MCA-101
Data Structures and Algorithms

Max. Marks: 100 (80+20) *Time: 3Hrs*

Note: *Examiner will be required to set NINE questions with all questions carrying equal marks. Question Number 1, covering the entire syllabus, will be compulsory. Examiner will set two questions from each Unit with internal choice. Student will be required to attempt FIVE questions in all, selection one question from every unit apart from the Question Number 1.*

UNIT-I

Introduction: Data Types: Primitive, Composite and Abstract Data Types, Data Structures: Concept, Classification, and Importance; Data Structures v/s Data Types, Linear v/s Non-Linear Data Structures.

Arrays: Single and Multidimensional arrays; Address Calculation using Column and Row major ordering; Various operations on Arrays; Vectors; Sparse Matrix; Application of Arrays; Implementation of Arrays in C/C++.

UNIT-II

Stacks and Queues: Representation of stacks and queues using arrays and linked-list. Circular queues. Priority Queue and D-Queue. Applications of stacks: Conversion from infix to postfix and prefix expressions. Evaluation of postfix expression using stacks; Implementation in C/C++.

Linked list: Singly Linked List; Operations on Linked Lists. Linked Stacks and Queues. Polynomial Representation and Manipulation using Linked Lists. Circular Linked Lists. Doubly linked lists; Implementation in C/C++.

UNIT-III

Trees: Concept, Representation and Applications of Trees, Forest, Binary Tree, Threaded Binary Tree; Binary tree representation of a general tree; Conversion of forest into tree; Binary search tree: Height balanced (AVL) tree, B-trees, B+ Tree, B* Tree.

Binary tree traversal methods: Pre-order. In-order. Post-ordered traversal. Recursive Algorithms.

Heap: Heap operations. Binomial heaps. Fibonacci heaps. Skew heaps, heap set.

UNIT-IV

Graphs: Representation: Adjacency matrix, Adjacency lists; Type of Graphs; Paths: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning.

Graph Algorithms: Breadth-First Search, Depth-First Search; Minimum Spanning Trees: Prim's and Kruskal's algorithms; Shortest-path Algorithms: Dijkstra's and Floyd's algorithm; Topological sort, Maxflow: Ford-Fulkerson algorithm, max flow -min cut.

Textbooks & References:

1. Hubbard JR: Schaum’s outline of Data Structures with C++. TMH.
2. R.Kruse, C.LTonodo and B.Leung: Data Structures and Program Design in C, Pearson Education.
3. S.Chottopadhyay, D.Ghoshdastidar & M.Chottopadhyay: Data Structures Through 'C Language. BPB Publication.
4. E. Horowitz, Sahni and D. Mehta: Fundamentals of Data Structures in C++. Galgotia Publiction.
5. Y.LangsaiiL M.J.Augenstein and A.M.Tanenbaum: Data Structures Using C and C++, Prentice Hall of India.

MCA-102

System Software and Operating System

Max. Marks: 100 (80+20) *Time: 3Hrs*

Note: *Examiner will be required to set NINE questions with all questions carrying equal marks. Question Number 1, covering the entire syllabus, will be compulsory. Examiner will set two questions from each Unit with internal choice. Student will be required to attempt FIVE questions in all, selection one question from every unit apart from the Question Number 1.*

UNIT-I

Introduction: System V/s Application Software, Relative advantage and disadvantages of Machine, Assembly and High-Level Languages; Language Translators: Assembler, Compiler and Interpreter; Macros, Debuggers, Text editors, Debug monitor; Overview of Loading, Linking and Relocation.

Basics of Operating Systems: Evolution, Objectives & Functions, Characteristics; Classification of Operating Systems, Windows v/s Linux Operating Systems, Mobile Operating Systems, Network based Operating Systems.

Process Concepts: Definition, Process Relationship, Process states, Process State transitions, Process Control Block, Context switching.

UNIT-II

Threads: Multicore Programming, Multithreading Models, Threading Issues.

Process Scheduling: Definition, Preemptive v/s Non-preemptive Scheduling, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, RR etc; Multiprocessor scheduling, Scheduling Algorithm Evaluation.

Process Synchronization: Critical Section Problem, Peterson's Solution, Hardware Solution, Semaphores, Classical Problems of Synchronization: Reader's & Writer Problem, Dinning Philosopher Problem; Monitors.

UNIT-III

Deadlocks - System Model. Deadlock Principles, Deadlock Characterization. Methods for Handling Deadlocks Deadlock Prevention, Deadlock Avoidance: Resource Allocation Graph Algorithm, Banker's Algorithm; Deadlock Detection, Recovery from Deadlock.

Memory Management: Basic Memory Management, Logical and Physical address map, Memory allocation, Fragmentation and Compaction, Paging and its disadvantages, Virtual Memory, Locality of reference, Page Fault, Working Set, Demand paging concept, Page Replacement policies.

Overview of Input/Output & File Management, Disk Scheduling Algorithms.

UNIT-IV

Linux Operating System: Design Principles, Kernel Modules, Shells, Editors, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Interprocess Communication, Network Structure.

Linux Utilities: File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text Processing utilities and backup utilities.

Shell programming: Introduction, shell responsibilities, pipes and Redirection, Running a shell scripts, The shell as a programming language, Shell meta characters, File name substitution, Shell variables, Command substitution, Shell commands, The environment, Quoting, Test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

Textbooks & References:

1. Silberschatz & Galvin: Operating System Concepts. Wiley.
2. A.S. Tanenbaum: Modem Operating Systems, Pearson/PHI.
3. Dhamdhere: Operating Systems, Tata McGraw Hill.
4. William Stallings: Operating Systems. PHI.
5. Yashawant Kanetkar: Unix Shell Programming. BPB.
6. Jason Cannon: Linux For Beginners.

MCA-103

Object Oriented Programming Using C++

Max. Marks: 100 (80+20) *Time: 3Hrs*

Note: *Examiner will be required to set NINE questions with all questions carrying equal marks. Question Number 1, covering the entire syllabus, will be compulsory. Examiner will set two questions from each Unit with internal choice. Student will be required to attempt FIVE questions in all, selection one question from every unit apart from the Question Number 1.*

UNIT-I

Introduction: Software crisis, Evolution of Programming Paradigms: - Procedural, Structured, Function-oriented, Object based and Object-Oriented Programming Languages; Functional Abstraction v/s Data Abstraction, Object Oriented Programming Paradigm: concept of Classes, Objects, Data Encapsulation, Inheritance, Polymorphism, Dynamic Binding and Message Passing.

Recap of C++: C vs C++, Why named C++, Tokens, Keywords, Identifiers, Constants, Data Types: Basic, User Defined and Derived, Type Compatibility, Declaring Variable, Dynamic Initialization of Variables, Reference Variables, Operators not in C but available in C++, Operator Precedence, Special Assignment Expressions, Implicit Conversion, Control Structures in C++, Structure of C++ program.

Functions in C++: Role of Main Function, Function Prototyping, Call by Reference and Return by Reference, Default Arguments, const Arguments, Function Overloading.

UNIT-II

Classes & Objects: C struct v/s C++ struct, Specifying Class, Implementing Data Hiding and Data Encapsulation through **private** and **public** Access Specifiers, Defining Member Functions, Inline Functions, Nesting of Member Functions, Arrays within Class, Creating Objects, Array of Objects, Memory Allocation for Objects, Static Data Members and Member Functions, Objects as Function Arguments, Returning Objects, Friendly Functions, **const** Member Functions, Pointers to Members, Local Classes.

Constructors: Concept, Purpose and Usage, Type of Constructors in C++: Default, Parameterized and Copy Constructors, Overloading of Constructors and Multiple Constructors, Constructors with Default Arguments, Dynamic Initialization of Objects, Dynamic Constructors, **const** Objects.

Destructors: Concept, Purpose and Usage.

UNIT-III

Inheritance: Concept of Reusability, Defining Derived Class, **protected** Access Specifier, Inheritance Types in C++: Single, Multilevel, Multiple, Hierarchical and Hybrid Inheritance; Ambiguity Resolution in Multiple Inheritance, Virtual Base Class, Abstract Class, Constructors in Derived Classes, Member Classes.

Operator Overloading: Concept, Operators that can't be overloaded, Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators using Member Functions and Friend Functions, Rules for Operator Overloading, Operators where Friend Function cannot be used, Overlading Assignment Operator, Type Conversions.

Polymorphism: Concept, Compile Time Vs Run Time Polymorphism, Pointers in C++, **this** Pointer, Pointers to a Derived Class, Virtual and Pure Virtual Functions, Late Binding with Virtual Functions.

UNIT-IV

I/O in C++: C++ Streams and Stream Classes, Overloading '**>>**' and '**<<**' Operators, Unformatted I/O Operations, Formatted I/O Operations, Managing Output with Manipulators, Classes for File Stream Operations, Opening and Closing a File, Detecting End of File, Sequential Input and Output Operations.

Templates: Concept, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading a Template Function, Non-Type Template Arguments,

Standard Template Library: Concept, STL in C++, Components of STL: Containers, Algorithms and Iterators.

Textbooks & References:

1. Bjarne Stroustrup: The C++ Programming Language, Addision-Wesley.
2. E. Balaguruswamy: Object Oriented Programming and C++, TMH.
3. Herbert Schildt: C++ - The Complete Reference. Tata McGraw Hill Publications
4. R.Rajaram: Object Oriented Programming and C++, New Age International.
5. Subburaj: Object-Oriented Programming with C++, VIKAS Publishing House.
6. Robert Lafore: Object Oriented Programming in C++, Galgotia.
7. V. Aklecha: A Comprehensive Guide to C++, BPB.

MCA-104
Data Communication and Computer Networks

Max. Marks: 100 (80+20) *Time: 3Hrs*

Note: *Examiner will be required to set NINE questions with all questions carrying equal marks. Question Number 1, covering the entire syllabus, will be compulsory. Examiner will set two questions from each Unit with internal choice. Student will be required to attempt FIVE questions in all, selection one question from every unit apart from the Question Number 1.*

UNIT-I

Computer Networks: Why Computer Networks**;** Network Topologies; Classification based on Size: Personal Area Networks, Local Area Networks, Metropolitan Area Networks, Wide Area Networks; Internetworks, Network Software: Protocol and Protocol Hierarchy, Design Issues for Layers; Connection Oriented Vs Connectionless Service, Service Primitives, The Relationship of Services to Protocols, Reference Models: The OSI Reference Model, The TCP/IP Reference Model, Comparison of OSI and TCP/IP Models; The ARPANET; Architecture of the Internet; Network Standardization.

Data Communication: Components of a Data Communication System, Simplex, Half-Duplex and Duplex Modes of Communication, Analog and Digital Signals, Noiseless and Noisy Channels, Bandwidth, Throughput and Latency, Digital and Analog Transmission, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.

UNIT-II

The Physical Layer: Fourier Analysis, The Maximum Data Rate of a Channel: Nyquist's Theorem v/s Shannon Capacity; Guided Transmission Media: Magnetic Media, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics; Wireless Transmission: The Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared Transmission, Light Transmission; Communication Satellites; Satellite v/s Fiber; Digital Modulation and Multiplexing: Baseband Transmission, Passband Transmission, Frequency Division Multiplexing, Wavelength Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing; Switching: Circuit Switching, Packet Switching, Message Switching;

The Data Link Layer: Design Issues: Service to Network Layer, Framing, Error Control, Flow Control; Error Detection and Correction: Error Correcting Codes v/s Error Detecting Codes**,** Hamming Codes, Convolution Codes, Reed Solomon Codes, Checksum, CRC; Elementary Data Link Protocols: A Utopian Simplex Protocol, A simplex Stop and Wait Protocol; Sliding Window Protocols: A One Bit Sliding Window Protocol, A Protocol Using Go-Back-N, A Protocol Using Selective Repeat; ADSL, HDLC.

UNIT-III

The MAC Sublayer: Purpose; The Channel Allocation Problem: Static v/s Dynamic Channel Allocation; Multiple Access Protocols: ALOHA, CSMA, CSMA/CD, Collision Free Protocols, Limited Contention Protocols; Wireless LAN Protocols: Hidden Terminal and Exposed Terminal Problems; Ethernet, Virtual LANs.

The Network Layer: Design Issue: Store and Forward Packet Switching, Service to Transport Layer, Connectionless v/s Connection Oriented Service; Routing Algorithms: Adaptive v/s Nonadaptive Algorithms, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing and the Count to Infinity Problem, Link State Routing, Hierarchical Routing, Broadcast v/s Multicast Routing, Unicast v/s Anycast Routing; Congestion Control Algorithms: Traffic Aware Routing, Admission Control, Traffic Throttling, Load Shedding; Concept of QoS;

The Network Layer in the Internet: IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery, Routing Algorithms.

UNIT-IV

The Transport Layer: Service to Upper Layer- Transport Service Primitives; Elements of Transport Protocol: Addressing, Connection Establishment and Release, Error Control and Flow Control, Multiplexing, Crash Recovery; Congestion Control.

The Internet Transport Protocols: TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

The Application Layer: The Domain Name System (DNS); Resolution: Mapping Names to Addresses and Addresses to Names; HTTP, Electronic Mail Architecture, SMTP, POP and IMAP, TELNET, FTP.

Textbooks & References:

1. A.S. Tanenbaum: Computer Networks, Prentice-Hall of India.
2. Behrouz Forouzan and S.C. Fegan: Data Communications and Networking, McGraw Hill.
3. W. Tomasi: Introduction to Data Communications and Networking, Pearson Education.
4. P.C. Gupta: Data Communications and Computer Networks, Prentice-Hall of India.
5. L. L, Peterson and B. S. Davie: Computer Networks: A Systems Approach, Morgan Kaufmann.
6. William Stallings: Data and Computer Communications, Pearson Education.

MCA-105
Artificial Intelligence

Max. Marks: 100 (80+20) *Time: 3Hrs*

Note: *Examiner will be required to set NINE questions with all questions carrying equal marks. Question Number 1, covering the entire syllabus, will be compulsory. Examiner will set two questions from each Unit with internal choice. Student will be required to attempt FIVE questions in all, selection one question from every unit apart from the Question Number 1.*

UNIT-I

Introduction: Definition and applications of Artificial Intelligence; Approaches to AI: Turing Test and Rational Agent Approaches; Problem solving: Problem characteristics, Defining the problem as state space, Production System.

Search techniques: Brute Force v/s Heuristic Search, Hill climbing and issues, Best first search, A* algorithm, Problem reduction; Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures.

UNIT-II

Expert Systems: Definition, Role of knowledge in expert system, Architecture of Expert Systems.

Expert System Development Life Cycle: Problem selection, Prototype construction, Formalization, Implementation, Evaluation.

Knowledge: Definition and Importance of Knowledge; Knowledge Based Systems.

Knowledge acquisition: Knowledge engineer, Cognitive behavior, Acquisition techniques.

Knowledge representation: Level of representation, Knowledge representation schemes, Formal logic, Inference Engine, Semantic net, Frame, Rules, Scripts, Conceptual Dependency and Ontologies, Handling Uncertainty in Knowledge.

UNIT-III

Artificial Neural Networks (ANN): Introduction, ANN v/s Biological Neural Networks; Learning in neural networks: Supervised, Unsupervised and Reinforcement Learning; Perceptions: Single Perceptron, Multi-Layer Perceptron; Back propagation networks, Self-Organizing Maps, Hopfield Network; Application of neural networks,

Fuzzy logic: Definition, Difference between Boolean and Fuzzy logic; Fuzzy Sets: Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy expert system, Inference process for fuzzy expert system, fuzzy controller; Fuzzy Control System and Fuzzy Rule Based Systems.

UNIT-IV

Programming in Logic (PROLOG): Introduction. Prolog variables, Using rules, Input and Output predicates. Fail and cut predicates, Recursion, Arithmetic operation. Compound object. Dynamic database, Lists, String. File operations.

Textbooks & References:

1. Elaine Rich, Kevin Knight: Artificial Intelligence. Tata McGraw Hill.
2. V.S. Janakiraman: Foundations of Artificial Intelligence and Expert Systems, Trinity Press
3. David W. Rolston: Principles of Artificial Intelligence and Expert System Development, McGraw Hill Book Company.
4. Carl Townsend: Introduction to Turbo Prolog, BPB.
5. Stamations V. Kartalopous: Understanding Neural Networks and Fuzzy Logic, PHI.
6. Dan W. Patterson: Introduction to Artificial Intelligence and Expert Systems, PHI