

# **Assam Don Bosco University**

## **Programme Project Report (PPR)**

### **Master of Science (Information Technology)**

#### ***i. Programme's Mission and Objectives***

Creating an intense teaching and research environment that moulds individuals into competent professionals who are innovative and committed to meet real world challenges.

##### **Mission**

1. To produce competent Computer Science professionals by promoting excellence in education and training.
2. To inculcate the spirit of self-sustainability through research, consultancy, development activities and lifelong learning.
3. To extend technical expertise to meet real world challenges and play a leading role in technical innovation, creativity and application development.
4. To infuse a sense of commitment in individuals for the betterment of the society through technology.

##### **Programme Educational Objectives (PEOs)**

1. To prepare the students to have strong foundation in computer science engineering with impetus to higher studies, consultancy, research and development.
2. To prepare the students to be self sustainable and proficient to meet the real world challenges ethically and responsibly, in service to socio-economic development of the society.
3. To inculcate the spirit of life-long learning, understanding, and applying new ideas and technologies to provide novel engineering solutions in the rapidly changing environment.

#### ***ii. Relevance of Program with the Assam Don Bosco University Mission & Goals***

***The programmes mission and objectives are in alignment with the University's mission, vision and goals, as detailed below.***

##### **Vision**

*The vision of Don Bosco University is:*

'To mould young persons into intellectually competent, morally upright, socially committed and spiritually inspired citizens at the service of India and the world of today and tomorrow, by imparting holistic and personalized education.'

Guided by this vision and leveraging its century-old expertise in education in India and abroad, Don Bosco University is envisaged to be a centre of excellence in study and research focusing upon the following:

- Providing easier access to higher education for the under-privileged.
- Harmonizing technical excellence with human and religious values.
- Employment-oriented courses in emerging areas of contemporary technology and service.
- 'Teacher Education' as a privileged area of interest to accelerate the pace, reach and quality of education.
- Impetus to research initiatives with practical and social relevance.
- Providing a forum for debate and research on key human issues like religion & culture, peace & justice.
- Contributing to the socio-economic development of North-East India.
- Boosting international linkages and collaboration in university education.

The spirit of the university has been encapsulated in its emblem which has five distinct elements:

- The Cross' signifies its underlying Christian inspiration;
- 'The Profile of St. John Bosco' denotes its distinctive educational philosophy;
- 'The book emphasizes its commitment to academic excellence;
- 'The rays of the Rising Sun' stand for its dynamism and commitment to society; and,
- The motto, 'Carpe Diem' which meaning 'Seize the Day' challenging every Bosconian to grasp the opportunities presented by each new day and attain 'life in its fullness.'

### **Mission**

*Built on a great legacy inherited from our founding fathers, our mission is to create an environment of stimulating intellectual dialogue across disciplines and harvest **knowledge with a cutting-edge through high quality teaching, research, and extension activities** leading to the generation of students who would provide leadership, vision and direction to society.*

### **Goal**

*Our goal is to realize this vision by 2025. **Our strategy is to develop innovative programmes in basic and emerging disciplines** in a phased manner and to update them periodically so as to keep ourselves on track and on time. Our commitment is to involve the faculty and students in **interactive learning environment both within and outside the University through contextual and experiential programmes** so that they would be builders of a **worldwide-network of knowledge-sharing** and excel in their performance with a winning edge in the wider context of globalization.*

### **iii. Nature of Prospective Target Group of Learners**

This Program is designed to target working individuals who wish to further their

professional and academic qualifications, or wish to acquire domain specific knowledge and skills in their chosen profession or industry, in the field of IT and Software.

**iv. *Appropriateness of Programme to be conducted in Online Learning mode to acquire specific skills and competence***

A IT program of this nature is apt for delivery in the Online mode, given its practical nature. Its students, who would already be working in the Software/IT industry, shall benefit from putting into practice their learnings on an ongoing basis, and shall be able to recognize aspects and applicability of their studies in their everyday work life.

**v. *Instructional Design***

**a. *Curriculum Design***

As per University Curriculum in place for campus programs.(Attached)

**b. *For Online Mode:***

**E-Learning Materials Quality Standard:**

The online courses should comply with the following Quality standards, namely:-

(i) The courses should follow the following four quadrant approach, as per the SWAYAM Guidelines:-

**(a) Quadrant-I is e-Tutorial;** which shall contain: Video and Audio Content in an organized form, Animation, Simulations, video demonstrations, Virtual Labs, etc, along with the transcription of the video.

**(b) Quadrant-II is e-Content;** which shall contain; self-instructional material (digital Self Learning Material), e-Books, illustrations, case studies, presentations etc, and also contain Web Resources such as further references, Related Links, Open source Content on Internet, Video, Case Studies, books including e-books, research papers and journals, Anecdotal information, Historical development of the subject, Articles, etc.

**(c) Quadrant-III is the Discussion forum;** for raising of doubts and clarifying the same on real time basis by the Course Coordinator or his team.

**(d) Quadrant-IV is Assessment;** which shall contain; Problems and Solutions, which could be in the form of Multiple Choice Questions, Fill in the blanks, Matching Questions, Short Answer Questions, Long Answer Questions, Quizzes, Assignments and solutions, Discussion forum topics and setting up the FAQs, Clarifications on general misconceptions.

***c. Duration of the Program***

As per University duration policy for on campus programs, in conjunction with the UGC regulation in place.

***d. Faculty and Support Staff Requirement***

As per UGC Regulations

***e. Instructional Delivery Mechanisms***

Courses to be delivered in an 'online' mode with learning material in the form of E-SLM's, and Self Assessments being available for the students. Additionally, virtual live lectures and recorded lecture sessions to be provided as per a fixed schedule towards the end of each term.

***f. Student Support Systems***

Learner Support Service via Web, Chat, Call Support. Access to counsellors at Department on University campus. Access to E-Learning Library resources in the student portal.

***vi. Procedure for admissions, curriculum transaction and evaluation***

***a. Admission Policy***

Admissions to be conducted twice a year (January and July), and as per common regulation for online programs already in place and in effect at the time, in conjunction with UGC Regulations.

***b. Minimum Eligibility***

As per common regulation for online programs already in place and in effect at the time, in conjunction with UGC Regulations.

***c. Fee Structure***

As per fee structure in place for online programs, and as decided by fee committee from time to time.

***d. Programme Delivery Methodology***

Courses to be delivered under the 'online' mode of learning, with students being provided Self learning material in eBook format, along with access to

online Self Assessment tools. Contact Programs Sessions to be conducted online once per semester.

**e. Web Based Tools**

A Web based Portal which shall allow the student access to the following

- Admission & Enrolment Details
- Fee Details and Online Fee Payment Gateway
- Prospectus, Regulations & Syllabus
- Notifications (Admissions, fees, examinations etc)
- Course List, with completion status and scores / results
- eBook's of SLM's.
- Self Assessment Tests (unscored)
- Internal Assessments - IA1 & IA2
- Online PCP Lectures (Recorded or via Virtual Classroom session) as conducted each semester.
- Online Learners forum, for student to student interaction.
- Online Copy of the Grade sheet.
- Access to online support in the form of web chat, ticketed email support etc.

**f. Evaluation Methodology – Tools & Methods**

Internal Assessment marks to comprise the results of Internal Assessment Tests (IA1 & IA2) over the duration of the Semester/Term towards 30% of the final marks, whereas the End Term Assessment , conducted at Examination centres (as per UGC Regulations) to comprise of the remaining 70%.

End Term Exam Regulations to be as per regulations governing on campus programs.

Being an online program, there shall be no provision or requirement to repeat or drop a year within the program.

**vii. 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.

Library resources can be accessed online.

**viii. *Cost Estimate of the Programme and the provisions***

Upon receipt of approval from the UGC, the Finance Committee may set aside budgetary provisions towards Programme Development, Programme Delivery, Programme Maintenance. Once the programs are operational, fee receipts from the program may be used to cover the same, as per the guidance of the Syndicate and Finance Committee.

**ix. *Quality Assurance mechanism and expected programme outcomes***

The expected outcome from these programs is a measurable increase in the skills and knowledge of the student in his/her area of study, and that increase should be reflected in a proportional increase in available job opportunities / role or profile changes in his or her current job or industry, and a change / increment in earning capability .

A Centre for Internal Quality Assurance shall be setup within 1 year of the launch of these programs (as per UGC requirements). The CIQA, working in collaboration with the Department , shall put in place a continuous quality measurement and improvement framework, using both student – teacher feedback, and outcome measurement on data gathered from students during and after completion of their programs via surveys. The findings, action taken report and results shall be published and made available via the CIQA each year in the form of a report.

## Master of Science (Information Technology)

Term	Course	Credits
1	Network Programming	5
1	Computer System and Architecture	5
1	Internetworking Technologies	5
1	Software Engineering	5
1	Data Warehousing	5
2	Pervasive Computing	5
2	Software Quality Management	5
2	Database Management Systems	5
2	Python Programming	5
2	Embedded System Design	5
3	Communication Skills	5
3	E-commerce Technologies	5
3	IT Project Management	5
3	Advanced Operating Systems	5
3	Theory of Computation	5
4	Real Time Systems	5
4	Data Mining	5
4	Applied Cryptography	5
4	Geographic Information Systems	5
4	Project Work	8

# **Master of Science in Information Technology**

## **Syllabus**

### **Term- I**



# NETWORK PROGRAMMING (USING UNIX)

## MODULE 1- INTRODUCTION AND TCP/IP

**Introduction-** A Simple Day Time Client, Protocol Independence, Error Handling: Wrapper Functions, A Simple Day Time Server, Roadmap to Client/ Server Examples in the Text, OSI MODEL BSD Networking History, Test Networks and Host, Unix Standards, 64-Bit Architectures.

**The Transport Layer-** TCP, UDP,SCTP- The Big Picture, User Data Gram Protocol, Transmission Transfer Protocol, Stream Control Transmission Transfer Control, TCP Connection Establishment and Termination, Time Wait Statue, SCTP Association, Establishment and Termination, Port Numbers, TCP Port Numbers and Concurrent Servers, Buffer Sizes and Limitations, Standard Internet Services, Protocol Usage by Common Internet Application.

## MODULE 2- ELEMENTARY SOCKETS

**Sockets Introduction-** Socket Address Structures, Value-Result Arguments, Byte-ordering Functions, Byte manipulation Functions, inet\_aton, inet\_addr and inet\_ntoa Functions, inet\_pton and inet\_ntop Functions, sock\_ntop and Related Function, readn, wrotn and redline Function.

**Elementary TCP Sockets-** socket Function, connect Function, bind Function, listen Function, accept Function, fork and exec Function, Concurrent Services, Close Function.

**TCP Client/Server Example-** TCP Echo server: main Function, TCP Echo server: str\_echo Function, TCP Echo Client :main Function, TCP Echo Client: str\_cli Function Normal Startup, Normal Termination, POSIX Signal Handling, Handling SIGCHLD Signal, Wait and waitpid Function, Connection Abort before accept Returns, Termination of Server Process, SIGPIPE Signal, Crashing of Server Host, Crashing and Rebooting of Server Host, Summary of TCP Example, Data Format.

**Socket Options-** Get sockopt and setsockopt Functions, Checking if an Option Is Supported and Obtaining the Default, Socket States, Generic Socket Options, IPv4 Socket Option, ICMPv6 Socket Option, IPv6 Socket Option, TCP Socket Option, SCTP Socket Option, fcntl Function.

**Elementary SCTP Sockets-** Interface Models, Different Types of Functions, Shutdown Function, Notification.

## MODULE 3- ADVANCED SOCKETS

**IPv4 and IPv6 Interoperability-** IPv4 Client, IPv6 Server, IPv6 Client, IPv4 Server, IPv6 Address Testing Macros, Source Code Probability.

**Daemon Processes and the inetd Superserver-** syslogd Daemon, syslog Function, daemon\_init Function, inetd Daemon, daemon\_inetd Function.

**Advanced I/O Functions-** Socket Timeouts, recv and send Functions, readv and writev Functions, recvmsg and sendmsg Functions, Ancillary Data, How Much Data Is Queued?, Sockets and Standards I/O, Advanced polling.

**Routing Sockets-** Datalink Socket Address Structure, Reading and Writing, sysctl Operations, get\_ifi\_info Function (Revisited), Interface Name and Index functions.

**Key Management Sockets-** Reading and Writing, Dumping the Security Association Database (SADB), Creating a Static Security Association (SA), Dynamically Maintaining SAs.

**Broadcasting-** Broadcast Address, Unicast Versus Broadcast, dg\_cli Function Using Broadcasting, Race Conditions.

**Signal- Driven I/O-** Signal- Driven I/O for Sockets, UDP Echo Server Using SIGIO.

**Threads-** Basic Thread Functions: Creation and Termination, str\_cli Function Using Threads, TCP Echo Server Threads, Thread-Specific Data, Web Client and Simultaneous Connections (Continued), Mutexes: Mutual Exclusion, Condition Variables, Web client simultaneous Connections (continued).

**Suggested Reading-**

1. UNIX Network Programming by W. Richard Stevens.

## **INTERNETWORKING TECHNOLOGIES**

### **MODULE 1- INTRODUCTORY CONCEPTS IN INTERNETWORKING**

Constituents of an Internetwork, Hierarchy in Internetworks, Classification of Internetworks, Local Area/Campus Internetwork Design, Competing LAN Technologies, Wide Area Network Design, Competing WAN Technologies, Steps Involved in Internetwork Design, Primary Design Goals of Internetwork Systems, Hierarchical Internetworking Design Models.

### **MODULE 2-MULTIMEDIA INTERNETWORKING TECHNOLOGY**

Elements of Multimedia Communication, Defining Multimedia Network, Multimedia Internetworks, Principles of Redesign and Upgrading of Data-Intranets to Multimedia Intranets, Multimedia Internetwork Requirements, Multimedia Internetwork Integration, Generic Classification of Multimedia Internetworks, Link-based Classification of Multimedia Internetworks, Interactive Multimedia Internetworks, Estimating Bandwidth Requirements for Multimedia Internetworks, The Bandwidth Factor, Network Interactive Multimedia Video, Video servers, Multimedia Broadcast Standards.

### **MODULE 3- DATA COMPRESSION TECHNOLOGY**

Space/Storage Compression, Lossy versus Lossless Data Compression, Graphics Metafiles, Language-based Redundancy Probabilities, Primary Classes of Data Encoding Techniques, GIF Compression, PNG Compression, JPEG Compression, MPEG Compression.

### **MODULE 4- INTELLIGENT AGENT TECHNOLOGY IN INTERNETWORKING**

Intelligent Software Systems, Intelligent Agents, Attributes of Intelligent Agents, Intelligent Architectures, Internetworking Applicants of Intelligent Agents, Role of Agents, Components of Intelligent Agent-based Distributed Systems.

### **MODULE 5- TCP/IPV6 INTERNETWORKING ARCHITECTURE**

TCP/IPv6 Architecture, The Internet Protocol, The Congestion Control in Internetworks, Generic Transport Layer Concepts, Application Client and Application Server Processes.

**Suggested Reading-**

1. Internetworking Technologies by Rahul Banerjee.

# DATA WAREHOUSING

## MODULE 1- OVERVIEW AND CONCEPTS

**The Compelling Need for Data Warehousing-** Escalating Need for Strategic Information, Failures of Past Decision-Support System, Operational versus Decision-Support System, Data Warehousing- The Only Viable Solution, Data Warehouse Defined, The Data Warehousing Movement, Evolution of Business Intelligence.

**Data Warehouse: The Building Blocks-** Defining Features, Data Warehouse and Data Marts, Architectural Types, Overview of the Components, Metadata in the Data Warehouse.

## MODULE 2- ARCHITECTURE AND INFRASTRUCTURE

**Architectural Components-** Understanding Data Warehouse Architecture, Distinguishing Characteristics, Architectural Framework, Technical Architecture, Architectural Types.

The Significant Role of Metadata- Importance of Metadata, Metadata Types by Functional Areas, Business Metadata, Technical Metadata, How to Provide Metadata.

## MODULE 3- DATA DESIGN AND DATA PREPARATION

**Principles of Dimensional Modeling-** Form Requirements to Data Design, The Star Schema, Star Schema Keys, Advantages of the Star Schema.

**Dimensional Modeling: Advanced Topics-** Updates to the Dimension Tables, Miscellaneous Dimensions, The Snowflake Schema, Aggregate Fact Tables, Families of Stars.

**Data Extraction, Transformation and Loading-** ETL Overview, ETL Requirements and Steps, Data Extraction, Data Transformation, Data loading, ETL Summary, Other integration Approaches.

## MODULE 4- INFORMATION ACCESS AND DELIVERY

**Matching Information to the classes of Users-** Information from the Data Warehouse, Uses of the information, Information Delivery Tools, Information Delivery: Special Topics.

**OLAP in the Data Warehouse-** Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Consideration.

**Data Warehousing and the Web-** Web-Enabled data Warehouse, Web-Based Information Delivery, OLAP in The Web, Building a Web-Enabled Data Warehouse.

**The Physical Design Process-** Physical Design Steps, Physical Design Considerations, Physical Storage, Indexing the Data Warehouse, Performance Enhancement Techniques.

### Suggested Reading-

1. Data Warehousing by Paulraj Ponniah.

# SOFTWARE ENGINEERING

## MODULE 1- INTRODUCTION TO SOFTWARE ENGINEERING AND THE SOFTWARE PROCESS

**Software and Software Engineering-** The Nature of Software, The Unique Nature of WebApps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths.

**Process Models-** A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology, Product and Process.

**Agile Development-** Define Agility, Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models A Tool Set for the Agile Process.

## MODULE 2- MODELING

**Software Engineering Practice-** Software Engineering Knowledge, Core Principles, Principles that Guide Each Framework Activity.

**Requirements Engineering-** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

**Building the Analysis Model-** Requirements Analysis, Scenario-Based Modeling, UML Models that Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling.

**Requirements Modeling: Flow, Behaviour, Patterns and Webapps-** Requirements Modeling Strategies, Flow Oriented Modeling, Creating a Behavioral Model, Patterns for Requirements Modeling, Requirements Modeling for WebApps.

**Design Engineering-** Design with the Context of Software Engineering, The Design Process, Design Concepts, The Design Model.

**Creating an Architectural Design-** Software Architecture, Architectural Genes, Architectural Styles, Architectural Design, Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow.

**Modeling Component-Level Design-** Define Component, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for WebApps, Designing Traditional Components, Component-Based Development.

**Performing User Interface Design-** The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, WebApp Interface Design.

**Pattern-Based Design-** Design Patterns, Pattern-Based Software Design, Architectural Patterns, Component-Level Design Patterns, User Interface Design Patterns, WebApp Design Patterns.

### Suggested Reading-

1. Software Engineering by Roger S. Pressman

# **COMPUTER SYSTEM ARCHITECTURE**

## **UNIT 1- INTRODUCTION**

Digital Computers, Why study Computer Organization and Architecture, A few basics in Computer Architecture, Organization and Design, Von Neumann Computers, Basic Organizations of a Computer, History of Computers, Performance Benchmarking.

## **UNIT 2- DIGITAL LOGIC CIRCUITS**

Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip-Flops, Sequential Circuits.

## **UNIT 3- DIGITAL COMPONENTS**

Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit.

## **UNIT 4- DATA REPRESENTATION**

Data Types, Complements, Fixed-Point Representation, Conversion of Fractions, Floating-Point Representation, Other Binary Codes, Error Detection Codes.

## **UNIT 5- REGISTER TRANSFER AND MICROOPERATIONS**

Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Arithmetic Logic Shift Unit.

## **UNIT 6- BASIC COMPUTER ORGANIZATION AND DESIGN**

Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory- Reference Instructions, Input-Output and Interrupt, Complete Computer Description, Basic Computer Design, Design of Accumulator Logic.

## **UNIT 7- PROGRAMMING THE BASIC COMPUTER**

Machine Language, Assembly Language, The Assembler, Program Loops, Programming Arithmetic and Logic Operations, Subroutines, Input-Output Programming.

## **UNIT 8- CENTRAL PROCESSING UNIT**

General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC).

## **UNIT 9- COMPUTER ARITHMETIC**

Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-Point Arithmetic Operations, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

## **UNIT 10- INPUT-OUTPUT ORGANIZATION**

Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor (IOP), Serial Communication, Bus Standards.

## **UNIT 11- MEMORY ORGANIZATION**

Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

## **UNIT 12- MULTIPROCESSORS**

Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor Communication and Synchronization, Symmetric Multiprocessors, Cache Coherence.

### **Suggested Reading-**

1. Computer System Architecture by M. Morris Mano

# **Master of Science in Information Technology**

## **Syllabus**

### **Term- II**

# PERVASIVE COMPUTING

## **Unit 1- Ubiquitous Computing: Basics and Vision-**

Living in a Digital World, Modelling the Key Ubiquitous Computing Properties, Ubiquitous System Environment Interaction, Architectural Design for UbiCom Systems: Smart DEI Model.

## **Unit 2- Applications and Requirements-**

Early UbiCom Research Projects, Applications in the Virtual, Human and Physical World.

## **Unit 3- Smart Devices and Services-**

Service Architecture Models, Service Provision Life-Cycle, Service Invocation, Virtual Machines and Operating Systems.

## **Unit 4- Smart Mobiles, Cards and Device Networks-**

Smart Mobile Devices, Users, Resources and Code, Operating Systems for Mobile Computers and Communicator Devices, Smart Card Devices, Device Networks.

## **Unit 5- Human-Computer Interaction-**

User Interfaces and Interaction for Four Widely Used Devices, Hidden UI Via Basic Smart Devices, Hidden UI Via Wearable and Implanted Devices, Human-Centered Design (HCD), User Models: Acquisition and Representation, iHCI Design.

## **Unit 6- Tagging, Sensing and Controlling-**

Tagging the Physical World, Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real-Time Systems, Control Systems, Robots.

## **Unit 7- Context-Aware Systems-**

Modelling Context-Aware Systems, Mobility Awareness, Spatial Awareness, Temporal Awareness: Coordinating and Scheduling, ICT System Awareness.

## **Unit 8- Intelligent Systems (IS)-**

Basic Concepts, IS Architectures, Semantic K B IS, Classical Logic IS, Soft Computing Is Models, IS System Operations.

## **Unit 9- Intelligent System Interaction-**

Interaction Multiplicity, Interaction Design, Generic Intelligent Interaction Applications.

## **Unit 10- Autonomous Systems and Artificial Life-**

Basic Autonomous Intra-Acting Systems, Reflective and Self-Aware Systems, Self-Management and Autonomic Computing, Complex Systems, Artificial Life.

## **Unit 11- Ubiquitous Communication-**

Audio Networks, Data Networks, Wireless Data Networks, Universal and Transparent Audio, Video and Alphanumeric Data Network Access, Ubiquitous Networks, Network Design Issues.

## **Unit 12- Management of Smart Devices-**

Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User-Centered Environments, Managing Smart Devices in Physical Environments.



### **Unit 13- Ubiquitous System: Challenges and Outlook-**

Overview of Challenges, Smart Devices, Smart Interaction, Smart Physical Environment Device Interaction, Smart Human-Device Interaction, Human Intelligence Versus Machine Intelligence, Social Issues: Promise Versus Peril.

#### **Suggested Reading-**

1. Ubiquitous Computing by Stefan Poslad.

## **EMBEDDED SYSTEM**

### **Unit 1- Embedded Computing-**

Complex Systems and Microprocessors, Embedded System Design Process, Model Train Controller.

### **Unit 2- Instruction Sets-**

Preliminaries, ARM Processor, PIC Micro Mid-Range Family, TI C55x DSP, TI C64x.

### **Unit 3- CPUs-**

Programming Input and Output, Supervisor Mode, Exceptions and Traps, Co-Processors, Memory System Mechanisms, CPU Performance, CPU Power Consumption, Data Compressor-Design.

### **Unit 4- Computing Platforms-**

Basic Computing Platforms, CPU Bus, Memory Devices and Systems, Designing with Computing Platforms, Consumer Electronics Architecture, Platform-Level Performance Analysis, Alarm Clock- Design.

### **Unit 5- Program Design and Analysis-**

Components for Embedded Programs, Models of Programs, Assembly, Linking and Loading, Compilation Techniques, Program-Level Performance Analysis, Software Performance Optimization, Program-Level Energy and Power Analysis and Optimization, Analysis and Optimization of Program Size, Program Validation and Testing, Software Modem- Design, Digital Still Camera- Design.

### **Unit 6- Processes and Operating Systems-**

Multiple Tasks and Multiple Processes, Multirate Systems, Preemptive Real-Time Operating Systems, Priority Based Scheduling, Interprocess Communication Mechanisms, Evaluating Operating System Performance, Power Optimization Strategies for Processes, Real-Time Operating Systems, Telephone Answering Machine- Design, Engine Control Unit- Design.

### **Unit 7- System Design Techniques-**

Design Methodologies, Requirements and Analysis, Specifications, System Analysis and Architecture Design, Quality Assurance.

### **Unit 8- Networks and Multiprocessors-**

Categories of Multiprocessors, Distributed Embedded Systems, MPSoCs and Shared Memory Multiprocessors, Video Accelerator- Design, Compact Disc- Application.

### **Suggested Reading-**

1. Computers as Components, Principles of Embedded Computing System Design by Marilyn Wolf.

## **PYTHON PROGRAMMING**

### **Unit 1- Introduction to Computers and Problem Solving Strategies-**

Define Computers, History of Computers, Characteristics of Computers, Classifications of Computers, Basic Applications of Computers, Stored Program Concept, Components and Functions of a Computer System, Hardware and Software Concept, Central Processing Unit: Basic Architecture, Input and Output Devices, Computer Memory, Classification of Computer Software, Representation of Data- Bits and Bytes, Problem Solving Strategies, Program Design Tools: Algorithms, Flowcharts, Pseudocodes, Types of Errors, Testing and Debugging.

### **Unit 2- Introduction to Object Oriented Programming (OOP)-**

Computer Programming and Programming Languages, Generations of Programming Languages, Programming Paradigms, Features of Object Oriented Programming, Merits and Demerits of Object Oriented Programming.

### **Unit 3- Basics of Python Programming-**

Features, History and Future of Python, Writing and Executing First Python Program, Literal Constants, Variables and Identifiers, Data Types, Input Operation, Comments, Reserved Words, Indentation, Operators and Expressions, Expressions in Python, Operations in Strings, Other Data Types, Type Conversion.

### **Unit 4- Decision Control Statements-**

Introduction to Decision Control Statements, Selection/Conditional Branching Statements, Basic Loop Structures/ Iterative Statements, Nested Loops, Statements- The *break*, The *continue*, The *pass*, The *else* statement used with Loops.

### **Unit 5- Functions and Modules-**

Function Definition, Function Call, Variable Scope and Lifetime, The *return* statement, More on Defining Functions, Lambda or Anonymous Functions, Documentation Strings, Good Programming Practices, Recursive Functions, Modules, Packages in Python, Standard Library Modules, Globals ( ), Locals ( ) and Reload ( ), Function Redefinition.

### **Unit 6- Python Strings Revisited-**

Concatenating, Appending, and Multiplying Strings, Strings are Immutable, String Formatting Operator, Built-in String Methods and Functions, Slice Operation, ord() and chr() Functions, in and not in operators, Comparing Strings, Iterating String, The String Module, Regular Expressions, Metacharacters in Regular Expression.

### **Unit 7- File Handling-**

Introduction, File Path, Types of Files, Opening and Closing Files, Reading and Writing Files, File Positions, Renaming and Deleting Files, Directory Methods.

### **Unit 8- Data Structures-**

Sequence, Lists, Functional Programming, Tuple, Sets, Dictionaries.

### **Unit 9- Classes and Objects-**

Classes and Objects, Class Method and *self* Argument, The `__init__()` Method (The Class Constructor), Class Variables and Object Variables, The `__del__()` Method, Other Special Methods, Public and Private Data Members, Private Methods, Calling a Class Method from Another Class Method, Built-in Functions to Check, Get, Set, and Delete Class Attributes, Built-in Class Attributes, Garbage Collection (Destroying Objects), Class Methods, Static Methods.

### **Unit 10- Inheritance-**

Inheriting Classes in Python, Types of Inheritance, Composition or Containership or Complex Objects, Abstract Classes and Interfaces, Metaclass.

### **Unit 11- Operator Overloading-**

Introduction, Implementing Operator Overloading, Reverse Adding, Overriding `__getitem__()` and `__setitem__()` Methods, Overriding the `in` Operator, Overloading Miscellaneous Functions, Overriding the `__call__()` Method.

### **Unit 12- Error and Exception Handling-**

Introduction to Errors and Exceptions, Handling Exceptions, Multiple Except Blocks, Multiple Exceptions in a Single Block, Except Block Without Exception, The `else` Clause, Raising Exceptions, Instantiating Exceptions, Handling Exceptions in Invoked Functions, Built-in and User-defined Exceptions, The `finally` Block, Pre-defined Clean-up Action, Re-raising Exception, Assertions in Python.

### **Suggested Reading-**

1. Python Programming (Using Problem Solving Approach) by Reema Thareja.

## **DATABASE MANAGEMENT SYSTEMS**

### **Unit 1- Database Systems-**

Database, Database Management System (DBMS), Classical File Based Systems, Modern DBMS Approach, Significance of Database Systems.

### **Unit 2- Modelling a Database-**

Representation of Data, Data Models, Entity-Relationship Model (E-R model), Logical Data Models, Comparison of Logical Data Models, Other Data Models.

### **Unit 3- Modelling with E-R Diagram-**

E-R Based Modelling, Symbolic Representation of E-R Components, Mapping between Entities, Use of Entity Sets and Relationship Sets, Modelling with E-R Diagrams, Advantages and Disadvantages of E-R Model.

### **Unit 4- Principles of Relational Database Management Systems-**

Foundations of Relational Model, Application Areas of RDBMS, Advantages of RDBMS, RDBMS Packages and their Developers, CODD's Rules for RDBMS, Relational Operations.

### **Unit 5- Relational Database Design-**

Designing a Database, Functional Dependency, Relational Decomposition, Normalization, Importance of Normalization, Limitations of Normal Forms.

### **Unit 6- Structured Query Language-**

SQL- A Query Language, Data Sub Languages, Single Row Functions Used in SQL, SQL\*PLUS, Data Dictionary.

### **Unit 7- Information Retrieval and Data Manipulation-**

Features of SQL, Sub-query Handling, Join Operations, Data Consistency and Integrity Constraints, Transaction Control Statements, Views of Tables, Embedded SQL.

### **Unit 8- Programming with PL/ SQL-**

Basics of PL/SQL Programming, PL/SQL Programming, Exception Handling in PL/SQL, SQL Cursor, SQL Trigger, Benefits of PL/SQL.

### **Unit 9- Query Processing and Optimization-**

Query Processing, Query Optimization, Common Rules of Algebraic Manipulation, Algorithms for Relational Algebraic Operations.

### **Unit 10- Concurrent Transaction Processing-**

Transaction and Concurrency Control, Serial and Concurrent Transaction Schedules, Two Phase Lock-Unlock Protocol, Deadlock, Concurrency Control Using Timestamps.

### **Unit 11- Database Recovery-**

Transaction State Diagram, Recovery Strategies, Recovery of Non-volatile Storage, Residual Dump Backup Strategy, Other Backup Strategies.

### **Unit 12- File Organization, Indexing and Hashing-**

Storage Devices, Heap File Structure, Sorted File Structure, Indexed Files, Multilevel Indexing, B-Tree Indexing, B<sup>+</sup> - Tree Indexing, Hash File Structure.

### **Suggested Reading-**

1. Database Management System by Malay K. Pakhira.

# Software Quality Management

**Unit 1- Quality Concepts-** Define Quality, Software Quality, The Software Quality Dilemma, Achieving Software Quality.

**Unit 2- Software Quality Assurance-** Elements of Software Quality Assurance, SQA Tasks, Goals and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan.

**Unit 3- Software Testing Strategies-** A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System Testing, The Art of Debugging.

**Unit 4- Testing Conventional Applications-** Fundamentals of Software Testing, Internal and External Views of Software Testing, White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing, Model-Based Testing, Testing for Specialized Environments, Architectures and Applications, Patterns for Software Testing.

**Unit 5- Testing for Web Apps-** Testing Concepts for WebApps, The Testing Process, Content Testing, User Interface Testing, Component-Level Testing, Navigation Testing, Configuration Testing, Security Testing, Performance Testing.

**Unit 6- Software Configuration Management-** Software Configuration Management, The SCM Repository, The SCM Process, Configuration Management for WebApps.

**Unit 7- Product Metrics-** A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for the Design Model, Design Metrics for WebApps, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

**Unit 8- Project Management-** The Management Spectrum, People, The Product, The Process, The Project, The W<sup>5</sup> HH Principle.

**Unit 9- Metrics for Process and Project-** Metrics in the Process and Project Domains, Software Measurement, Metrics for Software Quality, Integrating Metrics within the Software Process, Metrics for Small Organizations, Establishing a Software Metrics Program.

**Unit 10- Estimation for Software Projects-** Observations on Estimation, The Project Planning Process, Software Scope and Feasibility, Resources, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Estimation for Object-Oriented Projects, Specialized Estimation Techniques, The Make/Buy Decision.

**Unit 11- Project Scheduling-** Concepts, Project Scheduling, Defining a Task Set for the Software Project, Defining a Task Network, Scheduling, Earned Value Analysis.

**Unit 12- Risk Management-** Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Refinement, Risk Mitigation, Monitoring and Management, The RMMM Plan.

## Suggested Reading-

1. Software Engineering by Roger S. Pressman

# **Master of Science in Information Technology**

## **Syllabus**

### **Term- III**

# Advanced Operating System

## Module I - Process Synchronization

**Overview-** Functions of an Operating System, Design Approaches, Use of Advanced Operating Systems, Types of Advanced Operating Systems.

**Synchronization Mechanisms** – Concept of a Process, Concurrent Processes, Critical Section Problems and Other Synchronization Problems, Language Mechanisms for Synchronization.

**Process Deadlocks** – Definition, Models of Deadlocks, Models of Resources, A Graph-Theoretic Model of a System State, Necessary and Sufficient Conditions for a Deadlock.

## Module II - Distributed Operating Systems

**Architectures of Distributed Systems** - Motivation, System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Networks, Communication Primitives.

**Theoretical Foundations** - Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Global State, Cuts of a Distributed Computation, Termination Detection.

**Distributed Mutual Exclusion** - The Classification of Mutual Exclusion Algorithms, Preliminaries, Simple Solution to Distributed Mutual Exclusion, Non-Token-Based Algorithm, Maekawa's Algorithm, A Generalized Non-Token-Based Algorithm, Token-Based Algorithms, Suzuki-Kasami Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Tree Based Algorithm, Comparative Performance Analysis

**Distributed Deadlock Detection** - Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized Deadlock-Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms, Perspective.

**Agreement Protocols** - System Model, Classification of Agreement Problems, Solutions to the Byzantine Agreement Problem, Applications of Agreement Algorithms.

## Module III- Distributed Resource Management

**Distributed File Systems** - Architecture, Mechanisms for Building Distributed File Systems, Design Issues, Log-Structured File Systems.

**Distributed Shared Memory** - Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues.

**Distributed Scheduling** - Motivation, Issues in Load Distributing, Components of a Load Distributing Algorithm, Stability, Load Distributing Algorithms, Performance Comparison, Suitable Load Sharing algorithm, Requirements for Load Distributing, V-System, Sprite, Condor, Task Migration, Issues in Task Migration.

## **Module IV- Failure Recovery and Fault Tolerance**

**Recovery** - Basic Concepts, Classification of Failures, Backward and Forward Error Recovery, Basic Approach: Backward -Error Recovery, Recovery in Concurrent Systems, Consistent Set of Checkpoints, Synchronous Checkpointing and Recovery, Asynchronous Checkpointing and Recovery, Checkpointing for Distributed Database Systems.

**Fault Tolerance** - Issues, Atomic Actions and Committing, Commit Protocols, Nonblocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols, Majority Based Dynamic Voting Protocol, Dynamic Vote Reassignment Protocols, Failure Resilient Processes, Reliable Communication.

### ***Suggested Readings-***

1. Advanced Concepts in Operating Systems by Mukesh Singhal, Niranjana G. Shivaratri.

## **IT Project Management**

### **Module I - Introduction to Software Project Management**

**Introduction-** Software Projects v/s Other Types of Project, Plans, Methods and Methodologies, Categorizing Software Projects, Stakeholders, Definition of Management, Management Control, Traditional v/s Modern Project Management.

### **Module II – An Overview of Project Planning**

**Project Evaluation and Programme Management-** Project Portfolio Management, Evaluation of Individual Projects, Cost-benefit Evaluation Techniques, Risk Evaluation, Programme Management, Managing the Allocation of Resources within Programmes, Strategic Programme Management, Creating a Programme, Aids to Programme Management, Some Reservations about Programme Management, Benefits Management.

**Project Planning and Selection of an Appropriate Project Approach** - Introduction to Stepwise Project Planning, Choosing Methodologies and Technologies, Software Processes and Process Models, Choice of Process Models, Structure vs Speed of Delivery, The Waterfall Model, The Spiral Model, Software Prototyping, Ways of Categorizing Prototypes, Incremental Delivery, Atern/Dynamic Systems Development Method, Rapid Application Development, Agile Methods, Extreme Programming, Scrum, Managing Iterative Processes, Selecting the Most Appropriate Process Model.

**Software Effort Estimation-** Problems with Over-and Under-Estimates, Basis for Software Estimating, Estimation Techniques, Top-Down Approach and Parametric Models, Expert Judgement, Estimating by Analogy, Albrecht Function Point Analysis, Function Point Marks II, COSMIC Full Function Points, COCOMO II: A Parametric Productivity Model, Cost Estimation, Effect of Schedule Compression, Capers Jones Estimating Rules of Thumb.



## **Module III- Planning, Monitoring and Control**

**Activity Planning-** Objectives, When to Plan, Project Schedules, Projects and Activities, Sequencing and Scheduling, Network Planning Models, Formulating a Network Model, Time Dimension, Forward and Backward Pass, Critical Path, Activity Float, Shortening the Project Duration, Critical Activities.

**Risk Management-** Risk, Categories of Risk, Framework for Dealing with Risk, Risk Identification, Risk Assessment, Risk Planning and Risk Management, Evaluating Risk to Schedule, Applying the PERT Technique, Monte Carlo Simulation, Critical Chain Concepts.

**Resource Allocation-** The Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost, Cost Schedules, The Scheduling Sequence.

**Monitoring and Control-** Creating the Framework, Collecting the Data, Project Termination Review, Visualizing Progress, Cost Monitoring, Earned Value Analysis, Prioritizing Monitoring, Software Configuration Management (SCM).

## **Module IV - Managing Contract and Software Quality**

**Managing Contract-** Types of Contract, Stages in Contract Placement, Terms of Contract, Contract Management, Acceptance.

**Software Quality-** The Place of Software Quality in Project Planning, The Importance of Software Quality, Defining Software Quality, ISO 9126, Product and Process Metrics, Product versus Process Quality Management, Quality Management Systems, Process Capability Models, Techniques to Help Enhance Software Quality, Testing, Software Reliability, Quality Plans

### ***Suggested Readings-***

1. Software Project Management by Bob Hughes, Mike Cotterell, Rajib Mall.

## **Communication Skills**

### **Module I - Introduction**

**Communication in the Workplace-** Role of Communication in Business, Business Communication Process, 'Six Sigma' Communication; Communication Across Cultures - Growing Importance of Cross - cultural communication, web tools for cross cultural communication, high context v/s low context cultures, dimensions of culture, advice for communicating across cultures.

### **Module II - Fundamentals of Business Writing**

**Adaptation and the Selection of Words -** Importance of Adaptation, Suggestions for Selecting Words, Suggestions for Nondiscriminatory Writing.

**Construction of Clear Sentences and Paragraphs -** Care in Sentence Design, Care in Paragraph Design.

### **Module III - Basic Patterns of Business Messages**

**The Writing Process and an Introduction to Business Messages-** Process of Writing, Importance of Readable Formatting, Letters, Memorandum, Email, Text Messaging, Instant Messaging.

**Directness in Good News and Neutral Messages-** General Direct Plan, Routine Inquiries, Favorable Responses, Acknowledgement, Adjustment Grants, Order Acknowledgements, Claims, Inquiries and Responses about Job Applicants, Operational Communications.

**Indirectness in Bad News Messages –** Situations Requiring Indirectness, General Indirect Plan, Refused Requests, Adjustment Refusals, Credit Refusals, Negative Announcements.

### **Module IV - Fundamentals of Report Writing**

**Basics of Report Writing-** Defining Reports, Determining the Report Problem and Purpose, Determining the Factors, Gathering the Information Needed, Interpreting the Findings, Organizing the Report Information, Writing the Report, Collaborating Report Writing.

**Short Reports and Proposals-** Overview of Report Structure, Characteristics of Shorter Reports, Form of Shorter Reports, Types of Shorter Reports.

**Long, Formal Reports-** Organization and Content of Longer Reports, Prefatory Parts, Report Proper, Structural Coherence Plan, Long Analytical Report Illustrated.

### **Module V - Oral Forms of Business Communication**

**Informal Oral Communication-** Informal Talking, Conducting and Participating in Meetings, Using the Phone, Using Speech Recognition for Messages and Reports, Listening, Reinforcing Role of Nonverbal Communication

**Public Speaking and Oral Reporting-** Formal Speeches, Team Presentations, Reporting Orally, Presenting Virtually.

#### ***Suggested Readings-***

1. Business communication by Raymond V. Lesikar, Marie.E.Flatley, Kathryn Rentz, Paula Lentz, Neerja Pande

## **E-commerce Technologies**

### **Module I - Beginning of E – Commerce and The World Wide Web**

**Introduction to E-Commerce-** Advantages and Issues in E-Commerce, Benefits and Limitations of the Internet, Role of E-Strategy, Value Chain in E-Commerce, Integrating E-Commerce, E-Commerce Business Models.

**The World Wide Web-** The Beginnings of the Internet, The Making of the World Wide Web, Internet Service Providers, Web Fundamentals, Internet Services and Languages.

## **Module II- The Technology of E-Commerce**

**Internet Architecture-** Define Network, Information Transfer, Network Hardware, Design Considerations, Managerial Factors, E-commerce Issues.

**Intranets and Extranets -** The Basics, The Technical Infrastructure, Planning an Intranet, E-Mail and the Intranet, Back to Blogging, Instant Messaging, Extranets and SCM.

**Hosting A Web Site-** ISPs, ISP Structure and Services, Choosing an ISP, Registering a Domain name, Role of an Application Service Providers, ASP Infrastructure.

**Mobile Commerce: The Business of Time-** Define M-Commerce, Basic Concept of Wireless Commerce, Reasons for Going Wireless, How Wireless Technology is Employed, Wireless LAN, Wireless Application Protocol.

## **Module III- E-Strategies and Tactics**

**Building E-Presence -** Building Life Cycle - From Page to Stage, Constructing Your Web Site, Web Navigation Design, Design Criteria, Hiring a Web Designer.

**Web Site Evaluation and Usability Testing-** Anatomy of a Site, Color and Its Psychological Effects, Site Evaluation Criteria, The Cookie and its Many Wonders, What makes a Website usable, Site Content and Traffic Management.

**Internet Marketing-** The Pros and Cons of Online Shopping, Internet Marketing Techniques, The E-Cycle of Internet, Steps Taken in Launching a Marketing Campaign, Attracting and Tracking Customers on the Internet, Importance of Customer Service, Basics of CRM and How it Contributes to Adding Value to e-commerce, Customer Relationship Management and E-Value.

**Web Portals and Services and B2B E-Commerce-** Concept of a Web Portal, Search Engine, The Business Challenge, Enterprise Portal Technologies, Web Services and Portals,

**Business-to-Business E-Commerce-** Define B2B, Supply-Chain Management and B2B, B2B Models and Tools.

## **Module IV- Security Threats and Payment Systems**

**E - Security and the USA Patriot Act-** Security in Cyberspace, Designing for Security, Risk Afford, The Virus: Computer Enemy Number One, Security Protection and Recovery, Role of Biometrics Security, Security and Terrorism.

**Encryption-** A Matter of Trust- Define Encryption, The Basic Algorithm, Authentication and Trust, Managing Cryptographic Keys, Internet Security Protocols and Standards.

**Getting the Money-** Real-world and Electronic Cash, Requirements for Internet-Based Payments, Methods of Payment, B2B and E Payment, M-Commerce and M-Payment, Guide to E-Payment.

## Module V- Managerial and Customer Related Issues

Going Online- The Lifecycle Approach, The Business Planning and Strategizing Phase, Hardware, Software, Security and Setup, The Design Phase, The Marketing Phase, Know your Customer, The Fulfillment Phase, The Maintenance and Enhancement Phase.

### ***Suggested Readings-***

1. Electronic Commerce Technologies, Elias M. Awad

## **Theory of Computation**

### **Unit 1-**

**Theory of Automata-** Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NDFAs, Mealy and Moore Models, Minimization of Finite Automata.

### **Unit- 2**

**Formal Languages, Regular Sets & Regular Grammars-** Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars Exercises.

### **Unit- 3**

**Context-free Languages-** Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages Exercises.

### **Unit- 4**

**Pushdown Automata Turing Machines and Linear Bounded Automata-** Basic Definitions, Acceptance by pda, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

### **Suggested Readings:**

1. Theory of Computer Science: Automata, Languages and Computation, K. L. P. Mishra, PHI.
2. Elements of the Theory of Computation, H.R. Lewis and C.H.Papadimitriou, PHI.

**Master of Science in Information Technology**  
**Syllabus**  
**Term – IV**

# Data Mining

## **Module I – Introduction**

Define Data Mining, Motivating Challenges, Origins of Data Mining, Data Mining Tasks.

## **Module II – Data**

Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity, Similarities between Data Objects.

## **Module III - Exploring Data**

Iris Data Set, Statistics, Visualization, OLAP and Multidimensional Data Analysis.

## **Module IV - Classification: Basic Concepts, Decision Trees, and Model Evaluation**

Preliminaries, General Approach to Solve a Classification Problem, Decision Tree Induction, Model Overfitting, Evaluating the Performance of a Classifier and Methods for Comparing Classifiers.

## **Module V - Classification: Alternative Techniques**

Rule-Based Classifier, Nearest-Neighbour Classifiers, Bayesian Classifiers, Artificial Neural Network (ANN), Support Vector Machine (SVM), Ensemble Methods, Class Imbalance Problem and Multi-class Problem.

## **Module VI - Association Analysis: Basic Concepts and Algorithms**

Problem Definition, Frequent itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, Alternative Methods for Generating Frequent Itemsets, FP-Growth Algorithm, Evaluation of Association of Patterns and Effect of Skewed Support Distribution.

## **Module VII - Association Analysis: Advanced Concepts**

Handling Categorical Attributes, Handling Continuous Attributes, Handling a Concept Hierarchy, Sequential Patterns, Subgraph Patterns and Infrequent Patterns.

## **Module VIII- Cluster Analysis: Basic Concepts and Algorithms**

Overview of Cluster Analysis, K-Means, Agglomerative Hierarchical Clustering, DBSCAN and Cluster Evaluation.

## **Module IX- Cluster Analysis: Additional Issues and Algorithms**

Characteristics of Data, Clusters, and Clustering Algorithms, Prototype-Based Clustering, Density-Based Clustering, Graph-Based Clustering and Scalable Clustering Algorithms.

## **Module X- Anomaly Detection**

Preliminaries, Statistical Approaches, Proximity-Based Outlier Detection, Density- Based Outlier Detection and Clustering-Based Techniques.

### ***Suggested Readings:***

1. Introduction to Data Mining by Pang-NingTan, Vipin Kumar and Micheal Steinbach

# Real Time Systems

## **Module I**

### **T 1- Unit 1- Typical Real-Time Applications**

Digital Control, High-Level Controls, Signal Processing, Other Real-Time Applications,

### **T 2- Unit 1- Fundamentals of Real-Time Systems**

Concepts and Misconceptions, Multidisciplinary Design Challenges, Birth and Evolution of Real-Time Systems.

## **Module II**

### **T1- Unit 2- Hard Versus Soft Real-Time Systems**

Jobs and Processors, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real-Time Systems and Soft-Real Time Systems.

### **T2 – Unit 2 - Hardware for Real-Time Systems**

Basic Processor Architecture, Memory Technologies, Architectural Advancements, Peripheral Interfacing, Microprocessor versus Microcontroller, Distributed Real-Time Architectures.

## **Module III**

### **T1- Unit 3- A Reference Model of Real- Time Systems**

Processors and Resources, Temporal Parameters of Real-Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency, Other Types of Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources and Scheduling Hierarchy

### **T2 – Unit 3 - Real-Time Operating Systems**

From Pseudokernels to Operating Systems, Theoretical Foundations of Scheduling, System Services for Application Programs, Memory Management Issues, Selecting Real-Time Operating Systems.

## **Module IV**

### **T1- Unit 4 - Approaches to Real-time Scheduling**

Clock-Driven Approach, Weighted Round-Robin Approach, Priority-Driven Approach, Dynamic versus Static Systems, Effective Release Times and Deadlines, Optimality and Non-Optimality of the EDF and the LST Algorithms, Challenges in Validating Timing Constraints in Priority-Driven Systems and Off-Line versus On-Line Scheduling.

### **T2- Unit 4 - Requirements Engineering Methodologies**

Requirements Engineering for Real-Time Systems, Formal Methods in System Specification, Semiformal Methods in System Specification, The Requirements Document.

## **Module V**

### **T1 - Unit 5- Clock-Driven Scheduling**

Notations and Assumptions, Static, Timer-Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of Aperiodic Jobs, Scheduling Sporadic Jobs, Practical Considerations and Generalizations, Algorithm for Constructing Static Schedules and Pros and Cons of Clock-Driven Scheduling.

### **T2 - Unit 5 - Software Design Approaches**

Qualities of Real-Time Software, Software Engineering Principles, Procedural Design Approach, Object-Oriented Design Approach, Life Cycle Models.

## **Module VI**

### **T1- Unit 6- Priority-Driven Scheduling of Periodic Tasks**

Static Assumption, Fixed Priority versus Dynamic- Priority Algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM Algorithms, A Schedulability Test for Fixed-Priority Tasks with Short Response Times, Schedulability Test for Fixed-Priority Tasks with Arbitrary Response Times, Sufficient Schedulability Conditions for the RM and DM Algorithms and Practical Factors.

### **T2 - Unit 6 - Programming Languages for Real-Time Systems**

Coding of Real-Time Software, Assembly Language, Procedural Languages, Object-Oriented Languages, Overview of Programming Languages, Automatic Code Generation and Compiler Optimizations of Code.

## **Module VII**

### **T1 - Unit 7 - Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems**

Assumptions and Approaches, Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and Weighted Fair-Queuing Servers, Slack Stealing in Deadline-Driven Systems, Slack Stealing in Fixed-Priority Systems, Scheduling of Sporadic Jobs, Real-Time Performance for Jobs with Soft Timing Constraints, A Two-Level Scheme for Integrated Scheduling

### **Module VIII**

#### **T1 - Unit 8 - Resources and Resource Access Control**

Assumptions on Resources and their Usage, Effects of Resource Contention and Resource Access Control, Non-preemptive Critical Sections, Basic Priority-Inheritance Protocol, Basic Priority-Ceiling Protocol, Stack-Based, Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic-Priority Systems, Preemption-Ceiling Protocol, Controlling Accesses to Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects

#### ***Suggested Readings:***

1. T1 – Real Time Systems by Jane W.S. Liu
2. T2- Real time Systems Design and Analysis by Phillip A. Laplante.

## **Geographic Information Systems**

### **Module I- Introduction**

GIS, Elements of GIS, Applications of GIS, Integration of GIS, Web2.0, and Mobile Technology.

### **Module II – Coordinate Systems**

Geographic Coordinate System, Map Projections, Commonly Used Map Projections, Projected Coordinate Systems, and Options for Coordinate Systems in GIS.

### **Module III – Vector Data Model**

Representation of Spatial Features, Topology, Geo-relational Data Model, Object-Based Data Model and Representation of Composite Features.

### **Module IV - Raster Data Model**

Elements of the Raster Data Model, Satellite Images, Digital Elevation Models, Other Types of Raster Data, Raster Data Structure, Raster Data Compression and Data Conversion and Integration.

### **Module V – GIS Data Acquisition**

Existing GIS Data, Metadata, Conversion of Existing Data and Creation of New Data.

### **Module VI – Geometric Transformation**

Geometric Transformation, Root Mean Square (RMS) Error, Interpretation of RMS Errors on Digitized Maps and Re-sampling of Pixel Values.

### **Module VII – Spatial Data Accuracy and Quality**

Location Errors, Spatial Data Accuracy Standards, Topological Errors, Topological Editing, Non-topological Editing and Other Editing Operations.

### **Module VIII – Attribute Data Management**

Attribute Data in GIS, The Relational Model, Joins, Relates, and Relationship Classes, Spatial Join, Attribute Data Entry and Manipulation of Fields and Attribute Data.

### **Module IX - Data Display and Cartography**

Cartographic Representation, Types of Quantitative Maps, Typography, Map Design, Animated Maps and Map Production.



### **Module X – Data Exploration**

Data Exploration, Map-Based Data Manipulation, Attribute Data Query, Spatial Data Query and Raster Data Query.

### **Module XI – Vector Data Analysis**

Buffering, Overlay, Distance Measurement, Pattern Analysis and Feature Manipulation.

### **Module XII – Raster Data Analysis**

Data Analysis Environment, Local Operations, Neighbourhood Operations, Zonal Operations, Physical Distance Measure Operations, Other Raster Data Operations, Map Algebra, Comparison of Vector- and Raster-Based Data Analysis.

### **Module XIII – Terrain Mapping and analysis**

Data for Terrain Mapping and Analysis, Terrain Mapping, Slope and Aspect, Surface Curvature and Raster versus TIN.

### **Module XIV – Viewshed and Watershed Analysis**

Viewshed Analysis, Parameters of Viewshed Analysis, Applications of Viewshed Analysis, Watershed Analysis, Factors Influencing Watershed Analysis and Applications of Watershed Analysis.

### **Module XV – Spatial Interpolation**

Elements of Spatial Interpolation, Global Methods, Local Methods, Kriging and Comparison of Spatial Interpolation Methods.

### **Module XVI – Geocoding and Dynamic Segmentation**

Geocoding, Variations of Geocoding, Applications of Geocoding, Dynamic Segmentation and Applications of Dynamic Segmentation.

#### ***Suggested Reading:***

1. Introduction to Geographic Information Systems by Kang-tsung Chang

## **Applied Cryptography**

### **Module I - Overview of Cryptography and its Applications**

Secure Communications and Cryptographic Applications.

### **Module II - Classical Cryptosystems**

Shift Ciphers, Affine Ciphers, The vignere Ciphers, Substitution Ciphers, Sherlock Holmes, The playfair and ADFGX Ciphers, Block Ciphers, Binary Numbers and ASCII, One-Time Pads, Pseudo-random Bit Generation and LFSR Sequences and Enigma.

### **Module III- Basic Number Theory**

Basic Notions, Solving  $ax + by = d$ , Congruences, The Chinese Remainder Theorem, Modular Exponentiation, Fermat and Euler, Primitive Roots, Inverting Matrices Mod  $n$ , Square Roots Mod  $n$ , Legendre and Jacobi Symbols, Finite Fields and Continued Fractions.

### **Module IV- The Data Encryption Standard**

Introduction, A Simplified DES-Type Algorithm, Differential Cryptanalysis, DES, Modes of Operation, Breaking DES, Meet-in-the-Middle Attacks and Password Security.

### **Module V- The RSA Algorithm**

The RSA Algorithm, Attacks on RSA, Primality Testing, Factoring, The RSA Challenge, An Application to Treaty Verification and The Public Key Concept.

**Module VI- Discrete Logarithms**

Discrete Logarithms, Computing Discrete Logs, Bit Commitment, Diffie-Hellman Key Exchange and The ElGamal public key Cryptosystem.

**Module VII- Hash Functions**

Hash Functions, A Simple Hash Example, The Secure Hash Algorithm, Birthday Attacks, Multi-collisions, The Random Oracle Model and Using Hash Functions to Encrypt.

**Module VIII- Digital Signatures**

RSA Signatures, The ElGamal Signature Scheme, Hashing and Signing, Birthday Attacks on Signatures and The Digital Signature Algorithm.

**Module IX - Security Protocols**

Intruders-in-the-Middle and Impostors, Key Distribution, Kerberos, Public Key Infrastructures (PKI), X.509 Certificates, Pretty Good Privacy, SSL and TLS and Secure Electronic Transaction.

**Module X - Digital Cash**

Digital Cash

**Suggested Readings:**

1. Cryptography with Coding Theory by Wade Trappe, Lawrence C. Washington.

  
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