# ASSAM DON BOSCO UNIVERSITY

## PROGRAMME PROJECT REPORT

## ON

## BACHELOR OF COMPUTER APPLICATION (BCA)

**Submitted to**

**UNIVERSITY GRANTS COMMISSION**
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## PROGRAMME PROJECT REPORT

## BCA PROGRAMME FOR THE ACADEMIC SESSION 2025-26

### 1. PROGRAMME'S MISSION AND OBJECTIVES:

1.1 **Mission**

The Online Bachelor of Computer Applications (BCA) programme at Assam Don Bosco University (ADBU) is designed to build a strong foundation in computer science, programming, and information technology, preparing learners to meet the growing demands of the digital world. Whether aspiring to become software developers, system administrators, data analysts, or IT entrepreneurs, graduates will acquire the knowledge and technical skills necessary to contribute effectively to the IT industry and related sectors.

Assam Don Bosco University is committed to providing learning opportunities for students, working professionals, technology enthusiasts, and aspiring entrepreneurs who wish to enhance their understanding of computing, data management, and digital innovation. The BCA programme is carefully structured to impart knowledge in key areas such as Programming, Database Management, Networking, Web Technologies, Cybersecurity, and Artificial Intelligence, thereby nurturing analytical thinking, creativity, and professional competence.

The curriculum has been developed in consultation with academic experts and industry professionals, ensuring that it aligns with the UGC Regulations on Open and Distance Learning and Online Programmes, 2020, as well as the principles of the National Education Policy (NEP) 2020. It integrates hands-on learning, practical assignments, and real-world projects to foster experiential and outcome-based education.

The mission of the ADBU BCA programme is to deliver accessible, affordable, and quality higher education through a flexible Online Learning (OL) platform, empowering learners to gain technological expertise regardless of geographical or socio-economic barriers. The university's ethos of "education beyond barriers" drives this mission, ensuring inclusivity and preparing students to become competent, ethical, and innovative professionals who can lead and adapt in the ever-evolving digital landscape.

#### 1.2 Objectives of the BCA Programme

**Technical Proficiency**: Develop advanced technical expertise in computer science and applications, encompassing programming, software development, database management, cloud computing, and network administration to meet industry demands.

**Problem-Solving & Analytical Thinking**: Strengthen problem-solving abilities and analytical thinking to effectively analyze, design, and implement computational solutions using advanced algorithms, data structures, and emerging technologies.

**Software Development & Project Management**: Gain proficiency in software development methodologies, agile project management, and software engineering best practices to design, develop, test, and deploy scalable and efficient applications.

**Information Security & Cybersecurity**: Build a deep understanding of cybersecurity principles, ethical hacking, and data privacy to safeguard digital assets and ensure the confidentiality, integrity, and availability of information systems.

**Research & Innovation**: Cultivate a research-oriented mindset to explore cutting-edge trends in artificial intelligence, machine learning, blockchain, and other emerging domains, contributing to technological advancements and innovation.

**Communication & Collaboration**: Enhance communication, teamwork, and leadership skills to work effectively in multidisciplinary teams, bridge the gap between technical and non-technical stakeholders, and present complex concepts with clarity.

**Professional Ethics & Lifelong Learning**: Foster a commitment to ethical computing practices, industry standards, and continuous learning to stay updated with technological advancements and remain competitive in the evolving IT landscape.

By achieving these objectives, graduates of the BCA programme will be well-equipped for diverse roles, including software development, systems analysis, database administration, cybersecurity, AI & data science, and IT consultancy. They will emerge as competent professionals capable of driving innovation and contributing meaningfully to the digital world.

**1.3 Programme Outcomes – BCA**

Technical Competence: Build a strong foundation in computer science and information technology, covering key areas such as programming, software development, database management, computer networks, and web technologies to prepare learners for professional roles in the IT sector.

Analytical and Problem-Solving Skills: Develop logical reasoning and analytical thinking to design, analyze, and implement effective computational solutions using structured programming, algorithms, and data structures.

Application Development: Gain hands-on experience in software and web application development using contemporary tools, programming languages, and frameworks, enabling learners to design and deploy efficient and user-friendly applications.

Information Security Awareness: Understand the basic principles of cybersecurity, data protection, and ethical computing to ensure the responsible and secure use of technology in professional environments.

Innovation and Emerging Technologies: Encourage curiosity and innovation by introducing learners to evolving technologies such as Artificial Intelligence, Cloud Computing, Data Analytics, and the Internet of Things, fostering adaptability and creativity.

Communication and Teamwork: Strengthen communication, collaboration, and interpersonal skills to work effectively in teams and communicate technical ideas clearly to both technical and non-technical audiences.

Professional Ethics and Lifelong Learning: Instill ethical values, responsibility, and a culture of continuous learning to help learners stay current with technological developments and industry standards.

By achieving these objectives, graduates of the BCA programme will be well-prepared for diverse roles such as software developers, web designers, system administrators, database managers, and IT support professionals. They will emerge as capable and responsible computing professionals ready to contribute to the growth of the digital economy and society.

**2. Relevance of the Programme with the Mission and Goals of Assam Don Bosco University**

The Bachelor of Computer Applications (BCA) programme at Assam Don Bosco University (ADBU) is designed in close alignment with the vision, mission, and goals of the University. It embodies ADBU's commitment to providing holistic, value-based, and industry-oriented education that empowers learners to become competent, ethical, and socially responsible professionals in the digital era.

**VISION**

The vision of Don Bosco University is to mould young persons into intellectually competent, morally upright, socially committed, and spiritually inspired citizens who contribute to the service of India and the world through holistic and personalized education.

Guided by this vision and rooted in the Don Bosco educational philosophy, the Online BCA Programme supports and advances this mission in the following ways:

Promoting Access and Inclusion: The programme provides greater access to quality higher education in computer science for learners across geographical and socio-economic boundaries, especially those from the North-Eastern region of India.

Balancing Technical Excellence with Human Values: While fostering technological competence and digital innovation, the BCA programme also integrates ethical, social, and environmental awareness, harmonizing professional skill with human and moral values.

Employment-Oriented Curriculum: The programme offers an industry-aligned curriculum focused on employability and skill development in areas such as programming, networking, cybersecurity, and data management—key domains of the contemporary technology sector.

Encouraging Research and Innovation: Learners are exposed to problem-based learning, mini projects, and applied research that nurture creativity and analytical thinking, contributing to technological advancement with social relevance.

Facilitating Socio-Economic Development: By building digital skills and promoting entrepreneurship, the programme contributes to the socio-economic growth of the North-East region and the broader national context.

Fostering Global Outlook: The BCA curriculum introduces learners to global IT practices and collaborative technologies, preparing them for opportunities in international and cross-cultural work environments.

**Symbolism of the University Emblem and its Relevance to BCA**

The spirit of Assam Don Bosco University is captured in its emblem, whose elements mirror the ideals that the BCA programme seeks to uphold:

The Cross signifies the University's spiritual foundation and commitment to ethical conduct in education and professional life.

The Profile of St. John Bosco represents its distinctive educational philosophy that combines discipline, compassion, and holistic growth.

The Book symbolizes academic excellence and lifelong learning, which are central to computer education and technological innovation.

The Rays of the Rising Sun reflect progress, dynamism, and a forward-looking vision, qualities essential in the ever-evolving field of computer science.

The Motto 'Carpe Diem' (Seize the Day) inspires learners to embrace opportunities, maximize their potential, and strive for excellence in the digital age.

In essence, the BCA Programme at ADBU serves as a bridge between technological proficiency and value-based education, empowering students to become not only skilled IT professionals but also responsible global citizens who embody the Don Bosco spirit of service, innovation, and integrity.

**MISSION**

Built on a rich legacy inherited from its founding visionaries, Assam Don Bosco University (ADBU) is committed to creating an environment that fosters intellectual dialogue, interdisciplinary collaboration, and innovation. Through high-quality teaching, research, and extension activities, the University strives to produce graduates who can provide leadership, vision, and direction to society.

In alignment with this mission, the Online BCA Programme seeks to:

Cultivate a stimulating academic environment that encourages learners to think critically and creatively in solving technological and organizational challenges.

Promote interdisciplinary learning by integrating concepts from management, mathematics, and information science within the broader framework of computer applications.

Develop technologically proficient graduates who can lead, innovate, and contribute effectively to both the IT industry and society.

Foster a culture of research, digital literacy, and innovation, enabling learners to adapt to emerging technologies and evolving workplace demands.

GOAL

The University's goal is to realize its vision by developing innovative programmes in basic and emerging disciplines, keeping pace with global trends and national priorities. Its strategy emphasizes continuous curriculum enhancement, experiential learning, and knowledge sharing.

The BCA Programme contributes directly to this goal by:

Offering an updated, industry-aligned curriculum that reflects advancements in computing, software development, and digital transformation.

Engaging both faculty and learners in an interactive and experiential learning environment through virtual labs, coding projects, simulations, and case-based learning.

Encouraging knowledge-sharing and collaboration through online discussions, workshops, and community-based learning experiences.

Preparing learners to excel globally by nurturing adaptability, innovation, and ethical professionalism in the context of globalization and technological change.

Through this alignment with the University's Mission and Goals**, the** Online BCA Programme embodies ADBU's broader purpose to educate, empower, and inspire students to become responsible, competent, and forward-looking professionals in the ever-evolving digital landscape.

1. **NATURE OF PROSPECTIVE TARGET GROUP OF LEARNERS**

Assam Don Bosco University (ADBU) is dedicated to providing accessible and high-quality education in computer applications, ensuring that no geographical, socio-economic, or personal barriers hinder a learner's academic or professional aspirations. Guided by its philosophy of "Education Beyond Barriers," the Bachelor of Computer Applications (BCA) programme is designed to equip learners with foundational computing skills, problem-solving abilities, and industry-relevant knowledge to succeed in the rapidly advancing digital world.

The Online BCA Programme integrates key domains such as programming, web development, database management, networking, cybersecurity, and emerging technologies, providing learners with both theoretical understanding and practical competence essential for professional growth.

The **ADBU BCA Programme** is ideally suited for the following target groups:

1. **School Graduates and Young Aspirants** who have completed their higher secondary (10+2) education and wish to build a strong academic and professional foundation in computer science, programming, and information technology.
2. **Women Learners** who aspire to pursue careers in technology, software development, web design, or IT administration, and seek flexible learning opportunities that support their academic and professional goals.
3. **Working Individuals and Early-Career Professionals** who aim to upskill, transition into the IT sector, or strengthen their technical expertise while continuing their current employment.
4. **Entrepreneurs and Self-Employed Individuals** who wish to enhance their understanding of software tools, database systems, and digital technologies to support and expand their businesses.
5. **Learners from Rural, Remote, or Underprivileged Backgrounds** who have limited access to conventional higher education institutions but seek a recognized qualification in computer applications through an affordable and flexible online mode.
6. **Technology Enthusiasts and Career Switchers** who wish to develop a systematic understanding of computing and gain employable skills for entry-level roles in the IT and digital service industries.

The Online BCA Programme at ADBU caters to this wide range of learners through a flexible, inclusive, and industry-oriented curriculum. It empowers students with the technical competence, digital literacy, and professional ethics required to thrive in the ever-evolving technological landscape and to contribute meaningfully to society and the global IT community.

**4. Appropriateness of Programme to be Conducted in Online Learning Mode to Acquire Specific Skills and Competence**

The Bachelor of Computer Applications (BCA) programme at Assam Don Bosco University (ADBU) has been thoughtfully designed to help learners acquire both theoretical knowledge and practical skills in computing through the Online Learning (OL) mode. The programme emphasizes learner autonomy, flexibility, and engagement, ensuring that students actively participate in their academic journey while gaining industry-relevant competencies.

Unlike conventional classroom-based education, the Online Learning system at ADBU is learner-centric, allowing students to study at their own pace while interacting with digital resources, faculty, and peers through the University's Learning Management System (LMS). The instructional approach adheres strictly to the UGC Online Learning Regulations, 2020, ensuring academic quality, accessibility, and professional relevance.

ADBU adopts a multimedia-based instructional methodology, combining self-learning materials, video lectures, coding demonstrations, online assignments, and discussion forums to make learning interactive and application-driven.

**Self-Learning Materials (SLMs):**

The BCA programme provides well-structured digital study materials designed in a self-instructional format, addressing both conceptual clarity and practical application. The curriculum aligns with the recommendations of the Madhava Menon Committee Report (2011) and is regularly updated to reflect changes in the IT industry, software tools, and emerging technologies.

The Self-Learning Materials (SLMs) of the BCA programme possess the following key features:

1. Self-Explanatory and Self-Contained:
   The study materials are designed to help learners understand and apply computing concepts independently, covering core areas such as programming, web development, and data management without requiring constant instructor guidance.
2. Self-Directed:
   The SLMs provide a clear structure and learning flow, including step-by-step explanations, guided examples, coding exercises, and interactive content, enabling learners to track their progress and deepen their understanding of technical topics.
3. Self-Motivating:
   Recognizing the need to sustain learner interest in an online environment, the materials integrate real-world examples, problem-based learning, mini-projects, and coding practice exercises to keep learners engaged and motivated throughout the course.
4. Interactive and Evaluative:
   The SLMs include elements such as "Try It Yourself" coding activities, "Check Your Progress" sections, and model assignments that promote active learning, self-assessment, and reinforcement of key concepts.

**Outcome of the Online Learning Approach:**

1. Through this structured, technology-enabled, and learner-driven methodology, the Online BCA Programme at ADBU ensures that learners:
2. Acquire essential technical and programming skills applicable in real-world computing environments.
3. Develop problem-solving and analytical thinking abilities through guided coding and project-based exercises.
4. Gain exposure to emerging technologies such as data analytics, cloud computing, and cybersecurity through digital simulations and multimedia content.
5. Build confidence in independent and collaborative online learning, preparing them for both professional careers and lifelong digital education.

By integrating interactive multimedia content, self-instructional materials, and flexible learning opportunities, the ADBU BCA Programme effectively equips students with the technical skills, digital fluency, and professional competence required to excel in the dynamic and evolving field of computer applications.

**5. INSTRUCTIONAL DESIGN**

The curriculum of the Bachelor of Computer Applications (BCA) programme at Assam Don Bosco University (ADBU) has been carefully designed with expert inputs from academicians, researchers, and industry professionals from reputed institutions such as Gauhati University, Assam University, and other leading universities. Their contributions have ensured that the programme remains academically robust, practically relevant, and aligned with current technological trends.

While formulating the curriculum, UGC Model Syllabi, the syllabi of other renowned universities, and the recommendations of the Madhava Menon Committee have been thoroughly considered to maintain both academic quality and industry

relevance.
(The detail Syllabus of the BCA Programme is placed in *Annexure-I* )

**5.1 Curriculum Design**

To facilitate effective and engaging online learning for **BCA learners**, the following instructional instruments and learner support mechanisms are provided:

**a) Self-Learning Materials (SLM):**

The BCA programme offers well-structured Self-Learning Materials (SLMs) developed by experts in computer science, information systems, and related fields. These SLMs are tailored specifically for the Online Learning environment and address the needs of diverse learners. They are supplemented by e-learning resources accessible through the University's Learning Management System (LMS). Learners can also access e-SLMs, past question papers, and academic guidelines via the LMS and the official university website.

**b) Online Counselling by University Faculty:**

The **School of Computer Science and Applications** at ADBU organizes **online counselling sessions** throughout the semester. These sessions enable learners to:

- Interact directly with faculty members.
- Seek academic guidance and feedback.
- Clarify conceptual doubts in real time.
- Participate in discussions related to assignments, coding exercises, and project work.

These virtual interactions ensure that learners remain academically connected and supported throughout their course of study.

**c) Multimedia Study Materials:**

In addition to e-text content, ADBU has developed high-quality audio-visual lectures and tutorials for all BCA courses. These multimedia resources simplify complex programming and computing concepts, making them more accessible and engaging. The Electronic Multimedia Production Centre of ADBU plays a key role in creating these instructional videos, which are available on the university's LMS.

**d) Learner Support Services:**

ADBU provides a comprehensive range of ICT-enabled student support services to ensure a seamless academic experience:
i. Access to E-Library Services: Learners have full access to ADBU's extensive digital library, which includes e-books, journals, and research databases.
ii. Dedicated Feedback and Query Support: Students can raise academic or technical queries through the LMS using general or faculty-specific channels. Prompt responses are provided by faculty members, university officials, and the help desk team.
iii. Structured Grievance Redressal System: A dedicated Grievance Redressal Cell addresses student concerns through an online grievance portal [Hyperlink of the Grievance Portal].
iv. Mobile Learning Support: ADBU's official Android/iOS mobile application, available on the Google Play Store and iOS App Store, provides instant access to academic notifications, contact details, learning materials, and other essential information.

**5.2 Duration of the Programme:**

The BCA programme comprises six semesters with a minimum duration of 3 years. It includes a balanced combination of core courses, electives, and practical components, along with a mandatory project/internship in the final semester. Each course carries 100 marks—with 70 marks for summative assessment (end-semester examination) and 30 marks for formative assessment (continuous internal evaluation, assignments, and quizzes).

**5.3 Credit Distribution:**

In accordance with the UGC ODL/OL Regulations, 2020, the University follows the credit system wherein 1 credit equals 30 hours of learner engagement (including study, assignments, and assessments). The total credit load for the BCA programme is structured to ensure a balance between theoretical knowledge, practical exposure, and skill development. (Detailed credit distribution is provided in *Annexure-I*.)

**5.4 Faculty and Support Staff Requirement:**

The University has a **dedicated team of qualified faculty members, course coordinators, and mentors** in the discipline of Computer Applications. Currently, there are:

- **6 full-time Course Coordinators**, responsible for academic delivery and coordination.
- **5 full-time Course Mentors**, providing academic counselling and student support for various courses under the BCA programme.

A detailed list of faculty members, coordinators, and mentors associated with each course is uploaded in the UGC DEB online application form.

Through this comprehensive instructional design, Assam Don Bosco University ensures that the Online BCA Programme provides an engaging, flexible, and high-quality learning experience. It combines the strengths of technology-enhanced learning, expert mentorship, and continuous support, enabling learners to achieve both academic excellence and industry-readiness in the field of computer applications.

## 6. PROCEDURES FOR ADMISSIONS, CURRICULUM TRANSACTION AND EVALUATION FOR BCA PROGRAMME

### 6.1 Admission Procedure:

For admission into the BCA programme for the 2025–26 session, candidates must have successfully completed their Higher Secondary (10+2) or equivalent examination in any discipline from a recognized board. There will be no entrance test for admission.

Admission announcements will be made through the University website, newspapers, social media platforms, and other official communication channels. Applicants are required to submit their applications online along with relevant supporting documents, including educational certificates, mark sheets, government-issued identification, and a recent passport-size photograph.

Upon enrollment, learners will receive:

- Digital Self-Learning Materials (SLMs) for their first semester,
- A unique registration number,
- Programme guidelines and academic calendar, and
- A student identity card, enabling access to university services and the Learning Management System (LMS).

This systematic and transparent admission process ensures accessibility and equal opportunity for all learners seeking quality higher education in computer applications through the online mode.

### 6.2 Continuous Admission:

a) After completing a semester, learners must secure admission into the next semester within one month of the last examination of the previous semester. Admission is mandatory, irrespective of whether the learner has appeared in the examination or received results. Learners must maintain uninterrupted enrollment in the BCA programme. They will be allowed to appear in all examinations, including backlogs, within the stipulated duration of the programme.

b) Learners who fail to enroll within the initial one-month period may still gain admission within two months from the last examination date of the previous semester by paying a prescribed late fine.

c) In exceptional cases, and under special consideration, learners may be granted admission beyond the two-month period, provided this occurs before the official notification for examination form submission for that semester. Such cases must be supported by a written application stating valid reasons and will be subject to an additional fine as determined by the University.

By ensuring a structured yet flexible re-admission policy, Assam Don Bosco University aims to provide a smooth and uninterrupted learning experience for all BCA learners, accommodating diverse personal, professional, and geographical constraints while maintaining academic continuity and discipline.

**6.3 Fee Structure:**

The following is the fee structure of the BCA Programme:

| Semester | Fee |
|---|---|
| 1st Semester | **INR 25,000/-** (includes course and examination fee**)** |
| 2nd Semester | **INR 25,000/-** (includes course and examination fee**)** |
| 3rd Semester | **INR 25,000/-** (includes course and examination fee**)** |
| 4th Semester | **INR 25,000/-** (includes course and project fee**)** |
| 3rd Semester | **INR 25,000/-** (includes course and examination fee**)** |
| 4th Semester | **INR 25,000/-** (includes course and examination fee**)** |

**6.4 Curriculum Transaction and Activity Planner:**

An Academic Calendar, outlining the overall schedule of academic activities for the BCA programme, will be published prior to the commencement of admissions each session. The Centre for Internal Quality Assurance (CIQA), established in accordance with UGC guidelines, in collaboration with the Office of the Academic Registrar, will prepare and upload the Academic Plan and a month-wise Academic Calendar on the University's official website and Learning Management System (LMS).

This planner will include details on assignment deadlines, counselling sessions, project timelines, internal assessments, and examination schedules, enabling learners to plan their academic activities in advance and manage their studies effectively throughout the semester.

**6.5 Evaluation System of the Programme:**

The evaluation system of the BCA programme at Assam Don Bosco University (ADBU) is designed to ensure comprehensive, transparent, and outcome-based assessment of learner performance. The system integrates both continuous and summative evaluation components, assessing conceptual understanding, analytical skills, and practical application.

a) Continuous Evaluation:

ADBU follows a robust continuous assessment system comprising internal and external evaluation mechanisms. Internal evaluation includes self-assessment exercises, assignments, coding tasks, and project activities that allow learners to monitor their progress. External evaluation involves faculty-reviewed assignments and project reports to ensure objective assessment.

b) Self-Assessment Tools:

Each unit within the Self-Learning Materials (SLMs) includes "Check Your Progress" sections and practice questions, allowing learners to evaluate their understanding of key programming and theoretical concepts independently.

c) Assignments:

Continuous evaluation is largely based on tutor-marked assignments, which carry a weightage of 30%. These assignments are designed to strengthen conceptual clarity, analytical reasoning, and practical problem-solving skills. Learners are required to submit assignments within the stipulated time frame via the designated online submission portal.

Faculty members assess these assignments and provide constructive feedback to help learners improve their academic performance.

d) Summative Assessment:

The overall course evaluation in each semester includes:

- Formative Assessment (Assignments): 30% weightage
- Summative Assessment (Semester-End Examinations): 70% weightage

This two-tiered system ensures a balance between continuous learning and comprehensive end-term evaluation.

e) Semester-End Examinations:

The semester-end examinations are conducted at designated examination centres in compliance with UGC-DEB regulations. These examinations evaluate both theoretical knowledge and practical skills, based on the prescribed learning outcomes.

The evaluation process involves expert examiners, moderation, and scrutiny to ensure accuracy and fairness. Results are declared in accordance with the Academic and Examination Calendar.

f) Re-Evaluation:

Learners who are not satisfied with their evaluation results may apply for re-evaluation of answer scripts within the specified timeframe as per university regulations.

g) Question Paper Standards:

Question papers for semester-end examinations are framed based on Bloom's Taxonomy, ensuring balanced coverage across different levels of learning — remembering, understanding, applying, analyzing, evaluating, and creating. This ensures alignment with the course learning outcomes and programme objectives.

h) Secure Certification:

ADBU ensures authenticity and durability in academic documentation by using high-security, eco-friendly synthetic paper for mark sheets and degree certificates, maintaining transparency and credibility in certification.

i) Plagiarism Checks:

To uphold academic integrity, all assignments, projects, and reports submitted by learners undergo plagiarism detection using advanced tools. Any violation of ethical or institutional standards is dealt with as per University policy.

Through this structured and learner-centric evaluation system, the Online BCA Programme at ADBU ensures fair, credible, and comprehensive assessment, equipping learners with the technical expertise, analytical capability, and ethical understanding necessary to succeed in the field of computer applications and the broader digital ecosystem.

## 7. REQUIREMENT OF THE LABORATORY SUPPORT AND LIBRARY RESOURCES

Practical Subjects in this subject can mostly be covered with access to a computer, internet and software tools (available under FOSS/Open Source). Students may be asked to make arrangements for the same at their own cost. As per the syllabus/curriculum, should there be need for special equipment/laboratory access (other than the above-mentioned regular computer lab or internet connectivity), the same shall be arranged by student on their own which shall be notified by prior intimation. Provisions also shall be made for access to virtual lab's and simulators via the students online study portal.

Through these comprehensive instructional tools and learner support services, ADBU aims to provide a holistic and enriching academic experience for BCA students, ensuring they are well-equipped for their professional journeys.

## 8. COST ESTIMATE OF THE PROGRAMME AND THE PROVISIONS:

The Office of the Finance Officer at Assam Don Bosco University (ADBU) maintains detailed financial records related to the development, delivery, and maintenance of the BCA programme. This includes expenses associated with the preparation and publishing of Self-Learning Materials (SLMs), honorariums for external subject matter experts, content writers, editors, and proofreaders, as well as costs incurred in organizing faculty development workshops and other related seminars.

Additionally, the finance office keeps track of expenditures for infrastructure enhancements such as the procurement of computers, expansion of digital learning platforms, subscriptions to academic databases, and the purchase of books and journals. The financial accounts are maintained in compliance with established government guidelines and university policies.

**8. 1 Programme Development Cost:**

The approximate findings are presented below in respect of the BCA programme.

| **Programme Development Cost** | **Cost** |
|---|---|
| SLM Development Cost for Master Degree Programme: | |
| a) E- Text Preparation | INR 5,00,000/- |
| b) E- Text Content Editing | INR 2,00,000/- |
| c) Language Editing | INR 1,00,000/- |
| d) Studio Setup | INR 45,00,000/- |
| e) Video recording and editing | INR 3,00,000/- |
| Infrastructure development cost | INR 28,00,000/- |

**9. QUALITY ASSURANCE MECHANISM AND EXPECTED PROGRAMME OUTCOMES:**

**a) QUALITY ASSURANCE MECHANISM**

To ensure that the quality of Online Learning (OL) programmes is equivalent to that of conventional programmes, Assam Don Bosco University (ADBU) strictly adheres to the regulatory guidelines set by UGC, AICTE, and NAAC. The BCA programme maintains parity in curriculum design, learning outcomes, assessment methods, and faculty qualifications to ensure uniform academic standards across both delivery modes.

The University employs a robust Learning Management System (LMS) to facilitate interactive and engaging learning. Continuous assessment through formative and summative evaluations, including AI-enabled proctored examinations, ensures fairness and academic integrity. Credit transfer provisions are aligned with the Academic Bank of Credits (ABC) framework to promote flexibility and lifelong learning.

Comprehensive learner support services—such as academic counselling, discussion forums, and online helpdesks—enhance engagement and student satisfaction. Regular quality audits, feedback mechanisms, and third-party reviews are undertaken to uphold excellence in online education.

Faculty for online courses are carefully selected by a dedicated academic committee after a thorough evaluation of their subject expertise, pedagogical competence, and communication skills. This process ensures that only qualified and motivated educators guide learners toward academic and professional success.

The Centre for Distance and Online Education (CDOE), ADBU adopts a proactive approach to enhance the quality of its online programmes by identifying and integrating best practices from leading Higher Education Institutions (HEIs) excelling in online learning. These practices include the use of advanced digital tools, learner-centric pedagogy, and robust support systems, fostering a seamless and enriching learning experience. By aligning with global standards and innovative educational strategies, CDOE continues to strengthen its academic framework, promoting holistic development and lifelong learning.

At **Assam Don Bosco University (ADBU)**, the quality of Online Learning (OL) programmes is meticulously aligned with that of conventional programmes through a structured mechanism:

• **Curriculum Development and Approval:**
The curriculum for OL programmes is designed by a **dedicated syllabus sub-committee**, ensuring parity with corresponding conventional programmes in terms of academic depth, rigor, and learning outcomes. The syllabus is subsequently reviewed and approved by the **Board of Studies (BoS)** of the respective faculty, maintaining uniformity in course structure and evaluation standards.

• **Examination and Evaluation:**
The **Controller of Examinations (CoE)** at ADBU oversees examinations for ODL/OL programmes, following identical standards as those applied to conventional courses. Question paper setting, examination conduct, and evaluation processes strictly adhere to University norms to ensure **uniformity and credibility** in assessments.

• **Attendance and Engagement:**
To ensure consistent participation and accountability, learners are required to maintain a **minimum of 75% attendance** in online counselling sessions or live classes to be eligible for end-semester examinations. This promotes active engagement and continuous learning.

• **Technology-Enhanced Learning:**
Interactive learning is strengthened through **Personal Contact Programmes (PCPs)**, live sessions, and digital engagement tools such as the **Learning Management System (LMS)**, **multimedia resources**, and **virtual labs**. These tools replicate the effectiveness of classroom interaction and ensure comprehensive learner involvement.

Through these measures, ADBU ensures that the quality of its **Online Learning (OL)** programmes, including the **BCA programme**, is on par with conventional offerings, upholding the University's commitment to **academic excellence, innovation, and equitable access**.

The **Centre for Internal Quality Assurance (CIQA)** of ADBU is responsible for maintaining and enhancing the quality of all academic and administrative processes under the online mode. It undertakes the following activities:

- **SLM Quality Workshops/FDPs** to ensure the development of high-standard learning materials.
- **Stakeholders' Meetings** to incorporate suggestions from faculty, learners, and industry representatives.
- **Feedback Collection and Analysis** from BCA learners to identify areas of improvement.
- **SLM Audits** to verify the quality, accuracy, and consistency of instructional content.
- **Monitoring of the Overall Functioning of ADBU-CDOE** to ensure compliance with regulatory norms and academic standards.

In order to keep the programme up to date, periodic **curriculum revisions and improvements** are implemented based on inputs received from **learners, faculty, CIQA reviews, and industry experts**. These continuous feedback loops ensure that the **BCA programme** remains current, relevant, and aligned with both academic expectations and industry requirements.

Through this well-defined **Quality Assurance Mechanism**, **Assam Don Bosco University** ensures that its **Online BCA Programme** delivers a learning experience that is **credible, innovative, and globally benchmarked**, embodying the University's guiding principle of **"Education Beyond Barriers."**

**b) Expected Programme Outcomes (BCA)**

The Bachelor of Computer Applications (BCA) programme at Assam Don Bosco University (ADBU) is designed to equip learners with essential computing knowledge, analytical skills, and professional competencies required to excel in the dynamic field of information technology. The programme aims to develop graduates who are technically proficient, innovative, and ethically responsible professionals capable of contributing meaningfully to the IT industry and society.

The key outcomes of the programme include:

• Developing strong analytical and problem-solving abilities to design, analyze, and implement computing solutions for real-world challenges across diverse domains.

• Enhancing career opportunities for learners across software development firms, IT services, startups, and public and private sector organizations, enabling them to contribute effectively as skilled professionals.

• Building a foundation for entrepreneurship by empowering learners to establish startups and self-employment ventures in areas such as web development, mobile application design, and IT consulting.

• Producing competent IT professionals with sound knowledge of programming languages, database systems, networking, software engineering, and cybersecurity fundamentals.

• Encouraging higher education and research pursuits by preparing learners for postgraduate studies such as MCA, MBA (IT), and specialized certifications in emerging technologies.

• Cultivating teamwork, leadership, and project management skills essential for coordinating technical projects, collaborating in teams, and contributing to organizational growth.

• Preparing learners for competitive and professional certification examinations such as NIELIT, AWS, Google Cloud, CCNA, and other industry-recognized credentials.

• Developing socially responsible and ethical computing professionals who can apply technology for inclusive growth, social innovation, and sustainable development.

• Promoting lifelong learning and adaptability by instilling the habit of continuous skill enhancement to stay updated with emerging tools, technologies, and industry practices.

Through these structured outcomes, the BCA programme at Assam Don Bosco University aims to produce a technically skilled, innovative, and responsible workforce that contributes effectively to the advancement of the IT sector and the development of society in the digital age.

Annexure I

# ASSAM DON BOSCO UNIVERSITY
# DETAIL SYLLABUS
## PROGRAMME: BACHELOR OF COMPUTER APPLICATIONS (BCA)

| Semester | SL No | Course Code | Course Name | Credit |
|---|---|---|---|---|
| **FIRST SEMESTER** | 1 | CACL100T | Computer Programming in C Language (Theory) | 2 |
| | | CACL101L | Computer Programming in C Language (Lab) | 2 |
| | 2 | CALE104T | Cyber Law and Ethics | 4 |
| | 3 | CACF106L | Computer Fundamentals | 3 |
| | 4 | MTFB107T | Fundamentals of Business, Management & Economics | 3 |
| | 5 | CBES101T | Environmental Studies | 2 |
| | 6 | CACE109T | Service Learning Project | 2 |
| | 7 | AECH100T | Business Communication | 2 |
| | **TOTAL CREDIT** | | | **20** |
| **SECOND SEMESTER** | 1 | CADS102T | Data Structures Using C (Theory) | 3 |
| | | CADS103L | Data Structures Using C (Lab) | 1 |
| | 2 | CAET105T | E-commerce Technologies | 4 |
| | 3 | CAHS107L | Hardware and Server Maintenance | 3 |
| | 4 | AECE100T | Communicative English | 2 |
| | 5 | MTIE108T | Indian Economy | 3 |
| | 6 | CBDT103T | Digital and Technological Solutions | 1 |
| | 7 | CBUI104T | Understanding India | 1 |
| | 8 | CESL102P | Service-Learning Practice | 2 |
| | **TOTAL CREDIT** | | | **20** |
| **Semester** | **Category** | **Course Code** | **Course Name** | **Credit** |
| **THIRD SEMESTER** | 1 | CAIJT200T | Introduction to Java Programming (Theory) | 3 |

| | | | | |
|---|---|---|---|---|
| | | CAIJ201L | Introduction to Java Programming (Lab) | 1 |
| | **2** | CALD202T | Digital Logic Design (Theory) | 3 |
| | | CALD203L | Digital Logic Design (Lab) | 1 |
| | 3 | CAER210T | Enterprise Resource Planning | 4 |
| | 4 | CAMG214L | Multimedia and Graphics | 3 |
| | 5 | CESL103P | Service-Learning Practice | 2 |
| | 6 | MTEI109T | Emotional Intelligence | 3 |
| | | | | **20** |
| **FOURTH SEMESTER** | 1 | CAOS204T | Operating System (Theory) | 3 |
| | | CAOS205L | Operating System (Lab) | 2 |
| | 2 | CACA206T | Computer Organization and Architecture (Theory) | 3 |
| | | CACA207L | Computer Organization and Architecture (Lab) | 2 |
| | 3 | CARD208T | Relational Database Management Systems (Theory) | 3 |
| | | CARD209L | Relational Database Management Systems (Lab) | 1 |
| | 4 | CAWD211T | Basics of Web Designing (Theory) | 3 |
| | | CAWR212L | Basics of Web Designing (Lab) | 1 |
| | 5 | AECE201T | Communicative English II | 2 |
| | **TOTAL CREDIT** | | | **20** |
| **Semester** | **Category** | **Course Code** | **Course Name** | **Credit** |
| **FIFTH SEMESTER** | 1 | CACN300T | Computer Network Fundamentals (Theory) | 3 |
| | | CACN301L | Computer Network Fundamentals (Lab) | 2 |
| | **2** | CAWT302T | Web Technologies (Theory) | 3 |
| | | CAWT303L | Web Technologies (Lab) | 2 |

| | | | | |
|---|---|---|---|---|
| | 3 | CASE304T | Software Engineering (Theory) | 3 |
| | | CASE305L | Software Engineering (Lab) | 1 |
| | 4 | CAPT310T | Basics of Python (Theory) | 2 |
| | | CAPT311L | Basics of Python (Lab) | 2 |
| | 5 | CAIN314I | Internship | 2 |
| | **TOTAL CREDIT** | | | **20** |
| **SIXTH SEMESTER** | 1 | CACC306T | Cloud Computing | 4 |
| | 2 | CAAD307T | Android Application Development Fundamentals | 4 |
| | 3 | CANS308T | Network Security | 4 |
| | 4 | CAPW309P | Minor Project | 4 |
| | 5 | CABS312T | Business Statistics | 4 |
| | **TOTAL CREDIT** | | | **20** |
| | **Grand Total Credit** | | | **120** |

# DEPARTMENT OF COMPUTER APPLICATIONS
## PROGRAMME: BACHELOR OF COMPUTER APPLICATIONS (BCA)

**VISION**

Impart 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 careers and higher studies by providing conducive teaching, learning, and research environment.
- To produce skilled individuals and entrepreneurs in emerging areas of technologies through academia-industry collaboration.
- To instill in individuals a sense of commitment to work for the betterment of society using technology.

**PROGRAM OUTCOMES - 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-centered 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 of socio-technological changes

**PO 8: Innovation and Entrepreneurship:** Identify a timely opportunity and use innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

**PROGRAM SPECIFIC OUTCOMES – BCA**

**PSO 1: Knowledge of Computing Systems:** An ability to understand the principles and workings 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 languages and open-source platforms.

**PSO 4: Research Skills**: Ability to enhance research skills by utilizing standard research-based tools for analysis, design, and implementation of techniques for resolving real-life and/or social problems.

**POs and PSOs mapping**

| | PO1 | PO2 | PO3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | H | | | | | | | L | | M | H | M |
| 1.2 | H | | | | | | | L | | M | H | M |
| 1.3 | M | | | | | | | M | H | M | H | H |
| 1.4 | | H | | | | | L | | H | | | |
| 2.1 | H | | | | | | | L | | M | M | |
| 2.2 | H | | | | | | | L | | M | M | |
| 2.3 | M | H | | L | | | | M | | | | |
| 2.4 | | | | | | | L | L | | | | |
| 3.1 | H | | | | | | | L | | M | H | M |
| 3.2 | H | | | | | | | L | | M | H | M |
| 3.3 | M | | | | | | | | H | | | |
| 3.4 | M | | | | | | | | H | | | |
| 3.5 | L | M | | | | | | H | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.6 | L | M | | | | | H | M | M | H | L | H |
| 4.1 | L | | | | | | | | H | L | M | |
| 4.2 | L | | | | | | | | H | L | M | |
| 4.3 | L | | | | | | | | H | L | | M |
| 4.4 | L | | | | | | | | H | L | | M |
| 4.5 | L | | | | | | | L | | H | M | |
| 4.6 | L | | | | | | | L | | H | M | |
| 4.7 | | M | | M | | | | H | | M | M | |
| 4.8 | | M | | M | | | | H | | M | M | |
| 5.1 | M | | | | L | L | H | H | H | M | | H |
| 5.2 | | M | L | | M | M | H | H | H | M | M | H |
| 5.3 | | M | | M | | | | H | | M | M | |
| 5.4 | | M | | M | | | | H | | M | M | |
| 5.5 | M | | | | M | H | H | H | H | H | M | M |
| 5.6 | L | | | | M | M | H | H | H | H | M | M |
| 5.7 | M | | | | | | | H | | H | H | M |
| 5.8 | M | | | | | | | H | | H | H | M |
| 5.9 | H | H | | | | | M | H | M | H | H | H |
| 6.1 | M | | | | | | | | H | M | L | |
| 6.2 | M | | | | | | | | H | H | H | |
| 6.3 | H | | | | M | | M | | M | M | M | H |
| 6.4 | H | M | H | M | M | H | H | M | M | H | H | H |
| 6.5 | H | | | | | | | M | M | | L | M |

# DETAILED
# SYLLABUS MAJOR
# COURSES

| Semester | Category | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Major Course 1 | CACL100T | Computer Programming in C Language (Theory) | 2 |
| | | CACL101L | Computer Programming in C Language (Lab) | 2 |
| 2 | Major Course 2 | CADS102T | Data Structures Using C (Theory) | 3 |
| | | CADS103L | Data Structures Using C (Lab) | 1 |
| 3 | Major Course 3 | CAIJT200T | Introduction to Java Programming (Theory) | 3 |
| | | CAIJ201L | Introduction to Java Programming (Lab) | 1 |
| 3 | Major Course 4 | CALD202T | Digital Logic Design (Theory) | 3 |
| | | CALD203L | Digital Logic Design (Lab) | 1 |
| 4 | Major Course 5 | CAOS204T | Operating System (Theory) | 3 |
| | | CAOS205L | Operating System (Lab) | 2 |
| 4 | Major Course 6 | CACA206T | Computer Organization and Architecture (Theory) | 3 |
| | | CACA207L | Computer Organization and Architecture (Lab) | 2 |
| 4 | Major Course 7 | CARD208T | Relational Database Management Systems (Theory) | 3 |
| | | CARD209L | Relational Database Management Systems (Lab) | 1 |
| 5 | Major Course 8 | CACN300T | Computer Network Fundamentals (Theory ) | 3 |
| | | CACN301L | Computer Network Fundamentals (Lab) | 2 |
| 5 | Major Course 9 | CAWT302T | Web Technologies (Theory) | 3 |
| | | CAWT303L | Web Technologies (Lab) | 2 |
| 5 | Major Course 10 | CASE304T | Software Engineering (Theory) | 3 |
| | | CASE305L | Software Engineering (Lab) | 1 |
| 6 | Major Course 11 | CACC306T | Cloud Computing | 4 |
| 6 | Major Course 12 | CAAD307T | Android Application Development Fundamentals | 4 |
| 6 | Major Course 13 | CANS308T | Network Security | 4 |
| 6 | Major Course 14 | CAPW309P | Minor Project | 4 |

**CACL100T: COMPUTER PROGRAMMING IN C LANGUAGE**
(2 credits – 30 hours) (L-T-P: 2-0-0)

**Objective:**
*The objective of the course is to learn the concept of C programming language and to solve the problem statement using the C language.*

**COURSE / LEARNING OUTCOMES**
At the end of this course, students will be able to:
CO 1: Define information based on the understanding of the concepts of C language's syntax, data types, control statements,
functions, pointers, arrays, structures and pointers in C. (Understanding)
CO 2: Solve problems using standard algorithms, translate pseudo-codes into C programs, and implement them. (Applying)
CO 3: Evaluate the data structure, function, data types, and algorithms used for searching, sorting, solving problem instances, etc. in terms of correctness and computation cost. (Evaluating)
CO 4: Combine the various concepts and ideas learned in C to plan, propose, and develop a product. (Creating)

**Module I: Introduction to Algorithms and Programming Languages (8 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 (8 hours)**
Decision Control Statements and Loops: Introduction to Decision Control Statements, Conditional Branching statements, while loop, do-while loop, for loops, 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 (8 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, dynamic memory allocation.

**Module IV: Structures and Unions (6 hours)**
Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types.

**Suggested Readings**

1. Thareja, R., Computer Fundamentals and Programming in C, Oxford University Press, New Delhi.
2. Gottfried, Byron S., Programming with C (Schaum's Outlines Series), Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Kernighan, B.W., and Ritchie, Dennis M., The C Programming Language, Prentice Hall Pvt. Ltd, New Jersey.


**E Resources**
1. NPTEL SWAYAM Course on- Introduction To Programming In C- By Prof. Satyadev Nandakumar, IIT Kanpur
2. NPTEL SWAYAM Course on- Problem-Solving Through Programming In C, By Prof. Anupam Basu, IIT Kharagpur
3. C Programming - Learn Computer Programming With C Language, Udemy

**Mapping of COs to Syllabus:**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | H | H | H | H |
| **CO 2** | L | H | H | M |
| **CO 3** | H | H | M | M |
| **CO 4** | | M | H | H |

## CACL101L: COMPUTER PROGRAMMING IN C LANGUAGE LAB

(2 credits – 30 hours) (L-T-P: 0-0-2)

**Objective**
*The objective of the course is to learn how to solve problems using c programming language.*

**COURSE / LEARNING OUTCOMES**
At the end of the Lab experiments students will be able to:
CO 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)
CO 2: Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
CO 3: Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)

**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
3. If else
4. Switch-case statements
5. Break, continue
6. Loops
7. Single and multidimensional arrays
8. Functions and recursion
9. Pointers, address operator, declaring pointers and operations on pointers

**Suggested Readings**

1. Balagurusamy, E., Computer Fundamentals and C Programming, Tata McGraw Hill Publishing Company Limited, New

Delhi.
2. Kanetkar, Y., Let us C, BPB Publication, New Delhi

**Mapping of COs to Syllabus:**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V | Module VI | Module VII | Module VIII | Module IX |
|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | L | M | L | L | L | H | H | H | H |
| **CO 2** | | | L | L | L | H | M | H | H |
| **CO 3** | L | M | M | M | H | H | H | H | H |

## CADS102T: DATA STRUCTURES USING C

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**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.*

**COURSE / LEARNING OUTCOMES**

At the end of this course, students will be able to:

CO 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, graphs and trees. (Remembering)

CO 2: Define C constructs for explaining and generalizing these data structures and choosing appropriate algorithms for efficient program design using C syntax. (Understanding)

CO 3: Compute and demonstrate these data structures and algorithms in different real world problem domain (Applying) CO 4: Review the choice of data structure and algorithms based on the problem domain. (Evaluating).

**Module I: Arrays and Lists (13 Hours)**

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). 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 (12 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 (10 Hours)**

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), B-tree (construction and traversal of a B-tree of given order) Introducing Graphs; Graph representation: Adjacency matrix, adjacency lists, incidence matrix; Traversal schemes: Depth first search, Breadth first search

**Module IV: Searching and Sorting (10 Hours)**

Linear and binary search, Indexed search; Hashing, Hash Functions (division method, mid square method, folding), Basic Sorting algorithms.

**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.


**E Resources**

1. NPTEL SWAYAM Course on- Data Structure using C Programming, By Dr. Dipti Verma and Mr. Aditya Tiwari, Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

2. Data Structures and Algorithms In C (DSA) by Udemy

**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** | | M | M | H |

## CADS103L: DATA STRUCTURES USING C Lab

(1 Credit – 15 hours) (L-T-P: 0-0-1)

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:

CO 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, graphs and trees. (Remembering)

CO 2: Define C constructs for explaining and generalizing these data structures and choosing appropriate algorithms for efficient program design using C syntax. (Understanding)

CO 3: Compute and demonstrate these data structures and algorithms in different real world problem domain (Applying)

CO 4: Review the choice of data structure and algorithms based on the problem domain. (Evaluating).

**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 Sort.

**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 to Syllabus:**

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

## CAIJ200T: INTRODUCTION TO JAVA PROGRAMMING

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**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).*

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:

CO 1: Recall the knowledge of the structure and model of the Java programming language, (Remembering)

CO 2: Explain the use of Java programming language for various programming technologies (Understanding) CO 3: Develop software in the Java programming language. (Applying)

CO 4: Analyse user requirements for software functionality required to decide whether the Java programming language can meet user requirements. (Analysing)
CO 5: Choose an engineering approach to solving problems, starting from the acquired knowledge of programming and knowledge of operating systems. (Evaluating)
CO 6: Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem (Creating)

**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)**
1. Introduction, Classes, Working with Objects, Packages, Inheritance, Interfaces
2. Data Flow with Java Streams, Input Streams, Output Streams

**Module III: Exception Handling in Java and Java threads (10 hours)**
1. Introduction, Exception Methods, java.lang Exceptions
2. 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.

**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


**E Resources**
1. Coursera course on Introduction to Java
2. Udemy Course on Java Programming for Complete Beginners

**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 |

## CAIJ201L: Introduction to Java Programming Lab
(1 Credit – 15 hours) (L-T-P: 0-0-1)

**COURSE / LEARNING OUTCOMES**
At the end of the Lab experiments students will be able to:
CO 1: Identify classes, objects, members of a class and relationships among them needed for a specific problem.(Remembering/Evaluating)
CO 2: Write Java application programs using OOP principles and proper Program structuring.
(Applying/Understanding) CO 3: Demonstrate the concepts of polymorphism and inheritance .(Applying)
CO 4: Write Java programs to implement error handling techniques using exception handling.(Applying) CO 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**

1. Java, www.spoken-tutorial.org

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V | Module VI | Module VII |
|---|---|---|---|---|---|---|---|
| **CO 1** | H | H | | | | | |
| **CO 2** | M | M | M | M | | | |
| **CO 3** | | | M | | | | |
| **CO 4** | | | | H | | | |
| **CO 5** | | | | | M | M | M |

## CALD202T: DIGITAL LOGIC DESIGN

(3 credits–45 hours) (L-T-P) (2-1-0)

**Objectives**

*This course covers the basic concepts of digital logic. The course includes the fundamental concepts of Boolean algebra and its application for circuit analysis, multilevel gates networks, flip-lops, counters logic devices and synchronous and asynchronous sequential logic and digital integrated circuits.*

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:

CO 1: To solve conversion among different number systems (Applying)

CO 2: Apply the knowledge of Boolean algebra, Karnaugh-map or tabulation method to minimises Boolean expressions. (Applying)

CO 3: Design and analyse a given combinational/ sequential circuit and determine the corresponding truth table/ state table. (Analysing)

**Module I: Number Systems (6 Hours)**

Binary, Octal, & Hexadecimal Number Systems and Their Conversions, Representation of Signed Numbers-Floating Point Number, Binary Arithmetic, Representation-of BCD-ASCII-Excess 3 -Gray Code —Error Detecting and Correcting Codes.

**Module II: Boolean Algebra, Simplification of Boolean Functions (13 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 III: Combinational Logic and Sequential Logic (26 Hours)**

Digital devices: Logic gates, wired-logic, 8 non-degenerate forms of NOR and NAND, multilevel NAND and NOR gats, 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. Difference between Combinational and sequential circuits; Arithmetic circuits: Half-adder, Full-adder, Binary Adder, Binary Parallel Adder, BCD Adder, Binary Adder-Subtractor, Half-subtractor, Binary Incrementer, carry propagation, look ahead carry, carry generator, magnitude comparator; Encoders, Decoders, Multiplexers, Demultiplexers

Flip-flops: Different types of flip-flops, Flip-flop excitation tables, characteristic equations, truth tables, Triggering of Flip-flops. Registers: Registers (Register with Parallel Load), Shift registers

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.

**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

**E Resources**

1. SWAYAM course on Digital System Design By Prof. Neeraj Goel, IIT Ropar
2. SWAYAM Course on Digital Circuits by Prof. Santanu Chattopadhyay, IIT Kharagpur

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III |
|---|---|---|---|
| **CO 1** | H | | |
| **CO 2** | | H | M |
| **CO 3** | | | H |

## CALD203L: DIGITAL LOGIC DESIGN LAB

(1 Credit – 15 hours) (L-T-P: 0-0-1)

**COURSE / LEARNING OUTCOMES**

At the end of the experiments students will be able to:
CO 1: Explain the working of the various logic gates. (Understanding)
CO 2: Experiment with different logic gates to solve any given problem.
(Applying) CO 3: Analyse a given logic circuit and point out errors in it.
(Analysing)
CO 4: Evaluate the output of a logic circuit for given inputs. (Evaluating)

**List of experiments-**

1. *Study of the Truth tables of logic gates*
2. *Realization of half/full adder and half/full adder subtractor*
3. *Verify truth table of multiplexer and demultiplexer*
4. *Verify truth table of one bit and four bit comparators*
5. *Verify truth table of flip-flops*
6. *Simulation with VDHL*
7. *Adders*
8. *Subtractors*
9. *Logic gates*
10. *MUX and DEMUX*

**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

**E Resources**

1. SWAYAM course on Digital Logic and Circuits Simulations by Prof. Awadhesh Kumar, Banaras Hindu University

**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 | M | | |
| **CO 3** | | | M | M | H | H |
| **CO 4** | | | M | M | M | H |

## CAOS204T: OPERATING SYSTEMS

(3 Credits – 45 hours) (L-T-P: 2-1-0)

**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 gives knowledge on existing common operating systems like UNIX, Linux and Windows.*

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:
CO 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)
CO 2: Analyze important algorithms such as Process scheduling and memory management algorithms. (Analysing)
CO 3: Categorize the operating system's resource management techniques, deadlock management techniques, memory management techniques. (Analysing)
CO 4: Discuss and examine the importance of File and I/O system management in operating systems. (Evaluating)

**Module I: Introduction to Operating systems (5 Hours)**

Definition of Operating Systems, Functions of Operating Systems, Types of Operating Systems: Batch, Multiprogram med, 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 (8 Hours)**
File management (Systems, Secondary Storage Structure)-File Concepts, Access methods, Directory Structure, Protection and consistency, Recovery.
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.

**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.


**E Resources**
1. NPTEL SWAYAM Course on- Introduction to Operating Systems, By Prof. Chester Rebeiro, IIT Madras
2. NPTEL SWAYAM Course on- Operating System Fundamentals, By Prof. Santanu Chattopadhyay, IIT Kharagpur
3. Operating System, Udemy

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V |
|---|---|---|---|---|---|
| **CO 1** | H | M | M | M | M |
| **CO 2** | | H | | H | |
| **CO 3** | | | H | H | |
| **CO 4** | | | | | H |

**CAOS205L: OPERATING SYSTEMS LAB**
(2 CREDIT-30 Hours) (L-T-P) (0-0-2)

**COURSE / LEARNING OUTCOMES**
At the end of Introduction to Operating Systems Lab students will be able to:
CO 1: Experiment with *fork()* system call to create a new process.
CO 2: Infer the concepts related to shell programming and their significance.

(Understanding) CO 3: Experiment with various scheduling algorithms (FCFS, SJF and Round Robin). (Applying)
CO 4: Examine the results obtained from page replacement algorithms-(FIFO, LRU), and understand the underlying principles and working of space management concepts. (Analysing)

**List of experiments-**

1. Programs using fork system calls.
2. Shell programming.
3. Programs to simulate process scheduling- FCFS, SJF and Round Robin.
4. Programs to simulate page replacement algorithms-FIFO, LRU.
5. Programs to simulate free space management.

**E-resource for learning:**

Linux-Ubuntu, www.spoken-tutorial.org

**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 |

## CACA206T: COMPUTER ORGANIZATION AND ARCHITECTURE

(3 Credits – 45 hours) (L-T-P: 3-1-0)

**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:
CO 1: Recognize and define the basic components and design of a computer, including CPU, memories, and input/output units. (Remembering)
CO 2: Identify and classify the major components of a CPU and discuss, review the operations intrinsic to it.
(Understanding) CO 3: Discover the parameters of performance improvement and use them in predicting the issues in instruction cycle.
(Applying)
CO 4: Analyse the mapping techniques of different memory units; instruction sets interpret the different performance trade- offs between them. (Analysing)
CO 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: Control Unit (10 Hours)**

a. Major Components of a CPU; General Register Organization; Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation); 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 II: Parallel Processing and Multiprocessors (12 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. Multiprocessors: Tightly Coupled, Loosely Coupled;

**Module III: Memory Organization (10 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 IV: Input-Output Organization (13 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


**E Resources**

1. SWAYAM course on Computer Architecture and Organization by Prof. Indranil Sengupta, Prof. Kamalika Datta, IIT Kharagpur

2. SWAYAM course on Computer Architecture by Prof. Smruti Ranjan Sarangi, IIT Delhi

**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 | H | L | |
| **CO 4** | | | H | L | |
| **CO 5** | | | | | H |
| **CO 6** | | | H | H | L |

## CACA207L: COMPUTER ORGANISATION AND ARCHITECTURE LAB

(2 credits – 30 hours) (L-T-P: 0-0-2)

**Objective**
*This course aims to provide the student with the concepts and basic knowledge necessary to develop the organization and architecture of computing systems.*

**COURSE / LEARNING OUTCOMES**
At the end of the Lab experiments students will be able to:
CO 1: Recall different OPcodes and syntax used in 8086 (Remembering).
CO 2: Illustrate the syntax of 8086 assembly language (Understanding).
CO 3: Choose the appropriate method to Categorize different types of OPcodes and write an 8086 assembly program (Evaluating).

**Module 1**
Dismantling and assembling a PC along with study of connections, ports, chipsets, SMPS etc.

**Module 2**
Assembly language programming using IA32(gcc), Introduction of gcc assembly programming, Verification of Instruction Set, Arithmetic operations

**Module 3**
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.

**Module 4**
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.

**Suggested Readings**


1. V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996
2. William Stallings, Computer Organization and Architecture, Sixth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002


**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | L | H | H | M |
| **CO 2** | M | M | L | L |
| **CO 3** | | H | H | H |

## CARD208T: RELATIONAL DATABASE MANAGEMENT SYSTEMS

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**Objective**

*The objectives of 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 modeling, design, and management for solving real problems.*

**COURSE / LEARNING OUTCOMES:**

At the end of this course, students will be able to:

CO 1: Define the terminologies and features related to database systems and also describe the main functions and benefits of each of the database systems. (Remembering)

CO 2: Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. (Understanding)

CO 3: Master sound design principles for the logical design of databases, including the E-R model, EER model, and schema diagrams. (Evaluating)

CO 4: Transform an information model into a relational database schema and use the various types of query languages to implement and use the schema using a DBMS. (Applying)

CO 5: Analyze the concepts used for transaction processing and also the issues and techniques related to concurrency and recovery management. (Analyzing)

**Module I (10 hours)**

a. Database System – Database, Database System, DBMS, Advantages of using the database system, Functionalities of the database, Data Independence, Data Abstraction
b. Data models - Entity Relationship (ER), Enhanced Entity Relationship (EER), Mapping ER Model to Relational data model, Hierarchical and Network data models, Object Oriented and Object-Relational Data Models

**Module II (15 hours)**

a. SQL Queries - Relation Query Languages, SQL data types, Data Definition Language (DDL) commands, Data Manipulation Language (DML) commands, Data Retrieval commands, Single-row and Group functions, Multi-table querying (Joins and Subqueries)
b. Query Languages - Relational Algebra, Tuple and Domain Relational Calculus, Relational Database Design: Domain and
Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

**Module III (8 hours)**

a. Normalization: Concepts of Normalization and Denormalization, First Normal Form, Second Normal Form, Third Normal Form, Fourth Normal Form, and Fifth Normal Form
b. Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Query Optimization Algorithms

**Module IV (12 hours)**

a. Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers
b. Advanced topics: 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.

**E Resources**

1. SWAYAM Course on Database Management System by Prof. Partha Pratim Das, IIT Kharagpur
2. SWAYAM Course on Database Management Systems by Dr. K. Arul Deepa, Assistant Professor, Dr.K.Arul Deepa & Dr.P.Velvizhy, Asst. Professor Dept. of IST, Anna University, CEG, Chennai, Anna University, Chennai, Anna University

**Mapping of COs to Syllabus:**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | H | H | | |
| **CO 2** | L | M | H | |
| **CO 3** | | M | | H |
| **CO 4** | | | M | H |
| **CO 5** | | | H | M |

## CARD209L: RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB

(1 credit – 15 hours) (L-T-P:0-0-1)

**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.*

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:
CO 1: Infer database language commands to create simple database CO 2: Analyze the database using queries to retrieve records
CO 3: Applying PL/SQL for processing database

**Module I: SQL Queries (10 hours)**

SQL Queries: Data Definition Language (DDL) commands – CREATE, DROP, ALTER and RENAME; Data Manipulation Language (DML) commands – INSERT, UPDATE, and DELETE; Data Retrieval command – SELECT, Single-row Functions – String functions, Numeric Functions, Date-Time Functions, General Functions, Data Type Conversion Functions; Group functions -SUM, AVG, MIN, MAX, COUNT, Multi-table querying (Joins and Subqueries)

**Module II: PL/SQL Programming (5 hours)**

PL/SQL Programming: PL/SQL Block Structure – DECLARE, BEGIN, END, EXCEPTION, SQL Within PL/SQL, Loops and Decision-making statements, Cursor Types – Implicit and Explicit cursors

**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 |
|---|---|---|
| **CO 1** | H | |
| **CO 2** | H | L |
| **CO 3** | | H |

## CACN300T: COMPUTER NETWORK FUNDAMENTALS

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**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:

CO 1: Define the basic concepts of Computer Networks, its goals and network related terminologies. (Remembering)

CO 2: Explain the concepts of Analog and Digital signals, Electromagnetic spectrum and related concepts on various architecture used in computer networks. (Understanding)

CO 3: Experiment with various Networks concepts such as Types of networks, Topologies, Transmission media. (Applying)

CO 4: Comprehend Network Security Devices, Digital Signature and Internet Basics for designing 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, Lineof-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, 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.


**E Resources**

1. Udemy Course on Computer Network Fundamentals
2. Coursera course on Networking Fundamentals

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III |
|---|---|---|---|
| **CO 1** | L | M | M |
| **CO 2** | | M | M |
| **CO 3** | L | L | L |
| **CO 4** | H | | H |

## CACN301L: COMPUTER NETWORK FUNDAMENTALS LAB

(2 credits – 30 hours) (L-T-P: 0-0-2)

**COURSE / LEARNING OUTCOMES**

At the end of this course, students will be able to:

CO 1: Implement various commands and evaluate the significance of socket programming used in networking. (Understanding)

CO 2: Make client-server communication with optimum algorithm and topology. (Creating)

CO 3: Make a distinctive comparison of various routing algorithms to select the optimum network path for data

transfer.(Analysing)

**List of Experiments**

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

**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 | L | L | M | M | L |
| **CO 2** | L | H | M | M | H | M | L |
| **CO 3** | | | M | M | | | H |

## CAWT302T: WEB TECHNOLOGIES

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**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.*

**COURSE / LEARNING OUTCOMES**

On successful completion of the course students will be able to:
CO 1:Recall the various Internet related terminologies and examine the history and growth of Internet.
(Remembering) CO 2:Identify and differentiate the various services provided by the internet. (Understanding)
CO 3:Experiment with various mark-up languages and style sheets to design a static website.
(Applying) CO 4:Experiment with various scripting languages to design a dynamic website.
(Applying)
CO 5:Develop and create a website using standard tools and technologies. (Creating)

**Module I: Basic Internet-related Terms and Static Web Development (13 Hours)**

Basics of Internet – History of Internet and WWW, W3C Recommendations, Internet Connectivity (Dial-up, Leased Line, DSL, WiFi, and VSAT); Requirements for Internet Connectivity; Search Engines, Various Internet Services; Web Portal; Different types of browsers (IE, Firefox, Chrome); URLs, Domain names
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 and XML (12 Hours)**

Cascading Style Sheets: Types of Style Sheets-Inline, Embedded, and External; CSS Background properties, text and font properties, Use of CSS for positioning elements, Background, and Text flow, CSS Box Model, CSS Borders and Outlines, Style class and Pseudo-class
XML: Introduction to XML; Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Parser; Document Object Model; Extensible Stylesheet Language (XSL)

**Module III: Website Design Considerations and JavaScript (12 Hours)**

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)
DHTML: Introduction to DHTML and JavaScript, Data types, operators, variables, input and output statements, Built-in functions, Arrays, If statement, Switch statement, Looping statements, JavaScript Form Validation, Events in JavaScript.

**Module IV: Web Servers and PHP (8 Hours)**

1. 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

2. 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.


**E Resources**

1. Spoken Tutorial on HTML by Praveen S, IIT Bombay
2. Spoken Tutorial on CSS by Neha Solanki, IIT Bombay
3. Spoken Tutorial on JavaScript by Jayesh K Ramalingaiah
4. Spoken Tutorial on PHP by Kavita Kharad

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | H | | | L |
| **CO 2** | H | | | |
| **CO 3** | H | H | | |
| **CO 4** | | | H | H |
| **CO 5** | | L | L | H |

## CAWT303L: WEB TECHNOLOGIES LAB

(2 CREDIT - 30 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.*

**COURSE/LEARNING OUTCOMES**

At the end of the experiments, students will be able to

CO 1: Experiment with various mark-up languages and style sheets to design a static web site (Applying) CO 2: Develop and create a dynamic website using scripting languages. (Creating)

CO 3: Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)

**Module I: Static Web Designing (10 Hours)**

Web Designing: Creating static websites involving various XHTML elements Cascading Style Sheets: Designing web pages that use CSS for standard formatting

**Module II: Dynamic Web Designing (5 Hours)**

JavaScript: Designing websites that use JavaScript for creating interactive web pages

PHP: Designing websites that use PHP as server-side scripting language to connect and access the web server

**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 to Syllabus:**

| Course Outcomes | Module I | Module II |
|---|---|---|
| **CO 1** | H | |
| **CO 2** | | H |
| **CO 3** | H | H |

**CASE304T: SOFTWARE ENGINEERING**

(3 Credits – 45 hours) (L-T-P: 3-0-0)

**Objective**

*To provide the ability to 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:
CO 1: Relate and examine the life cycle models of software. (Remembering)
CO 2: Interpret and differentiate various software life cycle models(Understanding)
CO 3: Experiment with different software architectures and identify the best feasible one (Applying)
CO 4: Analyse and design the software requirement specification and formulate an effort estimation plan (Analysing) CO 5: Develop and create various design diagrams and find solutions to problems. (Creating)

**Module I (15 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, The feasibility study, Software Requirement Analysis and Specifications, work breakdown structure (WBS), Problem Analysis, Creating software requirement specification document (SRS).

**Module II (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, The relationship between design and implementation, Coding the procedural design, Good coding style and review of correctness and readability.

**Module III (15 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.

**E Resources**

4. Udemy course on Complete Software Engineering Course : Build Better Software
5. NPTEL course on Software Engineering By Prof. Rajib Mall, IIT Kharagpur

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III |
|---|---|---|---|
| **CO 1** | H | M | L |
| **CO 2** | | H | L |
| **CO 3** | H | M | L |
| **CO 4** | | H | H |
| **CO 5** | | | H |

**CASE305L: SOFTWARE ENGINEERING LAB**

(1 Credit – 15 hours) (L-T-P: 0-0-1)

**COURSE / LEARNING OUTCOMES**

At the end of the Lab experiments students will be able to:
CO 1: Implement the software engineering process to develop any software project and formulate an effort estimation plan. (Understanding)
CO 2: Apply software design patterns. (Applying)
CO 3: Maintain the software project by using maintenance plan. (Creating)

**Module I (5 Hours)**
Identifying the requirements from problem
statements. Estimation of project metrics. Modelling
Data Flow Diagrams

**Module II (3 Hours)**
Development of User stories.
Identifying domain classes from the problem statements

**Module III (7 Hours)**
Modeling UML use case diagram & capturing use
case scenarios Class diagram, Activity diagram etc.
Designing test suite and testing.

**Suggested Readings**
1. Lab using IBM RSA tools
2. Virtual lab Weblink: http://vlabs.iitkgp.ernet.in/se/

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III |
|---|---|---|---|
| **CO 1** | H | L | H |
| **CO 2** | L | H | H |
| **CO 3** | H | L | H |

**CACC306T: CLOUD COMPUTING**
(4 credits-60Hours) (L-T-P: 4-0-0)

**Objective**
*This course is designed to enable students*
- *To get acquaint 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**
On successful completion of the course students will be able to:
CO 1: Recall and identify the various cloud service models. (Remembering)
CO 2: Understand the basic concepts of Big Data and interpret using Hadoop.
(Understanding). CO 3: Identify and relate security issues with respect to cloud
environment. (Applying)
CO 4: Analyse the Quality of Service rendered by various cloud service providers. (Analysis)

**Module I: Introduction and Cloud Service Models (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 on amazon web service as VPC.

**Module II: Cloud data handling (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: Security Issues (15 Hours)**
Putting security on the spot with questions: Understanding Security Risks, Reducing Cloud Security Breaches,

Vulnerability assessment tools, Cloud computing security architecture, Architectural considerations, general issues, Trusted cloud computing, Cloud computing security challenges, Virtualization security management, VM Security recommendations, Secure execution environments and communications in cloud.

**Module IV: Quality of Service (QoS) in Cloud (12 Hours)**
Issues in cloud computing, implementing real-time application over cloud platform, Issues in Inter cloud environments, Dependability, Dita migration, streaming in cloud, Quality of Service (QoS) monitoring in cloud computing environment, taking virtualization into cloud, develop an application on cloud platform and deploy.

**Suggested Readings:**


1. John W. Rittinghouse , *"Cloud Computing: Implementation, Management, and Security"*, CRC Press
2. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, *"Cloud Computing for Dummies"*,Wiley India Edition
3. Gautam Shroff, *"Enterprise Cloud Computing"*, Cambridge
4. Ronald Krutz and Russell Dean Vines, *"Cloud Security"*, Wiley-India
5. Jeffrey Dean, Sanjay Ghemawat, *"MapReduce: Simplified Data Processing on Large Clusters"*, OSDI'04: Sixth Symposium on
   Operating System Design and Implementation,San Francisco, CA, December, 2004.
6. Tim Malhar, S.Kumaraswammy, S.Latif,*"Cloud Security & Privacy"*,SPD,O'REILLY
7. Antohy T Velte, et.al,*"Cloud Computing : A Practical Approach"*, McGraw Hill,


**E Resources**

1. http://aws.amazon.com/
2. SWAYAM course on Cloud computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur

**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 | L |
| **CO 4** | | | M | H |

## CAAD307T: ANDROID APPLICATION DEVELOPMENT FUNDAMENTALS

(4 credits-60Hours) (L-T-P: 4-0-0)

**Objective**

*This course is designed to enable students to get a complete understanding of the development of android applications. On completion of this course, students will be able to design, develop, debug and deploy various real-time applications.*

**COURSE / LEARNING OUTCOMES**

CO 1: Interpret the android architecture and configure the development environment
(Understanding) CO 2: Design and build user defined app with different types of menus and
views (Applying)
CO 3: Make use of AsyncTask for accomplishing different background task (Applying)
CO 4: Create SQlite database and use views to interact with the database and publishing of application.(Creating)

**Module I: Get started (10 Hours)**
Get started: Build your first app, Introduction to Android, Create Your First Android App, Layouts, Views and Resources, Text and Scrolling Views. Activities: Understanding Activities and Intents, the Activity Lifecycle and Managing State, Activities and Implicit Intents. Testing, debugging, and using support libraries: The Android Studio Debugger, Testing your App, The Android Support Library

**Module II: User experience (13 Hours)**
User interaction: User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience: Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts Testing your UI: Testing the User Interface

**Module III: Working in the background (15 Hours)**
Background Tasks: Async Task and Async Task Loader, connect to the Internet, Broadcast Receivers, Services, Triggering, scheduling and optimizing background tasks: Notifications, Scheduling Alarms, Transferring Data Efficiently

**Module IV: All about data (22 Hours)**

Preferences and Settings: Storing Data, Shared Preferences, App Settings b) Storing data using SQLite: SQLite Primer, SQLite Database, Sharing data with content providers: Share Data Through Content Providers d) Loading data using loaders: Loaders. Permissions, Performance and Security, Firebase and AdMob, Publish

**Suggested Readings**

1. Android Developer Fundamentals Course – E-book by the Google Developer Training team.
2. The practical workbook: Android Developer Fundamentals Course—Practical's E-book.
3. Slide decks & Videos of lectures for reference provided by Google.

**E Resources**

4. Udemy Course on Learn Android Application Development: A beginner course on Android Application development
5. Coursera Course on Introduction to Android Mobile Application Development

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | H | | | |
| **CO 2** | | H | | |
| **CO 3** | | H | H | |
| **CO 4** | | | M | H |

## CANS308T: NETWORK SECURITY

(4 credits – 60 hours) (L-T-P:4-0-0)

**Objective**

*The objective of the course is to learn the network security attacks, system vulnerabilities and strategies that can be deployed to increase the efficiency of the network service.*

**COURSE / LEARNING OUTCOMES**

CO 1: Recall and identify the different security attacks, requirements, mechanisms and services in the practical field. (Remembering)

CO 2: Recognize and summarize the core principles of cryptography and cryptanalysis available today, including symmetric and asymmetric encryption, hashing, and digital signatures. (Understanding)

CO 3: Identify and relate themselves with the different vulnerabilities, a system in a network can have.

(Applying) CO 4: Inference and predict the issues of securing computer and information systems.

(Analyzing)

CO 5: Construct how malicious code functions, relate the vulnerabilities that make proliferation possible and rewrite methods and practices available for alleviation. (Creating)

**Module 1 (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 2 (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 3 (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 4 (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.

**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

**E Resources**

1. SWAYAM: Introduction to Cyber Security (IGNOU)o https://onlinecourses.swayam2.ac.in/nou24_cs13/preview
2. Cybrary - Free and paid courses on various aspects of network security. Cybrary Network Security
3. SANS Institute - Cybersecurity training and certification programs. SANS Institute
4. Kali Linux Documentation - Resources for using Kali Linux in network security. Kali Linux Documentation
5. OWASP - Resources and tools for improving web application security. OWASP
6. Coursera Network Security Courses - Various courses on network security fundamentals and advanced topics. Coursera Network Security
7. E-Book: Introduction to Cyber Security https://uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | H | | | |
| **CO 2** | M | H | M | |
| **CO 3** | L | H | M | L |
| **CO 4** | L | M | H | M |
| **CO 5** | | M | H | L |

## CAPW309P: MINOR PROJECT

(4 credits – 60 hours) (L-T-P: 0-0-4)

**Objective**

*This course aims to provide the student with various practical knowledge on different problem specific system deployment techniques and analysis.*

**COURSE / LEARNING OUTCOMES**

At the end of the Lab experiments students will be able to:

CO 1: Recall different processes involved in software development life cycle
(Remembering). CO 2: Understanding the problem statement and related
literature study (Understanding).

CO 3: Analyse end user requirements for identifying system functionality metrics and decide whether developed system can meet end user requirements. (Analysing)

CO 4: Choose an engineering approach to solving problems, starting from the acquired knowledge to visual interpretation. (Evaluating)

CO 5: Propose the use of certain technologies by implementing them in different programming languages to solve the problem statement (Creating).

**Module 1**

Feasibility study of the problem statement and solution, evaluation of existing system, finding the limitation of existing system

**Module 2**

**Literature** study, identification of software and hardware requirement, schedule feasibility, economic and operational feasibility, identification software development metrics

**Module 3**

Evaluate Design diagrams for solving the problem statement. Identify deployment strategy.

**Module 4**

Develop algorithms and implement those using programming languages. Resolve and implement the problem

statement through proposed software model and system architecture.

**Module 5**
Prepare a report to highlight the problem statement, design diagram, technologies deployed, and references used to resolve end user's requirement.

**Suggested Readings:**

1. Roger S. Pressman, "Software Engineering–A Practitioner's Approach", McGraw Hill Companies.
2. Rajib Mall, Fundamentals of Software Engineering, PHI.


**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V |
|---|---|---|---|---|---|
| **CO 1** | H | H | L | L | |
| **CO 2** | H | H | | | |
| **CO 3** | L | L | H | H | M |
| **CO 4** | | L | H | H | L |
| **CO 5** | | | M | H | H |

# MINOR COURSES

| Semester | Category | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Minor Course 1 | CALE104T | Cyber Law and Ethics | 4 |
| 2 | Minor Course 2 | CAET105T | E-Commerce Technology | 4 |
| 3 | Minor Course 3 | CAER210T | Enterprise Resource Planning | 4 |
| 4 | Minor Course 4 | CAWD211T | Basics of Web Designing | 4 |
| 5 | Minor Course 5 | CAPT310T | Basics of Python | 2 |
| | | CAPT311L | Basics of Python Lab | 4 |
| 6 | Minor Course 6 | CABS312T | Business Statistics | 4 |
| 7 | Minot Course 7 | CBT103T | Digital and Technological Solutions | 1 |

## CALE104T: CYBER LAW AND ETHICS

(4 credits – 60 hours) (L-T-P: 4-0-0)

**Objective**
*The course aims to learn about the different cyber threats, law and ethics that are associated with cyberspace.*

**COURSE/LEARNING OUTCOMES:**
At the end of the course, students will be able to:
CO 1: Identify knowledge related to the constitution and its legal issues in cyberspace.
(Remembering) CO 2: Explain the different cybercrimes, and the related cyber laws.
(Understanding)
CO 3: Demonstrate the different perspectives of professional ethics and responsibilities of engineers. (Understand)
CO 4: Illustrate the concepts behind Cyber Torts, Intellectual Property Rights and describe the concepts in connection to dispute resolution in cyberspace. (Analyzing)

**Module I (14 Hours)**
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.

**Module II (18 Hours)**
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

**Module III (14 Hours)**

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.

**Module IV (14 Hours)**
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.


**E Resources**
1. SWAYAM Course on Cyber Laws by Vishal Goyal Punjabi University - Patiala

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| **CO 1** | L | M | M | M |
| **CO 2** | L | H | H | M |
| **CO 3** | L | H | M | M |
| **CO 4** | | M | H | M |

## CAET105T: E-COMMERCE TECHNOLOGY

(4 CREDITS- 60 HOURS) (L-T-P: 4-0-0)

**Objectives**
*To enable the student to become familiar with the mechanism for conducting business transactions through electronic means, buildup knowledge on electronic business, online marketing and make the students to devise marketing strategies for concerns engaged in ecommerce and understand the current status of e-business.*

**COURSE/LEARNING OUTCOMES:**
After learning this course, the students will be able to:
CO 1: Interpret the basic concepts and technologies used in the field of E-Commerce.
(Remembering) CO 2: Explain the different regulatory provisions relating to E-Commerce.
(Understanding)
CO 3: Develop processes of developing and implementing information systems.
(Applying) CO 4: Define the ethical, social, and security issues of information
systems. (Analysing)
CO 5: Evaluate the various online business transactions (Evaluating)

**Module I: Introduction (12 Hours)**
E – Commerce: Meaning, definition, features, functions of E-Commerce, Scope, Benefits and limitations of E-Commerce – The Internet and India – E-commerce opportunities and challenges for Industries 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: Electronic Data Interchange (12 Hours)**
Benefits of EDI, EDI technology, EDI standards, EDI communications, EDI, EDI Agreements, EDI Security, 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, Implementation, Legal Framework for E-Commerce: E-Commerce Legal Framework, Rights and Obligations in the World of E-commerce , Copyrights , Defamation, Privacy, Contracts, Taxation, Signing a contract Electronically ,Domain name and Registration.

**Module III: E-payment System (12 Hours)**
**E-payment Systems:** Digital payment Requirements, Digital Token-based E-payment systems, Benefits to Buyers , Benefits to Sellers, Credit card as E-payment system, Mobile payments, smart card cash payment system,

Micropayment system, E- Cash, Risk and e-Payment Systems, Designing e-Payment Systems, E-Retailing, E services. **E-Finance:** Areas of Financing, E-Banking, Traditional Banking Vs. E-Banking, Operations in E-Banking, E-Trading, Stock Market trading, Importance and advantages of E-Trading.

**Module IV: Security and Encryption: (12 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 , 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 V: IT Act 2000 and Cyber Crimes (12 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

**Suggested Readings**


1. Joseph P. T., E - Commerce – An Indian Perspective
2. Kenneth C. Laudon and Carlo GuercioTraver, E-Commerce,Pearson Education.
3. David Whiteley, E-commerce:Strategy,TechnologyandApplications,McGrawHill Education
4. Bharat Bhaskar, Electronic Commerce: Framework, Technology and Application, 4thEd., McGraw Hill Education
5. Joseph P T, E-Commerce: An Indian Perspective, PHILearning
6. Bajaj K K and Debjani Nag, E-commerce, McGraw HillEducation
7. Chhabra T N, E-Commerce, Dhanpat Rai Co.
8. Madan Sushila, E-Commerce, Taxmann


**E Resources**
1. Udemy Course on Mastering E-commerce: The Ultimate Course
2. Swayam course on E-Business By Prof. Mamata Jenamani, IIT Kharagpur

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V |
|---|---|---|---|---|---|
| **CO1** | H | M | | | M |
| **CO2** | M | H | | | |
| **CO3** | | M | H | | M |
| **CO4** | | | M | H | |
| **CO5** | | | H | M | M |

## CAER210T: ENTERPRISE RESOURCE PLANNING

(4 CREDITS – 60 HOURS) (L-T-P: 4-0-0)

**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:
CO 1: Recall the conceptual elements of ERP. (Remembering)
CO 2: Demonstrate the Influence of ERP in Large Organizations. (Understanding)
CO 3: Identify the impact of ERP into the daily operations of firms with respect to their productivity, integration, communication etc. (Applying)
CO 4: Analyse the practical side of ERP implementation with different vendors. (Analysing)
CO 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)**
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 modelling, integrated data model 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 (10 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)**
SAP AG: R/3 –, overview of R/3 system, R/3 modules, R/3 and the internet BAAN: Baan ERP modules, Baan ERP Tools Oracle: Oracle modules – Financials, Human Resources, Projects, Manufacturing, Supply chain. 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 (15hours)**
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. 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


**E Resources**

1. Oracle course on Oracle Fusion Cloud Enterprise Resource Planning Training and Certification
2. Udemy course on SAP ERP Fundamentals

**Mapping of COs to Modules**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V |
|---|---|---|---|---|---|
| **CO 1** | H | M | | | M |
| **CO 2** | | H | M | | |
| **CO 3** | | M | H | | M |
| **CO 4** | | | M | H | |
| **CO 5** | | | | M | H |

**CAWD211T: BASICS OF WEB DESIGNING**
(3 Credit – 45 Hours) (L-T-P: 3-0-0)

**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 and scripting language are also being discussed to make the student competent to design websites.*

**COURSE/LEARNING OUTCOMES**

On successful completion of the course students will be able to:
CO 1: Recall the various Internet related terminologies and examine the history and growth of Internet.
(Remembering) CO 2: Identify and differentiate the various services provided by the internet.
(Understanding)
CO 3: Experiment with various mark-up languages and style sheets to design a static
website. (Applying) CO 4: Experiment with various scripting languages to design a dynamic
website. (Applying)
CO 5: Develop and create a website using standard tools and technologies. (Creating)

**Module I: Basics of Internet and XHTML (15 Hours)**

**Basics of Internet:** History of the Internet and the World Wide Web; W3C; Levels of Internet Connectivity; Requirements for Internet Connectivity; Search Engines, Various Internet Services, Web Portal; Different types of browsers; URLs, Domain names, HTTP and URL

**XHTML**: Basic HTML Tags – html, head, title, body, paragraph, headings, horizontal, break, image, table, lists, links, and forms. Introduction to XHTML; HTML vs. XHTML, XHTML comments;

**Module II: Cascading Style Sheets and JavaScript (18 Hours)**

**Cascading Style Sheets:** Types of Style Sheets - Inline, Embedded, and External; CSS Text properties, font properties, and Background properties; CSS Borders and Outlines, CSS Box Model, Style class and Pseudo-class

**JavaScript**: Client-side scripting, Introduction to JavaScript, Simple JavaScript code, JavaScript variables, functions, conditions and loops

**Module III: Website Design Considerations and Web Servers (12 Hours)**

**Website Design Considerations:** Planning to design a website, use of sitemaps, Creating a compatible website for different color depths, resolutions, and browser considerations, validating a website

**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, MAMP, XAMPP

**Suggested Readings**


1. Steven Holzner,"HTML Black Book", Dremtech Press
2. Web Technologies, Black Book, Dreamtech Press
3. Web Applications: Concepts and Real-World Design, Knuckles, Wiley-India
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson
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


**E Resources**

1. Spoken Tutorial on HTML by Praveen S, IIT Bombay
2. Spoken Tutorial on CSS by Neha Solanki, IIT Bombay
3. Spoken Tutorial on JavaScript by Jayesh K Ramalingaiah

**Mapping of COs to Modules**

| Course Outcomes | Module I | Module II | Module III |
|---|---|---|---|
| 1 | H | | |
| 2 | H | | |
| 3 | H | H | |
| 4 | | H | |
| 5 | M | L | H |

**CAWR212L: BASICS OF WEB DESIGNING LAB**

(1 Credit - 15 Hours) (L-T-P: 0-0-1)

**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.*

**COURSE/LEARNING OUTCOMES**

At the end of the experiments, students will be able to
CO 1: Experiment with various mark-up languages and style sheets to design a static web
site (Applying) CO 2: Develop and create a dynamic website using scripting language.
(Creating)
CO 3: Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)

**Module I: Static Web Designing (10 Hours)**

Web Designing: Creating static websites involving various
XHTML elements. Using Style Sheets: Designing web pages that
use CSS for standard formatting

**Module II: Dynamic Web Designing (5 Hours)**

JavaScript: Designing websites that use JavaScript for creating interactive web pages

**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 to Syllabus**

| Course Outcomes | Module I | Module II |
|---|---|---|
| 1 | H | |
| 2 | | H |
| 3 | H | M |

## CAPT310T: BASICS OF PYTHON

(2 Credits – 30 hours) (L-T-P: 2-0-0)

**Objective:**

*The objective of the course is to provide learners with a solid foundation in the fundamentals of the Python programming language. The course aims to equip students with the knowledge and skills necessary to write simple Python programs and understand the core concepts and principles of Python programming.*

**COURSE / LEARNING OUTCOMES**

At the end of this course students will be able to:
CO 1: Learn the syntax, semantics and OOP concepts of Python Programming
Language. CO 2: Comprehend the flow control logic in Python
CO 3: Use Python functions to facilitate code reuse and manipulate strings.
CO 4: Illustrate the process of exception handling, structuring the data using lists, tuples and dictionaries.

**Module I: Introduction to Python (8 hours)**

What is Python? and history of Python, Unique features of Python, Install Python and Environment Setup, Python Identifiers, Keywords and Indentation, Comments and document interlude in Python, Command line arguments, Getting User Input, Python Data Types, variables

**Module II: Control Statements (8 hours)**

if-else, if-elif-else, while loop, for loop, break, continue, assert,
pass, return List, Ranges & Tuples in Python
Lists in Python, Understanding Iterators, Generators, Comprehensions and Lambda Expressions, Generators and Yield, Next and Ranges, Understanding and using Ranges, Ordered Sets with tuples
Python Dictionaries and Sets
Introduction to the section, Python Dictionaries, More on Dictionaries, Sets, Python Sets Examples

**Module III: Input and Output in Python (8 hours)**

Reading and writing text files, writing Text Files, appending to Files and Challenge, Writing Binary Files Manually, Using Pickle to Write Binary Files
Python built in function, Python user defined functions, Python packages functions, Defining and calling Function, The anonymous Functions, Loops and statement in Python, Python Modules & Packages

**Module IV: OOP concept in Python (6 hours)**
Overview of OOP, The self-variable, Constructor, Namespaces, Creating Classes and Objects, Inheritance, Types of Methods, Instance Methods, Static Methods, Class Methods, Accessing attributes, Built-In Class Attributes, Destroying Objects, Abstract classes and Interfaces, Abstract Methods and Abstract class, Interface in Python, Abstract classes and Interfaces

**Suggested Readings**

1. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978- 0199480173
2. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.
3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978- 8126556014.
4. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978- 9332555365.


**E Resources**
1. Coursera course on Introduction to Python Fundamentals
2. Udemy course on Extensive Python Fundamentals in 4 Weeks

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| 1 | L | H | H | H |
| 2 | | H | H | H |
| 3 | L | M | M | H |
| 4 | H | | H | H |

## CAPT311L: BASICS OF PYTHON LAB

(2 Credits- 30 Hours) (L-T-P: 0-0-2)

**Objective**
*The objective of the course is to provide learners with a solid foundation in the practical knowledge of Python programming language. The course aims to equip students with the knowledge and skills necessary to write simple Python programs and understand the core concepts and principles of Python programming.*

**COURSE / LEARNING OUTCOMES**
At the end of the lab experiments, students will be able to learn
CO 1: Writing programs in python, Understanding the basic structure of Python programming. CO 2: Understanding the built – in libraries
CO 3: Implementing the concepts of OOPs in Python

**Lists of experiments:**
1. if-else, if-elif-else, while loop, for loop, break, continue, assert, pass, return
2. List, Ranges & Tuples in Python
3. Python Dictionaries and Sets
4. Reading and writing text files, writing Text Files, appending to Files and Challenge, Writing Binary Files Manually, Using Pickle to Write Binary Files
5. Constructor, Namespaces, Creating Classes and Objects

**Suggested Readings**

1. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978- 0199480173
2. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.

3. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978- 8126556014.
4. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978- 9332555365.

**Mapping of COs to Syllabus**

| Course Outcomes | Module I | Module II | Module III | Module IV | Module V |
|---|---|---|---|---|---|
| CO 1 | H | H | H | H | H |
| CO2 | | L | H | H | M |
| CO 3 | M | M | M | H | H |

**CABS312T: BUSINESS STATISTICS**
(4 Credit – 60 Hours) (L-T-P: 2-0-0)

**COURSE / LEARNING OUTCOMES**
At the end of this course students will be able to:
CO 1: Recall the key terminology, concepts tools and techniques used in business statistical analysis (Remembering)
CO 2: Understand the use of Graph Theory, Probability and Time-series analysis for management decisions. (Understanding) CO 3: Apply differential and inferential statistics to solve problems related to statistical analysis (Applying)
CO 4: Apply coorelation and regression analysis to solve problems related to statistical analysis (Applying)

**Objective:** *The objective of this course is to familiarize the students with basic concepts of Statistics in Business and an in-depth learning of the various statistical techniques. The aim of this course is to impart knowledge to students to improve their logical reasoning ability and interpretation of various business results. The course makes an effort to acquaint the students with the emerging issues in business, trade, and commerce regarding analyzing business facts.*

**Module I: Introduction to Statistics, Frequency Distribution, and Graphs (12 Hours)**
**Introduction to Statistics:** Statistics as a Subject of Study, Information and Data, Census data vs. Sample data, Methods of statistical data collection, Statistical Variables: Qualitative and Quantitative
**Frequency Distribution and Graphs:** Frequency, Stem and Leaf Display, Frequency Distributions, Data Grouping - Discrete and Continuous, Introduction to Graphs, Graph for Qualitative variables, Graph for Quantitative variables, Various types of graphs and diagrams: pictographs, bar diagram, scatter diagram, histogram, pie chart, frequency curve and frequency polygon

**Module II: Descriptive and Inferential Statistics (18 Hours)**

**Descriptive Statistics:** Measures of Central Tendency (Median, Mode, Arithmetic Mean, Geometric Mean, Harmonic Mean), Measures of Dispersion, Range, Co-efficient of Range, Quartiles, Inter-Quartile Range and Quartile Deviation, Standard Deviation, Skewness and Kurtosis; Co-efficient of Skewness: Karl Pearson's Coefficient
**Inferential Statistics**: Hypothesis Testing, Parametric vs. Non-Parametric tests, Parametric Tests (z-test, t-test, Chi-Square test, and F-test)

**Module III: Correlation and Regression Analysis (15 Hours)**
**Correlation Analysis:** Introduction to Correlation, Karl Pearson's product moment Co-efficient of Correlation, Positive, negative and zero correlation, Correlation through Scatter diagrams, Interpretation of Correlation Co-efficient, Simple and Multiple Correlation;
**Regression Analysis:** Regression and the criterion for the Line of Best Fit, Linear Regression, Logistic Regression, Polynomial Regression

**Module IV: Probability and Probability Distributions (15 Hours)**
**Probability and Probability Distributions:** Sample space and Events, Simple and Compound Events, Probability and Probability distributions: Normal Distribution, Binomial and Poisson Distribution
**Time-Series Analysis:** Definition, Overview of Time-Series Analysis, Components of Time-Series, Time-Series Forecasting Models using Stochastic Models (AR, MA, ARMA and ARIMA)

**Suggested Readings**
1. Sharma, Japuji K. *Business statistics*. Pearson Education India, 2012.

2. Bajpai, Naval. *Business statistics*. Pearson Education India, 2009.
3. Siegel, Andrew F. *Practical business statistics*. Academic Press, 2016.

**E Resources**

1. NPTEL course on Business Statistics
2. Study.com course on Business 212: Business Statistics

**Mapping of COs to Modules**

| Course Outcomes | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| 1 | H | L | | |
| 2 | H | | | H |
| 3 | | H | | |
| 4 | | | H | |

**DIGITAL AND TECHNOLOGICAL SOLUTIONS (1 CREDIT: 15 HOURS)**

**Module I: Computer Fundamentals and Office automation (8 Hours)**

Evolution of Computers and its applications, latest IT gadgets, basics of hardware and software, Operating Systems: types and functions, Office tools – Word Processor, Spreadsheets, Power Presentation, Introduction to graphic editing tools.

**Module II: Communication Systems and Digital Solutions (4 Hours)**

Types of Communication Systems model and principles, Types of transmission media, Internet concepts, Web browsers, search engines, Email, Social networking and Netiquettes.

Introduction & Evolution of Digital Systems, Role and Significance of Digital Technology, Overview of e-governance, E-commerce & Digital Marketing: Basic Concepts, Benefits & Challenges, Digital India & e-Governance: Initiatives, Infrastructure, Services and Empowerment, Digital Financial Tools: Unified Payment Interface (UPI), Unstructured Supplementary Service Data (USSD), Aadhaar Enabled Payment System (AEPS), Banking Cards, e-Wallets, Internet Banking, 5G Technology.

**Module III: Cyber Security and Emerging Technologies (4 Hours)**

Concepts of cyber security, Issues and challenges of cyber security, Classification of cyber-crimes, Introduction to IT Act 2000 and its amendments, Needs and best practices for the use of Social media.

Introduction to emerging technologies, Internet of Things (IoT), Big Data Analytics, Cloud Computing, Virtual reality, Artificial Intelligence, Block Chain technology, 3D Printing, Robotic Process automation.

**Suggested Readings**

1. Rajaraman V., Fundamentals of Computers, PHI Publications

2. Anita Goel, Computer Fundamentals, Pearson Publication New Delhi

3. Suresh Basandra, Computers Today A. Shinde, Introduction to Cyber Security: Guide to the World of Cyber Security, Notion Press, 2021

4. U Sharma, P Nand, J Chatterjee , V Jain, N Z Jhanjhi, R. Sujatha, Cyber-Physical Systems: Foundations and Techniques, Wiley, 2022.

5. U Sharma, P Astya, A Baliyan, S Krit,V Jain, M Z Khan, Advancing Computational Intelligence Techniques for Security Systems Design, CRC Press, 2021

6. Rich & Knight, Artificial Intelligence, TMG, 3 e/d

7. Rachel Schutt, Cathy O'Neil, "Doing Data Science: Straight Talk from the Frontline" Schroff/O'Reilly

8. Khan, Jamil Y., and Mehmet R. Yuce, eds. Internet of Things (IoT): systems and applications. CRC Press, 2019.

9. Redwood, Ben, Filemon Schöffer, and Brian Garret. The 3D printing handbook: technologies, design and applications. 3D Hubs, 2017.

10. G. Nandi, R. K. Sharma, Data Science Fundamentals and Practical Approaches, BPB, 1st Edition, 2020

E Resources

Module I:

1. Evolution of Computers and its Applications: https://computerhistory.org/

2. Basics of Hardware and Software: Tutorial by Khan Academy

3. Hardware and Sotware: https://www.coursera.org/learn/computer-hardware

4. Operating Systems: Types and Functions: Geeks for Geeks Tutorial Website

5. Office Tools: Spoken Tutorial on Office Tools 6. GIMP Tutorials

Module II:

1. Internet Fundamentals and Digital Systems - Courses by Geeks for Geeks and Coursera

Module II:

7. IT Act 2000 – Website on IndiaKanoon

8. Social Media Best Practices – Website on Hootsuite

9. Cloud Computing – Resources by AWS

10. 3D Printing – Coursera Website

# SKILL ENHANCEMENT COURSES

| Semester | Category | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | S E Course 1 | CACF106L | Computer Fundamentals | 3 |
| 2 | S E Course 2 | CAHS213L | Hardware and Server Maintenance | 3 |
| 3 | S E Course 3 | CAMG313L | Multimedia and Graphics | 3 |

**CACF106L: COMPUTER FUNDAMENTALS**

(3 credits – 90 hours) (L-T-P:0-0-3)

After completing the course successfully, the students will be able to:

CO 1: Demonstrate working with Unix files, folders, applications and operations. (Understanding)

CO 2: Write SQL queries to handle single or multi-table queries and other complex queries. Creating)

CO 3: Apply explorative analysis techniques. (Applying)

CO 4: Evaluate the data visualization outcomes (Evaluating)

**Module I: Introduction to the Unix Operating System**

Unix kernel, file system, Directories, Navigating the file system, Filename wildcard characters, Manipulating files and directories, Overview of the vi editor, Basic functions, Searching and Replacing text, Searching for text with grep, Linking files, File Permissions and Access Control, Monitoring and killing process, wc, find, cut, sort command, Condition and loop Execution, User and Group management

**Module II: SQL Operations Basic**

Introduction to DBMS, Basic SQL Commands, Data Definition Language, Data Manipulation Language, SQL SELECT Statement, business analysis using SQL, math operation, joins, union, SQL built-in functions

**Module III: Data Visualization using Spreadsheet**

Introduction to data visualization, 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, scatter plots, histograms, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, all relevant 2-D/3-D charts, sample analysis.

**Suggested Reading**

1. Yashwant Kanetkar, UNIX Shell Programming, BPB Publications
2. Mansoor, I.T. Tools and Applications, Pragya Publications, Matura
3. Allen G. Taylor, SQL All-in-One for Dummies, Wiley

**Mapping of CO to Syllabus**

| | Module I | Module II | Module III |
|---|---|---|---|
| CO1 | H | L | L |
| CO2 | | H | |
| CO3 | L | H | M |
| CO4 | | | H |

## CAHS213L: HARDWARE AND SERVER MAINTENANCE

(3 credits – 45 hours) (L-T-P: 0-1-2)

**COURSE/LEARNING OUTCOMES:**

CO 1: To understand the different components of computer hardware and their functions.

CO 2: To be able to identify and explain the various types of servers and their uses and to appreciate the importance of hardware and server maintenance in ensuring the smooth operation of computer systems.

CO 3: To learn basic hardware components and be able to install and configure operating systems on servers and monitor the performance of servers and tune them for optimal performance.

CO 4: To understand data backup and disaster recovery procedures and implement them effectively and learn about server virtualization, cloud computing, and high availability.

**Module I: Introduction to Hardware and Server Maintenance: (5 hours)**

Overview of computer hardware components, Types of servers and their uses, Importance of hardware and server maintenance

**Module II: Basic Computer Hardware Components: (10 hours)**

Processor and memory, Motherboard and BIOS, Power supply and cooling, Hard drives and solid-state drives, Input/Output (I/O) devices

**Module III: Servers: (15 hours)**

Web servers, Database servers, File servers, Mail servers, Virtual servers.
Operating system installation and configuration, Network configuration, Security updates and patches, Performance monitoring and tuning, Data backup and disaster recovery

**Module IV: Advanced Topics in Hardware and Server Maintenance (20 hours)**

Server virtualization, Cloud computing, High availability and redundancy, Storage area networks (SAN), Network-attached storage (NAS) Documentation and asset management, Preventive maintenance, Disaster planning and recovery, Compliance and regulatory requirements

**Module V: Practical, Case Studies and Hands-On Labs (10 hours)**

- Hands-on experience with hardware and server maintenance tasks
- Case studies of real-world hardware and server maintenance scenarios
- Independent research on a topic related to hardware and server maintenance
- Presentation of findings and recommendations

**Suggested Readings**

1. "Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L.

Hennessy
2. "Operating System Concepts" by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne
3. "Essential System Administration: Tools and Techniques for Linux and Unix Administration" by AEleen Frisch
4. "Windows Server 2019 Inside Out" by Orin Thomas and J.C. Mackin
5. "Linux Server Hacks: 100 Industrial-Strength Tips and Tools" by Nicholas D. Wells
6. "Data Center Fundamentals" by José Manuel Moreno Pérez and Jorge Bañuelos García
7. "Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems" by Marc Farley
8. "Virtualization: A Beginner's Guide" by Sander van Vugt
9. "The Cloud Adoption Playbook: Proven Strategies for Transforming Your Organization with the Cloud" by Ryan O'Hara
10. "Disaster Recovery Planning: Preparing for the Unthinkable" by Jon William Toigo.

**E Resources**

1. Udemy: Computer Hardware, Operating System and Networking
2. CompTIA - Training and certifications for hardware and server maintenance.
3. TechTarget - Articles and guides on server maintenance and hardware troubleshooting.
4. Cisco Networking Academy - Courses on server management and IT infrastructure.

**Mapping of COs to Syllabus**

| Course Outcomes | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|
| **CO 1** | H | H | | | |
| **CO 2** | M | M | M | M | |
| **CO 3** | | | M | | M |
| **CO 4** | | | | | H |

## CAMG313L: MULTIMEDIA AND GRAPHICS

(3 Credits – 45 Hours) (L-T-P:0-0-3)

**Objective**

*This course will introduce the students to relevant modules of multimedia and graphics using technical education tools. The course is designed to build up opportunities to understand graphic design, illustration, image manipulation, video editing, and*

*visual effects and experiment with the creativity and conceptualizing ability designing trends as solutions for representation of different aspects of social interaction.*

**COURSE/LEARNING OUTCOMES**

CO 1: List the feature of multimedia tools for representation of design aspects
(Remembering) CO 2: Explain the technique for multimedia design for content development. (Understanding) CO 3: Experiment with different editing process to solve problem statement. (Applying)
CO 4: Design prototype to represent any real-life scenario using multimedia techniques. (Creating)

**Module I (15 hours):**

Text, Font, Faces, animating Text, hyper text, sound – MIDI, audio editing, digitization of sound, audio filtering

**Module II (15 hours):**

Modelling , Lighting & Texturing, Character Rigging, Movie Merchandising, Video Editing & Compositing,

**Module III (15 hours):**

Portfolio Developments, Matte Painting, GNU Image Manipulation Program (GIMP)

**Suggested Reading:**

1. Fazreil Amreen, Instant GIMP Starter, PACKT Publishing
2. Jan Smith,Roman JoosGIMP for Absolute Beginners, Apress

**E Resources**

1. Web Link https://www.gimp.org/tutorials/
2. Coursera course on Interactive Computer Graphics
3. NPTEL course on Computer Graphics By Prof. Samit Bhattacharya, IIT Guwahati
4. NPTEL course on Introduction to Multimedia Systems and Processing, Prof. Somnath Sengupta, IIT Kharagpur

**Mapping of Cos to Syllabus:**

| Course Outcomes | Module 1 | Module 2 | Module 3 |
|---|---|---|---|
| CO 1 | M | L | |
| CO 2 | H | M | |
| CO 3 | H | H | H |
| CO 4 | H | H | H |

# INTERNSHIPS

| Semester | Category | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 2 | Internship | CAIN107I | Internship | 4 |
| 4 | Internship | CAIN213I | Internship | 4 |
| 5 | Internship | CAIN314I | Internship | 2 |

**CAIN107I/ CAIN108I: INTERNSHIP**
(4 Credits: 120 hours)

**CAIN314I: INTERNSHIP**
(2 Credits-60 Hours)

**Objectives**
*The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in classroom courses to real-life industry work situations. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills.*

**COURSE/ LEARNING OUTCOMES**
At the end of the internship, students will be able to:
CO 1: Relate theory and practical with real life examples. (Remembering)
CO 2: Explain the technical processes involved in the industry.
(Understanding) CO 3: Identify the importance of learning the
computer technology. (Applying)
CO 4: Analyse application of computer technology into the practical field.
(Analysing) CO 5: Discuss the actual technological advancements in the
industry. (Creating)

**GUIDELINES:**
The students should follow the following instruction and guidelines during the course of the internship:

The internship should be for a minimum duration of 80 hours which can be extended up to any limit depending upon the convenience and requirement of the student and the organisation respectively.

- The students have to undergo the internship during the Summer/Winter Break.
- The students can undergo an internship at any organisation which is recognised or registered, as applicable, of their choice but the work must be related to computer technology.
- 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.
- There would be a Seminar Presentation (PPT) and Viva-Voce Examination based on which the students would be evaluated for the internship. The Internship report would also be a part of the evaluation.

**STRUCTURE OF INTERNSHIP**
The Internship Report must comprise the following:
a. Recommendation Letter from the Department.
b. Completion Certificate from the Organisation where the student has worked as an 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.

The Contents of the Report must include:
a. Introduction.
b. Objectives of the Internship.
c. About the Organisation (Sector, Activities, Operations).
d. Description of the work.
e. Learning Outcomes.

The Assessment for the internship must have the following components:

- Internship Report: 20 Marks
- Internship Diary: 20 Marks
- Seminar Presentation: 30 Marks
- Viva-Voce Examination: 30 Mark

## Multi Disciplinary Course

**Multi-disciplinary 1: INDIAN ECONOMY (3 Credits – 45 Hours) (L-T-P: 4-0-0)**

**Objective:** This course seeks to enable the student to grasp the major economic problems in India and their solution.

**Module I: Basic Issues in Economic Development (5 Hours)**

Concept and Measures of Development and Underdevelopment; Human Development

**Module II: Basic Features of the Indian Economy at Independence (5 Hours)**

Composition of national income and occupational structure, the agrarian scene and industrial structure

**Module III: Policy Regimes (8 Hours)**

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 (12 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 (15 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,

**Course/Learning Outcomes**

At the end of the course students will be able to:

CO1: Define the features of the Indian Economy. (Remembering)

CO2: Illustrate the policy regimes of the Indian Economy. (Understanding)

CO3: Identify the growth, development and structural changes of the Indian economy over the years. (Applying)

CO4: Compare the sectoral trends – growth, performance and issues. (Analysing)

**Suggested Readings:**

1. Mishra and Puri, Indian Economy, Himalaya PUblishing House
2. IC Dhingra, Indian Economics, Sultan Chand & Sons
3. Gaurav Dutt 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.
6. Ahluwalia, MontekS. 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.
9. Uma Kapila (ed), "Indian Economy since Independence", Relevant articles.
10. Rangarajan, C. and N. Jadhav. Issues in Financial Sector Reform.BimalJalan. (ed). The Indian Economy. Oxford University Press, New Delhi.

**Mapping of COs to Syllabus**

| COs | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|
| CO 1 | H | | | | |
| CO 2 | | H | H | | |
| CO 3 | | | | H | |
| CO 4 | | | | | H |

**Multi-disciplinary 2: Fundamentals of Business, Management & Economics**

**Module I: Introduction to Management, Organization and Foundations of Planning**

Definition of Management; Nature of Management, Types of Managerial skills, Management Roles; Importance of Management, Functions of Management: Levels of Management, Functions of Management, Recent Development in Management, Management Challenges.
Nature and Purpose of Planning; Hierarchy of Plans, Process of Planning, Management by Objectives (MBO); Environment Analysis; SWOT Analysis.

**Module II: Foundations of Organizing, Staffing and Direction**

Organizing: Organization Theory; Design of Organizational Structure; Formal and Informal Organizations; Span of Management; Centralization and Decentralization; Organization Structures: Types of Organization Structures; Line and Staff Relationships; Authority & Power; Delegation of Power.
Fundamentals of Staffing; Human Resource Planning; Job Analysis; Recruitment and Selection Process; Performance Appraisal – Need & Methods; Training and Development – Need & Methods.
Direction – Meaning & Definition, Importance of Direction, Principles of Direction; Hierarchy of Needs; Motivation & Leadership: Motivation Theories; Leadership Theories.

**Module III: Controlling, Communication and E-Governance**

Coordination and Controlling - Meaning, Features, Importance, Control Process, Characteristics of an Effective Control System; Types of Control; Co-ordination – Characteristics, Essentials, Types. Communication: Process of Communication; Barriers of Communication; Organizational Communication. Introduction to E-Governance: Definition, objectives, and scope of e-governance in modern management. E-Governance Models: Government to Citizen (G2C), Government to Business (G2B), Government to Government (G2G), and Government to Employee (G2E). Digital Transformation in Organizations: Role of technology in enhancing efficiency and transparency. E-Governance Tools and Techniques; Challenges in E-Governance: Issues related to cybersecurity, data privacy, and digital divide.

**Course/Learning Outcomes**

At the end of the course students will be able to:
CO1: Define Management and scope of management. Recall the evolution of management concepts and contributions by management thinkers. (Remembering)
CO2: Define the management functions, skills and roles of managers. (Remembering)
CO3: Explain the steps and various aspects of planning, organizing, staffing, and controlling process. (Applying)
CO4: Experiment with different types of plans. Identify and make use of critical aspects of organizing, staffing, and controlling and utilize it for different situations. Make use of Control tools and techniques to suggest suitable control system. (Analysing)
CO5: Compare the different forms of business. (Analysing)
CO6: Interpret the market and determine its specific characteristics that will impact business. (Evaluating)
CO7: Formulate a plan for achieving specific business objective (Creating)
CO8: Create a business plan (Creating)

**Suggested Readings**


1. Principles of Management, 2e, Koontz and O'Donnel, 2015, McGraw Hill.
2. Principles and Practice of Management, 3e, L. M. Prasad, 2013, Sultan Chand & Sons.
3. Principles of Management, 2e, Tripathi, 2012, McGraw Hill.
4. Essentials of Management, 3e, Massie, Joseph L., 2010, Prentice Hall
5. Cases in Management: Indian and International Perspectives, 1e, Jham, 2012, Wiley
6. Practice of Management, 2e, Peter Drucker, 1999, Allied Publisher


**Mapping of COs with Syllabus**

| | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|
| CO 1 | H | | L | L | L |
| CO 2 | H | | | | L |
| CO 3 | | H | H | H | H |
| CO 4 | | M | H | H | H |
| CO 5 | | | M | | H |
| CO 6 | L | | L | L | H |
| CO 7 | H | L | M | M | H |
| CO 8 | M | H | M | M | H |

**Multi Disciplinary 3**

**Subject: ENVIRONMENTAL STUDIES**

**CREDITS: 02**

**Course Objective**

The objective of the course is to equip students with a clear, foundational understanding of environmental concerns and sustainable development covering the function of an ecosystem, resource management, and biodiversity conservation to develop responsible practices and contribute to environmental protection at individual, community, and national levels.

**Course/Learning Outcomes**

At the end of the course students will be able to:

CO1: Define key environmental terms and list major natural resource types and pollution categories (Remember).
CO2: Explain the scope and importance of environmental studies and the need for public awareness (Understand).
CO3: Apply food chain, food web, and energy-flow concepts to trace trophic pathways in an ecosystem (Apply).
CO4: Analyze ecosystem case data to differentiate ecosystem types and identify relationships among producers, consumers, and decomposers (Analyze).

CO5: Evaluate alternative control measures for a specified pollution problem and justify the most suitable option using stated criteria (Evaluate).

**Syllabus**

**Module I: Foundations of Environmental Studies & Natural Resources**

Definition, scope, and importance; need for public awareness; types of natural resources and associated problems (forest, water, mineral, food, energy, land); and conservation of natural resources.

**Module II: Ecosystems and Biodiversity Conservation**

Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs; Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

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 III: Environmental Pollution**

Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e-pollution, Solid waste management, Disaster management.

**Suggested Readings:**

1. Erach Bharucha; 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**

| CO | Module 1 | Module 2 | Module 3 |
|---|---|---|---|
| CO 1 | H | L | H |
| CO 2 | H | L | L |
| CO 3 | L | H | L |
| CO 4 | L | H | L |
| CO5 | M | L | M |

## Common Value Added Course 1

**UNDERSTANDING INDIA**

Credit – 1 (0-0-1) – 15 Hours

Course Outcomes

CO 1: At the end of this course, students will be able to explain the social, cultural and religious diversity of India and its impact on Indian psyche.

CO 2: At the end of this course, students will be able to evaluate the political and economic system of India.

Module 1: India and its Diversity (18 hours)

· Overview of India’s geography, diversity, demographics and development indicators

· A brief survey of India's history, highlighting key events, personalities and movements that shaped its identity and destiny

· An exploration of India's rich and varied cultural heritage, including its languages, religions, arts, literature and philosophy

· An overview of India's social structure, institutions, norms and values, with a focus on issues such as caste, gender, class and ethnicity

Module 2: Indian Political System (12 hours)

· A study of India's political system, institutions, parties and ideologies

· India's role in regional and global affairs

· A review of India's economic performance; the challenges and opportunities for growth;

· An overview of sectors such as agriculture, industry, services, and trade.

· A discussion of India's environmental problems & the solutions for sustainable development

· A discussion on India's journey towards a developed nation.

Suggested Readings

1. Thapar, R. (2015). The Penguin History of Early India: From the Origins to AD 1300. India: Penguin Books Limited.

2. Kosambi, D. D. (2022). The Culture and Civilization of Ancient India in Historical Outline. United Kingdom: Taylor & Francis.

3. Zimmer, H. R. (2020). Philosophies of India. United States: Princeton University Press.

4. Mohanty, M. (2004). Class, Caste, Gender. India: SAGE Publications.

5. Mitra, S. K. (2017). Politics in India: Structure, Process and Policy. United Kingdom: Taylor & Francis.

6. Kothari, R. (1970). Politics in India. India: Orient Longman.

7. Balasubramanyam, V. N. (2019). The Economy of India. United Kingdom: Taylor & Francis.

8. Fisher, M. H. (2018). An Environmental History of India: From Earliest Times to the Twenty-First Century. United Kingdom: Cambridge University Press.

## Common value added 2

**Subject: Service-Learning Project**

**Credits:** 2

**Objectives**

The Service Learning Project aims to develop essential student competencies such as critical and creative thinking, reflective ability, communication, collaboration, information literacy, and social skills. The course emphasizes active civic participation by engaging students in structured community-based activities. Through experiential learning, students contribute meaningfully to society while achieving the intended goals of the curriculum.

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**Course Learning Outcomes (CLOs)**

Upon successful completion of the course, students will be able to:

CO1: Define the different types of research projects. (Remembering)
CO2: Explain the various steps involved in designing a research project. (Understanding)
CO3: Construct questionnaires and schedules for field-based data collection. (Applying)
CO4: Analyse the collected data using appropriate analytical techniques. (Analyzing)
CO5: Classify and evaluate findings for inclusion in a structured report. (Evaluating)

**Instructions and Guidelines for Students**

a. The fieldwork shall be of a minimum duration of 30 hours, which may be extended based on the nature of work and the requirements of the host organisation or community.
b. The fieldwork must be undertaken during the semester break after the 2nd semester or after the 3rd semester.
c. Upon completion of the fieldwork, students must submit the Service-Learning Project Report in the prescribed format.
d. Assessment shall be conducted through a Presentation (PPT) and Viva-Voce Examination towards the end of the 3rd or 4th semester, based on which students will be evaluated.

**Structure of the Service-Learning Project Report**

The Service-Learning Fieldwork Report shall be spiral bound and must include the following components:

a. Recommendation letter from the concerned Department.
b. Certificate of authentication issued by a competent authority such as the Village Headman, Gram Panchayat member, or a recognised community representative.
c. Internship or fieldwork diary maintained as per the prescribed format.
d. The contents of the report shall include:

- Introduction
- Need for the study
- Objectives of the study
- Significance of the study
- Methodology adopted
- Description of the work undertaken
- Learning outcomes
- Feedback from the target audience or community members
- Geo-tagged photographs of field activities

**Assessment Scheme**

The assessment of the Service Learning Project shall consist of a Project Report carrying 40 marks, a Seminar Presentation carrying 30 marks, and a Viva-Voce Examination carrying 30 marks.

**Ability Enhancement 1**

**Subject: Business Communication**

Objective: The course helps students develop new perspectives and adapt to the evolving demands of business communication in a rapidly changing world shaped by technology and globalization. It aims to enhance proficiency in both verbal and non-verbal communication, with a focus on cross-cultural understanding and long-term skill development. Additionally, the course fosters personality growth and improved communication competencies.

**Module I: Introduction to Business Communication**

Understanding Business Communication, Objectives of Communication, Communication Process, Barriers to Communication, Overcoming the Barriers, Effective Communication, Types of Reading in Business Communication, different software aids in e-reading.

**Module II: Forms of Communication and Communication Skills**

Forms of Communication, Mastering Listening and Nonverbal Communication Skills, Communicating in Teams, Communicating Cross-culturally.

**Module III: The Types and Style of Business Communication**

Oral & Written Communication, Conversation Skills, The Three Step Writing Process- Planning, Writing and Completing the Business Messages, Written Business Communication, Writing Messages for Electronic Media, Writing Business Letters, Circulars, Notice and Memos, Writing Reports and Proposals, Writing Positive and Negative Messages, Designing Visual Communication

**Module IV: Skills for Business Communication**

Presentation Skills, Creating and Delivering Oral and Online Presentations, Enhancing Presentations with Slides and Other Visuals, Negotiation Skills, Business Etiquette, Job Application and CVs, Personal Interviews, and Group Discussions, Academic Report Writing

**Course/Learning Outcomes**

At the end of the course students will be able to:

CO1. Explain and illustrate various aspects of business communication, Determine the different types of reading, summarize the various conversation skills (Understanding)

CO2. Develop and apply the spirit and skills of business communication (Applying)

CO3. Interpret the different forms of Written business communication (Applying)

CO4. Examine the different forms of negotiation skills and business etiquettes(applying)

CO5. Analyse the barriers and distinguish among the various types of communications (Analysing)

CO6. Synthesize the Presentation skills for effective business communication. (Creating)

**Suggested Readings**


1. Business communication today, 8e, Bovée, C., & Thill, J., 2019, Pearson
2. Business communication, 2e, Bisen, V., & Priya., 2019, New Age International Ltd.
3. Business communication, 2e, Gopal, N., 2018, New Age International.
4. Contemporary business communication, 3e, Ober, S., 2014, Boston: Houghton Mifflin Co.
5. Business Communication, 3e, Sehgal, M.K & Khetarpal Vandana, 2014, Excel Books
6. Business Writing Today: A Practical Guide, 2e, Natalie Canavor, 2015, SAGE Publications
7. Business Communication: Connecting at Work, 1e, Hory Sankar Mukerjee, 2013, OUP India
8. Business Correspondence and Report Writing: Third Edition. Sharma, R. C. & Krishna Mohan, New Delhi: Tata McGraw-Hill Publishing company Limited, 2007.
9. Winning at Interviews. Thorpe, Edgar & Showick Thorpe. 2nd Edition. Delhi: Dorling Kindersley, 2006.
10. Types of Reading, e-pathshala, MHRD, Govt. of India


**Mapping of COs to Syllabus**

| | Module 1 | Module 2 | Module 3 | Module 4 |
|---|---|---|---|---|
| CO1 | H | | | |
| CO2 | | H | | |
| CO3 | | | M | |
| CO4 | | | | H |
| CO5 | M | | H | |
| CO6 | M | | | H |

**Common value added 3**

**EMOTIONAL INTELLIGENCE**

**Objective:** To acquaint the students with the knowledge of emotional intelligence and its importance to personal and professional success.

**Module I: Concept of Emotional Intelligence (10 Hours)**

a. Emotion- Meaning, characteristics of emotion, components of emotion-cognitive component, physiological component, Behavioral component.

b. Types of emotions, exposing the myths about emotion, physiological or bodily changes accompanying emotions, how emotions affect our thinking and actions.

c. Development of emotions and emotional maturity, Emotional Intelligence – concept, history, measurement of EI - Bar-On Emotional Quotient Inventory, emotional competency inventory, Emotional and social competency inventory, Mayer-Salovey-Caruso Emotional Intelligence Test, self-rated emotional intelligence scale.

**Module II: Intrapersonal Awareness (10 Hours)**

a. Working with EI - EI can be enhanced or developed, models of EI: Ability models, Trait models, Mixed model, development of EI

b. Emotional Self Awareness – Introduction, Meaning and Definition, Emotional Self-awareness and Success, development of emotional self-awareness

c. Accurate self-assessment-meaning and definition, Introduction, accurate self-assessment and success

d. Self-confidence –Introduction, need and importance of self-confidence in one's life.

**Module III: Intrapersonal Management (15 Hours)**

a. Emotional self-control-meaning and definition, emotional self-control and success

b. Developing or improving the ability of emotional self-control: stage1- identification or awareness about the parent emotional state, stage2- determining underlying causes responsible for the present emotional state, stage3-adopting measures for getting control of the emotional state

c. Stress Tolerance: Stress - Meaning and definition, Factors responsible for inducing stress, Development of stress Tolerance

d. Assertiveness, Self –actualization and Optimism- concept, meaning and importance

**Module IV: Interpersonal and Intrapersonal Awareness (10 Hours)**

a. Interpersonal Awareness Introduction, awareness about others-meaning and definition, awareness about others and success, personal life, professional life, development of awareness about others, empathy and reality testing.

b. Interpersonal Management - Managing Interpersonal Relationships, Flexibility, Flexibility and success

c. Problem Solving – meaning, scientific method of problem solving, development of problem-solving ability.

**Course/Learning Outcomes**

**At the end of the course students will be able to:**

**CO1: Acquaint with the knowledge of emotional intelligence and its importance to personal and professional success. (Knowledge)**

**CO2: Recognize four domains of Emotional Intelligence (Analyse)**

**CO3: Employ the emotions for better decision making (Applying)**

Suggested Readings

1. Daniel Goleman (1996) Emotional Intelligence. Why it can matter more than IQ. Bantam Doubleday Dell Publishing Group.

2. Daniel Goleman (2000) Working with Emotional Intelligence. Bantam Doubleday Dell Publishing Group

3. Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan Page India Private Limited.

4. Gupta S.K. (1980), Guidance and Counselling in Indian Education, New Delhi: NCERT

**Mapping of COs to syllabus**

| COs | Module I | Module II | Module III | Module IV |
|---|---|---|---|---|
| CO1 | H | M | M | |
| CO2 | | H | | M |
| CO3 | | | H | M |

**Ability Enhancement Course 2**

**Communicative English**

(2 credits – 30 hours) (L-T-P: 2-0-0)

Objective: The objective of this course is to equip the learners with the basic skills of effective communication in English language in all real life contexts, with area to enable fluency and clarity.

Course Outcomes

The course is intensely practice oriented and it specifically attempts to:

CO1: *Familiarize* the students with the basic tools of oral communication.

CO2: *Teach* the students to use grammar in meaningful contexts.

CO3: *Enable* the students to communicate in English confidently.

**Module I: Essential grammar of English: An Introduction**

Parts of speech; Basic sentence structures; Articles; Prepositions; Person and number; Tenses and their uses; Subject–verb agreement; Vocabulary building; Common idioms and phrases

**Module II: Basic tools of oral communication in English**

a. Syllables, stress–pattern and intonation

b. Consonants, vowels and diphthongs

c. Differences between spoken and written English

**Module III: Functional English: Situational Conversation Practice**

a. At the post office, bank, hotel

b. At the doctors', at the chemists, in the library c) at the market, Tailors', at the garage

c. In the kitchen, with a close friend, Ata wedding

d. Greetings, small talk, congratulations, condolences, offers, invitations

**Module IV: Functional English: Structural Conversation Practice**

Telephone conversation, Interviewing a film star; At a travel agent's, An interview; Buying, Hiring a taxi, buying a motorcycle;

Agreement, disagreement; Hypothetical conditions, likelihood; Public speaking: Speeches of great men; Interjection, exclamation, emotion emphasis; Expressions of hope, disappointment, surprise, concern, worry; Willingness, wish, intention; Commands, requests, advice, promise, threat.

Suggested Readings

1. Leech, Geoffrey and Jan Svartvik, A Communicative Grammar of English, Third edition, Pearson Education, 2002.
2. Sasikumar, V and Dhamija, P.V, Spoken English, Tata McGraw Hill, New Delhi.
3. Taylor, Grant, English Conversation Practice, Tata McGraw Hill, 1975.
4. Dixon, Robert J., Everyday Dialogues in English, Prentice Hall India, 2006.
5. Apte, Madhabi, A Course in English Communication, Prentice Hall India, 2007.
6. Seely, John, The Oxford Guide to Writing and Speaking, Oxford.
7. Plathottam, George, Public Speaking: Resource Book for Effective Communication, Don Bosco Publications, Guwahati, 2007.