and Data Discretization
Data Plotting and Visualization: Introduction to Data Visualization, Visual Encoding, Data Visualization Libraries, Basic Data Visualization Tools (Histograms, Bar Charts, Scatter Plots, Line Charts, Area Plots, Pie Charts, Donut Charts); Specialized Data Visualization Tools (Box Plots, Bubble Plots, Violin Plots, Heat Map, Dendogram, Radar Chart, Venn Diagram, 3D Scatter Plots), Advanced Data Visualization Tools (Wordclouds, Chord Diagram, Waffle Charts, Choropleth Map, Bubble Map), Data Visualization Types

Module II: Statistical Data Analysis and Machine Learning (18 Hours)
Statistical Data Analysis: Role of Statistics in Data Science, Kinds of Statistics, Descriptive Statistics (Measures of Frequency, Central Tendency, Dispersion, and Position), Inferential Statistics, Parametric vs Non-Parametric Hypothesis Testing, Probability Theory, Four Perspectives on Probability, Bayesian Probability, Probability Distribution
Machine Learning for Data Science: Overview of Machine Learning, Supervised Machine Learning - Regression Methods (linear, polynomial, and logistic), Classification Methods (KNN Classification, Support Vector Machine (SVM) Classification, and Decision Tree Classification); Unsupervised Machine Learning - Clustering Methods (Fuzzy c-means Clustering and Principle Component Analysis (PCA) Clustering), Association Analysis - Apriori Algorithm and FP-Growth Analysis, Introduction to Reinforcement Learning

Module III: Time-Series Analysis and Deep Learning (12 Hours)
Time-Series Analysis: Overview of Time-Series Analysis, Components of Time-Series, Time-Series Forecasting Models using Stochastic Models (AR, MA, ARMA and ARIMA), Time-Series Forecasting using Support Vector Machines Based Models

Deep Learning for Data Science: Introduction to TensorFlow, Pytorch, Deep Learning Primitives, Convolutional Neural Network (Softmax, ReLU, Sigmoid or Logistic Activation function, and Pooling), TensorFlow and CNN, AutoEncoder (Convolutional Autoencoder and Sparse Autoencoder)

Module IV: Social Media Analytics, Business Analytics, and Big Data Analytics (16 Hours)
Social Media Analytics: Overview of Social Media Analytics, Seven Layers of Social Media Analytics, Social Network Analysis (Link Prediction, Community Detection, and Influence Maximization), Text Analytics/Mining (Text Categorization, Document or Text Summarization, and Sentiment Analysis), Trend Analytics
Business Analytics: An Overview of Business Analytics, The Business Analytics Life Cycle, Basic Tools Used in Business Analytics, Financial Analytics, Market Analytics, Customer Analytics, and Employee Analytics
Big Data Analytics: An Overview of Big Data, Hadoop, Hadoop Distributed File System, Interacting with HDFS from Python Applications, Introduction to Snake, Pig and Spark

Suggested Readings

1. J. Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 2nd Edition, 2019
2. Silberschatz, H. F. Korth, S Sudarshan, Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, 1st Edition, Dreamtech, 2016
3. C. Neil, R. Schutt, Doing Data Science: Straight Talk from the Frontline, O'Reilly, 1st Edition, 2019.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2	H			
CO 3		H	M	M
CO 4			M	M

CAVS0055: DATA VISUALIZATION FOR DATA SCIENCE

(4-0-0) (4 Credits – 60 Hours)

Course/Learning Outcomes

1. Learn what data visualization is, how it's used, and how computers display information. Also explore different types of visualization and how humans perceive information. (Remembering)
2. Apply principles of design and colour to make visualizations more engaging and effective. (Applying).
3. Learn how to visualize graphs that depict relationships between data items. (Understanding)
4. Designing your own visualization system for large datasets and dashboards. (Creating)
5. Create and interpret the visualization from the data set, and apply techniques from user-interface design to create an effective visualization system. (Creating, Evaluating)

Module I: (12 hours)
Introduction to Data Visualization: Overview of Visualization, Defining data visualization; Visualization workflow: describing data visualization workflow, process in practice; Data representation: chart types: categorical, hierarchical, relational, temporal & spatial.

Module II: (15 hours)
Visualization Tools: 2-D: bar charts, clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar charts, Range chart, Box-and-whisker plots, univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, all relevant 2-D charts. 3-D: surfaces, contours, hidden surfaces, pm3d coloring, 3D mapping; multi-dimensional data visualization; manifold visualization; graph data visualization; Annotation; Word Clouds, Seaborn and Regression Plots.

Module III: (12 hours)
Visualization of Numerical Data**:** Data, Mapping, Charts, Glyphs, Parallel Coordinates, Stacked Graphs, Tufte's Design Rules.

Module IV: (10 hours)
Visualization of Non-Numerical Data**:** Graphs and Networks**,** Embedding Planar Graphs**,** Graph Visualization**,** Creating Maps and Visualizing Geospatial Data, Introduction to Folium, Maps with Markers, Choropleth Maps, Tree Maps**,** Principal Component Analysis**,** Multidimensional Scaling**,** Packing.

Module V: (11 hours)
The Visualization Dashboard: Introduction, Visualization Systems, the Information Visualization, Database Visualization, Visualization System Design.

Suggested Readings

1. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016
2. Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H	M		
CO 3			M	M	
CO 4				H	
CO 5					H

CABD0056: BIG DATA MANAGEMENT

(4-0-0) (4 Credits – 60 Hours)

COURSE / LEARNIG OUTCOMES:

1. List the components of Hadoop and Hadoop Ecosystem. (Remembering)
2. Understanding of big data basics and problems over big data. (Understanding)
3. Identify Big Data and its Business Implications. (Applying)
4. Make use of Hadoop and MapReduce programming to tackle big data problems. (Applying)
5. Demonstrate Machine Learning Techniques using R/Python. (Understanding)

Module I (12 Hours)

Introduction to Big Data and Hadoop Types of Digital Data: Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem, IBM Big Data Strategy, Introduction to Infosphere Big, Insights and Big Sheets.

Module II (12 Hours)

HDFS (Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Module III (10 Hours)

Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module IV (14 Hours)

Hadoop Ecosystem: Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. HBase : HBasics, Concepts, Clients, Example, HBase Versus RDBMS.

Module V (12 Hours)

Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Introduction to Big Data Analytics with BigR.

Suggested Readings

1. Hadoop: The Definitive Guide, Third Edition, Tom White, 2012, O'reily Media.
2. Big Data Analytics, Seema Acharya, Subhasini Chellappan, 2015, Wiley.
3. Machine Learning (in Python and R), First Edition, J. P. Mueller, L. Massaron, 2016, Wiley.

Mapping of Course Outcomes:

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H			H	
CO 2	H	M			
CO 3			M	H	
CO 4			H	H	
CO 5				M	H

CAWA0057: WEB ANALYTICS AND DEVELOPMENT

(4-0-0) (4 Credits – 60 Hours)

Course Outcomes:

1. Recall the various Web Analytics--related terms, tools, and technologies (Remembering)
2. Illustrate the various web data capturing procedures and the various important web metrics (Understanding)
3. Experiment how to deploy web intelligence to improve the outcomes of marketing or business plan. (Applying)
4. Compare and contrast the various web analytics tools (Analysing)
5. Analyze, test, and judge results based on search analytics, competitive intelligence analytics and Google analytics. (Analyzing, Evaluating)

Module I: Basic Concepts of web Analytics and Web Data Collection (14 Hours)

Introduction: Web Analytics – brief history, evolution, importance and need; advantages and limitations of web analytics, site references, Basic Terms - keywords and key phrases, onsite web, offsite web, visit characterization terms, content characterization terms, conversion metrics; Web analytics platform

Data Collection: Clickstream Data - Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

Module II: Web Data Capturing and Web Metrics (16 Hours)

Capturing data: Web logs, data capture, Type and size of data, Innovation, Integration, selecting optimal web analytic tool, Understanding click stream data quality, identifying unique page definition, Using cookies, Link coding issues

Web Metrics: Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non-ecommerce sites): Improving bounce rates, optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI.

Module III: Search Analytics and Qualitative Analysis of Web Data (12 Hours)

Search Analytics: Performing Internal Search Site Analytics, Search engine optimization, Measuring SEO Efforts, Analyzing Pay per Click effectiveness,

Qualitative Analysis: Essence of customer eccentricity, Heuristic evaluations, Site Visits: Conducting a site visit, Benefits of site visits; Surveys - Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys .

Module IV: Web Analytics Tools, Competitive Intelligence and Google Analytics (18 Hours)

Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys

Competitive Intelligence (CI) analysis: CI data sources, Toolbar data, Panel data, ISP data, Search engine data, Hybrid data,

Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

Suggested Readings

1. Kaushik, Avinash. Web Analytics: An Hour a Day. United States, Wiley, 2007.
2. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed
3. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed.
4. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			L
CO 2		H		
CO 3		L	H	M
CO 4				H
CO 5			H	H

CACP0058: COMPUTER PROGRAMMING IN C LANGUAGE

(4-0-0) (4 Credits – 60 Hours)

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define and describe various terms and concepts of C programming language. (Remembering)
2. Interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures and pointers in C. (Understanding)

3. Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
4. Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)
5. Evaluate various algorithms used for searching, sorting etc. in terms of correctness and computation cost. (Evaluating)
6. Combine the various concepts and ideas learnt in C to plan, propose and develop a product. (Creating)

Module I: Introduction to Algorithms and Programming Languages (16 hours)
Introduction to structured programming and problem solving methods: Algorithms, key features of algorithms, flowcharts, pseudocode, generation of programming languages, structured programming languages.
Overview of C: Introduction to C, basic structure of a C program, compiling and executing C programs, comments, characteristics of a good program, character set, identifiers, keywords, data types, constants and variables, I/O statements, operators and expressions, precedence and associativity of operators, type conversion and typecasting.

Module II: Decision Control Statements, Loops and Functions (16 hours)
Decision Control Statements and Loops: Introduction to decision control statements, conditional branching statements, goto statements, while loop, do-while loop, for loop, nested loops, break and continue statements.
C Functions: Need for functions, function declaration and definition, user defined and library functions, passing parameters to function, return statement, scope of variables, storage classes, recursive functions.

Module III: Arrays, Strings and Pointers (15 hours)
Arrays and Strings: One-dimensional arrays, passing array to function, multidimensional arrays and their applications, character arrays and string operations.
Pointers: Introduction to pointers, pointer expressions, null pointers, generic pointers, pointers and arrays, dynamic memory allocation.

Module IV: Structures, Files and Preprocessor Directives (13 hours)
Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types.
Files: Introduction to files, file management – open, close, input/output operations, Command line arguments.
Preprocessor Directives: Introduction to preprocessor directives, macros and file inclusion.

Suggested Readings
1. Thareja, R., Computer Fundamentals and Programming in C, Oxford University Press, New Delhi.
2. Balagurusamy, E., Computer Fundamentals and C Programming, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Gottfried, Byron S., Programming with C (Schaum's Outlines Series), Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Kanetkar, Y., Let us C, BPB Publication, New Delhi.
5. Kernighan, B.W., and Ritchie, Dennis M., The C Programming Language, Prentice Hall Pvt. Ltd, New Jersey.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	L	L	L
CO2	H	M	L	L
CO3	H			
CO4		H	M	L
CO5			H	
CO6	L	H	H	M

CAIB0059: IT TOOLS FOR BUSINESS

(5-1-0) (6 Credits – 90 Hours)

Course/Learning Outcomes:
1. Explain the foundation level knowledge required to understand computer and its operations. (Understanding)
2. Explain the hardware and software components of the computer. (Understanding)
3. Explain the basic concept of operating system and get knowledge about various different operating systems. (Understanding)
4. Learn and apply the packages of word processing, spread sheet and presentation in detail. (Applying)
5. Explain various data base concepts and operations. (Understanding)
6. Explain the issues related to IT and IT applications. (Understanding)

Module I: Computer Organization (17 Hours)

Characteristics of Computers, Input, Output, Storage units, CPU, Computer System, Number system, Central Processing Unit - Processor Speed, Cache, Memory, RAM, ROM, Booting, Memory- Secondary Storage Devices: Floppy and Hard Disks, Optical Disks CD-ROM, DVD, Mass Storage Devices: USB thumb drive. Managing disk Partitions, File System Input Devices - Keyboard, Mouse, joystick, Scanner, web cam, Output Devices- Monitors, Printers – Dot matrix, inkjet, laser, Multimedia- What is Multimedia, Text, Graphics, Animation, Audio, Images, Video; Multimedia Application in Education, Entertainment, Marketing. Names of common multimedia file formats, Computer Software- Relationship between Hardware and Software; System Software, Application Software, Compiler, names of some high level languages, free domain software.

Module II: Operating System (17 Hours)
Microsoft Windows- An overview of different versions of Windows, Basic Windows elements, File management through Windows. Using essential accessories: System tools – Disk clean-up, Disk defragmenter, Entertainment, Games, Calculator, Imaging – Fax, Notepad, Paint, WordPad. Command Prompt- Directory navigation, path setting, creating and using batch files. Drives, files, directories, directory structure. Application Management: Installing, uninstalling, Running applications. Linux- An overview of Linux, Basic Linux elements: System Features, Software Features, File Structure, File handling in Linux: H/W, S/W requirements, Preliminary steps before installation, specifics on Hard drive repartitioning and booting a Linux system.

Module III: Word Processing (16 Hours)
Word processing concepts: saving, closing, opening an existing document, selecting text, editing text, Finding and replacing text, printing documents, Creating and Printing Merged Documents, Character and Paragraph Formatting, Page Design and Layout. Editing and Profiling Tools: Checking and correcting spellings. Handling Graphics, Creating Tables and Charts, Document Templates and Wizards.

Module IV: Spreadsheet Package (16 Hours)
Spreadsheet Concepts, Creating, Saving and Editing a Workbook, Inserting, Deleting Work Sheets, entering data in a cell / formula Copying and Moving from selected cells, handling operators in Formulae, Functions: Mathematical, Logical, statistical, text, financial, Date and Time functions, Using Function Wizard. Formatting a Worksheet: Formatting Cells – changing data alignment, changing date, number, character or currency format, changing font, adding borders and colours, Printing worksheets, Charts and Graphs – Creating, Previewing, Modifying Charts. Integrating word processor, spread sheets, web pages.

Module V: Presentation Package (12 Hours)
Creating, Opening and Saving Presentations, Creating the Look of Your Presentation, working in Different Views, working with Slides, Adding and Formatting Text, Formatting Paragraphs, Checking Spelling and Correcting Typing Mistakes, Making Notes Pages and Handouts, Drawing and Working with Objects, Adding Clip Art and other pictures, Designing Slide Shows, Running and Controlling a Slide Show, Printing Presentations.

Module VI: Data Base Operations and Information Technology (12 Hours)
Data Manipulation-Concept: Database, Relational Database, Integrity. Operations: Creating, dropping, manipulating table structure. Manipulation of Data: Query, Data Entry Form, Reports.
Indian IT Act, Intellectual Property Rights – issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

Suggested Readings

1. P.K. Sinha and P. Sinha, “Foundations of Computing”, BPB Publication, 2008.
2. Sagman S, “MS Office for Windows XP”, Pearson Education, 2007.
3. ITL Educational Society, “Introduction to IT”, Pearson Education, 2009.
4. Miller M, “Absolute Beginners Guide to Computer Basics”, Pearson Education, 2009.
5. D’Suoza & D’souza, “Learn Computer Step by Step”, Pearson Education, 2006. 7. Kulkarni, “IT Strategy for Business”, Oxford University Press
6. Refer: Open Office/ MS Office Environment for practice.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2		M				
CO 3		H				
CO 4			H	H	H	
CO 5						H
CO 6						H

CAMD0060: MEAN STACK WEB DEVELOPMENT

(Credits: Theory-02)

Course Objective:

- Understand the MEAN Stack and its Use cases.
- Apply JavaScript-based technologies to develop web applications.
- Familiarize with the front and back-end technologies by implementing knowledge of Angular and Node.js.
- Familiarize with the storage of data in a highly scalable, flexible, and distributed NoSQL database – MongoDB.

Course Outcomes:

1. List the components of MEAN Stack Program. (Remembering)
2. Understanding of JavaScript-based technologies. (Understanding)
3. Demonstrate the knowledge of Angular and Node.js. (Understanding)
4. Build scalable websites for diverse clients using Angular and Node.js (Creating)
5. Experiment with the distributed NoSQL database – MongoDB. (Applying)

Module I (6 Hours)

Introduction to JavaScript, Understanding JS Syntax, Introduction to Document and Window Object, Variables and Operators, Data Types, Conditional Statements, Functions, Strings

Module II (8 Hours)

Node.js Overview, Node.js basics and setup, Node Package manager, Command Utilities, Asynchronous Programming, Callbacks, Events and Event Loop, Event Emitter, Node.js database access

Module III (6 Hours)

Introduction to Angular.js, dynamic binding, modules, controllers and scope, Views, Event Directives, Expressions, Built-in and custom filters, Loops, Form validations, Service types, Factories, Routing

Module IV (10 Hours)

MongoDB concepts, Scaling, SQL and NoSQL Concepts, SQL and Complex Transactions, Creating and Managing Database using MongoDB

Suggested Readings

1. Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications (Developer's Library), 2nd Edition, Brad Dayley, Brendan Dayley, Caleb Dayley, 2018, Addison-Wesley.
2. Full Stack Javascript Development with Mean: MongoDB, Express, AngularJS, and Node.JS, 1st Edition, Colin J Ihring, Adam Bretz, 2015, Shroff Publishers.
3. Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap, Mayur Ramgir, 2020, Wiley.

Mapping of Course Outcomes:

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M	M	
CO 2	H	H	M	
CO 3		H	H	
CO 4	L	M		
CO 5				H

CAMP0061: MANAGERIAL COMPETENCIES FOR PROFESSIONALS

(2 Credits -30 hours)

Course Outcomes

1. Define the basic concepts and facts of management (REMEMBERING)
2. Identify the best practices from around the globe in management. (UNDERSTANDING)
3. Interpret management principles and practices. (APPLYING)
4. Analyse the learnings to transform the management practices of organisations. (ANALYSING)

Module I: Introduction to Management (5 Hours)

Concept and Definitions of Management; Need and Significance of Management; Evolution of the Management Thought, Classical Approach – Taylor and Fayol, Neo-Classical and Human Relations Approaches; Behavioural Approach, Systems Approach, Contingency Approach; MBO

Module II: Planning and Organising (7 Hours)

Concept and significance of planning; types of plan, Strategic planning – Concept, process, Importance and limitations
Concept and process of organising; Span of management, Different types of authority (line, staff and functional), Decentralisation, Delegation of authority
Formal and Informal Structure; Principles of Organising; Network Organisation Structure

Module III: Staffing and Directing (4 Hours)
Staffing: Concept, process and significance
Decision-making – Concept, Importance; Process and types; Committee and Group Decision-making, Process

Module IV: Controlling (4 Hours)
Controlling: Concept, Significance, Process, Limitations; Principles of Effective Control; Major Techniques of controlling; Emerging issues in Management

Module V: Communication , Motivation and Leadership (10 Hours)
Communication: Concept, purpose, process; Oral and written communication; Formal and informal communication networks, Barriers to communication, Overcoming barriers to communication.
Motivation: Concept, Importance, extrinsic and intrinsic motivation; Major Motivation theories - Maslow's Need-Hierarchy Theory; Hertzberg's Two-factor Theory
Leadership: Concept, Importance, Trait theory, Behavioural theory and Contingency theory of leadership,.

Suggested Readings:

1. Harold Koontz and Heinz Weihrich, Essentials of Management: An International and Leadership Perspective, McGraw Hill Education.
2. Stephen P Robbins and Madhushree Nanda Agrawal, Fundamentals of Management : Essential Concepts and Applications, Pearson Education.
3. George Terry, Principles of Management, Richard D. Irwin
4. Newman, Summer, and Gilbert, Management ,PHI
5. James H. Donnelly, Fundamentals of Management, Pearson Education.
6. B.P. Singh and A.K. Singh, Essentials of Management, Excel Books
7. Robert Kreitner, Management Theory and Application, Cengage Learning
8. T N Chhabra, Management Concepts and Practice, Dhanpat Rai & Co. (Pvt. Ltd.),New Delhi
9. Peter F Drucker, Practice of Management, Mercury Books, London

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4			M	H	M

CADA0062: DESIGN AND ANALYSIS OF ALGORITHMS

(4 credits – 60 Hours)

Objective:
- To introduce first level topics covering basics in algorithms.
- To understand the necessary mathematical abstraction to solve problems.
- To apply important algorithmic design paradigms and methods of analysis.

Module I: Basic Concepts of Algorithms (12 Hours)
Introduction to Algorithms: Importance of Algorithms. History of Algorithms, Fundamentals of Algorithmic Solving, Ways of writing an Algorithm, Important problem types, Design and Analysis Vs Analysis and Design.
Growth of Functions: Basic Mathematical Concepts- Logarithms, Arithmetic Progression, Geometric Progression. Asymptotic Notations. Properties of Asymptotic Notations.

Module II: Recursive and Non-Recursive Algorithms (16 Hours)
Recursion, Mathematical Analysis of Recursive Algorithm: Solving Linear Recurrence Equation, Solving Non-Linear Recurrence Equation. Complexity of Recursive Algorithms, Substitution Method, Recursion Tree, Master Theorem. Amortized Analysis
Mathematical Analysis of Non-Recursive Algorithms, Empirical Analysis of Algorithms, Models of Computations - RAM model, Turing Machine.

Module III: Sorting and Searching Algorithms (16 Hours)

The sorting problem, Brute Force Approach - Sequential Search, Bubble Sort, Selection Sort, Decrease-and-Conquer Approach - Insertion Sort, Depth first Search and Breadth First Search, Binary Search, Divide-and-Conquer Approach – Quick Sort, MergeSort, Transform-and-Conquer Approach -Heap Sort, Linear Sorting Algorithms -Radix Sort, Hashing - Hash Function, Collisions in Hashing, Analysis of Search Operations.

Module IV: Greedy Technique and Dynamic Programming (16 Hours)
Concept of Greedy Approach, 0/1 Knapsack Problem, Minimum Spanning Trees (MST), Prim's Algorithm, Kruskal's Algorithm, Huffman Trees, Single-Source Shortest Path, Analysis and Design of Greedy Approach.
Concept of Dynamic Programming, Longest Common Subsequence (LCS) problem, Matrix Chain Multiplication, Travelling Salesperson Problem. Concept of Backtracking. Introduction to Tractable and Intractable Problems, Computability classes – P, NP, NP-complete and NP-hard.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Define algorithms, importance of analysis of an algorithm and their asymptotic bounds and relate the different types of problem and their solutions. (Remembering)
2. Explain different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms. (Understanding)
3. Design algorithms for given problems. (Applying)
4. Compare and analyze different design strategies. (Analyzing)

Suggested Readings
1. S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, The MIT Press, 2009.
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, 2008.
4. Narsimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications; Fifth Edition, 2016

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H	M	M	M
Module II	L	L	H	H
Module III	L	M	H	H
Module IV	L	M	H	H

CADY0063: INTODUCTION TO DATA ANALYTICS

(4 credits – 60 hours)

Objective:
The objective of this course is to introduce to the students the fundamental concepts, tools and techniques needed for dealing with various facets of Data Analysis. Being a data analyst mainly requires an integrated skill set such as mathematics, statistics, machine learning, along with other branches of computer science. This course will introduce students to this rapidly growing field and equip them with some of its basic principles and tools as well as its general mindset.

Module I: Basics of Data Analytics and Data Pre-processing (15 Hours)
Introduction to Data Analytics: Why Learn Data Analysis, Data Analytics Life Cycle, Types of Data Analysis, Types of Jobs in Data Analytics, Main Data Analytics Tools, Fundamentals Areas of Study in Data Analysis, Data Analytics in Different Sectors
Data Pre-processing: Introduction to Data Pre-processing, Dealing with different Types of Data, Possible Data Error Types, Various Data Pre-processing Operations - Data Cleaning, Data Integration, Data Transformation, Data Reduction, and Data Discretization

Module II: Data Visualization and Machine Learning for Data Analysis (15 Hours)
Data Visualization: Introduction to Data Visualization, Data Visualization Libraries, Basic Data Visualization Tools - Histogram, Bar Chart, Line Chart, Scatter Plot, Area Plot, and Pie Chart; Specialized Data Visualization Tools - Box Plot, Bubble Plot, Violin Plot, and Heat Map
Machine Learning for Data Analysis: Overview of Machine Learning, Supervised Machine Learning - Regression Methods (linear and logistic), Classification Methods (KNN Classification and SVM Classification); Unsupervised Machine Learning – K-means Clustering

Module III: Statistical Data Analysis (15 Hours)

Descriptive Statistical Analysis: Role of Statistics in Data Analysis, Kinds of Statistics, Measures of Frequency (Count, Percent, Frequency), Central Tendency (Mean, Mode, Median), Dispersion (Range, Variance, Standard Deviation), and Position (Percentile Ranks, Quartile Ranks),
Probability Theory: Fundamental Concepts related to Probability – Sample space, Events, Expected value, Odds and Risks; Four Perspectives on Probability, Law of Total Probability, Baye's Theorem, Bernoulli Trial

Module IV: Text Analysis and Business Analysis (15 Hours)
Text Analysis: Overview of Text Analysis, working with Text – Feature extraction, Tokenization, Stemming; Text Categorization, Text summarization, Sentiment analysis
Business Analysis: An Overview of Business Analytics, The Business Analytics Life Cycle, Financial Analysis, Customer Analysis, and Employee Analysis

Course/Learning Outcomes:
At the end of this course students will be able to:
1. Identify the fundamental concepts and tools related to data analytics (Understanding)
2. Recognize which tools and methodologies can be applied to solve data analysis tasks. (Remembering)
3. Obtain, clean/process, and transform data and analyse the transformed data using a data analysis approach (Applying and Analysing)
4. Visualize and present the inference using various data visualization tools (Applying)
5. Compare and estimate the right machine learning techniques and/or statistical data analysis to be used for a specific data analytics task (Evaluating)
6. Formulate and use appropriate text analysis or business analysis to solve organization and business-related challenges (Creating)

Suggested Readings
1. Moreira, João, Andre Carvalho, and Tomás Horvath. A general introduction to data analytics. John Wiley & Sons, 2018.
2. G. Nandi, R. K. Sharma, Data Science Fundamentals and Practical Approaches, BPB, 1st Edition, 2020.
3. Sedkaoui, Soraya. Data analytics and Big data. John Wiley & Sons, 2018.
4. Silberschatz, H. F. Korth, S Sudarshan, Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, 1st Edition, Dreamtech, 2016

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			L
CO 2	H	M		
CO 3	H	L		
CO 4		H	M	M
CO 5		H	H	
CO 6				H

CAIT0064: INTERNET OF THINGS

6 Credits – 90 Hours (5-1-0)

Objective
This course will introduce the students to Internet of Things(IoT) and basic structure of communication protocols in sensor network. The course is designed to build up basic understanding of how to set up an application specific IoT network with better orientation and representation of sensor nodes.

Module I (20 hours)
Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics; IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

Module II (25 hours)
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, a use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT M2M vs IoT an Architectural Overview–Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.
IoT Architecture: Introduction, Reference Model, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module III (16 hours)
IoT with Arduino: Hands on Experience with Arduino (Firmware development & RTOS) - General Purpose I/O(GPIO), Serial Communication Interfaces: RS-232/485, Synchronous Peripheral Interfaces: I2C, SPI Sensors interfacing with Arduino.

Module IV (18 hours)
IoT with Raspberry PI: Hands on Experience with Raspberry PI (Firmware development) - Setting up Raspberry PI SD Card, Raspberry PI booting up & Initialization; General Purpose I/O(GPIO), Serial Communication Interfaces: RS-232/485, Synchronous Peripheral Interfaces: I2C, SPI; Sensors Interfacing with Raspberry PI

Module V (11 hours)
Domain specific applications of IoT: Home automation, Industry applications, Surveillance, applications, Other IoT applications. Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

COURSE/LEARNING OUTCOMES
1. Explain the definition and usage of the term "Internet of Things" in different contexts and understand the key components that make up an IoT system (Remembering)
2. Understand why it is necessary to build a separate model for IoT and what parameters influences the operation of IoT network. (Understanding)
3. Apply the knowledge in designing IoT network for addressing real life issues for easing the day to day life activities. (Applying)
4. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis. (Applying)
5. Implement interfacing of various sensors with Arduino/Raspberry Pi.

Suggested Readings
1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, 2013.
2. Qusay F. Hassan, Internet of Things A to Z: Technologies and Applications, Wiley-Blackwell, 2018.
3. Peter Waher, Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3, Packt Publishing, 2018.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2		H			
CO 3					M
CO 4			H	H	
CO 5			H	H	

CANM0065: COMPUTER ORIENTED NUMERICAL METHODS

(4 credits – 60 hours) 4-0-0

Objective:
- Obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis.
- Trace error in these methods and need to analyze and predict it.
- Provide knowledge of various significant and fundamental concepts to inculcate in the students an adequate understanding of the application of Statistical Methods.
- Demonstrate the concepts of numerical methods used for different applications

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. To learn about different Interpolation methods. (Applying)
2. To learn how data is manipulated by using arithmetic operation. (Remembering)
3. Apply differential equations for monitoring and finding stability of solutions. (Applying)
4. To understand the concepts of Statistical Computations. (Understanding)

Module I: Interpolation (16 Hours)
Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula, Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation, Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula.

Module II: Introduction and Solution of Algebraic and Transcendental Equation (14 Hours)
Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation
Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.

Module III: Numerical Integration and Differentiation (8 Hours)
Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Module IV: Solution of differential Equations: (10 Hours)
Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution

Module V: Statistical Computation: (12 Hours)
Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic splines, Regression Analysis, Linear and Non-linear Regression, Multiple regression, Statistical Quality Control methods.

Suggested Readings:

1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
2. Gerald & Whealey, "Applied Numerical Analyses", AW
3. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
4. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi
5. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
6. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH
7. Francis Scheld, " Numerical Analysis", TMH
8. Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
9. Gupta C.B., Vijay Gupta, "Introduction to Statistical Methods", Vikas Publishing.
10. Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II		H		
Module III		H		
Module IV			H	
Module V				H

CACD0066: COMPILER DESIGN

(4 credits – 60 hours)

Objective
The objectives of the course are to understand, design and implement a lexical Analyser, a parser, and generation schemes and to understand optimization of codes and runtime environment.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall the different phases of compiler design, their functionalities and the compiler design tools and techniques. (Remembering)
2. Interpret various types of parser and their merits and demerits and illustrate the error handling techniques in compiler construction. (Understanding)
3. Experiment with the different parsing techniques to input string. (Applying)
4. Compare and Analyse different techniques of parsing. (Analysing)
5. Adapt to handle with code optimization, run time environment etc. during compilation. (Creating)

Module I (12 hours)
Introduction to compiling: Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis – Role of Lexical Analyser – Input Buffering – Specification of Tokens.

Module II (12 hours)

Syntax Analysis: Role of the parser, Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.

Module III (20 hours)

a. Intermediate Code Generation: Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back patching – Procedure calls.
b. Code Generation: Issues in the design of code generator – The target machine – Runtime Storage management – Basic Blocks and Flow Graphs –DAG representation of Basic Blocks – Peephole Optimization.

Module IV (16 hours)

Code Optimization and Run Time Environments: Introduction – Principal Sources of Optimization –Optimization of basic Blocks – Introduction to Global Data Flow Analysis – Runtime Environments – Source Language issues Storage Organization – Storage Allocation strategies – Access to non-local names – Parameter Passing.

Suggested Readings

1. Compilers Principles, Techniques and Tools- Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Pearson Education.
2. Introduction to Compiler Techniques- J.P. Bennet, Tata McGraw-Hill.
3. Compiler Construction: Principles and Practice Learning. - Kenneth C. Louden, Thompson.
4. Practice and Principles of Compiler Building with C- Henk Alblas and Albert Nymeyer, PHI

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3		H		
CO 4		H		L
CO 5			M	H

CAMS0068: COMPUTER GRAPHICS

(4 credits – 60 hours)

Objective

Computer graphics is one of the most exciting and rapidly growing computer fields. It has got numerous areas of applications such as user interface, data visualization, television commercials, motion pictures, etc. This paper is meant to give the students' knowledge of hardware, graphics concepts and algorithms to implement the concepts.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define various graphics systems, Graphics software and software standards. (Remembering)
2. Explain the output primitives that will comprise of various algorithms. (Understanding)
3. write programmes to design simple applications of computer graphics. (Applying)
4. Examine the 2D transformations, 2D viewing and concepts on 3D dimensional concepts and some object representation. (Analysing)
5. Evaluate the performance of the algorithms that will be required to design the shapes and curves. (Evaluating)
6. Draw lines, curves, circle using algorithms and implement many functions to fill colors; further they will be able to design animations using various transformations. (Creating)

Module I (15 Hours)

Overview of Graphics Systems : Video Display Devices, Refresh cathode-ray Tubes, Raster Scan Display, Random Scan Display Color CRT Monitor, Direct View Storage Tubes, Flat panel Display, Three Dimensional Viewing Devices, Stereoscopic and Virtual-Reality Systems, Raster Scan Systems Video Controller, Raster Scan Display Processor, Random-Scan Systems, Graphics Monitors.

Module II (12 Hours)

Output Primitives: Points and Lines, Line Drawing Algorithms, Loading the Frame Buffer, Line Functions, Circle –generating Algorithms, Ellipse-generating Algorithms, Polynomial and Spline Curves, Pixel Address and Object Geometry Screen Grid Coordinate, Filled-Area Primitives, Scan-line polygon Fill Algorithm, Inside Outside Test, Scan –Line Fill of Curved Boundary Areas, Boundary Fill Algorithm, Flood Fill Algorithm.

Module III (12 Hours)
Two- Dimensional Geometric Transformations: Basic Transformations: Translations, Rotations, Scaling; Matrix Representations and Homogeneous Coordinates, Composite Transformations: Translations, Rotations, Scaling, General Pivot Point Rotations, General Fixed Point Scaling, General Scaling Directions, Concatenation Properties, General Composite Transformations and Computational Efficiency, Other Transformations: Reflections, Shear; Transformations Between Coordinate Systems.

Module IV (10 Hours)
Two-Dimensional Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to- Viewport Coordinate Transformations. Two -Dimensional Viewing Functions, Clipping Operations, Point Clipping, Line Clipping: Cohen-Sutherland Line Clipping, Liang- Barsky Line Clipping; Polygon Clipping: Sutherland- Hodgeman Polygon Clipping; Curve Clipping, Text Clipping, Exterior Clipping.

Module V (11 Hours)
Three Dimensional Concept and Some Object Representation: Three-Dimensional Display Methods, Parallel Projections, Perspective Projections, Depth Cueing, Visible Line and Surface, Identification, Surface Rendering, Exploded and Cutway Views, Three-dimensional and Stereoscopic Views, Three Dimensional Graphic Packages, Polygon Surfaces, Polygon Tables, Place Equations, Polygon Meshes, Curved Line and Surfaces, Spline Representations, Interpolations and Approximations Splines, Parametric Continuity Conditions, Geometric Continuity Conditions, Spline Specifications, Bezier Curves, Properties of Bezier Curves.

Suggested Readings

1. Donald Hearn and M Pauline Baker, Computer Graphics, 2nd Edition, PHI, India.
2. R Plastock and G Kalley, Theory and Problems of Computer Graphics, 2nd Edition, Schaum's Series, Mc GrawHill.
3. J Foley and A Van Dam, S Feiner , J Huges., Computer Graphics : Principles and Practice, Addison – Wesley.
4. D Rogers and J Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw Hill, International Edition.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3		M	M	M	
CO 4			H		
CO 5			M	M	
CO 6		H	M		

CADW0069: DATA WAREHOUSING AND DATA MINING

(6 Credits – 90 hours) (5-1-0)

Objective
The main purpose of the course is to develop and gain an understanding of the principles, concepts, functions and uses of data warehouses, data modeling and data mining in business.

Module I: Data warehousing (25 hours)
Definitions and characteristics, Multidimensional data model, Warehouse schema. Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart. Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multidimensional view, snowflake schema; OLAP tools.

Module II: Developing a Data Warehouse (20 hours)
Building of a Data Warehouse, Architectural strategies and organizational issues, design considerations, data content, distribution of data, Tools for Data Warehousing Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing and Data mining in Government.

Module III: Association Rules (25 hours)
Apriori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule. Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS.

Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Module IV: Web Mining (20 hours)
Web content Mining, Web structure Mining, Web usage Mining, Text Mining. Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Recall the principles, concepts, functions and various applications of data warehouse. (Remembering)
2. Explain the concepts related to Online Analytical Processing. (Understanding)
3. Identify the association rules and can implement various Data Mining algorithms. (Applying)
4. Analyse the pros and cons of various data mining techniques. (Analysing)
5. Compare and assess different approaches of data ware housing and data mining with various technologies. (Evaluating)
6. Elaborate the various concepts of Web Mining for practical applications. (Creating)

Suggested Readings
1. C.S.R.Prabhu, Data Warehousing- Concepts, Techniques, Products, Application, PHI.
2. AK Pujari, Data Mining Techniques, Universities Press.
3. Berson and S.J.Smith, Data Warehousing, Data Mining and OLAP, TMH.
4. M.H.Dunham, Data Mining Introductory and Advanced Topics, Pearson.

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4	CO5	CO6
Module I	H	M		L		
Module II				M	M	
Module III			H		H	
Module IV						H

CAIP0070: DIGITAL IMAGE PROCESSING
(Credits: 4 - 60 Hours)

Objective
The main objective of this course is to introduce the students to fundamentals of image processing concepts and computer vision algorithms. This course will help the students to develop mathematical foundations for digital manipulation of images; image acquisition; image enhancement; image restoration, morphological operations on images, segmentation; Fourier domain processing; and compression. This course also aims to introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.

Course Outcomes:
At the end of this course the students will be able to:
1. Define the Digital Image Processing terminology used to describe features of images and also to list the fundamental steps in images processing. (Remembering)
2. Explain the concept of image enhancement in spatial and frequency domain. (Understanding)
3. Solve problems in image processing by applying their knowledge on-image enhancement, image restoration, compression, segmentation and morphological operations. (Applying)
4. Analyse the various morphological operations and segmentation methods. (Analyse)
5. Evaluate the performance of different filters for a particular image. (Evaluating)
6. Develop image processing applications. (Creating)

Module I: Fundamentals of Image Processing (14 Hours)
Introduction to image processing, applications, types of image processing. Digital Image Processing- Introduction, fundamental steps in digital image processing, elements of Digital Image Processing Systems, Image acquisition, Image sampling and quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels, digital image representation.

Module II: Image Enhancement (16 Hours)
Image Transformation in Spatial Domain: Image enhancement by- point processing, neighborhood processing, Basic Intensity Transformation Functions- Image Negatives, Gamma transformation; Histogram processing, Spatial Filtering, Smoothing Filters, Sharpening Filters.

Image Transformation in Frequency Domain: Introduction to Fourier Transform and the frequency Domain, Discrete Fourier transform, Image smoothing and sharpening using frequency domain filters.

Module III: Image Restoration and colour image processing (14 Hours)
Image Restoration: Noise Models, Image restoration using spatial domain filtering, Image restoration using frequency domain filtering. Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse Filtering, Wiener Filtering.
Colour fundamentals, colour models, colour transformation, smoothing and sharpening.

Module IV: Morphological Image Processing and Image Compression (16 Hours)
Introduction to morphology, erosion, dilation, opening, closing, some basic morphological algorithms (boundary extraction, hole filing, extraction of connected components, thinning, thickening etc.), Image Segmentation: Fundamentals; point line and edge detection; thresholding.
Fundamentals of image compression- redundancy, Compression models, Lossy and Lossless compression.

Suggested Readings
1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 2nd edition, Pearson Education.
2. A.K. Jain, "Fundamentals of Digital Image Processing", 2nd edition, Prentice-Hall, Addison-Wesley.
3. J. C. Russ, "The Image Processing Handbook". 4th edition, CRC, Boca Raton, FL.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO1	H	L	L	L
CO2		H		
CO3		H	H	H
CO4				H
CO5		H		
C06	L	H	H	H

CACC0071: CLOUD COMPUTING

(4 credits – 60 hours)

Objective
Identify the technical foundations of cloud systems architectures. Analyze the problems and solutions to cloud application problems. Identify and define technical challenges for cloud applications and assess their importance.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing. (Understanding)
2. Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as GFS, HDFS, Map Reduce. (Understanding)
3. Identify security aspects in cloud computation (Applying)
4. Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model. (Creating)

Module I (12 hours)
Introduction to Cloud Computing, the Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication- as- a-Service, Infrastructure-as-a-Service, Monitoring-as-a-Service, Platform- as-a-Service, Software- as- a-Service, Building Cloud Network.

Module II (18 hours)
Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module III (14 hours)
Putting Security on the Spot with Questions: Understanding Security Risks, Reducing Cloud Security Breaches, Implementing Identity Management, Benefits of identity management, Aspects of identity management, Playing Detective: Detection and Forensics, Activity logs, HIPS and NIPS, Data audit, Encrypting Data, Creating a Cloud Security Strategy

Module IV (16 hours)
Virtualization and the Cloud: Visualizing Virtualization, Characteristics, Using a hypervisor in virtualization, Abstracting hardware assets, Managing Virtualization, Foundational issues, Abstraction layer, Provisioning software, Virtualizing storage, Hardware provisioning, Security issues, Taking Virtualization into the Cloud

Suggested Readings
1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kaufman, F.Halper, (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff,Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman,Pearson
5. Cloud Security and Privacy by Tim Malhar, S.Kumaraswamy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Anthony T Velte, et.al McGraw Hill,
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4
Module I	H			
Module II	M	H		
Module III	L		H	
Module IV	L			H

CAOR0073: OPERATION RESEARCH

(Credits 4 – 60 Hours)

Objectives
To impart knowledge in concepts and tools of Operations Research. Understand mathematical models used in Operations Research and to apply these techniques constructively to make effective business decisions.

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Formulate a real-world problem as a mathematical programming model. (Creating)
2. Formulate and obtain the optimal solution for Linear Programming problems. (Creating)
3. Determine the optimal solution for Transportation problems and assignment problems. (Evaluating)
4. Solve network models and problems on queuing theory. (Applying)
5. Determine the best strategy and value of the given game model. (Creating)

Module I: (10 Hours)
Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem – Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M method, two-phase method, degeneracy and unbound solutions.

Module II: (12 Hours)
LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

Module III: (14 Hours)
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Travelling Salesman Problem (TSP).

Module IV: (12 Hours)
Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems. Queuing Theory: Queuing systems and their characteristics

Module V: (12 Hours)

Game Theory: Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.

Suggested Readings

1. P. Sankara Iyer," Operations Research", Tata McGraw-Hill, 2008.
2. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2005.
3. J K Sharma., "Operations Research Theory & Applications, 3e", Macmillan India Ltd, 2007.
4. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & co., 2007.
5. J K Sharma., "Operations Research, Problems and Solutions, 3e", Macmillan India Ltd.
6. N.V.S. Raju, "Operations Research", HI-TECH, 2002

Mapping of COs to Syllabus

Course Outcomes	CO1	CO2	CO3	CO4	CO5
Module I	H				
Module II	L	H			
Module III	L		H		
Module IV	L			H	
Module V	L				H

CANW0074: COMPUTER NETWORK FUNDAMENTALS

(3 Credits - 45 Hours)

Objective

The objective of this course is to make the students understand basic terminologies of computer networks along with their types, mode of communication, models, transmission media, connecting devices. It also emphasizes to make the students aware about network security and basic conception of the World Wide Web.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Define the basic concepts of Computer Networks, its goals and network related terminologies. (Remembering)
2. Explain the concepts of Analog and Digital signals, Electromagnetic spectrum and related concepts on various architecture used in computer networks (Understanding)
3. Experiment with various Networks concepts such as Types of networks, Topologies, Transmission media and implement these concepts in setting up a lab in a real time scenario. (Applying)
4. Comprehend on Network Security Devices, Digital Signature and Internet Basics. (Understanding)
5. Evaluate the performance of the network based on the network criteria. (Evaluating)
6. Design the network with a suitable topology and network types.(Creating)

Module I (15 Hours)

Computer Network: Definition, Goals, Applications, Structure, Components, Topology, Types of Topology, Types of Networks (LAN, MAN, WAN, Internet), Broadcast and Point-To-Point Networks, Communications Types (Synchronous, Asynchronous), Modes of Communication, Topology, Client/Server architecture, Network Models, Design issues of the layer, Protocol Hierarchy, ISO-OSI Reference Model (Functions of each layer),Terminology, SAP, Connection Oriented and connectionless services, Peer Entities, TCP/IP model, Layers, Ports, Protocol Stack, Comparison of ISO-OSI and TCP/IP Model

Module II (10 Hours)

Transmission Media, Classes of Transmission Media, Guided Media: Coaxial Cable, Twisted Pair, Fiber Optics Cable, Connectors. Unguided Media (Wireless) Electromagnetic Spectrum for Wireless Communication, Propagation Methods (Ground, Sky, Line-of-Sight), Wireless Transmission, Radio Waves, Infrared, Microwave, Wireless LANs Architecture, MAC Sublayer, Frame Format, Frame Types, Bluetooth Architecture.

Module III (10 Hours)

Analog and Digital Signals, Data Encoding, Parallel and Serial Transmission, Network Connectivity Devices, Categories of Connectivity Devices, Passive and Active Hubs, Repeaters, Bridges, Switches (2-Layer Switch, 3-Layer Switch (Router)), Gateways, Network Interface Cards (NIC), Internetworking Principles.

Module IV (10 Hours)

Network Security : Definition, Network Security Requirements and Attacks, Network Security Devices (firewalls, Proxy Server), Encryption and Digital Signatures, Internet Basics, Concept of Intranet and Extranet, Web Server, World Wide Web (WWW) Architecture, Web Documents, Search Engines, Internet Service Providers (ISP).

Suggested Readings

1. Andrew S. Tannenbaum, "Computer Networks", Tata McGraw-Hill Publishing Company Limited New Delhi.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill Publishing Company Limited New Delhi.
3. William Stallings, "Data and Computer Communications", Pearson Education Asia.

CAEC0076: E-COMMERCE

(6 Credits- 90 Hours)

Objectives

To enable the student to become familiar with the mechanism for conducting business transactions through electronic means.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

1. CO1: Interpret the basic concepts and technologies used in the field of E-Commerce. (Remembering)
2. CO2: Explain the different regulatory provisions relating to E-Commerce. (Understanding)
3. CO 3: Develop processes of developing and implementing information systems. (Applying)
4. CO 4: Define the ethical, social, and security issues of information systems. (Analysing)
5. CO 5: Evaluate the various online business transactions (Evaluating)

Module I: Introduction (20 Hours)

Overview of developments in Information Technology and Defining E-Commerce: The scope of E commerce, Electronic Market, Electronic Data Interchange, Internet Commerce, Benefits and limitations of E-Commerce, Produce a generic framework for E-Commerce, Architectural framework of Electronic Commerce, Web based E-Commerce Architecture.

Module II: Security and Encryption: (16 Hours)

Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls, Proxy Server.

Module III: IT Act 2000 and Cyber Crimes (18 Hours)

IT Act 2000: Definitions, Digital signature, Electronic governance, Attribution, acknowledgement and dispatch of electronic records, Regulation of certifying authorities, Digital signatures certificates, Duties of subscribers, Penalties and adjudication, Appellate Tribunal, Offences and Cyber-crimes

Module IV: E-payment System (18 Hours)

Digital Payment Requirements, Digital Token-based e-Payment Systems, Smart Card Cash Payment System, Micropayment Systems, Electronic Cash, Risk and e-Payment Systems, Designing e-Payment Systems.

Module V: On-line Business Transactions (18 Hours)

Business Model, E-business Models Based on the Relationship of Transaction Parties: Business-to-Consumer (B2C), Business to-Business (B2B), Consumer-to-Consumer (C2C), Consumer-to-Business (C2B), E-business Models Based on the Relationship of Transaction Types: Brokerage Model, Aggregator Model

Suggested Readings

1. Kenneth C. Laudon and Carlo GuercioTraver, E-Commerce,Pearson Education.
2. David Whiteley, E-commerce:Strategy,TechnologyandApplications,McGrawHill Education
3. Bharat Bhaskar, Electronic Commerce: Framework, Technology and Application, 4thEd., McGraw Hill Education
4. Joseph P T, E-Commerce: An Indian Perspective, PHILearning
5. Bajaj K K and Debjani Nag, E-commerce, McGraw HillEducation
6. Chhabra T N, E-Commerce, Dhanpat Rai Co.

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2			H			
CO 3				M	M	
CO 4		H	M			
CO 5					H	

CACA0075: COMPUTER APPLICATIONS IN BUSINESS

(6 Credits: 90 Hours)

Objectives

To provide computer skills and knowledge for commerce students and to enhance the student understanding of the usefulness of information technology tools for business operations.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

1. Interpret the use of computer application in business. (Remembering)
2. Execute business presentation with the help of various computer applications. (Understanding)
3. Develop database management system. (Analysing)
4. Describe the use of the Word Processing package in business applications. (Applying)
5. Evaluate the use of spreadsheet packages in business applications. (Evaluating)
6. Design the database management system for business applications. (Creating)

Module I: Word Processing (20 hours)

Introduction to word Processing, Working with word document: Editing text, Find and replace text, Formatting, spell check and Grammar check; Page set-up; Inserting equations and symbol, Auto text; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Tables; filling and formatting a table; Inserting Pictures and Video; Mail Merge; Printing documents

Module II: Preparing Presentations (15 hours)

Basics of presentations: Slides, Fonts, Drawing, editing; Inserting: Tables, Images, texts, Symbols, Media; Different Views; Design; Transition; Animation; and Slideshow. Creating Business Presentations using above facilities

Module III: Spreadsheet and its Business Applications (20 hours)

Spreadsheet concepts, managing worksheets; Formatting, entering data, Editing and Printing a worksheet; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs; Spreadsheet functions: Mathematical, Statistical, Financial, Logical, Date and Time, Lookup and reference, Database, and Text functions

Module IV: Creating Business Spreadsheet (15 hours)

Creating spreadsheet in the area of: Loan and Lease statement; Ratio Analysis; Payroll statements; Capital Budgeting; Depreciation Accounting; Graphical representation of data; Frequency distribution and its statistical parameters; Correlation and Regression.

Module V: Database Management System (20 hours)

Database Designs for Accounting and Business Applications: Reality-Expressing the Application; Creating Initial design in Entity Relationship (ER) Model; Transforming ER Model to Relational data model concepts; Implementing RDBMS design using an appropriate DBMS. SQL and Retrieval of Information: Basic Queries in SQL; Embedded Queries in SQL; Insert, Delete and Update statements in SQL, Different commonly used mathematical functions in SQL such as SUM, MAX, MIN, AVG, etc.

Mapping of COs with Syllabus

Module-1	Module-2	Module III	Module IV	Module V
CO 1	H			M
CO 2		H		
CO 3				H
CO 4	H			
CO 5			H	
CO 6				H

LABORATORY COURSES

CADL6002: DIGITAL LOGIC DESIGN LAB
(2 credits)

COURSE / LEARNING OUTCOMES
At the end of the experiments students will be able to:
1. List and label the various logic gates. (Remembering)
2. Explain the working of the various logic gates. (Understanding)
3. Experiment with different logic gates to solve any given problem. (Applying)
4. Analyse a given logic circuit and point out errors in it. (Analysing)
5. Evaluate the output of a logic circuit for given inputs. (Evaluating)
6. Design combinational and sequential digital circuits for any given real life problem. (Creating)

List of experiments:
1. Study of the Truth tables of logic gates
2. Realization of half/full adder and half/full adder subtractor
3. Binary number to Gray code conversion and vice versa
4. Verify truth table of multiplexer and demultiplexer
5. Verify truth table of one bit and four bit comparators
7. Verify truth table of flip-flops
8. Realization of 3-bit asynchronous counter and Mod-N counters
9. Realization of 3-bit synchronous counter
10. Realization of 2:4 decoder and 4:2 encoder
11. Simulation with VDHL
    a. Adders
    b. Subtractors
    c. Logic gates
    d. MUX and DEMUX

Mapping of COs to Syllabus

Course Outcomes	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Mod 6	Mod 7	Mod 8	Mod 9	Mod 10
CO1	H									
CO2	H									
CO3		H	M	M	M	M	M	M		
CO4		H	H	H	M	M				
CO5		H	H	H	H	H	H	H	H	
CO6		H	H	H	H	H	M	H	H	M

CAOP6004: OBJECT ORIENTED PROGRAMMING AND DESIGN LAB
(2 credits)

COURSE / LEARNING OUTCOMES
At the end of the Lab experiments students will be able to:
1. Identify classes, objects, members of a class and relationships among them needed for a specific problem. (Remembering/Evaluating)
2. Write C++ programs using OOP principles and proper Program structuring. (Applying/ Understanding)
3. Demonstrate the concepts of polymorphism and inheritance. (Applying)
4. Write C++ programs to implement error handling techniques using exception handling.(Applying)
5. Analyse the real world problems and solve using C++ programming.(Analysing/ Applying)

Programs on
1. Concept of classes and objects, constructors and destructors
2. Use of memory management.
3. Inheritance
4. Virtual functions
5. Using polymorphism – i) operator overloading ii) dynamic binding
6. Use of operator overloading.
7. Exception handling and use of templates.

8. File handling in C++.

Mapping of COs to Syllabus

Course Outcomes	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Mod 6	Mod 7	Mod 8
CO1	H							
CO2			H	H	H	H		
CO3					H	H		
CO4							H	
CO5	H	H	H	H	H	H	H	H

CAOA6006: COMPUTER ORGANISATION AND ARCHITECTURE LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Recall different OPcodes used in 8086 (Remembering).
2. Recall the syntax of 8086 assembly language (Remembering).
3. Illustrate the syntax of 8086 assembly language (Understanding).
4. Categorize different types of OPcodes (Analysing).
5. Choose the appropriate method to write an 8086 assembly program (Evaluating).

Module1:

Dismantling and assembling a PC along with study of connections, ports, chipsets, SMPS etc.

Module2:

Assembly language programming using IA32(gcc) I. Introduction gcc assembly programming II. Verification of Instruction Set. III. Arithmetic operations

Module3:

Addition, Subtraction, Multiplication and Division of two 8-bit numbers.
Multi byte Addition and Subtraction, Multiplication and Division – Signed and unsigned Arithmetic operation, ASCII – arithmetic operation.

Module4:

Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison.
DOS/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.

Mapping of COs with Syllabus:

Course Outcomes	Module1	Module2	Module3	Module4
CO1	H	H		
CO2	H	M		L
CO3	M	H	L	
CO4	L	L	H	
CO5		L	M	H

CACF6007: COMPUTER FUNDAMENTALS LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Label and Identify hardware commonly found in or attached to computing devices and identify software commonly installed on computing devices. (Remembering)
2. Demonstrate working with files, folders, and applications. (Understanding)
3. Make use of the basics of word processing techniques to create a document, format it, and make changes to it. They explore the use of graphics and different fonts that add more to documents. (Applying)
4. Examine a situation and learn how to do basic troubleshooting, what tool or application works best for the situation, and how to ask for help when they need it.(Analysing)
5. Evaluate that a document or presentation is ready for publication. (Evaluating)

6. Improve their learning though tips and tricks to make presentations and documents more professional. (Creating)

Module I: Word Processing

a. Word Processing Basics: introduction to office software; introduction to word processing software; features and area of use; menus and commands; toolbars and buttons; shortcut menus, wizards and templates; creating a new document; different page views and layouts; applying various text enhancements; working with styles, text attributes; paragraph and page formatting; text editing using various features ; bullets, numbering, auto formatting, printing and various print options
b. Advanced word processing features: spell check, thesaurus, find and replace; headers and footers; inserting – page numbers, pictures, files, auto texts, symbols etc.; working with columns, tabs and indents; creation and working with tables including conversion to and from text; margins and space management in document; adding references and graphics; mail merge, envelopes and mailing labels. importing and exporting to and from various formats.

Module II: Spreadsheet

Introduction and area of use; concepts of workbook and worksheets; using wizards; various data types; using different features with data, cell and texts; inserting, removing and resizing of columns and rows; working with data and ranges; different views of worksheets; column freezing, labels, hiding, splitting etc.; using different features with data and text; use of formulas, calculations and functions; cell formatting including borders and shading; working with different chart types; printing of workbook and worksheets with various options.

Module III: Presentation

Introduction and area of use; creating a new presentation; working with presentation; using wizards; slides and it's different views; inserting, deleting and copying of slides; working with notes, handouts, columns and lists; adding graphics, sounds and movies to a slide; working with objects; designing and presentation of a slide show; printing presentations, notes, handouts with print options.

Module IV: UNIX Commands

Basic unix commands (log in, create/delete files/directories, listing files/directories, changing permission of files/directories etc), file related commands, process related commands, i/o redirection and piping, vi editor, gedit

Suggested Readings

1. Manuals of the Office Software
2. A. Mansoor, I.T. Tools and Applications, Pragya Publications, Matura
3. Yashwant Kanetkar, UNIX Shell Programming

Mapping of COs with Syllabus:

Course Outcomes	Module1	Module2	Module3	Module4
CO1	M			
CO2		H		
CO3	H			
CO4	M	M	M	
CO5			H	M

CACP6008: COMPUTER PROGRAMMING IN C LANGUAGE LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures and pointers in C. (Understanding)
2. Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
3. Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)
4. Evaluate various algorithms used for searching, sorting etc. in terms of correctness and computation cost. (Evaluating)

List of experiments:

1. *Introduction to OS: Linux/Unix, Vi editor, file handling, directory structures, creating and editing simple C programs.*
2. *C programming using variables, assignment and simple arithmetic expressions*
   a. *If else*
   b. *Switch-case statements*
   c. *Break, continue*
   d. *Loops*

e. Single and multidimensional arrays
f. Functions and recursion
g. Pointers, address operator, declaring pointers and operations on pointers
h. File handling in C.

E-resource for learning
C, www.spoken-tutorial.org

Mapping of CO's with Syllabus

Course Outcomes	Experiment Nos.			
	1, 2, 3, 4, 5	6,7	8	9
CO1	H	M	L	M
CO2	H			
CO3	M	H	M	H
CO4			H	

CADS6009: DATA STRUCTURES USING C LAB

(2 Credits)

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

1. Recall the basic C constructs and familiarize with basic C syntax, also define and outline the relationship between data and operations on these data using different data structures like arrays, linked list, stacks and queues, graph and trees (Remembering)
2. Explain C constructs for generalizing these data structures and choosing appropriate algorithm for efficient program design using C syntax. (Understanding)
3. Compute and demonstrate these data structures and algorithms in different real world problem domain(Applying)
4. Compare and Analyse the performance of algorithms based on problem domain. (Analysing)
5. Review the choice of data structure and algorithms based on problem domain, and judge and assess the algorithm efficiency based on space and time complexity which forms the fundamental step in he design of an efficient program. (Evaluating).
6. Design and create efficient algorithms for application development related to academia and industry. (Creating)

Solution of problems on

1. Arrays
2. Stacks and Stack Application, Queues
3. Linked Lists, Circular and Doubly Linked Lists
4. Binary Trees
5. Searching and data modification: Linear search, Binary search, Hashing
6. Sorting Techniques: Selection, Insertion, Bubble, Merge, Quick and Merge sort.

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4	5	6
CO1	H	M	M	H		
CO2	H	H	M			
CO3			H	H		
CO4		H	M	H		H
CO5		H	M	M	H	H
CO6	M	H	H	M	M	M

CANW6010: COMPUTER NETWORKS FUNDAMENTALS LAB

(2 Credits)

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

1. Implement various commands used in networking. (Remembering)
2. Infer the concepts related to socket programming and their significance. (Understanding)
3. Apply the concepts of client –server communication using TCP and UDP sockets. (Applying)
4. Analyse and interpret the results obtained from Routing algorithms-(Shortest Path routing algorithms), and understand the underlying principles. (Analysing)

5. Make a distinctive comparison of various routing algorithms to select the optimum network path for data transfer. (Evaluate)
6. Develop source codes to connect between client and server. Also perform the remote command communication (Creating)

At the end of the experiments, students will be able to

1. Basic Networking Commands and troubleshooting.
2. Introduction and implementation of LAN Trainer for various topologies and protocols simulation.
3. Programs using TCP Sockets (like date and time server and client, echo server and client, file transfer, etc.)
4. Programs using UDP Sockets (like simple DNS, file transfer, etc.)
5. Program to implement Remote Command Execution.
6. Create HTTP socket for web page upload and download.
7. Perform a case study on the following routing algorithms to select the optimum network path for data transfer.
   a. Shortest path routing
   b. Flooding
   c. Distance vector

Suggested Readings

1. Behrouz A. Forouzan, "TCP/IP Protocol Suite", Tata McGraw Hill.
2. Laboratory Manual

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4	5	6	7
CO1	H						
CO2		M	H				
CO3			H	H			
CO4							H
CO5							H
CO6					H	M	

CAWT6011: WEB TECHNOLOGIES LAB

(2 credits)

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

1. Define various mark-up languages, style sheets and scripting languages (Remembering)
2. Explain what HTML elements and formatting styles to be used for a given web page design.(Understanding)
3. Experiment with various mark-up languages, style sheets and scripting languages. (Applying)
4. Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
5. Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)
6. Develop and create a website of their own. (Creating)

At the end of the experiments, students will be able to

1. Creating static websites involving various XHTML elements.
2. Designing web pages that use CSS for standard formatting.
3. Designing websites that use JavaScript for creating interactive web pages.
4. Designing web pages that use PHP for handling loops, strings and arrays.

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4
CO1	H	M		
CO2		H		
CO3			H	
CO4		H	H	
CO5	M	M	M	M
CO6	M	M	M	M

CAOS6012: OPERATING SYSTEMS LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Recall and label the basic commands in Linux. (Remembering)
2. Classify system calls, library functions calls to write on standard output device. (Understanding)
3. Experiment with shell programs. (Applying)
4. Construct programs on process scheduling, page replacement algorithms. (Creating)
5. Evaluate free space management using programs. (Evaluating)

Module1

Introduction to Linux

File System (Types of file, Filename, parent-child relationship, absolute and relative pathname, file and directory permissions) Introduction to vi editor (start vi, the three modes, create, save and open a text file, positioning by character, positioning by line, positioning by word, positioning in the word, positioning on a numbered line, inserting text, deleting text), Simple Linux commands, Shell Programming

Module2:

Semaphores, Shared Memory and Message Queues: Semaphore (Binary semaphore, Linux Semaphore Facilities, Using Semaphores), Shared Memory, Message Queues

Module3:

Processes and Signals : Process Structure, Starting a new Process, Replacing a Process Image, Duplicating a Process Image, Waiting for a process, Zombie Processes, Terminating a Process, Signals (Signal handling, Sending signals, Signal interface, Signals sets).

Module4:

POSIX Threads: Creating threads, Simultaneous execution of threads, Synchronization and Critical sections, Synchronization with Semaphores, Synchronization with Mutexes, Thread Attributes, Cancelling a thread.

Inter-Process Communication: Pipes, Process Pipes, and The Pipe Call, Parent and Child processes, FIFOs (Accessing a FIFO, opening a FIFO, Reading and Writing FIFO).

Mapping of COs with Syllabus:

Course Outcomes	Module1	Module2	Module3	Module4
CO1	H	M		
CO2		H	M	
CO3		M	H	L
CO4	L	M	H	
CO5		L	M	H

CADA6013: DESIGN AND ANALYSIS OF ALGORITHMS LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Recall existing algorithms and how to Analyse them using graph notation. (Remembering)
2. Demonstrate implementation of the existing algorithms. (Understanding)
3. Apply existing algorithms in developing different applications. (Applying)
4. Evaluate an algorithm in terms of time and space efficiency. (Evaluating)
5. Create efficient applications by using the right algorithm depending on input pattern and size. (Creating)

At the end of the experiments, students will be able to

1. Prove that bubble sort algorithm has time complexity (n2) by showing the graph notation.
2. Implement the Dynamic programming technique and Analyse the algorithm showing the graph notation.
3. Implement the Greedy programming technique and Analyse the algorithm showing the graph notation.
4. Implement the Divide and Conquer technique and Analyse the algorithm showing the graph notation.
5. Design a small file compressor and decompressor by using Huffman coding technique

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4	5
CO1	H				
CO2		M	M	M	M
CO3		H	H	H	H

CO4		M	M	M	
CO5				M	H

CAPJ6014: PROGRAMMING THROUGH JAVA LAB
(2 credits)

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. List various GUI and thus will be able to select the suitable GUI to resolve a given problem. (Remembering)
2. Distinguish among the various utility class like vector, stack, Hash Table, String Tokenizer, etc. (Understanding)
3. Apply their knowledge to solve practical problems like reading from a dataset, writing into a file and develop games using JAVA program. (Applying)
4. Evaluate the performance of various swing GUI components and design various applications using Swings depending on the domain and requirement. (Evaluating)

At the end of the experiments, students will be able to
1. Program to illustrate class, objects and constructors
2. Program to implement overloading, overriding, polymorphism etc
3. Program to implement the usage of packages
4. Program to create our own exception
5. Program for handling file operation
6. Implement the concept of thread programming
7. Program to implement Generic class and generic methods
8. Program for event-driven paradigm in Java
9. Program that uses Menu driven Application
10. Program to implement JDBC in GUI and Console Application
11. Socket programming to implement communications
12. Develop a multi-threaded GUI application of your choice.

E-resource for learning
Java, www.spoken-tutorial.org

Mapping of COs with Syllabus:

Course Outcomes	1,2,3,4,5	6,7	8,9,10,11,12
CO1		M	H
CO2	H		
CO3		M	H
CO4	M	M	H

CAIT6017: INTERNET TECHNOLOGY AND APPLICATIONS LAB
(2 credits)

COURSE / LEARNING OUTCOMES
At the end of this course students will be able to:
1. Utilise and experiment with mark-up languages such as XHTML and style sheets such as CSS to design static web pages. (Applying)
2. Design and validate a website and can also identify the faults in the design. (Analysing)
3. Create and develop a web application using various available frameworks and scripting languages such as JavaScript and PHP. (Creating)
4. Validate and examine a dynamic web application using database handling and various other services and deploy them after proper validation (Evaluating and creating)

Module I
a. XHTML: Components of XHTML; Elements of XHTML (Headers, Linking, Images, Special Characters, Lists, Tables, Forms, Framesets)
b. Cascading Style Sheets: Inline Styles; Embedded Style; Conflicting Style; Linking External Styles; W3C CSS Validation Service; Use of CSS (Positioning Elements, Backgrounds, Text flow)
c. Web Site Design Considerations: Using Logical Design: Planning your website, drawing a map, using a top-down approach, flexibility, other web design metaphors. Creating templates. Creating a Compatible Design: Designing for different color depths, resolutions, different browser considerations, accommodating limited bandwidth. Validating your work.

Module II

a. Web servers: HTTP Request Types; System Architecture of a Web server; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Apache Web Server. b) Databases: Introduction to each one of the following: SQL, MYSQL, DBI
b. Scripting Languages: JavaScript: Operators, Data Types, Control Structures, Functions, Arrays, String Manipulation. VBScript Introduction to Perl and CGI (Common Gateway Interface).
c. PHP: Introduction to PHP; Data Types; Control Structures; Functions; Strings; Arrays; Querying Web Databases using PHP; Writing to Web Databases; Errors, Debugging and Deployment.

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 2nd Edition, Prentice Hall of India Pvt. Ltd. , New Delhi
2. Hugh E. Williams and David Lane, PHP and MySQL, 2nd Edition, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd.
3. Internet Complete, 2nd Edition, BPB Publications. , New Delhi
4. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi

Mapping of COs to Syllabus

Course Outcomes	**Module 1**	**Module 2**
CO 1	H	
CO 2	H	
CO 3	L	H
CO 4		H

CAOS6020: INTRODUCTION TO OPERATING SYSTEMS LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of Introduction to Operating Systems Lab students will be able to:

1. Identify, recall and outline the concepts of system calls, library function calls and to display and write strings on standard output devices. (Remembering)
2. Infer the concepts related to shell programming and their significance. (Understanding)
3. Use the concepts of error reporting functions, pipes, various scheduling algorithms (FCFS, SJF and Round Robin). (Applying)
4. Analyse and interpret the results obtained from page replacement algorithms-(FIFO, LRU), and understand the underlying principles and working of space management concepts. (Analysing)
5. Compare, contrast and assess their hypotheses with the file system concepts (UNIX/ FAT/NTFS). (Evaluating)
6. Simulate deadlock detection in operating system and summarize some critical functionalities related to deadlock in operating systems.(Creating)

At the end of the experiments, students will be able to

1. Simple Unix-C programs: Programs using system calls, library function calls to display and write strings on standard output devices and files.
2. Programs using fork system call.
3. Programs for error reporting using errno, perror() functions.
4. Programs using pipes.
5. Shell programming.
6. Programs to simulate process scheduling- FCFS, SJF and Round Robin.
7. Programs to simulate page replacement algorithms-FIFO, LRU.
8. Programs to simulate free space management.
9. Programs to simulate deadlock detection.
10. Study of file system-UNIX/FAT/NTFS

E-resource for learning:

Linux-Ubuntu, www.spoken-tutorial.org

Mapping of COs to Syllabus

Course Outcomes	1	2	3	4	5	6	7	8	9	10
CO 1	H	M								
CO 2					H					
CO 3			H	H		H	H			

CO 4							H			
CO 5										H
CO 6								L	H	

CADB6022: RDBMS LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Build a database using any DBMS package for a given relational schema. (Creating)
2. Implement SQL queries for various database handling such as DDL, DML, TCL, and Data Retrieval related transactions. (Apply)
3. Predict and associate each multi-table SQL command with a database query to solve any complex database-oriented tasks. (Understand)
4. Write PL/SQL programs for efficient relational database handling using the ORACLE software. (Creating)

Module 1:

Basic SQL Commands: Use SQL Queries to apply the Data Definition Language (DDL) Commands – Create, Alter, Drop, and Rename; Data Manipulation Language (DML) Commands – Insert, Update, and Delete; and Transaction Control Language (TCL) Commands - Commit and Rollback; SQL Retrieval Command SELECT Using From, Where, Group By, Having, and Order By Clauses
Advanced SQL Commands: Multi-Table Queries Using Joins – Inner Join, Left Join, Right Join, and Full Join; Use of Subqueries; Use of EXISTS and NOT EXISTS Operators

Module 2:

PL/SQL Programming Fundamentals:
Basics of PL/SQL: PL/SQL block structure, character set, identifiers, literals, delimiters, comments, data types in Pl/SQL
Program Structure: Conditional constructs, iterative constructs, exception handling
SQL in PL/SQL – Using DDL, DML and TCL Commands in PL/SQL, Data Retrieval, Cursors (Explicit and Implicit)

Mapping of COs to Syllabus:

Course Outcomes	Module 1	Module 2
CO1	H	
CO2	H	M
CO3	H	
CO4		H

CASE6023: BASIC SOFTWARE ENGINEERING LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Implement the software engineering process to develop any software project. (Remembering)
2. Explain and formulate an effort estimation plan. (Understanding)
3. Apply software design patterns. (Applying)
4. Test the software project through various testing approaches. (Evaluating)
5. Maintain the software project by using maintenance plan. (Creating)

A. Lab using IBM RSA tools

B. Virtual lab

Weblink: http://iitkgp.vlab.co.in/?sub=38andamp;brch=204

Module1:

Identifying the requirements from problem statements
Estimation of project metrics
Modelling Data Flow Diagrams

Module2:

Development of User stories
Identifying domain classes from the problem statements

Module3:

Modelling UML use case diagram & capturing use case scenarios
Class diagram, Activity diagram etc
Designing test suite and testing

Mapping of COs with Syllabus:

Course Outcomes	Module1	Module2	Module3
CO1	H	L	L
CO2	H	M	L
CO3	M	H	L
CO4		H	
CO5		M	H

CAPA6024: PRINCIPLES OF ARTIFICIAL INTELLIGENCE LAB

(2 Credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Recall how to Identify the problem state and solve the problem with AI technique (Remembering)
2. Explain the various search techniques. (Understanding)
3. Apply the performance of the search algorithm with complexity analysis. (Applying)
4. Analyse the concept of machine learning with reference to neural network, expert systems. (Analysing)
5. Develop in the Prolog and Lisp environment for interpreting knowledge and complex information and representing using the prolog interpreter. (Creating)
6. Evaluate the various search techniques. (Evaluating)

List of Experiments

1. Write a LISP Program to solve the water-jug problem using heuristic function.
2. Create a compound object using Turbo Prolog.
3. Write a Prolog Program to show the advantage and disadvantage of green and red cuts.
4. Write a prolog program to use BEST-FIRST SEARCH applied to the eight puzzle problem.
5. Implementation of the problem solving strategies: Forward Chaining, Backward Chaining, Problem Reduction.
6. Write a LISP Program to implement the STEEPEST-ASCENT HILL CLIMBING.
7. Write a PROLOG Program to implement COUNTE PROPAGATION NETWORK.

CAMP6039: MAJOR PROJECT – MCA

(18 Credits)

Objective

The primary objective of the Major Project is to enable students to have a thorough understanding of the theoretical principles learnt in earlier five semesters through a prolonged practical experience. The major project is oriented towards developing requisite skills, knowledge of latest technologies and an entrepreneurial attitude in a student which are needed to make an effective start as a computer/IT professional.

COURSE / LEARNING OUTCOMES

At the end of Major Project students will be able to:

1. Identify different API and development environment tools for building the project, research terminologies such as scaling, sampling, information gathering etc for research-based project. (Understanding, Applying)
2. Learn different programming languages/research tools needed to meet different objectives of the project based on the company/institutional requirements. (Remembering)
3. Apply the knowledge of programming to develop application specific but not limited to Web, Android, IoT etc. For research based projects, the different algorithm design techniques, classification & clustering techniques, etc. will be applied. (Applying)
4. Analyse the advantages and limitations of different development languages, APIs, platforms, algorithms (for research) (Analysing)
5. Create applications to meet real time needs. For research-based projects, students will be able to design novel or hybrid research techniques to meet the problem statement objectives (Creating)
6. Judge the efficiency of the project using various evaluation parameters and testing methodologies, efficiency of the algorithm for research based (complexity measure) (Evaluating)

CADC6028: DATA COMMUNICATION LAB

(2 credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Relate about networking devices and various networking commands(Remembering)
2. Illustrate different types of network (Understanding)
3. Implement different networking protocols in different network topology. (Applying)
4. Compare different topology and functioning of different protocols. (Analysing)

List of Experiments

1. Simple file transfer between two systems (without protocols): By opening socket connection to a server on one system and sending a file from one system to another.
2. Writing a Chat application:
   a) One-One: By opening socket connection and displaying what is written by one party to the other.
   b) Many-Many (Broad cast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.
3. Introduction to Packet Tracer
4. Simulation of Telnet: Provide a user interface to contact well-known ports, so that client- server interaction can be seen by the user.
5. TFTP- Client: To develop a TFTP client for file transfer.
6. HTTP-Server: Develop a HTTP server to implement the commands – GET, POST, HEAD, DELETE. The server must handle multiple clients.

Suggested Reading

1. Networking and Data Communications Laboratory manual, Frances S. Grodzinsky, PH, 1999.

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4	5	6
CO1	H					
CO2		M				
CO3			M		H	H
CO4			M		H	H

CAIJ6029: INTRODUCTION TO JAVA PROGRAMMING LAB

(2 Credits)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Identify classes, objects, members of a class and relationships among them needed for a specific problem.(Remembering/Evaluating)
2. Write Java application programs using OOP principles and proper Program structuring. (Applying/Understanding)
3. Demonstrate the concepts of polymorphism and inheritance .(Applying)
4. Write Java programs to implement error handling techniques using exception handling.(Applying)
5. Analyse the real world problems and solve using Java programming .(Analysing/ Applying)

List of Experiments

1. Java Fundamentals using Data Types, Declarations, Control Flow
2. Java Classes and Java Packages
3. Java Interfaces and Java Streams
4. Java Exception Handling
5. Java Threads
6. Java Applets
7. Java AWT

E-resource for learning

Java, www.spoken-tutorial.org

Mapping of COs with Syllabus:

Course Outcomes	1	2	3	4	5	6	7

CO1	H	H					
CO2	M	M	M	M			
CO3			M				
CO4				H			
CO5					M	M	M

CAPM6032: PYTHON AND MACHINE LEARNING LAB

(2 credits)

Objective

The course is intended to give students hands on experience on python and building machine learning systems using python.

COURSE/LEARNING OUTCOMES

At the end of the Python and Machine Learning Lab students will be able to:

1. Using different control structures, python operators and built-in functions for performing different basic operations. (Remembering)
2. Judging what Numpy or Pandas functions to use for data Preprocessing and what control structures to use for building the learning. (Understanding)
3. Apply python for building machine learning systems for classification problem (Applying)
4. Compare and judge on the learning parameter, weight vector space and proper error functions. (Analysing)
5. Apply different learning algorithms to a given problem, compare and contrast their results. (Evaluating)
6. Create new results after applying all the above to certain use case problems. (Creating)

List of experiments

1. Installation of PyCharm and Jupyter. Making the Machine learning environment ready.
2. Practice of loops, iterators, string operations, file handling and classes in Python.
3. Use of Numpy and Pandas for data reading and preprocessing - standard dataset as an example.
4. Writing program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Java/Python ML library classes/API
8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Suggested Reading

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas Muller

Mapping of COs with Syllabus

Course Outcomes	Experiment Nos.			
	1, 2, 3	4, 5	6, 7, 8	9
CO1	H			
CO2	H	M	H	
CO3		H	H	H
CO4			L	M

CADA6033: DATA STRUCTURES AND ALGORITHM LAB

(2 Credits)

Objectives

1. To introduce first level topics covering basics in algorithms and data structures.
2. To enable students to choose appropriate data structures, understand the ADT/libraries, and use of it to design algorithms for a specific problem.
3. To understand the necessary mathematical abstraction to solve problems.

4. To apply important algorithmic design paradigms and methods of analysis.

COURSE/LEARNING OUTCOMES

At the end of the course, students would be able to:

1. Get introduced to existing algorithms and how to analyse them using graph notation. (Remembering)
2. Demonstrate the existing standard algorithms. (Understanding)
3. Apply existing algorithms in developing different applications. (Applying)
4. Analyse the time complexity of standard algorithms. (Analysing and Evaluating)
5. Create efficient applications by using the right algorithm depending on input pattern and size. (Creating).

List of Programs

1. Implement the linear search and binary search algorithm to search for a given element e from a list of n numbers. Analyze the algorithms.
2. Prove that the Bubble Sort algorithm has time complexity of $O(n^2)$ by showing the graph notation.
3. Prove that the Selection Sort algorithm has time complexity of $O(n^2)$ by showing the graph notation.
4. Implement the Insertion Sort algorithm and analyse the algorithm using the graph notation.
5. Implement the Divide-and-Conquer technique and analyze the algorithm showing the graph notation.
6. Implement the Greedy Programming technique and analyze the algorithm showing graph notation.
7. Implement the Dynamic Programming technique and analyze the algorithm showing graph notation.
8. Design a small file compressor and decompressor by using Huffman coding technique.

Suggested Readings

1. Alfred V Aho, John E Hopcroft and Jeffrey D Ullman, The Design and Analysis of Computer Algorithms. Addision Wesley, 2001. (Modules I, II, III and IV)
2. Alfred V Aho, John E Hopcroft and Jeffrey D Ullman, Data Structures and Algorithms.. Addision Wesley, 2000. (Modules I and V)
3. Thomas H Corman, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 2nd PHI, 2004
4. V Manbar, Introduction to Algorithms - A Creative Approach, Addision Wesley, 2000.
5. Ellis Harwitz, Sartaz Sahani, Fundamentals of Computer Algorithms.. ,Computer Science Press, 2000.
6. Peter Linz, An Introduction to Formal Languages and Automata. Narosa Publishing House 2001

Mapping of COs with Syllabus

Course Outcomes	1	2	3	4	5	6	7	8
CO1	H	H	H	H				
CO2	H	H	H	H				
CO3					H	H	H	
CO4	H	H	H					
CO5								H

CACC6034: DATA COMMUNICATION AND COMPUTER NETWORKS LAB

(2 Credits)

Objective

Network programming involves writing programs that communicate with other programs across a computer network. Most operating systems provide pre-compiled programs that communicate across a network. This course envisages providing an introduction to such networking programming, whereby students will learn to write their own network programs. At the end of this course in network programming, the students are expected to have elementary ideas about the socket programming and their usage in setting up TCP and UDP communications.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. List various network related commands. They will get introduced to socket programming in TCP and UDP environments. (Remembering)
2. Illustrate the functions used in TCP and UDP client server communication. (Understanding)
3. Apply their knowledge of socket programming to perform various types of communications, address conversions and so on. (Applying)
4. Analyze the efficiency of TCP and UDP client –server communication. (Analysing)
5. Design and evaluate code for conducting chat or communication between client and server in UDP environment. (Creating, Evaluating)

Module I

a. Introduction to Network Programming: Introduction to Sockets; Address Structure – IPv4, IPv6; Value-Result Arguments; Byte Order Functions; Byte Manipulation Functions; inet_aton, inet_addr, inet_ntoa, inet_pton, inet_ntop, readn, written, readline, isfdtype functions
b. Elementary TCP Sockets: Introduction; socket, connect, bind, listen, accept, fork, exec, close, getsockname, getpeername functions; TCP Client Server example; signal, sigaction, wait, waitpid functions; Connection Termination; SIGPIPE signal
c. i/O Multiplexing: I/O models; select function; Batch input; shutdown, pselect, poll functions; Example – TCP Echo Server.
d. Socket Options: getsockopt, setsockopt, fcult, ioclt functions; Socket status – generic socket options
e. Elementary UDP Sockets: Introduction; recvfrom, sendto functions; UDP Examples; connect function with UDP; UDP socket receive buffer; Example – UDP Echo Server

Module II

a. Elementary Name and Address Conversion: Introduction; gethostbyname function; RES_USE_INET6 resolver option; gethostbyaddr, uname, gethostname, getservbyname, getservbyport functions.
b. IPv4 and IPv6 Interoperability: Introduction; IPv4 Client - IPv6 Server, IPv6 Client – IPv4Server; IPv6 Address Testing Macros, IPV6_ADDRFORM.
c. Advanced Name and Address Conversions: Introduction; getaddrinfo, gai_strerror, freeaddrinfo, getnameinfo functions; Reentrant functions.
d. Daemon Processes: Introduction; syslogd daemon; syslog, daemon_init functions; inetd daemon; daemon_inetd function.

Suggested Readings

1. W Richard Stevens, UNIX Network Programming – Volume I, Second Edition, Prentice Hall of India Pvt. Ltd., 2002
2. Douglas E Comer, Internetworking with TCP/IP: Principles, Protocols, and Architectures Volume I, Fourth Edition, Prentice Hall of India Pvt. Ltd.
3. Douglas E Comer, David L Stevens, Internetworking with TCP/IP: Design, Implementation, and Internals – Volume II, Third Edition, Prentice Hall of India Pvt. Ltd.
4. Douglas E Comer, David L Stevens, Internetworking with TCP/IP: Client Server Programming and Applications – Volume III, Second Edition, Prentice Hall of India Pvt. Ltd.

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II
CO1	H	M
CO2	H	M
CO3	H	
CO4	H	
CO5		H

CADM6035: ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

(2 Credits)

Objectives:

1. Learn to create and use a database
2. Be familiarized with a query language.
3. Have hands on experience on DDL Commands
4. Have a good understanding of DML Commands and DCL commands
5. Familiarize advanced SQL queries.
6. Be Exposed to different applications

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

1. Identify basic SQL operations and fetch results with respect to specific requirement. (Remembering/Evaluating)
2. Describe PL/SQL program structure like conditional constructs, iterative construct, and exception handling. (Understanding)
3. Use different program structures and apply them to solve problems. (Applying)
4. Apply and analyze PL/SQL procedures, functions, packages, triggers to practice assignments. (Analysing)
5. Create applications using Oracle forms and Oracle report. (Creating)

Module I: Query handling with SQL in Oracle

a. Creation, altering and dropping of tables and inserting rows into a table (use of constraints while creating tables) examples using SELECT command.Queries using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSECT, Constraints.
b. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.Queries implementing various joins (left,right,full). Implementation of complex queries: nested queries,sub

queries.

c. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions

Module II: PL/SQL Programming

a. Language fundamentals - PL/SQL block structure, character set, identifiers, literals, delimiters, comments, data types in PL/SQL
b. Program Structure - Conditional constructs, Iterative constructs, Exception handling
c. SQL in PL/SQL- DML and Transaction Management (Commit and Rollback), Data Retrieval, Cursors (Explicit and Implicit), error handling with Cursors
b. d) Procedures, Functions, packages, Triggers- creating and managing functions, procedures, packages and triggers
a. Built-in functions - String functions (ascii, chr, concat, greatest, instr, least, length, lower, lpad, ltrim, replace, rpad, rtrim, substr, trim, upper) Numeric functions (bitand, ceil, exp, floor, ln, mod, power, round, sign, sqrt, trunk) , Date and time functions (add_months, current_date, current_timestamp, last_day, months_between, next_day, round, sysdate, systimestamp, trunk) Conversion functions (to_number, to_char, cast, to_date, to_timestamp)

Module II: Forms Builder and Reports Builder

Components of application development in Oracle Forms (Form modules, menus, PL/SQL libraries, Object libraries, Database objects), Features of the Report Builder, defining a data model for a report, specifying the layout of the report using the Oracle Reports Wizard.

Suggested Readings

1. Ivan Bayross, Commercial Application Development Using Oracle Developer 2000 Forms 6i, BPB Publications, 2nd Revised Edition, 2005
2. John Day, Craig Van Slyke, Starting out with Oracle, Dreamtech Press, 2004
3. Steven Feuerstein, Oracle PL/SQL Programming, O'Reilly Publications, 3rd Edition.

Mapping of COs with Syllabus

Course Outcomes	Module I	Module II
CO1	H	M
CO2	M	H
CO3	M	H
CO4	M	H
CO5	M	H

CAML6036: MACHINE LEARNING LAB

(0-0-2) (2 Credits – 30 Hours)

COURSE/LEARNING OUTCOMES:

1. Explain the implementation procedures for the machine learning algorithms. (Understanding)
2. Design Java/Python programs for various Learning algorithms. (Creating)
3. Apply appropriate data sets to the Machine Learning algorithms. (Applying)
4. Identify and apply Machine Learning algorithms to solve real world problems (Applying)

Experiments:

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
5. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Suggested Readings:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems – 2nd edition, Aurelien Geron, O'Reilly.
2. Building Machine Learning Systems with Python, Willi Richert and Luis Pedro Coelho, Packt Publishing.

Mapping of COs with Syllabus

Course Outcomes	1	2	3	4	5	6	7	8	9
CO1	H	H	H						
CO2	M	M	M	M	M	M	M	M	M
CO3				H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M

CADY6041: INTODUCTION TO DATA ANALYTICS LAB

(2 credits – 30 hours)

Objective

The objective of this course is to make the students learn to extract valuable information for use in strategic decision making, trend analysis, and forecasting. The students will acquire an in-depth understanding of practical concepts of statistics, data mining, machine learning, and other advanced concepts used for data analysis. Through the practical approaches, quantitative modeling and data analysis techniques can be applied to find the solution of real-world business problems, communicate findings, and effectively present results using data visualization techniques.

Course/Learning Outcomes:

At the end of this course students will be able to:

1. Obtain, clean/process, and transform data and analyze the transformed data using a data analysis approach (Applying and Analyzing)
2. Apply the right machine learning techniques and/or statistical data analysis to be used for a specific data analytics task. (Understanding and Applying)
3. Visualize and present the inference using various data visualization tools (Applying)
4. Formulate and use appropriate text analysis or business analysis to solve organization and business-related challenges (Applying and Creating)

Module I: Data Preprocessing, Data Visualization, and Machine Learning (15 Hours)

Data Preprocessing: Data Cleaning – Filling missing values, Smoothing noisy data, Detecting and Removing Outliers; Data Integration, Data Transformation – Rescaling data, Normalizing data, Binarizing data, Standardizing data, Label encoding, One hot encoding; Dimensionality Reduction

Data Visualization: Data Visualization Libraries, Plotting Histogram, Bar Chart, Line Chart, Scatter Plot, Area Plot, Pie Chart, Box Plot, Bubble Plot, Violin Plot, and Heat Map

Machine Learning for Data Analysis: Linear Regression, Logistic Regression, KNN Classification, SVM Classification, K-means Clustering

Module II: Statistical Data Analysis, Text Analysis and Business Analysis (15 Hours)

Statistical Analysis: Measures of Frequency (Count, Percent, Frequency), Central Tendency (Mean, Mode, Median), Dispersion (Range, Variance, Standard Deviation), and Position (Percentile Ranks, Quartile Ranks), Baye's Theorem, Bernoulli Trial

Text Analysis: Working with Text – Feature extraction, Tokenization, Stemming; Text Categorization, Text summarization, Sentiment analysis

Business Analysis: Financial Analysis, Customer Analysis, and Employee Analysis

Suggested Readings

1. Moreira, João, Andre Carvalho, and Tomás Horvath. A general introduction to data analytics. John Wiley & Sons, 2018.
2. G. Nandi, R. K. Sharma, Data Science Fundamentals and Practical Approaches, BPB, 1st Edition, 2020.
3. Sedkaoui, Soraya. Data analytics and Big data. John Wiley & Sons, 2018.
4. Silberschatz, H. F. Korth, S Sudarshan, Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, 1st Edition, Dreamtech, 2016

CANM6042: COMPUTER ORIENTED NUMERICAL METHODS LAB

(2 credits – 30 hours) 0-0-2

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. To learn how data is manipulated by using arithmetic operation. (Remembering)
2. To learn about different Interpolation methods. (Applying)
3. Apply differential equations for monitoring and finding stability of solutions. (Applying)
4. To understand the concepts of Statistical Computations. (Understanding)

List of Experiments:

1. To implement Newton's Forward Interpolation formula.
2. To implement Newton's Backward Interpolation formula.
3. To implement Lagrange's Interpolation formula
4. To implement Gauss Forward Interpolation formula.
5. To deduce error involved in polynomial equation.
6. To Find out the root of the Algebraic and Transcendental equations using Newton-Raphson method.
7. To Find out the root of the Algebraic and Transcendental equations using Iterative method.
8. To implement Numerical Integration using Trapezoidal rule.
9. To implement Numerical Integration using Simpson 1/3 rule.
10. To implement Least Square Method for curve fitting.
11. To draw frequency chart like histogram, frequency curve and pie-chart etc.

Suggested Readings:

1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
2. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int.
3. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
4. Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
5. Goyal, M, "Computer Based Numerical and Statistical Techniques", Firewall Media, New Delhi.

CAMI6046: MINI PROJECT – BCA

(2 Credits)

Mini projects are assigned to students in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to create Industry oriented software or hardware applications in his/her field of interest.

COURSE / LEARNING OUTCOMES

At the end of this Mini Project students will be able to:

1. Recall, identify and recognize the available project domains and its related requirements for project development. (Remembering)
2. Illustrate and explain the requirements and modules to be included in designing the system. (Understanding)
3. Estimate and predict the feasibility of the system/application/project to be developed. (Understanding)
4. Develop the system, by applying the knowledge they hold or (learn during or before the project phase). (Applying)
5. Evaluate, assess their work based on the certain defined metrics such as robustness, optimality, scalability, etc. (Evaluating)
6. Summarize their learning in the form of a final system/application/product. (Creating)

CAAD6047: ANDROID APPLICATION DEVELOPMENT FUNDAMENTALS LABORATORY

(2 credits – 30 hours)

Objective

This course is designed to enable students to get a complete understanding of the android applications development. On completion of this course, students will be able to design, develop, debug and deploy various real-time android apps.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

1. Recall the programming structure of Kotlin and OOPS concepts and android basic concept and use while creating

application (Remembering)
2. Use various Android development frameworks to develop application. (Understanding)
3. Incorporate different features to design user friendly and interactive Android Applications. (Applying)
4. Analyse various aspects of commercializing an application by publishing on play store. (Analysing)
5. Evaluate effectiveness of different application. (Evaluation)
6. Design Android application for different real world requirements. (Creating)

MODULE I:
1. Use Kotlin data structures to develop small program.
2. Build app using various layouts.
3. Use RecyclerView in the App.
4. Complete the AndroidTrivia app, which is a game in which users answer trivia questions about Android development and can share their results if they win.
5. Implement Fragment lifecycles, and demonstrate how to handle complex lifecycle situations, and use logging to help debug and track the state of the app.
6. Create a database using the Room library and use coroutines to simplify asynchronous programming.
7. Demonstrate how to connect to and use network resources, and how to define a Retrofit service and display images.
8. Demonstrate UI best practices and deploy material designs.

Suggested Readings
1. Complete Study Material provide by Google: https://docs.google.com/presentation/d/1EXRoxyZxMdy4UEJ7YvWgZLEHwOGDE_QmbXkQ543JwnA/edit#slide=id.g8ef83c870c_0_70

CADI6048: DIGITAL IMAGE PROCESSING LAB

(Credit-2, 30 Hours)

Course Outcomes:

At the end of the lab experiments the students will be able to-
1. Experiment with different algorithms/techniques related to image processing and computer vision. (Applying)
2. Design, implement and evaluate digital image processing applications. (Creating)
3. Analyze image processing problems and develop solutions through suitable algorithms, structures, diagrams, and other appropriate methods. (Analyzing and Creating)

Write programs to perform/implement the following-
1. Read, Display, and Store images. Scaling, translation and rotation, sums and differences.
2. Spatial Filters.
3. Histograms modification.
4. Fourier transforms and the frequency domain filters.
5. Discrete Cosine transform.
6. Image filtering: smoothing and sharpening.
7. 2D convolution and correlation.
8. Implement various edge detection operators, Segmentation.
9. Image compression and restoration.

Suggested Readings:
1. Rafael C. Gonzalez & Richard E. Woods, “Digital Image Processing”, 2nd edition, Pearson Education.
2. David A. Forsyth, Jean Ponce, “Computer Vision: A Modern Approach”, 2nd edition, Pearson.

Mapping of COs to Syllabus

Course Outcomes	1	2	3	4	5	6	7	8	9
CO1	H	M	L	L	L	L	L	L	L
CO2	L	L	M	M	M	H	H	H	H
CO3	L	L	H	H	H	M	M	M	M

CAMP6050: MAJOR PROJECT – BCA

(4 Credits)

Objective

The primary objective of the Major Project is to enable students to have a thorough understanding of the theoretical principles learnt in earlier five semesters through a prolonged practical experience. The major project is oriented towards developing

requisite skills, knowledge of latest technologies and an entrepreneurial attitude in a student which are needed to make an effective start as a computer/IT professional.

COURSE / LEARNING OUTCOMES

At the end of Major Project students will be able to:

1. Locate the domain, explain the requirements and modules to be included in designing the system. (Remembering, Understanding)
2. Explain, estimate and predict the feasibility of the system/application/project to be developed. (Understanding)
3. Apply the knowledge of various tools and techniques in designing the system. (Applying)
4. Analyse and modify (if needed) the system based on the requirements. (Analysing)
5. Evaluate, assess their work based on the certain defined metrics such as robustness, optimality, scalability, etc. (Evaluate)
6. Develop the system, by applying the knowledge they hold or (learn during or before the project phase). (Creating)

VALUE ADDED COURSES

CARP6051: ROBOTIC PROCESS AUTOMATION

(30 Hours)

COURSE/ LEARNING OUTCOMES

1. Explain the RPA Developer enablement journey and an introduce to the role. (Understanding)
2. Explain the three constructs that are fundamental in any software process: variables, arguments and control flow. (Understanding)
3. Address what selectors are, the UI Explorer, the Property Explorer, Selector types, where to use them and how to fine-tune Selectors when encountering difficult situations. (Remembering)
4. Creating UI input and output actions. (Creating)
5. Learn about the many email tasks that can be automated to help you save valuable time. Cover an essential aspect of development, identifying and solving bugs in your projects and learn about how to get automation production-ready: how to anticipate, detect and resolve errors in your workflows. (Applying)

Module I: (8 Hours)

RPA Overview: Overview of Robotic Process Automation (RPA), Benefits of RPA in industries and business processes, Introduction to the RPA Developer Role, Variables, Data Types and Control Flow, Version Control, Data Manipulation, Excel and Data Tables, Selectors.

Module II: (22 Hours)

Bot Building: UI Automation, Introduction to Logging in Studio, IMDB Movie Rating, Contact Details, RPA Challenge.

Amazon Data Scraping, Recording Demo.

Calculate Client Hash, PDF Automation, Error and Exception Handling, Debugging.

Email Automation, Connecting Robot to Orchestrator, Publishing workflow to Orchestrator, Orchestrator Demos.

Suggested Readings

1. The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems by Tom Taulli, Publisher: Apress
2. Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool – UiPath by Alok Mani Tripathi, Publisher: Packt Publishing; 1st edition
3. Robotic Process Automation Projects: Build Real-world RPA Solutions Using UiPath and Automation Anywhere by Arun Kumar Asokan and Nandan Mullakara, Publisher: Packt Publishing Limited

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II
CO1	H	
CO2	H	
CO3		H
CO4		H
CO5		H

CABC6052: BLOCKCHAIN

(30 Hours)

COURSE/ LEARNING OUTCOMES

1. To understand what Blockchain is and why it is used. (Remembering)
2. To be able to explain the different components involved within Blockchain. (Understanding)
3. To know when and why you may want to use Blockchain within your environment. (Remembering)

Module I: (7 Hours)

Introduction to Blockchain Technology and its Importance; Evolution of the Blockchain Technology,

Module II: (7 Hours)

Elements of a Blockchain, Basic Crypto Primitives – Cryptographic Hash, Digital Signature

Module III: (16 Hours)

Blockchain Consensus I – Permissionless Models, Blockchain Consensus II – Permissioned Models, Smart Contract Hands On I – Ethereum Smart Contracts (Permissionless Model), Blockchain Applications

Suggested Readings

1. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020,
2. Hyperledger Tutorials - https://www.hyperledger.org/use/tutorials
3. Ethereum Development Resources - https://ethereum.org/en/developers

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III
CO1	H		
CO2	M	H	
CO3		M	H

CAAW6053: ADVANCED WEB APPLICATION DEVELOPMENT TECHNIQUES

(30 Hours)

COURSE/ LEARNING OUTCOMES

1. Explain the JavaScript and an introduce to the role in client server architecture.(Understanding)
2. Explain the importance of data validation and understand the process of data sanitization. (Understanding)
3. Address the threat handling mechanism while development. (Remembering)
4. Creating User interface, service design pattern, and remote connection. (Creating)
5. Learn about the recent trend in web development architecture based on micro service design pattern. Cover an overview of recent trend in management of load balancing and service scalability. (Applying)

Module I: (18 Hours)

JavaScript Overview: Form events, Client Side Validation (Length check, Numeric field check, Alphanumeric field check, Empty Field, special character, password format, All field entry check), Server Side validation (Data sanitization), SQL Injection, Overview of session management, Cross site scripting, URL validation, Importance of Asynchronous JavaScript and XML (Ajax), loading page content using AJAX, Database connection, Back end data update using AJAX.

Module II: (12 Hours)

Micro Service Applicability: Micro Service design pattern, Overview of Service Oriented Architecture, Principles of Web Service, SOAP / RESTful Web Service, Overview of Containerization: Kubernetes with Docker.

Suggested Readings

1. Beginning JavaScript with DOM Scripting and Ajax – Russ Ferguson and Christian Heilmann, Publisher: Apress ; 2nd edition
2. Ajax programming for the absolute beginner, Jerry Lee Ford, Jr. Publisher: Course Technology, 1st Edition
3. Kubernetes Microservices with Docker by Deepak Vohra, Publisher: Apress, 1st Edition

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II
CO1	M	
CO2	M	
CO3		M
CO4		H
CO5		H

CASL0200: SERVICE LEARNING

(2 Credits)

Objective

The objective of this course is to understanding of the theory and practice of community university engagement. The students provide an insight on the theme of Social Responsibility of Higher Education Institution and to introduce community based participatory research and the tools to facilitate engaged research.

COURSE/LEARNING OUTCOMES

At the end of this course, students will demonstrate the ability to

1. Define and explain the understanding of Community-University Engagement (CUE) and outline CUE in relation to higher education policy in India. (Remembering)
2. Analyze and identify the social responsibility of higher education institutions to facilitate engaged teaching, research & service. (Analyzing)
3. Determine the various methods and tools on Community-Based Participatory Research (CBPR). (Evaluating)
4. Evaluate how Higher education institutions can undertake community engagement post COVID-19. (Evaluating)
5. Design a plan for the engagement of students with the community through engaged teaching, research and service. (Creating)

Module I: Community University Engagement (CUE) (7 Hours)
History and Role of Community University Engagement (CUE) in Indian Higher Education Policy, Fostering Social Responsibility by Higher Education, Current status and possible interventions, Recent initiatives related to CUE, Principles of community engagement and its principles, Forms of community engagement

Module II: Social Responsibility of HEIs. (8 Hours)
Understanding Social Responsibility of HEIs – Engaged Teaching, Research & Service, Community Engaged teaching and research, community-based participatory research, practice-based learning, Community service, Reforming Existing and developing new courses, Engaged service on educating students to become active citizens, Effective Methods and Tools for Engaging Community in Research

Module III: Community Based Participatory Research (CBPR) (8 Hours)
Understanding Community Based Participatory Research (CBPR), Engaged research, Knowledge and research, Development and use of CBPR, Building Partnerships in Research, data collection and Analysis Multi modal, Knowledge sharing and Mobilisation, Practical challenges, littered dignity, Solutions for sustainable livelihoods, Capacities of panchayats and small nagarpalikas for disaster preparedness

Module IV: Service Learning-based Assignments (7 Hours)
Carrying out group assignments on service-learning for community university engagement
Sample use cases:
Digitally literate the unemployed youth/women/rural area-based students to train them to learn the basics of computer and digital transactions
Identify an area of need in the nearby community and design a project related to it addressing their social well-being.
Build awareness in the community about various social and ethical issues in Information Technology.
Launch digital campaign to raise awareness around – Personal hygiene and cleanliness, metal health, environment, food and nutrition.

Suggested Readings
1. W. James Jacob, Stewart E. Sutin, John C. Weidman, John L. Yeager, “Community Engagement in Higher Education: Policy Reforms and Practice”, Springer, 2015.
2. David Coghlan, Mary Brydon-Miller, “The SAGE Encyclopedia of Action Research”, SAGE, 2014.
3. Kronick, Robert F., “Emerging Perspectives on Community Schools and the Engaged University”, IGI Global,2019
4. Tami L. Moore, “Community-University Engagement: A Process for Building Democratic Communities”, John Wiley & Sons, 2014.
5. Marshall Welch, “Engaging Higher Education: Purpose, Platforms, and Programs for Community Engagement”, Stylus Publishing, 2016.
6. Barbara Jacoby, “Building Partnerships for Service-Learning”, John Wiley & Sons, 2003.
7. Becca Berkey, Emily A. Eddins, Patrick M. Green, Cara Meixner, “Reconceptualizing Faculty Development in Service-Learning/Community Engagement: Exploring Intersections, Frameworks, and Models of Practice”, Stylus Publishing, 2018.

SCHOOL OF TECHNOLOGY

DEPARTMENT OF BASIC SCIENCES

BOBI0001: BIOLOGY (2-1-0)

Course Outcomes

1. Recall the biological observations of 18th Century that lead to major discoveries? (Remembering)
2. Compare the two, three, four and five kingdom classifications. Highlight the criteria for classification (Understanding)
3. Apply thermodynamic principles to biological systems. (Applying)
4. Analyze biological processes at the reductionist level. (Analyzing)
5. Examine DNA as a genetic material in the molecular basis of information transfer (Evaluating)

Module 1: Introduction (4 lectures)

Importance of Biology: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft; Aspect of biology as an independent scientific discipline. History of Biology: Biological observations of the 18th Century; Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Module 2: Classification (5 lectures)

Classification and its criteria: Morphological, Biochemical and Ecological; Hierarchy of Classifications, based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eukaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e)Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life; Organism from different based on classification for the study :1. E.coli, 2. S.cerevisiae, 3. D. Melanogaster, 4.C. elegance, 5. A. Thaliana, 6. M. Musculus

Module 3: Genetics and Information Transfer (13 lectures)

a) Mendel's laws: Law of segregation and Law of independent assortment, Dominance, Recessiveness; Allele, Gene mapping, Gene interaction, Epistasis; Meiosis and Mitosis in heredity; Gene – mapping; Genetic disorders in humans; complementation in human genetics.

b) DNA as a genetic material; Structure of DNA- single stranded, double stranded and nucleosomes; Genetic code- Salient features; Gene - complementation and recombination.

Module 4: Biomolecules and Enzymes (14 lectures)

a) Biomolecules of life: Micromolecules and Macromolecules- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/RNA; Two carbon units and lipids. Structure of proteins: Primary, Secondary, tertiary and Quaternary; Proteins as enzymes, transporters, receptors and structural elements.

b) Enzyme classification. Mechanism of enzyme action of any two enzyme. Enzyme kinetics and kinetic parameters; RNA catalysis.

Module 5: Metabolism (5 lectures)

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Key and its relation to standard free energy.

Spontaneity. ATP as an energy currency; Glycolysis and Krebs cycle; Photosynthesis; Energy yielding and energy consuming reactions. Energy charge

Module 6: Microbiology (4 lectures)

Unicellular organisms; Species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of unicellular organisms. Sterilization and media compositions. Growth kinetics.

Suggested Readings

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calendar, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	M			

CO 2	H	H	M		H	
CO 3					M	
CO 4		M		M	H	H
CO 5		M	H	H		

BOBE0002: BIOLOGY FOR ENGINEERING (3-0-0)

Course Outcomes

1. Recall the biological observations of 18th Century that lead to major discoveries? (Remembering)
2. Compare the two, three, four and five kingdom classifications Highlight the criteria for classification (Understanding)
3. Apply thermodynamic principles to biological systems. (Applying)
4. Analyse biological processes at the reductionist level. (Analysing)
5. Examine DNA as a genetic material in the molecular basis of information transfer (Evaluating)

Module 1: Introduction (4 lectures)

Importance of Biology: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft; Aspect of biology as an independent scientific discipline. History of Biology: Biological observations of the 18th Century; Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Module 2: Classification (5 lectures)

Classification and its criteria: Morphological, Biochemical and Ecological; Hierarchy of Classifications, based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e)Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life; Organism from different based on classification for the study :1. E.coli, 2. S.cerevisiae, 3. D. Melanogaster, 4.C. elegance, 5. A. Thaliana, 6. M. musculus

Module 3: Genetics and Information Transfer (13 lectures

a) Mendel's laws: Law of segregation and Law of independent assortment, Dominance, Recessiveness; Allele, Gene mapping, Gene interaction, Epistasis ; Meiosis and Mitosis in heredity; Gene – mapping; Genetic disorders in humans; complementation in human genetics.

b) DNA as a genetic material; Structure of DNA- single stranded, double stranded and nucleosomes; Genetic code- Salient features; Gene - complementation and recombination.

Module 4: Biomolecules and Enzymes (14 lectures)

a) Biomolecules of life: Micromolecules and Macromolecules- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/RNA; Two carbon units and lipids. Structure of proteins: Primary, Secondary, tertiary and Quaternary;Proteins as enzymes, transporters, receptors and structural elements.

b) Enzyme classification. Mechanism of enzyme action of any two enzyme. Enzyme kinetics and kinetic parameters; RNA catalysis.

Module 5: Metabolism (5 lectures)

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Key and its relation to standard free energy. Spontaneity. ATP as an energy currency; Glycolysis and Krebs cycle; Photosynthesis; Energy yielding and energy consuming reactions. Energy charge

Module 6: Microbiology (4 lectures)

Unicellular organisms; Species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of unicellular organisms. Sterilization and media compositions. Growth kinetics.

Suggested Readings

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calendar, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M	L	L	L	L
CO 2	H	H	L	L	H	L

CO 3	L	L	L	M	H	L
CO 4	L	M	L	L	H	H
CO 5	L	L	H	H	L	L

MBLS0001: LIFE SCIENCE (2-0-0) (2 Credit-30 lectures)

Course Outcome:

1. Recall various structures of biomolecules and statistical tools. (Remembering)
2. Describe about the environment. (Understanding)
3. Apply statistical tools in life sciences. (Applying)
4. Analyze biological processes at the reductionist level. (Analyzing)
5. Prove the problems of Biostatistics. (Evaluating)
6. Create environmental awareness among people. (Creating)

Module 1: (4 Lectures)

a. Plant Physiology covering, Transpiration; Mineral nutrition (3 Lectures)

b. Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and Abiotic factors, food chain, food web, ecological
pyramids

Module 2: (4 Lectures)

a. Population Dynamics covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity;

b. Environmental Management covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant)

Module 3: (4 Lectures)

a. Molecular Genetics covering, Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept;

b. Biotechnology covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications

Module 4 (3 Lectures)

Biostatistics covering, Introduction to Biostatistics: -Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor)

Module 5: **(15 Lectures)-**

Laboratory & Fieldwork Sessions covering, Comparison of stomatal index in different plants; Study of mineral crystals in plants; Determination of diversity indices in plant communities; To construct ecological pyramids of population sizes in an ecosystem; Determination of ImportanceValue Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g.,Airport, Thermal/Nuclear Power Plant/ Oil spill scenario); Preparation and extraction of genomic
DNA and determination of yield by UV absorbance; Isolation of Plasmid DNA and its separation byGel Electrophoresis; Data analysis using Bio-statistical tools;

Suggested Readings:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;
2. Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley
4. and Sons
5. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H.
6. Freeman and Company
7. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and
8. company, Distributed by Satish Kumar Jain for CBS Publisher
9. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.
10. Brown Publishers

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1			H		

CO 2	H	H			
CO 3		M		H	
CO 4	H	M			
CO 5				H	M
CO 6	H	H			M

CHES0002: ENVIRONMENTAL STUDIES
CHES0029: ENVIRONMENTAL SCIENCE (2-0-0)

Course Outcomes:

1. Name different types of natural resources; state the concept of an ecosystem, recall the types of biodiversity and ways of conserving biodiversity, causes, effects and control measures of pollution, social issues and its effect on the environment. (Remembering)
2. Explain what they understand by an ecosystem, biodiversity, explain how environmental pollution occurs and steps that can be taken to control pollution. (Understanding)
3. Value the overall benefit to the environment of preserving natural resources, preserving ecosystems and conserving biodiversity. Learn about sustainable development to protect the environment and promote human health. (Evaluating)
4. Develop ideas of how to preserve the environment by connecting the ideas of minimizing pollution, regulating human population growth, conserving biodiversity by preserving ecosystems and judicious use of natural resources. (Creating)

Module 1: The Multidisciplinary Nature of Environmental Studies (3 lectures)
Definition, scope and importance, need for public awareness.

Module 2: Natural Resources (3 lectures)
a) Different types of natural resources and associated problems - forest resources, water resources, mineral resources, food resources, energy resources, land resources.
b) Conservation of natural resources.

Module 3: Ecosystems (4 lectures)
a) Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs.
b) Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Module 4: Biodiversity and Its Conservation (4 lectures)
Types of biodiversity – genetic, species and ecosystem, value of biodiversity, global biodiversity, India as a mega-diversity nation, threats to biodiversity, conservation of biodiversity - in-situ and ex-situ conservation.

Module 5: Environmental Pollution (6 lectures)
a) Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e- pollution.
b) Solid waste management
c) Disaster management

Module 6: Social Issues and the Environment (6 lectures)
a) From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
b) Environment protection act.
c) Introduction to environmental impact assessment.

Module 7: Human Population and the Environment (4 lectures)
Population growth and sex ratio; Population explosion - family welfare programme; Environment and human health; HIV/AIDS; Role of information technology in environment and human health.

Suggested Readings

1. Textbook of Environmental Studies, Erach Bharucha; UGC, New Delhi
2. Environmental Studies, University , J.P. Sharma; Science Press
3. Real World Cases in Green Chemistry, Cann, M.C. & Connelly, M.E., ACS, 2000
4. Understanding our Environment: An Introduction to Environmental Chemistry and Pollution, Roy, M. Harrison; R.S.C.

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7
CO 1		H			M		H
CO 2	M			H		H	

CO 3		M					M
CO 4			M		H		

CHCE0027: ENGINEERING CHEMISTRY (3-1-0)

Course Outcomes:

1. Recall fundamental concepts of 10+2 level of physical, organic and inorganic chemistry. (Remembering).
2. An ability to gain knowledge on molecular structure and spectroscopy, intermolecular forces and periodic properties (Understanding).
3. Analyse the structures of atoms and molecules using spectroscopic techniques. (Analysis)
4. Apply the knowledge of spectroscopy for determining molecular geometries, interpret the thermodynamics of system and structure of organic compounds and their reaction paths/mechanism. (Applying)
5. Assess the knowledge of atomic and molecular structure to evaluate the energy level diagram in the atomic and molecular level (Evaluating)

Module 1: Atomic and molecular structure (12 lectures)

Schrodinger equation, Particle in a box solutions, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Equations for atomic and molecular orbitals, Energy level diagrams of diatomic, Pi-molecular orbitals of butadiene and benzene and aromaticity, Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties, Structure of Solids, Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications (12 lectures)

Principles of spectroscopy and selection rules, electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques, Diffraction and scattering.

Module 3: Use of free energy in chemical equilibria (8 lectures)

Thermodynamic functions: energy, entropy and free energy, Free energy and emf, Cell potentials, the Nernst equation and applications., Acid base, oxidation reduction and solubility equilibria, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 4: Intermolecular forces and Periodic properties (12 lectures)

a) Ionic, dipolar and van Der Waals interactions.

b) Effective nuclear charge, penetration of orbitals, variations of s, p, d orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases.

Module 5: Stereochemistry (10 lectures)

Representations of three-dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis, Isomerism in transition metal compounds.

Module 6: Organic reactions and synthesis of a drug molecule (6 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation and reduction, Synthesis of a commonly used drug molecule – Aspirin and Paracetamol.

Suggested Readings

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	L		H	H		
CO 2	H	H		H	H	H
CO 3			M	L	H	
CO 4	M	H	M			H
CO 5	M	H			M	M

CHCE6006: ENGINEERING CHEMISTRY I LAB (1 Credit) (L:0, T:0, P:2)

Course Outcomes:

1. Explain the principles of the experiments learned about in class, illustrating the principles of chemistry relevant to the study of science and engineering (Understanding)

2. Estimate molecular/system properties such as surface tension, viscosity, conductance of solution, water hardness, etc. (Applying)

3. Assess the limitations and advantages of the procedures they use in the laboratory for the various estimations and analysis. (Evaluating)

List of experiments:

1. Determination of Water Hardness with EDTA.
2. Estimation of Calcium in Limestone.
3. Determination of dissolved Oxygen in a given Water Sample by Winkler's Method.
4. Determination of Surface Tension of a given Liquid by Stalagmometer.
5. To determine the co-efficient of Viscosity of a given liquid or solution with the help of Ostwald's Viscometer.
6. Adsorption of Acetic Acid by Charcoal.
7. Determination of Chloride Content of Water.
8. To determine the Strength of Magnesium Ions in Magnesium Sulphate solution by Complexometric Method.
9. Determination of Partition Coefficient of a substance between two immiscible liquids.
10. Determination of Free Carbon Dioxide in a given Water sample.
11. To determine the Alkalinity of a given water Sample.
12. Determination of Ferrous Ion in Mohr's Salt by $KMnO_4$.
13. To determine the Acidity of the given water sample.
14. Determination of the Cell Constant and Conductance of solution.
15. Determination of Sodium Hydroxide and Sodium Carbonate in mixture.

Suggested Readings

1. Engineering Chemistry, Shashi Chawla, Dhanpat Rai and Co, Education and technical publishers
2. Vogel's Practical Chemistry.

CHCE6007: ENGINEERING CHEMISTRY II LAB (2 Credits) (L:0, T:0, P:4)

***Objective**: This course consists of experiments illustrating the principles of chemistry relevant to the study of science and engineering.*

Course Outcomes:

1. Explain the principles of the experiments learned about in class, illustrating the principles of chemistry relevant to the study of science and engineering (Understanding)
2. Estimate molecular/system properties such as surface tension, viscosity, conductance of solution, water hardness, etc. (Applying)
3. Assess the limitations and advantages of the procedures they use in the laboratory for the various estimations and analysis. (Evaluating)

List of experiments:

1. Determination of Water Hardness with EDTA.
2. Estimation of Calcium in Limestone.
3. Determination of dissolved Oxygen in a given Water Sample by Winkler's Method.
4. Determination of Surface Tension of a given Liquid by Stalagmometer.
5. To determine the co-efficient of Viscosity of a given liquid or solution with the help of Ostwald's Viscometer.
6. Adsorption of Acetic Acid by Charcoal.
7. Determination of Chloride Content of Water.
8. To determine the Strength of Magnesium Ions in Magnesium Sulphate solution by Complexometric Method.
9. Determination of Partition Coefficient of a substance between two immiscible liquids.
10. Determination of Free Carbon Dioxide in a given Water sample.
11. To determine the Alkalinity of a given water Sample.
12. Determination of Ferrous Ion in Mohr's Salt by $KMnO_4$.
13. To determine the Acidity of the given water sample.
14. Determination of the Cell Constant and Conductance of solution.
15. Determination of Sodium Hydroxide and Sodium Carbonate in mixture.

Suggested Readings

1. S. Rattan Experiments in Applied Chemistry, Katson Books
2. S. Giri, D. N. Bajpai, O. P. Pandey Practical Chemistry, S. Chand And Co.

MACL0012: MATHEMATICS I - CALCULUS AND LINEAR ALGEBRA (3-1-0)

Course Outcomes:

1. Classify various types of mean value theorems, and their properties, (understanding)
2. Develop different methods to definite integrals to determine surface areas and volumes of revolutions. (Applying)
3. Find the concepts of convergence of sequence and series of real numbers. (Remembering)
4. Determine vector spaces, linear transformations and their properties (Evaluating)
5. Examine and recognize the use of eigen values and eigen vectors of matrices applicable to various complex engineering problems. (Analysing)

Module 1: Differential and Integral Calculus (23 lectures)

(a) Rolle's theorem, mean value theorems, Taylor's and Maclaurin's theorems with remainders; indeterminate forms and L'Hospital's rule; maxima and minima.

(b) Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; maxima, minima and saddle points; method of Lagrange multipliers.

(c) Evolutes and involutes; evaluation of definite and improper integrals; beta and gamma functions and their properties; applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Sequence and Series (11 lectures)

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: half range sine and cosine series, Parseval's theorem.

Module 3: Linear Algebra (11 lectures)

Vector space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, inverse of a linear transformation, rank nullity theorem, composition of linear maps, matrix associated with a linear map.

Module 4: Matrices (15 lectures)

Matrices, linear systems of equations, linear independence, rank of a matrix, determinants, Cramer's rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination. eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbasis, diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Suggested Readings:

1. Calculus and Analytic geometry, 9th Edition, G.B. Thomas and R.L. Finney, Pearson, Reprint,2002.
2. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig , John Wiley & Sons, 2006.
3. Engineering Mathematics for first year, Veerarajan T., Tata McGraw-Hill, New Delhi, 2008.
4. Higher Engineering Mathematics, 11th Reprint, Ramana B.V.Tata McGraw Hill New Delhi 2010.
5. Linear Algebra: A Modern Introduction, 2nd Edition, D. Poole, Brooks/Cole, 2005.
6. 6.A textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2008.
7. Higher Engineering Mathematics, 36th Edition, B.S. Grewal, Khanna Publishers, 2010.

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	H			
CO 3		H		
CO 4			H	
CO 5			M	H

MAIN0013: MATHEMATICS II - MULTIPLE INTEGRALS, NUMERICAL METHODS AND DIFFERENTIAL EQUATIONS (3-1-0)

Course Outcomes:

1. Classify gradient, curl and divergence and evaluate multiple integrals in various co-ordinates systems. (Understanding)
2. Appraise numerical solutions of algebraic and transcendental equations with error analysis, (Evaluating)
3. Solve initial and boundary value problems in differential equations using numerical methods. (Creating)
4. Categorize the techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order. (Analysing)
5. Determine the solution of partial differential equations by adopting various methods, (Evaluating)

Module 1: Multiple Integrals (12 lectures)
Gradient, curl and divergence, multiple integration: Double and triple integrals (cartesian and polar), change of order of integration in double integrals, change of variables (cartesian to polar), applications: areas and volumes by (double integration) Center of mass and gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 2: Numerical Methods (23 lectures)
a) Solution of polynomial and transcendental equations – bisection method, Newton-Raphson method and Regula-Falsi method. finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. numerical differentiation
b) Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. partial differential equations: finite difference solution two dimensional Laplace equation and Poission equation, implicit and explicit methods for one dimensional heat equation

Module 3: Ordinary Differential Calculus (15 lectures
Exact, linear and Bernoulli's equations, Euler's equations, equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type .second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy- Euler equation; power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Introduction to Partial Differential Equations (10 lectures)
First order partial differential equations, solutions of first order linear and non-linear PDEs. solution to homogeneous and non-homogenous linear partial differential equations second and higher order by complementary function and particular integral methods.

Suggested Readings
1. Calculus and Analytic geometry, 9th Edition, G.B. Thomas and R.L. Finney, Pearson,Reprint, 2002.
2. 2Advanced Engineering Mathematics, 9th Edition, . Erwin Kreyszig, John Wiley & Sons, 2006.
3. Elementary Differential Equations and Boundary Value Problems, 9th Ed., W. E. Boyce and R. C. DiPrima, Wiley India, 2009.
4. Differential Equations, 3rd Ed., S. L. Ross, Wiley India, 1984.
5. An Introduction to Ordinary Differential Equations, E. A. Coddington, Prentice Hall India, 1995.
6. Tata McGraw Hill, B.V.Ramana, Higher Engineering Mathematics, New Delhi, 11th Reprint, 2010
7. Ordinary Differential Equations, E. L. Ince, Dover Publications, 1958
8. A textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2008.
9. Higher Engineering Mathematics, 36th Edition, B.S. Grewal, Khanna Publishers, 2010.

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3		H		
CO 4			H	
CO 5				H

MAPS0024: MATHEMATICS III -PROBABILITY AND STATISTICS (2-0-0)

Course Outcomes:
1. Explain the ideas of probability and random variables and various discrete and probability distributions and their properties. (Understanding)
2. Determine probabilities and derive the marginal and conditional distribution of bivariate random variables. (Evaluating)
3. Apply the basic ideas of the measures of central tendency, correlation and regression to solve social and scientific related problems. (Applying)
4. Use appropriate statistical methods to summarize and analyse data using testing of hypothesis. (Analysing)

Module 1: Basic Probability and Continuous Probability Distributions: (12 lectures)
a) Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum,

Correlation coefficient, Chebyshev's Inequality.

b) Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities.

Module 2: Bivariate Distribution (5 lectures)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 3 Applied Statistics (13 lectures)

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Suggested Readings

1. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, John Wiley & Sons, 2006
2. Introduction to Probability Theory, P.G.Hoel, S.C.Port and C.J.Stone , Universal Book Stall,
3. 2003(Reprint)
4. 3 A first course in Probability, 6th Ed.. S.Ross, Pearson Education India, 2002
5. An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed. W. Feller, Wiley, 1968
6. A textbook of Engineering Mathematics, N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2010
7. Higher Engineering Mathematics , 35th Edition,,B.S.Grewal, Khanna publishers, 2000
8. Engineering Mathematics, Veeranjan T., Tata McGraw-Hill, New Delhi, 2010

Mapping COs to the syllabus

COs	Module 1	Module 2	Module 3
CO1	H		
CO2		H	
CO3		M	H
Co4			H

MADM0025: DISCRETE MATHEMATICS WITH APPLICATIONS (3-1-0)

COURSE OUTCOMES

1. Show a given logic sentence express it in terms of predicates, quantifiers, and logical connectives. (Understanding)
2. Derive the solution using deductive logic and prove the solution based on logical inference. (Evaluating)
3. For a given a mathematical problem, classify its algebraic structure. (Understanding)
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
5. Develop the given problem as graph networks and solve with techniques of graph theory. (Understanding)

Module 1: Sets, Relation and Function (14 lectures)

Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 2: Introduction to Counting (8 lectures)

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module 3: Propositional Logic: (12 lectures)

Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module 4: Algebraic Structures and Morphism (14 lectures)

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module 5: Graphs and Trees (12 lectures)

Graphs and their properties, Degree, Connectivity, Path, Cycle,Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph

Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Suggested Readings

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, Tata McGraw – Hill
2. Discrete Mathematics with Applications,4th edition, Susanna S. Epp, Wadsworth Publishing Co.Inc.
3. Elements of Discrete Mathematics A Computer Oriented Approach, 3rdEdition, C L Liu and D P Mohapatra, Tata McGraw – Hill.
4. Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, J.P. Tremblay and R. Manohar Tata McGraw-Hill
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
6. Discrete Mathematics, Schum's Outlines Series, Seymour Lipschitz, Marc Lipson, Tata McGraw- Hill

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H			M	
CO 2	M	H			
CO 3			H		
CO 4	M			H	
CO 5					H

MATC0026: MATHEMATICS III- (TRANSFORM CALCULUS, COMPLEX VARIABLE AND PROBABILITY AND STATISTICS) (2-1-0)

(3-credit-45 hours) (L-T-P:2-1-0)

Course Outcomes

1. Apply Laplace transform for evaluation of integrals and solving ODEs and PDEs. (Applying)
2. Illustrate the significance of differentiability and analyticity of complex functions leading to the Cauchy Riemann equations. (Understanding)
3. Learn Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem. (Analysing)
4. Illustrate the concepts of random variables and various probability distributions and their properties. (Understanding)

Module 1: Transform Calculus (14 lectures)

a) Polynomials-Orthogonal Polynomial-Lagrange's, Chebyshev polynomials; Trigonometric polynomials; Laplace transform, Properties of Laplace transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method.

b) Fourier series: convergence and sum of Fourier series, even and off functions, cosine and sine Fourier series; Fourier Integrals: Fourier cosine and sine integrals; Fourier transforms, Z-transform and wavelet transform: properties, methods, inverses and their applications

Module 2: Complex variable (15 lectures)

a) Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

b) Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Module 3: Basic Probability (8 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, the multinomial distribution, Poisson approximation to the binomial distribution, Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Applied Statistics (8 lectures

Measures of Central tendency: Moments, skewness and Kurtosis -Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Suggested Readings

1. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, John Wiley & Sons, 2006

2. Introduction to Probability Theory, P.G.Hoel, S.C.Port and C.J.Stone , Universal Book Stall,
3. 2003(Reprint)
4. 3 A first course in Probability, 6th Ed.. S.Ross, Pearson Education India, 2002
5. An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed. W. Feller, Wiley, 1968
6. A textbook of Engineering Mathematics, N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2010
7. Higher Engineering Mathematics , 35th Edition,,B.S.Grewal, Khanna publishers, 2000
8. Engineering Mathematics, Veeranjan T., Tata McGraw-Hill, New Delhi, 2010

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3			H	M
CO 4			M	H

MACS0027: MATHEMATICS III-(COMPLEX VARIABLE, TRANSFORM CALCULUS, PROBABILITY AND STATISTICS) (3-1-0)

Course Outcomes:

1. Use the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems. (Applying)
2. Develop the tool of Laplace transform and Fourier series for learning advanced Engineering Mathematics. (Understanding)
3. Apply the basic ideas of the measures of central tendency, correlation and regression to solve social and scientific related problems. (Applying)
4. Define the basic principles of probability theory and the concept of random variables. (Remembering)

Module 1: Complex variable (18 lectures)

a) Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

b) Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, evaluation of certain improper integrals using the Bromwich contour.

Module 2: Transform Calculus (10 lectures)

Laplace transform, properties of Laplace of transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method. Fourier Series and Fourier transform.

Module 3: Basic probability (10 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Applied Statistics (12 lecture)

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance : Large sample test for single proportion, difference of proportions, test for single mean, difference of means and standard deviations. Test for ratio of variance-Chi-square test for goodness of fit and independence of attributes.

Suggested Readings:

1. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, John Wiley & Sons, 2006
2. Introduction to Probability Theory, P.G.Hoel, S.C.Port and C.J.Stone , Universal Book Stall,
3. 2003(Reprint)
4. 3 A first course in Probability, 6th Ed.. S.Ross, Pearson Education India, 2002
5. An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed. W. Feller, Wiley, 1968
6. A textbook of Engineering Mathematics, N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2010
7. Higher Engineering Mathematics , 35th Edition,,B.S.Grewal, Khanna publishers, 2000
8. Engineering Mathematics, Veeranjan T., Tata McGraw-Hill, New Delhi, 2010

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3			H	
CO 4			M	H

MATD0028: MATHEMATICS III- TRANSFORM CALCULUS AND DISCRETE MATHEMATICS (2-0-0)

COURSE OUTCOMES:

1. Develop the tool of Laplace transform and Fourier series for learning advanced Engineering Mathematics. (Understanding)
2. Solve problems using counting techniques and combinatorics. (Applying)
3. Explain the ideas of probability and random variables and various discrete and probability distributions and their properties. (Understanding)

Module 1: Transform Calculus (9 lectures)

a) Polynomials-Orthogonal Polynomial-Lagrange's, Chebyshev polynomials; Trigonometric polynomials; Laplace transform, Properties of Laplace transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method.

b) Fourier transforms, Z-transform and wavelet transform: properties, methods, inverses and their applications.

Module 2: Discrete Mathematics: Sets, relations and functions: (10 lectures)

a) Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses. Complete partial ordering.

b) Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions. Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Module 3: Basic Probability and Distributions: (11 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Suggested Readings

1. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, John Wiley & Sons, 2006
2. Introduction to Probability Theory, P.G.Hoel, S.C.Port and C.J.Stone , Universal Book Stall, 2003(Reprint)
3. A first course in Probability, 6th Ed., S.Ross, Pearson Education India, 2002
4. An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., W. Feller, Wiley, 1968
5. Fourier Analysis with Application to Boundary Value Problems, M.R.spiegel, Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
6. 6 A textbook of Engineering Mathematics, . N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2010
7. Higher Engineering Mathematics, 35th Edition, B.S.Grewal, Khanna publishers, 2000
8. Engineering Mathematics, Veeranjan T., Tata McGraw-Hill, New Delhi, 2008

Mapping of COs to Syllabus

COs	Module 1	Module 2	Module 3
CO1	H		
CO2		H	
CO3			H

MACP0029: MATHEMATICS III - COMPLEX VARIABLES, PDE AND PROBABILITY AND STATISTICS (3-1-0)

Course Outcomes:

1. Use the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems. (Applying)
2. Solve partial differential equations by range of techniques and to predict the behaviour of certain model physical phenomena. (Applying)

3. Define the basic principles of probability theory and the concept of random variables. (Remembering)
4. Apply the basic ideas of the measures of central tendency, correlation and regression to solve social and scientific related problems. (Applying)

Module 1: Complex Variables (19 lectures)

a) Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

b) Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, evaluation of certain improper integrals using the Bromwich contour.

Module 2: Partial differential equations (17 lectures)

Second order linear equations and their classification, initial and boundary conditions, D'Alemberts solution of the wave equation; Duhamel's principle for one dimensional wave equation. Finite vibrating string problem and Fourier series. Heat diffusion and vibration problems, separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solution with Bessel functions and Legendre function. One dimensional diffusion equation and its solution by separation of variables.

Module 3: Basic probability (12 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's

Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Beyes' rule.

Module 4: Applied Statistics (12 lectures

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance : Large sample test for single proportion, difference of proportions, test for single mean, difference of means and standard deviations. Test for ratio of variance-Chi-square test for goodness of fit and independence of attributes.

Suggested Readings

1. Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, John Wiley & Sons, 2006
2. Introduction to Probability Theory, P.G.Hoel, S.C.Port and C.J.Stone , Universal Book Stall, 2003(Reprint)
3. A first course in Probability, 6th Ed., S.Ross, Pearson Education India, 2002
4. An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., W. Feller, Wiley, 1968
5. Fourier Analysis with Application to Boundary Value Problems, M.R.spiegel, Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
6. 6 A textbook of Engineering Mathematics, . N.P.Bali and Manish Goyal, Laxmi Publications, Reprint, 2010
7. Higher Engineering Mathematics, 35th Edition, B.S.Grewal, Khanna publishers, 2000
8. Engineering Mathematics, Veeranjan T., Tata McGraw-Hill, New Delhi, 2008

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3			H	
CO4			M	H

CAMF0043: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE (4-0-0) (4 Credits-60 lectures)

COURSE OUTCOMES

1. Discuss application of mathematical logic to solve problems (Remembering, Understanding)
2. Describe basic concept of set theory, graph theory and Group theory. (Understanding)
3. 3.Derive the solution of a problem using deductive logic and prove the solution based on logical inference (Applying)
4. 4.Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
5. Develop the given problem as graph networks and solve with techniques of graph theory. (Applying)

Module 1(13 lectures)

Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, Logical equivalence: The Laws of logic, Logical Implication, Normal forms, Quantifiers, universal quantifiers. Predicates: Predicate logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction.

Module 2(20 lectures)
Set theory: Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Matrix representation of relations and partial ordered sets, representation of relations by Graphs; Lattices as Partially Ordered Sets, Boolean algebra; Functions. Algebraic Structures: Introduction, Algebraic Systems, Semi groups and Monoids; Groups, Congruence Relation and Quotient Structures, permutation groups, Lagrange's Theorem; Normal subgroups. Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. (Definition, basic properties and examples)

Module 3 (12 lectures)
Elementary Combinatorics: Basics of counting, Combinations & Permutations with repetitions, Constrained repetitions, Binomial Coefficients, Binomial and Multinomial theorem, Pigeonhole Principle, principles of Inclusion – Exclusion.

Module 4 (15 lectures)
Graph Theory: Basic Concepts, Sub graphs, Multi graphs Representation of Graphs, Isomorphism, Paths and Circuits, Traversing a Graph, DFS, BFS, Eulerian and Hamiltonian graphs, shortest path algorithms, Planar Graphs, Chromatic Numbers. Tree and Spanning Trees. Applications of Graph Theory.

Suggested Readings

1. Discrete Mathematical Structures with Applications to Computer Science by J. P. Tremblay and R Manohar, Tata McGraw-Hill Publications, 1997.
2. Graph Theory by Narsingh Deo, Prentice-Hall of India publications, 2004.
3. Discrete Mathematical Structures, Theory and Applications. D.S. Malik, Thomson Learning, I Edn
4. Discrete Mathematics for Computer Science, Haggard, Thomson Learning, I Edn
5. Discrete Mathematics and Its Applications by Kenneth H Rosen. Tata McGraw-Hill Publications
6. Mathematical foundation of Computer Science by Y. N Sings. New Age international Publishers
7. Bernard Kolman, Robert. C.Busby & Sharon Ross, "Discrete Mathematical structures" Prentice Hall of India,2001.

Mapping of COs to Syllabus

	Module I	Module II	Module III	ModuleIV
CO 1	H	M		
CO 2	H	H		H
CO 3	H		H	
CO 4		M	H	
CO5				H

PSPT0038: PHYSICS FOR TECHNOLOGISTS (3-1-0)

Course Outcomes
1. Recall the principles of wave optics (Remembering)
2. Explain the electromagnetic theory and electromagnetic waves (Understanding)
3. Interpret the concepts and principles in quantum mechanics (Understanding)
4. Analyse the physics of semiconductors and their applications (Analysing)

Module 1: Wave Optics (10 lectures)
a) Interference and diffraction: Huygen's principle, superposition of two waves, coherent sources, Young's double slit experiment, intensity distribution; Newton's rings and applications. Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to a single slit, plane transmission grating; zone plates. Polarization of transverse waves, plane, circular, and elliptically polarized light; polarization by reflection, refraction and scattering.
b) Photonics: spontaneous and stimulated emission, fundamentals of laser action, ruby Laser, He-Ne laser, applications of lasers. Elements of fibre optics, types of optical fibres, numerical aperture. Principles of holography.

Module 2: Electromagnetic Theory (18 lectures
a) Electromagnetism: basic idea of divergence and stokes theorems, Gauss's law and its applications, electrostatic potential, Poisson's and Laplace's equation, work and energy, dielectric polarization bound charges, electric displacement (D); magnetic induction (B), magnetic intensity (H), Biot-Savart's Law, Ampere's circuital law; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in differential and integral forms.
b) Electromagnetic waves: Electromagnetic energy densities, Electromagnetic wave equations for E and B, transverse nature and speed of electromagnetic waves, Poynting vector, Poynting theorem.

Module 3: Quantum Physics and Applications (14 lectures)

a) Quantum physics: historical overview; particle aspect of radiation – blackbody radiation, photoelectric effect, Compton scattering; wave aspect of particles – de Broglie's hypothesis, matter waves; Heisenberg's uncertainty principle; transition from deterministic to probabilistic states of a system – wave functions, probability density, superposition principle; observables and operators, expectation values. Schrodinger wave equation.

b) Application of quantum mechanics: solutions of one-dimensional problem, infinite deep potential well – energy eigenvalues, eigenfunctions, potential barrier – tunneling.

Module 4: Semiconductor Physics (18 lectures)

a) Free electron theory, density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), energy bands in solids, E-k diagram, direct and indirect bandgaps, types of electronic materials: metals, semiconductors, and insulators, density of states, occupation probability, Fermi level, effective mass, phonons.

b) Intrinsic and extrinsic semiconductors, dependence of Fermi level on carrier- concentration and temperature (equilibrium carrier statistics), carrier generation and recombination, carrier transport: diffusion and drift, p-n junction, metal-semiconductor junction.

c) Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; joint density of states, density of states for photons, transition rates (Fermi's golden rule), optical loss and gain; photovoltaic effect, exciton, drude model.

Suggested Readings

1. S. Dey, Physics for Engineers and Technologists, Eastern Book House.
2. Halliday, Resnick and Walker, Fundamentals of Physics (Extended), Wiley.
3. H. D. Young and R. A. Freedman, Sears and Zemansky's University Physics, Pearson Education.
4. A. Ghatak, Optics, Tata Mcgraw Hill.
5. D. J. Griffiths, Introduction to Electrodynamics, Pearson, Prentice Hall.
6. A. Beiser, Concepts of Modern Physics, McGraw Hill.
7. L. I. Shiff, Quantum Mechanics, McGraw Hills.
8. E. Merzbacher, Quantum Mechanics, Wiley.
9. G. Aruldas, Quantum Mechanics, PHI Learning.
10. H. Goldstein, Classical Mechanics, Addison-Wesley.
11. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw Hill.
12. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley.
13. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India.

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H	L		
CO 2		H		
CO 3		L	H	
CO 4			L	H

PSEP0039: ENGINEERING PHYSICS: MECHANICS (3-1-0)

Course Outcomes:

1. Recall vector algebra and its application (Remembering)
2. Explain motion under constraints and friction (Understanding)
3. Analyse rotating and translating motion of a rigid body (Analysing)
4. Explain the concept elasticity, stress and strain at a point (Evaluating)

Module 1: Vector Mechanics of Particles (20 lectures)

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates; Potential energy function; F = - Grad V; Conservative and non-conservative forces; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Application: Satellite manoeuvres; Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula — Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance.

Module 2: Planar Rigid Body Mechanics (10 lectures)

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples; Introduction to three-

dimensional rigid body motion — only need to highlight the distinction from two- dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Module 3: Statics (10 lectures)
Free body diagrams with examples on modelling of typical supports and joints; Condition for equilibrium in three- and two-dimensions; Friction: limiting and non- limiting cases; Force- displacement relationship; Geometric compatibility for small deformations; Illustrations through simple problems on axially loaded members like trusses.

Module 4: Mechanics of solids (20 lectures)
Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stresses and Mohr's circle; Displacement field; Concept of strain at a point; Plane strain: transformation of strain at a point, principal strains and Mohr's circle; Strain RoseOe; Discussion of experimental results on one- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one- dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials; Complete equations of elasticity; Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions); Torsion of circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed)

Suggested Readings

1. Engineering Mechanics, M. K. Harbola,
2. Introduction to Mechanics., M. K. Verma,
3. An Introduction to Mechanics. D. Kleppner and R. Kolenkow,
4. A. Griths, Principles of Mechanics. J. L. Synge and B. Mechanics. J. P. Den Hartog
5. Engineering Mechanics – Dynamics. J. L. Meriam,
2. Mechanical Vibrations. J. P. Den Hartog,
3. Theory of Vibrations with Applications. W. T. Thomson
4. An Introduction to the Mechanics of Solids. S. H. Crandall, N. C. Dahl & T. J. Lardner,
5. , Engineering Mechanics: Statics. J. L. Meriam
6. , Engineering Mechanics of Solids. E. P. Popov

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	H	L		
CO 2	M	H		
CO 3		M	H	
CO 4			L	H

PSET0040: ENGINEERING PHYSICS: ELECTROMAGNETIC THEORY (3-1-0)

Course Outcomes:
1. Recall the concepts of vector algebra and its application (Remembering)
2. Explain the basic laws of electrostatics and magnetostatics (Understanding)
3. Analyse Faraday's law in terms of EMF produced by changing magnetic flux (Analysing)
4. Explain Maxwell's equations and Electromagnetic waves (Evaluating)

Module 1: Electrostatics in Vacuum (10 lectures)
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module 2: Electrostatics in a Linear Dielectric Medium (8 lectures)
Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magnetostatics (9 lectures)
Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module 4: Magnetostatics in a Linear Magnetic Medium (7 lectures)
Magnetization and associated bound currents; auxiliary magnetic field ; Boundary conditions on and Solving for magnetic field

due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module 5: Faraday's law (8 lectures)
Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic braking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module 6: Maxwell's equations (9 lectures)
Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module 7: Electromagnetic Waves (9 lectures)
The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a nonconducting medium-vacuum interface for normal incidence.

Suggested Readings
1. Introduction to Electrodynamics. David Griffiths,
2. Electricity, Magnetism and Light. , Halliday and Resnick, Physics. W. Saslow,

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7
CO 1	H	L					
CO 2		H	H	M			
CO 3					H	M	
CO 4						M	H

PSWO0049: ENGINEERING PHYSICS: WAVES AND OPTICS (3-1-0)

COURSE OUTCOMES
1. Recall the principle of simple harmonic motion (Remembering)
2. Explain the reflection and transmission of waves at a boundary and characteristics of standing waves (Understanding)
3. Analyse the principles of wave optics, interference and diffraction (Analysing)
4. Explain the working principles of optical instruments like interferometers, Newton's rings, etc. and LASER (Evaluating)

Module 1: SHM and Oscillators (11 lectures)
Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Module 2: 1D Waves and Dispersion (11 lectures)
Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module 3: Light propagation and geometrical optics (15 lectures)
Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Module 4: Wave Optics (11 lectures)
Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a

single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 5: Laser Fundamentals (12 lectures)
Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO 2), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Suggested Readings
1. Oscillations and waves in physics., Ian G. Main,
2. The physics of vibrations and waves., H. J. Pain,
3. Optics., E. Hecht,
4. Optics. A. Ghatak,
5. Laser Fundamentals, W. T. Silfvast,
6. Principles of Lasers., O. Svelto,

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	L			
CO 2		H			
CO 3			M	H	
CO 4				L	H

PSTC6016: PHYSICS LAB FOR TECHNOLOGISTS (2 credits) (L-T-P:0-0-4)

Course Outcomes:
1. Explain the usage of mechanical and optical systems for various measurements (Understanding)
2. Apply the analytical techniques and graphical analysis to the experimental data (Applying)
3. Evaluate vernier calipers, various rulers, meters, scales and other measuring devices to acquire measurements within the stated precision (Evaluating)

At least 10 experiments to be performed from the following.
1. To determine the frequency of an Electrical maintained tuning fork by Melde's experiments
2. Determination of surface tension by capillary rise method.
3. Determination of wavelength of light by Newton's ring method.
4. Determination of grating element of a diffraction grating.
5. Determination of wavelength of laser source by diffraction grating method.
6. Study of photoemission.
7. Determination of Rigidity modulus by static method.
8. Determination of acceleration due to gravity by Bar pendulum.
9. Determination of thermal conductivity by Lee's method
10. Plotting of characteristic curve of a PN junction diode.
11. Determination of Young's modulus by Searle's method.
12. Study of RC circuit.

PSEG6017: PHYSICS LAB FOR ENGINEERS (1 credit) (L-T-P:0-0-2)

Course Outcomes:
1. Explain the usage of mechanical and optical systems for various measurements (Understanding)
2. Apply the analytical techniques and graphical analysis to the experimental data (Applying)
3. Evaluate vernier calipers, various rulers, meters, scales and other measuring devices to acquire measurements within the stated precision (Evaluating)

At least 10 experiments to be performed from the following.
1. To determine the frequency of an Electrical maintained tuning fork by Melde's experiments
2. Determination of surface tension by capillary rise method.
3. Determination of wavelength of light by Newton's ring method.
4. Determination of grating element of a diffraction grating.
5. Determination of wavelength of laser source by diffraction grating method.
6. Study of photoemission.
7. Determination of Rigidity modulus by static method.
8. Determination of acceleration due to gravity by Bar pendulum.
9. Determination of thermal conductivity by Lee's method

10. Plotting of characteristic curve of a PN junction diode.
11. Determination of Young's modulus by Searle's method.
12. Study of RC circuit.

BOBY0003: BIOLOGY (2-0-0)

Course Outcomes

1. Compare the two, three, four and five kingdom classifications. Highlight the criteria for classification (Understanding)
2. Apply thermodynamic principles to biological systems. (Applying)
3. Analyze biological processes at the reductionist level. (Analyzing)
4. Examine DNA as a genetic material in the molecular basis of information transfer (Evaluating)

Module I: Classification 5 lectures

Classification and its criteria**:** Morphological, Biochemical and Ecological; Hierarchy of
Classifications, based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e)Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life; Organism from different based on classification for the study :1. E.coli, 2. S.cerevisiae, 3. D. Melanogaster, 4.C. elegance, 5. A. Thaliana, 6. M. musculus

Module 2: Genetics and Information Transfer 13 lectures

a. Mendel's laws: Law of segregation and Law of independent assortment, Dominance,Recessiveness; Allele, Gene mapping, Gene interaction, Epistasis ; Meiosis and Mitosis in heredity; Gene – mapping; Genetic disorders in humans; complementation in human genetics.

b. DNA as a genetic material; Structure of DNA- single stranded, double stranded and nucleosomes; Genetic code- Salient features; Gene - complementation and recombination.

Module 3: Biomolecules and Enzymes 14 lectures

a. Biomolecules of life: Micromolecules and Macromolecules- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/RNA; Two carbon units and lipids. Structure of proteins: Primary, Secondary, tertiary and Quaternary; Proteins as enzymes, transporters, receptors and structural elements.

b. Enzyme classification. Mechanism of enzyme action of any two enzyme. Enzyme kinetics and kinetic parameters; RNA catalysis.

Module 4: Metabolism 5 lectures

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency; Glycolysis and Krebs cycle; Photosynthesis; Energy yielding and energy consuming reactions. Energy charge

Module 5: Microbiology 4 lectures

Unicellular organisms; Species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of unicellular organisms. Sterilization and media compositions. Growth kinetics.

Suggested Readings

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	M		H	
CO 2				M	
CO 3	M		M	H	H
CO 4	M	H	H		

SCHOOL OF TECHNOLOGY

DEPARTMENT OF HUMANITIES

EGRW0015: ENGLISH FOR RESEARCH PAPER WRITING (Audit Course)

***Objectives**: Students will be able to:*

- *Understand that how to improve your writing skills and level of readability*
- *Learn about what to write in each section*
- *Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission.*

Module I (4 hours)

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module II (4 hours)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Module III (4 hours)

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Module IV (4 hours)

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V (4 hours)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Module VI (4 hours)

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Readings

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg

EGEC0107: ENGLISH COMMUNICATION (2 Credits- 30 Hours)

***Objective**: The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. The present course hopes to address some of these aspects through an interactive mode of teaching-learning process and by focusing on various dimensions of communication skills.*

Module I: Introduction

Theory of Communication, Types and modes of Communication

Module II: Language of Communication

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business, Barriers and Strategies, Intra-personal, Interpersonal and Group communication

Module III: Speaking Skills

Monologue, Dialogue, Group Discussion Effective Communication/ Mis- Communication Interview, Public Speech

Module IV: Reading and Understanding

Close Reading, Comprehension, Summary, Paraphrasing, Analysis and Interpretation
Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Module V: Writing Skills

Documenting, Report Writing, Making notes, Letter writing

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO 1: Define the theories of Communication, its types and modes
CO 2: Explain various dimensions of communication skills
CO 3: Use the correct and suitable art of communication in today's world of complexities, multiplicities and competition
CO 4: Analyse the difference in personal and professional interactions
CO 5: Summarize various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments
CO 6: Evaluate different documents and reports, prepared or presented

Suggested Readings

1. *Fluency in English* - Part II, Oxford University Press, 2006.
2. *Business English*, Pearson, 2008.
3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul,Dr Brati Biswas

EGCS0110: COMMUNICATION SKILLS (Audit Course)

***Objective**: The objective of this audit course is to prepare students to be effective in their career in the corporate world where they will use their professional expertise. This course enables students*

- *To understand the difference between hard skills and soft skills*
- *To learn the importance of communication skills as part of the soft skills,*
- *To be familiar with the various features of effective communication, which includes verbal, non-verbal, written communication and body language.*

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO 1: *Recognise* the difference between hard and soft skills
CO 2: *Understand* the importance of communication skills
CO 3: *Analyse* features of effective communication
CO 4: *Apply* the soft skills in the corporate world

EGEH0111: ENGLISH (2 Credits- 30 hours) (L-T-P: 2-0-0)

***Objective:** The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.*

Module I: Vocabulary Building (6 hours)

1. The concept of Word Formation
2. Root words from foreign languages and their use in English
3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
4. Synonyms, antonyms, and standard abbreviations.

Module II: Basic Writing Skills (6 hours)

a) Sentence Structures
b) Use of phrases and clauses in sentences
c) Importance of proper punctuation
d) Creating coherence
e) Organizing principles of paragraphs in documents
f) Techniques for writing precisely

Module III: Identifying Common Errors in Writing (5 hours)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

Module IV: Nature and Style of sensible Writing (6 hours)

Describing, Defining, Classifying, providing examples or evidence, Writing introduction and conclusion

Module V: Writing Practices (7 hours)

Comprehension, Précis Writing, Essay Writing

Suggested Readings

1. *Practical English Usage*. Michael Swan. OUP. 1995.

2. *Remedial English Grammar*. F.T. Wood. Macmillan.2007
3. *On Writing Well.* William Zinsser. Harper Resource Book. 2001
4. *Study Writing*. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

EGBC0112: BUSINESS COMMUNICATION (2 Credits - 30 hours) (L-T-P:2-0-0)

***Objective**: To equip students effectively to acquire skills in reading, writing, comprehension and communication, as also to use electronic media for business communication.*

Module I: Introduction (6 hours)

Nature of Communication, Process of Communication, Types of Communication (verbal & Non-Verbal), Importance of Communication, Different forms of Communication Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers

Module II: Business Correspondence (6 hours)

Letter Writing, presentation, inviting quotations, sending quotations, placing orders, inviting tenders, Sales letters, claim & adjustment letters and social correspondence, Memorandum, Inter- office Memo, Notices, Agenda, Minutes, Job application letter, preparing the Resume.

Module III: Report Writing (6 hours)

Business Reports: Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check-lists for reports.

Module IV: Vocabulary (6 hours)

Words often confused, Words often misspelled, Common errors in English.

Module V: Oral Presentation (6 hours)

Importance, Characteristics, Presentation Plan, Power-point presentation, Visual aids.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO 1: List out the different parts of speech in English grammar (Remembering)
CO 2: Illustrate the basic sentence structures in English (Understanding)
CO 3: Identify the barriers of effective communication (Applying)
CO 4: Categories the different types of business letters (Analysing)
CO 5: Compare between greetings and small talks (Evaluating)
CO 6: Discuss the important themes/motifs in a short story (Creating)

Suggested Readings

1. Bovee, and Thill, *Business Communication Essentials,* Pearson Education
2. Shirley Taylor, *Communication for Business, Pearson Education*
3. Locker and Kaczmarek, *Business Communication: Building Critical Skills, McGraw Hill Education*
4. Herta A Murphy*, Herbert W Hildebrandt, Jane P. Thomas, Effective Business Communication (SIE), McGraw Hill Education*
5. Dona Young*, Foundations of Business Communication: An Integrative Approach, McGraw Hill Education*
6. Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz*,* Paula Lentz, and Neerja Pande*, Business Communication: Connecting in a Digital World (SIE), McGraw Hill Education*

Note: Latest edition of text-books may be used.

EGOC6005: ORAL COMMUNICATION PRACTICE LAB (1 Credit) (L-T-P:0-0-2)

(This unit involves interactive practice sessions in Language Lab)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

COURSE /LEARNING OUTCOMES

After the completion of this Lab the students will be able to:

CO 1: *List* out the different vowel sounds and consonant sounds (Remembering)
CO 2: *Illustrate* the stress and intonation patterns in language. (Understanding)
CO 3: *Identify* the erroneous pronunciations. (Applying)

CO 4: *Compare* the pronunciation of similar sounding words. (Analysing)
CO 5: *Discuss* the tips for facing an interview. (Evaluating)
CO 6: *Determine* the common patterns in everyday conversations and dialogues. (Creating)

Suggested Readings

1. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
2. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

MTOB0069: INTRODUCTION TO ORGANISATIONAL BEHAVIOUR (2 credits – 30 hours) (L-T-P:2-0-0)

***Objective**: This course is designed to give students the basic knowledge of human behavior needed to provide a more effective organizational environment. The basic elements of the course will be the behavior of individuals in organizations, group behavior in organizations, and how these behaviors affect the overall performance of organizations. Particular emphasis is placed on individual difference, attitude, motivation, job satisfaction, communication, leadership, stress, change, and organizational culture.*

Module I (5 hours)

The Study of Organizational Behaviour (OB): Learning objectives, Definition and Meaning, Why Study OB, Models in OB, New Challenges for OB Manager. Learning – Nature of Learning, How Learning occurs, Learning and OB. Case Analysis

Module II (7 hours)

Foundations of Individual Behaviour: Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB. Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation– Nature and Importance, Hertzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations. Case Analysis

Module III (10 hours)

a) Organizational Behaviour Process: Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making Managerial Implications, Effective Team Building.
b) Leadership – Leadership and Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA). Case Analysis

Module IV (8 hours)

Organization: Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training and Development, Performance Appraisal, Incentives; Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective. Case Analysis

Suggested Readings

1. VSP Rao, Organizational Behaviour, Excel Books.
2. Stephen P Robbins, Organizational Behaviour, PHI Learning, New Delhi
3. JW Newstorm and K. Davis, Organizational Behaviour: Human Behaviour at Work, MGH, New Delhi
4. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, New Delhi
5. PN Khandawalla, Organizational Behaviour, McGraw Hill, New Delhi.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the meaning of organization behavior (Knowledge)
CO2: Explain the models and the theory of learning and the foundations of individual behavior. (Comprehension)
CO3: Establish the relationship between the various theories of motivation and workplace behavior. (Application)
CO4: Differentiate between leadership and management and the different leadership theories. (Analysis)
CO5: Formulate different types of leadership strategies. (Synthesis)
CO6: Evaluate the various human resource management functions. (Evaluation)

MTEC0074: ECONOMICS FOR ENGINEERS (2 credits – 30 hours)(L-T-P:2-0-0)

***Objective**: The objective of this course is to make the students of engineering aware of the basic concepts in Economics, introduce them to the preliminary techniques of quantitative analysis in Economics and finally to certain relevant concepts of the stock market. The purpose of this course is to increase the all round knowledge of the engineer and enhance his/her professional competence in the work field.*

Module I (9 hours)

a) Definition of Economics: Subject matter, scope, principal division of Economics – Microeconomics and Macroeconomics.
b) Theory of Demand: Meaning of Demand and Supply, The law of demand, meaning of utility, marginal utility and total utility, law of diminishing marginal utility, Indifference curve approach, Consumer's Equilibrium, elasticity of demand- determinants, types and measurement, exceptions to the law of demand.
c) Theory of Production: Meaning of Production function, production function with one variable input – Law of Variable Proportions, production function with two variable inputs– Law of Returns to Scale, Cobb-Douglas production function. Economic concept of cost- short-run and long-run.
d) Market Structure: Market Classification- perfect competition, monopoly, monopolistic competition. Concepts of Revenue - Average Revenue, Marginal Revenue and Total Revenue. The firm- objectives and constraints, Equilibrium of the firm- TR-TC approach, MR-MC approach.

Module II (10 hours)

a) Macroeconomic concepts and aggregates: Circular flow of income, National Income- GDP, GNP, Meaning and relation between: consumption, saving, investment. Aggregate demand and aggregate supply - Saving and Investment functions, Multiplier Mechanism
b) Money: Definition of money, functions of money, Money Supply- M1M2M3M4, Inflation- meaning, types, control of inflation- monetary policy, fiscal policy.
c) Banking: Central Banks, Commercial Banks, creation of credit.
d) Trade Cycles: Meaning of Trade Cycle, Various phases of Trade Cycle.
e) International Trade: Balance of Payments, Devaluation, Exchange Rate, Special Drawing Rights (SDR), IMF, WTO, concept of Globalization, Role of MNCs, Regional Economic Integration.

Module III (6 hours)

a) Quantitative Analysis in Economics: Profit Maximization problems, break-even analysis, demand estimation.
b) Introduction to Statistics: Data, diagram, Data Interpretation problems, Measures of Central Tendency, Measures of Dispersion, dispersion, Index numbers.

Module IV (5 hours)

a) Introduction to Stock Market: Stock Markets - Meaning, NSE, BSE, NYSE, Stock Market Indices - SENSEX, NIFTY, DOW. Bull Market and Bear Market, Role of SEBI in stock market, FDIs and FIIs, Role of FIIs in stock market.
b) Basic terms related to stock market: Shares, equity shares, bonus shares, preference shares, buyback shares, splitting of shares, trading - intraday trading, commodity trading, futures, hedging, arbitrage.
c) Mutual Funds: Meaning of Mutual funds, Types of Mutual Fund.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Describe the subject matter of Economics. (Comprehension)
CO2: Define and comprehend the meaning of demand and supply. (Knowledge & Comprehension)
CO3: Describe the factors of production (Comprehension)
CO4: Distinguish between different market forms (Knowledge)
CO5: Compute cost, revenue and profit of firms (Comprehension)
CO6: Explain how money is circulated in an economy. (Comprehension)
CO7: Outline the different concepts of national income. (Analysis)
CO8: Describe the banking system of an economy. (Comprehension)
CO9: Apply the statistical concepts to interpret different forms of data. (Application)
CO10: Construct price index. (Synthesis)
CO11: Interpret and evaluate the functioning of the stock market. (Evaluation)

Suggested Readings

1. H.L. Ahuja, Modern Economics, S. Chand & Co. Ltd., New Delhi
2. Dr. K.K Dewett and M.H. Navalur, Modern Economic Theory, S. Chand & Co. Ltd., New Delhi
3. Manab Adhikary, Business Economics, Excel Books.
4. Madhu Vij, International Financial Management, Excel Books.
5. Koutsoyiannis, Modern Microeconomics, Palgrave MacMillan, 2003, 2nd Revised edition
6. Dominik Salvatore, Microeconomic Theory, Schaum's Outline series, TMH.
7. Bradley Schiller, Essentials of Economics, Tata Mcgraw Hill.
8. Atmanand, Managerial Economics, Excel Books.
9. M S Loganathan and B Nandhakumar, Dictionary for Economics, Excel Books.
10. Sheetal Thomas, Dictionary of Finance, Excel Books.

MTOB0086: ORGANISATIONAL BEHAVIOUR (3 credits – 30 hours) (L-T-P:3-0-0)

***Objective**: This course is designed to give students the basic knowledge of human behavior needed to provide a more effective organizational environment. The basic elements of the course will be the behavior of individuals in organizations, group behavior in organizations, and how these behaviors affect the overall performance of organizations. Particular emphasis is placed on individual difference, attitude, motivation, job satisfaction, communication, leadership, stress, change, and organizational culture.*

Module I (5 hours)

The Study of Organizational Behaviour (OB): Learning objectives, Definition and Meaning, Why Study OB, Models in OB, New Challenges for OB Manager. Learning – Nature of Learning, How Learning occurs, Learning and OB. Case Analysis

Module II (7 hours)

Foundations of Individual Behaviour: Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB. Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation– Nature and Importance, Hertzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations. Case Analysis

Module III (10 hours)

a) Organizational Behaviour Process: Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making Managerial Implications, Effective Team Building.
b) Leadership – Leadership and Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA). Case Analysis

Module IV (8 hours)

Organization: Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training and Development, Performance Appraisal, Incentives; Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective. Case Analysis

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the meaning of organization behavior (Knowledge)
CO2: Explain the models and the theory of learning and the foundations of individual behavior. (Comprehension)
CO3: Establish the relationship between the various theories of motivation and workplace behavior. (Application)
CO4: Differentiate between leadership and management and the different leadership theories. (Analysis)
CO5: Formulate different types of leadership strategies. (Synthesis)
CO6: Evaluate the various human resource management functions. (Evaluation)

Suggested Readings

1. VSP Rao, Organizational Behaviour, Excel Books.
2. Stephen P Robbins, Organizational Behaviour, PHI Learning, New Delhi
3. JW Newstorm and K. Davis, Organizational Behaviour: Human Behaviour at Work, MGH, New Delhi
4. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, New Delhi
5. PN Khandawalla, Organizational Behaviour, McGraw Hill, New Delhi.

MTEE0104: ECONOMICS FOR ENGINEERS (3 credits – 45 hours) (L-T-P:3-0-0)

***Objective**: The objective of this course is to make the students of engineering aware of the basic concepts in Economics, introduce them to the preliminary techniques of quantitative analysis in Economics and finally to certain relevant concepts of the stock market. The purpose of this course is to increase the all round knowledge of the engineer and enhance his/her professional competence in the work field.*

Module I (15 hours)

a) Definition of Economics: Subject matter, scope, principal division of Economics – Microeconomics and Macroeconomics.
b) Theory of Demand: Meaning of Demand and Supply, The law of demand, meaning of utility, marginal utility and total utility, law of diminishing marginal utility, Indifference curve approach, Consumer's Equilibrium, elasticity of demand- determinants, types and measurement, exceptions to the law of demand.
c) Theory of Production: Meaning of Production function, production function with one variable input – Law of Variable

Proportions, production function with two variable inputs – Law of Returns to Scale, Cobb-Douglas production function. Economic concept of cost- short-run and long-run.

d) Market Structure: Market Classification- perfect competition, monopoly, monopolistic competition. Concepts of Revenue - Average Revenue, Marginal Revenue and Total Revenue. The firm- objectives and constraints, Equilibrium of the firm- TR-TC approach, MR-MC approach.

Module II (10 hours)

a) Macroeconomic concepts and aggregates: Circular flow of income, National Income- GDP, GNP, Meaning and relation between: consumption, saving, investment. Aggregate demand and aggregate supply - Saving and Investment functions, Multiplier Mechanism.
b) Money: Definition of money, functions of money, Money Supply- M1M2M3M4, Inflation- meaning, types, control of inflation- monetary policy, fiscal policy.
c) Banking: Central Banks, Commercial Banks, creation of credit.
d) Trade Cycles: Meaning of Trade Cycle, Various phases of Trade Cycle.
e) International Trade: Balance of Payments, Devaluation, Exchange Rate, Special Drawing Rights (SDR), IMF, WTO, concept of Globalization, Role of MNCs, Regional Economic Integration.

Module III (10 hours)

a) Quantitative Analysis in Economics: Profit Maximization problems, break-even analysis, demand estimation.
b) Introduction to Statistics: Data, diagram, Data Interpretation problems, Measures of Central Tendency, Measures of Dispersion, dispersion, Index numbers.

Module IV (10 hours)

a) Introduction to Stock Market: Stock Markets - Meaning, NSE, BSE, NYSE, Stock Market Indices - SENSEX, NIFTY, DOW. Bull Market and Bear Market, Role of SEBI in stock market, FDIs and FIIs, Role of FIIs in stock market.
b) Basic terms related to stock market: Shares, equity shares, bonus shares, preference shares, buyback shares, splitting of shares, trading - intraday trading, commodity trading, futures, hedging, arbitrage.
c) Mutual Funds: Meaning of Mutual funds, Types of Mutual Fund.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Describe the subject matter of Economics. (Comprehension)
CO2: Define and comprehend the meaning of demand and supply. (Knowledge & Comprehension)
CO3: Describe the factors of production (Comprehension)
CO4: Distinguish between different market forms (Knowledge)
CO5: Compute cost, revenue and profit of firms (Comprehension)
CO6: Explain how money is circulated in an economy. (Comprehension)
CO7: Outline the different concepts of national income. (Analysis)
CO8: Describe the banking system of an economy. (Comprehension)
CO9: Apply the statistical concepts to interpret different forms of data. (Application)
CO10: Construct price index. (Synthesis)
CO11: Interpret and evaluate the functioning of the stock market. (Evaluation)

Suggested Readings

1. H.L. Ahuja, Modern Economics, S. Chand & Co. Ltd., New Delhi
2. Dr. K.K Dewett and M.H. Navalur, Modern Economic Theory, S. Chand & Co. Ltd., New Delhi
3. Manab Adhikary, Business Economics, Excel Books.
4. Madhu Vij, International Financial Management, Excel Books.
5. Koutsoyiannis, Modern Microeconomics, Palgrave MacMillan, 2003, 2nd Revised edition
6. Dominick Salvatore, Microeconomic Theory, Schaum's Outline series, TMH.
7. Bradley Schiller, Essentials of Economics, Tata Mcgraw Hill.
8. Atmanand, Managerial Economics, Excel Books.
9. M S Loganathan and B Nandhakumar, Dictionary for Economics, Excel Books.
10. Sheetal Thomas, Dictionary of Finance, Excel Books.

MTPP0105: PROFESSIONAL PRACTICE LAW AND ETHICS (2 credits –30 hours) (L-T-P:2-0-0)

***Objective**: Basic elements of civil engineering professional practice are introduced in this course. Roles of all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers - are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced. The course covers professional relations, civic responsibilities, and ethical obligations for engineering practice. The course will make the students understand contracts management and various legal aspects related to engineering. Further, the course familiarizes*

students with elementary knowledge of laws that would be of utility in their profession, including several new areas of law such as IPR, ADR. The course is designed to address the following:
To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession. To develop some ideas of the legal and practical aspects of their profession.

Module I: Professional Practice (5 Hours)
Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI,
Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction);
Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards)

Module II: Professional Ethics (4 Hours)
Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Module III: General Principles of Contracts Management (4 Hours)
Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and subcontracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build- Own-Operate & variations; Public- Private Partnerships; International Commercial Terms.

Module IV: Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system. (6 Hours)
Meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

Module V: Engagement of Labour and Labour & other construction-related Laws. (6 Hours)
Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

Module VI: Law relating to Intellectual property. (6 Hours)
Introduction – meaning of intellectual property,main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
- CO1: To familiarise the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession (Remembering)
- CO2: To give a good insight into contracts and contracts management in civil engineering, dispute resolution mechanisms; laws governing engagement of labour (Understanding)
- CO3: To give an understanding of Intellectual Property Rights, Patents (Applying)

CO4: To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession (Analysing)
CO5: To develop good ideas of the legal and practical aspects of their profession (Evaluating)
CO6: To develop some ideas of the legal and practical aspects of their profession (Creating)

Suggested Readings

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
6. Avtar Singh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R. (1979), Law of Contract, Oxford University Press
9. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
11. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
12. Bare text (2005), Right to Information Act
13. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
14. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
15. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
16. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss2, pp 117-127, MCB UP Ltd
17. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
18. Ethics in Engineering- M.W.Martin & R.Schinzinger, McGraw-Hill
19. Engineering Ethics, National Institute for Engineering Ethics, USA
20. www.ieindia.org
21. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
22. CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm
23. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
24. Contract & Agreements http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
25. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
26. Business & Personal Law. Chapter 7. "How Contracts Arise", http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
27. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt

MTPO0106: PRODUCTION AND OPERATIONS MANAGEMENT (3 credits – 45 hours) (L-T-P:3-0-0)

***Objective**: This course aims at acquainting the students with the functions of production and operations management and basic issues and tools of managing production and operation functions of an organization. The course also intends to provide the students a system theoretic view on project management and helps develop an understanding on why today's organizations are cultivating a formal project management process to gain competitive advantage. The syllabus has an in-depth coverage of the most critical topics found in PMBOK (Project Management Body of Knowledge) Guide.*

Module I: Introduction and Work Study (10 hours)

a) Introduction to Production and operations management
b) Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement
c) Method/ Motion study- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy
d) Micro-motion study – Meaning and scope, therbligs, use of motion camera in micro- motion study
e) Work measurement – concept of observed time, rating/leveling factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time.

Module II: Plant Location and layout (10 hours)

a) Objectives, Locational factors, Economics of plant location
b) Meaning, objectives and types of plant layout and their relevance to mass, batch and job- order production systems.
c) Systematic Layout Planning (SLP) procedure
d) Use of computers for layout design
e) Group Technology (GT), Flexible manufacturing systems (FMS) and Computer integrated manufacturing (CIM)
f) Assembly Line Balancing (ALB) - meaning and objective, Heuristic methods for solution of ALB problems.

Module III: Product design and Development and PPC (10 hours)

a) Meaning of product, Product life cycle (PLC) and Product mix
b) Decisions to be taken during product development and design
c) Procedure for product development and design
d) Value of a product – its meaning, Value Analysis (VA) – its objectives, procedure and example, Simplification and Standardization.
e) Meaning and Objectives of PPC, Effects of types of production
f) Steps in PPC primarily stressing the needs of marketing research, Demand forecasting, process planning/routing, scheduling of flow-shop and job-shop productions, Use of Gantt chart, Machine loading, Make/Buy decision and Break-even analysis, Master production schedule, MRP and MRP-II, Capacity planning, Inventory management.
g) Production control – monitoring, expediting and re-planning, Planning and control of batch production. TOC, Use of L.P in Production Management, Product and service Reliability.

Module IV: Project Management (15 hours)

a) Project management framework, Scope management.
b) Project management processes, Cost and Time management, Project integration management, Project risk management, Project Quality management, Project communication management.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define a production system. (Knowledge)
CO2: Distinguish between production and operations. (Comprehension)
CO3: Use the tools and techniques to measure work study, motion study. (Application)
CO4: Apply the concepts of work sampling techniques in the determination of standard time. (Application)
CO5: Comprehend the significance of plant location and prepare systematic layout planning procedure. (Synthesis)
CO6: Explain product life cycle and product mix. (Comprehension)
CO7: Demonstrate the procedure for product development and design. (Application)
CO8: Compare between make or buy decisions. (Analysis)
CO9: Apply various tools of demand forecasting. (Application)
CO10: Determine inventory and inventory control techniques. (Application)
CO11: Synthesize project management framework. (Synthesis)
CO12: Compute project completion time and Analyse and evaluate project risk management techniques. (Application, Analysis & Evaluation)

Suggested Reading

1. M. Telsang, Industrial Engineering, S. Chand & Company Ltd.
2. Kanishka Bedi, Production and Operations Management, Oxford University Press.
3. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai & Sons.
4. M. Mahajan, Industrial engineering, Dhanpat Rai & Company.
5. L. Krajewski, L. Ritzman and M. Malhotra, Operations Management, Pearson Education.
6. Adam, Ebert, Production and Operations Management, PHI.
7. R. Panneerselvam, Production and Operations Management, PHI.
8. K. Aswathappa & K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing

MTFC0107: FINANCIAL MANAGEMENT AND ACCOUNTING (2 credits - 30 hours)

Objective: *The objective of the course is to provide a broad exposure to the basic terminology, tools, and techniques of financial management and accounting which will enable the students to understand accounting issues as they arise in either the financial press or in the workplace. The knowledge gained through this subject can also be helpful in operational and strategic decision making.*

Module I (7 hours)

a) Introduction: Financial Management, Financial Planning and Capitalization- definitions, objectives, changing roles and functions, Financial Decision.
b) Capital Budgeting: Nature of Investment decision, Importance of Capital Budgeting, The Capital. Budgeting Process - Investment criterion, Pay-back period, Accounting, ROR (Rate of Return) Method, Discounting Cash flow method, Net - present value method, IRR (Internal Rate of Return) method.

Module II (7 hours)

a) Management of Working Capital: Various concepts, Elements, Classification, Financing and importance of working capital, Investment analysis, Cash flow determination, cost of capital, capital budgeting methods.

Module III (8 hours)

Cost - Volume - Profit Analysis: Classification of costs, Allocation, apportionment and absorption, Cost centers, different costing systems, Cost analysis for managerial decisions, Meaning of Linear CVP analysis, Objectives, Assumptions, Break - Even analysis, determining the Break-Even point profit, Volume graph profit, Volume ratios margin of Safety.

Module IV (8 hours)

a) Introduction to Accounting: basic accounting concepts, important definitions, uses; types of accounting, financial statements, introduction to journal accounting; different types of vouchers, double entry bookkeeping, different types of transactions related to financial accounting.
b) Financial Control: Ledgers and preparation of trial balance, preparation of balance sheet and profit and loss accounts, controlling other departments by financial accounting.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Describe the term financial management (Understanding)
CO2: State the different tools and techniques of financial management. (Analysing)
CO3: Describe in detail about capital budgeting. (Applying)
CO4: Define Internal Rate of Return (Remembering)
CO5: Illustrate investment analysis (Understanding)
CO6: Define cost analysis for marginal decision (Understanding)
CO7: Estimate break-even point and explain what break even analysis is. (Evaluating)
CO8: Estimate margin of safety (Evaluating)
CO9: Prepare journals, ledger, Trial Balance (Applying)
CO10 Prepare and assess financial statement (Evaluating)

Suggested Readings

1. P.K. Jain, Financial Management and Accounting, S. Chand and Co.
2. R.K. Sharma and S.K. Gupta, Management and Accounting: Principles and Practice, Kalyani Publishers.
3. R.S. Kaplan and A.A. Atkinson, Advanced Management Accounting, PHI.
4. Van Horne, Fundamentals of Financial Management, Pearson

Mapping of COs to Syllabus

	Module 1	Module 2	Module 3	Module 4
CO 1	M			
CO 2		H		M
CO 3	L		H	
CO 4	H	L		

BTUH0001: STUDENT INDUCTION PROGRAM
(P/NP)

The following list presents the topics covered in the Mandatory Student Induction Program conducted in the Assam Don Bosco University School of Technology:

1. Physical activity – Yoga and sports activity (indoor and outdoor)
2. Creative arts through Extra-curricular clubs e.g., music & singing, dance, drama, debating & quiz, art & craft, photography
3. Universal Human Values – group discussions on the following topics:
    a) Aspirations and family expectations
    b) Gratitude
    c) Competition and cooperation
    d) Competition and excellence
    e) Peer pressure
    f) Self-confidence
    g) Relationships in family
    h) Trust and respect
    i) Anger management
    j) Happiness and prosperity
    k) Dealing language barriers – tests on communication skill for future follow up.

l) Sexual orientation / courting / sexual harassment

4. Literary exposure through Literary Club
5. Proficiency Modules – Psychological tests and orientation, introduction to Co-curricular clubs and innovations.
6. Lectures by eminent people – in-campus invited Guests and over SKYPE
7. Visit to local areas – visit to industry and institutions of repute
8. Familiarization to departments and common facilities
9. Mentoring system – introduction and assignment of mentors
10. Selection / election of Class Representatives for college association
11. Health check-up for all with documentation for future reference
12. Library Orientation, Introduction to ERP and e-Resources, filling up "Online anti-ragging affidavit" by all.

BTUH0002: UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY
(3 Credits – 45 hours)

Objective*: The objective of the course is four fold:*

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Module I: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education (9 hours)

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
7. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module II: Understanding Harmony in the Human Being - Harmony in Myself! (8 hours)

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.
7. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship (9 hours)

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
6. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Module IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence (9 hours)

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module V: Implications of the above Holistic Understanding of Harmony on Professional Ethics (10 hours)

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. Discuss the conduct as an engineer or scientist etc.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: recognize the nature of themselves, and their surroundings (family, society, nature); (understanding)
CO2: identify their responsibility in life, and handle problems with sustainable solutions, while keeping human relationships and human nature in mind. (understanding)
CO3: demonstrate their critical ability and also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). (applying)
CO4: execute what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. (applying)

Suggested Readings

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English

Mapping of CO to Syllabus

	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	M	M			
CO 2		H			
CO 3			H		
CO 4				M	H

SCHOOL OF COMMERCE AND MANAGEMENT

SCHOOL OF COMMERCE AND MANAGEMENT

DEPARTMENT OF COMMERCE

Course Structure of BACHELOR OF COMMERCE (BCOM Honours)

SEMESTER I				
Type of Course/Category	**Course Code**	**Course Name**	**Credits T-L-P**	**Page**
Core Course 1 (Theory)	CMFA0067	Financial Accounting	4-1-1	641
Core Course 2 (Theory)	CMBL0068	Business Law	5-1-0	642
Ability Enhancement compulsory Course -1	CHES0002	Environmental Studies	2-0-0	617
Generic Elective Course 1			5-1-0	
Total Credits			**20**	
SEMESTER II				
Core Course 3 (Theory)	CMCA0070	Corporate Accounting	5-1-0	644
Core Course 4 (Theory)	CMCL0071	Corporate Laws	5-1-0	645
Ability Enhancement compulsory Course –2	EGBC0112	Business Communication	2-0-0	618
Generic Elective Course 2			5-1-0	
Total Credits			**20**	
SEMESTER III				
Core Course 5 (Theory)	CMHR0073	Human Resource Management	5-1-0	647
Core Course 6 (Theory)	CMIT0074	Income Tax Law and Practice	5-1-0	648
Core Course 7 (Theory)	CMMP0075	Management Principles and Applications	5-1-0	649
Skill Enhancement Course 1 (Theory)	CMEC0076	E-Commerce	2-0-0	650
Generic Elective Course 3			5-1-0	
Total Credits			**26**	
SEMESTER IV				
Core Course 8 (Theory)	CMCA0078	Cost Accounting	5-1-0	652
Core Course 9 (Theory)	CMBM0079	Business Mathematics	5-1-0	653
Core Course 10 (Theory)	CMCA0080	Computer Applications in Business	5-1-0	655
Skill Enhancement Course 2 (Theory)	CMET0081	Entrepreneurship	2-0-0	655
Generic Elective Course 4			5-1-0	
Compulsory Course	CMIN6004	*Internship	P/NP	
*Internship is a compulsory non- credited course which will be assesses as P/NP in the sixth semester grade sheet. The time to do the internship is after the third semester gets over but before the sixth semester begins class.				
Total Credits			**26**	
SEMESTER V				
Core Course 11 (Theory)	CMPG0086	Principles of Marketing	5-1-0	658
Core Course 12 (Theory)	CMFF0087	Fundamentals of Financial Management	4-1-1	658
Discipline Specific Elective 1 (Theory)	CMMA0088	Management Accounting	5-1-0	659
	CMCP0089	Corporate Tax Planning	5-1-0	660
	CMCA0090	Computerized Accounting System	4-2-0	661
	CMPM0091	Project Management	5-1-0	662
Discipline Specific Elective 2 (Theory)	CMFS0092	Financial Markets, Institutions and Financial Services	5-1-0	663
	CMAD0093	Advertising	5-1-0	663
	CMBI0094	Banking and Insurance	5-1-0	664
		Financial Technology and Analytics	5-1-0	

	CMPR6009	Project Phase I	NP	
Total Credits			**24**	
SEMESTER VI				
Core Course 13 (Theory)	CMAG0098	Auditing and Corporate Governance	5-1-0	666
Core Course 14 (Theory)	CMIT0099	Indirect Tax Law	5-1-0	667
Discipline Specific Elective 3 (Theory)	CMIB00100	International Business	5-1-0	668
	CMBT0101	Business Tax Procedures and Management	5-1-0	669
	CMFI0102	Fundamentals of Investment	5-1-0	670
	CMIE0083	Indian Economy	5-1-0	657
Discipline Specific Elective 4 (Theory)	CMIR0103	Industrial Relations and Labour Laws	5-1-0	671
	CMCC0104	Consumer Affairs and Customer Care	5-1-0	672
	CMBR0105	Business Research Methods and Project Work	5-1-0	673
		Personnel Finance and Planning	5-1-0	
	CMPR6010	Project Phase II	P/NP	
	CMIN6004	Internship	P/NP	
Total Credits			**24**	
Total Programme Credits			**140**	

Generic Electives – Commerce Department

Type of Course/Category	Course Code	Course Name	Credits T-L-P	Page
Generic Elective Course 1	CMME0069	Micro Economics	5-1-0	643
	CMIR0096	Insurance and Risk Management		
	CMFA0106	Fundamentals of Accounting		674
Generic Elective Course 2	CMSM0095	Investing in Stock Markets	5-1-0	665
	CMBI0107	Practice of Banking and Insurance		675
Generic Elective Course 3	CMBS0077	Business Statistics	5-1-0	651
	CMPT0085	Project Management and Techniques		
	CMCH0108	Indian Cultural Heritage and Business History		676
Generic Elective Course 4	CMCM0109	Cost and Management Accounting	5-1-0	676
	CMIF0082	Indian Financial System		656
	CMGB0110	Global Business Environment		677

MASTER OF COMMERCE

Course Structure of MASTER OF COMMERCE

SEMESTER I				
Type of Course/Category	**Course Code**	**Course Name**	**Credits T-L-P**	**Page**
Core Course (Theory)	CMOT0041	Organizational Theory and Behavior	4-0-0	619
Core Course(Theory)	CMBD0042	Business Statistics and Decisions	4-0-0	620
Core Course(Theory)	CMFY0043	Financial Statement Analysis	4-0-0	620
Core Course (Theory)	CMMG0044	Managerial Economics	4-0-0	621
Core Course (Theory)	CMAG0045	Cost and Management Accounting	4-0-0	622
Total Credits			**20**	
SEMESTER II				
Core Course (Theory)	CMRC0046	Research Methodology In Commerce	4-0-0	623
Core Course (Theory)	CMBE0047	Business Environment	3-0-0	624
Core Course (Theory)	CMBL0048	Business Law	3-0-0	625
Core Course (Theory)	CMFI0049	Corporate Finance	4-0-0	626
Core Course (Theory)	CMPG0050	Principles of Marketing	4-0-0	626
Core Course (Theory)	CMBS0051	International Business	4-0-0	628

Total Credits			**22**	
SEMESTER III				
Core Course (Theory)	CMSH0052	Strategic Human Resource Management	4-0-0	628
Core Course (Theory)	CMCR0053	Consumer Behaviour	4-0-0	629
Project Work	CMDS6006	Dissertation - I	4-0-0	679
Specialisation:	CMTM0054	Corporate Tax Management	4-0-0	630
Accounting and Taxation(Theory)	CMAF0055	Accounting Theory and Financial Reporting	4-0-0	631
Specialisation:	CMCR0056	Advance Corporate Finance	4-0-0	632
Finance and Investment(Theory)	CMBK0057	Investment Banking	4-0-0	632
Specialisation:	CMIG0058	International Marketing	4-0-0	633
Management(Theory)	CMBC0059	Business Ethics and Corporate Governance	4-0-0	634
Total Credits			**20**	
SEMESTER IV				
Core Course (Theory)	CMEM0060	Entrepreneurship Management and E-Commerce	4-0-0	635
Project Work	CMDS6007	Dissertation – II	6-0-0	679
Specialisation:	CMMD0061	Modern Accounting	4-0-0	636
Accounting and Taxation(Theory)	CMAV0062	Advanced Accounting	4-0-0	637
Specialisation:	CMFI063	Financial Institution Management	4-0-0	638
Finance and Investment(Theory)	CMPN0064	Portfolio Management	4-0-0	639
Specialisation:	CMIL0065	Management of Industrial Laws	4-0-0	639
Management(Theory)	CMSM0066	Supply Chain Management	4-0-0	640
Total Credits			**18**	
Total Programme Credits			**80**	

DEPARTMENT OF MANAGEMENT
BACHELOR OF BUSINESS ADMINISTRATION -HONOURS IN MARKETING/HUMAN RESOURCES/FINANCE/AVIATION MANAGEMENT

SEMESTER I				
Type of Course/Category	**Course Code**	**Course Name**	**Credits T-L-P**	**Page**
Core Course 1 (Theory)	MTMP0118	Management Process and Principles	5-1-0	691
Core Course 2 (Theory)	MTIA0119	Introduction to Aviation Industry	5-1-0	692
Ability Enhancement compulsory Course -1	EGBC0112	Business Communication	2-0-0	686
Generic Elective Course 1			5-1-0	
Total Credits			**20**	
SEMESTER II				
Core Course 3 (Theory)	MTMG0089	Managerial Economics	5-1-0	687
Core Course 4 (Theory)	MTSB0091	Statistics for Business Decisions	5-1-0	688
Ability Enhancement compulsory Course –2	CHES0002	Environmental Studies	2-0-0	685
Generic Elective Course 2			5-1-0	
Mandatory Course	EDCI0200	Constitution of India	P/NP	
Mandatory Course	MTSL0200	*Service Learning (Theory - 30 Hours)	P/NP	
*The service learning field work of 60 hours will be carried out by each student during the semester break (After second semester exams get over) and the reports will be presented and evaluation will be done in the third semester Note: Students following Aviation Track will go for Ab Initio visit to Airport and Collect information on Airline Safety, Security, regulatory norms and passenger and cargo handling as part of GE-2/Industrial Visit				
Total Credits			**20**	
SEMESTER III				
Core Course 5 (Theory)	MTFH0120	Fundamentals of Human Resource Management	5-1-0	692
Core Course 6 (Theory)	MTPM0121	Principles of Marketing	5-1-0	693
Core Course 7 (Theory)	MTFF0122	Fundamentals of Finance	5-1-0	694
Skill Enhancement Course 1	MTIB0097	IT Tools for Business Decision	2-0-0	690
Generic Elective Course 3			5-1-0	
Mandatory course	MTSL0200	**Service Learning (Field - 60 Hours)	P/NP	
**The service learning field work of 60 hours will be carried out by each student during the semester break (After third semester exams get over) and the reports will be presented and evaluation will be done in the fourth semester.				
Total Credits			**26**	
SEMESTER IV				
Core Course 8 (Theory)	MTFM0123	Financial Management	5-1-0	695
Core Course 9 (Theory)	MTOG0093	Organizational Behavior	5-1-0	689
Core Course 10 (Theory)	MTAO0124	Airport Operations	5-1-0	696
Skill Enhancement Course 2	MTEC0125	E-Commerce	2-0-0	696
Generic Elective Course 4			5-1-0	
Compulsory Course	MTIP6003	***Internship	P/NP	
***Internship is a compulsory non- credited course which will be assesses as P/NP in the sixth semester grade sheet. The minimum duration is 80-100 hours and the time to do the internship is after the third semester gets over but before the sixth semester begins class.				
Total Credits			**26**	
SEMESTER V				
Core Course 11 (Theory)	MTCB0126	Corporate and Business Law	5-1-0	
Core Course 12 (Theory)	MTRM0127	Research Methodology	5-1-0	
Discipline Specific Elective 1 (Theory)	**Specialisation: Finance**			
	MTCF0128	Corporate Finance	5-1-0	
	Specialisation: Marketing			
	MTCB0129	Consumer Behavior	5-1-0	

	Specialisation: Human Resources			
	MTSH0130	Strategic Human Resource Management	5-1-0	
	Specialisation: Aviation			
	MTGH0131	Ground Handling Services at Airport	5-1-0	
Discipline Specific Elective 2 (Theory)	**Specialisation: Finance**			
	MTIA0132	Investment Analysis and Portfolio Management	5-1-0	
	Specialisation: Marketing			
	MTSD0133	Sales and Distribution Management	5-1-0	
	Specialisation: Human Resources			
	MTIR0134	Management of Industrial Relations	5-1-0	
	Specialisation: Aviation			
	MTRP0135	Airport Resource Planning and Services Management	5-1-0	
Compulsory course	MTPR6001	RESEARCH PROJECT Phase-I	P/NP	
Total Credits			**24**	
SEMESTER VI				
Core Course 13 (Theory)	MTBS0136	Business Policy and Strategic Management	5-1-0	
Core Course 14 (Theory)	MTED0137	Entrepreneurship Development	5-1-0	
Discipline Specific Elective 3 (Theory)	**Specialisation: Finance**			
	MTIF0138	International Finance	5-1-0	
	Specialisation: Marketing			
	MTSM0139	Services Marketing	5-1-0	
	Specialisation: Human Resources			
	MTEW0140	Employee Welfare and Compensation Management	5-1-0	
	Specialisation: Aviation			
	MTAC0141	Air Cargo Operation	5-1-0	
Discipline Specific Elective 4 (Project)	**Specialisation: Finance/Marketing/ Human Resources/Aviation**			
	MTPR6002	Research Project PHASE -II		
Compulsory course	MTIP6003	**Internship**	**P/NP**	
Total Credits			**24**	
Total Programme Credits			**140**	

Generic Electives - Management Department

Type of Course/Category	Course Code	Course Name	Credits T-L-P	Page
Generic Elective Course 1	MTBE0142	Introduction to Business Environment	5-1-0	697
	MTPM0143	Principles of Management	5-1-0	698
		Insurance and Risk Management	5-1-0	
Generic Elective Course 2	MTSM0145	Stock Market Operations	5-1-0	699
	MTME0146	Introduction to Macro Economics	5-1-0	700
Generic Elective Course 3	MTBE0147	Business Ethics and Corporate Governance	5-1-0	701
	MTOM0148	Operations Management	5-1-0	702
Generic Elective Course4	MTRM0149	Fundamentals of Retail Management	5-1-0	703
	MTIE0150	Indian Economy	5-1-0	704

DEPARTMENT OF COMMERCE
BACHELOR OF COMMERCE (HONOURS)

PROGRAMME OUTCOMES (POs)

PO 1: **Critical Thinking-** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: **Effective Communication-** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: **Social Interaction-** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: **Ethical and responsible citizen-** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: **Environment and Sustainability-** Understand the issues of environmental contexts and sustainable development.

PO 6: **Leadership, Self-directed and Life-long Learning-** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: Demonstrate the role of accounting in society and business; computerized set of accounting books; various tax issues and tax forms.

PSO 2: Apply systematic and subject skills within various disciplines of commerce, business, accounting, economics, finance, auditing, law, marketing and environment.

PSO 3: Recognise relevant financial accounting and managerial accounting career skills, applying both quantitative and qualitative knowledge to their future careers in business.

LIST OF COURSES- BCOM (HONOURS)

COURSES
1.1 Financial Accounting
1.2 Business Law
1.3 Environmental Studies
1.4 Micro-Economics
1.5 Insurance and Risk Management
1.6 Principles of Management
1.7 Entrepreneurship Development
2.1 Corporate Accounting
2.2 Corporate Laws
2.3 Business Communications
2.4 Macro Economics
2.5 Investing in Stock Markets
2.6 Practice of Banking and Insurance
2.7 Introduction to Macro Economics
3.1 Human Resource Management
3.2 Income Tax Law and Practice
3.3 Management Principles and Applications
3.4 E-Commerce
3.5 Business Statistics
3.6. Project Management and Techniques
3.7 Principles of Management
3.8 Business Statistics
4.1 Cost Accounting
4.2 Business Mathematics
4.3 Computer Applications in Business
4.4 Entrepreneurship
4.5 Indian Economy
4.6 Indian Financial System
4.7 Global Business Environment

5.1 Principles of Marketing
5.2 Fundamentals of Financial Management
5.3 Management Accounting
5.4 Financial Markets, Institutions and Financial Services
6.1 Auditing and Corporate Governance
6.2 Indirect Tax Law
6.3 International Business
6.4 Industrial relations and Labour Laws

MAPPING OF COURSES WITH POS/PSOS

MAPPING OF COURSES WITH POS/PSOS

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1.1	M				M	M	H	M	M
1.2	M	L			L	M	L	L	L
1.3				H				M	
1.4		M	L		M	L		L	
2.1	M				M	H	M		M
2.2	M	L			L	M	L	L	L
2.3		L					M		
2.4	M	M	M				M	L	L
3.1	M	L				M		M	H
3.2	H	M	M		M	M	H	H	M
3.3	M	M	H					M	L
3.4		M	H		M			M	H
3.5		M				M	M	M	H
4.1	H	M			L	M	H	M	M
4.2	H	L				L		M	
4.3	M	L				L	H	M	M
4.4		H			H	M		H	M
4.5	M	L			L	M	H		M
5.1	H	H	M	H		L	H	H	M
5.2	M	M	H	H	H		M	H	H
5.3		H		L	M	H	H	M	H
5.4	M	H	H	H		H	H	H	H
6.1	H	M	H		H		H	H	H
6.2		H		M	H	H	H	H	H
6.3	H	H	M	M	H	H	H	H	H
6.4	H	H	H			H	H	H	H

MASTER OF COMMERCE

(Specialisations in Accounting and Taxation, Finance and Investment and Management)

PROGRAMME OUTCOMES (POs)

PO 1: **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: **Effective Communicatio**n: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: **Ethical and responsible citizen:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them. : Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO 6: **Leadership, Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: **Knowledge of Commerce:** To accustom the students with conventional as well as contemporary areas in the discipline of Commerce. To inculcate the knowledge of business and the techniques of managing the business with special focus on accounting and taxation, finance and investment and management

PSO 2: **Research, Innovation and Advancements:** To serve industry and society with contemporary knowledge and skills in the area of Commerce and Management and the ability to create new knowledge which can be added on to the existing knowledge on emerging fields and to pursue advanced education in the domain of Commerce

PSO 3: **Entrepreneurial Ability:** To enable them to start their own business by enhancing the horizon of knowledge in various field of commerce through teamwork, effective communication, ethical decision-making ability

LIST OF COURSES IN MCOM

COURSES
1.1 Organizational Theory & Behavior
1.2 Business Statistics & Decisions
1.3 Financial Statement Analysis
1.4 Managerial Economics
1.5 Cost & Management Accounting
2.1 Research Methodology iIn Commerce
2.2 Business Environment
2.3 Business Law
2.4 Corporate Finance
2.5 Principles of Marketing
2.6 International Business
3.1 Strategic Human Resource Management
3.2 Consumer Behaviour
3.3 Dissertation - I
COURSES
3.4 (A) Corporate Tax Management
3.5 (A) Accounting Theory and Financial Reporting
3.4 (F) Advance Corporate Finance
3.5 (F) Investment Banking
3.4 (M) International Marketing
3.5 (M) Business Ethics and Corporate Governance
4.1 Entrepreneurship Management and E-Commerce
4.2 Dissertation – II
4.3 (A) Modern Accounting
4.3 (A) Advanced Accounting
4.4 (F) Financial Institution Management
4.4 (F) Portfolio Management
4.4 (M) Management of Industrial Laws

4.4 (M) Supply Chain Management

MAPPING OF COURSES WITH POS/PSOS

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1.1	L	L	M	L	L		L		M
1.2		H	M	M					H
1.3	H	L	M		M		H	M	M
1.4		L	M		L	H			
1.5	H	L	M	M	M		M	H	M
2.1	H	H	H	M	M		H		H
2.2	M		M		L		H		L
2.3	M		M	M	H		M		
2.4	H	M	H	H	M		L	M	H
2.5	M	M	M	M		L	M		M
2.6	H	M			H		H		L
3.1	M			M		M	M		L
3.2	M	H	H		M	L	M		M
3.3	M	H	H	H		L	H	L	H
3.4 (A)	H		M	M	M		H	M	M
3.5 (A)	H	H	M				H	H	M
3.4 (F)	M		M	H		L	M	H	H
3.5 (F)	H	H	H			L	H	M	H
3.4 (M)	H	M	M		H	M	H		L
3.5 (M)	M	L				H	H	L	
4.1	H	L	L		H	H	H		L
4.2	M	H	H	H		L	H	L	H
4.3 (A)	H	L	M	M		L	H	H	M
4.3 (A)	H	H	M	M		L	H	H	H
4.4 (F)	H	L	L	H		H	H	H	H
4.4 (F)	H	L	M	H		L	H	M	H
4.4 (M)	H	L	H	L		H	H		H
4.4 (M)	H		L	M	L	M	H		

DETAILED SYLLABUS

CHES0002 ENVIRONMENTAL STUDIES

(Credits: 2- 30 hours) (L-T-P: 2-0-0)

Objective: *The objective of this course is to provide multidisciplinary nature of Environmental Studies, identifying different structure and function of an ecosystem, analyse the types of biodiversity and its conservation and environmental pollution sources.*

Course Outcomes:

After learning the course, the students will be able to:

1. Define the Multidisciplinary Nature of Environmental Studies(Understanding)
2. Identify the different structure and function of an ecosystem(Applying)
3. Analyse the types of biodiversity and its conservation (Analyzing)
4. Evaluate the various sources of environmental pollution (Evaluating)

Module I: The Multidisciplinary Nature of Environmental Studies (3 hours)

Definition, scope and importance, need for public awareness.

Module II: Natural Resources (3 Lectures)

a. Different types of natural resources and associated problems - forest resources, water
b. resources, mineral resources, food resources, energy resources, land resources.
c. Conservation of natural resources.

Module III: Ecosystems (4 hours)

a. Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs.
b. Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Module IV: Biodiversity and Its Conservation (4 hours)

Types of biodiversity – genetic, species and ecosystem, value of biodiversity, global biodiversity, India as a mega-diversity nation, threats to biodiversity, conservation of biodiversity - in-situ and ex-situ conservation.

Module V: Environmental Pollution (6 hours)

a. Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e-pollution.
b. Solid waste management
c. Disaster management

Module VI: Social Issues and the Environment (6 hours)

a. From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
b. Environment protection act.
c. Introduction to environmental impact assessment.

Module VII: Human Population and the Environment (4 hours)

a. Population growth and sex ratio.
b. Population explosion - family welfare programme.
c. Environment and human health.
d. HIV/AIDS.
e. Role of information technology in environment and human health.

Suggested Readings

1. ErachBharucha; Textbook for Enviromental Studies, UGC, New Delhi
2. S. Somvanshi and R. Dhupper; Fundamentals of Environmental Studies, S.K. Kataria and Sons Publisher.
3. A.K. De; Environmental Chemistry, New age publishers.
4. J.P. Sharma; Environmental Studies, University Science Press, Third edition, 2009.
5. K.G. Bhattacharyya and A. Sarma; Comprehensive Environmental Studies, Narosa Publishing House Pvt, Ltd, 2015.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7
CO 1	H	M			L		L
CO 2	L	H	L		L		
CO 3			H	M	L	M	L
CO 4				L	M	M	H

EGBC0112: BUSINESS COMMUNICATION

(Credits: 2- 30 hours) (L-T-P: 2-0-0)

Objective: *The objective of this course is to make students learned and be proficient in effective communication skills and also make their comprehensive knowledge strong in business letter drafting and also the knowledge of sentence structure strong.*

Course Outcomes

1. Illustrate the basic sentence structures in English(Remembering)
2. Identify the barriers of effective communication(Understanding)
3. Categories the different types of business letters (Applying)
4. Compare between greetings and small talks (Analysing)

Module I: Introduction (6 hours)

Nature of Communication, Process of Communication, Types of Communication (verbal & Non Verbal),Importance of Communication, Different forms of Communication Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers

Module II: Business Correspondence (7 hours)

Letter Writing, presentation, Inviting quotations, Sending quotations, Placing orders, Inviting tenders, Sales letters, claim & adjustment letters and social correspondence, Memorandum, Inter- office Memo, Notices, Agenda, Minutes, Job application letter, preparing the Resume.

Module III: Report Writing(7 hours)

Business Reports: Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check lists for reports.

Module IV: Vocabulary (8 hours)

Words often confused, Words often mis spelt, Common errors in English.

Module V Oral Presentation: (8 hours)

Importance, Characteristics, Presentation Plan, Power point presentation, Visual aids.

Suggested Readings

1. Bovee, and Thill, Business Communication Essentials, Pearson Education
2. Shirley Taylor, Communication for Business, Pearson Education
3. Locker and Kaczmarek, Business Communication: Building Critical Skills, McGraw Hill Education
4. Herta A Murphy, Herbert W Hildebrandt, Jane P. Thomas, Effective Business Communication (SIE), McGraw Hill Education
5. Dona Young, Foundations of Business Communication: An Integrative Approach, McGraw Hill Education
6. Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz, Paula Lentz, and NeerjaPande,Business Communication: Connecting in a Digital World (SIE), McGraw Hill Education

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	M

CMES0023: ENTREPRENEURSHIP (AUDIT COURSE)

Objective*: The objective of the course is to introduce students to the concept of entrepreneurship, entrepreneurial skills and their use in a variety of situations. The students are examined on the personal skills to help them define entrepreneurial opportunity and are taught to develop a criteria to judge a situation to develop into a venture, plan and prepare business plans considering the market, technical, financial and legal requirements.*

The various topics that are generally covered in the course are:

- *Meaning of entrepreneur and entrepreneurship and its relation with problem - solving, characteristics of an entrepreneur, factors influencing entrepreneurship*
- *Identify and explain entrepreneurial opportunities, generating a list of entrepreneurial opportunities in a number of commercial and non-commercial situations*
- *Preliminary Project appraisal methods - Selecting the right opportunity, market*
- *Survey and research, techno-economic feasibility, financial feasibility- sources of finance – identify various sources of capital, ways to access the capital. Legal environment – identify the types of the regulatory systems and predict their effects on the creation of the entrepreneurial venture, role of government and government agencies.*
- *Creating the business model – business plan preparation.*
- *Recognize and assess the expected life of a venture, break-even analysis, recognize the common causes of failure of business ventures, how to deal with seven business crisis- planning for survival and growth.*

CMOT0041: ORGANISATIONAL THEORY AND BEHAVIOUR (4 CREDITS– 60 HOURS)

***Objective**: The objective of this paper is to provide the students an insight into the principles of organizational behaviour and its relation to other activities in an organization, and to introduce the students to the techniques of organisational behaviour used as a management tool.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO 1: Define the concepts of Organisational Behaviour in the global context (Remembering)
CO 2: Explain the Cognitive processes of organizational behavior and its application in workplace (Understanding)
CO 3: Develop models of group dynamics, leadership theories, power & politics in terms of its application in workplace (Applying)
CO 4: Analyse the importance of communication and decision making techniques for improving productivity of employees (Analysing)
CO 5: Determine and develop models of Organizational culture, work stress and Conflict & negotiation in various workplace settings (Evaluating and Creating)

Module I: Introduction to Organizational Behaviour (8 Hours)

Defining Organisational Behaviour, historical background: the Hawthorne Studies; early development, conceptual development; the nature of people; theoretical frameworks; explaining and predicting behaviour; OB in the global context.

Module II: Cognitive processes of organizational behavior (12 Hours)

Nature and importance of Perception and attribution; perception and individual decision making; values, nature and dimensions of attitudes and job satisfaction; personality; aptitude; interests; learning; intelligence, motivation - theories of motivation.

Module III: Group Dynamics (14 Hours)

a) Understanding group dynamics, types of groups, group goals, group cohesiveness, group pressure and norms, teamwork; group structure - formal leadership, roles and norms; group member resources - abilities, personality, characteristics, stages in group development.
b) Leadership Theories - trait, behavioural, contingency, attributional, charismatic, transactional vs. transformational.
c) Power and politics: Contrasting leadership and power; power in groups; power tactics; politics-power in action.

Module IV: Communication and Decision Making (12 Hours)

Role of communication; Communication media and technology, communication networks - formal vs. informal; barriers to effective communication; communication skills; feedback information; persuasion in communication; active listening; participative decision-making techniques; groups vs. the individual; groupthink and group shift; the decision-making process

Module V: Organizational culture and Work Stress (14 Hours)

a) Definition of organizational culture; cultural typologies; organizational culture vs. national culture; functions of culture; formation of cultures; potential sources of stress - environmental factors, organizational factors; individual differences - perception, job experience, social support, locus of control, hostility; Stress – the emergence of stress, causes of stress; stress consequences - physiological symptoms, psychological symptoms, behavioural symptoms, stress management strategies : individual approaches, organizational approaches.
b) Conflict and negotiation: Definition of conflict; the conflict process; conflict in intergroup relations; creating functional conflicts; bargaining strategies; role of personality traits on negotiation; third party negotiations; intergroup relations and factors affecting intergroup relations.

Suggested Readings

1. Luthans Fred, Organisational Behaviour, 10th Edition, McGraw Hill India, 2005
2. Robbins Stephen P, Organizational Behaviour, 11th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004
3. Gilmer, Industrial Psychology, McGraw Hill.
4. Ghiselle and Brown, Personnel and Industrial Psychology, McGraw Hill.
5. Davis Keith, Human Relations at Work, Tata McGraw Hill.
6. Leavitt, Managerial Psychology, University of Chicago Press.
7. Bass B M , Leadership Psychology and Organizational Behaviour, Harper International.
8. Litterer, Analysis of Organizations, John Wiley.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3	M	M	M	
CO 4		H	H	M
CO 5				H

CMBD0042: BUSINESS STATISTICS AND DECISIONS (4 CREDITS-60 HOURS)

***Objective**: The objective of this course is to familiarize students with the applications of statistical techniques in business decisions. This purpose of this course is to provide students with statistical tools needed by managers. The course emphasizes understanding the process associated with statistical decisions, defining and formulating problems, Analysing the data, and using the results in decision making.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO 1: Find the techniques for decision-making under uncertainty.(Remembering)
CO 2: Demonstrate understanding of statistical thinking and data analysis. (Understanding)
CO 3: Apply methods of Correlation, Regression and also use Time based data. (Applying)
CO 4: Analyse from theoretical and practical perspectives, decision making concepts and processes in business settings. (Analysing)
CO 5: Estimate different kinds of Statistical methods like Mean, Median, Mode, Standard Deviation, Index Number. (Evaluating)
CO 6: Combine research concepts and methods in a business setting. (Creating)

Part A: BUSINESS STATISTICS

Module I: Uni-variate Analysis (15 hours)

Measures of Central Tendency including Arithmetic mean, Geometric mean and Harmonic mean: properties and applications; Mode and Median. Partition values - quartiles, deciles, and percentiles. Measures of Variation: absolute and relative. Range, quartile deviation and mean deviation; Variance and Standard deviation: calculation and properties.

Module II: Bi-variate Analysis (10 hours)

Simple Linear Correlation Analysis: Meaning, and measurement. Karl Pearson's coefficient and Spearman's rank correlation. Simple Linear Regression Analysis: Regression equations and estimation. Relationship between correlation and regression coefficients.

Module III: Time-based Data: Index Numbers and Time Series Analysis(15 hours)

Meaning and uses of index numbers; Construction of index numbers: Aggregative and average of relatives – simple and weighted, Tests of adequacy of index numbers, Construction of consumer price indices.
Components of time series; additive and multiplicative models; Trend analysis: Finding trend by moving average method and Fitting of linear trend line using principle of least squares.

Part B: BUSINESS DECISION

Module IV (10 hours)

Course introduction. Introduction to Evidence Based Management. Introduction to measurement theory and statistical inference. Simple decision tools; Rational choice, limited rationality and biases; Modern test theory. Rapid evidence assessment. Academic Survey design and testing.

Module V (10 hours)

Multiple-person decision making. Exploratory data analysis; Forecasting; roadmaps Optimisation; Big data, inference and dimension reduction. Forecasting, roadmaps.

Suggested Readings

1. Sharma J. K., Business Statistics, Pearson Education.
2. Gupta S.C., Fundamentals of Statistics, Himalaya Publishing House.
3. Gupta S.P. and Gupta A, Elementary Statistics, Sultan Chand and Sons, New Delhi.
4. Levin R and Rubin David S, Statistics for Management, Prentice Hall of India, New Delhi.
5. Spiegel M.R., Theory and Problems of Statistics, Schaum's Outlines Series, McGraw Hill Publishing

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	L	M			
CO 2	M	H	M		
CO 3			M	H	H

CMFY0043: FINANCIAL STATEMENT ANALYSI (4 credits – 60 hours)

***Objective**: The course introduces the knowledge of decision makers information about a business enterprise for use in decision-making and to evaluate the economic situation of the firm and predicting its future course based on the financial statements.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO 1: Define the role of standard setters and regulators in Financial Reporting (Remembering).

CO 2: Illustrate the information provided by Balance Sheet, Income Statement and Cash Flow Statement (Understanding)
CO 3: Identify and compare cash flow classifications of operating, investing and financing activities (Applying)
CO 4: Analysing the link between Income statement, Balance Sheet and Cash Flow Statement (Analysing)
CO 5: Criticise rations used to analyse a company's liquidity, profitability, solvency and efficiency (Evaluating)
CO 6: Build a strong base on financial statement analysis (Creating)

Module I: Introduction to Financial Statement Analysis (10 hours)
Scope of Financial Statement Analysis; Financial Statements and other information sources; Financial Statement Analysis Framework; Classification of Business Activities; Financial Reporting Standards; Regulatory Authorities; International Financial Reporting Standards Framework (IFRS); Comparison of IFRS with other Reporting Standards.

Module II: Analysis of Income Statement (15 hours)
Components and format of Income Statement; Revenue Recognition; Expense Recognition; Non- recurring and Non-operating items; Earnings Per Share(EPS) : Simple Vs complex capital structure, Basic EPS, Diluted EPS; Analysis of Income Statement: Common size analysis, Income Statement Ratios.Case Study I

Module III: Balance Sheet (10 hours)
Components and format of Balance Sheet; Measurement Bases of Assets and Liabilities; Equity: Components, Statement of Changes in Shareholders Equity; Uses and Analysis of Balance Sheet: Common size analysis, Balance Sheet Ratios.Case Study II

Module IV: Cash Flow Statement (15 hours)
Components and format of Cash Flow Statement; Linkages and Preparation: Cash Flow Statement with Income Statement and Balance Sheet, Preparation of Cash Flow Statement, Conversion from Indirect to Direct method; Cash Flow Statement Analysis: Evaluation of Sources and Uses of Cash, Common size analysis, Free Cash Flow to Firm and Free Cash Flow to Equity, Cash Flow Ratios.Case Study III

Module V: Financial Statement Analysis Techniques (10 hours)
Financial Analysis Process; Analysis tools and techniques; Common Ratios: Activity Ratios, Liquidity Ratios, Solvency Ratios, Profitability Ratios; Integrated Financial Ratio Analysis.Case Study IV

Suggested Readings

1. Thomas R. Robinson and Elaine Henry: International Financial Statement Analysis, Wiley.
2. Charles H. Gibson:Financial Statement Analysis, Cengage.
3. Subramanyam K R and Wild John J. :Financial Statement Analysis, McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	L	L		M	
CO 2	M	H	H		
CO 3		M			H
CO 4			H		
CO 5			M		H
CO 6	M	H	H	H	

CMMG0044: MANAGERIAL ECONOMICS (4 CREDITS-60 HOURS)

***Objective**: The objective of the course is to acquaint students with the basic principles of micro and macroeconomics for developing the understanding of theory of the firm, markets and the macro environment. This will help them in managerial decision making processes.*

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
CO1: Understand the scope of managerial economics.
CO2: State the difference between demand and supply.
CO2: Outline the determinants of supply and estimate elasticity of supply.
CO3: Summarize the concept of production function and relate it with economies and diseconomies of scale.
CO4: Explain the various kinds of production functions.
CO7: Estimate cost of production of firms.
CO5: Summarize and evaluate fiscal policy and monetary policy to control inflation.
CO9: Describe Balance of Payments and its various components.
CO6: Outline various Open macro-economic concepts

Module I: Managerial Economics (10 Hours)
Introduction to Managerial Economics; Economic factors influencing decisions, Functions Role and Responsibilities of Managerial Economist; Principles in Managerial decision analysis; Micro-Macro Economics, Paradox of Micro Economics, Distinction between Micro and Macro Economics.

Module II: Demand Analysis (10 Hours)
Theories in Demand, Derivation of demand, types, Environment influencing demand; Elasticity of Demand; Advertising or promotional Elasticity; Demand forecasting ; Demand forecasting for new products, Demand Estimation for consumer durables and non-consumer durables.

Module III: Production And Cost Analysis (15 Hours)
Production Function; Law of variable proportions, Production with two variable inputs; Cost Analysis: concept, importance, types – Real opportunity, Money, Fixed, variable, Direct, indirect, Explicit, implicit, past, feature, controllable and uncontrollable, Escapable, inescapable, urgent, potable cost, Replacement and Historical cost, Total Average and Marginal cost in short Run – and Long Run curve; Revenue - Concepts, definition, types-Total, Average, Marginal and relationship with AR and MR

Module IV: Market Structure (13 Hours)
Concept, meaning and classification of Market; Perfect competition-features and price determination; Monopoly – definition, features, types and price determination; Monopolistic competition-meaning, concept, types, price determination and defects; Pricing - types, cost pulls, going rate, Intuitive, Imitative, Marginal cost, Pioneering, Transfer pricing; Price discrimination – Definition, Concept, meaning, types, conditions, Dumping and socio – economic consideration in pricing; Firm objectives, staff, sales and growth Maximization.

Module V: Business Cycle (13 Hours)
Business cycle–cobweb, Hick's Samuelson Theories of Trade cycle; Measures to control Business Cycle; Inflation; Deflation; Economic effects on production distribution and employment, remedies demand full v/s cost push Inflation; Monetary and fiscal policies objectives, role and impact on economic development, Concept of sustainable development, consumption and its inclusive growth.

Suggested Readings

1. Koutsyiannis, A., Modern Microeconomics, Macmillan Press Ltd.
2. Varian, Micro-Economic Analysis , Norton
3. Pindyck Robert S., Daniel L. Rubinfeld and Prem L. Mehta, Micro Economics, Pearson Education Asia, New Delhi.
4. Branson William H., Macro Economics Theory and Policy, First East – West Press.
5. Dornbusch, R. and S. Fischer Macro Economics , Publisher Tata McGraw Hill.
6. Oliver Blanchard ,Macro Economics, Pearson Education, LPE.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L	L		
CO 2	M	M	H	
CO 3		H	M	M
CO 4			M	H

CMAG0045: COST AND MANAGEMENT ACCOUNTING (4 CREDITS-60 HOURS)

***Objectives**:*

- *To understand the different concepts of cost, costing and cost accounting and their practical application in real world scenarios.*
- *To provide in-depth knowledge of the detailed procedure and documentation involved in cost ascertainment systems.*

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
CO1: Define the meaning of cost, costing and cost accounting. (Remembering)
CO2: Illustrate the application of management accounting. (Understanding)
CO3: Identify the detailed procedure and documentation involved in the cost ascertainment system. (Applying)
CO4: Compare profit maximization and wealth maximization as an objective to financial management. (Analysing)
CO5: Interpret the effective techniques for inventory control. (Evaluating)
CO6: Estimate cost of production under different situations. (Creating)

Module I: Introduction to Cost and Management Accounting (10 Hours)
Concepts of Costs; Classifications and Elements of Cost; Cost Centre and Cost Unit; Methods and Techniques of Costing; Installation of a Costing System.

Module II: Management Accounting (10 Hours)
Tools and Techniques of Management Accounting; Relationship of Cost Accounting, Financial Accounting, Management Accounting and Financial Management; Conflicts in Profit Vs Value Maximisation Principle; Role of Management Accountant in Decision Making.

Module III: Material Cost (10 Hours)
Materials Control – Concept and Techniques; Stock Verification; Methods of Pricing of Material: FIFO, LIFO, Simple Average, Weighted Average; Inventory Management: Techniques of fixing of minimum, maximum and reorder levels, Economic Order Quantity, ABC Analysis ; Stock Verification and Perpetual Inventory.

Module IV: Activity Based Costing (Abc) And Cost Records (10 Hours)
ABC Vs Traditional Costing; Uses and Limitations; Cost Ledgers – Integrated Accounts and Non- Integrated Accounts; Reconciliation of Cost and Financial Accounts.

Module V: Costing Systems (20 Hours)
Unit and Output Costing; Job Costing: Job Cost Cards, Collecting Direct Costs; Batch Costing: Features and Applications; Contract Costing: Features, Distinction between Job and Contract Costing, Contract Accounts, Accounting for Material, Accounting for Plant Used in a Contract; Process Costing: Features, Applications and Types of Process Costing; Joint Products, By-Products; Service Costing: Features and Applications; Unit Costing and Multiple Costing.

Suggested Readings
1. Arora, M. N., "Cost and Management Accounting", Vikash Publishing House, New Delhi.
2. Zad, N. S., " Cost and Management Accounting", Taxman, New Delhi.
3. Aggarwal, P., "Cost and Management Accounting", Bharat Law House, New Delhi.
4. Banarjee, H., "Cost and Management Accounting", Prentice Hall India Pvt, Ltd, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	L	M		L	
CO 2	L	L			
CO 3			M	M	M
CO 4			H		
CO 5					H

CMRC0046: RESEARCH METHODOLOGY IN COMMERCE (4 CREDITS-60 HOURS)

***Objective**: This course is designed to provide students with the necessary skills and knowledge to determine the information necessary to address an identified research problem (basic or applied) and, using this understanding, develop and use an actionable research proposal. In this process, the students will gain an understanding of relevant approaches and elements of undertaking a research enquiry specifically to provide insights to solving a relevant problem.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define and tell why research and its methodology are important. (Remembering)
CO2: Explain the use of methodology in understanding the process of research. (Understanding)
CO3: Identify the sources of data and apply various data collecting techniques. (Applying)
CO4: Classify, analyse and draw inferences from Data. (Analysing)
CO5: Justify the use of various methods in evaluating data. (Evaluating)
CO6: Design methodology specific to the study under consideration. (Creating)

Module I: Introduction to research (10 Hours)
Concept and nature, objectives, criteria of a good research, social science research, business research, approaches to research-qualitative and quantitative research, types of research; case study research, research methodology, difficulties of social science research in India.

Module II: Research design (8 Hours)
features of a good research design; research problem: definition, Components, selection and formulation of research problem; formulation of hypothesis, research design: types, research design for experimental exploratory and descriptive research.

Module III: Sampling design (8 Hours)
Meaning, significance; sampling process; principles of sampling essentials of a good sample, methods of sampling; determination of sample size.

Module IV: Data collection (8 Hours)
Meaning, types, methods; Sources of data-Use of secondary data-Methods of collecting primary data-Observation-Interviews-Questionnaires and Schedules.

Module V: Processing and Analysis of Data (8 Hours)
Processing Operations –Types of Analysis-Presentation and Interpretation of Data- Editing, Classification and Tabulation-Interpretation.

Module VI (8 Hours)

Preparation of a Report-Types of Report-Research Report-Format-Principles of Writing Reports- Documentation-Footnotes and Bibliography.

Module VII (10 Hours)

Quantitative Tools-Measures of Central Tendency-Dispersion-Measures of Correlation- Simple and Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z and Chi square-Time Series Analysis-Trend Measurement-Moving Averages.

Suggested Readings

1. Kothari C.R , Research Methodology: Methods and Techniques, New Age International,
2. Srivastava, S. C. : Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.
3. Sharma H.D. and Mukherji S. P: Research Methods in Economics and Business, New York : The Macmillan Company, 1992.
4. Saunders M , Philip Lewis and Adrian Thornhill, Research Methodology for business students, Pearson Education
5. Michael V.P, Research Methodology in Management, Himalaya Publishing House

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M		M	
CO 2	M	H	H		
CO 3		M			H

CMBE0047: BUSINESS ENVIRONMENT (3 CREDITS– 45 HOURS)

***Objective**: To apply relevant knowledge, skills and exercise professional judgement in understanding the macro environment in which a business organisation operates. The course would also make the students capable of analysing and understanding policies of the government implemented from time to time and assess their impact on business.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define economic systems in depth (Remembering)
CO2: Outline how an entity operates in a business environment (Understanding)
CO3: Identify the role of Public and Private sector in the business environment (Applying)
CO4: Examine the trade environment in details (Analysing)
CO5: Explain the impacts of Government policy on the economic environment (Evaluating)
CO6: Elaborate the various trade blocs and the role of WTO (Creating)

Module I: Business Environment (9 classes)

Concept, Components and importance; Indian Business Environment; Cultural, social, political, technological, economic and legal environment; scanning techniques of environmental forecasting; SWOT- Internal environment -their impact on policy formulation.

Module II: Economic trends (9 classes)

Economic reforms in India –Liberalization, privatization and globalization; Competitive Strength of Indian industry; Impact of liberalization policy on different sectors; Foreign Investments policy in India.

Module III: Multinational Corporations (8 classes)

Multinational corporations and their participation in India; strategies of multinational corporations;competitive strengths policies and performance.

Module IV: Business Ethics and Social Responsibilities (9 classes)

Business ethics and social responsibilities; relationship between business and society; Corporate power social accountability; Ethical issues and values in business; Corporate Social policies - issues and challenges; Ecological and environmental issues.

Module VI: Economic Development of North Eastern Region (10 classes)

Special package for economic development of the north eastern region; DONER and its role in economic development, infrastructure and industry; North East Industrial Policy- promotional measures for cross-border trade, Role of NEC and NEDFI. Problems and prospects of the industry in Assam, Brief study of the tea industry, paper industry, food processing industry, silk industry and bell metal industry; tourism industry.

Suggested Readings

1. Wheelen, Concepts of Strategic Management and Business policy, Pearson Education, New Delhi.
2. Islam Swabera & Kharkongor; Business Environment, Taxman's Publication, New Delhi.
3. Misra S.K., Puri V.K.; Indian Economy, Himalaya Publishing House, Mumbai.
4. Deepashree, Indian Economy, Tata McGraw Hill, New Delhi.
5. Dutta Rnddar and Sundaram KPM , S. Chand & Co. Ltd., New Delhi.
6. Agarwal A.N., Indian Economy, New Delhi.

7. Kazhmi Azhar, Business Policy,
8. Gupta, Liberalisation - its impact on Indian Economy, Macmillan.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	L	M	H		
CO 2	M	M	M		
CO 3		L		H	H
CO 4			M	M	H

CMBL0048: BUSINESS LAW (3 CREDITS- 45 HOURS)

***Objectives**: The objectives of this course is to enable students to have a detailed understanding of the Indian Contract Act, 1872, The Companies Act, The partnership act. The course also aims at giving the students in depth knowledge about the Negotiable Instruments Act 1881.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Relate with the legal environment that is influencing business functioning. (Remembering)
CO2: Illustrate a proper perspective about legal environment for better decision making. (Understanding)
CO3: Identify the legal provisions in the formation of a company and partnership. (Applying)
CO4: Examine the validity of any contract as per the law. (Analysing)
CO5: Interpret the uses and application of the various negotiable instruments. (Evaluating)
CO6: Formulate a valid contract with all legal provisions and conditions. (Creating)

Module I: The Indian Contract Act, 1872

a) Proposal- its communication, acceptance and revocation; Agreement vis-à-vis contract, void agreement & voidable contract
b) Consideration – essential elements, exception to rule- No consideration no contract; privity of contract and consideration
c) Capacity to contract; Free consent – coercion, undue influence, misrepresentation, fraud; Mistake – of fact and of law
d) Legality of object – agreements opposed to public policy and in restraint of marriage, trade & legal proceedings; Contingent contracts
e) Performance of contract–liability of joint promisor; Consequences of breach of contract–liquidated damages and penalty
f) Quasi contract; Indemnity guarantee–surety's liability
g) Bailment–Duties and liabilities of bailor and bailee, bailment of pledges;
h) Agency–types of agency, agents duty to principal and vice-versa, ratification and revocation of agent's authority

Module II: The Companies Act, 1956

a) Meaning, characteristics and kinds; Lifting the corporate veil; Registration and incorporation; Memorandum of Association–alteration therein
b) Doctrine of Ultra Vires–consequences of ultra vires transaction
c) Articles of Association–alteration therein, its relation with memorandum of Association; Rule of constructive notice; Doctrine of Indoor Management; Prospectus- liability for misstatement, statement in lieu of prospectus
d) Shares–statutory restrictions, kinds of share capital; Debentures
e) Directors- Position, Appointment, Removal, Power & Duties, their responsibility for offence under N.I. Act & I.T.Act,2000
f) Meetings; Majority Powers and Minority Rights; Prevention of Oppression and Mismanagement
g) Winding up-liability under N.I.Act, Winding up by order of court and subject to its supervision; Voluntary winding up; Conduct of winding up

Module III: The Partnership Act, 1932

a) Nature of Partnership; Relation of partners-inter se; Relation of partners to third parties; Incoming and outgoing partners
b) Dissolution of Firm; Registration of Firms-effect of non-registration
c) Offences by Firm- liability under N.I. Act & I.T. Act, 2000

Module IV: The Negotiable Instruments Act, 1881 - As Amended by The Negotiable Instruments(Amendment and Miscellaneous Provisions) Act, 2002

a) Notes, Bills and Cheques-Promissory notes, Bills of exchange and cheques (Demand drafts, payment orders etc.);Drawer, Drawee, Acceptor, Holder, Holder in due course, payment in due course
b) Endorsement-Endorsement in blank and endorsement in full, conversion of endorsement in blank into endorsement in full and its effects
c) Negotiation; Presentment-At sight, on presentment, after sight, presentment for payment; Maturity-Calculating its period; Noting and protest-Protest for better security; Presumption as to negotiable instruments-and estoppel; Cross

Cheques- Cheques crossed generally and specially;Of penalties in case of Dishonour of certain cheques for insufficiency of funds etc.; Offences by companies

Suggested Readings

1. Majumdar A.K. & Kapoor G.K., Company Law & Practice, Taxmann Publication
2. Gupta Vijay, K.C. Garg ,Company Law, Kalyani Publishers
3. Auter, Company Law- Singh, Eastern Book Company, Lucknow.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2	M	H		
CO 3			H	H

CMFI0049: CORPORATE FINANCE (4 CREDITS – 60 HOURS)

***Objectives**: The main objective of the course is to provide the conceptual background for corporate financial analysis from the point of corporate value creation. The course develops a theoretical framework for understanding and analysing major financial problems of modern firms in the market environment.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Explain the basic tools and concepts necessary to understand modern financial theory and its application in corporations. (Understanding)
CO2: Apply capital budgeting tools for evaluating investments. (Applying)
CO3: Analyse the relationship between capital structure, risk and shareholder value using the Modigliani Miller Theorems. (Analysing)

Module I: Introduction to Corporate Finance (15 hours)

Objective of Corporate Finance; Role of finance manager in corporations; types of firms; stock markets; financial institutions; Financial Statement Analysis: Balance Sheet analysis, Income Statement analysis, Cash Flow statement; Case Study - Enron

Module II: Investment Decisions (10 hours)

Net Present Value (NPV) rule; Payback rule; Internal Rate of Return (IRR) rule; Modified Internal Rate of Return; Choosing between projects; Capital Budgeting process; Forecasting Incremental Earnings; Break even Analysis; Scenario analysis; Options in Capital Budgeting – Delay, Expand, Abandon

Module III: Stock Valuation (20 hours)

Models of Stock Valuation; Dividend Discount Model; Discounted Cash Flow Model; Comparable Companies Analysis; Systematic Risk vs Equity Risk; Measuring Systematic risks; Beta; Capital Asset Pricing Model (CAPM); Cost of Capital: Weighted Average Cost of Capital (WACC), Cost of Debt, Cost of Equity, Using WACC to value a project.

Module IV: Long Term Financing (15 hours)

Equity financing for Private Companies; Initial Public Offerings (IPO); Case Study – Google's IPO; Debt Financing: Private Debt and Public Debt, Bond Covenants, Repayment Provisions; Capital Structure: Capital Structure Choices, Capital Structure in Perfect Capital Markets, Modigliani and Miller (MM) Model, Debt and Taxes.

Suggested Readings

1. Berk and DeMarzo : Corporate Finance, Pearson.
2. Brealey, Richard/ Myers, Stewart C. / Allen, Franklin :Principles of Corporate Finance, McGraw Hill.
3. Aswath Damodaran : Investment Valuation, John Wiley.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			M
CO 2		M	H	
CO 3	M		M	
CO 4		H		
CO 5				H

CMPG0050: PRINCIPLES OF MARKETING (4 CREDITS – 60 HOURS)

***Objective**: To apply relevant knowledge, skills and exercise professional judgement in selecting and applying marketing principles and concepts in different business contexts and to contribute to the evaluation of the performance of an organisation and its strategic and operational development.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO 1: Define and explain marketing mix models in workplace and contribute to organisational growth (Remembering and Understanding)
CO 2: Assess the impact of product and brand management decisions on organizational performance (Applying)
CO 3: Examine the effectiveness of pricing and promotion decisions (Analysing)
CO 4: Determine appropriate distribution and retailing strategies in improving organisational performance (Evaluating)
CO 5: Elaborate the Rural Marketing initiatives and Developments in Marketing (Creating)

Module I: Introduction to Marketing (12 classes)

Marketing in the Twenty-First Century; The Impact of the New Economy; Change in Customers; Changes in Business Scenario; Marketing Objectives; Marketing Environment; Marketing Mix; Elements of Marketing Mix, Product Mix, Price Mix, Promotion/Communication Mix, Place Mix/ Distribution Mix; Significance of Marketing Mix; Factors Affecting Marketing Mix; Growth & Future of marketing in India.

Module II: Product, and Product Brand Management (12 hours)

Definition, Features, Characteristics and Classification of Product; Product Life Cycle definitions, Stages of the Product Life Cycle; Implications of the Product Life Cycle Concept; Types of New Products; Challenges to New Product Development; Steps in the Development of the New Product; Introduction, Objectives, Problems and Process of Test Marketing; Introduction to Product Brand, Definition of Product Branding, Purpose of Branding, Features of Good Brands, Significance and Importance of Branding, Branding in a new economy.

Module III: Pricing and Promotion Decision (12 Classes)

a) Pricing Decisions; Concept of Price; Significance of Pricing; Factors Affecting Pricing Decisions; Major Pricing Methods; Pricing Policies and Strategies; Geographical Pricing, Product Line Pricing, Discounts and Rebates.
b) Meaning and Nature of Promotion, Importance of Promotion, Communication Process, Concept of Integrated Marketing Communication, Meaning of Promotion Mix, Elements of Promotion Mix (Methods of Promotion), Factors Influencing Promotion Mix Decisions, Promotion Mix Strategies, Communication Planning and Control.

Module IV: Distribution and Retailing (12 Classes)

a) Channels of Distribution: Meaning of a Channel of Distribution, Importance of Channels of Distribution, Types of Distribution Channels, Choice of a Channel of Distribution, Functions of Distribution Middlemen, Distribution Strategies, Wholesaling.
b) Meaning of Physical Distribution, Importance of Physical Distribution, Elements of Physical Distribution, Marketing Logistics Decisions.
c) Meaning of Retailing, Functions and Services of Retailers, Types of Retailing; Malls and major markets; FDI in retail market; Management of Retailing Operations: An Overview, Retailing in India – Changing Scenario.

Module IV: Rural Marketing, Consumer Protection and Developments In Marketing (12 Classes)

a) Growing Importance of Rural Markets, Distinguishing Characteristics of Rural Markets, Understanding Rural Consumer and Rural Markets, Marketing Mix Planning for Rural Markets.
b) Consumer Protection, Need for Consumer Protection, Measures for Consumer Protection, Consumerism – Evolution, Meaning and Approaches, Laws to Protect Interests of Consumers.
c) Recent Developments in Marketing, Social Marketing, Direct Marketing, Online Marketing, Relationship Marketing, Green Marketing, Marketing Ethics, Sustainable Marketing, Marketing of Services.

Suggested Readings

1. Gupta C.B., Principles of Marketing, Sultan Chand & Sons.
2. Kotler Philip , Marketing Management, Pearson Education, New Delhi.
3. Sherlekar S. A., Marketing Management, Himalaya Publishing House, Mumbai.
4. Kumar A & Meenakshi, Marketing Management, Vikas Publishing House, New Delhi.
5. Saxena R, Marketing, Himalaya Publishing House, Mumbai.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3	M	M	M	
CO 4		H	H	M
CO 5				H

CMBS0051: INTERNATIONAL BUSINESS (4 CREDITS – 60 HOURS)

***Objective**: This course provides an overview of the environment, concepts, and basic differences involved in international business.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO 1: Describe the foundation of international business.
CO 2: Describe international organizations and multinational corporations.
CO 3: Define forms of foreign involvement.
CO 4: Discuss international trade theory.

Module I: Introduction to Global Business (15 hours)

Global Business: Scope, Global Linkages today; Culture and Global Business: Elements of culture, Training Challenge; Global Trade and Investment Theory: Mercantilism, Classical Trade Theory, Factor Proportion Theory, International Trade and Product cycle theory, Theory of International Investments; Structure of Indian Foreign Trade: Composition & direction; EXIM Bank; Exit Policy of India; Regulation and Promotion of Foreign Trade.

Module II: Global Financial Markets (15 hours)

Foreign exchange markets; Fixed and Floating Foreign exchange rates; Significant monetary events; Exchange rates, interest rates and economic policy; Economic Integration; Government Trade Policies.

Module III: Global Business Environment (15 hours)

Private International Law; Public International Law; Risk to Global Business; Doctrine of Sovereign Immunity; Doctrine of Eminent Domain; Labour Law Differences; Theoretical foundations of International Business; Balance of Payments; International Liquidity; International Economic; Accounting and Tax differences; Multinational Corporations; Foreign Direct Investment.

Module IV: International Finance (15 hours)

Financing exports and imports; International Capital and Cash Management; Capital Structure: International Dimensions; International Capital Markets; International Banking and Security Markets; IMF; World Bank; IFC; ITA; ADB; WTO.

Suggested Readings

1. Joshi Rakesh Mohan: International Business, Oxford University Press.
2. Cherunilam F: International Business: Text and Cases, PHI Learning.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L	M		H
CO 2	M		M	
CO 3		M	H	M
CO 4		H	M	H

CMSH0052: STRATEGIC HUMAN RESOURCE MANAGEMENT (4 CREDITS – 60 HOURS)

***Objective**: The objective of this course is to develop within the students the understanding of the student with relevant concepts, roles and challenges related to strategic human resource management practices in the workplace and design the requisite skills to be competent contributors in the organization's strategic decision-making process and make them competent to for various managerial and administrative positions in different organizations.*

COURSE/ LEARNING OUTCOMES:

After learning this course, the students will be able to:

CO 1: Define the hierarchy of strategy, classify between traditional HR and strategic HR. (Remembering)
CO 2: Explain the factors behind the emergence of strategic human resource management (Understanding)
CO 3: Choose the aims of strategic HRM, interpret the various approaches to strategic HRM and identify the barriers in implementing HR strategies (Applying)
CO 4: Analyse the concept of HR strategies, explain the approaches of developing HR strategies and analyse the ways in which HR strategies can be implemented (Analysing)
CO 5: Analyse the strategic role of the HR director, determine the strategic role of the HR specialists and design the new mandate for HR
CO 6: Evaluate the various approaches to motivation, develop the retention strategy and flexibility strategy that should be adopted by an organisation (Creating)

Module I: Introduction to Strategic Human Resource Management (12 hours)

Introduction, Strategy, Hierarchy of Strategy, Corporate Level Strategy, Business Level Strategy, Functional Level Strategy, Strategic HRM, Emergence of Strategic Human Resource Management (SHRM), The Evolutionary Stages of Strategic HRM, Difference Between Traditional HR and Strategic HR, Case study

Module II: Concepts of Strategic Human Resource Management (12 hours)

Introduction, Trends in Strategic Human Resource Management, HR Practitioners Role, Human Resource as Competitive Advantage, Aims of Strategic HRM, Approaches to Strategic HRM, Formulation of HR Strategies, The Classical Sequential Approach, The Empirical Need-based Approach, Achieving Strategic Fit, Problems in Achieving Strategic Fit, Benefits of Strategic HRM, Barriers to Strategic HRM, Case study

Module III: Human Resource Strategies and its Implementation (12 hours)
Introduction, HR Strategies, Types of HR Strategies, Overarching Strategies, Specific HR Strategies, Criteria for an Effective HR Strategy, Developing HR Strategies, Methodology for Formulating HR Strategies, Setting Out the Strategy, conducting a Strategic Review, Implementing HR Strategies Barriers to the Implementation of HR Strategies, Overcoming the Barriers, Case study

Module IV: Roles in Strategic Human Resource Management (12 hours)
The Strategic Role of Top Management, The Strategic Role of Front-line Management, The Strategic Role of the HR Director, The Strategic Role of the HR Specialists, The New Mandate for HR, The Specific Strategic Roles of HR, Business Partner, The Innovation Role, The Change Manager Role, The Implementer Role, Case study

Module V: Challenges in Strategic Human Resource Management (12 hours)

Introduction, The Challenges of Workplace Diversity, The Management of Workplace Diversity, Managing Diverse Workforce in an Organisation, Planning a Mentoring Program, Organising Talents Strategically, Retention Strategy, Talent Management Strategy and its components, Approaches to Human Resource Planning, Managing Executive Information Systems, Challenges for HR Managers, HRM Strategic Challenges, Case study

Suggested Readings

1. Deb Tapomoy , Strategic Approach to Human Resource Management Concept, Tools and Application, Atlantic Publishers & Distributors Pvt Ltd.
2. Nayantara Padhi, Strategic Human Resources Management: Theory and Practice, Atlantic Publishers and Distributors Pvt. Ltd; 1 edition
3. Mello Jeffrey A., Strategic Management of Human Resources, Cengage Learning, 3rd edition
4. Sharma A, Khandekar A, Strategic Human Resource Management – An Indian Perspective, SAGE Publications
5. Schuler, R. S., & Jackson, S. E., 2009, Strategic Human Resource Management.2nd ed., Wiley-India
6. Sharma, A and Khandekar, A., 2006, Strategic Human Resource Management: an Indian perspective.1st ed., Response Books.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3	M	M	M	
CO 4		H	H	M
CO 5				H

CMCR0053: CONSUMER BEHAVIOUR (4 CREDITS – 60 HOURS)

***Objective**: The objective of this course is that the students should be able to understand the different concepts of consumer behaviour, implications of motivation, personality, perception, learning in marketing, role of social and cultural settings on consumer behaviour and consumer buying process and will make them competent for taking responsible positions in the area of marketing in different organizations.*

COURSE/ LEARNING OUTCOMES:

After learning this course, the students will be able to:

CO1: Define the consumer behaviour, relate the various marketing implications select the learning principles in marketing, find the influence of culture and subculture on consumer behaviour and define the stages of consumer buying process (Remembering)

CO2: Explain the models of consumer decision process, interpret the concepts of motivation, personality and perception with reference to consumer buying behaviour, relate the concept of conditioning in consumer buying (Understanding)

CO3: Apply the factors influencing consumer behaviour in developing marketing strategies, identify the impact of personality and perception on marketing strategies, choose the important aspects of information processing theory, make use of social stratification to develop marketing strategy, identify purchase decision and post purchase behaviour in varied marketing situations (Applying)

CO4: Analyse market segmentation and segmentation of consumer markets, classify the types of brand personality, analyse the split-brain theory, compare the various types group influence on consumer behaviour and analyse traditional and contemporary models of consumer behaviour (Analysing)

CO5: Assess the positioning strategies on buying behaviour, determine the relationship between personality and self image, evaluate the relationship between traditional and contemporary models of consumer behaviour (Evaluating)

CO6: Discuss the types of research methods, Elaborate the measures of consumer learning and design strategies for influencing family purchasing decision-making and the consumption related roles (Creating)

Module I: Contemporary Dimensions of Consumer Behaviour (12 hours)
Consumer Behaviour, Consumer Decision-Making, Models of Consumer Decision –Making, Types of Consumer Buying Behaviour, Factors influencing Consumer Behaviour, Market Segmentation, Segmentation of Consumer markets, Positioning, Differentiation and Marketing Mix, Marketing Research;Consumer Research Process, Types of Research Methods.

Module II: Marketing implications of Motivation, Personality and Perception (12 hours)
Motivation and its Marketing Implications, Personality and its Marketing Implications, Brand Personality, Personality and self Image, The Concept of Perception, Perception and its Impact on Marketing strategies

Module III: Application of Learning Principles in Marketing (12 hours)
Consumer Learning, Concept of Conditioning, Important Aspects of Information Processing Theory, Split-Brain Theory, Measures of Consumer Learning

Module IV: Implications Social and Cultural Settings on Consumer Behaviour (12 hours)
Influence of culture and Subculture on Consumer Behaviour, Influence of Social Class on Consumer Behaviour, Social Stratification and Marketing Strategy, Group Influence on Consumer Behaviour, Household and Family Influence on Consumer Behaviour, Socialisation of family Members, Family Purchasing Decision-Making and Consumption Related Roles, family Life Cycle.

Module V: Consumer Buying Process (12 hours)

Stages of Consumer Buying Process, Purchase Decision and Post Purchase Behaviour, Traditional and Contemporary Models of Consumer Behaviour; Case study

Suggested Readings

1. Blackwell, Roger D, Paul W Miniard and James F Engel, Consumer Behaviour, Thomson Learning Inc.,2002.
2. Duhan S.N., GarimaSahni N.K. , Consumer Behaviour, 1st edition, 2016, Kalyani Publishers
3. Loudon, David l., and Albert J. Della Bitta, Consumer Behaviour, Tata McGraw Hill, New Delhi
4. Schiffman, Leon G., and Leslie kanuk, Consumer Behaviour, Prentice Hall, New Delhi
5. Schiffman, Kanuk L L., S Ramesh Kumar, Consumer Behaviour, 10th edition, Pearson
6. Dheeraj Sinha, Consumer India Inside the Indian Mind and Wallet, 2011, Jain Book Depot

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3	M	M	M	
CO 4		H	H	M
CO 5				H

SPECIALISATION: ACCOUNTING AND TAXATION

CMTM0054: CORPORATE TAX MANAGEMENT (4 CREDITS-60 HOURS)

***Objectives**:*

- *To familiarize students with corporate tax planning.*
- *To cram the process of computation of tax for companies.*
- *To identify the process of business reorganization in terms of tax planning*

COURSE/LEARNING OUTCOMES

At the end of the course the students will be able to:

CO1: Define the concept of tax management. (Remembering)
CO2: Compare between tax planning and tax management. (Understanding)
CO3: Identify the tax planning process of companies. (Applying)
CO4: Analyse various tax incentive plans for corporate sector. (Analysing)
CO5: Measure tax planning in case of amalgamation or de-merger. (Evaluating)
CO6: Adapt the concept of limited liability partnership. (Creating)

Module I: Introduction of Tax Planning and Management: (5 Hours)
Tax planning, tax management, tax evasion and tax avoidance; Nature and scope of tax planning and tax management in the corporate sector.

Module II: Assessment of Companies' Tax Management: (15 Hours)
Residential Status and incidence of tax, Computation of corporate tax: Carry forward and set off of losses in the case of

certain companies under Sec. 79 of Income-tax Act, 1961; various deductions available to corporate assess.

Module III: Tax Computation of Companies (15 Hours)

Computation of taxable income of companies;Computation of amount of corporate tax liability; Minimum Alternate Tax; Tax on distributed profits of domestic companies; Tax on income distributed to unit holders.

Module IV: Tax Planning a Specific Tax Management Decisions (10 Hours)

Implications of Tax concessions and incentives for corporate decisions in respect of setting up a new business, location of business and nature of business.

Module V: Business Reorganisation (15 Hours)

Tax Planning in respect of amalgamation or de-merger of companies ,Slump sale, conversion of a firm into a company; Conversion of sole proprietorship into company, Conversion of company into limited liability partnership.

Suggested Readings

1. Srinivas, E.A, Corporate Tax Planning, Tata McGraw Hill, New Delhi.
2. Singhania,Vinod. K,Taxmann's Direct Taxes, Law & Practice, Taxman, New Delhi.
3. Ahuja. Girish & Gupta, Ravi, Bharat's Professional Approach to Direct Taxes, Law & Practice, BharatLaw House Pvt. Ltd., New Delhi.
4. Bhagmati Prasad, Direct Taxes and Laws and Practice, WishwaPrakashan, New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M		M	
CO 2	M	H	H		
CO 3		M			H
CO 4			H		

CMAF0055: ACCOUNTING THEORY AND FINANCIAL REPORTING (4 CREDITS-60 HOURS)

***Objectives**:*

- *To provide knowledge about the notion of accounting theory.*
- *To enable students to learn the reporting aspect of specific accounting standards.*
- *To identify the key issues in corporate financial reporting.*

COURSE/LEARNING OUTCOMES

At the end of the course the students will be able to:

CO1: Define the concept of accounting theory.(Remembering)
CO2: Compare various accounting standards (AS). (Understanding)
CO3: Apply the knowledge of IFRSs.(Applying)
CO4: Analyse the FASB and IASB. (Analysing)
CO5: Assess the issues in corporate reporting. (Evaluating)
CO6: Adapt the thought of segment reporting. .(Creating)

Module I: Accounting Theory (15 Hours)

Nature; Classifications of Accounting Theory; Different Approaches toTheory Construction; Factors Influencing Accounting Environment; Measurement in Accounting; Accounting Principles: Generally Accepted Accounting Principles; Indian Accounting Standards.

Module II: Reporting of Explicit Accounting Standards (10 Hours)

AS-1: Disclosure of Accounting Principles; AS-6: Depreciation accounting; AS-9: Revenue Recognition; AS-27: Financial Reporting of Interests in Joint Ventures; AS-29: Provisions, Contingent Liabilities and Contingent Assets.

Module II: Financial Reporting (10 Hours)

Nature, Objectives and Benefits; General purpose and Specific Purpose Report; Qualitative Characteristics of Accounting Information; Conceptual Framework: Financial Accounting Standards Board (FASB)International Accounting Standards Board (IASB).

Module III: International Financial Reporting Standards (Ifrss) (15 Hours)

Role of International Accounting Standards Board (IASB); Arguments for Global Convergence; Required Disclosure as per International Financial Reporting Standards; Achievements of International Accounting Standards Board(IASB)and Obstacles in Convergence;Difference between International Financial Reporting Standards(IFRSs) and Indian Accounting Standards; US GAAP.

Module IV: Issues in Corporate Financial Reporting (10 Hours)

Accounting for Changing Prices; Segment Reporting; Interim Reporting; Foreign Currency Translation

Suggested Readings

1. Porwal, L.S, Accounting Theory, McGraw Hill Education (India) Ltd. New Delhi

2. Lal,Jawahar,Accounting Theory and Practice, Himalaya Publishing House, New Delhi.
3. Das, Arjun &Saxena, Vishal, Accounting Theory & Practice, Navyug Publications; 2nd edition, Uttar Pradesh.
4. Evans, Thomas G., Accounting Theory, South-Western, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			L
CO 2	M	H		M	
CO 3			H		
CO 4				H	
CO 5					H

SPECIALISATION: FINANCE AND INVESTMENT

CMCR0056: ADVANCED CORPORATE FINANCE (4 CREDITS – 60 HOURS)

***Objectives**: The objective of this course is to equip students with the background to act as finance managers in organizations. This course develops a theoretical framework for understanding and Analysing major financial problems of modern firms in the market environment.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Apply the concept of Time Value of Money for valuation of cash flows. (Applying)
CO2: Explain the determinants of interest rates. (Understanding)
CO3: Illustrate the features of debt securities. (Understanding)
CO4: Build a valuation model for bonds. (Applying)
CO5: Explain Capital structure choices and its impact on the firm. (Understanding)
CO6: Explain the rationale and process of a Mergers and Acquisition deal. (Understanding)

Module I: Interest Rates and Valuation of Cash Flows (15 hours)

Introduction to Time Value of Money; Converting cash across time; Timelines; Finding the present value of a stream of cash flows; Finding the future value of a stream of cash flows; Perpetuity; Annuities – Present Value and Future Value; Growing Cash flows – Growing perpetuity and growing annuity; Determinants of Interest rates; Yield curves.

Module II: Bonds (20 hours)

Features of debt securities – Indenture and covenants, Maturity, Par Value; Coupon rates; Embedded options bonds; Risk associated with bonds – Interest rate risk, Yield Curve risk, Call and prepayment risk, Credit risk, Liquidity risk, Sovereign risk; Yield spreads; Valuation of Bonds; Measurement of Interest rate risk.

Module III: Capital Structure and Payout Policy (15 hours)

Capital Structure choices – Across industries and within industries; Leverage and firm value; Effect of leverage on risk and return; Homemade leverage; Leverage and cost of capital; Costs of Bankruptcy and financial distress – Direct and Indirect costs; Tradeoff theory of Optimal Capital Structure; Dividend versus share repurchase in perfect capital markets; Payout versus retention of cash; Signaling with payout policy; Dividends, splits and spin offs.

Module IV: Mergers and Acquisitions (10 hours)

Background and trends; Rationale of a mergers and acquisition (M&A) deal; Steps in M&A deal; Takeover defences – Poison pills, Staggered Boards, White Knight, Golden Parachutes; Value added in a takeover.

Suggested Readings

1. Berk and DeMarzo: Corporate Finance, Pearson.
2. Brealey, Richard/ Myers, Stewart C. / Allen, Franklin: Principles of Corporate Finance, McGraw Hill.
3. AswathDamodaran: Investment Valuation, John Wiley.
4. Ross, Westerfield, Jordan: Fundamentals of Corporate Finance, McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		H
CO 3		M	M	
CO 4			H	

CMBK0057: INVESTMENT BANKING (4 CREDITS – 60 HOURS)

***Objectives**:The objective of this course is to acquaint students with the various models of equity valuation. Students are expected to be proficient in the use of Microsoft excel for conducting a comparable company analysis and discounted cash*

flow valuation of a publicly traded company.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Explain different valuation models. (Understanding)
CO2: Distinguish between Comparable companies analysis model and Discounted cash flow model. (Analysing)
CO3: Apply the technique of comparable company analysis for valuation of companies. (Applying)
CO4: Build a Discounted Cash Flow model to value a subject company. (Applying)
CO5: Make use of Microsoft Excel for building valuation models. (Applying)
CO6: Explain the steps involved in the Leveraged Buyout process. (Understanding)

Module I: Comparable Companies Analysis (15 hours)

Comparable companies analysis steps; Selecting the universe of comparable companies; Identifying key characteristics of target; Spread key statistics, ratios and trading multiples; Benchmarking comparable companies; Valuation implied by EV/EBITDA; Valuation implied by P/E; Pros and cons of comparable analysis.

Case study I: Valuation of a publicly listed company using comparable company analysis.

Module II: Discounted Cash Flow Analysis I (15 hours)

Summary of Discounted Cash Flow (DCF) analysis steps; Studying the target, Determination of key performance drivers; Financial statement analysis for valuation; Estimation of growth; Models for estimation of Cost of Equity – Capital Asset Pricing Model and Fama-French model.

Case study II: Valuation of a publicly traded company using Discounted Cash Flow model.

Module III: Discounted Cash Flow Analysis II(15 hours)

Estimation of cost of debt; Determination of Weighted Average Cost of Capital; Projection of Free Cash Flow; Determining Terminal Value- Exit Multiple method and Perpetuity growth method; Calculation of present value; Determination of Valuation; Pros and cons of DCF analysis.

Case study II (contd.): Valuation of a publicly traded company using Discounted Cash Flow model.

Module IV: Leveraged Buyouts(15 hours)

Meaning and objective of Leveraged Buyout (LBO); Rationale of LBOs in modern finance; Key participants; Characteristics of a strong LBO candidate; Economics of LBO; Exit and Monetizing strategies; LBO financing.

Suggested Readings

1. Rosenbaum and Pearl: Investment Banking, Wiley Finance.
2. E. Soubeiga: Mastering Financial Models, McGraw Hill.
3. J. Tija: Building Financial Models, McGraw Hill.
4. PratapGiri S: Investment Banking, McGraw Hill.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L	M	H	
CO 2	M	M	M	L
CO 3		H	M	M
CO 4		M	H	H

SPECIALIZATION: MANAGEMENT

CMIG0058: INTERNATIONAL MARKETING (4 CREDITS – 60 HOURS)

***Objective**: To familiarize the students with the concept and issues of international marketing and enable them to be able to analyse the foreign market environment and develop international marketing strategies for a business firm.*

COURSE/ LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define international marketing (Remembering)
CO2: Explain International Product Planning and Pricing decisions (Understanding)
CO3: Identify the traditional to modern channel structures, Intermediaries (Applying)
CO4: Analyse the international distribution decisions in terms of issues and planning (Analysing)
CO5: Evaluate the different aspects of international promotional strategies (Evaluating)
CO6: Elaborate the trends associated with international marketing in the present context (Creating)

Module I: Introduction: Introduction to International Business (14 hours)

An overview; International marketing management process, International marketing information system. International Marketing Environment: Influence of physical, economic, socio - cultural, political and legal environments on international

marketing decisions; International marketing information system. International Market Segmentation, Selection and Positioning; International market entry strategies – Exporting, licensing, contract manufacturing, joint venture, setting -up of wholly owned subsidiaries abroad.

Module II: International Product Planning and Pricing decisions (14 hours)

Major Product decisions-product design, labeling, packaging, branding and product support services; Product standardization vs. adaptation; Managing product line; International trade product life cycle; New product development. Pricing decisions for International Markets: Factors affecting international price determination; International pricing process and policies; Delivery terms and currency for export price quotations; Transfer pricing; Counter trade as a pricing tool- types and problems of counter trading.

Module III: International Distribution Decisions (12 hours)

Distribution channel- from traditional to modern channel structures, Intermediaries for international markets-their roles and functions; Alternative middlemen choices, Factors affecting choice of channels; Locating, selecting and motivating channel members; International distribution logistics- Issues and Planning.

Module IV: International Promotion Strategies (12 hours)

Communications across countries-complexities and issues; Country -of-origin effect; Sales promotions in international markets, trade fairs and exhibitions, International public relations, International Advertising decisions, Personal selling and sales management; Developing international promotion campaign.

Module V: Emerging trends in International Marketing (8 hours)

International Marketing through Internet; Ecological concerns and international marketing ethics.

Suggested Readings

1. Cateora, Philip R, Grahm John L and Prashant Salwan, International Marketing, Tata Mc Graw Hill
2. Czinkota, Michael R. and Illka A. Ronkainon, International Marketing, Cengage Learning
3. International Marketing, P K Vasudeva, 4th edition, 2010, Excel Books , New Delhi.
4. Jain, Subash C., International Marketing, South-Western.
5. Keegan, Warran J and Mark C Green, Global Marketing, Pearson
6. Kotabe, Masaaki and Kristiaan Helsen, Global Marketing Management, John Wiley and Sons.
7. Onkvist, Sak and John J.Shaw, International Marketing; Analysis and Strategy, Psychology Press.
8. Rajagopal, International Marketing, Vikas Publishing House.
9. Terpstra, Vern; Foley, James and Ravi Sarathy, International Marketing, Naper Press.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3		M	M	
CO 4	M		H	M
CO 5				H

CMBC0059: BUSINESS ETHICS AND CORPORATE GOVERNANCE (4 CREDITS-60 HOURS)

***Objective**: This paper aims at providing the students the understanding of ethical issues related to business and good governance necessary for long term survival of business.*

COURSE/LEARNING OUTCOMES

After learning the course the students will be able to:

CO1: Define business ethics. (Remembering)
CO2: Distinguish between ethical and unethical behavior at workplace. (Understanding)
CO3: Elaborate the various theories on ethics in practice. (Applying)
CO4: Evaluate legal and economic aspects of ethics in business. (Analysing)
CO5: Interpret the accountability hierarchy from a corporate governance perspective. (Understanding)
CO6: Design issues involved in addressing litigation risks in corporate governance and regulatory contexts. (Creating)
CO7: Examine ethical theories and frameworks to Analyse ethical dilemmas in business and resolve practical problems. (Analysing)
CO8: Identify different stakeholders and understand why they may hold differing perspectives on ethical issues. (Applying)

Module I: Introduction (9 hours)

Definition & nature of business ethics, characteristics, ethical theories; causes of unethical behavior;ethical abuses; work ethics; code of conduct; public good.

Module II: Ethics Theory and Beyond (13 hours)

Management of ethics - ethics analysis [Hosmer-model]; ethical dilemma; ethics in practice, ethics for managers; role and function of ethical managers- comparative ethical behavior of managers; code of ethics; competitiveness, organizational size, profitability and ethics; cost of ethics in corporate ethics evaluation; business and ecological / environmental issues in the Indian context and case studies.

Module III: Legal Aspects of Ethics (10 hours)

Political – legal environment; provisions of the Indian constitution pertaining to business; political setup – major characteristics and their implications for business; prominent features of MRTP &FERA; social – cultural environment and their impact on business operations, salient features fIndian culture and values.

Module IV: Environmental Ethics (10 hours)

Economic environment; philosophy of economic growth and its implications for business, main features of economic planning with respect to business; industrial policy and framework of government contract over business; role of chamber of commerce and confederation of Indian industries.

Module V: Corporate Social Responsibility and Governance (15 hours)

Definition, evolution and need for CSR; theoretical perspectives; corporate citizenship; business practices; strategies for CSR; challenges and implementation; evolution of corporate governance; governance practices and regulation; structure and development of boards; role of capital market and government; governance ratings; future of governance- innovative practices; case studies with lessons learnt

Suggested Readings

1. Sherlekar S.A. , Ethics in Management, Himalaya Publishing House.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc.
3. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons.
4. Shaw W.H., Business Ethics, Cengage Learning.
5. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis.
6. Kotler Philip and Lee Nancy, Corporate social responsibility: doing the most good for company and your cause, Wiley.
7. Banerjee Subhabrata Bobby , Corporate social responsibility: the good, the bad and the ugly,
8. Edward Elgar Publishing.
9. Kumar Satheesh , Corporate governance, Oxford University, Press.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3			M	M
CO 4		M		H
CO 5	M		H	

CMEM0060: ENTREPRENEURSHIP MANAGEMENT AND E-COMMERCE (4 CREDITS- 60 HOURS)

***Objective**: The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.*

COURSE/LEARNING OUTCOMES

CO1: Define entrepreneurship, its features and ability to discern distinct entrepreneurial traits (Remembering)
CO2: Illustrate the parameters to assess opportunities and constraints for new business ideas (Understanding)
CO3: Demonstrate the systematic process to select and screen a business idea(Understanding)
CO4: Choose the entrepreneurship as a career objective (Applying)
CO5: Analysing the legal framework to set up new ventures (Analysing)
CO6: Find the meaning and Concept of E-Commerce; Business Model for E Commerce (Remembering)
CO7: Discuss the entrepreneurial prospects in e-commerce (Creative)

Module I (15 Hours)

a) Entrepreneurship: Definition, Concept, Growth and role. The Entrepreneur : Types, characteristics, theories of entrepreneurial class, Urges and importance of Entrepreneurship Stimulates; Seed Beds of Entrepreneurship, Influencing Factors; Problems(Operational and Non Operational) and Obstacles. Entrepreneurial Management. Role of socio economic environment.
b) Skills for a New Class of Entrepreneurs; The Ideal Entrepreneurs; The Entrepreneurship Audit; Identification of opportunities by an Entrepreneur; The steps to identify the project/ ventures; Process of converting business opportunities into reality; Feasibility Report and analysis; Process of setting up a small scale industry/unit.

Module II (15 Hours)

Promotion of a venture, External Environment Analysis; Economic, Social, Technological and competition; Legal Framework for establishing and fund raising Venture Capital: Sources and Documents required

Module III (15 Hours)

E-Commerce and Entrepreneurs; Exports and entrepreneurs. Balanced Regional Development and Entrepreneurs, relevant Acts for Entrepreneurs (An overview only); Foreign Exchange and Entrepreneurs; Micro and small enterprises; Recent Initiatives taken by the government to revitalize the Entrepreneurship.

Module IV (15 Hours)

a) Introduction to E-commerce: Meaning and Concept of E-Commerce; Business Model for E Commerce; Sales and Marketing Cycle; Features of E Commerce; Element of E-Commerce; Benefits and Limitations of E-Commerce; Types of E-Commerce System; B2B, B2C, C2C, C2B, B2G andG2C.

b) Electronic Payment systems : Features of an ideal electronic payment system; Types of an Electronic Payment System, Credit Cards, Debit Cards, Smart Cards, E-Money, E Check and Electronic fund transfer (EFT). Need of security in E Commerce; Essential security requirements for safe electronic payments; Security Schemes for an Electronic Payment Systems, Encryption, Digital Signature, Security Certificates; internet security Protocol, SSL, HTTP,SET.

Suggested Readings

1. Entrepreneurship Development Institute of India, "Handbook for New Entrepreneurs", Oxford University Press.
2. Patel V. G., "When the Going Gets Tough – Strategic responses to Business Crisis", Tata McGraw Hill Publishing Company Limited.
3. Desai Vasant, "Small scale industries and entrepreneurship", Himalayan Publishing House.
4. Desai Vasant, "Management of small scale industries", Himalayan Publishing House.
5. Bolton William, "The University Handbook on Enterprise Development", Columbus.
6. Desai Vasant, "Management of small scale industries", Himalayan Publishing House.
7. Gupta Sarika, E-Commerce, Publisher: Khanna Books
8. Joseph P. T., E-Commerce, An Indian Perspective, Prentice Hall India Pvt., Limited

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L	M		
CO 2		M	H	
CO 3			M	H
CO 4		L	M	H

SPECIALISATION: ACCOUNTING AND TAXATION

CMMD0061: MODERN ACCOUNTING (4 CREDITS-60 HOURS)

***Objectives**:*

- *To provide knowledge about the various concepts of accounting.*
- *To learn the application of various accounting concepts.*
- *To categorize the key areas of modern accounting.*

COURSE/LEARNING OUTCOMES

At the end of the course the students will be able to:

CO1: Define the concept of modern accounting. (Remembering)
CO2: Compare various systems of modern accounting. (Understanding)
CO3: Apply the knowledge of environmental accounting. (Applying)
CO4: Analyse behavioural accounting. (Analysing)
CO5: Assess the challenges in social accounting. (Evaluating)
CO6: Adapt the thought of forensic accounting. (Creating)

Module I: Introduction to Modern Accounting (10 Hours)

Various concepts of modern accounting: inflation accounting, environmental accounting, social accounting, forensic accounting and behavioural accounting; its application, process and its scope.

Module II: Inflation Accounting (10 Hours)

Meaning; techniques of inflation accounting; determination of value of assets and liabilities under inflation accounting; accounts preparation under inflation accounting.

Module III: Environmental Accounting (10 Hours)

Meaning; functions of environmental accounting;valuation process under environmental accounting, methods of evaluation under environmental accounting; accounts preparation under environmental accounting.

Module IV: Forensic Accounting (10 Hours)

Meaning;branches of forensic accounting; activities under forensic accounting; procedure of forensic accounting; stages of forensic accounting; application and consequences of forensic accounting.

Module V: Behavioural Accounting (10 Hours)
Meaning; process of behavioural accounting; application of behavioural accounting; techniques of behavioural accounting; influence of accounting information on behaviour.

Module VI: Social Accounting (10 Hours)
Meaning; purpose of social accounting; scope & objectives of social accounting; benefits & challenges of social accounting; accounting under social accounting.

Suggested Readings

1. Lal, Jawahar, Accounting Theory and Practice, Himalaya Publishing House, New Delhi
2. Pedneault, Stephen, Forensic Accounting and Fraud Investigation for Non–Experts, John Wiley & Sons; 3rd edition , New Delhi.
3. Pahuja, Shuchi, Environmental Accounting & Reporting: Theory, Law & Empirical Evidence, New Century Publications, New Delhi.
4. Hellmann, Andreas, Behavioural Accounting, Routledge; 1 edition, New Delhi.
5. Rao, P.M., Corporate Social Accounting and Reporting, Deep & Deep Publications Pvt.ltd , Delhi.

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M		M	
CO 2	M	H	H		
CO 3		M			H

CMAV0062: ADVANCED ACCOUNTING (4 Credits- 60 hours)

***Objective**: The objective of this course is to provide advanced knowledge in the field of accounting. It stresses on specialised accounting processes followed in specific organisations. This course also gives insight into various modern concepts of Accounting.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the recent concepts of accounting (Remembering)
CO2: Explain the conceptual framework in the preparation and presentation of financial statements (Understanding)
CO3: Identify the various modes of liquidation of companies (Applying)
CO4: Compare the accounting techniques followed under general and special processes. (Analysing)
CO5: Determine insurance claims from loss of profit and stock (Evaluating)
CO6: Compile financial statements of insurance and banking companies (Creating)

Module I: Conceptual Framework (10 credits)
Conceptual Framework in the preparation and presentation of Financial Statements: Objectives, Purpose, Constituents of Financial Statements, Underlying assumptions in the preparation of Financial Statements, Qualitative Characteristics and Elements of Financial Statements, Capital Maintenance Adjustments, Recognition of the elements of Financial Statements, Concept of Capital and Capital Maintenance, GAAP and Accounting Standards in India, Compliance Requirements of Accounting Standards in India, Applicability of Accounting Standards

Module II: Accounts of Banking Companies (15 credits)
Accounting of Banking Companies: Nature, Features of Banking Companies, Banking Regulation Act, 1949, Rebate on Bills Discounted, Income recognition, Statutory books to be maintained, special features of Bank bookkeeping, Preparation and presentation of Financial Statements of Banks, Advances and its classification, provisions to be made against advances.

Module III: Accounts of Insurance Companies and Insurance Claims (15 credits)
Accounting of Insurance Companies: Meaning of Insurance Business, Accounts of Life insurance company – Revenue Account, Profit and Loss Account and Balance Sheet, Ascertainment of profit under Life insurance business, Accounts of general insurance business – Revenue Account, Profit and Loss Account and Balance Sheet.
Insurance Claims: Average clause, indemnity period, procedure of ascertaining loss of stock and loss of profit, Ascertainment of claims against loss of stock and loss of profit.

Module IV: Investment Accounts and Liquidation of a company (15 credits)
Investment Account: Meaning, features, concept of cum-interest, ex-interest, cum-dividend, ex- dividend, Accounting for fixed interest learning securities and variable earning securities, bonus shares and right shares, Intercompany investment.
Winding up of a company: Meaning, winding up by National Company law Tribunal, Modes of Winding up, preferential payments, Preparation of Statement of Affairs, Liquidator's Final statement of Account.

Module V: Inflation and Government Accounting (5 credits)
Inflation Accounting: Meaning, Need, Objectives, Current Purchasing Power Method, Current Cost Accounting; Government Accounting: Meaning, features and Objectives of Government Accounting; difference between commercial accounting and Government Accounting; General Principles of Government Accounting; System of financial administration

and financial control in India; Accounts keeping of the government; Classification of Accounts in Government Accounting; Accounting for Human Resources in an Organisation.

Suggested Readings

1. JawaharLal, Financial Accounting, S Chand
2. Hanif & Mukherjee, Advanced Accounting, McGraw Hill Education.
3. Dam B. B., Advanced Accounting, Capital Publishing Company
4. Khan M. Y. , Advanced AccountingM.C. Shukla, Advanced Accounting, S Chand & Co.
5. Maheshwari S. N. , Advanced Accounting, Vikas Publishing.

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2	M	H			
CO 3			M	M	
CO 4			H		
CO 5				H	H

SPECIALISATION: FINANCE AND INVESTMENT

CMFI0063: FINANCIAL INSTITUTIONS MANAGEMENT (4 CREDITS – 60 HOURS)

***Objectives**: The objective of this course is to impart the knowledge of the banking, finance and insurance industry to the students. The student will be able to articulate the operations of each of this industry; understand the various potential conflicts of interests and analyse the regulatory structure of the industry.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Explain the operations of the banking industry. (Understanding)
CO2: Analyse the potential conflicts of interest in the banking industry. (Analysing)
CO3: Explain the operations of the Insurance industry. (Understanding)
CO4: Explain the operations of the financial services industry. (Understanding)
CO5: Outline the risks in the financial industry. (Understanding)
CO6: Analyse the regulatory framework in the banking and financial industry. (Analysing)

Module I: Banking (15 hours)

Commercial Banking; Capital requirements of Banks; Merchant Banking; Investment Banking; Securities trading; Potential conflicts of Interests in Banking; Large Banks and their implications; Risks in Banking. Case study: 2008 financial crisis

Module II: Insurance companies (15 hours)

Life insurance companies: size, structure, composition of industry, recent trends and regulations; Property-casualty insurance: size, structure, composition of industry, recent trends and regulation; Health insurance; Moral hazard and adverse selection; risks in insurance industry.

Module III: Financial services industry (15 hours)

Mutual funds: size, structure, composition of industry, types, objectives, costs, recent trends and regulations; Hedge funds: types of hedge funds, fees in hedge funds industry, offshore hedge funds, and regulation of hedge funds.

Module IV: Risk and regulation (15 hours)

Interest rate risk; Market risk; Credit risk; Off balance sheet risk; Foreign exchange risk; Sovereign risk; Technology and Operational risk; Liquidity risk; Insolvency risk; Liability and liquidity management; Deposit insurance; Basel norms: rationale, Basel I, Basel II, Basel III; Dodd-Frank Act.

Suggested Readings

1. John C Hull: Risk Management and Financial Institutions, Wiley Finance Series.
2. Saunders: Financial Institutions Management, McGraw Hill.
3. Kohn: Financial Institutions and Markets, Oxford University Press.
4. Frank J Fabozzi, Franco Modigliami: Capital Markets – Institutions and Instruments, PHI Learning.

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	M	M	L	
CO 2		H		
CO 3	H			M
CO 4				H
CO 5			H	

CMPN0064: PORTFOLIO MANAGEMENT (4 CREDITS – 60 HOURS)

***Objective**: The objective of this course is to acquaint students with the portfolio perspective of investing. The student will be able to illustrate various risk and return objectives of investors and understand the justification of diversification in a portfolio.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Explain the Portfolio Perspective to Investing. (Understanding)
CO2: Analyse major return measures of an investment. (Analysing)
CO3: Explain the characteristics of the major asset classes that an investor should consider (Understanding)
CO4: Analyse the risk and return objectives and how they may be developed for a client. (Analysing)
CO5: Illustrate the steps in the Investment Management process. (Understanding)

Module I: Introduction to Portfolio Management (15 hours)

Meaning and objectives; Portfolio Perspective on Investing: Diversification, Risk Aversion, Composition, Downside Protection, Modern Portfolio Theory; Investment Clients; Steps in Investment Management Process; Pooled Investments: Mutual Funds, Types of Mutual Funds, Other Investment Products.

Module II: Portfolio Risk and Return I (20 hours)

Investment Characteristics of Assets: Return, Return measures and their applications, Variance and Covariance of Returns, Historical Risk and Returns, Other Investment Characteristics; Risk Aversion and Portfolio Selection; Portfolio Risk; Efficient frontier; Investor's Optimal Portfolio; Capital Market Theory; Pricing of Risk: Systematic Nonsystematic Risk.

Module III: Capital Market expectations and Asset allocation (15 hours)

Economic Analysis: Business Cycle Analysis, Economic Growth Trends, International Interactions; Asset Allocation: Strategic Asset Allocation in relation to Systematic Risk, Strategic vs Tactical Asset Allocation; Asset Allocation and Investor's Risk and Return objectives; Selection of Asset Classes; Optimization Approaches; Implementing Strategic Asset Allocation.

Module IV: Investment Planning (10 hours)

Investment Policy Statement (IPS): Components, Gathering Client Information; Capital Market Expectations; Strategic Asset Allocation; Investment Instruments: Equity, Fixed Income, Mutual Funds, Real Estate, Insurance Investments.

Suggested Readings

1. ZviBodie: Essentials of Investment, McGraw Hill.
2. Reilly and Brown: Analysis of Investments and Management of Portfolios, Cengage.
3. Chandra Prasanna : Investment Analysis and Portfolio Management, McGraw Hill.
4. Ranganatham: Security Analysis and Portfolio Management, Pearson.

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M		M	
CO 2	M	H	H		
CO 3		M			H
CO 4			H		

SPECIALIZATION: MANAGEMENT

CMIL0065: MANAGEMENT OF INDUSTRIAL LAWS (4 CREDITS- 60HOURS)

***Objective**: The objective of this course is to make the students aware of the legal aspects of management. Every industrial concern is set to follow certain terms and guidelines and the management has to take due care about it. This course will give a detailed idea about the various industrial laws and its provisions.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the terms commonly used in industrial laws (Remembering)
CO2: Explain the various provisions of labour laws (Understanding)
CO3: Identify the factors essential for management of labour unions (Applying)
CO4: Analyse the different theories of Trade Unionism.(Analysing)
CO5: Assess the impact of economic changes upon labour management (Evaluating)
CO6: Develop a model of business management abiding by all industrial laws (Creating)

Module I: Introduction to Labour Laws (15 credits)

Origin and Development, Objectives and Principles of Labour Laws, Development of Labour Laws in India, Concept of Industrial Relations- Importance, Scope & Aspects of Industrial Relations, Factor Affecting Industrial Relations, Different approaches/perspectives of Industrial Relations, Industrial conflict, unfair labour practices, concept of Labour welfare & activities of labour welfare officer, Political influence on trade unions, Workers Education, Role of trade union in the

changed economic scenario.

Module II: Regulatory framework for management of industries (15 credits)
Trade Union Act, 1926, The Industrial Employment (Standing Orders) Act, 1946, Factories Act, 1948, Payment of Bonus Act, 1956, Payment of Wages Act, 1936: scope, objectives and important provisions

Module III: Dispute and settlement (15 credits)
Industrial Disputes Act, 1947: Industrial Disputes, Development of Industrial Disputes Legislations in India, Mechanisms for settlement of Industrial Disputes, Constitutional and Statutory Framework in India, unions and technological changes, Industrial relation system, Instruments of economic coercion, discipline, domestic enquiry grievance procedure and disciplinary action, Principle of natural justice.

Modu:le IV Prevention and legal regulations regarding labour management (15 credits)
Machinery for prevention of industrial disputes, Welfare Officer works committees, Joint Management Council, Ethical Codes, Methods of setting Industrial Disputes, Arbitration Adjudication, Tripartite and Bipartite Machinery, Collective Bargaining, workers' participation in management, Labour management and cooperation, Industrial relations and related legislations with special reference to industrial disputes Act, 1947, labour welfare and social security, Lok Adalat as a body to conduct mediation. Case studies

Suggested Readings

1. Goswami G V , Labour Industrial Laws, Central Law Agency.
2. Pillai K M , Labour and Industrial Law, Allahabad Law Agency
3. Mishra S N , Labour and Industrial Laws, Central Law PublicationsS
4. Singh BD , Labour Law for Managers, Excel Books, New Delhi,
5. Pai GB , Labour Law in India, Butterworth's India, New Delhi
6. Srivastava SC, Industrial Relations and Labour Laws, Vikas Publishing House.

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L	M	H	H
CO 2	M	M	H	
CO 3		H	M	H
CO 4		L	M	H

CMSM0066: SUPPLY CHAIN MANAGEMENT AND LOGISTICS (4 CREDITS – 60 HOURS)

***Objective**: The objective of this paper is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for an international firm.*

COURSE/LEARNING OUTCOMES

After learning the course, the students will be able to:

CO1: Define the process of supply chain management. (Remembering)
CO2: Demonstrate operational purchasing methods and techniques on supplier management and supply in specific business contexts. (Understanding)
CO3: Explain the strategic importance of logistics elements and describe how they affect supply chain management. (Understanding)
CO4: Apply sales and operations planning, MRP and lean manufacturing concepts. (Applying)
CO5: Analyse the creation of new value in the supply chain for customers, society and the environment. (Analysing)

Module I: Basic Framework (9 hours)
Concept of supply chain management (SCM); SCM and trade Logistics; Business view of SCM; Push and pull of SCM; Decision phases; Impellers and drivers in SCM Process views of SCM, planning and operations; Supply chain modeling; Role of Relationship marketing in SCM; managing relationships with suppliers and customers; Designing strategic distribution network; Factors influencing distribution network.

Module II: Supply Chain and Information Management Systems (13 hours)
Purchasing Process- Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle;Supplier selection and evaluation; Vendor development; Importance of information management; Distribution and sharing of information; Information Technology as a platform for effective and efficient supply chain management.

Module III: Logistic System (10 hours)
Concept, objectives and scope of logistics; System elements; Inbound and Outbound logistics. Reverse inventory, Value added role of logistics, Logistics interface with manufacturer and marketing, Packing, Marking, Just in time concept; Third party logistic outsourcing–challenges and future directions.

Module IV: Transportation (16 hours)

Importance of effective transportation system; Service choices and their characteristics; inter- modal services; Transport cost characteristics and rate fixation; Carrier selection determinants and decision; Structure of Shipping: World seaborne trade; international shipping - characteristics and structure;Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Charter, party agreement; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD; Indian shipping – growth, policy and problems; Ports and port trust; International Air transport: International set up for air transport: Freight rates; India's exports and imports by air – Problems and prospects;Carriage of Goods by sea, sea and combined transport.

Module V: Warehousing and Inventory Management (12 hours)

Warehousing And Marketing Strategy;Objectives and functions of warehousing; Warehouse Strategies; Material handling equipment and material mobility Warehousing evaluation and requirements.

Inventory management-inventory categories, EOQ, LT, ICC; Inventory levels; Material planning and sourcing of procurement; Methods of cost reduction.

Suggested Readings

1. Ballau, R.H., Business Logistics Management, Prentice Hall,Englewood Cliffs.
2. Bes, J., Chartering Practices.
3. Bes, J., Dictionary of Shipping and chartering Practices.
4. Christopher, M., Logistics and Supply Chain Management, Prentice Hall.
5. ICAO Journal, New York., various issues.
6. Indian Shipping and Transport, Mumbai, Various issues.
7. Murphy, Paul R. and Donald F. Wood, Contemporary Logistics, Prentice Hall.
8. Marks, Daniel, Shipping Cartels.
9. Shapiro, R., Logistics Strategy: Cases and Concepts, West Publishing, St. Paul.
10. Coughlan, A.,Anderson, E. and Louis W. Stern, Marketing Channels, Prentice Hall.
11. The Marine Times, Mumbai, various issues.
12. John J Coyle, C. John and Langley,Brian J Gibs, Logistics approach to Supply Chain Management, Cengage Learning.
13. Burt, Dobler and Starling, World Class Supply Management, Tata McGraw Hill.
14. Bowersor, Donald J and David J Closs, Logistics management and Integrated Supply Chain Management, Tata McGraw Hill

Mapping of Course Outcomes

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	L			
CO 2		M	L	L
CO 3			M	M
CO 4		M		H
CO 5	M		H	

CMFA0067: FINANCIAL ACCOUNTING (CREDITS: 6- 75 HOURS) (L-T-P:4-2-0)

***Objectives**: The objective of this paper is to help students to acquire conceptual knowledge of financial accounting and to impart skills for recording various kinds of business transactions.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define the theoretical framework and accounting process (Remembering)
CO2: Explain the accounting process (Understanding)
CO3: Identify the important constituents of business income (Applying)
CO4: Analyse the final accounts (Analysing)
CO5: Evaluate the accounting for inland branches (Evaluating)
CO6: Elaborate the accounting system for dissolution of the partnership firm (Creating)

Module I: (a) Theoretical Framework (3 Hours)

1. Accounting as an information system, the users of financial accounting information and their needs. Qualitative characteristics of accounting, information. Functions, advantages and limitations of accounting. Branches of accounting. Bases of accounting; cash basis and accrual basis.
2. The nature of financial accounting principles–Basic concepts and conventions: entity, money measurement, going concern, cost, realization, accruals, periodicity, consistency, prudence (conservatism), materiality and full disclosures.
3. Financial accounting standards: Concept, benefits, procedure for issuing accounting standards in India. Salient features of First-Time Adoption of Indian Accounting Standard (Ind-AS) 101. International Financial Reporting Standards (IFRS): - Need and procedures.
   a) Accounting Process (2 Hours)
      From recording of a business transaction to preparation of trial balance including adjustments
   b) Computerized Accounting Systems (26 Hours)

Practical Lab Computerized Accounting Systems: Computerized Accounts by using any popular accounting software: Creating a Company; Configure and Features settings; Creating Accounting Ledgers and Groups; Creating Stock Items and Groups; Vouchers Entry; Generating Reports - Cash Book, Ledger Accounts, Trial Balance, Profit and Loss Account, Balance Sheet, Funds Flow Statement, Cash Flow Statement Selecting and shutting a Company; Backup and Restore data of a Company

Module II: (a) Business Income (10 Hours)

1. Measurement of business income-Net income: the accounting period, the continuity doctrine and matching concept. Objectives of measurement.
2. Revenue recognition: Recognition of expenses.
3. The nature of depreciation. The accounting concept of depreciation. Factors in the measurement of depreciation. Methods of computing depreciation: straight line method and diminishing balance method; Disposal of depreciable assets-change of method.
4. Inventories: Meaning. Significance of inventory valuation.
5. Inventory Record Systems: periodic and perpetual. Methods : FIFO, LIFO and Weighted Average; Salient features of Indian Accounting Standard (Ind-AS):2

(b) Final Accounts (7 Hours)

Capital and revenue expenditures and receipts: general introduction only. Preparation of financial statements of non-corporate business entities

Module III: Accounting for Hire Purchase and Installment Systems (10 Hours)

Calculation of interest, partial and full repossession, Hire purchase trading (total cash price basis),stock and debtors system; Concepts of operating and financial lease (theory only)

Module IV: Accounting for Inland Branches (10 Hours)

Concept of dependent branches; accounting aspects; debtors system, stock and debtors system, branch final accounts system and wholesale basis system. Independent branches: concept- accounting treatment: important adjustment entries and preparation of consolidated profit and loss account and balance sheet.

Module V: Accounting For Dissolution of the Partnership Firm (10 Hours)

Accounting of Dissolution of the Partnership Firm Including Insolvency of partners, sale to a limited company and piecemeal distribution

Note

1. The relevant Indian Accounting Standards in line with the IFRS for all the above topics should be covered.
2. Any revision of relevant Indian Accounting Standard would become applicable immediately.
3. There shall be 4 Credit hrs. for Hours plus one Credit hr. (Two Practical Periods per week per batch) for Practical Lab plus one credit Hr for Tutorials (per group)
4. Examination Scheme for Computerized Accounting Systems–Practical for 20marks.The practical examination will be for 1hour.
5. Theory Exam shall carry 80 marks

Suggested Readings

1. Anthony R N, Hawkins D, Kenneth A. Merchant, Accounting: Text and Cases. McGraw-Hill Education, 13th Ed.2013.
2. Horngren C T and Philbrick D, Introduction to Financial Accounting, Pearson Education.
3. Monga J R, Financial Accounting: Concepts and Applications. Mayur Paper Backs, New Delhi.
4. Shukla M C, T.S. Grewal and S.C.Gupta. Advanced Accounts. Vol.-I. S. Chand & Co., New Delhi.
5. Maheshwari S N, and. Maheshwari S K. Financial Accounting. Vikas Publishing House, NewDelhi.
6. Sehgal D. Financial Accounting. Vikas Publishing House, New Delhi.
7. Goyal B K and Tiwari H N, Financial Accounting, International Book House
8. Goldwin, Alderman and Sanyal, Financial Accounting, Cengage Learning.
9. Tulsian, P.C. Financial Accounting, Pearson Education.
10. Compendium of Statements and Standards of Accounting. The Institute of Chartered Accountants of India, New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2			H		
CO 3		H			
CO 4					
CO 5				H	
CO6					H

CMBL0068: BUSINESS LAW (CREDITS: 6- 75 HOURS) (L-T-P:4-2-0)

Objective*: The objective of the course is to impart basic knowledge of the important business legislation along with relevant case law.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define the Indian Contract Act, 1872: General Principle of Law of Contract (Remembering)
CO2: Explain the Indian Contract Act, 1872: Specific Contract (Understanding)
CO3: Identify the important constituents of partnership laws (Applying)
CO4: Analyse the Negotiable Instruments Act 1881 (Analysing)
CO5: Evaluate the important business legislation along with relevant case law. (Evaluating)
CO6: Elaborate the accounting system for dissolution of the partnership firm (Creating)

Module I: The Indian Contract Act, 1872: General Principle of Law of Contract (13 Hours)

Contract – meaning, characteristics and kinds; Essentials of a valid contract - Offer and acceptance, consideration, contractual capacity, free consent, legality of objects.; Void agreements, Discharge of a contract–modes of discharge, breach and remedies against breach of contract. Contingent contracts, Quasi -contracts

Module II: The Indian Contract Act, 1872: Specific Contract (13 Hours)

Contract of Indemnity and Guarantee; Contract of Bailment; Contract of Agency

Module III:The Sale of Goods Act, 1930 (13 Hours)

Contract of sale, meaning and difference between sale and agreement to sell. Conditions and warranties; Transfer of ownership in goods including sale by anon-owner; Performance of contract of sale; Unpaid seller–meaning, rights of an unpaid seller against the goods and the buyer.

Module IV: Partnership Laws (13 Hours) The Partnership Act, 1932

Nature and Characteristics of Partnership; Registration of a Partnership Firms, Types of Partners Rights and Duties of Partners Implied Authority of a Partner Incoming and outgoing Partners Mode of Dissolution of Partnership

The Limited Liability Partnership Act, 2008; Salient Features of LLP, Differences between LLP and Partnership, LLP and Company, LLP Agreement, Partners and Designated Partners Incorporation Document Incorporation by Registration Partners and their Relationship

Module V: The Negotiable Instruments Act 1881 (13 Hours)

Meaning, Characteristics, and Types of Negotiable Instruments: Promissory Note, Bill of Exchange, Cheque; Holder and Holder in Due Course, Privileges of Holder in Due Course. Negotiation: Types of Endorsements; Crossing of Cheque; Bouncing of Cheque

Suggested Readings

1. Kuchhal M.C., and Vivek Kuchhal, Business Law,Vikas Publishing House New Delhi.
2. Singh Avtar, Business Law, Eastern Book Company, Lucknow.
3. Kumar Ravinder, Legal Aspects of Business, Cengage Learning
4. Maheshwari S.N. and Maheshwari S.K., Business Law, National Publishing House, New Delhi.
5. Aggarwal S.K, Business Law, Galgotia Publishers Company, New Delhi.
6. Goyal Bhushan Kumar and Kinneri Jain, Business Laws, International Book House
7. Arora Sushma, Business Laws, Taxmann Publications.
8. Pathak Akhileshwar , Legal Aspects of Business, McGraw Hill Education
9. Tulsian P.C. and Tulsian Bharat, Business Law, McGraw Hill Education
10. Sharma, J.P. and Sunaina Kanojia, Business Laws, Ane Books Pvt .Ltd., New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H
CO6					M

CMME0069: MICRO ECONOMICS (CREDITS: 6- 75 HOURS) (L-T-P:4-2-0)

Objective*: The objective of the course is to acquaint the students with the concepts of microeconomics dealing with consumer behavior. The course also makes the student understand the supply side of the market through the production and cost behavior of firms.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define the concepts of revenue (Remembering)
CO2: Explain the concepts related to production and cost (Understanding)
CO3: Identify the assumptions of perfect competition (Applying)
CO4: Analyse the Monopoly short run and long run equilibrium (Analysing)
CO5: Evaluate the Monopolistic Competition and Oligopoly (Evaluating)
CO6: Elaborate the supply side of the market through production and cost behavior of firms (Creating)

Module I: Demand and Consumer Behavior (13 hours)

Concepts of revenue: marginal and Average: Revenue under conditions of Perfect and imperfect competition Elasticity of demand: price, income and cross.

Consumer Behavior: Indifference curve analysis of consumer behavior; Consumer's equilibrium (necessary and sufficient conditions). Price elasticity and price consumption curve, income consumption curve and Engel curve, price change and income and substitution effects. Indifference curves as an analytical tool (cash subsidy v/s. kind subsidy). Revealed Preference Theory.

Module II: Production and Cost (13 hours)

Production isoquants, marginal rate of technical substitution, economic region of production, optimal combination of resources, the expansion path, isoclines, returns to scale using isoquants.

Cost of Production: Social and private costs of production, long run and short run costs of production. Economies and diseconomies of scale and the shape to the long run average cost. Learning curve and economies of scope.

Module III: Perfect Competition (13 hours)

Perfect competition: Assumptions. Equilibrium of the firm and the industry in the short and the long runs, including industry's long run supply curve. Measuring producer surplus under perfect competition. Stability Analysis – Walrasian and Marshallian. Demand - supply analysis including impact of taxes and subsidy.

Module IV: Monopoly (10 hours)

Monopoly: Monopoly short run and long run equilibrium. Shifts is demand curve and the absence of the supply curve. Measurement of monopoly power and the rule of thumb for pricing. Horizontal and vertical integration of firms. The social costs of monopoly power including deadweight loss. Degrees of price discrimination.

Module V: Imperfect Competition (16 hours)

Monopolistic Competition and Oligopoly: Monopolistic competition price and output decision- equilibrium. Monopolistic Competition and economic efficiency Oligopoly and Interdependence – Cournot's duopoly model, Stackelberg model, Kinked demand model. Prisoner's dilemma, collusive oligopoly – price- leadership model – dominant firm, cartels, sales maximization, Contestable markets theory. Pricing Public Utilities.

Suggested Readings

1. Pindyck, R.S., D.L. Rubinfeld and P.L. Mehta; Microeconomics, Pearson Education.
2. N. Gregory mankiw, Principles of Micro Economics, Cengage Learning
3. Maddala G.S. and E. Miller; Microeconomics: Theory and Applications, McGraw-Hill Education
4. Salvatore, D. Schaum's Outline: Microeconomic Theory, McGraw-Hill, Education.
5. Case and Fair, Principles of Micro Economics, Pearson Education
6. Koutsiyannis, Modern Micro Economic Theory.
7. Snyder C , Microeconomic Theory: Basic Principles and Extensions, Cengage Learning
8. Bilas, Richard A., Microeconomics Theory: A Graphical Analysis, McGraw-Hill Education.
9. Paul A Samuelson, William D Nordhaus, Microeconomics, McGraw-Hill Education.
10. Sachdeva Amit , Micro Economics, KusumLata Publishers

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H
CO 6			M		

CMCA0070: CORPORATE ACCOUNTING (CREDITS: 6- 75 HOURS) (L-T-P:4-2-0)

***Objectives**: To help the students to acquire the conceptual knowledge of the corporate accounting and to learn the techniques of preparing the financial statements.*

COURSE/LEARNING OUTCOMES

CO1: Define the meaning and types of shares.(Remembering)
CO2: Illustrate the procedure of forfeiture and re-issue of company's shares.(Understanding)
CO3: Construct the redemption of company's debenture accounts.(Applying)
CO4: Analyse the valuation of goodwill and shares of a company.(Analysing)
CO5: Determine the alteration and reduction of company's share capital.(Evaluating)
CO6: Adapt the accounting problems related to amalgamation of companies.(Creating)

Module I: Accounting for Share Capital & Debentures (12 Hours)
Issue, forfeiture and reissue of forfeited shares: concept & process of book building; Issue of rights and bonus shares; Buyback of shares; Redemption of preference shares; Issue and Redemption of Debentures

Module II: Final Accounts (9 Hours)

Preparation of profit and loss account and balance sheet of corporate entities, excluding calculation of managerial remuneration, Disposal of company profits

Module III: Valuation of Goodwill and Valuation of Shares (6 Hours)
Concepts and calculation: simple problem only

Module IV: Amalgamation of Companies (12 Hours)
Concepts and accounting treatment as per Accounting Standard: 14 (ICAI) (excluding inter- company holdings). Internal reconstruction: concepts and accounting treatment excluding scheme of reconstruction.

Module V: Accounts of Holding Companies/Parent Companies (12 Hours)

Preparation of consolidated balance sheet with one subsidiary company. Relevant provisions of Accounting Standard: 21 (ICAI).

Module VI: Banking Companies (7 Hours)

Difference between balance sheet of banking and non banking company; prudential norms. Asset structure of a commercial bank. Non-performing assets (NPA).

Module VII: Cash Flow Statement (7 Hours)

Concepts of funds. Preparation of cash flow statement as per Indian Accounting Standard (Ind- AS): 7

Note:

1. The relevant Indian Accounting Standards in line with the IFRS for all the above topics should be covered.
2. Any revision of relevant Indian Accounting Standard would become applicable immediately.

Suggested Readings

1. Monga J.R., Fundamentals of Corporate Accounting. Mayur Paper Backs, New Delhi.
2. Shukla M.C., Grewal T.S.,and Gupta S.C.. Advanced Accounts .Vol.- II. S. Chand & Co., New Delhi.
3. Maheshwari S.N., and S. K. Maheshwari. Corporate Accounting. Vikas Publishing House, New Delhi.
4. Sehgal A , Fundamentals of Corporate Accounting. Taxman Publication, New Delhi.
5. Goyal V.K. and Goyal R,. Corporate Accounting. PHI Learning.
6. Jain, S.P. and Narang K.L.. Corporate Accounting. Kalyani Publishers, New Delhi.
7. Goyal B K, Fundamentals of Corporate Accounting, International Book House
8. Compendium of Statements and Standards of Accounting. The Institute of Chartered Accountants of India, New Delhi.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI	Module VII
CO1	H						
CO2		H					
CO3			H				
CO4				H			L
CO5					H		
CO6						H	M

CMCL0071: CORPORATE LAWS (CREDITS: 6- 75 HOURS)(L-T-P:4-2-0)

***Objective**: The objective of the course is to impart basic knowledge of the provisions of the Companies Act 2013 and the Depositories Act, 1996. Case studies involving issues in corporate laws are required to be discussed.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:
CO 1: Explain what a company is and how it is formed. (Understanding)
CO 2: Define the concepts related to various essential documents relating to a company. (Remembering)
CO 3: Develop the knowledge regarding management of a company. (Applying)

CO 4: Analyse the various provisions relating to dividends,accounts and audit of a company. (Analysis)
CO 5: Explain the various concepts regarding winding up of companies, insider trading and whistle blowing (Evaluating)
CO 6: Elaborate the meaning, definition, rights, obligations, etc. under The Depositories Act, 1996 (Creating)

Module I: Introduction (15 Hours)
Administration of Company Law [including National Company Law Tribunal (NCLT), National Company Law Appellate Tribunal (NCLAT), Special Courts]; Characteristics of a company; lifting of corporate veil; types of companies including one person company, small company, and dormant company; association not for profit; illegal association; formation of company, on-line filing of documents, promoters, their legal position ,pre-incorporation contract; on-line registration of a company.

Module II: Documents (15 Hours)
Memorandum of association, Articles of association, Doctrine of constructive notice and indoor management, prospector-shelf and red herring prospectus, misstatement in prospectus, GDR; book-building; issue, allotment and forfeiture of share, transmission of shares, buyback and provisions regarding buyback; issue of bonus shares.

Module III: Management (15 Hours)
Classification of directors, women directors, independent director, small shareholder's director; disqualifications, director identity number (DIN); appointment; Legal positions, powers and duties; removal of directors; Key managerial personnel, managing director, manager;
Meetings: Meetings of shareholders and board of directors; Types of meetings, Convening and conduct of meetings, Requisites of a valid meeting, postal ballot, meeting through video conferencing, e-voting.
Committees of Board of Directors- Audit Committee, Nomination and Remuneration Committee, Stakeholders Relationship Committee, Corporate Social Responsibility Committee

Module IV: Dividends, Accounts, Audit 15 Hours
Provisions relating to payment of Dividend, Provisions relating to Books of Account, Provisions relating to Audit, Auditors' Appointment, Rotation of Auditors, Auditors' Report, Secretarial Audit.

Winding Up: Concept and modes of Winding Up. Insider Trading, Whistle Blowing: Insider Trading; meaning & legal provisions; Whistle- blowing: Concept and Mechanism.

Module V: Depositories Law 5 Hours
The Depositories Act 1996 – Definitions; rights and obligations of depositories; participants, issuers and beneficial owners; inquiry and inspections, penalty.

Suggested Readings

1. Kuchhal MC , Modern Indian Company Law, Shri Mahavir Book Depot (Publishers), Delhi.
2. Kapoor GK and Dhamija Sanjay , Company Law, Bharat Law House, Delhi.
3. Kumar Anil, Corporate Laws, Indian Book House, Delhi
4. Chadha Reena and Chadha Sumant , Corporate Laws, Scholar Tech Press, Delhi.
5. Singh Avtar, Introduction to Company Law, Eastern Book Company
6. Ramaiya, A Guide to Companies Act, LexisNexis, Wadhwa and Buttersworth.
7. Manual of Companies Act, Corporate Laws and SEBI Guideline, Bharat Law House, New Delhi,.
8. A Compendium of Companies Act 2013, along with Rules ,by Taxmann Publications.
9. Gower and Davies, Principles of Modern Company Law, Sweet & Maxwell
10. Sharma, J.P. An Easy Approach to Corporate Laws, Ane Books Pvt. Ltd., New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMMC0072: MACRO ECONOMICS (CREDITS: 6- 75 HOURS)(L-T-P:4-2-0)

***Objectives**: The course aims at providing the student with knowledge of basic concepts of macro economics. The modern tools of macro-economic analysis are discussed and the policy framework is elaborated, including the open economy.*

COURSE/LEARNING OUTCOMES
After learning this course, the students are able to:
CO1: Explain how money is circulated in an economy. (Remembering)
CO2: Outline the different concepts of National Income. (Understanding)
CO3: Estimate National Income Accounting. (Applying)
CO4: Explain Keynesian National Income Determination by using Aggregate Demand and Aggregate Supply concept.

(Analysing)
CO5: Summarize Consumption Function and determinants of propensity to consume. (Evaluating)
CO6: Determine Investment Function and investment multiplier. (Creating)

Module I: Introduction 5 Hours
concepts and variables of macroeconomics, income, expenditure and the circular flow, components of expenditure. Static macroeconomic analysis short and the long run – determination of supply, determination of demand, and conditions of equilibrium

Module II: Economy in the short run (20 Hours)
IS–LM framework, fiscal and monetary policy, determination of aggregate demand, shifts in aggregate demand, aggregate supply in the short and long run, and aggregate demand- aggregate supply analysis.

Module III: Inflation, Unemployment and Labour market (20 Hours)
Inflation: Causes of rising and falling inflation, inflation and interest rates, social costs of inflation; Unemployment–natural rate of unemployment, frictional and wait unemployment. Labour market and its interaction with production system; Phillips curve, the trade- off between inflation and unemployment, sacrifice ratio, role of expectations adaptive and rational

Module IV: Open economy (13 Hours)
Open economy– flows of goods and capital, saving and investment in a small and a large open economy, exchange rates, Mundell – Fleming model with fixed and flexible prices in a small open economy with fixed and flexible exchange rates , Interest-rate differentials in the case of a large economy.

Module V (7 Hours)
Behavioral Foundations- Investment– determinants of business fixed investment ,effect of tax, determinants of residential investment and inventory investment. Demand for Money – Portfolio and transactions theories of demand for real balances, interest and income elasticities of demand for real balances. Supply of money

Suggested Readings
1. Mankiw, N. Gregory. Principles of Macroeconomics. Cengage Learning
2. Robert J Gordon, Macro economics, Pearson Education
3. Branson, William H. Macro Economic Theory and Policy. Harper Collins India Pvt. Ltd.
4. Rudiger Dornbusch and Stanley Fischer, Macro economics. McGraw-Hill Education.
5. Rudiger Dornbusch, Stanley Fischer, and Richard Startz ,Macro economics. McGraw-Hill Education
6. Oliver J. Blanchard, Macro economics, Pearson Education
7. Gupta G. S. , Macro economics: Theory and Applications, McGraw-Hill Education
8. Shapiro, Macro economic Analysis,
9. Samuelson Paul A, Nordhaus William D and Chaudhuri Sudip , Macro economic, McGraw-Hill Education

CMHR0073: HUMAN RESOURCE MANAGEMENT (CREDITS: 6- 75 HOURS) (L-T-P:5-1-0)

***Objective**: The objective of the course is to acquaint students with the techniques and principles to manage human resources of an organisation.*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:
CO1: Analyse the importance of human resource management as a field of study and as a central management function. (Remembering)
CO2: Define the implications for human resource management of the behavioural sciences, government regulations, and court decisions. (Understanding)
CO3: Explain the elements of the HR function (e.g. – recruitment, selection, training and development, etc.) and be familiar with each element's key concepts & terminology. (Applying)
CO4: Apply the principles and techniques of human resource management gained through this course to the discussion of major personnel issues and the solution of typical case problems. (Analysing)
CO5: Evaluate the performance appraisal techniques (Evaluating)
CO6: Design the employee health and safety provisions with reference to Industrial disputes Act, 1947 (Creating)

Module I: Introduction to HRM (15 Hours)
Human Resource Management: Concept and Functions, Personnel Management vs HRM; Role, Status and competencies of HR Manager, HR Policies, Evolution of HRM; HRM vs HRD. Emerging Challenges of Human Resource Management; Workforce diversity; Empowerment; Downsizing; VRS; Human Resource Information System.

Module II: Acquisition of Human Resource (15 Hours)
Human Resource Planning- Quantitative and Qualitative techniques such as delphi technique, statistical approach etc; job analysis – job description and job specification; Recruitment – Concept and sources; Selection – Concept and process; test and interview; placement and induction

Module III: Training and Development (15 Hours)
Concept and Importance; Identifying Training and Development Needs; Training vs Development; Designing Training Programmes; Role- Specific and Competency- Based Training; Evaluating Training Effectiveness; Training Process Outsourcing; Management Development; Career Development.

Module IV: Performance Appraisal (15 Hours)
Nature, objectives and importance; Modern techniques of performance appraisal; potential appraisal and employee counselling; job changes - transfers and promotions; Compensation: concept and policies; job evaluation; methods of wage payments and incentive plans; fringe benefits; performance linked compensation.

Module V: Maintenance (15 Hours)
Employee health and safety; employee welfare; social security; Provisions of Factories Act, 1948; Employer-Employee relations-an overview; grievance-handling and redressal; Industrial Disputes: causes and settlement machinery. Provisions of Industrial Dispute Act, 1947.

Suggested Readings

1. Dessler Gary.AFrameworkforHumanResourceManagement.PearsonEducation.
2. DeCenzo, D.A. and S.P. Robbins, Personnel/Human Resource Management, Pearson Education.
3. Bohlander and Snell,Principles of Human Resource Management, Cengage Learning
4. Ivancevich, John M. Human Resource Management. McGrawHill.
5. Wreather and Davis. Human Resource Management. Pearson Education.
6. Mathis Robert L and John H. Jackson.Human Resource Management. Cengage Learning.
7. Chhabra T N, Human Resource Management, Dhanpat Rai & Co., Delhi
8. Patttanayak Biswajeet, Human Resource PHI Learning

Mapping of COs to Syllabus:

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	M

CMIT0074: INCOME TAX LAW AND PRACTICE (Credits: 6 – 75 hours) (L-T-P: 4 - 1 - 1)

***Objective**: To provide basic knowledge and equip the students with application of the principles of taxation and to acquaint them with the various provisions of Income-tax Act, 1961 and the relevant rules for filing of returns.*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:
CO1: Define the various concepts related to direct taxes. (Remembering)
CO2: Explain the provisions of the direct tax laws. (Understanding)
CO3: Execute the knowledge of the provisions of the direct tax laws to the various situations in actual practice. (Applying)
CO4: Analyse the procedures related to filing of returns and TDS (Analysing)
CO5: Evaluate the requirements of different assessee for filing tax returns under the income tax laws. (Evaluating)
CO6: Develop the skill of creativity in the field of direct tax laws with regard to tax savings. (Creating)

Module I: Introduction (10 hours)
Basic concepts: Income, agricultural income, person, assessee, assessment year, previous year, gross total income, total income, maximum marginal rate of tax; Permanent Account Number (PAN)
Residential status: Scope of total income on the basis of residential status, Exempted income under section10

Module II: Computation of Income under different heads-1 (15 hours)
Income from Salaries; Income from house property

Module III: Computation of Income under different heads-2 (10 hours)
Profits and gains of business or profession (basic numerical only); Capital gains; Income from other sources

Module IV: Computation of Total Income and Tax Liability (15 hours)
Income of other persons included in assessee's total income; Aggregation of income and set-off and carry forward of losses; Deductions from gross total income; Rebates and reliefs, Computation of total income of individuals and firms; Tax liability of an individual and a firm.

Module V: Preparation of Return of Income (25 hours)
Filing of returns: Manually, Online filing of Returns of Income & TDS; Provision & Procedures of Compulsory Online filing of returns for assessee with salaried income and/or business income.
Note:
1. There shall be a practical examination of 20 Marks on E-filing of Income Tax Returns using a software utility tool.

The student is required to fill an appropriate Form and generate the XML file.

2. There shall be 4 Credit Hrs. for Lectures + one Credit hr. (Two Practical Periods per week per batch) for Practical Lab + one credit Hr for Tutorials (per group)
3. Latest edition of textbooks and Software may be used.

Suggested Readings

1. Singhania, Vinod K. and Monica Singhania. Students' Guide to Income Tax, University Edition. Taxmann Publications Pvt. Ltd., New Delhi.
2. Ahuja, Girish and Ravi Gupta. Systematic Approach to Income Tax. Bharat Law House, Delhi. Journals
1. Income Tax Reports. Company Law Institute of India Pvt. Ltd., Chennai.
2. Taxman. Taxmann Allied Services Pvt. Ltd., New Delhi.
3. Current Tax Reporter. Current Tax Reporter, Jodhpur. Software
4. Singhania Vinod Kumar, e- filing of Income Tax Returns and Computation of Tax, Taxmann Publication Pvt. Ltd., New Delhi. Latest version
5. Excel Utility' available at incometaxindiaefiling.gov.in

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H
CO 6				L	M

CMMP0075: MANAGEMENT PRINCIPLES AND APPLICATIONS (6 CREDITS- 5-1-0-75 HOURS)

***Objective**: The objective of the course is to provide the student with an understanding of basic management concepts, principles and practices.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define the basic concepts and facts of management. (Remembering)
CO2: Identify the best practices from around the globe in management. (Understanding)
CO3: Appraise the learnings to transform the management practices of organisations. (Applying)
CO4: Interpret management principles and practices. (Analysing)
CO5: Evaluate the various staffing functions. (Evaluating)
CO6: Design the various control techniques for effective monitoring. (Creating)

Module I: Introduction to Management (15 Hours)

Concept and Definitions of Management; Need and Significance of Management; Managerial Functions- Planning, Organising, Staffing, Directing and Controlling.Evolution of the Management Thought, Classical Approach – Taylor and Fayol,Neo-Classical and Human Relations Approaches – Mayo, Hawthorne Experiments, Behavioural Approach, Systems Approach, Contingency Approach; MBO and MBE- Peter F. Drucker, Michael Porter – Five-force analysis, Three generic strategies and value- chain, analysis; 'Fortune at the Bottom of the Pyramid' – C. K. Prahalad.

Module II: Planning (15 Hours)

Concept and significance of planning; types of plan.
Strategic planning – Concept, process, Importance and limitations
Environmental Analysis and diagnosis (Internal and external environment) – Definition, Importance and Techniques (SWOT, BCG Matrix, Competitor Analysis), Business environment; Concept and Components
Decision-making – concept, importance; Committee and Group Decision-making, Process, Perfect rationality and bounded rationality, Techniques (qualitative and quantitative, MIS and DSS)

Module III: Organising (15 Hours)

Concept and process of organising; Span of management, Different types of authority (line, staff and functional), Decentralisation, Delegation of authority
Formal and Informal Structure; Principles of Organising; Network Organisation Structure

Module IV: Staffing and Directing (15 Hours)

Staffing: Concept of staffing, staffing process; Motivation: Concept, Importance, extrinsic and intrinsic motivation; Major Motivation theories - Maslow's Need-Hierarchy Theory; Hertzberg's Two-factor Theory, Vroom's Expectancy Theory.
Leadership: Concept, Importance, Major theories of Leadership (Likert's scale theory, Blake and Mouten's Managerial Grid theory,), Transactional leadership, Transformational Leadership, Transforming Leadership.
Communication: Concept, purpose, process; Oral and written communication; Formal and informal communication

networks, Barriers to communication, Overcoming barriers to communication.

Module V: Control (15 Hours)
Control: Concept, Process, Limitations, Principles of Effective Control, Major Techniques of control - Ratio Analysis, ROI, Budgetary Control, EVA, PERT/CPM; Emerging issues in Management.

Suggested Readings

1. Koontz H and Weihrich H, Essentials of Management: An International and Leadership Perspective, McGraw Hill Education.
2. Robbins S P and Agrawal Madhushree Nanda,Fundamentals of Management:Essential Concepts and Applications, Pearson Education.
3. Terry G, Principles of Management, Richard D.Irwin
4. Newman, Summer, and Gilbert, Management,PHI
5. Donnelly James H., Fundamentals of Management, Pearson Education.
6. Singh B.P. and Singh A.K., Essentials of Management, Excel Books
7. Kreitner Robert, Management Theory and Application, Cengage Learning
8. Chhabra T N , Management Concepts and Practice, DhanpatRai& Co. (Pvt. Ltd.),New Delhi
9. Drucker Peter F, Practice of Management, Mercury Books, London

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4			M	H	M

CMEC0076: E-COMMERCE (2 CREDITS- LECTURES: 40, PRACTICAL LAB: 26)

***Objectives**: To enable the student to become familiar with the mechanism for conducting business transactions through electronic means*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:

CO1: Interpret the basic concepts and technologies used in the field of E-Commerce. (Remembering)
CO2: Explain the different regulatory provisions relating to E-Commerce. (Understanding)
CO3: Develop processes of developing and implementing information systems. (Applying)
CO4: Define the ethical, social, and security issues of information systems. (Analysing)
CO5: Evaluate the various online business transactions (Evaluating)
CO6: Design websites for online business transactions (Creating)

ModuleI: Introduction (8 Hours)
Introduction to Electronic Commerce, E-Commerce vs E-Business, Advantages of E-commerce, Disadvantages of E-commerce, Transition to E-commerce in India
Technology used in E-commerce: The dynamics of world wide web and internet (meaning, evolution and features); Designing, building and launching e-commerce website (A systematic approach involving decisions regarding selection of hardware, software, outsourcing vs. in-house development of a website)

Module II: Security and Encryption: (8 Hours)
E-commerce security environment: dimension, definition and scope of e- security, security threats in the E-commerce environment, technology solutions, business procedures, and public laws

Module III: IT Act 2000 and Cyber Crimes (8 Hours)
IT Act 2000: Definitions, Digital signature, Electronic governance, Attribution, acknowledgement and dispatch of electronic records, Regulation of certifying authorities, Digital signatures certificates, Duties of subscribers, Penalties and adjudication, Appellate Tribunal, Offences and Cyber-crimes

Module IV: E-payment System (8 Hours, 4 Lab)
Digital Payment Requirements, Digital Token-based e-Payment Systems, Smart Card Cash Payment System, Micropayment Systems, Electronic Cash, Risk and e-Payment Systems, Designing e-Payment Systems.

Module V: On-line Business Transactions (8 Hours, 4 Lab)
Business Model, E-business Models Based on the Relationship of Transaction Parties: Business-to-Consumer (B2C), Business-to-Business (B2B), Consumer-to-Consumer (C2C), Consumer-to-Business (C2B), E-business Models Based on the Relationship of Transaction Types: Brokerage Model, Aggregator Model

Module VI: Website designing (18 Lab)
HTML basics, elements, attributes, formatting, CSS, links, images, tables, lists, block, inline, JavaScript basics, forms, inputs.

Note: There shall be 3 Credit Hrs. for lectures + One Credit hour. (2 Practical periods per week per batch) for Practical Lab

Suggested Readings

1. Kenneth C. Laudon and Carlo GuercioTraver, E-Commerce,Pearson Education.
2. David Whiteley, E-commerce:Strategy,TechnologyandApplications,McGrawHill Education
3. Bharat Bhaskar, Electronic Commerce: Framework, Technology and Application, 4thEd., McGraw Hill Education
4. Joseph P T, E-Commerce: An Indian Perspective, PHILearning
5. Bajaj K K and Debjani Nag, E-commerce, McGraw HillEducation
6. Chhabra T N, E-Commerce, Dhanpat Rai Co.
7. Madan Sushila, E-Commerce, Taxmann

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module II	Module III	Module IV	Module V	Module VI
CO 1	H	M				
CO 2		H	M	L		
CO 3					H	M

CMBS0077: BUSINESS STATISTICS (6 credits- 75 hours) (L-T-P: 4-1-1)

***Objective**: The objective of this course is to familiarise students with the basic statistical tools used for managerial decision-making.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Summarize data sets using descriptive statistics (Remembering)
CO2: Analyze the relationship between two variables (Understanding)
CO3: Determine trend and seasonality in a time series data (Analysing)
CO4: Explain the concept of probability and its applications in a business context. (Applying)
CO5: Constructing the price indices using the concept of Index number. (Evaluating)
CO6: Design the various methods of sampling. (Creating)

Module I: Statistical Data and Descriptive Statistics (12 hours)

a. Nature and Classification of data: univariate, bivariate and multivariate data; time-series and cross-sectional data
b. Measures of Central Tendency
   i. Mathematical averages including arithmetic mean, geometric mean and harmonic mean. Properties and applications.
   ii. Positional Averages Mode and Median (and other partition values including quartiles, deciles, and percentiles)
c. Measures of Variation: absolute and relative. Range, quartile deviation, mean deviation, standard deviation, and their coefficients, Properties of standard deviation/variance

Module II: Probability and Probability Distributions (12 hours)

a. Theory of Probability. Approaches to the calculation of probability; Calculation of event probabilities. Addition and multiplication laws of probability (Proof not required); Conditional probability and Bayes' Theorem (Proof not required)
b. Probability distributions: Binomial distribution, Poisson distribution, Normal distribution

Module III:Simple Correlation and Regression Analysis (13 hours)

a. Correlation Analysis: Meaning of Correlation: simple, multiple and partial; linear and non-linear, Correlation and Causation, Scatter diagram, Pearson's coefficient of correlation;calculation and properties(Proof not required).Rank Correlation
b. RegressionAnalysis:Principle Of Least Squares And regression lines,Regression Equations and estimation; Properties Of Regression Coefficients;RelationshipbetweenCorrelation and Regression coefficients.

Module IV:Index Numbers (10 hours)

Meaning and uses of index numbers; Construction of index numbers: fixed and chain base: univariate and composite. Aggregative and average of relatives – simple and weighted

Tests of adequacy of index numbers, Problems in the construction of index numbers; Construction of consumer price indices: Important share price indices, including BSE SENSEX and NSE NIFTY

Module V: Time Series Analysis (8 hours)

Components of time series; Additive and multiplicative models; Trend analysis: Fitting of trend line using principle of least squares, Moving averages.

Module VI: Sampling: (5 hours)

Sampling: Populations and samples, Parameters and Statistics, Descriptive and inferential statistics; Sampling methods (including Simple Random sampling, Stratified sampling, Systematic sampling, Judgement sampling, and Convenience sampling)

Lab: (30 hours)

The students will be familiarized with software like MS Excel (Spreadsheet) and the statistical and other functions contained therein related to formation of frequency distributions and calculation of averages, measures of Dispersion and variation, correlation and regression co- efficient.

Note:

1. There shall be 4 Credit Hrs. for Lectures + one Credit hr. (Two Practical Periods per week per batch) for Practical Lab + one credit Hr. for Tutorials (per group)
2. Latest edition of textbooks may be used.

Suggested Readings

1. Levin, Richard, David S. Rubin, Sanjay Rastogi, and H.M.Siddiqui. Statistics for Management. 7th ed., PearsonEducation.
2. David M. Levine, Mark L. Berenson, Timothy C. Krehbiel, P. K. Viswanathan, Business Statistics: A First Course, PearsonEducation.
3. Siegel Andrew F. Practical Business Statistics. McGraw HillEducation.
4. Gupta,S.P. andArchanaAgarwal.BusinessStatistics,SultanChandandSons,NewDelhi.
5. Vohra N. D., Business Statistics, McGraw HillEducation.
6. Murray R Spiegel, Larry J. Stephens, Narinder Kumar. Statistics (Schaum's Outline Series), McGraw HillEducation.
7. Gupta, S.C. Fundamentals of Statistics. Himalaya PublishingHouse.
8. Anderson, Sweeney, and Williams, Statistics for Students of Economics and Business, CengageLearning.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	M					
CO 2		H		H		H
CO 3						
CO 4			M			
CO 5					M	M

CMCA0078: COST ACCOUNTING (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

***Objective**: To acquaint the students with basic concepts used in cost accounting, various methods involved in cost ascertainment and cost accounting bookkeeping systems.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Describe the place and role of cost accounting in the modern economic environment. (Remembering)
CO2: Select the costs according to their impact on business. (Understanding)
CO3: Differentiate methods of schedule costs per Module of production. (Analysing)
CO4: Differentiate methods of calculating stock consumption. (Applying)
CO5: Interpret the impact of the selected costs method. (Evaluating)
CO6: Identify the specifics of different costing methods. (Creating)

Module: I (10 Hours)

Meaning, objectives and advantages of cost accounting; Difference between cost accounting and financial accounting; Cost concepts and classifications; Elements of cost; Installation of a costing system; Role of a cost accountant in an organisation, Preparation of Cost Sheet

Module: II (20 Hours)

a. Materials: Material/inventory control techniques; Accounting and control of purchases, storage and issue of materials; Methods of pricing of materials issues — FIFO, LIFO, Simple Average, Weighted Average
b. Labour: Accounting and Control of labour cost; Time keeping and time booking; Concept and treatment of idle time, over time, labour turnover and fringe benefits; Methods of wage payment and the Incentive schemes-Halsey, Rowan, Taylor's Differential piece wage.

Module: III (20 Hours)

Definition; Importance; Classification; allocation, apportionment and absorption of overheads; Meaning of Under- and over- absorption; Methods of absorption of manufacturing overheads.

Module: IV (15Hours)

Module costing; Job costing; Contract costing; Process Costing (process losses,valuation of work in progress, joint and by-products), Service costing (only transport); Distinguish between job costing and process costing.

Module: V (10 Hours)

Integrated and non-integrated accounting system; Reconciliation Cost and financial accounts.

Suggested Readings

1. Charles T. Horngren, Srikant M. Datar, MadhavV.Rajan,Cost Accounting: A Managerial Emphasis, Pearson Education.
2. Drury, Colin. Management and Cost Accounting. CengageLearning.
3. JawaharLal, Cost Accounting. McGraw HillEducation
4. Nigam, B.M. Lall and I.C. Jain. Cost Accounting: Principles and Practice. PHILearning
5. Rajiv Goel, Cost Accounting. International BookHouse
6. Singh, Surender. Cost Accounting, Scholar Tech Press, NewDelhi.
7. Jain,S.P.andNarang , K.L CostAccounting:PrinciplesandMethods.KalyaniPublishers
8. Arora, M.N. Cost Accounting–Principles and Practice. Vikas Publishing House, New Delhi.
9. Maheshwari, S.N. and S.N. Mittal. Cost Accounting: Theory and Problems. Shri Mahavir Book Depot, New Delhi.
10. Iyengar, S.P. Cost Accounting. Sultan Chand &Sons
11. Jhamb H.V., Fundamentals of Cost Accounting, Ane Books Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3			H	
CO 4				H

CMBM0079: BUSINESS MATHEMATICS (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

***Objective**: The objective of this course is to familiarize the students with the basic mathematical tools, with an emphasis on applications to business and economic situations.*

COURSE/LEARNING OUTCOMES

At the end of this course, students will be able to:

CO1: Define basic terms in the areas of Business Calculus and financial mathematics (Remembering)

CO2: Describing the principles of simple interest to solve relevant problems in financial applications such as simple-interest-based loans. (Understanding)

CO3: Analyze problems in economics, business to determine appropriate methods for solving them using business maths concepts and applications (Analyzing)

CO4: Demonstrate mastery of mathematical concepts that are foundational in business mathematics, including functions and their mappings, linear systems and their solutions, and descriptive statistics and their applications. (Applying)

CO5: Evaluate various business related problems by means of mathematical laws avoiding tedious calculations. (Evaluating)

CO6: Depending upon such analysis, a student will be able to narrate which mathematical law is applicable in which business related problem. (Creating)

Module I: Matrices and Determinants (12 hours)

Algebra of matrices- Determinants- properties of determinants, Adjoint of a Matrix, Inverse of a matrix, Matrix Operation– Business Application. Solution of system of linear using matrix Method and Cremer's Rule

Module II: Calculus I (16 hours)

a) Mathematical functions and various types functions (define only), Concepts of limit, Fundamental theorems of limits, continuity of a function. Differentiation: Meaning and geometrical interpretation of differentiation; Standard derivatives; Second and higher order derivatives Applications of differentiation: Optimization of functions; Maxima and Minima involving second or higher order derivatives.
b) Concept of Marginal Analysis, Concept of Elasticity, Applied Maximum and Minimum Problems Including the effect of Tax on Monopolist's optimal price and quantity, Economic Order Quantity.

Module III: Calculus II (20 hours)

a) Partial Differentiation: Partial derivatives upto second order; Homogeneity of functions and Euler's theorem; Maxima and Minima for functions of two variables.
b) Integration: Standard forms. Methods of integration – by substitution, by parts, and by use of partial fractions; Definite integration; Finding areas in simple cases. Application of Integration to marginal analysis. Consumers and Producers Surplus, Rate of Sales and the Learning Curve

Module IV: Mathematics of Finance (12 hours)

Calculation of compound interest and amount with different types of interest rates Types of annuities, like ordinary, due, deferred, continuous, perpetual, and their future and present value using different types of rates of interest. Depreciation of Assets.(General annuities to be excluded)

Module V: Linear Programming (14 hours)

Formulation of linear programming problem (LPP). Graphical solution to LPP. Cases of unique and multiple optimal solutions. Unbounded solutions, infeasibility and redundant constraints. Solution to LPP using Simplex method –

maximization and minimization cases.

Note: In addition, the students will work on software packages (Spreadsheet, Mathematica, etc) for solving linear programming problems and topics listed in Module IV above and analyze the results obtained there from.

Suggested Readings

1. Mizrahi Sullivan.Mathematics fo rBusiness and Social Sciences. Wiley and Sons.
2. Budnick, P. Applied Mathematics. McGraw Hill Education.
3. R.G.D. Allen, Mathematical Analysis For Economists
4. Ayres, Frank Jr. Schaum's Outlines Series: Theory and Problems of Mathematics of Finance. McGraw Hill Education.
5. Dowling, E.T., Mathematics for Economics, Schaum's Outlines Series. McGraw Hill Education.
6. Wikes,F.M.,MathematicsforBusiness,Finance and Economics.Thomson Learning.
7. Thukral, J.K., Mathematics for Business Studies.
8. Vohra,N.D. Quantitative Techniques in Management. McGraw Hill Education.
9. Soni, R.S,. Business Mathematics. Ane Books, New Delhi.
10. Singh J. K., Business Mathematics. Himalaya PublishingHouse.

Mapping of COs to Syllabus

Course Outcomes	Module-1	Module-2	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO5				L	H
CO 6				L	M

CMCA0080: COMPUTER APPLICATIONS IN BUSINESS (6 CREDITS: 75 HOURS) (L-T-P: 3-0-3)

***Objectives**: To provide computer skills and knowledge for commerce students and to enhance the student understanding of the usefulness of information technology tools for business operations.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO 1: Interpret the use of computer application in business. (Remembering)
CO 2: Execute business presentation with the help of various computer applications. (Understanding)
CO 3: Develop database management system. (Analysing)
CO 4: Describe the use of the Word Processing package in business applications. (Applying)
CO 5: Evaluate the use of spreadsheet packages in business applications. (Evaluating)
CO 6: Design the database management system for business applications. (Creating)

Module I: Word Processing (6 hours, Lab 6)

Introduction to word Processing, Word processing concepts, Use of Templates, Working with word document: Editing text, Find and replace text, Formatting, spell check and Grammar check; Page set-up; Inserting equations and sym Autocorrect, Auto text; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Tables; Inserting equations and symbols, filling and formatting a table; Inserting Pictures and Video; Mail Merge: including linking with Database; Printing documents; Creating Business Documents using the above facilities

Module II: PreparingPresentations (6 hours, Lab 6)

Basics of presentations: Slides, Fonts, Drawing, editing; Inserting: Tables, Images, texts, Symbols, Media; Different Views; Design; Transition; Animation; and Slideshow. Creating Business Presentations using above facilities

Module III: Spreadsheet and its Business Applications (12 hours, Lab 12)

Spreadsheet concepts, Managing worksheets; Formatting ,Entering data, Editing and Printing a worksheet; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs Generally used Spreadsheet functions: Mathematical, Statistical, Financial, Logical, Date and Time, Lookup and reference, Database, and Text functions

Module IV: Creating Business Spreadsheet (12 hours, Lab 12)

Creating spreadsheet in the area of: Loan and Lease statement; Ratio Analysis; Payroll statements; Capital Budgeting; Depreciation Accounting; Graphical representation of data; Frequency distribution and its statistical parameters; Correlation and Regression

Module V: Database Management System (16 hours, Lab16)

Database Designs for Accounting and Business Applications: Reality-Expressing the Application; Creating Initial design in Entity Relationship (ER) Model; Transforming ER Model to Relational data model concepts; Implementing RDBMS design using an appropriate DBMS. SQL and Retrieval of Information: Basic Queries in SQL; Embedded Queries in SQL; Insert, Delete and Update statements in SQL, Different commonly used mathematical functions in SQL such as SUM, MAX, MIN,

AVG, etc. DBMS Software: Environment; Tables; Forms; Queries; Reports; Modules; Applying DBMS in the areas of Accounting, Inventory, HRM and its accounting, Managing the data records of Employees, Suppliers and Customers.

Note:

1. The General Purpose Software referred in this course will be notified by the University Departments Every three years. If the specific Features,referred in the detailed course above, is not available in that software, to that extent it will be deemed to have been modified.
2. There shall be a practical examination of 100 Marks (Practical-80 Marks, Viva-10 Marks and WorkBook-10 Marks) and duration of Examination shall be 3 Hrs.
3. Teaching arrangement need to be made in the computerLab
4. There shall be four lectures per class and 4 Practical Lab periods per batch to be taught in computerLab.

Mapping of COs with Syllabus

Course Outcomes	Module-1	Module-2	Module III	Module IV	Module V
CO 1	H	M			
CO 2		H	M		
CO 3			H	M	M

CMET0081: ENTREPRENEURSHIP (2 CREDITS-30 HOURS) (L-T-P: 2-0-0)

***Objective**: The purpose of the paper is to orient the learner toward entrepreneurship as a career option and creative thinking and behavior.*

COURSE/ LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the concept of entrepreneur. (Remembering)
CO2: Classify different types of entrepreneurs and entrepreneurial ventures. (Understanding)
CO3: Describe the dimensions of entrepreneurial orientation. (Applying)
CO4: Identify strengths, weaknesses of oneself. (Analysing)
CO5: Evaluate the skills and characteristics of successful entrepreneurs (Evaluating)
CO6: Design the key entrepreneurial motivations (Creating)

Module I: Introduction (6 hours)

Meaning, elements, determinants and importance of entrepreneurship and creative behavior; Entrepreneurship and creative response to the society' problems and at work; Dimensions of entrepreneurship: intrapreneurship, technopreneurship, cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship

Module II: Entrepreneurship and Micro, Small and Medium Enterprises (6 hours)

Concept of business groups and role of business houses and family business in India; The contemporary role models in Indian business: their values, business philosophy and behavioural orientations;Conflict in family business and its resolution

Module III: Sustainability of Entrepreneurship (6 hours)

Public and private system of stimulation, support and sustainability of entrepreneurship. Requirement, availability and access to finance, marketing assistance, technology, and industrial accommodation,Role Of Industries/entrepreneur's association and self-help groups,The concept, role and functions of business incubators,angel investors,venture capital and private equity fund

Module IV: Sources of business ideas and tests of feasibility (6 hours).

Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation, planning & control; preparation of project report (various aspects of the project report such as size of investment, nature of product, market potential may be covered); Project submission/ presentation and appraisal there of by external agencies,such as financial/non-financial institutions

Module V: Mobilising Resources (6 hours).

Mobilising resources for start-up. Accommodation and utilities; Preliminary contracts with the vendors, suppliers, bankers, principal customers; Contract management: Basic start-up problems

Suggested Readings

1. Kuratkoand Rao,Entrepreneurship:A South Asian Perspective, Cengage Learning.
2. Hisrich R, Peters M, Dean Shepherd, Entrepreneurship, McGrawHill lEducation
3. Desai, Vasant. Dynamics of Entrepreneurial Development and Management. Mumbai, Himalaya Publishing House.
4. Dollinger, Mare J. Entrepreneurship: Strategies and Resources.Illinois,Irwin.
5. David H. Entrepreneurship: New Venture Creation.Prentice-Hall of India ,NewDelhi.
6. Paul P E. Creativity, Innovation and Quality. (Eastern Economic Edition), New Delhi: Prentice-Hall of India.ISBN-81-203-1690-8.

7. Singh, Nagendra P. Emerging Trends in Entrepreneurship Development. New Delhi: ASEED.
8. Khanka S S, Entrepreneurial Development, S. Chand &Co,Delhi.
9. Ramachandran K, Entrepreneurship Development, McGraw-HillEducation
10. SIDBI Reports on Small Scale IndustriesSector.

Mapping of COs with Syllabus

Course Outcomes	Module-1	Module-2	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3			H	M
CO4			H	L

CMIF0082: INDIAN FINANCIAL SYSTEM (6 Credits-75 Hours) (L-T-P: 5-1-0)

***Objective**: This course primarily deals with the Financial System of India. It will enable students to acquire a basic understanding of the structure, organization and functioning of the financial system and will give an exposure to different financial instruments and their implications in the existing regulatory framework.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Explain the importance of the financial system for the national economy. (Remembering)
CO2: Explain financial system design and market structure. (Understanding)
CO3: Identify the role of Money markets and Capital markets. (Analysing)
CO4: Analyse the role of the Reserve Bank of India in the Indian financial system. (Applying)
CO5: Evaluate the function of financial intermediaries. (Evaluating)
CO6: Summarize the functioning of development financial institutions. (Creating)

Module I: Financial System (15 Hours)

Introduction to financial system, role and the structure of financial system; an overview of financial institutions, market structure and its components, financial instruments and services; financial system and economic significance; reforms in the financial system.

Module II: Financial Markets (20 Hours)

a) Money Markets: Meaning, objectives, importance, characteristics, money markets instruments, participants and functions of money market, role of Reserve Bank of India and Commercial Banks in the Indian money market.
b) Capital Markets: Meaning, objectives and functions, classification of capital markets, capital market instruments.
c) Primary market or new issue market: meaning, methods of marketing of securities, Book Building, Red herring prospectus.
d) Secondary Market: Meaning, characteristics and functions, growth of stock exchange, functions of stock exchange, types of speculators on stock exchange, SENSEX, NIFTY, OTCEI (Over the Counter Exchange of India); Debt Market; Derivatives Market.

Module III: Financial Instruments (15 Hours)

a) Financial instruments: meaning, role, and classification of financial instruments: general issue, functional categories, maturity and type of interest rate; financial derivatives and employee stock options.
b) Proposed functional category and instrument breakdown
c) Investment, type of investments, assets, liabilities
d) IAS 32 financial instruments

Module IV: Financial Institutions (15 Hours)

Development Financial Institutions: IDBI, IFCI, ICICI, SIDBI, NABARD, NEDFI; Non- Banking Financial Companies (NBFCs); Management of NPAs, changes in NPAs provisioning norms, BASEL III norms; Mutual Fund and Insurance; Financial Regulatory Authorities.

Module V: Financial Services (10 Hours)

Financial Services- Introduction, characteristics, types; investment banking; depositories and custodians; credit rating; factoring and forfeiting; housing finance; leasing and hire purchase; merchant banking; venture capital.

Mapping of COs with Syllabus

Course Outcomes	Module-1	Module II	Module III	Module IV
CO 1	H			
CO 2		H		
CO 3			H	
CO 4				H

CO 5				M

CMIE0083: INDIAN ECONOMY (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Define the basic issues in economic development (Understanding)
2. Note down the critical assessment of economic reforms (Applying)
3. Explain economic development strategy since independence (Analyzing)
4. Evaluate the economic planning and development issues (Evaluating)
5. Elaborate the sectoral trends and issues(Evaluating)

Module I: Basic Issues in Economic Development (10 hours)

Concept and Measures of Development and Underdevelopment; Human Development

Module II: Basic Features of the Indian Economy at Independence (10 hours)

Composition of national income and occupational structure, the agrarian scene and industrial structure

Module III: Policy Regimes (Lectures 10)

a. The evolution of planning and import substituting industrialization.
b. Economic Reforms since 1991.
c. Monetary and Fiscal policies with their implications on economy

Module IV: Growth, Development and Structural Change (15 hours)

a. The experience of Growth, Development and Structural Change in different phases of growth and policy regimes across sectors and regions.
b. The Institutional Framework: Patterns of assets ownership in agriculture and industry; Policies for restructuring agrarian relations and for regulating concentration of economic power;
c. Changes in policy perspectives on the role of institutional framework after 1991.
d. Growth and Distribution; Unemployment and Poverty; Human Development; Environmental concerns.
e. Demographic Constraints: Interaction between population change and economic development.

Module V: Sectoral Trends and Issues and Industrialization in North Easter Region (20 hours)

a. Agriculture Sector: Agrarian growth and performance in different phases of policy regimes i.e. pre green revolution and the two phases of green revolution; Factors influencing productivity and growth; the role of technology and institutions; price policy, the public distribution system and food security.
b. Industry and Services Sector: Phases of Industrialisation – the rate and pattern of industrial growth across alternative policy regimes; Public sector – its role, performance and reforms; The small-scale sector; Role of Foreign capital.
c. Financial Sector: Structure, Performance and Reforms. Foreign Trade and balance of Payments: Structural Changes and Performance of India's Foreign Trade and Balance of Payments; Trade Policy Debate; Export policies and performance; Macro Economic Stabilisation and Structural Adjustment; India and the WTO, Role of FDI, Capital account convertibility,
d. Industrialization in North Easter Region- Types of industries, industrial policies, Act East policy, Cross Border Trade, Border Area Development, Institutions – NEDFI, DONNER, NEC

Suggested Readings:

1. Mishra and Puri, Indian Economy, Himalaya PublishingHouse
2. IC Dhingra, Indian Economics, Sultan Chand & Sons
3. GauravDutt and KPM Sundarum, Indian Economy, S. Chand & Company.
4. Bhagwati, J. and Desai, P. India: Planning for industrialization, OUP, Ch 2.
5. Patnaik, Prabhat. Some Indian Debates on Planning. T. J. Byres (ed.). The Indian Economy: Major Debates since Independence, OUP.34
6. Ahluwalia, Montek S. State-level Performance under Economic Reforms in India in A. O. Krueger. (ed.). Economic Policy Reforms and the Indian Economy, The University of Chicago Press.
7. Dreze, Jean and Amartya Sen. Economic Development and Social Opportunity. Ch. 2. OUP. 8. Khanna, Sushil. Financial Reforms and Industrial Sector in India.Economic and Political Weekly.Vol. 34.No. 45.
8. Uma Kapila (ed), "Indian Economy since Independence", Relevant articles.
9. Rangarajan, C. and N. Jadhav. Issues in Financial Sector Reform.BimalJalan. (ed). The Indian Economy. Oxford University Press, New Delhi. Note: Latest edition of text books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	H			

CO 2			H	H	
CO 3		H			
CO 4			H		M
CO 5					H

CMPG0086: PRINCIPLES OF MARKETING (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Define the scope and importance of marketing environment channels of distribution, Promotion(Remembering)
2. Explain the concepts of Product classification, concepts of product mix and new product development process (Understanding)
3. Identify factors influencing consumer buying behavior, factors affecting price of a product and pricing policies and strategies(Applying)
4. Distinguish selling and marketing and compare product differentiation with market segmentation (Analyzing)
5. Evaluate Recent developments in marketing different distribution channels and promotional techniques etc. (Evaluating)

Module I: Introduction (15 hours)

Nature, scope and importance of marketing; Evolution of marketing; Selling's Marketing; Marketing mix, marketing environment: Concept, importance, and components (Economic, Demographic, Technological, Natural, Socio-Cultural and legal).

Module II: Consumer Behavior (15 hours)

Nature and Importance, Consumer buying decision process; Factors influencing consumer buying behavior: Marketing segmentation: Concept, importance and bases; Target market selection; Positioning concept, importance and bases; Product differentiation vs. market segmentation.

Module III: Products (15 hours)

Concept and importance, Product classifications; Concept of product mix; Branding, packaging and labeling; Product-support Services; Product life-cycle; New product Development process; Consumer adoption process.

Module IV: Pricing and Distribution: (15 lectures)

Significance Factors, Affecting price of a product, Pricing policies and strategies

a. Distribution channels and Physical Distribution: Channels of distribution-meaning and importance; Types of distribution channels; Functions of middle man: Factors affecting choice of distribution channel; Wholesaling and retailing; Types of Retailers; e-tailing, Physical Distribution.

Module V: Promotion and Recent Developments in Marketing (15 lectures)

Nature and importance of promotion; Communication process; Types of promotion: advertising, personal selling, public relations &sales promotion, and their distinctive characteristics; Promotion mix and factors affecting promotion mix decisions;

Recent developments in marketing: Social Marketing, online/digital marketing, direct marketing, services marketing, green marketing, rural marketing; Consumerism

Suggested Readings

1. Principles of Marketing, 13thEdition, Kotler, Philip, Gary Armstrong, Prafulla Agnihotri and Ehsanul Haque, Pearson Education.
2. Marketing Concepts and Cases,(Special Indian Edition), Michael, J. Etzel, Bruce J. Walker, William J Stanton and Ajay Pandit, McGraw Hill Education.
3. Basic Marketing, William D. Perreault, and McCarthy, E.Jerome, Pearson Education.
4. The Essence of Marketing, Majaro, Simon, Pearson Education, New Delhi.
5. The Consumer Protection Act, 1986.
6. Marketing Management: A south Asian Perspective, Iacobucci and Kapoor, Cengage Learning.
7. Marketing, Dhruv Grewal, Michael levy, McGraw Hill Education.
8. Marketing Management, 4th Edition, Chhabra, T.N, S.K. Grover, Dhanpat Rai &Company.
9. Principles of Marketing, Neeru Kapoor, PHI Learning.
10. Principles of Marketing, Rajendra Maheshwari, International Book House.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3		M	H		
CO 4			L	H	
CO 5		L			H

CMFF0087: FUNDAMENTALS OF FINANCIAL MANAGEMENT (6 CREDITS- 75 HOURS) (L-T-P: 4-0-2)

Course Outcomes

1. Explain the objectives and scope of financial management and time value of money (Remembering)
2. Explain various capital structure theories and factor affecting capital structure decision (Understanding)
3. Analyse the process of working capital management and capital budgeting process(Analysing)
4. Critically judge the various theories of dividend and determine the factors affecting dividend polices (Evaluating)

Module I: Introduction (15 hours)

Nature, scope and objective of Financial Management, Time value of money, Risk and return (including Capital Asset Model), Valuation of securities – Bonds and Equities

Module II: Investment Decisions (15 hours, 32 Lab)

The Capital Budgeting process, Cash flow Estimation, Payback period Method, Accounting Rate of return, Net Present Value(NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index, Capital budgeting under Risk- Certainty Equivalent Approach and Risk Adjusted Discount Rate.

Module III: Financing Decisions (15 hours, 32 Lab)

Cost of Capital and Financing Decision: Sources of long-term financing Estimation of components of cost of capital. Methods for calculating cost of equity capital Cost of retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average Cost of capital (WACC) and Marginal cost of capital. Capital structure- Theories of capital structure (Net Income, Net Operating, MM, Hypothesis, and Traditional Approach). Operating and financial leverage; Determinants of capital structure

Module IV: Dividend Decisions (15 hours)

Theories of Relevance and irrelevance of dividend decision for corporate valuation; Cash and stock dividends; Dividend polices in practice

Module V: Working Capital Decisions (15 hours)

Concepts of working capital, the risk –return trade off, sources of short-term finance, working capital estimation, cash management, receivables management, inventory management and payables management.

Suggested Readings

1. Financial Management and Policy, James C. Van Horne and Sanjay Dhamija, Pearson Education.
2. Principles of Financial Management, Levy h. and M. Sarnat, Pearson Education.
3. Fundamentals of Financial Management, Brigham and Houston, Cengage Learning.
4. Basic Financial Management, Khan and Jain, McGraw Hill Education
5. Fundamentals of Financial Management, Prasanna Chandra, McGraw Hill Education
6. Financial Management-text and Problems, Singh, J.K, DhanapatiRai and Company , Delhi
7. Fundamentals of Financial Management, Rustagi, R.P, Taxmann Publications Pvt.Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	M

CMMA0088: MANAGEMENT ACCOUNTING (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Define Responsibility accounting, Transfer pricing(Remembering)
2. Interpret conceptual framework of Management Accounting and Marginal Costing(Understanding)
3. Construct income statements using absorption and variable costing and apply marginal costing and different costing techniques in different business situations(Applying)
4. Distinguish between cost control and cost reduction and compare the different forms of accounting(Analysing)
5. Assess budgetary control system and standard costing as tool of managerial planning and control(Evaluating)

Module I: Introduction (6 hours)

Meaning, Objectives, Nature and Scope of management accounting, Difference between cost accounting and management accounting, Cost control and cost reduction, Cost management

Module II: Budgetary Control (10 hours)

Budgeting and Budgetary Control: Concepts of budget, budgeting and budgetary control, objectives, merits and limitations: Budget administration, Functional budgets. Fixed and flexible budgets. Zero base budgeting. Programme and performance budgeting.

Module III: Standard costing (12 hours)
Standard Costing and Variance Analysis: Meaning of standard cost and standard costing, advantages, limitations and applications. Variance Analysis-material, labour, overheads and sales variances.Disposition of Variances, Control Ratios

Module IV: Marginal Costing (12 hours)
Absorption versus Variable Costing: Distinctive features and income determination. Cost-Volume- Profit Analysis, Profit Volume ratio. Break even analysis-algebraic and graphic methods. Angle of incidence, margin of safety, key factor, determination of cost indifference point

Module V: Decision making (20 hours)
Steps in Decision Making Process, Concepts of Relevant Costs and Benefits, Various short-term decision-making situations-profitable product mix, Acceptance or Rejection of special / exports offers, Make or buy, Addition or Elimination of a product line, Sell or process further, operate r shut down. Pricing Decisions: Major factors influencing pricing decisions, various methods of pricing

Module VI: Contemporary Issues (15 lectures)
Responsibility Accounting: Concepts, Significance, Different Responsibility Centres and Divisional Performance Measurement: Financial and Non –financial measures. Transfer Pricing

Suggested Readings

1. Introduction to Management Accounting Charles T. Horngren, Gary L. Sunder, Dave Burgstahler, Jeff O. Schatzberg, Pearson Education.
2. Management Accounting, Anthony A. Atkinson, Robert S. Kaplan, Ella Mae Matsumura, S. Mark Young. Dorling Kindersley (India) Pvt. Ltd.
3. Managerial Accounting, Ronald W. Hilton and David E. Platt. Creating Value in a Global Business Environment, McGraw Hill Education.
4. Management Accounting Singh, Surender, Scholar Tech Press, New Delhi.
5. Management Accounting, Goel, Rajiv, International Book House,
6. Management Accounting Arora, M.N. Vikas Publishing House, New Delhi.
7. Management Accounting, Maheshwari, S.N. and S.N. Mittal. Shree Mahavir Book Depot, New Delhi.
8. Management Accounting, Singh, S. K. and Gupta Lovleen. – Theory and Practice. Pinnacle PublishingHouse.
9. Management Accounting, Khan, M.Y. and Jain, P.K.. McGraw Hill Education
10. Fundamentals of Management Accounting, H. V. Jhamb, Ane Books Pvt. Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2		H				
CO 3			H			
CO 4				H		M
CO 5					H	

CMCP0089: CORPORATE TAX PLANNING (6 credits- 75 hours) (L-T-P: 5-1-0)

Course Outcomes

1. Define the basic concepts of Taxation of Companies and residential status (Remembering)
2. Summarise the various uses of corporate tax planning in business (Understanding)
3. Apply the concept of Tax-planning in specific management decisions (Applying)
4. Explain the provisions of taxation related to non-residents/ International Taxation (Analysing)
5. Assessing Tax planning in respect of business restructuring cases (Evaluating)

Module I: Introduction (9 hours)
Tax planning, tax management, tax evasion, tax avoidance; corporate tax in India; Types of companies; Residential status of companies and tax incidence; Tax liability and minimum alternate tax; Tax on distributed profits

Module II: TaxPlanning-1 (12 hours)
Tax planning with reference to setting up of a new business: Locational aspect, nature of business, forms of organization; Tax planning with reference to financial management decision - Capital structure, dividend including deemed dividend and bonus shares; Tax planning with reference to sale of scientific research assets.

Module III: Tax Planning-2 (15 hours)
Tax planning with reference to specific management decisions –Make or buy; owner lease; repair or replace, Tax planning with reference to employees' remuneration, Tax planning with reference to receipt of insurance compensation, Tax planning with reference to distribution of assets at the time of liquidation.

Module IV: Special provisions relating to non-residents (12 hours)

Double taxation relief; Provisions regulating transfer pricing; Advance rulings; Advance pricing agreement

Module V: Tax Planning with reference to Business Restructuring (17 hours)
Amalgamation, Demerger, Slump sale, Conversion of sole proprietary concern/partnership firm into company, Conversion of company into LLP, Transfer of assets between holding and subsidiary companies

Suggested Readings:

1. Vinod K. Singhania and Monica Singhania, *Corporate Tax Planning.* Taxmann Publications Pvt. Ltd., NewDelhi.
2. GirishAhuja and Ravi Gupta. *Corporate Tax Planning and Management*. Bharat Law House, Delhi.
3. Shuklendra Acharya and M.G. Gurha. *Tax Planning under Direct Taxes*. Modern Law Publication, Allahabad.
4. MittalD.P., Law of Transfer Pricing. Taxmann Publications Pvt. Ltd., NewDelhi.
5. IAS – 12 and AS –22.
6. T.P. Ghosh, *IFRS,* Taxmann Publications Pvt. Ltd. NewDelhi.

Journals

1. *Income Tax Reports*, Company Law Institute of India Pvt. Ltd., Chennai.
2. *Taxman,* Taxman Allied Services Pvt. Ltd., New Delhi.
3. *Current Tax Reporter***,** Current Tax Reporter,Jodhpur

Note: Latest edition of text books may be used

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M	L	L	
CO 2		H	H		M
CO 3		M	H		L
CO 4		L	L	H	M
CO 5	L				H

CMCA0090: COMPUTERIZED ACCOUNTING SYSTEM (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Define the theoretical framework of SQL, DBMS package and other accounting software (Tally Erp9) (Remembering).
2. Understand the Preparation of ledgers, Trial balance and report with SQL. (Understanding).
3. Application of Computer software in the area of administration of direct and indirect taxes, with the use of generic software. (Application)
4. Application of computer software for statutory audit, verification of voucher, verification ofrelated party transactions (Analysing)
5. Design the accounting software system (Creating)

Module I: Computerized Accounting: Using Generic Software (10 hours,1 hour Lab)
Taxation: TDS, VAT and Service Tax, auditing in Computerized Accounting system: Statutory Audit, Voucher verification; Verification of related party transaction, CAAT: Various Tools.

Module II: Designing Computerised Accounting System (24 hours , 24 hours Lab)
Designing Computerised Accounting System using a DBMSP package, creating a voucher entry Form, preparing ledgers with SQL, Form, and Report, preparing Trial Balance with SQL and Report

Module III: Designing Accounting Support System (16 Lectures, 16 Practical Lab)
Designing Supplier and customers System for Accounting using Form, Query, Module, and Report; Designing Payroll System for Accounting using Form, Query, Module, and Report.

Note:

1. The General-Purpose Software referred in this course will be notified by the University Departments every three years. If the specific features, referred in the detailed course above, is not available in that software, to that extent it will be deemed to have been modified.
2. There shall be a practical examination of 100 Marks (Practical-80 Marks, Viva-10 Marks and Work Book-10Marks) and duration of Examination shall be 3Hrs.
3. Teaching arrangements need to be made in the computer Lab.
4. There shall be Four Lectures per class and 4 Practical periods per batch to be taught in computer Lab.

Suggested Readings:

1. SQL For Beginners: SQL Made Easy; A Step-By-Step Guide to SQL Programming for the Beginner, Intermediate and Advanced User (Including Projects and Exercises) Craig berg
2. TallyERP 9 with GST in Simple Steps Paperback; Dreamtech press
3. Learning Tally ERP 9 with GST; SajeeKurian, Blessing Inc
4. Database Management Systems (DBMS) Rajiv Chopra, S.Chand Publishing
5. Learning SQL; Alan Beaulieu, O'Reilly Media

Mapping of Courses to PO/PSO

Course Outcomes	Module I	Module II	Module III
CO 1	L	L	L
CO 2		M	
CO 3	H	H	
CO 4	H		
CO 6			H

CMPM0091: PROJECT MANAGEMENT (CREDITS: 6- 75 HOURS) (L-T-P: 5-1-0)

Course Outcome

1. Explain the concept and attributes of projects, project management system, process and its principles (Remembering)
2. Perform technical feasibility, marketing feasibility and commercial viability using NPV, and further to understand tax and legal aspects of a project. (Applying)
3. Analyse project appraisal in public & private sector and estimate shadow prices and social discount rate. (Analysing)
4. Examine project risk and performance assessment. (Analysing)
5. Evaluate project management techniques using case studies. (Evaluating)

Module I: Introduction (15 hours)

Concept and attributes of Project, Identification of Investment opportunities, Project life cycle, Role of Project Manager, Project Management Information System, Project Management Process and Principles, Relationship between Project Manager and Line Manager, Project Stakeholder Analysis. Project Planning, Monitoring and Control of Investment Projects. Pre-Feasibility study

Module II: Project Preparation (15 hours)

Technical Feasibility, Marketing Feasibility, Financial Planning: Estimation of Costs and Funds (including sources of funds), Loan Syndication for the Projects, Demand Analysis and Commercial Viability (brief introduction to NPV), Project budget, Collaboration Arrangements, Tax considerations and legal aspects.

Module III: Project Appraisal (15 hours)

Business Criterion of Growth, Liquidity and Profitability, Social Cost Benefit Analysis in Public and Private Sector, Investment Criterion and Choice of techniques, Estimation of Shadow prices and Social discount rate

Module IV: Project Risk and Performance Assessment (15 hours)

Project Risk Management- Identification, Analysis and Reduction, Project quality management, Project Performance Measurement and Evaluation, Project Report,Project Closure and Audit.

Module V: Issues in Project Planning and Management, Techniques & Case Studies (15 hours)

Cost and Time Management issues in Project Planning and Management. Techniques (PERT & CPM).Two Case Studies in Project Management

Suggested Readings:

1. Chandra. Prasanna.Project Preparation, Appraisal and Implementation.Tata McGraw Hill.B.Com.(Hons)CBCS Department of Commerce, University of Delhi
2. Gido, Jackand Clements, James P. Project Management. Cengage Learning.
3. Gray, Clifford F., Larson, Eric W., and Desai, Gautam V. Project Management: The ManagerialProcessMcGrawHillEducation
4. Barker, Stephen and Cole, Rob. Brilliant Project Management, Pearson.
5. Kharua, Sitangshu. Project Management and Appraisal. Oxford Press University.

Note: Latest Editions of the text books may be used.

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMFS0092: FINANCIAL MARKETS, INSTITUTIONS AND FINANCIAL SERVICES (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Define Non- Banking Financial companies(NBFCs), Mutual Fund, Venture Capital Finance, Leasing ,Hire purchases etc(Remembering)
2. Explain the concepts of Money Market and Capital Market(Understanding)
3. Demonstrate the significances of merchant banking, factoring services and credit rating(Understanding)
4. Analyse the current developments in commercial banking(Analysing)
5. Evaluate the role of financial system in economic development(Evaluating)

Module I: Introduction (8 hours)

Financial System and its Components-financial markets and institutions; financial intermediation; Flow of funds matrix; financial system and economic development; an overview of Indian Financial system

Module II: Financial Markets (17 hours)

Money market- functions, organization and instruments. Role of central bank in money market; Indian money market- An overview; Capital Markets- functions, organization and instruments. Indian debt market; Indian equity market- primary and secondary markets; Role of stock exchanges in India

Module III: Financial Institutions (20 hours)

Commercial banking- introduction, its role in project finance and working capital finance; Development financial institutions (DFIs)- An overview and role in Indian economy; Life and non- life insurances companies in India; Mutual funds- Introduction and their role in capital market development. Non-banking financial companies (NBFCs)

Module IV: Financial Services (8 hours)

Overview of financial services industry: Merchant banking-pre and post issuer management, underwriting. Regulatory framework relating to merchant banking in India

Module V: Leasing and hire -Purchases (22 hours)

Consumer and housing finance; Capital financer; Factoring services, bank guarantees and letter of credit; Credit ratings; Financial counselling

Suggested Readings

1. L M Bhole, and JitendraMahakud. *Financial Institution and Markets*, McGraw-Hill Education
2. Khan, M.Y. Indian Financial System, McGraw- Hill Education.
3. Dhanekar. Pricing of securities. New Delhi: Bharat Publishing House.
4. Prasanna, Chandra, Financial Management: Theory and Practice, McGraw- HillEducation.
5. Clifford, G. FinancialMarkets,InstitutionsandFinancialServices,PHILearning
6. MY Khan and PK Jain. Financial Services. McGraw Hill Education

CMAD0093: ADVERTISING (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Defining the overall role of advertising in the business world. (Remembering)
2. Illustrating various advertising strategies and budgets. (Analysing)
3. Identifying the various advertising media. (Remembering)
4. Interpreting how an advertising agency operates. (Understanding)

Module I: Communication Process (10 hours)

Communication Process; Advertising as a tool of communication; Meaning, nature and importance of advertising; Types of advertising; Advertising objectives. Audience analysis; Setting of advertising budget: Determinants and major methods

Module II: Major media types (15 hours)

Major media types-their characteristics, internet as an advertising media, merits and demerits; Factors influencing media choice; media selection, media scheduling, Advertising through the Internet-media devices

Module III: Advertising appeals (15 hours)
Advertising appeals, Advertising copy and elements, Preparing ads for different media

Module IV Evaluating communication and sales effects (15 hours)
Evaluating communication and sales effects; Pre- and Post-testing techniques

Module V: Advertising Agency (10 hours)
a. Advertising Agency: Role, types and selection of advertising agency.
b. Social, ethical and legal aspects of advertising in India.

Suggested Readings:
1. *Advertising and Promotion an Integrated Marketing Communications Perspective,* George E Belch, Michael A Belch, KeyoorPurani, McGraw Hill Education
2. *Advertising: Its Role in Marketing*, S. Wats Dunn and Arnold M. Barban,Dryden Press
3. *Advertising: Principles and Practice*, Burnett, Wells, and Moriatty, Prentice Hall of India, New Delhi.
4. *Advertising Management*, Batra, Myers and Aakers, PHI Learning.
5. *Advertising,*Chunawala and Sethia,Himalaya Publishing House
6. *Advertising,*RuchiGupta,S. Chand &Co.

Mapping of COs to syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2			M	H	
CO 3		L	H		
CO 4					H

CMBI0094: BANKING AND INSURANCE (6 CREDITS- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes
1. Explain the basic principles of banking and insurance.(Remembering)
2. Relate the various services provided by banks. (Understanding)
3. Apply the concept of Internet Banking in day-to-day transactions. (Applying)
4. Examine the situations to relate the risk and insurance. (Analysing)

Module I: Introduction (15 hours)
Origin of banking: definition, banker and customer relationship, General and special types of customers, Types of deposits, Origin and growth of commercial banks in India. Financial Services offered by banks, changing role of commercial banks, types of banks.

Module II: Cheque and Paying Banker (15 hours)
Crossing and endorsement - meaning, definitions, types and rules of crossing. Duties, Statutory protection in due course, collecting bankers: duties, statutory protection for holderin due course, Concept of negligence.

Module III: Banking Lending (13 hours)
Principles of sound lending, secured vs. unsecured advances, types of advances, Advances against various securities.

Module IV: Internet Banking (15 hours)
Meaning, Benefits, Homebanking,Mobilebanking,Virtualbanking,E-payments,ATMCard/ iometriccard, Debit/Credit card, Smart card, NEFT, RTGS, ECS (credit/debit), E-money, Electronic purse, Digitalcash.

Module V: Insurance (17 hours)
Basicconceptofrisk,Typesofbusinessrisk,Assessmentandtransfer,Basicprinciplesofutmostgoodfaith,Indemnity,Economicfunction,Proximatecause,Subrogationandcontribution,Typesofinsurance:LifeandNon-life,Re-insurance,Riskandreturnrelationship,Needforcoordination. Power, functions and Role of IRDA, Online Insurance

Suggested Readings:
1. Agarwal, O.P., Banking and Insurance, Himalaya Publishing House
2. Satyadevi, C., Financial Services Banking and Insurance, S.Chand

3. Suneja, H.R., Practical and Law of Banking, Himalaya Publishing House
4. Chabra, T.N., Elements of Banking Law, Dhanpat Rai and Sons
2. Arthur C. And C. William Jr., Risk Management and Insurance, McGraw Hill
3. Saxena, G.S. Legal Aspects of Banking Operations, Sultan Chand and Sons
4. Varshney, P.N., Banking Law and Practice, Sultan Chand and Sons
5. Jyotsna Sethi and Nishwan Bhatia, Elements of Banking and Insurance, PHI Learning

Note: Latest edition of books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	M	M	H	M	H
CO 2	L	M	M	M	
CO 3		L	M	H	L
CO 4		L	L	M	H

CMSM0095: INVESTING IN STOCK MARKETS (CREDITS: 6- 75 HOURS) (L-T-P: 5-1-0)

Course Outcomes

1. Learn the basics of investing in stock market, the investment environment as well as risk & return (Remembering)
2. Explain Indian securities market including the derivatives market (Understanding)
3. Examine EIC framework and conduct fundamental analysis (Analysing)
4. Perform technical analysis (Applying)
5. Invest in mutual funds market (Applying)

Module I: Basics of Investing (15 hours)

Basics of Investment & Investment Environment. Risk and Return, Instruments of Investment - Equity shares, Preference shares, Bonds and Debentures. Indian Security Markets: Primary Markets (IPO, FPO, Private placement, Offer for sale), Secondary Markets (cash market and derivative market: Futures and Options) Market Participants: Stock Broker, Investor, Depositories, Clearing House, Stock Exchanges. Role of stock exchange, Stock exchanges in India: BSE, NSE, MSEI. Security Market Indices: Nifty & Sensex, Sources of financial information. Trading in securities: types of orders, using brokerage and analyst recommendations

Module II: Indian Security Markets (15 hours)

Primary Markets (IPO, FPO, Private placement, Offer for sale), Secondary Markets (cash market and derivative market: Futures and Options) Market Participants: Stock Broker, Investor, Depositories, Clearing House, Stock Exchanges. Role of stock exchange, Stock exchanges in India: BSE, NSE, MSEI. Security Market Indices: Nifty & Sensex, Sources of financial information.

Trading in securities: types of orders, using brokerage and analyst recommendations

Module III: Fundamental Analysis (15 hours)

Top down and bottom up approaches, Analysis of international & domestic economic scenario, Industry analysis, Company analysis (Quality of management, financial analysis : Both Annual and Quarterly, Income statement analysis, position statement analysis including key financial ratios, Cash flow statement analysis, Industry market ratios: PE, PEG, Price over sales, Price over book value, EVA), Understanding Shareholding pattern of the company.

Module IV: Technical Analysis (15 hours)

Trading rules (credit balance theory, confidence index, filter rules, market breath, advances vs declines and charting (use of historic prices, simple moving average and MACD) basic and advanced interactive charts. Do's & Don'ts of investing in markets.

Module V: Investing in Mutual Funds (15 hours)

Concept and background on Mutual Funds: Advantages, Disadvantages of investing in Mutual Funds, Types of Mutual funds: Open ended, close ended, equity, debt, hybrid, money market, and entry load vs. exit load funds. Factors affecting choice of mutual funds.CRISIL mutual fund ranking and its usage, calculation and use of Net Asset Value

Suggested Readings:

1. Kumar, Vinod and Nangia, Raj Sethi, Investing in Stock Markets, Ane books
2. Singh J K , Singh Amit Kumar, Investing in Stock Markets, A K Publications, Delhi.
3. Tripathi, Vanita and Pawar, Neeti (2019), Investing in Stock Market, Taxmann Publications

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5				M	H

CMAG0098: AUDITING AND CORPORATE GOVERNANCE (6 Credits-75 hours) (L-T-P: 5-1-0)

Objectives:

- *To understand the various concepts related to Auditing, liabilities of statutory Auditors under the companies Act 2013*
- *To gain knowledge of special areas of Audit and computer aided audit techniques and tools*
- *To learn the procedures related Corporate Governance theories and models and various corporate scandals in India and Abroad*
- *To understand the concept of CSR with responsibility with corporate Sustainability*

COURSE/LEARNING OUTCOMES

After completing the course successfully, the student will be able to-

CO1: Define the various concepts related to Auditing and types of Audits (Remembering)

CO2: Explain the concepts of audit of Limited companies, liabilities of statutory Auditors under the companies Act 2013(Understanding)

CO3: Execute the Knowledge of special areas of Audit and computer aided audit techniques and tools (Applying)

CO4: Examine the procedures related Corporate Governance theories and models and various corporate scandals in India and Abroad (Analysing)

CO5: Evaluate the requirements of different business ethics, corporate ethics in a business (Evaluating)

CO6: Explain the concept of CSR with responsibility with corporate Sustainability (Understanding)

Module I: Introduction (15 hours)

Auditing: Introduction, Meaning, Objectives, Basic Principles and Techniques; Classification of Audit, Audit Planning, Internal Control – Internal Check and Internal Audit; Audit Procedure Vouching and verification of Assets & Liabilities.

Module II: Audit of Companies (15 hours)

Audit of Limited Companies: Company Auditor- Qualifications and disqualifications, Appointment, Rotation, Removal, Remuneration, Rights and Duties Auditor's Report- Contents and Types. Liabilities of Statutory Auditors under the Companies Act 2013;Secretarial Audit i. Overview & introduction: Concept; advantages; legal provisions; risk of Secretarial Auditor; code of conduct

Module III: Special Areas of Audit (15 hours)

Special Areas of Audit: Special features of Cost audit, Tax audit, and Management audit; Recent Trends in Auditing: Basic considerations of audit in EDP Environment; Computer aided audit techniques and tools; Auditing Standards; Relevant Case Studies/Problems.

Module IV: Corporate Governance (10 hours)

Conceptual framework of Corporate Governance: Theories & Models, Broad Committees; Corporate Governance Reforms. Major Corporate Scandals in India and Abroad: Common Governance Problems Noticed in various Corporate Failures. Codes & Standards on Corporate Governance

Module V: Business Ethics (10 hours)

Morality and ethics, business values and ethics, approaches and practices of business ethics, corporate ethics, ethics program, codes of ethics, ethics committee; Ethical Behaviour: Concepts and advantages; Rating Agencies; Green Governance; Clause 49 and Listing Agreement

Module VI: Corporate Social Responsibility (CSR) (10 hours)

Concept of CSR, Corporate Philanthropy, Strategic Planning and Corporate Social Responsibility; Relationship of CSR with Corporate Sustainability; CSR and Business Ethics, CSR and Corporate Governance; CSR provisions under the Companies Act 2013; CSR Committee; CSR Models, Codes, and Standards on CSR

Suggested Readings

1. Ravinder Kumar and Virender Sharma, *Auditing Principles and Practice*, PHI Learning

2. . Aruna Jha, *Auditing*. Taxmann Publication.
3. A. K. Singh, and Gupta Lovleen*. Auditing Theory and Practice*. Galgotia Publishing Company.
4. Anil Kumar, *Corporate Governance: Theory and Practice*, Indian Book House, New Delhi
5. MC Kuchhal, *Modern Indian Company Law*, Shri Mahaveer Book Depot.(Publishers). (Relevant Chapters)
6. KV Bhanumurthy and Usha Krishna, *Politics, Ethics and Social Responsibility of Business,* Pearson Education
7. Erik Banks, *Corporate Governance: Financial Responsibility, Controls and Ethics*, Palgrave Macmillan
8. N Balasubramanian, A Casebook on Corporate Governance and Stewardship, McGraw Hill Education
9. B.N. Ghosh, Business Ethics and Corporate Governance, McGraw Hill Education
10. S K Mandal*, Ethics in Business and Corporate Governance*, McGraw Hill Education
11. Bob Tricker, *Corporate Governance-Principles, Policies, and Practice*(Indian Edition), Oxford University Press
12. Christine Mallin, *Corporate Governance (Indian Edition),* Oxford University Press
13. Relevant Publications of ICAI on *Auditing* (CARO)
14. Sharma, J.P., *Corporate Governance, Business Ethics, and CSR, Ane Books Pvt Ltd, New Delhi*

Note: Latest edition of text books may be used

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V	Module VI
CO 1	H					
CO 2		H				
CO 3			H			
CO 4				H		
CO 5					H	
CO 6						H

CMIT0099: INDIRECT TAX LAW (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To learn the various concepts of service tax and its general principles*
- *To understand the procedure of filling of returns, penalties, cenvat credit*
- *To gain the Knowledge of VAT and calculation of VAT liability*
- *To understand Excise Law, valuation and its basic procedures*
- *To know about the custom duties and Import and Export Procedures.*

COURSE/LEARNING OUTCOMES:

After completing the course successfully, the student will be able to-

CO1: Define the various concepts of service tax and it6s general principles (Remembering)

CO2: Explain the payments of service tax and filling of returns, penalties, cenvat credit (Understanding)

CO3: Execute the Knowledge of VAT and calculation of VAT liability (Applying)

CO4: Examine the Excise Law, valuation and its basic procedures (Analysing)

CO5: Evaluate the custom duties and Import and Export Procedures (Evaluating)

Module I: Service Tax-I (18 hours)

Service tax-concepts and general principles, Charge of service tax and taxable services

Module II: Service Tax II (18 hours)

Valuation of taxable services, Payment of services tax filling of returns, Penalties, CENVAT Credit

Module III: VAT (15 hours)

VAT-concepts and general principles, Calculation of VAT liability including input TAX Credits, Small dealers and Composition Scheme, VAT procedures

Module IV: Central Excise (14 hours)

Central Excise Law in brief-Goods, Excisable goods, Manufacture and Manufacturer, Valuation, CENVAT, Basic procedures, Export, SSI, Job Work

Module V: Customs Law (10 hours)

Basic concepts of customs law, Territorial waters, high seas, Types of custom duties – Basic, Countervailing & Anti-Dumping Duty, Safeguard Duty, Valuation, Customs Procedures, Import and Export Procedures, Baggage, Exemptions

Suggested Readings

1. Singhania Vinod K. and Monica Singhania, Students' Guide to Indirect Taxes, Taxmann Publications Pvt. Ltd., Delhi.
2. V.S. Datey. Indirect Tax Law and practice, Taxmann Publications Pvt. Ltd., Delhi,
3. Sanjeev Kumar. Systematic Approach to Indirect Taxes,
4. S. S. Gupta. Service Tax -How to meet your obligation Taxmann Publications Pvt. Ltd., Delhi,
5. Grish Ahuja and Ravi Gupta, Indirect Taxes, Flair Publication Pvt Ltd

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMIB0100: INTERNATIONAL BUSINESS (6 Credits-75 hours) (L-T-P: 5-1-0)

Objectives:

- *To Understand the process of globalization, its impact on the evolution and growth of international business*
- *To know the significance of different forms of regional economic integration and to appreciate the role played by various international economic organizations such as the WTO, UNCTAD, IMF and World Bank*
- *To Familiarize students with the international financial environment, and get them acquainted with the basic features of the foreign exchange market*
- *To examine the concepts of FDI and to create an awareness about emerging issues*

COURSE/LEARNING OUTCOMES:

After completing the course successfully, the student will be able to-

CO1: Understand the process of globalization, its impact on the evolution and growth of international business (Remembering)

CO2: Understand the significance of different forms of regional economic integration and to appreciate the role played by various international economic organizations such as the WTO, UNCTAD, IMF and World Bank (Understanding)

CO3: Familiarize students with the international financial environment, and get them acquainted with the basic features of the foreign exchange market (Applying)

CO4: Analyze the theoretical dimensions of international trade and intervention measures adopted; to appreciate the significance of different forms of regional economic (Analysing)

CO5: Critically examine the concepts of FDI and to create an awarness about emerging issues (Evaluating)

Module I: (10 hours)

a. Introduction to International Business: Globalisation and its importance in world economy; Impact of globalization; International business vs. domestic business: Complexities of international business; Modes of entry into international business.

b. International Business Environment: National and foreign environments and their components - economic, cultural and political-legal environments

Module II: (12 hours)

a. Theories of International Trade – an overview (Classical Theories, Product Life Cycle theory, Theory of National Competitive Advantage); Commercial Policy Instruments - tariff and non-tariff measures – difference in Impact on trade, types of tariff and non tariff barriers (Subsidy, Quota and Embargo in detail) ; Balance of payment account and its components.

b. International Organizations and Arrangements: WTO – Its objectives, principles, organizational structure and functioning; An overview of other organizations – UNCTAD; Commodity and other trading agreements (OPEC).

Module III: (14 hours)

a. Regional Economic Co-operation: Forms of regional groupings; Integration efforts among countries in Europe, North America and Asia (NAFTA, EU , ASEAN and SAARC) .

b. International Financial Environment: International financial system and institutions (IMFandWorld Bank – Objectives and Functions) ; Foreign exchange markets and risk management; Foreign investments - types and flows; Foreign investment in Indian perspective

Module IV: (12 hours)

a. Organisational structure for international business operations; International business

negotiations.

b. Developments and Issues in International Business: Outsourcing and its potentials for India; Role of IT in international business; International business and ecological considerations.

Module V: (12 hours)

a. Foreign Trade Promotion Measures and Organizations in India; Special economic zones (SEZs) and export oriented units (EOUs), ; Measures for promoting foreign investments into and from India; Indian joint ventures and acquisitions abroad.
b. Financing of foreign trade and payment terms – sources of trade finance (Banks, factoring, forfeiting, Banker's Acceptance and Corporate Guarantee) and forms of payment (Cash in advance, Letter of Credit, Documentary Collection, Open Account)

Suggested Readings

1. Charles W.L. Hill and Arun Kumar Jain, *International Business*. New Delhi: McGraw Hill Education
2. Daniels John, D. Lee H. Radenbaugh and David P. Sullivan. *International Business*. Pearson Education
3. Johnson, Derbe., and Colin Turner. *International Business - Themes & Issues in the Modern Global Economy*. London: Roultedge.
4. Sumati Varma, *International Business*, Pearson Education.
5. Cherunilam, Francis. *International Business: Text and Cases*. PHI Learnin
6. Michael R. Czinkota. et al. International Business.Fortforth: The Dryden Press.
7. Bennett, Roger. *International Business*. Pearson Education.
8. Peng and Srivastav, *Global Business*, Cengage Learning

Note: Latest edition of text books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMBT0101: BUSINESS TAX PROCEDURE AND MANAGEMENT (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To Understand the different concepts of Tax Procedures and Management in business*
- *To learn the detail procedures of assessment and filing return of income in business.*
- *To apply the provisions of Information technology in filing E-filing of forms*

COURSE/LEARNING OUTCOMES

After completing the course successfully, the student will be able to-

CO1: Highlight the different concepts of Tax Procedures and Management in business (Remembering)
CO2: Describe the detail procedures of assessment and filing return of income in business. (Understanding)
CO3: Applying the provisions of Information technology in filing E-filing of forms (Applying)

Module I: Introduction to Business Tax Procedure & Management (18 hours)

Advance payment of tax;Tax deduction/collection at source, documentation, returns, certificates; Interest payable by Assessee/Government; Collection and recovery of tax.

Module II: Assessment & Appeals (17 hours)

Assessment, reassessment, rectification of mistakes, appeals and revisions, Preparation and filing of appeals with appellate authorities, drafting of appeal; statement of facts and statement of law.

Module III: Penalties & Prosecution (12 hours)

Penalties and prosecutions, Settlement Commission, Search, seizure and survey.

Module IV: Specific provisions related to Tax-management (12 hours)

Transactions with persons located in notified jurisdictional area; General anti avoidance rule, Tax clearance certificate; securities transaction tax.

Module V: Information Technology and its usage in Tax-Procedure (6 hours)

Information Technology and Tax administration, TAN (Tax Deduction and Collection Account Number), TIN (Tax

Information Network), e-TDS/e-TCS.

Suggested Readings:

1. Singhania, Vinod K. and Monica Singhania. *Corporate Tax Planning and Business Tax Procedures.* Taxmann Publications Pvt. Ltd., NewDelhi.
2. Ahuja, Girish. and Ravi Gupta. *Corporate Tax Planning and Management.* Bharat Law House,Delhi.
3. Singhania, Vinod K. and KapilSinghania. *TDS on CD*. Taxmann Publications Pvt. Ltd., NewDelhi.

Note: Latest edition of text books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2			H	L	
CO 3	L	H		M	H

CMFI0102: FUNDAMENTALS OF INVESTMENT (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To learn the concept of risk and return*
- *To understand investment environment, bond valuation and role of credit rating agencies*
- *To know about portfolio diversification and understand the role of Mutual Funds and Financial Derivatives market in India*
- *To appraise investors protection framework*

COURSE/LEARNING OUTCOMES:

After completing the course successfully, the student will be able to-

CO1: Define concept of risk and return (Remembering)
CO2: Discuss investment environment, bond valuation and role of credit rating agencies (Understanding)
CO3: Compare equity approaches (Analysing)
CO4: Explain portfolio diversification and understand the role of Mutual Funds and Financial Derivatives market in India (Understanding)
CO5: Appraise investors protection framework (Evaluating)

Module I: The Investment Environment (20 hours)

The investment decision process, Types of Investments–Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept to free return and risk, Impact of Taxes and Inflation on return.

Module II: Fixed Income Securities (15 hours)

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risk, default risk and credit rating.

Module III: Approaches to Equity Analysis (15 hours)

Introductions to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis,dividend capitalization models, and price-earnings multiple approaches to equity valuation.

Module IV: Portfolio Analysis and Financial Derivatives (15 hours)

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

Module V: Investor Protection (10 hours)

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism

Suggested Readings

1. C.P. Jones, *Investments Analysis and Management*, Wiley, 8th ed.
2. Prasanna Chandra, *Investment Analysis and Portfolio Management*, McGraw Hill Education
3. R.P. Rustogi, *Fundamentals of Investment,* Sultan Chand & Sons, NewDelhi.
4. N.D. Vohra and B.R. Bagri, *Futures and Options*, McGraw Hill Education
5. Mayo, *An Introduction to Investment,* Cengage Learning.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module-5
CO 1	H			M	
CO 2	M	H			
CO 3		L	H	M	
CO 4				H	L
CO 5	M				H

CMIR0103: INDUSTRIAL RELATIONS AND LABOUR LAWS (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To Understand evolution of industrial relations and its significance in managerial world.*
- *To conceive how to interact, negotiate and transact with trade unions.*
- *To understand the basic framework of collective bargaining and workers' participation*
- *To understand the legal structure provided for grievance handling under the Industrial Disputes Act 1947.*

COURSE/LEARNING OUTCOMES:

After completing the course successfully, the student will be able to-

CO1: Understand evolution of industrial relations and its significance in managerial world. (Remembering)
CO2: Imbibe how to interact, negotiate and transact with trade unions. (Understanding)
CO3: Acquaint with the basic framework of collective bargaining and workers' participation (Applying)
CO4: Design and understand the discipline measures and address grievance mechanisms (Analysing)
CO5: Understand the legal structure provided for grievance handling under the Industrial Disputes Act 1947. (Evaluating)

Module I: Industrial Relations (IR) (15 hours)

Concept of Industrial Relations; Nature of Industrial Relations; Objectives of IR; Factors affecting IR in changing Environment, Evolution of IR in India; Role of State; Trade Union; Employers' Organisation; Human Resource Management and IR Role of ILO in Industrial Relations, International Dimensions of IR

Module II: Trade Union (15 hours)

Trade Union: Origin and growth, unions after Independence, unions in the era of liberalisation; Factors Affecting Growth of Trade Unions in India, Multiplicity & Recognition of Trade Unions; Major Provisions of Trade Union Act1926

Module III: Collective Bargaining and Workers' Participation in Management (15 hours)

a. Collective Bargaining: Meaning, Nature, Types, Process and Importance of Collective Bargaining, pre-requisites, issues involved; Status of Collective Bargaining in India, Functions and role of Trade Unions in collective bargaining
b. Workers' Participation in Management: Consent, practices in India, Works Committees, Joint management councils; Participative Management and co-ownership; Productive Bargaining and Gain Sharing

Module IV: Discipline and Grievance Redressal (15 hours)

Discipline: Causes of indiscipline, Maintenance of discipline and misconduct; Highlights of domestic enquiries; Principle of Natural Justice; Labour turnover; Absenteeism; Grievance: Meaning of Grievance, Grievance redressal machinery in India, Grievance handling procedure; salient features of Industrial Employment (Standing orders) Act 1946

Module V: (15 hours)

a. The Industrial Disputes Act, 1947: Definitions of Industry, workman, and Industrial Dispute; Authorities under the Act: Procedure, Powers and Duties of Authorities; Strikes and Lock outs: Lay-off and Retrenchment: Provisions relating to Layoff, Retrenchment, and closure
b. The Factories Act, 1948: Provisions relating to Health, Safety, Welfare facilities, working hours, Employment of young persons, Annual Leave with wages

Suggested Readings

1. PK Padhi, Industrial Relations and Labour Law, PHI Learning
2. Arun Monappa, Industrial Relations and Labour Law, McGraw Hill Education
3. SC Srivastav, Industrial Relations and Labour Law, Vikas Publishing House
4. C.S Venkata Ratnam, Industrial Relations, Oxford University Press
5. P.L. Malik's Handbook of Labour and Industrial Law, Vol 1 and 2, Eastern Book

Company

6. JP Sharma, Simplified Approach to Labour Laws, Bharat Law House (P) Ltd

Note: Latest edition of text books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMCC0104: CONSUMER AFFAIRS AND CUSTOMER CARE (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To Learn the concept of market, consumer, and sellers and so on (Remembering).*
- *To understand the importance of regulatory measures in consumer marketing (Understanding).*
- *To find out the remedies available in case of consumers' problems. (Applying)*

COURSE/LEARNING OUTCOMES:

After completing the course successfully, the student will be able to-

CO1: Learn the concept of market, consumer, and sellers and so on (Remembering).

CO2: Explain the importance of regulatory measures in consumer marketing (Understanding).

CO3: Develop insights into the remedies available in case of consumers' problems. (Applying)

Module I: Conceptual Framework (13 hours)

a. Consumer and Markets: Concept of Consumer, Nature of markets, Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP) and Local Taxes, Fair Price, labeling and packaging.

b. Experiencing and Voicing Dissatisfaction: Consumer Satisfaction/dissatisfaction-Grievances- Complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Internal and External Complaint handling: Corporate Redress Systems and Public Redress Systems.

Module II: TheConsumerProtectionAct,1986 (13 hours)

a. Objectives and Basic Concepts: Consumer, goods, service, defecting goods, deficiency in service, spurious goods and services, unfair trade practice, restrictive trade practice.

b. Organizational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels, Basic Consumer Rights; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA.

Module III: Grievance Redress Mechanism under the Consumer Protection Act, 1986 (13 hours)

a. Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy to be provided; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties.

b. Seven Leading Cases decided under Consumer Protection Act: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity, Water and Telecom Services; Education; Defective Product; Unfair Trade Practice.

Module IV: Industry Regulators and Consumer Complaint Redress Mechanism(13 hours)

a. Banking: RBI and Banking Ombudsman:
b. Insurance: IRDA and Insurance Ombudsman
c. Telecommunication: TRAI
d. Food Products: FSSAI (an overview)
e. Electricity Supply: Electricity Regulatory Commission
f. Advertising: ASCI

Module V: Consumer Protection in India (13 hours)

a. Consumer Movement in India: Evolution of Consumer Movement in India. Formation of consumer organizations and their role in consumer protection, Recent developments in Consumer protection in India, National Consumer Helpline, Citizens Charter, Product testing.

b. Quality and Standardization: Voluntary and Mandatory standards; Role of BIS, Indian Standards Mark (ISI), Ag-

mark, Hallmarking, Licensing and Surveillance; ISO: An overview

Suggested Readings:

1. Khanna, Sri Ram, Savita Hanspal, Sheetal Kapoor, and H.K. Awasthi. *Consumer Affairs"* (2007) Delhi University Publication. 334 pp.
2. Aggarwal, V. K. (2003). *Consumer Protection: Law and Practice*. 5th ed. Bharat Law House, Delhi, or latest edition.
3. Girimaji, Pushpa (2002). *Consumer Right for Everyone* Penguin Books.
4. Nader, Ralph (1973). *The Consumer and Corporate Accountability*. USA, Harcourt Brace Jovanovich, Inc.

Note: The Latest edition of text books and Acts should be used.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2			H	L	
CO 3	L	H		M	H

CMBR0105: BUSINESS RESEARCH METHODS AND PROJECT WORK (6 CREDITS-75 HOURS) (L-T-P: 5-1-0)

Objectives:

- *To learn the concept of research, its type, and characteristics.*
- *To understand the research process.*
- *To learn the different scaling and sampling technique.*
- *To prepare a report based on the results and findings*

COURSE/LEARNING OUTCOMES

After completing the course successfully, the student will be able to-

CO1: Learn the concept of research, its type, and characteristics. (Remembering)
CO2: Explain the importance of research process. (Understanding)
CO3: Develop an insight into the different scaling and sampling technique. (Applying)
CO4: Preparing a report based on the results and findings (Analyzing)

Section A: Business Research Methods

Module I: Introduction (10 hours)

Meaning of research; Scope of Business Research; Purpose of Research–exploration, Description, Explanation.
Unit of Analysis – Individual, Organization, Groups, and Data Series; Conception, Construct, Attributes, Variables, and Hypotheses.

Module II: Research Process (10 hours)

An Overview; Problem Identification and Definition; Selection of Basic Research Methods-Field Study, Laboratory Study, Survey Method, Observational Method, Existing Data Based Research, Longitudinal Studies, Panel Studies.

Module III: Measurement and Hypothesis Testing (19 hours)

a. Measurement: Definition; Designing and writing items; Uni-dimensional and multi-dimensional scales; Measurement Scales-Nominal, Ordinal, Interval, Ratio; Ratings and Ranking Scale, Likert and Semantic Differential scaling, Paired Comparison; Sampling –Steps, Types, Sample Size Decision; Secondary data sources

b. Hypothesis Testing: Tests concerning means and proportions; ANOVA, Chi-square test and other non-parametric tests. Testing the assumptions of Classical Normal Linear Regression.

Section B: Project Report

Module IV: Report Preparation (36 hours)

Meaning, types and layout of research report; Step sin report writing; Citations, Bibliography and Annexure in report.

Note:

1. There shall be a written examination of 50% Marks on the basis of Unit I to III.
2. The student will write a project report under the supervision of a faculty member assigned by the

college/institution based on field work. The Project Report carries 50% Marks and will be evaluated by university appointed examiners.

Suggested Readings:

1. Kothari C.R , Research Methodology: Methods and Techniques, New Age International,
2. Srivastava, S. C. : Foundation of Social Research and Economics Techniques, Himalaya Publishing House,1990.
3. Sharma H.D. and Mukherji S. P: Research Methods in Economics and Business, New York : The Macmillan Company, 1992.
4. Saunders M , Philip Lewis and Adrian Thornhill, Research Methodology for business students, Pearson Education
5. Michael V.P, Research Methodology in Management, Himalaya Publishing

Mapping of Syllabus to COs

Course Outcomes	Module I	Module II	Module III	Module IV
CO 1	H	M		
CO 2			H	L
CO 3	L	H		M
CO 4				H

CMFA0106: FUNDAMENTALS OF ACCOUNTING

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective:*To familiarize students with the mechanics of accounting and its detail procedure for preparation of financial statements and their applications in managerial decision.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

CO1: Define the commonly used accounting terminology (Remembering)
CO2: Classify the users of accounting information and their respective requirements (Understanding)
CO3: Understand the process of recording and classifying the business transactions and events (Understanding)
CO4: Sole practical problems on accounting like the financial statements, viz., Profit and Loss Account, Balance Sheet, and cash flow statement. (Applying)
CO5: Interpret the financial statements from the perspective of different stakeholders. (Evaluating)
CO6: Explain the financial crisis of a business concern. (Creating)

Module I (15 Hours)

Introduction to Financial Accounting: Accounting as an Information System, Importance and Scope, Limitations; Users of accounting information, Concepts, Principles and Conventions – Generally Accepted Accounting Principles; The Accounting Equation; Nature of Accounts, Types of books (Primary and Secondary) and Rules of Debit and Credit; Recording Transactions in Journal; Preparation of Ledger Accounts; Opening and Closing Entries; Preparation of Trial Balance.

Module II (20 Hours)

Preparation of Financial Statements: Trading Account, Profit & Loss Account and Balance Sheet, Adjustment Entries, understanding contents of financial statements of a joint stock company as per the Companies Act 2013; Understanding the contents of annual report of a company, Preparation of cash flow statement as per AS-3 (revised).

Module III (20 Hours)

Indian Accounting Standards (Ind-AS): Concept, benefits, procedure for issuing Ind-AS in India, salient features of Ind-AS issued by ICAI; International Financial Reporting Standards(IFRS): Main features, uses and objectives of IFRS, IFRS issued by IASB and concept of harmonization and convergence, obstacle in harmonization and convergence, suggestions for increased convergence and harmonization

Module IV (20 Hours)

Financial Statement Analysis: Objective of financial statement analysis, sources of information; Techniques of financial statement analysis: Horizontal analysis, Vertical analysis and Ratio Analysis; Financial Ratios: Meaning and Usefulness of Financial Ratios. Analysis of ratios from the perspective of Stakeholders like Investors, Lenders, and Short-term Creditors. Liquidity Ratios, Solvency Ratios, Profitability Ratios, and Turnover Ratios; Limitation of ratio. Analysing the power of ratios in forecasting business failures using Altman Z-score, multiple discriminate analysis and decision-tree analysis.

Suggested Readings

1. Monga, J.R., Financial Accounting: Concepts and Applications, Mayur Paperbacks
2. Tulsian, P.C., Financial Accounting, Pearson
3. Maheshwari, S.N. & Maheshwari, S.K., Financial Accounting for B. Com., CA, CS, & ICWA (Foundation) Courses, Vikas

Publishing House Pvt. Ltd.
4. Ghosh, T.P., Financial Accounting for Managers, Taxmann Allied Services (P) Ltd.
5. Balwani, Nitin, Accounting and Finance for Managers
6. Gupta, Ambrish: Financial Accounting for Management
7. Bhattacharyya, Asish K., Financial Accounting for Business Managers 8. Jain, S.P. &Narang, K.L., Advanced Accountancy.
8. Charles T. Horngren, Gart L. Sundem, John A. Elliot and Donna R. Philbrick, Introduction to Financial Accounting, Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	L	M		
CO 2		H		
CO 3			H	
CO 4				H
CO 5				H

CMBI0107: PRACTICE OF BANKING AND INSURANCE

(6 credits- 75 hours) (L-T-P: 5-1-0)

Course Outcomes

1. Explain the basic principles of banking and insurance.(Remembering)
2. Relate the various services provided by banks. (Understanding)
3. Apply the concept of Internet Banking in day-to-day transactions. (Applying)
4. Examine the situations to relate the risk and insurance. (Analyzing)

Module I: Introduction(15 hours)

Origin of banking: definition, banker and customer relationship, General and special types ofcustomers,Typesofdeposits,OriginandgrowthofcommercialbanksinIndia.FinancialServicesoffered by banks, changing role of commercial banks, types of banks.

Module II: Cheque and Paying Banker (15 hours)

Crossing and endorsement - meaning, definitions, types and rules of crossing. Duties, Statutory protection in due course, collecting bankers: duties, statutory protection for holderin due course, Concept of negligence.

Module III: Banking Lending (13 hours)

Principles of sound lending, secured vs. unsecured advances, types of advances, Advances against various securities.

Module IV: Internet Banking (15 hours)

Meaning, Benefits,Homebanking,Mobilebanking,Virtualbanking,E-payments,ATMCard/ biometriccard, Debit/Credit card, Smart card, NEFT, RTGS, ECS (credit/debit), E-money, electronic purse, Digitalcash.

Module V:Insurance (17 hours)

Basicconceptofrisk,Typesofbusinessrisk,Assessmentandtransfer,Basicprinciplesofutmostgoodfaith,Indemnity,Economicfunction,Proximatecause,Subrogationandcontribution,Typesofinsurance:LifeandNon-life,Re-insurance,Riskandreturnrelationship,Needforcoordination. Power, functions and Role of IRDA, Online Insurance

Suggested Readings:

1. Agarwal, O.P., Banking and Insurance, Himalaya Publishing House
2. Satyadevi, C., Financial Services Banking and Insurance, S.Chand
3. Suneja, H.R., Practical and Law of Banking, Himalaya Publishing House
4. Chabra, T.N., Elements of Banking Law, Dhanpat Rai and Sons
5. Arthur C. And C. William Jr., Risk Management and Insurance, McGraw Hill
6. Saxena, G.S. Legal Aspects of Banking Operations, Sultan Chand and Sons
7. Varshney, P.N., Banking Law and Practice, Sultan Chand and Sons
8. Jyotsna Sethi and Nishwan Bhatia, Elements of Banking and Insurance, PHI Learning

Note: Latest edition of books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	M	M	H	M	H
CO 2	L	M	M	M	
CO 3		L	M	H	L
CO 4		L	L	M	H

CMCH0108: INDIAN CULTURAL HERITAGE AND BUSINESS HISTORY

(6 credits- 75 hours) (L-T-P: 4-1-1)

Learning Outcome: This course enables students to explore various aspects of cultural heritage and cultural diversity in historical perspective that discusses numerous cultural practices that have evolved over centuries. They will acquire knowledge of changing socio-cultural scenarios of India.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Understand the Indian Culture and how it evolved over the years (Understanding)
CO2: Understand the evolution of script and languages in India (Understanding)
CO3: Understand and learn the art forms of India (Understanding)
CO4: Understand how business and industrial houses came into existence and how it evolved (Understanding)
CO5: Analyse the post-Independence Industrial Scenario in India (Understanding)

Module I: Indian Culture: An Introduction (15 Hours)

a. Characteristics of Indian culture, Significance of Geography on Indian Culture.
b. Society in India through ages- Ancient period- varna and jati, family and marriage in india, position of women in ancient India, Contemporary period; caste system and communalism.
c. Religion and Philosophy in India: Ancient Period: Pre-Vedic and Vedic Religion, Buddhism and Jainism, Indian philosophy – Vedanta and Mimansa school of Philosophy.

Module II: Indian Languages and Literature (15 Hours)

a. Evolution of script and languages in India: Harappan Script and Brahmi Script.
b. Short History of the Sanskrit literature: The Vedas, The Brahmanas and Upanishads & Sutras, Epics: Ramayana and Mahabharata & Puranas.
c. History of Buddhist and Jain Literature in Pali, Prakrit and Sanskrit, Sangama literature & Odia literature.

Module III: A Brief History of Indian Arts and Architecture (15 Hours)

a. Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture.
b. Indian Painting Tradition: ancient, medieval, modern indian painting and odishan painting tradition
c. Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

Module IV: Introduction to Indian Business History (15 Hours)

a. The arrival and Impact of the east India Company, 1700-1800
b. Rise of Indian Cities and Industrial Houses, 1750-1850
c. Swadeshi Movement and Indian entrepreneurs, 1850-1900
d. Indian Business and Economy during the First and Second World Wars, 1914-1945,

Module V: Industrialization post-Independence (15 Hours)

a. Independence & Industrial Planning, 1947-1960: Origin and evolution of PSUs
b. "License Raj" and Impact on Business, 1960-1980: Nationalisation of Banks and Key Energy Sector PSUs
c. Liberalization and Contemporary Business Trends: ONGC and Oil Diplomacy

Suggested Readings:

1. K.T Achaya, Indian food: A Historical Companion, Oxford University Press, 1998.
2. Banga, I. (ed).: The City in Indian History : Urban Demography, Society and Politics, Delhi, Manohar, 1991
3. A.L Basham: The wonder that was India. Picador Publisher, Indian ed. 2014
4. Sachin Shekhar Biswas: Protecting the Cultural Heritage (National Legislation and International Convention, Aryan Books International, 1999.
5. MedhaKudaisya (ed) The Oxford India anthology of business history, Oxford University Press, 2011
6. D. Tripathi and J. Jumani, The concise Oxford history of Indian business, Oxford University Press, 2007.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

CMCM0109: COST AND MANAGEMENT ACCOUNTING

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: *This paper will acquaint the students with cost and management accounting concepts and its application for decision making.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:
CO1: Define cost and management accounting. (Remembering)
CO2: Understand the different costing methods. (Understanding)
CO3: Analyse Break Even Point (Applying)
CO4: Evaluate the budget and budgetary control measures (Analysing)

Module I (20 Hours)

Cost concepts: Meaning, Scope, Objectives, and Importance of Cost Accounting, Cost, Costing, Cost Control, and Cost Reduction. Elements of Cost, Components of total Cost, Cost sheet. Classification of costs: Fixed, Variable, Semi-variable, and Step costs; Product, and Period costs; Direct, and Indirect costs; Relevant, and Irrelevant costs; Shut-down, and Sunk costs; Controllable, and Uncontrollable costs; Avoidable, and Unavoidable costs; Imputed / Hypothetical costs; Out-of-pocket costs; Opport Moduley costs; Expired, and Unexpired costs; Conversion cost. Cost Ascertainment: Cost Module, Cost Center, Profit Center, Cost Allocation and Cost Apportionment; Cost Reduction and Cost Control.

Module II (15 Hours)

Cost-Volume-Profit Analysis: Contribution, PV Ratio, Margin of safety, Break- even-point, cost break-even point, cash break-even-point, Composite break-even-point, Key Factor, Break- even Analysis. Relevant Costs and Decision Making: Pricing, Product Profitability, Make or Buy, Exploring new markets, Shut down or continue, Acceptance of an export order. Process costing. Process losses and wastage, abnormal effectives, Work-in-progress - computation of equivalent Modules (FIFO method), Joint and By-products.

Module III (20 Hours)

Budgets and Budgetary Control: Meaning, Types of Budgets (sales, production, purchase raw material consumption, cash budget. Steps in Budgetary Control, Fixed and Flexible Budgeting, Responsibility Accounting.

Module IV (20 Hours)

Standard Costing and Variance Analysis: Material, Labour & Overhead variances. Activity based costing, Target costing, Life cycle costing, and Quality costing (only theoretical knowledge)

Suggested Readings

At the end of the course students will be able to:

1. Maheshwari, S.N., and Mittal, S.N. Cost Accounting: Theory and Problems, Shree Mahavir Book Depot (Publishers), Delhi.
2. M.N.Arora, Management Accounting, Theory, Problems and Solutions, Himalaya Publishing House
3. Horngren, C.T., Foster, G, and Datar, S.M., Cost Accounting: A Managerial Emphasis,Prentice Hall of India Pvt. Ltd., New Delhi.
4. Henke, E.O., and Spoede, C.W., Cost Accounting: Managerial Use of Accounting Data, PWS-KENTPublishing Company, Boston.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2	H			
CO 3		H	M	
CO 4			H	

CMGB0110: GLOBAL BUSINESS ENVIRONMENT (6 Credits- 75 hours-5-1-0)

Objective: *The Objective of the course is to introduce the students to the domain of global business environment.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:
CO1: Introduction to global business environment (Knowledge)
CO2: Describing the global institutions. (Comprehension)
CO3: Assessing the global trade and commerce (Application)
CO4: Determining the global markets. (Analysis)
CO5: Evaluating the global business foundation skills (Synthesis)

Module I: Global Business Environment (8 Hours)

LPG-International trade theories-International economy International political environment- Positioning Indian brand in global arena

Module II: Global Institutions (12 Hours)
WTO-IMF-World Bank- Functions- Roles, TRIPS-TRIMS- Trade blocs SAARC-ASEAN-NAFTA-EU.

Module III: Global Trade and Commerce (12 Hours)
FDI-FII-Global monetary system, Balance of payments- Balance of trade-Fiscal policy and monetary policy with respect to global business

Module IV: Global Markets (12 Hours)
Indian Companies Entering Global Markets- Global Strategy- Marketing Strategy-Global HR strategy- MNC's entering India - Strategies, Mode of entry, India's Demographic dividend

Module V: Global business foundation Skills (14 Hours)
BPM industry and awareness-, Common BPM services provided by India- Current challenges, Business & corporate etiquettes-B2B, B2C, Corporate Lifestyle Basic understanding of corporate culture of western countries- culture shock - Cultural diversity Customer Satisfaction VS customer delight.

Suggested Readings

1. 1.International business Sumati Verma
2. International business environment Francis Cherunilam
3. International business environment; Dr.S.Sankaran
4. International Business - Text and cases; Sundaram & Black

Mapping of Cos with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H				
CO2		H			
CO3			H		
CO4				H	
CO5					H

CMIN6004: INTERNSHIP (2 CREDITS-30 HOURS)

***Objectives**: The students are required to undergo an internship in work related to Commerce and Management during the semester break at the end of fourth Semester or fifth Semester. The purpose of this internship is to expose the students to real-life industry work situations. This is an opportunity for the students to learn the application of knowledge that they have acquired from the classes, in an on-the-job situation. After the internship the students have to present their experiences in the form of reports and seminar presentations at a specified date towards the end of the sixth semester. Students will be evaluated on the basis of the report, seminar presentation and viva-voce examination.*

LEARNING OUTCOMES

At the end of the internship students will be able to:

CO1: Relate with working in the corporate sector. (Remembering)
CO2: Interpret the situations and real life problems in business management and operations. (Understanding)
CO3: Organise and work on projects under a supervisor and deal with situations. (Applying)
CO4: Analyse and understand group cohesion. (Analysing)
CO5: Justify any action on the part of management for greater efficiency (Evaluating)
CO6: Develop a corporate personality with improved communication skills, presentation and other soft skills. (Creating)

INTRODUCTION

The field of Commerce and Management is very practical oriented and requires an in-depth knowledge about both the theoretical and practical aspect of business operations. In the Three-Year Degree Course of Commerce (B.Com.), the students are made acquainted with the various facets of Accounting, Management and Finance. However, the lessons mostly remain with the limits of classroom discussion. The real practices of business are much more complex and subject to judgement of the manager. This internship is an attempt to enable the students to acquire some learning experiences in the practical field and equip themselves with necessary traits to succeed in the corporate environment.

INSTRUCTION AND GUIDELINES FOR STUDENTS

The students should follow the following instruction and guidelines during the course of internship:

a. The internship should be for a minimum duration of 80hours which can be extended up to any limit depending upon the convenience and requirement of the student and the organisation respectively.
b. The students have to undergo the internship during the Summer Break at the end of 4th Semester Examination or Winter Break at the end of 5th Semester Examination. Any students willing to undergo internship during the semester classes will not be encouraged and would be completely on his/her own cost of attendance and classes. Further, in such a case, the Department holds full right to reject the internship of such student.

c. The students can undergo internship at any organisation which is recognised or registered, as applicable, of their choice but the work must be related to commerce and management.
d. After the completion of the internship, the students must submit the Internship Report which should include the Internship Diary as an Annexure to the Report. The format of the Internship Report and Internship Diary should be in accordance with the one prescribed by the Department.
e. There would be a Seminar Presentation (PPT) and Viva-Voce Examination towards the end of the 6th Semester based on which the students would be evaluated for the internship. The Internship report would also be a part of evaluation.

STRUCTURE OF INTERNSHIP

I. The Internship Report must comprise of the following:
   a Recommendation Letter from the Department.
   b Completion Certificate from the Organisation where the student has worked as intern.
   c Internship Diary as per the prescribed format.
   d Organisation details (Address, E-mail, Contact Number) including name, contact number and e-mail of the supervisor is mandatory. This should be included as a part of the Internship Diary according to the prescribed format.
   e The Contents of the Report must include:

Ii. Introduction.
Iii. Objectives of the Internship.
Iv. About the Organisation (Sector, Activities, Operations).
V. Description of the work.
Vi. Learning Outcomes.
Vii. The Assessment for the internship must have the following components:
   a Internship Report: 20 marks
   b Internship Diary: 20 marks
   c Seminar Presentation: 30 marks
   d Viva-Voce Examination: 30 marks

CMDS6006: DISSERTATION-I (RESEARCH SOFTWARE) (4 CREDITS- 60 HOURS)

***Objective**: The objective of the course would be to educate the students about the various dimensions of a research based project work. The students will also be taught about the application of statistical tools through SPSS.*

This phase of the Dissertation will comprise of the following:

1. **Synopsis**: Submission of a write up on a specific area/topic of study (10hours)
2. **Review of Literature**: Submission of a specified number of reviews to respective guide (15 hours)
3. **Research Methodology**: Lecture based on the topic of study. (10 hours)
4. **Referencing Style**: Lecture on referencing style to be followed while submitting report (5 hours)
5. Training on application of Statistical software used in research (20hours)
6. **Submission of Progress Report after completion of Phase I**: Report should comprise of Introduction, Review of Literature, Research Methodology and References.

EVALUATION:

A diary will be maintained by every student to keep a record of meeting with his/her guide. A format of the diary will be circulated at the beginning with the semester. Evaluation at Phase I will be done by the respective guide based on timely submission of part-work and quality of work as follows:
Synopsis (30marks)
Review of Literature (30marks)
Research Methodology (30marks)
Referencing (10marks)

CMDS6007: DISSERTATION-II (6 credits - 75 hours)

***Objective**: The objective of the course would be to develop analytical skills among the students for solving any research queries. The students will also be taught about the preparation of a project report.*

This phase of the Dissertation will comprise of the following:

1. **Field Work**: Collection of data and validation with the respective guide (30 hours)
2. **Analysis of Data**: Analysis and presentation of the data collected though application of various statistical tools though SPSS and other statistical software packages. (10 hours)
3. Test of Plagiarism.
4. **Submission of Project Report**: Submission of the complete report in continuation from Phase I.
5. Presentation of work using PPT and Viva Voce Examination.

EVALUATION:

Evaluation at Phase II will be done by a panel comprising of an external and internal expert along with the respective guide

based on quality of work as follows:
Report (50marks)
Presentation (30marks)
Viva-Voce (10marks)

Suggested Reading

1. Singh, J.K.Venture Capital Financing in India. Dhanpat Rai and Company,NewDelhi.
2. Annual Reports of Major Financial Institutions in India.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5					H

VALUE ADDED COURSES

CMII6011: IDEATION TO INNOVATION
(0-0-2) (2 credits – 30 hours)

Objective: *The objective of the course is to turn an idea into a start-up by giving students a hands-on, real-life experience creating a start-up with like-minded partners from around the world. The course challenges the students to innovate, overcome obstacles, and grow rapidly with the goal of creating a business worth valuing.*

Learning Outcomes:
After completing the course, the learners will be able to:
1. Articulate the skills and know-how to develop their business idea from the conceptual stage to the marketplace (Applying)
2. Evaluate and select models for new ventures (Evaluating)
3. Apply both quantitative and qualitative customer and market research (Applying)
4. Understand the framework of product development (Understanding)
5. Design, evaluate, and implement marketing strategies (Creating)
6. Design a scalable business model via real-life experiments and tests in a live marketplace with genuine customer feedback (Creating)

Module 1: Team Formation and Ideation (2 Hours)
Ideation activities (problems submission, discussion, down-selection) Team Formation & Ideation, Introduction to Lean Canvas Model

Module 2: Problem – Solution Fit (3 Hours)
How to Find & Assess Ideas - Introduction to Design Thinking Idea validation & online tools, Idea Development

Module 3: Product - Market Fit analysis and development (4 Hours)
Market: Segmentation, Positioning, Market Info Sourcing, Customer Validation Prototyping & Solution Validation

Module 4: Business Model & Marketing Strategy (5 Hours)
Designing & Validating the Business & Revenue Model Marketing Strategy Development & Marketing Tools Business Model Fine Tuning Marketing Campaign Design: Goals, KPIs, Tracking Customer Engagement Campaign & Minimum Viable Product Launch

Module 5: Financial KPIs & Product Sprint (5 Hours)
Financial KPIs: Calculating, Interpreting & Presenting Start-up Financial Planning & Budgeting Calculating Financial Metrics & Starting Pitch Preparation

Module 6: Start-Up Funding & Pitch Preparation & Product Sprint (4 Hours)
Funding Alternatives for Start-ups, Designing Your Funding Strategy & Start-up Valuation, Investor Presentation Tips & Tricks , Funding Strategy Design & Pitch Deck Preparation , Compulsory exercises: (7 hours), Preparation of the business model, Prototype development, and The Venture Capitalist pitch

Suggested Readings:
The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company - Steve Blank and Bob Dorf Running Lean: Iterate from Plan A to a Plan That Works (Lean Series) - Ash Maurya

Mapping of COs with Syllabus:

Course Outcomes	M1	M 2	M3	M4	M5	M6
CO1	H	H	H	H	H	H
CO2	M	H				
CO3			H	M		
CO4			H	H		
CO5					H	M
CO6						H

CMSS6012: STATISTICAL SOFTWARE PACKAGES FOR DATA ANALYSIS (0-0-2)
(2 credits – 30 hours)

Course Objective: *This course is designed to familiarize students with some omnibus softwarepackages commonly utilized for statistical analysis in science and industry. Statistical programs include both proprietary and open-source packages.*

Learning Outcomes:
After completing this course, participants will be able to:
1. Create and manage data sets in several software programs (Creating)
2. Implementing knowledge and skill at using several software programs to run different forms of statistical analysis (Applying).

3. Implementing knowledge and skill at using software programs to create tables, graphs, and figures(Applying).
4. Assessing practical interpretation of statistical results for developing decisive insights and to inform decision-making and innovation (Evaluating).

Module 1: Data preparation (8 Hours)
Getting familiar with the interface – SPSS, PSPP, MS Excel; Enter, save data - SPSS, PSPP, MS Excel; Import data from Excel to SPSS/PSPP; Carry out different data preparation processes

Module 2: Exploratory Data Analysis (3 Hours)
EDA for one or more variables; Create charts for one variable; Transform data; Transforming scale into categorical variable

Module 3: Inferential Statistics for the mean and the median (6 Hours)
Descriptive statistics for two or more variables; Creating and editing charts for two or more variables Inferential statistics for the mean and the median; One-sample t-test and sign test, T-test ; Paired-difference t-test ; Power Analysis for t-test

Module 4: ANOVA and simple linear regression (4 Hours)
One-way and two-way ANOVA ; Bivariate linear regression; Power Analysis for ANOVA

Module 5: Multiple linear regression (4 Hours)
Multiple linear regression and correlation; Model building and selection; Interpreting regression coefficients and confidence intervals; Power Analysis for linear regression

Module 6: Inferential statistics for the proportion (5 Hours)
Inferential statistics for categorical variables
One-sample Chi-square; Chi-Squared Test of Independence; Power Analysis for the proportion

Suggested Readings:
1. Leech, Nancy L.; Karen C. Barrett; and George A. Morgan. 2014. SPSS forIntermediateStatistics: Use and Interpretation. 5th Edition. Routledge, New York, USA.
2. Maujis, D. Doing Quantitative Research in Education with SPSS. 2nd Edition.SAGEPublications, California, USA.
3. McCormick, K., J. Salcedo, J. Pock, and A. Wheeler. 2017. SPSS Statistics for Data Analysisand Visualization. John Wiley & Sons, Inc. Indianapolis, IN.

Mapping of COs with Syllabus:

CourseOutcomes	Module 1	Module2	Module3	Module 4	Module 5	Module 6
CO1	H					
CO2		H	H	H	H	H
CO3	H		M			
CO4			H	H	H	H

CMAS6013: ACCOUNTING SOFTWARE PACKAGE
Lectures: 10 Hours, Practical Lab: 20 Hours

Learning Outcomes:
1. CO1: Define the basic accounting concept, computerized accounting system and Data Based Management system (Understanding).
2. CO2: Understand the Preparation of ledgers, Trial balance and other financial statements with SQL (Understanding).
3. CO3: Application of accounting software (Tally ERP 9) in Voucher entries, preparation of accounts and other financial statements (Application) CO4: Application of Tally ERP 9 software in payroll and voucher entries with GST

Module 1: Basics of Accounting Concept. (5 hours)
Basic accounting concept; journal entries; preparation of books of accounts and ledgers; preparation of trial balance and final accounts of corporate entities; Accounting system; benefits of computerized accounting system and challenges associated with computerized accounting system.

Module 2: Application of SQL (5 hours practical Lab)
Preparation of ledgers; Trial Balance and Report with the help of SQL

Module 3: Tally ERP 9 Fundamentals (2 hours, 7 hours Practical Lab)
Introduction to Tally ERP 9; Features of Tally ERP 9; creating, selecting, altering, deleting and shutting up of company; creating, altering and deleting of group and ledgers, voucher entries; integrating accounts and inventory; Displaying the financial report .

Module 4: Application of Tally ERP 9 in advanced level (3 hours, 8 hours Practical lab)
Activating payroll in Tally; understanding of payroll; pay heads and categories; Attendance entries; salary payment example; pay-sheet and pay-slips. Activating Tally in GST; setting up GST (company level, ledger or inventory level); creating GST masters and generating reports.

Suggested Readings:

1. SQL For Beginners: SQL Made Easy; A Step-By-Step Guide to SQL Programming for the Beginner, Intermediate and Advanced User (Including Projects and Exercises) Craig berg
2. Tally.ERP 9 with GST in Simple Steps Paperback; Dreamtech press
3. Learning Tally ERP 9 with GST; Sajee Kurian, Blessing Inc
4. Database Management Systems (DBMS) Rajiv Chopra, S.Chand Publishing
5. Learning SQL ; Alan Beaulieu, O'Reilly Media
6. Ashok K Nadhani, GST Accounting with Tally.ERP9, BPB Publications, New Delhi

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	L			
CO 2		M		
CO 3			H	
CO 4				H

CMSL0200: SERVICE LEARNING (CREDIT: 2 HOURS: 30)

***Objective**: Service Learning will aim to support the development of basic skills among the students namely, critical and creative thinking, reflection, communication, collaboration, information literacy, and social skills. The emphasis will be on active civic participation. As the students will actively involved in a wide range of experiences, which will benefit both the community at large and the students in particular and in the process the goals of the curriculum shall be achieved.*

COURSE/ LEARNING OUTCOMES

After learning this course, the students will be able to:

CO1: Define and explain the Service-Learning framework (Remembering)
CO2: Explain the nature and types of community engagement work (Understanding)
CO3: Identify the need and importance of social responsibility (Applying)
CO4 Analyse the need for social intervention through community partners (Analysing)
CO5: Evaluate the academic outcomes through Service Learning (Evaluating)
CO6: Elaborate upon the social understanding to the issues faced in the community (Creating)

Assessment Process:

The allotment of marks will be as follows:
Internal Assessment: 40 marks
(This will consist of one test to find out the knowledge acquired by students; attendance; discipline)
External Assessment: 60 marks
(This will consist of the field work, logbook diary, report submission of the field work, viva–voce and presentation)
The Assessment will go beyond evaluation of only the final outcome. All the steps must be completed successfully.

I. Regular reporting and feedback - to allow continual adjustment and improvement.
Ii. Involving all stakeholders in the evaluation process is desirable.
Iii. Students will be given a log book diary which they will have to fill up on a regular basis. This comprehensive diary will have different sections which will effectively help the students to plan, document their activities and will act as a self-monitoring tool to measure the objectives, activities undertaken and the learning outcomes achieved.
Iv. Each faculty of the department will act as a supervisor for five or six students. The students will submit their logbook diary on a weekly basis. The logbook diary will have to be complete in all aspects along with supporting documents like photographs, etc.
V. Once the assigned field activity is complete, all the students will prepare a project report on the basis of the prescribed structure.
vi. Final presentation will be held wherein each student will present their report.

Module I: Concept of Service Learning (3 Hours):

Service Learning – meaning, concept, definition; value based framework of Service Learning; Understanding the core standards of Service Learning such as respect, reciprocity, relevance, and reflection; Elements of Service Learning; Understanding Service Learning – Its philosophy, historical background, purpose, value and theoretical framework; Locating Service Learning within the University context; Principles of Service Learning; Classification of Service Learning Models; Experiential Learning; Reflective Learning;; Journaling; Service Learning Pedagogy; Difference between Service Learning and other community experiences

Module II: Community Engagement and Community Partnerships (3 Hours)

Community Engagement – concept, meaning, definition and principles; benefits of community engagement, models of community engagement; Civic Engagement, University Community Engagement, Community partnerships – meaning, benefits, Reflection – meaning, definition and implications; Critical inquiry - meaning, definition and implications; Engaged Research - meaning, definition and implications;

Historical context of University Community Partnership; Understanding Community & Community Partnership; Ethical understanding of partnership; Understanding the agency of the Community – as co-educators; Community barriers

Module III: Social Responsibility and Communication Basics (3 Hours)

Social Responsibility – meaning, benefits, Socio-economic context – meaning, definition, Social issues – meaning, Understanding of society & social issues ; Conflict – meaning, types, Understanding various conflict resolution strategies; Community level partnerships – meaning, significance, types; Social Justice – meaning and implications; Communication – meaning, types, channels of communication, models of communication

Module IV: Identifying the Partners in the Community (3 Hours)

Partners in the community – meaning, types and functions of Community Partners namely, Corporate, Government and PSU Organizations, Panchayats, Community settings, Clinical settings, NGO's, Anganwadi Centres, Self Help Groups, Schools , Business Firms, Community Markets, Weekly Haats, Customer Relationship Management, etc

Module V: Basics of Professional Skills (3 Hours)

Aspects of Professional Skills Development: Factors affecting individual behaviour - personal, environmental and organizational, individual diversity –biographical and demographic characteristics, self-esteem, self-monitoring

Individual decision-making process, rational decision-making, decision-making styles, common biases and judgment errors in decision-making, individual v/s group decision-making.

Basics of Planning and Organising - Nature and purpose of planning, planning process, types of plans

Types of groups, stages of group development, characteristics of effective teams, how group status influences individual behavior, leaders and their role in teams, characteristics of an effective leader.

Module VI: Service Learning Projects (15 hours)

Service Learning Projects – stages, investigation, preparation, action, reflection, demonstration and documentation.

Areas of Study in Service Learning: Capacity building of youths, Single entry accounting system for small retailers, Preparation and benefits of maintain balance sheet, Financial Literacy, Financial Planning for Business Organisations, Basic Marketing Techniques, Selling Skills, Insurance, Human Resource Management, MSME schemes, Entrepreneurship ideas, start up ventures, Feasibility studies, Undertaking New Business Ventures, Venture Funding, Angel Investors, Partnership, Business Communication skills, Soft Skills Development, Poverty, livelihood, Health, Education, Water, Sanitation, Disability, Children, Women, NGO Management Practices, Environment, SDG's - technological solutions/suggestions for development, etc.

Note: Emphasis on Group Work, Projects, Case Studies, Assignments, Journaling, Report Preparation, Presentations, Workshops, Group Conferences Individual Conferences etc.

Suggested Readings:

1. Kaye Cathryn Berger, the complete Guide to Service Learning: Proven Practical Ways to Engage Students in Civic Responsibility, Academic Curriculum and Social Action, Free Spirit Publishing
2. Barbara Jacoby, Service Learning in Higher Education: Concepts and Practices
3. Patty H. Clayton, Robert G. Bringle and Julie A. Hatcher, Research on Service Learning: Conceptual Frameworks and Assessment
4. Barbara Jacoby, Service-Learning Essentials: Questions, Answers and Lessons Learned
5. Julie A, Hatcher and Robert G. Bringle, Understanding Service Learning and Community Engagement
6. Farbar Katy, Change the World with Service Learning

DEPARTMENT OF MANAGEMENT
BACHELOR OF BUSINESS ADMINISTRATION (HONOURS) IN MARKETING/HUMAN RESOURCES/FINANCE/AVIATION MANAGEMENT

DETAILED SYLLABUS

CHES0002 ENVIRONMENTAL STUDIES

(Credits: 2- 30 hours) (L-T-P: 2-0-0)

Objective: *The objective of this course is to provide multidisciplinary nature of Environmental Studies, identifying different structure and function of an ecosystem, analyse the types of biodiversity and its conservation and environmental pollution sources.*

Course Outcomes:

After learning the course, the students will be able to:

1. Define the Multidisciplinary Nature of Environmental Studies(Understanding)
2. Identify the different structure and function of an ecosystem(Applying)
3. Analyse the types of biodiversity and its conservation (Analyzing)
4. Evaluate the various sources of environmental pollution (Evaluating)

Module I: The Multidisciplinary Nature of Environmental Studies (3 hours)

Definition, scope and importance, need for public awareness.

Module II: Natural Resources (3 Lectures)

a. Different types of natural resources and associated problems - forest resources, water
b. resources, mineral resources, food resources, energy resources, land resources.
c. Conservation of natural resources.

Module III: Ecosystems (4 hours)

a. Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs.
b. Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Module IV: Biodiversity and Its Conservation (4 hours)

Types of biodiversity – genetic, species and ecosystem, value of biodiversity, global biodiversity, India as a mega-diversity nation, threats to biodiversity, conservation of biodiversity - in-situ and ex-situ conservation.

Module V: Environmental Pollution (6 hours)

a. Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e-pollution.
b. Solid waste management
c. Disaster management

Module VI: Social Issues and the Environment (6 hours)

a. From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
b. Environment protection act.
c. Introduction to environmental impact assessment.

Module VII: Human Population and the Environment (4 hours)

a. Population growth and sex ratio.
b. Population explosion - family welfare programme.
c. Environment and human health.
d. HIV/AIDS.
e. Role of information technology in environment and human health.

Suggested Readings

1. ErachBharucha; Textbook for Enviromental Studies, UGC, New Delhi
2. S. Somvanshi and R. Dhupper; Fundamentals of Environmental Studies, S.K. Kataria and Sons Publisher.
3. A.K. De; Environmental Chemistry, New age publishers.

4. J.P. Sharma; Environmental Studies, University Science Press, Third edition, 2009.
5. K.G. Bhattacharyya and A. Sarma; Comprehensive Environmental Studies, Narosa Publishing House Pvt, Ltd, 2015.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7
CO 1	H	M			L		L
CO 2	L	H	L		L		
CO 3			H	M	L	M	L
CO 4				L	M	M	H

EGBC0112: BUSINESS COMMUNICATION

(Credits: 2- 30 hours) (L-T-P: 2-0-0)

Objective: *The objective of this course is to make students learned and be proficient in effective communication skills and also make their comprehensive knowledge strong in business letter drafting and also the knowledge of sentence structure strong.*

Course Outcomes

1. Illustrate the basic sentence structures in English(Remembering)
2. Identify the barriers of effective communication(Understanding)
3. Categories the different types of business letters (Applying)
4. Compare between greetings and small talks (Analysing)

Module I: Introduction (6 hours)

Nature of Communication, Process of Communication, Types of Communication (verbal & Non Verbal),Importance of Communication, Different forms of Communication Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers

Module II: Business Correspondence (7 hours)

Letter Writing, presentation, Inviting quotations, Sending quotations, Placing orders, Inviting tenders, Sales letters, claim & adjustment letters and social correspondence, Memorandum, Inter- office Memo, Notices, Agenda, Minutes, Job application letter, preparing the Resume.

Module III: Report Writing(7 hours)

Business Reports: Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check lists for reports.

Module IV: Vocabulary (8 hours)

Words often confused, Words often mis spelt, Common errors in English.

Module V Oral Presentation: (8 hours)

Importance, Characteristics, Presentation Plan, Power point presentation, Visual aids.

Suggested Readings

1. Bovee, and Thill, Business Communication Essentials, Pearson Education
2. Shirley Taylor, Communication for Business, Pearson Education
3. Locker and Kaczmarek, Business Communication: Building Critical Skills, McGraw Hill Education
4. Herta A Murphy, Herbert W Hildebrandt, Jane P. Thomas, Effective Business Communication (SIE), McGraw Hill Education
5. Dona Young, Foundations of Business Communication: An Integrative Approach, McGraw Hill Education
6. Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz, Paula Lentz, and NeerjaPande,Business Communication: Connecting in a Digital World (SIE), McGraw Hill Education

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				

CO 2		H			
CO 3			H		
CO 4				H	M

MTMG0089: MANAGERIAL ECONOMICS

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives: *The purpose of this course is to apply micro economic concepts and techniques in evaluating business decisions taken by firms. The emphasis is on explaining how tools of standard price theory can be employed to formulate a decision problem, evaluate alternative courses of action and finally choose among alternatives. Simple geometry and basic concepts of mathematics will be used in the course of teaching.*

COURSE/LEARNING OUTCOME

At the end of the course students will be able to:

1. Fine the mechanics of supply and demand in allocating goods and services and resources (Remembering)
2. Illustrate how changes in demand and supply affect markets (Understanding)
3. Apply the choices made by a rational consumer (Applying)
4. Interpret the relationships between production and costs (Evaluating)
5. Discuss key characteristics and consequences of different forms of markets (Creating)

Module I (20 Hours)

Demand, Supply and Market equilibrium: individual demand, market demand, individual supply, market supply, market equilibrium; Elasticity of demand and supply : Price elasticity of demand, income elasticity of demand, cross price elasticity of demand, elasticity of supply;

Theory of consumer behavior : cardinal utility theory, ordinal utility theory(indifference curves, budget line, consumer choice, price effect, substitution effect, income effect for normal, inferior and giffen goods), revealed preference theory.

Module II (20 Hours)

Producer and optimal production choice: optimizing behavior in short run(geometry of product curves, law of diminishing marginal productivity, three stages of production), optimizing behavior in long run (isoquants, iso-cost line, optimal combination of resources) Costs and scale : traditional theory of cost (short run and long run, geometry of cost curves, envelope curves), modern theory of cost (short run and long run), economies of scale, economies of scope.

Module III (20 Hours)

Theory of firm and market organization : perfect competition (basic features, short run equilibrium of firm/industry, long run equilibrium of firm/industry, effect of changes in demand, cost and imposition of taxes) ; monopoly (basic features, short run equilibrium, long run equilibrium, effect of changes in demand, cost and imposition of taxes, comparison with perfect competition, welfare cost of monopoly), price discrimination; monopolistic competition (basic features, demand and cost, short run equilibrium, long run equilibrium, excess capacity) ; oligopoly (Cournot's model, kinked demand curve model, dominant price leadership model, prisoner's dilemma

Module IV (15 Hours)

Factor Market: demand for a factor by a firm under marginal productivity theory (perfect competition in the product market, monopoly in the product market), market demand for a factor, supply of labour, market supply of labour, factor market equilibrium.

Suggested Readings

1. Dominick Salvatore (2009). Principles of Microeconomics (5th ed.) Oxford University Press
2. Lipsey and Chrystal. (2008). Economics. (11th ed.) Oxford University Press
3. Koutosyannis (1979). Modern Micro Economics. Palgrave Macmillan
4. Pindyck, Rubinfeld and Mehta. (2009). Micro Economics. (7th ed.). Pearson.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	L	M		
CO 2		H		

CO 3			H	
CO 4				H
CO 5	H			M

MTSB0091: STATISTICS FOR BUSINESS DECISIONS

(6 credits-75 Hours) (L-T-P: 5-1-0)

***Objective**: To familiarize the students with various Statistical Data Analysis tools that can be used foreffective decision making. Emphasis will be on the application of the concepts learnt.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Summarize data sets using descriptive statistics (Understanding)
2. Analyse the relationship between two variables (Analysing)
3. Determine trend and seasonality in a time series data (Evaluating)
4. Propose conclusion about a population using testing of hypothesis (Creating)

Module I (15 Hours)

Measures of Central Value: Meaning, need for measuring central value. Characteristics of an ideal measureof central value. Types of averages - mean, median, mode, harmonic mean and geometric mean. Merits,Limitations and Suitability of averages. Relationship between averages. Measures of Dispersion: MeaningandSignificance. Absolute and Relative measures of dispersion - Range, Quartile Deviation, Mean Deviation,Standard Deviation, Moments, Skewness, Kurtosis

Module II (20 Hours)

Probability: Meaning and need. Theorems of addition and multiplication.Conditional probability. Bayes'theorem, Random Variable- discrete and continuous. Probability Distribution: Meaning, characteristics(Expectation and variance) of Binomial, Poisson, and Normal distribution. Correlation Analysis: Meaningand significance. Types of correlation. Methods of studying simple correlation - Karl Pearson's coefficientof correlation, Spearman's Rank correlation coefficient.

Module III (20 Hours)

Regression Analysis: Meaning and significance, Regression vs. Correlation. Linear Regression, Regression lines (X on Y, Y on X) and Standard error of estimate. Analysis of Time Series: Meaning and significance. Utility, Components of time series, Models (Additive and Multiplicative), Measurement of trend: Method of leasts quares, parabolic trend and logarithmic trend.

Module IV (20 Hours)

Introduction to testing of Hypothesis: Concept; Level of Significance; Process of testing; Test of hypothesis concerning Mean; Test of hypothesis concerning Proportion. Z test, t – test for single mean and differenceof means and ANOVA – one way and two way.Non parametric tests:One-Sample Wilcoxon Signed Rank Test,Paired-Sample Wil coxon Signed Rank Test, Paired Sample Sign Test, Two-Sample Kolmogorov-Smirnov Test,Mann- Whitney Test, Kruskal-Wallis ANOVA

Suggested Readings

1. S.P. Gupta (S.P.) : Statistical Methods, Sultan Chand & Sons, 34th Edition
2. Richard Levin & David Rubin : Statistics for management, Prentice Hall

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H	M		
CO 2	M	H		
CO 3			H	M
CO 4				H

MTOG0093: ORGANIZATIONAL BEHAVIOUR

(5 credits– 75 hours)

Objective*: The objective of this paper is to provide the students an insight into the various concepts of organizational behaviour and its relation to other activities in an organization, and to introduce the student to the techniques of organisational behaviour used as a management tool.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Define the meaning of organization behavior. (Knowledge)
2. Explain the models and the theory of learning and the foundations of individual behaviour. (Comprehension)
3. Establish the relationship between the various theories of motivation and workplace behaviour. (Application)
4. Differentiate between leadership and management and the different leadership theories. (Analysis)
5. Formulate different types of leadership strategies. (Synthesis)
6. Evaluate the various conflict resolution strategies. (Evaluation)
7. Describe various ways of managing stress at the workplace. (Comprehension)

Module I: Introduction to Organizational Behaviour (12 Hours)

Defining Organisational Behaviour, historical background: the Hawthorne Studies; early development, conceptual development; the nature of people; theoretical frameworks; explaining and predicting behaviour; OB in the global context.

Module II: Cognitive processes of organizational behavior (14 Hours)

Nature and importance of Perception and attribution; perception and individual decision making; values, nature and dimensions of attitudes and job satisfaction; personality; aptitude; interests; learning; intelligence, motivation - theories of motivation.

Module III: Group Dynamics (16 Hours)

a. Understanding group dynamics, types of groups, group goals, group cohesiveness, group pressure and norms, teamwork; group structure - formal leadership, roles and norms; group member resources - abilities, personality, characteristics, stages in group development.
b. Leadership : Theories - trait, behavioural, contingency, attributional, charismatic, transactional vs. transformational.

Module IV: Communication and Decision Making (13 Hours)

Role of communication; Communication media and technology, communication networks - formal vs. informal; barriers to effective communication; communication skills; feedback information; persuasion in communication; active listening; participative decision making techniques; group vs. the individual; groupthink and group shift; the decision making process

Module V: Organizational culture and Work Stress (20 Hours)

a. Definition of organizational culture; cultural typologies; organizational culture vs. national culture; functions of culture; formation of cultures; potential sources of stress - environmental factors, organizational factors; individual differences - perception, job experience, social support, locus of control, hostility; Stress – the emergence of stress, causes of stress; stress consequences - physiological symptoms, psychological symptoms, behavioural symptoms, stress management strategies - individual approaches, organizational approaches.
b. Conflict and negotiation : Definition of conflict; the conflict process; conflict in intergroup relations; creating functional conflicts; bargaining strategies; role of personality traits in negotiation; third party negotiations; intergroup relations and factors affecting intergroup relations.

Suggested Readings

1. Fred Luthans, Organisational Behaviour, 10th Edition, McGraw Hill India
2. Stephen P Robbins, Organizational Behaviour, 11th Edition, Prentice Hall of India Pvt. Ltd., New Delhi
3. Gilmer, Industrial Psychology, McGraw Hill.
4. Ghiselle and Brown, Personnel and Industrial Psychology, McGraw Hill.
5. Keith Davis, Human Relations at Work, Tata McGraw Hill.
6. Leavitt, Managerial Psychology, University of Chicago Press.
7. BM Bass, Leadership Psychology and Organizational Behaviour, Harper International.
8. Litterer, Analysis of Organizations, John Wiley.

Mapping of COs with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H				
CO2	H				
CO3		H			

CO4			H		
CO5				H	
CO6					H
CO7					H

MTIB0097: IT TOOLS FOR BUSINESS DECISION

(Credit: 2, Hours: 30)

Objective: *This course is an attempt to make the students aware the very basics applications of MS word, Excel and other tools in business analysis and its decision making*

COURSE/LEARNING OUTCOMES

On successful completion of the course students will be able to:

1. Interpret the use of Microsoft Word Processing Software. (Remembering)
2. Execute business presentation with the help of various computer applications (Applying)
3. Evaluate the use of spreadsheet packages in business applications. (Applying)
4. Evaluate the use of Excel in business documents. (Applying)
5. Design the database management system for business applications. (Applying)
6. Application of SCILAB in practical aspects of the business

Module I: Word Processing

Introduction to word Processing, Word processing concepts, Use of Templates, Working with word document: Editing text, Find and replace text, Formatting, spell check and Grammar check; Page set-up; Inserting equations and sym Autocorrect, Auto text; Bullets and numbering, Tabs, Paragraph Formatting, Indent, Page Formatting, Header and footer, Tables; Inserting equations and symbols, filling and formatting a table; Inserting Pictures and Video; Mail Merge: including linking with Database; Printing documents; Creating Business Documents using the above facilities

Module II: Preparing Presentations

Basics of presentations: Slides, Fonts, Drawing; Editing; Inserting: Tables, Images, texts, Symbols, Media; Different Views; Design; Transition; Animation; and Slideshow

Module III: Spreadsheet and its Business Applications

Spreadsheet concepts, Managing worksheets; Formatting, Entering data, Editing and Printing a worksheet; Handling operators in formula, Project involving multiple spreadsheets, Organizing Charts and graphs; Generally used Spreadsheet functions: Mathematical, Statistical, Financial, Logical, Date and Time ,Lookup and reference, Database, and Text functions

Module IV: Creating Business Spreadsheet

Creating spreadsheet in the area of: Loan and Lease statement; Ratio Analysis; Payroll statements; Capital Budgeting; Depreciation Accounting; Graphical representation of data; Frequency distribution and its statistical parameters; Correlation and Regression

Module V: Introduction to SCILAB

General environment and console, simple numerical calculations, menu bar, editor, graphics window, windows management and workspace customization, variables, assignment and display, loops, tests, 2D and 3D plots, supplements on matrices and vectors, calculation accuracy, solving differential equations, useful scilab functions-in analysis, in probability and statistics, to display and plot, utilities

Suggested Readings

1. Taxmann's Computer Applications in Business, Hem Chand Jain, H.N. Tiwari
2. Introduction to Scilab: For Engineers and Scientists, Sandeep Nagar
3. Sanjay Saxena, A First Course in Computers, Vikas Publishing House, New Delhi.
4. Pradeep K. Sinha and Preeti Sinha, Foundation of Computing, BPB, Publication.
5. Deepak Bharihoka, Fundaments of Information Technology, Excel Book,New Delhi.
6. V. Rajaraman, Introduction to Information Technology, PHI. New Delhi.
7. R. Hunt, J. Shelley, Computers and Commonsense, Prentice Hall of India New Delhi.

Mapping of COs with Syllabus

Course Outcomes	Module-1	Module-2	Module-3	Module-4	Module-5
CO1	H	H	H	H	H
CO2	M	H	M		
CO3					H
CO4	H				

CO5			H	H	
CO6					H

MTMP0118: MANAGEMENT PROCESS AND PRINCIPLES

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: *The objective of this course is to develop an understanding of the Principles and processes of management covering the basic management functions and challenges in the emerging perspective.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Define the meaning of MPP. (Knowledge)
2. Explain the theory of planning and control. (Comprehension)
3. Determining the organisational process. (Application)
4. Importance of communication in decision making process. (Analysis)
5. Understanding MPP in global perspective. (Synthesis)

Module I: Introduction to MPP (8 Hours)

Introduction: Concept, Nature, Process and Significance of Management; Managerial Roles (Mintzberg); An Overview of Functional areas of Management- Marketing, Finance, Production, HRM, IT, R&D; Development of Management Thought- Classical, Neo -classical, Behavioural and Management Science Approach, System and Contingency Approaches.

Module II: Planning & Control (12 Hours)

Planning and Control: Concept, Process and Types; Planning Tools- Forecasting and Scheduling; Decision -making concept and process; Bounded rationality; Management by objectives; Corporate Planning- Environment analysis and Diagnosis, Strategy Formulations; Managerial Control- Concept and process; Designing an Effective Control System; Techniques - Traditional and Modern (PERT and CPM)

Module III: Organising (14 Hours)

Organising: Concept, nature, process and significance; Authority and Responsibility relationships Delegation, Decentralisation; Departmentation basis and formats (Project and Matrix); Formal and Informal Organisation; Changing patterns in Organisation structures in the Knowledge economy. Directing- Motivating and Leading People at work- basic concepts.

Module IV: Communication and Decision Making (12 Hours)

Role of communication; Communication media and technology, communication networks - formal vs. informal; barriers to effective communication; communication skills; feedback information; persuasion in communication; active listening; participative decision making techniques; group vs. the individual; groupthink and group shift; the decision making process

Module V: International Management Practices (14 Hours)

Managing in Global Arena- Multinational Corporation, Complexities of managing multinational corporation, workforce in multinational corporation, management functions in multinational corporations, organising multinational corporations, influencing people in multinational corporation, Transnational corporation

Suggested Readings

1. Joseph L. Massie :*Essentials of Management* .PHI, New Delhi; 2015.
2. James F.Stoner :*Management*. Pearsons Education, Delhi ; 2020.
3. Harold Koontz, Heinz Weihrich: *Management*. Tata McGraw Hill Pub. Co., Delhi;2015.
4. AmitaiEtzioni :*Modern Organizations*. PHI, New Delhi; 2021.
5. Jones, Gareth R. and Jennifer M. George: *Contemporary Management*. Tata McGraw Hill.
6. Charles Hill, W.L. and Steven L.McShane: *Principles of Management*. Tata McGraw Hill.
7. Semuel C. Certo: *Modern Management*. Prentice Hall, New Jersey.

Mapping of Cos with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H				
CO2		H			
CO3			H		
CO4				H	
CO5					H

MTIA0119: INTRODUCTION TO AVIATION INDUSTRY

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: *The Objective of the course is to introduce the students to the domain of Aviation Industry and its different facets.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Introduction to aviation industry (Knowledge)
2. Assessing the fundamentals of Aviation industry. (Comprehension)
3. Assessing the organisational structure of aviation industry (Application)
4. Determining the airport services. (Analysis)
5. Evaluating the safety and security (Synthesis)

Module I: Introduction (8 Hours)

Airline Industry – Scope – Types – Scheduled and Non Scheduled Flights – Air Cargo Transport – Economic and Social impact – Regulatory Bodies – Key Performance indicators

Module II: Fundamentals of Aviation Industry (12 Hours)

Airline Profitability – Main Industry - Characteristics of Passenger airlines – Service Industry – Characteristics

Module III: Organisational Structure (12 Hours)

Airline Alliances – Development of commercial airlines – Deregulation – Impact of Deregulated Airline industry – Organizational Structure – Types of Airline Personnel – Flight crew and Cabin Crew – Training – Organizational Culture

Module IV: Airport and services (12 Hours)

Airports – Personnel – Processing Passengers and Freight – Airport Security – Air Navigation Services – Air Traffic Control – Airplanes – Manufacturers – Types of Aircraft

Module V: Safety and Security (14 Hours)

Air Safety and Security – Role of Regulatory Agencies – Airside Safety – Culture of Safety – Issues in Air safety – Accident and Incident Investigation – Future of Airline Industry

Suggested Readings

1. 1 AEROSPACE: The Journey of Flight, 2nd Edition
2. Aviation Management. Arijit Das. INSC. International Publisher, New Delhi. 2021
3. Aviation Management. Global and National Perspectives. Ratandeep Singh. Kanishka Publishing House. New Delhi. 2020
4. Essentials of Aviation Management. John H Mott and Thomas Q Carney. Kendell Hunt Publishing Company. 2021
5. A Study about Aviation. Rishiraj Singh Rathod. Notion Press. 2021
6. Introduction to Aviation. Fred Mabonga. Authorhouse Publication. 2019

Mapping of Cos with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H				
CO2		H			
CO3			H		
CO4				H	
CO5					H

MTFH0120: FUNDAMENTALS OF HUMAN RESOURCE MANAGEMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: *This course aims at imparting the students with relevant knowledge, principles, and practices of human resource management so as to groom them as competent contributors in the workforce, ready to occupy managerial and administrative positions in various organizations.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Enumerate the general principles and practices of human resource management. (Knowledge)
2. Explain the concepts of human resource management. (Comprehension)
3. Determine the human resource management process. (Application)
4. Analyse the various levels of strategies of human resource management. (Analysis)
5. Formulate methods of wage and salary administration and measure its impact (Synthesis)
6. Evaluate the various maintenance and evaluative functions (Evaluation)

Module I: Importance of Human Resource Management (16 hours)
Meaning, Nature and Scope, Functions and Role of HR Manager; Advisory and service function to other department; HRM function planning; objectives and policies, organizing the HRM department

Module II: Procurement and Development Functions: (12 hours)
Job Analysis, Job description, job specification, recruitment, selection, placement and induction and socialization

Module III: Training & development and Performance Appraisal (15 hours)
Types and method, job change – career planning, promotion, demotion, transfer, separations. Purpose, factors, methods; 360 degree feedback uses and application; human resource accounting.

Module IV: Compensation Functions: (16 hours)
Job evaluation; Merit rating; Methods of wage, payment; incentive compensation; Types, advantages, perquisites; Wage system in India – Minimum wage, fair wage, living wage

Module IV: Maintenance and Integration Functions: (16 hours)
Administration of welfare; amenities & fringe benefits; safety & accident prevention work; environment fatigue safety, accident prevention; Employee grievances and their redressal; suggestion schemes; administration of discipline

Suggested Readings
1. Harold Koontz & Heinz Weihrich, Essentials of Human Resource Management, Tata Mc Graw Hill.
2. Stoner, Freeman, Gilbert Jr., Human Resource Management, Prentice Hall.
3. Wheeler, T.L. Hunger, J.D., and Rangarajan K., Concepts in Human Resource Management & Business Policy, 11th edition, Pearson Education.
4. Ranjan Das, Crafting the Strategy: Concepts & Cases in Human Resource Management, Tata Mc Graw Hill.

Mapping of Cos with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO1	H			
CO2		H		
CO3			H	
CO4			H	
CO5				H
CO6				H

MTPM0121: PRINCIPLES OF MARKETING

Objective: *The Objective of the course is to introduce the students to the domain of marketing and to its practical applications.*

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
1. Enumerate the fundamentals of marketing management. (Knowledge)
2. Assessing the marketing management. (Comprehension)
3. Analysing market segmentation. (Application)
4. Determining pricing strategy and distribution channels. (Analysis)
5. Importance of communication in marketing (Synthesis)

Module I: Fundamentals of Marketing (8 Hours)
Conceptual Framework of Marketing, Core Concepts of Marketing, Marketing Philosophies, Marketing Myopia, Marketing Practices developed over 21st Century ; Different Contexts of Marketing Applications.

Module II: Marketing Environment (12 Hours)
Analysis of marketing environment: Macro and Micro components and their impact on marketing decisions, Macro & Micro environment of Marketing – Industry & Competitor analysis, Developing strategies.

Module III: Market Segmentation and Product Overview (14 Hours)
Consumer buying Model, Market segmentation, Targeting and Positioning, Market and Marketing research and Marketing Information System, Marketing Mix, Product mix strategies, : Product and service concept, Product Lines- Length, Breadth & depth, Product life cycle, New product Development, Brand concept, Brand Equity.

Module IV: Pricing and Distribution Strategies (12 Hours)
Pricing strategies, Price setting, Price determination. Channels of distribution: Types, Designing Distribution Channels, Managing Conflicts and Controls in Channels, Retailing, and Wholesaling, E-Retailing.

Module V: Marketing Communication Mix (14 Hours)
Marketing Communication, Integrated Marketing Communication, Promotional Mix Components- Advertising Vs Promotion, Advertising Vs Publicity, Sales Promotion, Public Relations, Personal Selling and Direct Marketing, Digital Marketing. Emerging issues in marketing, Ethical issues, Green marketing, Consumerism, CSR in marketing, Payment related issues in the cashless era.

Suggested Readings
1. Kotler, P., Keller, K., Koshy, L., & Jha, M: Marketing Management: A South Asian Perspective.
2. Pearson Education, New Delhi; 2019.
3. Saxena, R: Marketing Management. Tata McGraw Hill, New Delhi; 2015.
4. Stanton: Fundamentals of Marketing, McGraw Hill; 2020.
5. S.Jayachandran: Marketing Management, Tata McGraw Hill; 2015.
6. Ramaswamy, V. S., & Namakumari, S: Marketing Management: Global Perspective Indian Context. Laxmi Narayan Publication, New Delhi; 2014.

Mapping of Cos with Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO1	H				
CO2		H			
CO3			H		
CO4				H	
CO5					H

MTFF0122: FUNDAMENTALS OF FINANCE

(6 credits- 75 hours) (L-T-P: 5-1-0)
Objective: *This course aims to provide students with an understanding of fundamental concepts of business finance.*

Course/Learning Outcomes
1. After learning this course, the students will be able to:
2. Explain the objectives and scope of financial in the context of business (Remembering)
3. Explain various aspects of financial environment (Understanding)
4. Apply the concept of time value of money (Applying)
5. Evaluate investment opportunities using the capital budgeting process (Evaluating)

Module I: Introduction (15 hours)
Meaning of finance; Basic areas of finance; Finance functions; Finance in the organization structure of a firm; Forms of business organizations; Goals of financial management; relationship with other functions; Career in finance.

Module II: Financial Environment: Markets, Institutions, Interest Rates and Taxes (20 hours)
Financial markets: concept and types; Financial Institutions: concept, role in funds transfer, and types; Interest rates: level of Interest rate, determinants of market interest rates, the term structure of interest rate and yield curve: Taxes: corporate tax, marginal tax and average tax.

Module III: Time Value of Money (20 hours)
Future Value: Single period, multiple period; Present Value: single period and multiple period; Future Value and Present value for multiple cash flows; Present value of an annuity; Future value of an annuity; Perpetuities: present value; Effective annual rate.

Module 4: Capital Investment Decisions (20 hours)
Concept of investment decisions; Generating investment project proposal; Process of Capital budgeting decision; Classification of capital projects; Project cash flows; Incremental cash flows, sunk costs, opportunity costs, net working capital, financing costs and other issues; Net present value, payback method, internal rate of return.

Suggested Readings
1. Financial Management and Policy, James C.Van Horne and Sanjay Dhamija, Pearson Education.
2. Principles of Financial Management, Levy h.andM.Sarnat, Pearson Education.
3. Fundamentals of Financial Management, Brigham and Houston, Cengage Learning.
4. Basic Financial Management, Khan and Jain, McGraw Hill Education
5. Fundamentals of Financial Management, Prasanna Chandra, McGraw Hill Education
6. Financial Management-text and Problems, Singh, J.K, DhanapatiRai and Company , Delhi
7. Fundamentals of Financial Management, Rustagi, R.P, Taxmann Publications Pvt.Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3			H	
CO 4				H

MTFM0123: FINANCIAL MANAGEMENT

(6 credits- 75 hours) (L-T-P: 5-1-0)

Objective: *This course is aimed to provide the knowledge on scope of financial management and time value of money, capital structure theories and factor affecting capital structure decision, various theories of dividend and determine the factors affecting dividend polices.*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

1. Explain the objectives and scope of financial management and time value of money (Remembering)
2. Explain various capital structure theories and factor affecting capital structure decision (Understanding)
3. Analyze the process of working capital management and capital budgeting process(Analyzing)
4. Critically judge the various theories of dividend and determine the factors affecting dividend polices (Evaluating)

Module I: Introduction (15 hours)

Nature, scope and objective of Financial Management, Time value of money, Risk and return (including Capital Asset Model), Valuation of securities – Bonds and Equities

Module II: Investment Decisions (15 hours)

The Capital Budgeting process, Cash flow Estimation, Payback period Method, Accounting Rate of return, Net Present Value(NPV), Net Terminal Value, Internal Rate of Return (IRR), Profitability Index, Capital budgeting under Risk- Certainty Equivalent Approach and Risk Adjusted Discount Rate.

Module III: Financing Decisions (15 hours)

Cost of Capital and Financing Decision: Sources of long-term financing Estimation of components of cost of capital. Methods for calculating cost of equity capital Cost of retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average Cost of capital (WACC) and Marginal cost of capital. Capital structure- Theories of capital structure (Net Income, Net Operating, MM, Hypothesis, and Traditional Approach). Operating and financial leverage; Determinants of capital structure

Module IV: Dividend Decisions (15 hours)

Theories of Relevance and irrelevance of dividend decision for corporate valuation; Cash and stock dividends; Dividend polices in practice

Module V: Working Capital Decisions (15 hours)

Concepts of working capital, the risk –return trade off, sources of short-term finance, working capital estimation, cash management, receivables management, inventory management and payables management.

Suggested Readings

1. Financial Management and Policy, James C.Van Horne and Sanjay Dhamija, Pearson Education.
2. Principles of Financial Management, Levy h.andM.Sarnat, Pearson Education.
3. Fundamentals of Financial Management, Brigham and Houston, Cengage Learning.
4. Basic Financial Management, Khan and Jain, McGraw Hill Education
5. Fundamentals of Financial Management, Prasanna Chandra, McGraw Hill Education
6. Financial Management-text and Problems, Singh, J.K, DhanapatiRai and Company , Delhi
7. Fundamentals of Financial Management, Rustagi, R.P, Taxmann Publications Pvt.Ltd.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	M

MTAO0124: AIRPORT OPERATIONS

(6 credits- 75 hours) (L-T-P: 5-1-0)

Objective: *The main objective of this course is to aware about the basic concepts of airport operations, airline navigation systems, process of airport safety and security and various aspects of Airport Planning and Service*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

1. Explain the basic concepts of airport operations (Remembering)
2. Explain airline navigation systems (Understanding)
3. Analyze the process of airport safety and security (Analyzing)
4. Critically judge the various aspects of Airport Planning and Services (Evaluating)

Module I: Introduction (9 Hours)

Airport Definition – Aerodrome and Airport, ICAO set-up and functions, Aerodrome Data and Physical characteristics, Declared Distances, Obstacle Limitation Surfaces.

Module II: Airline Navigation (26 Hours)

Navigational Aids; Runway, Taxiway and Apron; Airfield Lighting; Visual Aids, Category of ILS (Instrument Landing System), Air Traffic Services and aeronautical communication (RT phraseology); Aeronautical Information Publication, NOTAM, Meteorological Report and Forecast, Facilitation (ICAO Annex – 9).

Module III: Airport Safety and Security (13 Hours)

Security – Safeguarding civil aviation; Safe transportation of dangerous goods; Basic Safety Concept at Airport; Hazards; Safety Risk Assessment; SMS framework; Phased approach of SMS implementation.

Module IV: Airport Planning and Services (27 Hours)

Airport Planning (Master planning); Set-up of an international airport; Terminal Management; Airfield Management; Airport Operations Control Centre; Landside Management; Immigration and Customs Procedure; APHO Services; Ramp Handling Services; Cargo Operations; Commercial Management; Airport's economic performance; National Civil Aviation Policy (2016).

Suggested Readings

1. Airport Operations, Third Edition Hardcover – Import, 16 December 2012
2. Managing Airports: An International Perspective Paperback

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H			
CO 2		H		
CO 3			H	
CO 4				H

MTEC0125: E-COMMERCE

(2 Credits- Lectures: 40, Practical Lab: 26)

Objectives*: To enable the student to become familiar with the mechanism for conducting business transactions through electronic means*

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

1. Interpret the basic concepts and technologies used in the field of E-Commerce.(Remembering)
2. Explain the different regulatory provisions relating to E-Commerce. (Understanding)
3. Develop processes of developing and implementing information systems. (Applying)
4. Define the ethical, social, and security issues of information systems. (Analysing)
5. Evaluate the various online business transactions (Evaluating)
6. Design websites for online business transactions (Creating)

Module I: Introduction (8 Hours)

Introduction to Electronic Commerce, E-Commerce vs E-Business, Advantages of E-commerce, Disadvantages of E-commerce, Transition to E-commerce in India

Technology used in E-commerce: The dynamics of world wide web and internet (meaning, evolution and features); Designing, building and launching e-commerce website (A systematic approach involving decisions regarding selection of

hardware,software, outsourcing vs. in-house development of a website)

Module II: Security and Encryption: (8 Hours)
E-commerce security environment: dimension, definition and scope of e- security, security threats in the E-commerce environment, technology solutions, business procedures, and public laws

Module III: IT Act 2000 and Cyber Crimes (8 Hours)
IT Act 2000: Definitions, Digital signature, Electronic governance, Attribution, acknowledgement and dispatch of electronic records, Regulation of certifying authorities, Digital signatures certificates, Duties of subscribers, Penalties and adjudication, Appellate Tribunal, Offences and Cyber-crimes

Module IV: E-payment System (8 Hours, 4 Lab)
Digital Payment Requirements, Digital Token-based e-Payment Systems, Smart Card Cash Payment System, Micropayment Systems, Electronic Cash, Risk and e-Payment Systems, Designing e-Payment Systems.

Module V: On-line Business Transactions (8 Hours, 4 Lab)
Business Model, E-business Models Based on the Relationship of Transaction Parties: Business-to-Consumer (B2C), Business-to-Business (B2B), Consumer-to-Consumer (C2C), Consumer-to-Business (C2B), E-business Models Based on the Relationship of Transaction Types: Brokerage Model, Aggregator Model

Module VI: Website designing (18 Lab)
HTML basics, elements, attributes, formatting, CSS, links, images, tables, lists, block, inline, JavaScript basics, forms, inputs.
Note: There shall be 3 Credit Hrs. for lectures + One Credit hour. (2 Practical periods per week per batch) for Practical Lab

Suggested Readings

1. Kenneth C. Laudon and Carlo GuercioTraver, E-Commerce, Pearson Education.
2. David Whiteley, E-commerce: Strategy. Technology and Applications, McGraw Hill Education
3. Bharat Bhaskar, Electronic Commerce: Framework, Technology and Application, 4thEd., McGraw Hill Education
4. Joseph P T, E-Commerce: An Indian Perspective, PHI Learning
5. Bajaj K K and Debjani Nag, E-commerce, McGraw Hill Education
6. Chhabra T N, E-Commerce, Dhanpat Rai Co.
7. Madan Sushila, E-Commerce, Taxmann

Mapping of COs to Syllabus:

Course Outcomes	Module-1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	M				
CO 2		H	M	L		
CO 3					H	M

MTBE0142: INTRODUCTION TO BUSINESS ENVIRONMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)
***Objective**: This course is designed to enhance knowledge, skills and attitude to the business environment. It will help student to get a broad exposure to understand the business environment and the problems faced by them.*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:
1. Define the Multidisciplinary nature of Business Environment. (Remembering)
2. Explain the nature and the structure of Indian Economy. (Understanding)
3. Interpret the monetary and fiscal policy. (Applying)
4. Analyze the relation between business and its socio cultural environment. (Analyzing)
5. Evaluate the legal environment of business. (Evaluating)
6. Elaborate the significance of technological environment and its regulations with regards to foreign investment. (Creating)

Module I: Understanding Business Environment- Meaning, Nature & Scope (15 Hours)
Meaning of Business Environment, Factors affecting environment of the business, Types of Business Environment- Internal & External Environment, Micro & Macro Environment; Types of business, Environmental Analysis**,** PESTEL & SWOT Analysis, Porter's 5 force model

Module II: Economic Environment of Business (15 Hours)

Indian Perspective, Nature & Structure of Indian Economy, Economic Policies & Conditions, Economic role of Government in India, Foreign Trade, Liberalization, Privatization, & Globalization, the contribution of Public sector enterprises in India, Foreign Direct Investment in India, its impact on Indian economy.

Module III: Financial Environment of Business (12 Hours)
Monetary Policy, Fiscal Policy, Capital Market, Money Market, Stock Exchange – An overview, Modes of Money inflow in an economy

Module IV: Socio Culture Environment of Business (13 Hours)
Business and Society, Business Culture and Language and Organizational behaviour, Social Objectives of Business, Corporate Social Responsibility, Consumer Rights & Corporate Governance.

Module V: Legal Environment of Business (12 Hours)
Indian Company Law, Competition policy and law, Patents & Trademarks, Industrial Policy- An overview, Labor Laws & Social Security, Business Ethics, Environmental Laws.

Module VI: Technological Environment (8 hours)
Concept and significance of technological environment, regulation of foreign investment and collaboration.

Suggested Readings
1. Francis Cherunilam, Business Environment, Himalayan Publishing House.
2. Naseem Akhter, Introduction to Business Environment, Adhyayan Books.
3. Dr. S. Sankaran, Business Environment, Margham Publications.
4. Dr. Amit Kumar, Business Environment, Sahitya Bhawan Publications.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6
CO 1	H	L				
CO 2	M	H	L			
CO 3			H		M	
CO 4				H	M	
CO5		L		L	H	
O6					L	H

MTPM0143: PRINCIPLES OF MANAGEMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)

COURSE/LEARNING OUTCOMES
At the end of the course students will be able to:
1. Define the concept related to Management (Remembering)
2. Explain the evolution of the management thought (Understanding)
3. Analysing major techniques of control (Applying)
4. Evaluate planning, organizing, staffing and control (Analysing)
5. Elaborate the various theory (Evaluating)

Module I: Introduction (13 hours)
a. Concept: Need for Study, Managerial Functions – An overview; Co-ordination: Essence of Managership
b. Evolution of the Management Thought, Classical Approach – Taylor, Fayol, Neo-Classical and Human Relations Approaches – Mayo, Hawthorne Experiments, Behavioural Approach, Systems Approach, Contingency Approach – Lawerence & Lorsch, MBO - Peter F. Drucker, Re-engineering - Hammer and Champy, Michael Porter – Five-force analysis, three generic strategies and value- chain, analysis, Senge's Learning Organisation, 'Fortune at the Bottom of the Pyramid' – C.K. Prahalad.

Module II: Planning (13 hours)
a. Types of Plans – An overview to highlight the differences
b. Strategic planning – Concept, process, Importance andlimitations
c. Environmental Analysis and diagnosis (Internal and external environment) – Definition, Importance and Techniques (SWOT/TOWS/WOTS-UP), Business environment; Concept and Components
d. Decision-making – concept, importance; Committee and Group Decision-making, Process, Perfect rationality and bounded rationality, Techniques.

Module III: Organising (13 hours)

Concept and process of organising – An overview, Span of management, Different types of authority (line, staff and functional), Decentralisation, Delegation of authority Formal and Informal Structure; Principles of Organising; Network Organisation Structure

Module IV: Staffing and Leading (13 hours)

a. Staffing: Concept of staffing, staffing process
b. Motivation: Concept, Importance, extrinsic and intrinsic motivation; Major Motivation theories - Maslow's Need-Hierarchy Theory; Hertzberg's Two-factor Theory, Vroom's Expectation Theory.
c. Leadership: Concept, Importance, Major theories of Leadership (Likert's scale theory, Blake and Mouten's Managerial Grid theory, House's Path Goal theory, Fred Fielder's situational Leadership), Transactional leadership, Transformational Leadership, Transforming Leadership.
d. Communication: Concept, purpose, process; Oral and written communication; Formal and informal communication networks, Barriers to communication, Overcoming barriers to communication.

Module V: Control (13 hours)

a. Control: Concept, Process, Limitations, Principles of Effective Control, Major Techniques of control - Ratio Analysis, ROI, Budgetary Control, EVA, PERT/CPM.
b. Emerging issues in Management

Suggested Readings

1. Joseph L. Massie :*Essentials of Management* .PHI, New Delhi; 2015.
2. James F.Stoner :*Management*. Pearsons Education, Delhi ; 2020.
3. Harold Koontz, Heinz Weihrich: *Management*. Tata McGraw Hill Pub. Co., Delhi;2015.
4. AmitaiEtzioni :*Modern Organizations*. PHI, New Delhi; 2021.
5. Jones, Gareth R. and Jennifer M. George: *Contemporary Management*. Tata McGraw Hill.
6. Charles Hill, W.L. and Steven L.McShane: *Principles of Management*. Tata McGraw Hill.
7. Semuel C. Certo: *Modern Management*. Prentice Hall, New Jersey.

Mapping of Cos with Syllabus

Course Outcomes	**Module 1**	**Module 2**	**Module 3**	**Module 4**	**Module 5**
CO1	H				
CO2		H			
CO3			H		
CO4				H	
CO5					H

Tutorial class for all course: In terms of Group discussion, seminar presentation etc. should be done by all concerned faculty members. Hence the 1 hour of tutorial class will be used for this purpose.

MTSM0145: STOCK MARKET OPERATIONS

(Credits: 6- 75 hours) (L-T-P: 5-1-0)

COURSE OUTCOMES

1. Learn the basics of investing in stock market, the investment environment as well as risk & return (Remembering)
2. Explain Indian securities market including the derivatives market (Understanding)
3. Examine EIC framework and conduct fundamental analysis (Analysing)
4. Perform technical analysis (Applying)
5. Invest in mutual funds market (Applying)

Module I: Basics of Investing (15 hours)

Basics of Investment & Investment Environment. Risk and Return, Instruments of Investment -Equity shares, Preference shares, Bonds and Debentures. Indian Security Markets: Primary Markets (IPO, FPO, Private placement, Offer for sale), Secondary Markets (cash market and derivative market: Futures and Options) MarketParticipants: Stock Broker, Investor, Depositories, Clearing House, Stock Exchanges. Role ofstock exchange, Stock exchanges in India: BSE, NSE, MSEI. Security Market Indices: Nifty &Sensex, Sources of financial information.Trading in securities: types of orders, using brokerage and analyst recommendations

Module II: Indian Security Markets (15 hours)

Primary Markets (IPO, FPO, Private placement, Offer for sale), Secondary Markets (cash marketand derivative market: Futures and Options) Market Participants: Stock Broker, Investor ,Depositories, Clearing House, Stock Exchanges. Role of stock

exchange, Stock exchanges in India: BSE, NSE, MSEI. Security Market Indices: Nifty & Sensex, Sources of financial information Trading in securities: types of orders, using brokerage and analyst recommendations

Module III: Fundamental Analysis (15 hours)
Top down and bottom up approaches, Analysis of international & domestic economic scenario, Industry analysis, Company analysis (Quality of management, financial analysis :Both Annual and Quarterly, Income statement analysis, position statement analysis including key financial ratios, Cash flow statement analysis, Industry market ratios: PE, PEG, Price over sales, Priceover book value, EVA), Understanding Shareholding pattern of the company.

Module IV: Technical Analysis(15 hours)
Trading rules (credit balance theory, confidence index, filter rules, market breath, advances vsdeclines and charting (use of historic prices, simple moving average and MACD) basic andadvanc ed interactive charts. Do's& Don'ts of investing in markets.

Module V: Investing in Mutual Funds (15 hours)
Concept and background on Mutual Funds: Advantages, Disadvantages of investing in Mutual Funds, Types of Mutual funds: Open ended, close ended, equity, debt, hybrid, money market and entry load vs. exit load funds. Factors affecting choice of mutual funds. CRISIL mutual fund ranking and its usage, calculation and use of Net Asset Value

Suggested Readings:
1. Kumar, Vinod and Nangia, Raj Sethi, Investing in Stock Markets, Ane books
2. Singh J K , Singh Amit Kumar, Investing in Stock Markets, A K Publications, Delhi.
3. Tripathi, Vanita and Pawar, Neeti (2019), Investing in Stock Market, Taxmann Publications

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H				
CO 2		H			
CO 3			H		
CO 4				H	
CO 5				M	H

MTME0146: INTRODUCTION TO MACRO ECONOMICS

(6 credits- 75 hours)
***Objective**: This course deals with the principles of Macroeconomics. The coverage includes determination of and linkages between major economic variables; level of output and prices, inflation, interest rates and exchange rates. The course is designed to study the impact of monetary and fiscal policy on the aggregate behavior of individuals.*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:
1. Define the macroeconomic variables (Remembering)
2. Explain the Keynesian theory of Income and Employment (Understanding)
3. Apply the different concepts of National Income Accounting in understanding how an economy works. (Applying)
4. Analyze the theories of consumption and investment (Analyzing)
5. Evaluate the various factors of inflation (Evaluating)
6. Elaborate the concept of Open Economy (Creating)

Module I: Measurement of macroeconomic variables (20 Hours)
National Income Accounts, Gross Domestic Product, National Income, Personal and Personal disposable income; Classical theory of income and employment: Quantity Theory of Money – Cambridge version, Classical aggregate demand curve, Classical theory of interest rate, effect of fiscal and monetary policy.

Module II: Keynesian theory of Income and employment (20 Hours)
Simple Keynesian model, components of aggregate demand, equilibrium income, multiplier, ISLM model: properties of ISLM curves, factors affecting the position and slope of ISLM curves, determination of equilibrium income and interest rates, effect of monetary and fiscal policy.

Module III: Consumption & Investment (20 Hours)
The Theories of consumption and Investment: The absolute income hypothesis, Relative Income Hypothesis, Permanent Income Hypothesis, Life Cycle Hypothesis. Concept of Marginal Efficiency of Capital and Marginal Efficiency Of investment. Accelerator theories of Investment; Inflation: meaning, demand and supply side factors, consequences of inflation, anti-inflationary policies, natural rate theory, monetary policy-output and inflation, Phillips curve (short run and long run)

Module IV: Open Economy (15 Hours)
Brief introduction to BoP account, market for foreign exchange and exchange rate, monetary and fiscal policy in open economy, Mundell Fleming model (perfect capital mobility and imperfect capital mobility under fixed and flexible exchange rate)

Suggested Readings

1. Froyen, R.P. (2011) Macroeconomics-theories and policies (8th ed.).Pearson.
2. Dornbusch and Fischer (2010). Macroeconomics (9th ed.). Tata McGraw Hill
3. N Gregory Mankiw (2010). Macroeconomics (7th ed.). Worth Publishers
4. Olivier Blanchard, Macroeconomics (2009). (5th ed.)Pearson
5. D'Souza, E. (2008), Macroeconomics, Pearson Education: New Delhi.

Mapping of COs to Syllabus

Course Outcomes	Module I	Module II	Module III	Module IV	Module V
CO 1	H	M			
CO 2		H			
CO 3		M	H	L	
CO 4	H		L		
CO5				H	M
CO6					H

MTBE0147: BUSINESS ETHICS & CORPORATE GOVERNANCE

(Credits-6-75 hours) (L-T-P: 5-1-0)
Objective: *The objective of this paper is to make the students aware about the importance of ethics in the business, practices of good governance to encourage moral imagination and heightening sensitivity towards the ethical dimension of managerial problems.*

COURSE/LEARNING OUTCOMES
After learning this course, the students will be able to:
1. Define Business Ethics and best practices of business ethics (Remembering)
2. Explain the various Corporate Social Responsibilities (Understanding)
3. The need and importance of corporate and professional responsibility (Analyzing)
4. Analyze corporate governance frameworks (Analyzing)
5. Evaluate the role of audit in corporate governance (Evaluating)
6. Elaborate the concepts of ethical reasoning (Creating)

Module I (18 Hours)
Business ethics: Introduction, Meaning of ethics, Types of business, ethical issues, why ethical problems occur in business, Ethical dilemmas in business,
Ethical principles in business: Utilitarianism, Rights and duties, Justice and fairness, The ethics of care, Integrating utility, rights, justice and caring, An alternative to moral principles: virtue ethics, Morality in international context, Ethical decision making, Personal and professional moral development and moral reasoning ,Computer ethics and business
Professional ethics: Ethics in international business
Case study on Indian companies like Tata related to Ethics in Business in Indian context
Corporate governance: concept, need to improve corporate governance standards, Features of good governance, Corporate governance abuses, Role played by regulators to improve corporate governance. Different Approaches to Corporate Governance, Leadership and Corporate Governance, Rights and Privileges of shareholders; Investor's Problem and protection; Board of Directors; Role, Duties and Responsibilities of Auditors, Bank and Corporate Governance. International experience- UK scenario (Cadbury committee; US scenario(Tread way commission, Blue ribbon committee)
Indian experience- imperatives, CII code of best practices, Kumar Mangalam Birla, Narayan Murthy committee report
Case study on Indian companies like Tata related to Governance in Business in Indian context

Module III (19 Hours)
Moral issues in business: Importance of moral issues and reasoning, Principles of moral reasoning, Quality of work life, implications of moral issues in different functional areas of business like finance, HR and marketing.
Whistle blowing: Kinds of Whistle blowing, Marketing truth and advertising: Marketing, Advertising, Truth and advertising, Allocation of moral responsibility in advertising Trade secrets, corporate disclosure, insider trading: Trade secrets, corporate disclosure, insider trading Accounting, finance Affirmative action, Ethics and Environment

Module IV (18 Hours)
Corporate Social Responsibility: Meaning, Evolution of Corporate Social Responsibility, Limits of Corporate Social Responsibility, Voluntary Responsibility Vs. Legal requirements, Profit maximization vs. social Responsibility, Socially Responsive Management:

Strategies of response, formulating socially responsive strategies, Implementing social responsiveness, Financial incentives for social responsibility, Role of self regulation in discharge of social responsibility. Case studies on Indian companies like Tata, Godrej etc related to Corporate Social Responsibility

Suggested Readings

1. Crane. A., Business Ethics: Managing Corporate Citizenship and Sustainability in the Age of Globalisation, Taxmann Publishing House.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4
CO 1	H		M	L
CO 2		M		H
CO 3		M	L	H
CO 4		H		L
CO5		H		M
CO6	M		H	L

MTOM0148: OPERATIONS MANAGEMENT

(6 credits – 75 hours) (L-T-P:5-1-0)

***Objective**: This course aims at acquainting the students with the functions of production and operations management and basic issues and tools of managing production and operation functions of an organization. The course also intends to provide the students a system theoretic view on project management and helps develop an understanding on why today's organizations are cultivating a formal project management process to gain competitive advantage. The syllabus has an in-depth coverage of the most critical topics found in PMBOK (Project Management Body of Knowledge) Guide.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Define a production system. (Knowledge)
2. Distinguish between production and operations. (Comprehension)
3. Use the tools and techniques to measure work study, motion study. (Application)
4. Apply the concepts of work sampling techniques in the determination of standard time. (Application)
5. Comprehend the significance of plant location and prepare systematic layout planning procedure. (Synthesis)
6. Explain product life cycle and product mix. (Comprehension)
7. Demonstrate the procedure for product development and design. (Application)
8. Compare between make or buy decisions. (Analysis)
9. Apply various tools of demand forecasting. (Application)
10. Determine inventory and inventory control techniques. (Application)
11. Synthesize project management framework. (Synthesis)
12. Compute project completion time and Analyse and evaluate project risk management techniques. (Application, Analysis & Evaluation)

Module I: Introduction and Work Study (20 hours)

a. Introduction to Production and operations management
b. Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement
c. Method/ Motion study- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy
d. Micro-motion study – Meaning and scope, therbligs, use of motion camera in micro- motion study
e. Work measurement – concept of observed time, rating/leveling factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time.

Module II: Plant Location and layout (25 hours)

a. Objectives, Locational factors, Economics of plant location
b. Meaning, objectives and types of plant layout and their relevance to mass, batch and job- order production systems.
c. Systematic Layout Planning (SLP) procedure
d. Use of computers for layout design
e. Group Technology (GT), Flexible manufacturing systems (FMS) and Computer integrated manufacturing (CIM)
f. Assembly Line Balancing (ALB) - meaning and objective, Heuristic methods for solution of ALB problems.

Module III: Product design and Development and PPC (10 hours)

a. Meaning of product, Product life cycle (PLC) and Product mix
b. Decisions to be taken during product development and design

c. Procedure for product development and design
d. Value of a product – its meaning, Value Analysis (VA) – its objectives, procedure and example, Simplification and Standardization.

Module IV: Production Planning and Control (15 hours)

Meaning and Objectives of PPC, Effects of types of production

a. Steps in PPC primarily stressing the needs of marketing research, Demand forecasting, process planning/routing, scheduling of flow-shop and job-shop productions, Use of Gantt chart, Machine loading, Make/Buy decision and Break-even analysis, Master production schedule, MRP and MRP-II, Capacity planning, Inventory management.
b. Production control – monitoring, expediting and re-planning, Planning and control of batch production. TOC, Use of L.P in Production Management, Product and service Reliability.

Suggested Reading

1. M. Telsang, Industrial Engineering, S. Chand & Company Ltd.
2. Kanishka Bedi, Production and Operations Management, Oxford University Press.
3. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai & Sons.
4. M. Mahajan, Industrial engineering, Dhanpat Rai & Company.
5. L. Krajewski, L. Ritzman and M. Malhotra, Operations Management, Pearson Education.
6. Adam, Ebert, Production and Operations Management, PHI.
7. R. Panneerselvam, Production and Operations Management, PHI.
8. K. Aswathappa& K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing

Mapping of Cos with Syllabus

Course Outcomes	**Module 1**	**Module 2**	**Module 3**	**Module 4**
CO1	H			
CO2	H			
CO3	H			
CO4	H			
CO5		H		
CO6		H		
CO7			H	
CO8			H	
CO9			H	
CO10			H	
CO11				H
CO12				H

MTRM0149: FUNDAMENTALS OF RETAIL MANAGEMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: *The objective of this paper is to introduce students with the basic concepts of retail management and the latest developments in retail industry in the Indian Context and to enhance the students with the skills required to be directly employed as a sales or marketing executive manager or top start a retail business of their own.*

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

1. Define the meaning of Retailing. (Knowledge)
2. Explain the models of Pricing Strategies. (Comprehension)
3. Establish the relationship between Retail purchasing and Pricing Strategies. (Application)

Module I:

Introduction to retailing: Definition and scope, Evolution of retailing, Types of retail, Trends in retailing industry, Retailing environment, Social and economic significance of retailing, Structure of retailing and distribution, Opportunities in retailing.

Module II:

Retail purchasing and pricing: Purchase management: - Merchandise purchasing, open to buy, open to buy planning, analyzing the merchandise performance, Pricing strategies: Every day pricing, Competitive based pricing, Price Skimming, Market-oriented pricing, Marginal cost pricing. Retail price strategies: - mark-up pricing, vendor pricing, competitive pricing, Psychological pricing.

Module III:
Retail marketing and promotion: Nature and scope: -relationship marketing, market strategies, retail research Understanding the retail customer: - retail market, population analysis, demographic analysis, consumer behaviour Retail promotion Mix: - Retail promotion programme, retail advertising media, promotional budget. Customer services: - customer services, services quality gaps, service recovery.

Module IV:
a. Information system in retailing: Acquiring and using information strategies, technology in retail, information sources, retail information system, The flow of information and products in supply chain
b. Retail pricing and communication mix: Pricing strategies, Consideration in setting retail prices, Pricing techniques for increasing sales and profits, Communication programs to develop brand images and build customer loyalty, Methods of communicating with customers, Planning the retail communication program.

Module V:
Retailing in India: Evolution and trends in organised retailing, Indian organised retail market, FDI in Indian organised retail sector, Retail scenario in India, Future trends of retail in India.

Module VI:
Ethical and legal issues in Retailing: Dealing with ethical issues, social responsibility, environmental orientation, waste reduction at retail stores.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7
CO1	H						
CO2		H					
CO3			H				

MTIE0150: INDIAN ECONOMY

(6 credits- 75 hours) (L-T-P: 5-1-0)

COURSE OUTCOMES
1. Define the basic issues in economic development (Understanding)
2. Note down the critical assessment of economic reforms (Applying)
3. Explain economic development strategy since independence (Analyzing)
4. Evaluate the economic planning and development issues (Evaluating)
5. Elaborate the sectoral trends and issues(Evaluating)

Module I: Basic Issues in Economic Development (10 hours)
Concept and Measures of Development and Underdevelopment; Human Development

Module II: Basic Features of the Indian Economy at Independence (10 hours)
Composition of national income and occupational structure, the agrarian scene and industrial structure

Module III: Policy Regimes (Lectures 10)
a. The evolution of planning and import substituting industrialization.
b. Economic Reforms since 1991.
c. Monetary and Fiscal policies with their implications on economy

Module IV: Growth, Development and Structural Change (15 hours)
a. The experience of Growth, Development and Structural Change in different phases of growth and policy regimes across sectors and regions.
b. The Institutional Framework: Patterns of assets ownership in agriculture and industry; Policies for restructuring agrarian relations and for regulating concentration of economic power;
c. Changes in policy perspectives on the role of institutional framework after 1991.
d. Growth and Distribution; Unemployment and Poverty; Human Development; Environmental concerns.
e. Demographic Constraints: Interaction between population change and economic development.

Module V: Sectoral Trends and Issues and Industrialization in North Easter Region (20 hours)
a. Agriculture Sector: Agrarian growth and performance in different phases of policy regimes i.e. pre green revolution and the two phases of green revolution; Factors influencing productivity and growth; the role of technology and institutions; price policy, the public distribution system and food security.
b. Industry and Services Sector: Phases of Industrialisation – the rate and pattern of industrial growth across alternative policy regimes; Public sector – its role, performance and reforms; The small-scale sector; Role of Foreign capital.

c. Financial Sector: Structure, Performance and Reforms. Foreign Trade and balance of Payments: Structural Changes and Performance of India's Foreign Trade and Balance of Payments; Trade Policy Debate; Export policies and performance; Macro Economic Stabilisation and Structural Adjustment; India and the WTO, Role of FDI, Capital account convertibility,
d. Industrialization in North Easter Region- Types of industries, industrial policies, Act East policy, Cross Border Trade, Border Area Development, Institutions – NEDFI, DONNER, NEC

Suggested Readings

1. Mishra and Puri, Indian Economy, Himalaya PublishingHouse
2. IC Dhingra, Indian Economics, Sultan Chand & Sons
3. GauravDutt and KPM Sundarum, Indian Economy, S. Chand & Company.
4. Bhagwati, J. and Desai, P. India: Planning for industrialization, OUP, Ch 2.
5. Patnaik, Prabhat. Some Indian Debates on Planning. T. J. Byres (ed.). The Indian Economy: Major Debates since Independence, OUP.34
6. Ahluwalia, Montek S. State-level Performance under Economic Reforms in India in A. O. Krueger. (ed.). Economic Policy Reforms and the Indian Economy, The University of Chicago Press.
7. Dreze, Jean and Amartya Sen. Economic Development and Social Opportunity. Ch. 2. OUP. 8. Khanna, Sushil. Financial Reforms and Industrial Sector in India.Economic and Political Weekly.Vol. 34.No. 45.
8. Uma Kapila (ed), "Indian Economy since Independence", Relevant articles.
9. Rangarajan, C. and N. Jadhav. Issues in Financial Sector Reform.BimalJalan. (ed). The Indian Economy. Oxford University Press, New Delhi. Note: Latest edition of text books may be used.

Mapping of COs to Syllabus

Course Outcomes	Module 1	Module 2	Module 3	Module 4	Module 5
CO 1	H	H			
CO 2			H	H	
CO 3		H			
CO 4			H		M
CO 5					H

MTSL0200: SERVICE LEARNING

(Credit: 2 Hours: 30)

***Objective**: Service Learning will aim to support the development of basic skills among the students namely, critical and creative thinking, reflection, communication, collaboration, information literacy, and social skills. The emphasis will be on active civic participation. As the students will actively involved in a wide range of experiences, which will benefit both the community at large and the students in particular and in the process the goals of the curriculum shall be achieved*

COURSE/ LEARNING OUTCOMES

After learning this course, the students will be able to:

1. Define and explain the Service Learning framework (Remembering)
2. Explain the nature and types of community engagement work(Understanding)
3. Identify the need and importance of social responsibility(Applying)
4. Analyse the need for social intervention through community partners(Analysing)
5. Evaluate the academic outcomes through Service Learning(Evaluating)
6. Elaborate upon the social understanding to the issues faced in the community(Creating)

Assessment Process:

The allotment of marks will be as follows:
Internal Assessment: 40 marks
(This will consist of one test to find out the knowledge acquired by students; attendance; discipline)
External Assessment: 60 marks
(This will consist of the field work, logbook diary, report submission of the field work, viva–voce and presentation)
The Assessment will go beyond evaluation of only the final outcome. All the steps must be completed successfully.

I. Regular reporting and feedback - to allow continual adjustment and improvement.

Ii. Involving all stakeholders in the evaluation process is desirable.
Iii. Students will be given a log book diary which they will have to fill up on a regular basis. This comprehensive diary will have different sections which will effectively help the students to plan, document their activities and will act as a self monitoring tool to measure the objectives, activities undertaken and the learning outcomes achieved.
Iv. Each faculty of the department will act as a supervisor for five or six students. The students will submit their logbook diary on a weekly basis. The logbook diary will have to be complete in all aspects along with supporting documents like photographs, etc.
V. Once the assigned field activity is complete, all the students will prepare a project report on the basis of the prescribed structure.
vi. Final presentation will be held wherein each student will present their report.

Module I: Concept of Service Learning (3 Hours):
Service Learning – meaning, concept, definition; value based framework of Service Learning; Understanding the core standards of Service Learning such as respect, reciprocity, relevance, and reflection; Elements of Service Learning; Understanding Service Learning – Its philosophy, historical background, purpose, value and theoretical framework; Locating Service Learning within the University context; Principles of Service Learning; Classification of Service Learning Models; Experiential Learning; Reflective Learning;; Journaling; Service Learning Pedagogy; Difference between Service Learning and other community experiences

Module II: Community Engagement and Community Partnerships (3 Hours)
Community Engagement – concept, meaning, definition and principles; benefits of community engagement, models of community engagement; Civic Engagement, University Community Engagement, Community partnerships – meaning, benefits, Reflection – meaning, definition and implications; Critical inquiry - meaning, definition and implications; Engaged Research - meaning, definition and implications;
Historical context of University Community Partnership; Understanding Community & Community Partnership; Ethical understanding of partnership; Understanding the agency of the Community – as co-educators; Community barriers

Module III: Social Responsibility and Communication Basics (3 Hours)
Social Responsibility – meaning, benefits, Socio-economic context – meaning, definition, Social issues – meaning, Understanding of society & social issues ; Conflict – meaning, types, Understanding various conflict resolution strategies; Community level partnerships – meaning, significance, types; Social Justice – meaning and implications; Communication – meaning, types, channels of communication, models of communication

Module IV: Identifying the Partners in the Community (3 Hours)
Partners in the community – meaning, types and functions of Community Partners namely, Corporate, Government and PSU Organizations, Panchayats, Community settings, Clinical settings, NGO's, Anganwadi Centres, Self Help Groups, Schools , Business Firms, Community Markets, Weekly Haats, Customer Relationship Management, etc

Module V: Basics of Professional Skills (3 Hours)
Aspects of Professional Skills Development: Factors affecting individual behaviour - personal, environmental and organizational, individual diversity –biographical and demographic characteristics, self-esteem, self-monitoring
Individual decision-making process, rational decision-making, decision-making styles, common biases and judgment errors in decision-making, individual v/s group decision-making.
Basics of Planning and Organising - Nature and purpose of planning, planning process, types of plans
Types of groups, stages of group development, characteristics of effective teams, how group status influences individual behavior, leaders and their role in teams, characteristics of an effective leader.

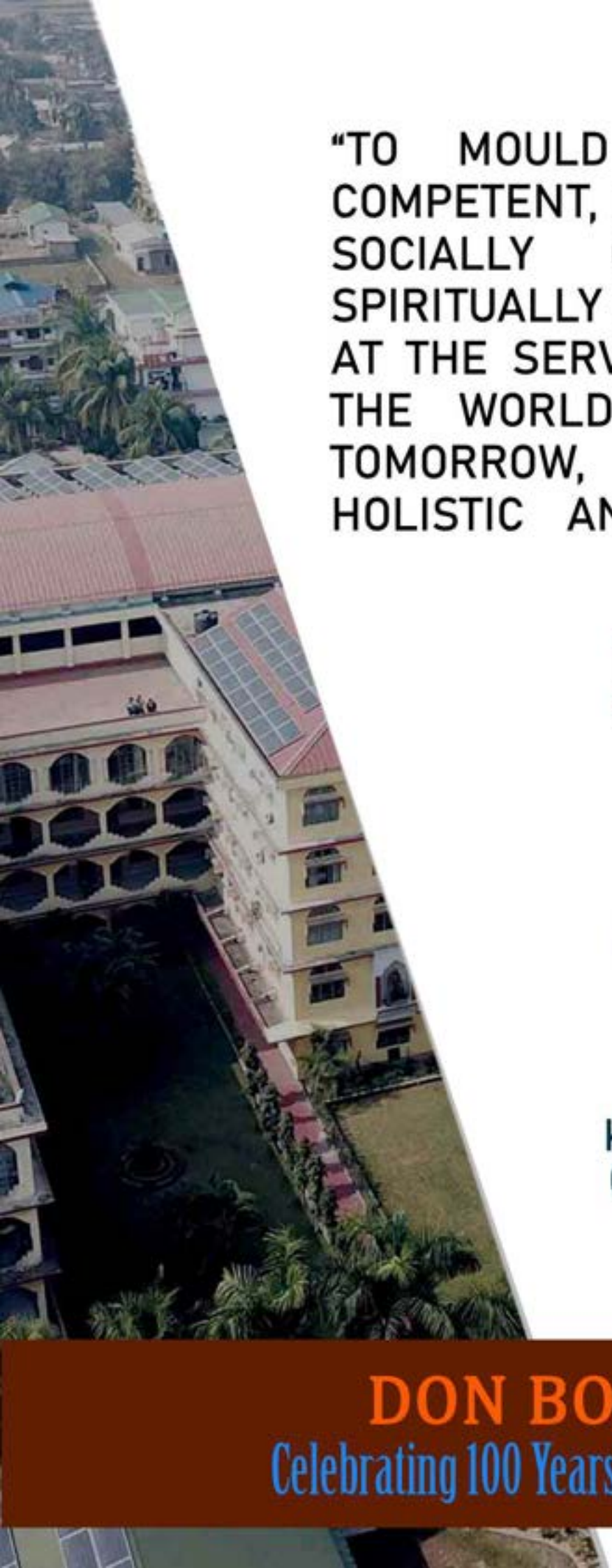
Module VI: Service Learning Projects (15 hours)
Service Learning Projects – stages, investigation, preparation, action, reflection, demonstration and documentation.
Areas of Study in Service Learning: Capacity building of youths, Single entry accounting system for small retailers, Preparation and benefits of maintain balance sheet, Financial Literacy, Financial Planning for Business Organisations, Basic Marketing Techniques, Selling Skills, Insurance, Human Resource Management, MSME schemes, Entrepreneurship ideas, start up ventures, Feasibility studies, Undertaking New Business Ventures, Venture Funding, Angel Investors, Partnership, Business Communication skills, Soft Skills Development, Poverty, livelihood, Health, Education, Water, Sanitation, Disability, Children, Women, NGO Management Practices, Environment, SDG's - technological solutions/suggestions for development, etc.
Note: Emphasis on Group Work, Projects, Case Studies, Assignments, Journaling, Report Preparation, Presentations, Workshops, Group Conferences Individual Conferences etc.

Suggested Readings:
1. Kaye Cathryn Berger, The complete Guide to Service Learning: Proven Practical Ways to Engage Students in Civic Responsibility, Academic Curriculum and Social Action, Free Spirit Publishing
2. Barbara Jacoby, Service Learning in Higher Education: Concepts and Practices
3. Patty H. Clayton, Robert G. Bringle and Julie A. Hatcher, Research on Service Learning: Conceptual Frameworks and

Assessment
4. Barbara Jacoby, Service Learning Essentials: Questions, Answers and Lessons Learned
5. Julie A, Hatcher and Robert G. Bringle, Understanding Service Learning and Community Engagement
6. Farbar Katy, Change the World with Service Learning

EDCI0200: CONSTITUTION OF INDIA

This course syllabus is already available in Moodle platform and students will have to complete the course in moodle itself. All students should complete this course in the second semester of their programme.



OUR VISION

"TO MOULD INTELLECTUALLY COMPETENT, MORALLY UPRIGHT, SOCIALLY COMMITTED AND SPIRITUALLY INSPIRED PERSONS AT THE SERVICE OF INDIA AND THE WORLD OF TODAY AND TOMORROW, BY IMPARTING HOLISTIC AND PERSONALISED EDUCATION"

TAPESIA GARDENS,
SONAPUR – 782402
ASSAM

AZARA,
GUWAHATI – 781017
ASSAM

KHARGULI CAMPUS,
GUWAHATI – 781004
ASSAM

DON BOSCO

Celebrating 100 Years in North East