Master of Computer Application

MCA PROGRAMME

Release Month & Year : July 2018
Course Structure
### 1st Year 1st Semester:

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**Total of Sessional** | **3** | **2**

**Total of Semester** | **34** | **30**
### 3rd Year 1st Semester:

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### Electives for 3rd Year 1st Semester:

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**Total** 176
Detailed Syllabus

1st Year 1st Semester
Module I [10L]

**Number System**
Data and number systems; Binary, Octal and Hexadecimal representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions; Fixed point representation of fractional number. Signed binary number representation with 1’s and 2’s complement methods, Binary arithmetic.

Module II [10L]
Logic gates- truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Kmap method, Quine Mc Clusky’s Method.

Module III [10L]

**Combinational Circuits and Memory**
Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Multiplexer, De-Multiplexer and Parity Generator. Overview of Memory Systems. Design of combinational circuits-using ROM. Overview of Programming logic devices and gate arrays (PLAs and PLDs).

Module IV [10L]

**Sequential Circuits**
Sequential Circuits - Basic memory element - S-R, J-K, D and T flip flops; Registers and counters and their design, Irregular counter, State table and state transition diagram; Sequential circuits design methodology.

**Text Books:**
2. Digital Logic Design, MansafAlam-Bashir Alam, PHI.

**Reference Books:**
2. Digital Logic Design Principle - Bradley Carlson, Norman Balabanian, Wiley India.
Problems related to

- Basic skills lab in using Personal Computer and common software tools
- Realization of Logic Gates
- Realization of Flip-Flop using logic gates
- Realization of Multiplexer
- Realization of Coder & Decoder
- Realization of Adder and Subtractor using logic gates
Module I [10L]

*Introduction*
History of Computing, Evolution of Programming Languages, Compilers, Familiarization with UNIX.

*Problem Solving Method*
Algorithm, Flowchart, Problem-Solving Methodology- Tools, Pseudocode.

*Overview of C language*

*Expressions*
Basic Data Types, Variables, Type Qualifiers, Storage Class Specifiers, Variable Scopes, Constants, Operators, Operator Precedence, Expression Evaluation, Type Conversion in Expressions, Type Casting.

*Console I/O*
Reading and Writing Characters, Reading and Writing Strings, Formatted Console I/O.

Module II [10L]

*Control Statements*
Selection Statements (if, switch-case), Iteration Statements (for loop, while loop, do-while loop), Jumping Statements (return, goto, break, exit, continue).

*Function:*
Functions and Modular Programming, General Form, Function Prototypes, Library Functions, Parameter Passing Mechanisms, Storage Classes, Recursive function.

Module III [10L]

*Arrays and Strings*
Single Dimension Arrays, Two Dimension Arrays, Multidimensional Arrays, Strings, Arrays of Strings, String Library Functions.

*Pointer*
Pointers and Memory Addressing, Pointer Variables, Pointer Arithmetic, Pointer Expressions, Pointers and Arrays, Functions and Pointers, Dynamic Memory Allocation, Command Line Arguments.

Module IV [10L]

*Structures, Unions, Enumerations*
Structures, Arrays of Structures, Structure and Pointers, Unions, Bit Fields, Enumerations, typedef keyword.

*File I/O*
Concept of Files, File operations, Text Files and Binary Files.
**The Preprocessor**  
Preprocessor Directives, Macros, File Inclusion.

**Text Books:**  
1. Programming with C - Gottfried, TMH.  

**Reference Books:**  
1. C Programming Made Easy - Raja Ram, SCITECH.  
2. The C Programming Language - Kernighan Ritchie, PHI.
Subject Name: PROGRAMMING LAB  
Paper Code: MCAP1112

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Programs related to

- Control Structures
- Array (1-d, 2-d)
- Functions
- Dynamic Memory Allocation
- String Handling
- Structures, Union
- File Handling
Module I  [10L]

**Probability**

**Random Variable and Probability Distribution**

Module II  [10L]

**Sampling and Estimation**
Population, Sample; Statistic, Estimation of Parameters (consistent and unbiased), Sampling Distribution of Sample Mean and Sample Variance (proof not required), Point Estimation. Overview of Testing of Hypothesis, Type I and Type II errors.

Module III  [10L]

**Numerical Analysis and Errors**
Introduction, Sources of Errors, Significant Figures: Absolute, Relative and Percentage Errors.

**Interpolation**
Introduction, Lagrange’s Interpolation Formula, Divided Differences and Properties, Newton’s Forward & Backward Interpolation Formula, Newton’s Divided Difference Formula, Error in Difference Table, Problems and Solutions.

**Numerical Differentiation and Integration**
Differentiation based on Newton’s Forward and Backward Interpolation Formula. Trapezoidal Rule and Simpson’s 1/3rd Rule, Errors in Numerical Integration Formulae, Problems and Solutions.

Module IV  [10L]

**Solution of System of Linear Equations**
Introduction, Gauss Elimination Method and Gauss-Seidel Method, Problems and Solutions.

**Solution of Algebraic and Transcendental Equation**

**Solution of Ordinary Differential Equations**
Introduction, Euler’s Method, Runge-Kutta Method (2nd and 4th order), Modified Euler’s Method, Problems and Solutions.
Text Books:
1. Statistical Methods (Volume 1 and 2) – N. G. Das, TMH.
2. Introductory Numerical Analysis – Dutta and Jana, Shreedhar Prakashani.

Reference Books:
Module I [10L]

Abstract Algebra
Overview of Discrete Mathematics, Set, Relations, Mappings, Poset, lattice, Hasse diagram, Vector Space.

Boolean algebra
Definition of Boolean algebra, Boolean function Simplification.

Mathematical Logic
Propositions, Connectives, Conditionals and Biconditionals, Well Formed Formulas (WFF), Tautologies, Equivalence formulas, duality law, Normal Forms, Predicate Calculus, free and bound variables.

Module II [10L]

Permutation and Combination

Generating-function and Recurrence-relation
Generating Function, Recurrence relations, Linear recurrence relations with constant Coefficients, Solution by Generating Function.

Module III [10L]

Graph Theory
Basic Concepts of Graphs, Trees, Forest, Adjacency and Incidence Matrices, Minimum Spanning Tree (Prim’s and Kruskals Algm), Shortest Path (Dijkstra’s Algm), Planar Graph. Various applications of Graph Theory in Computer Science.

Module IV [10L]

Mathematical Computing

Definition Of Grammars – Unrestricted grammar, Context-sensitive grammar, Context-free grammar, Regular grammar.

Text Books:
3. Discrete Mathematical Structures - Kolman, Busby and Ross, PHI.

Reference Books:
2. Graph Theory with Applications to Engineering and Computer Science - N. Deo, PHI.
3. Theory of Computer Science - K.L.P Mishra and N. Chandrasekaran, PHI.
Module I [10L]

Introduction to systems and Basic systems concepts, Types of systems, The systems Approach, Information systems-Definition and characteristics, types of Information, role of Information in Decision Making.

Introduction to Information Analysis and Design Tools-Decision Tree, Decision Table, Structured Analysis, Dataflow Analysis, Data dictionary, Structured Flow Chart, HIPO, Warnier/ORR diagram

Module II [10L]

An overview of Management Information System: Definition and Characteristics, Components of MIS, Hierarchy of Management Activity. Information requirements and Levels of Management, Model of decision making, structured Vs un-structured decisions, Formal vs Information systems

Module III [10L]

Storage and retrieval of data -transaction processing, office automation and information processing, Virtual office system, control functions, Decision making process, phases in the decision making process, Intelligence and design phases, concepts of decision making, Behavioral models of the decision maker/decision making

Module IV [10L]


Text Books:
1. Management Information System - W.S.Jawadekar, TMH.

Reference Books:
3. Management Information System - James O’Brien, TMH.
Module I [10L]
Communication Skill
Definition, nature & attributes of Communication
Process of Communication
Models or Theories of Communication
Types of Communication
Levels or Channels of Communication
Barriers to Communication

Module II [10L]
Business Communication- Scope & Importance
Writing Formal Business Letters
Writing Reports
Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular
Project Proposal
Technical Report Writing
Organizing e-mail messages
E-mail etiquette
Tips for e-mail effectiveness

Module III [10L]
Language through Literature
Modes of literary & non-literary expression
Introduction to Fiction, (An Astrologer’s Day by R.K. Narayan and Monkey’s Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Module IV [10L]
Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.

Text Books:
1. Theories of Communication: A Short Introduction - Armand Matterlart and Michele Matterlart, Sage Publications Ltd.

Reference Books:
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### Module I

Introduction to Linguistics  
Phonetics-Vowel and Consonant Sounds (Identification & articulation)  
Word-stress, Intonation (Falling and rising tone), Voice Modulation, Accent training  
Conversational Skills

### Module II

Writing Skill  
Writing Dialogue- (formal and informal)  
Descriptive, narrative and expository writing  
Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).  
Writing reports/essays/articles—logical organization of thoughts  
Job Application Letter  
CV& Resume  
Book review

### Module III

Major Areas of Formal, Verbal Communication  
Interpersonal Speaking & Public Speaking  
Group Discussion  
Oral Presentation, both technical and general  
Interview Techniques
1st Year 2nd Semester
Module I [10L]

*Introduction to Object Oriented Programming*

*Introduction to Java*

Module II [10L]

*Classes and Objects*

Module III [10L]

*Inheritance*

*Interface*
Defining Interfaces, Implementing Interfaces, Extending Interfaces, Interfaces and Multiple Inheritance.

*Package*
Using Packages, Java API, User Defined Packages, Classpath, Access Control.

Module IV [10L]

*Exception Handling*

*Multithreading*
Multitasking & Multithreading, Java and Multithreading, Creating Threads, Life Cycle of a Thread, Thread Methods, Thread Priorities, Synchronization and Deadlock.

*Excerpts from java.util and java.lang*
Garbage Collection, String Tokenizer, Collections API.
Text Books:
1. JAVA: The Complete Reference – Herbert Schildt, TMH.
2. Core Java I and II – Horstmann and Cornell, Oracle Corporation.

Reference Books:
1. Object Oriented Modeling & Design - James R. RumBaugh, PHI.
3. Java – How to Program – Deitel and Deitel, PHI.
Programs related to

- Language Features
- Arrays in Java and String Handling
- Classes and Objects
- Inheritance
- Interface and Package
- Exception Handling
- Multithreading
- java.util and java.lang
- Applet
Module I [8L]

**Introduction**
Concepts: Datatype and data structure, Abstract Data Type. Classification.

**Array**

**Linked List**
Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

Module II [8L]

**Stack and Queue**
Stack - implementation using array and linked list. Applications.
Queue, circular queue, deque - implementation using array and linked list. Applications.

**Recursion**

Module III [12L]

**Graphs**
Graph representations / storage – using adjacency matrix, adjacency list.

**Trees**
Basic Terminologies, tree representation – using array and linked list. Binary trees: traversal (pre-, in-, post-, level- order). Threaded binary trees. Huffman trees. Heaps – implementation of priority queue. Binary Search trees, AVL tree (insertion, deletion with examples only), B-tree (insertion, deletion with examples only), Trie (insertion, deletion with examples only).

Module IV [12L]

**Searching**
Sequential, Binary. Complexity analysis and comparison.

**Sorting**
Introduction – idea about internal and external sorting, in-place sorting, stability, adaptivity. Sorting algorithms - Bubble, Insertion, Selection, Shell, Quick, Merge, Heap, Radix. Complexity analysis (Average case analysis not required), and comparison.

**Hashing**
Hash Functions. Collision resolution – open and closed hashing.
Text Books:

Reference Books:
1. Data Structures -Seymour Lipshutz, McGraw Hill.
Programs related to

- 1-D and 2-D array
- Linked List (Singly linked list, Circular Linked List, Doubly Linked List)
- Stack and Queue implementation using array and linked list
- Implementation of different recursive algorithms
- Implementation of Binary Search Tree (insertion, deletion, searching, traversals)
- Different searching and sorting algorithms
Module I [10L]

Introduction to DBMS

Data Model
Data Modeling and Data Models, Importance of Data Models, Data Model Basic Building Blocks, The Evolution of Data Models, Degree of Data Abstraction.

Entity-Relationship Modeling
Entity and Entity Instances, Attributes, Entity Relationships, Cardinality of Relationships, Strong and Weak Entity, Generalization, Specialization, Aggregation, Developing an ER Diagram, Entity Integrity and Primary Key, Translating ER Model into Relational Model

Module II [10L]

Relational Model
A Logical View of Data, Keys, Integrity Rules, Relational Set Operators, Data Dictionary and the System Catalog, Relationships within the Relational Database, Data Redundancy Revisited, Indexes, Codd's Relational Database Rules.

Relational Database Design
Functional Dependency (FD) –Definition, Trivial and Non-Trivial FD, Closure of Set of FD, Closure Of Attribute Sets, Irreducible Set of FD, Canonical Cover, Normalization – 1NF, 2NF, 3NF, BCNF, Decomposition using FD, Lossless Decomposition, Dependency Preservation.

Module III [10L]

Relational Algebra
Select Operation, Project Operation, Join Operation, Division Operation, Cross Product Operation, Set operations.

Relational Calculus
Introduction, Tuple Relational Calculus, Operators used in TRC. Example queries using TRC, Domain Relational Calculus, Operators used in DRC, Example queries using DRC, Comparison of TRC, DRC, RA

Structured Query Language (SQL)
Introduction to SQL, DDL, DML, DCL, Basic Structure, Basic Queries, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, Assertions, Views, Joining Database Tables, Commit, Rollback.
Module IV [10L]

Advanced SQL
Subqueries and Correlated Queries, SQL Built in Functions - Numeric, Date, String Functions, Updatable Views.

Storage structure
Sequential and indexed file organization, B+ tree - creation, insertion & deletion.

Indexing
Primary, Secondary& Multi Level.

Text Books:
1. Database System Concepts - Korth, Silberschatz, S. Sudarshan, TMH.

Reference Books:
1. An Introduction to Database Systems - Date C. J, Addison-Wesley.
2. SQL-PL/SQL - Ivan Bayross, BPB.
Problems related to

1. Database Creation
   - Creating a Database
   - Creating a Table
   - Specifying Relational Data Types
   - Specifying Constraints
   - Creating Indexes

2. Table and Record Handling
   - INSERT statement
   - Using SELECT and INSERT together
   - DELETE, UPDATE, TRUNCATE statements
   - DROP, ALTER statements

3. Retrieving Data from a Database
   - The SELECT statement
   - Using the WHERE clause
   - Using Logical Operators in the WHERE clause
   - Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING

4. Clause
   - Using Aggregate Functions
   - Combining Tables Using JOINS
   - Subqueries

5. Database Management
   - Creating Views
   - Creating Column Aliases
   - Creating Database Users
   - Using GRANT and REVOKE
Module I [10L]

Introduction
The nature of Optimization Techniques, History, Meaning, Models, Principles Problem solving with mathematical models, optimization process.

Linear Programming
Basic LPP and applications, various components of LP problem formulation, Graphical Method, Simplex Method, Big-M method, Duality in linear programming.

Integer programming
Concepts, Formulation, Solution and Applications (Branch & Bound method).

Module II [10L]

Transportation Problem

Assignment Problem

Module III [10L]

Game theory

Network Optimizations
PERT/ CPM – Introduction, Significance of use, Network components and precedence relationship (AOA and AON diagram), Critical path analysis- Forward pass, Backward pass, Float(slack) of Activity and Event.

Module IV [10L]

Queuing Theory
Introduction, Basic definitions and notations, Structure of a Queuing system, Axiomatic derivation of the arrival & departure distributions for Poisson Queue, M/M/1 Queuing Model.

Sequencing Model
Introduction, Notation, Terminology and Assumption. Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of n jobs through m machines, Processing of two jobs through m machines.
Text Books:

Reference Books:
   2. Operations Research - Hillier & Lieberman, TMH.
Module I [12L]

Introduction to basic structures and operational concepts, Instruction formats, Instruction execution, sequencing, Addressing modes Control unit – Concepts, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction, Hardwired control, Microprogrammed control.

Module II [8L]

Fixed point Arithmetic - Arithmetic and logical operations of signed numbers and their implementation,
Hardware Multiplier, Booths’ multiplier, Booth pair multiplier, Binary Division restoring and non-restoring. IEEE-754 representation of floating point numbers, overflow and underflow.

Module III [10L]

Memory – Basic concepts, RAM, ROM – different types, Characteristics, Memory design (Linear addressing, interleaved memory) Cache memories, Performance (memory interleaving, hit rate etc.), Memory hierarchy - virtual memory – address translation, Secondary memories Data transfer through programmed I/O, interrupt and DMA, I/O processors.

Module IV [10L]

Input/output organization: memory mapped, standard (isolated) and linear selection techniques of I/O addressing.

Pipelining - arithmetic & instruction, speedup, vector processing, array processor, Introduction to RISC processor and parallel processing, Bit-Slice processors.

Text Books:

Reference Books:
1. Computer System Architecture-Morris Mano, PHI.
Module I [4L]

**Introduction to Business Management**
Basic concepts, Management Functions, Planning and decision making, scheduling, organizing, staffing, directing, controlling. Manager as Leader. Human Resource Planning, Human resource development and Organizational Development, Organizational Communication.

Module II [4L]

**Management for Organization**

Module III [17L]

**Accounting Principles & Financial Accounting**
Meaning and Scope of accounting, Accounting Concepts, Principles and Conventions, Accounting Standards – concepts, objectives, benefits, Accounting Policies, basic accounting equation, Accounting as a measurement discipline – valuation principles, accounting estimates. Financial accounting, rules of debit and credit, financial statements and analysis, seven basic steps of the accounting cycle for a sole proprietorship and a merchandising business using subsidiary ledgers and special journals. Books of Accounts leading to the preparation of Trial Balance, Journalize entries for uncollectible receivables including the direct write-off method and the allowance method.

Module IV [15L]

**Overview of Management and Cost Accounting**
Conceptual framework of Management Accounting, Meaning, Scope, Objectives and limitation. Cost–Volume profit analysis: Concept of break-even point, Profit volume relation, Margin of safety, Angle of incidence, Break-even point chart, Break even analysis. Introduction to cost accounting, meaning, objectives and advantages of cost accounting.

**Text Books:**
1. Management: A Systems Approach - Koontz and O’Donnel, TMH.
4. Management Accounting - I.M. Pande, VIKAS.

**Reference Books:**
2. Management Accounting - Khan & Jain, TMH.
2nd Year 1st Semester
Module I [10L]

**Introduction**
Algorithm specification, performance analysis - time and space complexity, asymptotic notations, Master theorem, Correctness of algorithms.

**Divide and Conquer**
General method, binary search, quick sort, merge sort, performance analysis; Strassen’s matrix multiplication.

**Lower Bound Theory**
Comparison tree, lower bound on comparison-based sorting, sorting in linear time, counting sort.

Module II [12L]

**The Greedy Method**
General method, fractional knapsack problem, job sequencing with deadlines, minimum cost spanning trees – Prim’s and Kruskal’s algorithms.

**Dynamic Programming**
General method, Shortest path algorithms – Bellman Ford, Floyd Warshall, 0/1 knapsack problem, traveling salesman problem.

Module III [8L]

**Traversal and Search Techniques**
Breadth first search and traversal, depth first search and traversal, bidirectional search.

**Pattern Matching**
Brute-force algorithm, Knuth-Morris-Pratt algorithm.

**Backtracking**
General method, 8 queens problem, graph colouring.

Module IV [10L]

**Branch and Bound**
General method, least cost search, 15-puzzles problem.

**Introduction to NP-completeness**
Basic concepts, the classes P, NP, NP-hard and NP-complete, Relative hardness of problems and polynomial time reductions. Satisfiability problem, Clique Decision Problem, Vertex Cover Problem.

**Approximation Algorithms**
Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes, approximation algorithms for vertex cover, travelling salesman problem.
Text Books:
1. Introduction to Algorithms - Cormen et al, PHI Learning.

Reference Books:
Programs related to

- (Divide and Conquer) Binary Search, Merge Sort, Quick Sort, finding maximum and minimum element from an array of integers
- (Greedy method) Minimum cost spanning trees by Prim’s and Kruskal’s algorithm, job sequencing with deadlines
- (Dynamic programming) single source shortest path – Bellman Ford, all pair shortest path – Floyd Warshall, traveling salesman problem
- (Graph traversal) BFS, DFS
- (Pattern matching) brute-force, KMP
- (Backtracking) 8 queens problem
- (Branch and Bound) 15 puzzles problem
Module I – Data Communication Fundamentals and Physical Layer [10L]

**Overview of Data Communication & Networking**

Introduction: Data Communication Systems, Networks, Protocols & Standards, The Internet


Connecting Devices: Repeater, Hub, Bridge, Switch, Router, Gateway

Switching: Overview of – Circuit Switching, Message Switching, Packet Switching, Virtual Circuit Switching

**Physical Layer**

Signals: Data & Signals, Data Rate Limits, Transmission Impairments

Digital Transmission: Line Coding, Sampling, Transmission Mode

Analog Transmission: Modulation of Digital Data, Modulation of Analog Signals

Multiplexing: FDM, TDM, WDM

Transmission Media: Guided Media, Unguided Media

Module II – Data Link Layer and MAC Sublayer [10L]

**Data Link Layer**

Framing: Character Stuffing, Bit Stuffing

Error Detection & Correction: Types of Error – Single Bit Error, Error Detection, Error Correction

Flow Control: Stop – And – Wait ARQ, Sliding Window Protocols

Data Link Layer Protocols: HDLC, PPP

**Medium Access Sub layer**

Random Access: ALOHA, Slotted ALOHA, CSMA/CD, CSMA/CA

Controlled Access: Reservation, Polling, Token Passing

LAN: Ethernet (Traditional, Fast and Gigabit), FDDI, DQDB

Module III – Network and Transport Layer [10L]

**Network Layer**

Internetworking, Addressing and Routing: Internetworking, Addressing (Internet Address, Classful Addressing, Subnetting), Routing (Static and Dynamic Routing, Distance Vector Routing, Link State Routing)

Network Layer Protocols: ARP, RARP, IP, ICMP and IGMP, IPv6

Network Monitoring and Management: Concepts of Wireshark and SNMP

Module IV – Application Layer and Miscellaneous Topics [10L]

**Transport Layer**

Congestion Control & Quality of Service: Data Traffic, Congestion and Congestion Control, Quality of Service (QOS), Techniques to improve QOS – Leaky Bucket and Token Bucket Algorithms

Application Layer
Application layer protocols: DNS, Telnet, FTP, SMTP, HTTP, WWW

Introduction to Network Security

Text Books:
1. Data Communications & Networking – B.A. Forouzan, TMH.
2. Computer Networks - Andrew S. Tanenbaum, Pearson Education.

Reference Books:
1. High speed Networks and Internets - William Stallings, Pearson Education.
UNIX AND NETWORK PROGRAMMING LAB

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**UNIX Fundamentals**
1. Basic UNIX Commands
2. Writing Shell Scripts

**Network Programming on the following (To be implemented in Java/C/C++)**
1. IPC: a) Pipes b) FIFO
2. File transfer using message queue form of IPC
3. TCP sockets (like date and time server & client, echo server & client, etc.)
4. UDP sockets (like simple DNS)
5. Raw sockets (like packet capturing and filtering)
6. Sliding window protocol and cyclic redundancy check
7. Routing protocols
8. Study of TCP/UDP performance
9. TCP client and server application to transfer file
10. UDP client and server application to transfer a file
11. RPC

**Testbed Development and Simulators**
1. Creating a LAN
2. Use of Network Simulators for Network Modeling (basic ideas/ demonstration only)

**Reference Books:**
1. Advance UNIX Programming - Richard Stevens, Pearson Education.
Module I [10L]

**Higher Normal Forms**
Overview of Lossless Join Decomposition and Dependency Preservation, Multi-valued Dependency and 4NF, Project-Join Decomposition and 5NF, domain-key and DKNF.

**Transaction Processing**
Transaction Concept and State, Implementation of Atomicity and Durability.

**Concurrency Control**
Executions, Serializability, Recoverability, Implementation of Isolation.
Multiple Granularity, Multiversion Schemes, Deadlock Handling.

Module II [10L]

**Recovery Management**

**Case Study: RDBMS Architecture**
Memory Structures, background processes, disk utilization structures, Starting and stopping the database instance, Creating a Database.

Module III [10L]

**Introduction to Procedural Language/Structured Query Language (PL/SQL)**

Module IV [10L]

**Introduction to Embedded SQL**
Pro*C syntax, Host variables, Static Vs. Dynamic SQL.

**Introduction to Distributed Database Management System**
Distributed DBMS Architecture, Distributed Query Processing, Distributed Concurrency Control, Distributed DBMS Reliability, Parallel Database Systems.

**Introduction to Temporal Database Management System**
Valid time and transaction time, Discrete bounded linear flow of time and the temporal structure, System-maintained transaction time, Temporal primary keys, Temporal queries at current time, Time points in the past or future or over durations.
**Introduction to Object-Oriented Database Management System**

Data types and Object, Evolution of Object Oriented Concepts, Characteristics of Object Oriented Data Model.
Object Hierarchies – Generalization, Specialization, Aggregation.
Object Schema. Inter-object Relationships, Similarities and difference between Object Oriented Database model and Other Data models.

**Concept of Grid, Cloud and Graph database.**

**Text Books:**
1. Database System Concepts – A.Silberschatz, Henry F. Korth, S. Sudarshan, TMH.
2. An Introduction to Database Systems - C.J. Date, Pearson.

**Reference Books:**
3. Distributed Databases Principles and Systems - Ceri, Pelagatti, TMH.
Problems on -

- **SQL**
  
  Creation of a database objects with constraints. Deletion and modification of database objects.
  
  Performing Insertion, Deletion, Modification, Alteration and Viewing records based on conditions.
  
  Creation of Views, Synonyms, Sequence, Indexes, Save points.

- **PL/SQL overview**
  
  - Structure of PL/SQL block.
  - Using PL/SQL variables, taking user input and displaying the output.
  - PL/SQL Control structures (Conditional control, Iterative control, Sequential control)
  - Built-in PL/SQL functions
  - PL/SQL composite datatype (Tables, ROWTYPE)
  - Subprograms
    - Procedures
    - Functions
  - Cursor Management
    - Implicit Cursor
    - Explicit Cursor
    - Cursor for-loop
  - Database Triggers
  - Error Handling
  - Packages

**Reference Books:**

1. SQL, PL/SQL The Programming Language of Oracle – Ivan Bayross, BPB.
## Paper Name: OPERATING SYSTEMS

### Paper Code: MCAP2104

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### Module I [8L]

#### Introduction
Introduction to Operating Systems, Concept of batch-processing, single and multi-programming, single and multi-processing, multi-tasking, real time, distributed and parallel processing.

#### Process and Scheduling
Concept of process, state diagram, process control block, Scheduling-short, medium and long term scheduling.

CPU Scheduling – criteria, types of scheduling, non-preemptive and preemptive scheduling algorithms like: First Come First Serve (FCFS), Shortest Job First/Next (SJF/N), Shortest Remaining Time Next (SRTN), Round Robin (RR), Highest Response Ratio Next (HRRN), Priority based scheduling, Multilevel queue scheduling, Multilevel feedback queue scheduling.

#### Threads
Concept, process vs thread, kernel and user threads, multi-threading models.

### Module II [12L]

#### Inter-process Communication
Shared memory approach, message passing, FIFO, concept of semaphore, critical region, monitor.

#### Process Synchronization
Concepts, race condition, mutual exclusion, critical section problem and its solutions; synchronization tools - semaphore, semaphore with queue, monitor; discussion of synchronization problems like producer-consumer, readers-writers, dining philosophers, sleeping-barber.

### Module III [10L]

#### Deadlock
Characterization, Prevention, avoidance, detection, recovery.

#### Memory Management
Address space and address translation; memory partitioning - static and dynamic, different types of fragmentation, swapping, paging, segmentation, virtual memory concepts, demand paging, performance, page replacement algorithms – FIFO, LRU, Optimal page replacement, variants of LRU; frame allocation, thrashing, working set strategy.

### Module IV [10L]

#### Disk Management
Disk structure, disk scheduling algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK; disk formatting, boot block, bad blocks.
**File Systems**
File and operations on it, file organization and access; file allocation; directory structures, file allocation methods – contiguous, linked, indexed; free space management – bit vector, linked list, grouping.

**I/O Management**
I/O hardware, polling, interrupts, DMA, application I/O interface – block and character devices, network devices, clocks and timers, blocking and non-blocking I/O; kernel I/O subsystem – scheduling, buffering, caching, spooling, error handling.

**Protection and Security**
Concepts of domain, Access matrix and its implementation, access control. Security concepts, program threats, system threats, threat monitoring, cryptography as security tool, user authentication.

**Text Books:**

**Reference Books:**
1. Operating Systems - Dietel, Dietel, Choffnes, Prentice Hall.
Module I [9L]

**Basic components of Environment & Ecology**
Basic ideas of environment and its component.
Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development.
General idea of ecology, ecosystem – components, types and function
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web.
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur].
Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

Module II [9L]

**Air pollution and control**
Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.
Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth’s heat budget, carbon capture, carbon footprint
Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth
Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN.
Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification
Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

Module III [9L]

**Water Pollution and Control**
Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides
River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD.
Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)
Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]
Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds]
Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic

**Noise Pollution**
Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level.
Noise pollution control.

**Module IV [9L]**

**Land Pollution**
Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste

**Social Issues, Health and Environment**
Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect)
Environmental impact assessment, Environmental audit, Environmental laws and protection act of India.
Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC)

**Text Books:**
1. Introduction to Environmental Engineering and Science – G.M. Masters, Prentice-Hall of India Pvt. Ltd.

**Reference Books:**
2. Basic Environmental Engineering and Elementary Biology - GourKrishna Das Mahapatra, Vikas Publishing House P. Ltd.
2\textsuperscript{nd} Year 2\textsuperscript{nd} Semester
Module I [10L]

Introduction
Introduction to software engineering, importance of software, the software evolution, software characteristics, software applications, software crisis: problem and causes.

Software Development Life Cycle
Waterfall model, incremental and evolutionary process models, specialized Model – The Unified Process, agile process, and agile models.

Software Requirement Specification
Problem analysis, requirement elicitation and validation, requirements modeling: scenarios, information and analysis classes, flow and behavioral modeling, documenting Software RequirementSpecification (SRS).

Module II [8L]

Software Cost Estimation

System Design
Design concepts, design models for architecture, component, data and user interfaces; Problem partitioning, abstraction, cohesiveness, coupling, top down and bottom up design approaches.

Module III [12L]

Structured Analysis and Design

Object Oriented Analysis and Design
OOAD basic concepts, Unified Modeling Language (UML) – different types of diagrams for different views of system, User view – Use case diagram with examples, Structural views – Class diagram with examples, Behavioral View – sequence, collaboration, Activity and State Chart Diagrams with examples. Implementation view-Component diagram, Environmental view- Deployment diagram, Functional versus Object Oriented Approach.

Coding
TOP-DOWN and BOTTOM-UP structure programming, information hiding, programming style, internal documentation, verification.
Module IV [10L]

Software Testing
Levels of testing, functional testing, structural testing, test plan, test case specification, software testing strategies, verification & validation, unit and integration testing, Top Down and Bottom Up integration testing, Alpha & Beta Testing, White box and black box testing techniques, system testing and debugging.

Software Maintenance
Types of maintenance – Corrective, Preventive, Adaptive. Change management and maintenance process.

Software Quality Assurance
Software Configuration Management, overview of software quality control and quality assurance, ISO 9000 certification for software industry, SEI Capability Maturity Model (CMM) and comparison between ISO & SEI CMM.

Overview of technical metrics for software and CASE tool.

Text Books:
1. Software Engineering: A Practitioner's Approach - Roger S. Pressman, TMH.
2. Fundamentals of Software Engineering – Rajib Mall, PHI.

Reference Books:
Problems related to

1. Identifying requirements from problem statements
2. Estimation of project metrics
3. Modeling UML Use Case Diagrams and capturing Use Case scenarios
4. E-R modeling from the problem statements
5. Modeling Data Flow Diagrams
6. Identifying domain classes from the problem statements
7. Statechart and Activity Modeling
8. Modeling UML Class Diagrams and Sequence Diagrams
9. Estimation of Test Coverage Metrics and Structural Complexity
10. Designing test suites using tools
Module I [10L]

**Introduction**
Internet Principles, concept of WWW, internet protocols and applications, web browser and web servers, features of Web 2.0

**Web Design**
Basic web concepts, Client/Server model, concepts of effective web design, web design issues including browser, display resolution, page layout and linking, user centric design, sitemap.

**Dynamic Web Pages**
The need of dynamic web pages; Comparative studies of different technologies of dynamic page creation.

**HTML**
Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, meta tags, character entities, frames and frame sets, browser architecture and web site structure. Overview and features of HTML5.

Module II [10L]

**Style sheets**
Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3

**Extensible Markup Language (XML)**
Introduction, tree, syntax, elements, attributes, validation, viewing. XHTML in brief.

**HTTP**
Message, request, response, methods, status codes.

Module III [10L]

**JavaScript**
CGI concepts, data types, variables, operators, conditional statements, array object, date object, string object.

**PHP**
Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string processing and regular expressions, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.
Module IV  [10L]

*PHP and MySQL*
Open Source Web server, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, updating and deleting data and tables, PHP myadmin and database bugs.

*Network security threats and techniques*
Threats: Malicious code, eavesdropping, spoofing, denial of service attacks. Techniques: VPN, password and authentication, firewall, proxies.

*Text Books:*

*Reference Books:*
1. HTML & CSS: Design and Build Web Sites - Jon Duckett, John Wiley & Sons.
2. PHP 6 and MySQL 5 for Dynamic Web Sites - Larry Ullman, Peachpit Press.
4. Internet Technology & Web Design – Satish Jain, BPB Publications
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**HTML**
1. Web page design using tables, frames, header, footer and menu.
2. Creating a form with support for redirection to other page(s).
3. Designing CSS with Bootstrap features to allow for responsive web content.

**JAVASCRIPT**
1. Create dynamic web pages by modifying features of HTML tags.
2. Validate the fields of a form.
3. Create simple animations.

**XML**
1. How to write a XML document.
2. How to validate XML document.

**PHP**
1. Writing methods to implement GET and POST requests.
2. Implementing cookies and sessions.
3. Writing PHP and HTML in open source environment.

**DATABASE CONNECTIVITY**
1. Connecting to database in web server.
2. Query processing to retrieve data from database and update tables.
Module I [10L]

Introduction
Basics of computer graphics, real world usage of computer graphics, classification of applications, display technologies, raster-scan systems, video controller, random-scan display processor, graphics input devices, graphics software and standard.

Graphics Primitives
Scan converting points.
Scan converting lines – DDA algorithm, Bresenham’s algorithm, Midpoint algorithm.
Scan converting circles – Midpoint algorithm.
Scan converting ellipse – Midpoint algorithm.
Fill area primitives–boundary-fill and flood-fill, scan-line polygon fill.

Module II [10L]

Affine Transformation (2D)
2D translation, rotation and scaling, homogeneous coordinates and matrix representation, composite transformations, reflection and shearing.

Viewing and Clipping
Viewing pipeline and coordinates system, window-to-viewport transformation, point clipping.
Line clipping algorithms - Cohen-Sutherland, Midpoint subdivision, Cyrus-Beck algorithms.
Polygon clipping – Sutherland Hodgeman algorithm, Weiler Atherton algorithm.

Module III [10L]

3D Transformation and Viewing
3D translation, rotation and scaling, composite transformations.
Projections - perspective and parallel projections, specifying an arbitrary 3D view.

Curves and Surfaces
Polygon surfaces, curved lines and surfaces, parametric cubic curves – Hermite curves, Bezier curves, Uniform Nonrational B-Splines, Nonuniform Nonrational B-Splines, comparisons of cubic curves, introduction to parametric bicubic surfaces.

Module IV [10L]

Visible Surface Detection
Classification of visible surface detection algorithms, back face detection, z-Buffer algorithm, scan-line algorithms, area subdivision algorithm, octree algorithms, visible-surface ray tracing.

Illumination and Shading
Illumination methods (ambient, diffused and specular reflection), constant and interpolated shading methods (Gouraud, Phong).
Text Books:

Reference Books:
1. Procedural Elements of Computer Graphics - Rogers, TMH.
The following set of experiments in this Lab will be conducted using C / OPENGL / JAVA in Windows / Linux Environment.

1. Implementation of algorithms for drawing 2D primitives –
   - Line (DDA, Bresenham, Midpoint)
   - Circle (Midpoint)
   - Ellipse (Midpoint).

2. Implementation of region filling algorithms – Boundary fill, flood fill.

3. 2D Geometric transformations –
   - Translation
   - Rotation
   - Scaling
   - Reflection
   - Shear
   - Composite 2D Transformations

4. Implementation of algorithms for line clipping –
   - Cohen-Sutherland
   - Midpoint subdivision
   - Cyrus-Beck

5. Drawing of curves – Cubic Bezier, B-Spline

6. Mini Project with animation
Module I [10L]

Introduction
Introduction to Intelligent Systems: concept, typical problems, practical impact, approaches and limits.

Intelligent Agents
Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, agent environment.

Problem Solving using Search - (Single agent)
State space search, explicit & implicit state space; Uninformed Search- search strategies, search tree, Breadth First Search, Uniform-cost search, Depth First Search; Informed search strategies – introduction, Hill Climbing search, Best First Search, Simulated Annealing, Genetic Algorithm Search, A* Search.

Module II [10L]

Problem Solving using Search - (Two agents)
Adversarial Search- and-or graph, AO* search, two agent games – minmax & game trees, refining minmax, Alpha-Beta pruning.

Constraint satisfaction problems (CSP)
Representation of CSP, solution of CSP, variable and value ordering, heuristic search in CSP.

Knowledge Representation and Logic (Propositional Logic)
Knowledge representation and reasoning, inference, rules of inference, using inference rules to prove a Query/Goal/Theorem, soundness and completeness.

Module III [10L]

Knowledge Representation and Logic (First Order Logic)
First Order Logic, unification, semantics, soundness, completeness, consistency, satisfiability; Inference in First Order Logic – resolution, proof as search, proof strategies, non-monotonic reasoning.

Knowledge Representation and Logic (Rule based Systems)
Rule Based Systems, Horn Clause Logic, Backward Chaining, Forward chaining, expert systems.

Other Representation Formalisms
Knowledge representation formalisms, semantic networks, inference in semantic networks; frame, inference in frame; script, inference in script.
Module IV [10L]

Planning
Introduction to planning, logic based planning, planning systems - representation of states and goals, representation of action; Planning algorithm - planning as search, Partial-Order planning, Plan-Space planning algorithms.

Reasoning with Uncertainty (Probabilistic reasoning)
Reasoning with uncertain information- Probabilistic reasoning, review of probability theory; Probabilistic inference rules; Bayesian Networks - semantics of Bayesian networks, learning of Bayesian Network parameters, inferencing in Bayesian Networks, approximate inferencing in Bayesian Networks.

Reasoning with Uncertainty (Fuzzy Reasoning)
Reasoning with uncertainty, the problem: Real-World Vagueness, Historic Fuzziness; Fuzzy Sets: Basic Concepts, operations on Fuzzy sets; Fuzzy reasoning - Fuzzy inferencing; applications.

Text Books:
1. Introduction to Artificial Intelligence and Expert Systems - Dan W. Patterson, PHI.

Reference Books:
1. Artificial Intelligence - Elaine Rich and Kelvin Knight, TMH.
Module I

**Human society and the Value System**
Values: definition, importance and application.
Formation of Values: The process of Socialization
   - Self and the integrated personality
   - Morality, courage, integrity

**Types of Values**
- Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
- Aesthetic Values: Perception and appreciation of beauty
- Organizational Values: Employee: Employer--- rights, relationships, obligations
- Psychological Values: Integrated personality and mental health
- Spiritual Values &their role in our everyday life
- Value Spectrum for a Good Life, meaning of Good Life

**Value Crisis in Contemporary Society**
Value crisis at----
   - Individual Level
   - Societal Level
   - Cultural Level
Value Crisis management --- Strategies and Case Studies

Module II

Ethics and Ethical Values
Principles and theories of ethics
Consequential and non-consequential ethics
Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives
Ethics of care, justice and fairness, rights and duties

**Ethics**
- Standardization
- Codification
- Acceptance
- Application

**Types of Ethics**
- Ethics of rights and Duties
- Ethics of Responsibility
- Ethics and Moral judgment
- Ethics of care
- Ethics of justice and fairness
- Work ethics and quality of life at work

**Computer Ethics**
Introduction to computer ethics, Computers used in the social context, Moral and legal issues
Professional relationships, conflicting responsibilities, code of ethics and professional conduct, collective responsibilities
**Ethics and the Internet**
Hacking and Hacker Ethics, Ethics and Criminality, Policy Approaches
Social implications and social values: Technology and Social change, embedded values, enhanced and impeded values, Democratic values in the Internet, Access and the digital divide, free expression.

**Privacy**
understanding the computers and privacy issue- global perspective proposals for better privacy protection.
Property rights in computer software, philosophical basis of property, proprietary software-legal and philosophical issues.

**Whistle Blowing**
Facts, contexts, justifications and case studies

**Module III**

**Science and Technology**
Science, Technology as knowledge and profession
--- Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non-renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types
The Indian Context

**Module IV**

**Environment and Eco-friendly Technology**
Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development Reports of Club of Rome.

**Suggested Readings:**
Module I - Professional Growth

- Self Growth: Anger, stress and time management - Theories and application, SWOT analysis.
- Growth and Environment: Impression management, Cross-cultural communication, Employability quotient
- Skill identification and Skill up gradation - (generic and specific), Local and global skills, Knowledge sources such as MOOC, NPTEL
- Career Planning - Skill mapping to job profile, Basic and add-on qualifications, Career growth, Self-appraisal, Lifelong learning

Assessment - Activity (20 marks)

Module II - Entrepreneurship

- The start-up ecosystem in India - Why entrepreneurship? Indian tech start-up landscape, Stand-up India policies, funding agencies, market development, trends and best practices
- E-Commerce - India as a growing E-commerce market, Possibilities of growth, funding, niche retailers
- Make in India - New processes, Investments, Focus sectors, Makers of Make In India, Opportunities, Policies

Assessment - Project (30 marks)

Module III - Industry specific opportunities

- Industry prospects in India and Beyond
- Industry-specific job opportunities
- Research & Development
- Other opportunities

Assessment --- Presentation (30 marks)

Module IV - Working and living happily

- Managing crisis - Organisational and personal crisis, Analysing crisis, Turnaround strategies, Learning from crisis as opportunity
- Work-life balance - Performance-expectation management, Personal and professional goal-mapping
- Understanding happiness - Components, Conflicts, Happiness Index

Assessment: Activity/case (20 marks)
Suggested Readings:

4. Crisis Management: Planning for the Inevitable - Steven Fink, iUniverse Inc.USA.
3\textsuperscript{rd} Year 1\textsuperscript{st} Semester
Module I [8L]

**Introduction to Linux**
Basic idea on proprietary, Open source, Free software; Introduction of various Linux variants and comparative study; Basic architecture of Linux system. Linux file system, Boot block, Super block, Inode table, Data blocks, Linux file access, Storage files, Standard directories, LILO, GRUB boot loader; Installation of Linux system, init and run levels.

Module II [11L]

**Linux Basics**
Login process, Creating user account and group, Getting help. Services and process, Files and file system, Working with files: Reading, Searching, Copying, Moving, Renaming, Deleting, Linking, and Editing files; Disk related commands. Various types of shell available in Linux and their comparisons, Shell programming in bash.

Module III [10L]

**System Administration**
Common administrative tasks, Identifying administrative files – Configuration and log files, Role of system administrator, Managing user accounts and groups, Creating and mounting file system, Checking and monitoring system performance, File security and permissions, Concepts of Super user; Getting system information. Backup and restore files, Reconfiguration hardware with kudzu, Installing and removing packages in Linux.

Module IV [11 L]

**Networking in Linux**
Installation and configuration of a simple LAN; Installation and configuration of: Proxy server (Squid), DNS server (BIND), Mail server, Web server (Apache), File server (Samba), DHCP server; Installation and configuration of SSH server and client, FTP server and client. Setting up Linux for firewalling, IP accounting.

**Text Books:**
1. Linux Administration: A Beginner’s Guide - Shah, TMH.
2. LINUX: The Complete Reference - Petersen, TMH.

**Reference Books:**
1. Red Hat LINUX-Administrator’s Guide - Cox, PHI.
2. LINUX Network Administrator’s Guide - Kirch, SPD/O’ REILLY.
3. Essentials System Administration - Frisch, SPD/O’REILLY.
1. Experiment on packet monitoring software (tcpdump, snort, ethereal)
2. Experiment on using trace route, Ping, Finger, Nmap
3. Server configuration (FTP, SMTP, DNS)
4. NFS configuration
5. Firewall configuration using iptables/ipchains.
Module I [10L]

**GUI Programming: Swing**
Swing components and containers, Layout managers, Menu, Event-Driven programming, Event handling mechanism, Event delegation model, Event classes, Event sources, Event listeners, Adapter classes.

**Database Programming: JDBC**
Introduction to JDBC, JDBC drivers & architecture, Different approaches of connection, Establishing database connection and executing SQL statements, JDBC prepared statements, JDBC data sources.

Module II [10L]

**Server Technologies: Servlet**

Introduction to servlet, Servlet life cycle, Developing and deploying servlets, Exploring deployment, Descriptor (web.xml), Handling Request and Response, Servlet Chaining, Session tracking and management, Dealing with cookies, Servlet Listeners.

Module III [10L]

**Server Technologies: JSP**
Comparison between JSP & servlet, Basic JSP architecture, JSP life cycle, JSP tags and expressions, Role of JSP in MVC-2, JSP with database, JSP implicit objects, Tag libraries, JSP Expression Language (EL), Using Custom tag, Exception handling, Session management, Directives.

**RMI (Remote Method Invocation)**
RMI overview, RMI architecture, Example demonstrating RMI

Module IV [10L]

**Enterprise JAVA Beans**

Text Books:
2. Professional JAVA Server Programming – Allamaraju and Buest, SPD Publication.

Reference Books:
1. Beginning J2EE 1.4 – Ivor Horton, SPD Publication.
2. Advanced Programming for JAVA 2 Platform – Austin and Pawlan, Pearson
3. Internet & Java Programming - Krishnamoorthy and S. Prabhu, New Age Publication
Programs related to

- Programming using Swing and Event handling
- JDBC connectivity
- Servlet programming
  - RequestDispatcher
  - sendRedirect
  - GET and POST methods
  - Cookies
  - Sessions
- JSP design
  - page, include, taglib
  - scripting elements
- Remote Method Invocation: programs to provide the mechanism by which the server and the client communicate and pass information back and forth
- JavaBeans
  - useBean action tag
  - getProperty
  - setProperty
  - programs to implement to dynamically generate HTML, XML or other types of documents in response to a web client request
Module I [8L]

Introduction
Overview of image processing, Application area of image processing, Digital image representation, Fundamental steps in image processing, Components of an image processing system. Sampling and quantization. Basic relationship between pixels – Neighbours, Adjacency, Connectivity, Regions, Boundaries and distance measures. Introduction to Fourier transform and Discrete Fourier transform, Properties of 2D Discrete Fourier transform.

Module II [12L]

Image Enhancement

Module III [10L]

Image Restoration
Model of image degradation/restoration process, Noise models, Image restoration in presence of noise only – Spatial filtering, Periodic noise reduction by frequency domain filtering – Bandreject and bandpass filtering. Inverse filtering, Least mean square error filtering, Constrained least squares filtering.

Image Compression

Module IV [10L]

Image Segmentation
**Image Representation**

Representation: Chain codes, Polygonal approximation. Boundary descriptors. Regional descriptors.

**Text Books:**

**Reference Books:**
2. Digital Image Processing and Analysis - Chanda, Majumder, PHI.
1. Reading, writing, and displaying images, Conversion from RGB to gray images.
3. Contrast stretching.
4. Image histogram and histogram equalization.
6. Fourier transformation of images.
7. Frequency domain filtering.
8. Point detection, Line detection and edge detection.
9. Thresholding – Local, Global, Optimum, Multiple and variable.
10. Region growing, Splitting and merging.
Module I [10L]

Introduction to Security
Security goals, Threats, Vulnerabilities and attacks, Types of attacks, Security services and mechanisms.

Mathematical Foundation
Number theory, Congruencies, Modular Arithmetic, Chinese Remainder theorem, Fermat and Euler’s theorem, Finite Fields, Discrete Logarithm.

Module II [10L]

Symmetric Key Encryption
Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers, Simple DES, DES analysis, Double and Triple DES, RC4, RC5, AES.

Module III [10L]

Asymmetric Key Encryption and Hash Functions
Diffie-Hellman Key Exchange, ElGamal Public Key Encryption, RSA, Elliptic Curve based cryptography, SHA4, SHA5, MD5, Digital signature.

Module IV [10L]

Network Security Applications
Authentication applications: Kerberos, X509, Public Key Infrastructure. Electronic mail security – PGP, S/MIME. IP and Web security – IPSec, SSL, TLS, SET.

System Security
Intruders, Malicious software, Viruses, Worms, Bots, Rootkits, Firewalls, Security standards.

Text Books:

Reference Books:
Module I [12L]

*Basic concepts*
Types of languages and grammars.

*Regular Language and Grammars*
Regular language, Regular expression, Regular grammar, Right and Left Linear Grammar, Closure property of regular languages, Pumping lemma, Properties of regular expressions, DFA, NFA and their equivalence. Identifying non regular languages, reduction of number of states, equivalence between regular language and regular grammars.

Module II [10L]

*Context free Language and Grammar*
Context free language, Context free grammar, Derivation tree, Left most and right most derivation, Parsing and ambiguity, Chomsky and Greibach Normal Form, Pumping Lemma, Properties of CFL including closure property.

Module III [10L]

*Pushdown Automata (PDA)*
PDA, NPDA as recognizer of CFL.

*Context Sensitive Language and Grammars*
Context sensitive language, Context sensitive grammars, Matrix grammar, Markov algorithm, L-Systems. Recursive and recursively enumerable languages, Recursive functions, Ackerman’s functions, r-recursive functions.

Module IV [8 L]

*Turing machine and thesis*
Non Deterministic Turing Machine, Universal Turing Machine, Computability and decidability, Undecidable problems: Halting problem of TM, Post correspondence problem, Undecidable problems of CFL, Post systems.

**Text Books:**
2. Theory of Computer Science - Mishra, Chandrashekharan, PHI.

**Reference Books:**
Module I [8L]

Introduction
Introduction to Big Data - Characteristics and foundation of Big Data. The need for Big Data analysis. Industry use cases for Big Data.
Statistical concepts: Populations and samples, Statistical modeling, Probability distribution, Fitting a model.

Module II [12L]

Big Data Architecture: Storage and analysis
Introduction of Hadoop and other Apache Big Data Tools, Hadoop cluster, HDFS Operations and HDFS file formats.
Introduction to Hadoop MapReduce Architecture and Programming.

Module III [12L]

Data extraction, transformation and loading mechanism
Introduction to Apache Sqoop - Data import and export mechanism.
Introduction to Hive, HQL and Hive operations.
Introduction to Pig and Pig scripting.

Module IV [8L]

Data visualization
Visualization using Tableau - Design reports, Dashboards etc
Case studies- Project initiation, Conceptualization, Design and environment preparation etc.

Text Books:
1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data - EMC Education Services, John Wiley & Sons.

Reference Books:
1. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die - E. Siegel, Wiley.
Module I [10L]

Introduction
Introduction to mobile computing, Mobile communication vs. wireless communication, Mobile computing applications, Characteristics of mobile computing, Structure of mobile computing application.

Wireless MAC Protocols
Wireless MAC issues: Motivation for a specialized MAC (Hidden and exposed station problem, Near-far station), Channel assignment scheme (static and dynamic), Random assignment schemes, Reservation based schemes.

Module II [10L]

Mobile Network Layer
Mobile IP (Goals, Assumptions, Entities and terminology), IP packet delivery, Agent advertisement and discovery, Registration, Route optimizations.

Mobile Transport Layer
Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit/Fast Recovery, Transmission /Time-out Freezing, Selective Retransmission, Transaction Oriented TCP.

Module III [10L]

Mobile Telecommunication Systems
Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS), Long Term Evolution (LTE).

Module IV [10L]

Mobile Ad-Hoc Networks

Text Books:

Reference Books:
2. Introduction to Wireless and Mobile systems – D. P. Agarval, Qing and An Zeng, Thomson Asia Pvt Ltd.
Module I [8L]

Introduction
Introduction to soft computing, Different tools and techniques, Usefulness and applications.

Genetic algorithm (GA)
Basic concepts, Working principle, Encoding, Fitness function, Genetic modeling: Inheritance, Selection, Cross over, Mutation, Bitwise operator, Convergence of GA, Overview of Multi-Objective Genetic Algorithm (MOGA).

Module II [10L]

Neural Network
Structure and function of biological neuron, Artificial neuron, Definition of Artificial Neural Network (ANN), Taxonomy of neural net, Difference between ANN and human brain, Characteristics and applications of ANN, Single layer network, Multilayer Perceptron (MLP), Linear separability, Different activation functions, Back propagation algorithm, Basic concept of convolution and recurrent neural network, Applications of neural networks.

Module III [12L]

Fuzzy sets and Fuzzy logic systems
Overview of classical set theory, Fuzzy sets and Fuzzy relations, Fuzzy set operations, Properties of Fuzzy sets, Cardinality, Properties of Fuzzy relations.

Membership functions
Features of membership functions, Standard forms and boundaries, Standard Fuzzification methods.

Fuzzy to Crisp conversions
Lambda cuts for Fuzzy sets, Fuzzy relations, Defuzzification methods, Overview of classical predicate logic, Fuzzy logic, Approximate reasoning and Fuzzy implication.

Fuzzy rule based systems:
Linguistic hedges, Fuzzy rule based system–Aggregation of Fuzzy rules.

Module IV [10L]

Rough Set
Introduction to Rough sets, Decision table, Indiscernibility relations and set approximation, Reducts & Core, Rough approximation, Decision matrix, Application of Rough set.

**Evolutionary Algorithm**
Introduction, Key principles of swarm, Overview and application of - Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial bee colony optimization (ABC)

**Text Books:**
1. Fuzzy logic with Engineering Applications - Timothy J. Ross, John Wiley and Sons.

**Reference Books:**
3. Artificial Neural Networks - B. Yegnanarayana, PHI.
Module I [8L]

Introduction
Overview of Data mining - definition, Data mining functionalities, Issues and challenges, Knowledge discovery process, Data preprocessing, Basic concepts of data mining in a Data warehouse environment.

Association Rules
Market basket analysis, Apriori algorithm, FP – tree growth algorithm, generalized association rule.

Module II [12L]

Data Mining Techniques and Decision Tree
Introduction of data mining techniques, Example of classification problem, Decision tree induction model over fitting pre-pruning, post-pruning, Rule-based classification.

Classification Techniques
Bayesian classification, Neural network, K-nearest neighbor, Support vector machine.

Module III [10L]

Clustering Techniques
Clustering paradigm, Partition algorithms, K-means, Fuzzy C-means, Hierarchical clustering, DBSCAN.

Data Mining Applications
Benefits of data mining, discussion on applications in real time system.

Module IV [10L]

Introduction to Data warehouse
Data warehousing – definitions and characteristics, DBMS schemas for decision support, Data warehouse life cycle, Building a data warehouse, Data Warehousing components and architecture, Warehouse schema, Data marts, OLTP and OLAP systems, OLAP tools.

Designing the Data Warehouse
Data Design - design decisions, Basics of dimensional modeling, Star schemas, Data warehouse design examples.

Text Books:
1. Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson Publishers.
2. Data Mining: Concepts and Techniques - Jiawei Han and Micheline Kamber, Elsevier.

**Reference Books:**
1. Data Warehousing – Concepts, Techniques, Products, Application - Prabhu, PHI.
3. Data Warehousing, Data Mining and OLAP - Alex Berson and Stephen J Smith, TMH.
4. Data Warehousing in the Real World - Anahory, Pearson Education.
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Module I [10L]

**Introduction**
Evolution of the computing paradigm, Overview of Ubiquitous Computing and its challenges.

**Advanced Networking Technologies**
NFC, Wireless Networking basics (Bluetooth, WiFi Direct, ZigBee).

Module II [10L]

**Location Aware Computing**
Personal Assistants, Location tracking, Architecture, Location based service and applications, Location based networks.

**Context-aware Computing**

Module III [10L]

**Privacy in Ubiquitous Computing**
Understanding Ubicomp Privacy, Technical solutions for Ubicomp Privacy.

**Ubiquitous Computing Applications**
Wearable Computing, Human activity and emotion sensing, Health Apps, Mobile p2p computing, Smart Homes and Intelligent Buildings.

Module IV [10L]

**IoT and Cloud**
Definition, Trend, IOT components, IOT applications, Open challenges, Architecture, Energy efficiency, Participatory sensing, New protocols, QoS, QoE.

**Text Books:**

**Reference Books:**
Module I [10L]

*Introduction to Parallel Computing*
Motivating parallelism, Scope of parallel computing, Pipelining and vector processing.

*Parallel Hardware and Parallel Software*
Some background - von Neumann architecture, Processes, Multitasking, and Threads, Modifications to the von Neumann model, Virtual memory and instruction-level parallelism, Hardware multithreading.
Parallel hardware – Flynn’s taxonomy, Interconnection networks, Cache coherence, Shared-memory versus distributed-memory.
Parallel software – Caveats, Coordinating the processes/threads, Shared-memory, Distributed memory, Programming hybrid systems.
Performance - Speedup and efficiency, Amdahl’s law, Scalability, Taking timings, Parallel program design example.
Parallel processing terminology - Data parallelism, Control parallelism.

*Parallel Methods for Data Sorting:*
Bubble sort - Sequential algorithm, Odd-Even transposition algorithm, Computation decomposition and analysis of information dependencies, Efficiency analysis.

Quick sort - Sequential algorithm, Parallel quick sort algorithm, Parallel computational scheme,
Efficiency analysis.

Module II [10L]

*Parallel Program Development*

*Parallel Methods for Matrix-Vector Multiplication*

*Parallel Methods for Matrix Multiplication*
Problem statement, Sequential algorithm, Data distribution - Block-Striped data decomposition, Checkerboard data decomposition (Fox algorithm, Cannon algorithm); Analysis of information dependencies, Efficiency analysis.

*Parallel Methods for Solving Linear Equation Systems*
Gauss elimination algorithm and Gauss-Seidel algorithm, Problem statement, Sequential algorithm, Analysis of information dependencies, Efficiency analysis.
Module III [10L]

Introduction to Distributed Computing
Why distributed computing, Parallel vs. distributed computing.

Models of Distributed Systems
Synchronous vs asynchronous systems, Inter process communication models (shared memory and message-passing models, agent-based models), complexity measures.

Program Correctness
Safety and liveness properties, atomicity, non-determinism, fairness.

Time and Clocks
Causality and concurrency, physical, logical and vector clocks, clock synchronization.

Distributed Mutual Exclusion
Lamport’s algorithm, Ricart-Agrawala’s algorithm, Suzuki-Kasami’s token-passing algorithm.

Distributed Snapshot and Global States
Consistent snapshots, Chandy-Lamport’s distributed snapshot algorithm, Termination detection: Dijkstra-Scholten’s algorithm, Distributed deadlock detection.

Module IV [10L]

Distributed Algorithms for Graphs
Routing algorithms (Shortest path, distance-vector, and link-state algorithms), Spanning tree and minimum spanning tree, Graph colouring algorithms.

Faults and Fault-tolerance
Classifications of faults and fault-tolerance, Triple modular redundancy, Sliding window protocols, how TCP works.

Distributed Consensus
The Byzantine Generals problem, Fault-tolerant state machines.

Replicated Data Management
Data consistency models: linearizability, Sequential consistency, Causal consistency, Eventual consistency.

Selected topics from Applications
Peer-to-Peer (P2P) networks, Sensor Networks, Cloud computing.

Text Books:
**Reference Books:**
1. Introduction to Parallel Computing – Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Addison Wesley.
2. Introduction to Parallel Processing - Sashi Kumar, PHI.
Module I [10L]

Compilation Basics
Analysis of the source program, Different phases of compilation. One / Two pass compilers.

Lexical Analysis
The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering. Specifications of a token, Token recognition, Lexical Analyzer Generator (Lex).

Finite Automata
Conversion from Regular Expression (RE) to NFA, NFA to DFA, Regular expression to DFA.

Module II [10L]

Language and Grammar
Chomsky Classification of grammar, Context free grammars.

Syntax Analysis
The role of a parser, Top down parsing, Nonrecursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

Module III [10L]

Syntax Directed Translation
Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Run Time Environment
Run time environments Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, Dynamic storage allocation techniques.

Module IV [10L]

Intermediate Code Generation
Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).
**Code Optimization & Final Code Generation**


**Text Books:**
2. Compiler Design in C - Allen Holub, Prentice Hall.

**Reference Books:**
2. Engineering a Compiler, Keith Cooper, Linda Torczon – Morgan Kauffman.
3. Compiler Design - Santanu Chattopadhyay, PHI.
Module I [10L]

**Introduction to E-Commerce**
Definition, Scope, Advantages and disadvantages of e-commerce, Electronic Commerce applications. E-Commerce Organization model based on transaction type, Model based on Transaction Party. E strategy: Overview, Strategic methods for developing E-commerce. Four C’s: (Convergence, Collaborative computing, Content Management & Call Center). Electronic payment systems: Digital payment systems; First virtual Internet payment system; Cyber cash model.

Module II [9L]

**E-Payment Mechanism**

Module III [10L]

**Enterprise Resource Planning (ERP)**
Introductory concepts: Scope, Benefits, Importance of ERP in the E-Business era. Supply Chain Management: Role of ERP in SCM, ERP features and capabilities. Overview of commercial software, Re-engineering work processes for IT applications, Business process redesign, Knowledge engineering and data warehouse, Advantages & disadvantages of ERP.

Module IV [11L]

**ERP Business Modules**

**Text Books:**
Reference Books:
2. E-Commerce An Indian Perspective - P.T. Joseph, PHI Publication.
4. Enterprise Resource Planning - Mary Sumner, PHI Learning India Pvt. Ltd.