

COMPUTER SCIENCE

PAPER-I

Section-A (50 Marks)

I. Introduction to Computing:

- Introduction to Information Technology and Computers
- History of Computing
- Computer HW and SW Details
- Computer System Components and Communication System
- Input & Output devices and their types
- Storage Media and their types
- Types of Computer Hardware, Software, and Programming languages
- Information Representation & Number Systems
- User interfaces
- Major Software Issues
- Creation, formatting, and maintenance of Computer documents
- Usage of Word processors, Spreadsheets, Power-Point, Email, Search Engines, Browsers, Messengers, and Internet
- Computers & Society
- Information Security/Privacy
- Computer Crimes and Ethical Challenges
- Viruses
- Plagiarism & Intellectual Property Rights
- Difference between computer science, software engineering, information technology, information systems, computer engineering and bioinformatics
- IEEE / ACM computing disciplines guidelines

II. Programming Fundamentals:

- Basic programming elements and concepts
- Problem Solving & Program Design
- Components of a programming language
- Program development and execution
- Program structure
- Data types and variable declarations
- Standard I/O streams, statements & Control structures
- Standard library functions & User-defined functions
- Parameter passing
- Arrays, pointers, and strings, Structures, unions, and bit manipulation operators.

III. Object-Oriented Paradigm:

- **Object-Oriented Programming Concepts:** Object-oriented paradigm, data abstraction, encapsulation, inheritance, Polymorphism)
- **Introduction to Classes and Objects:** classes, objects, data members, member functions
- **Classes Advanced:** friends, static, composition, this, const
- **Operator overloading:** stream insertion, stream extraction, binary operator, unary operator
- **Inheritance:** single inheritance, multiple inheritances, protected members, method over-riding
- **Polymorphism:** virtual function, pure-virtual functions, abstract class, abstract superclass
- Standard Template Library (STL)
- **Files & streams:** sequential access files, random access files
- File processing
- Exception Handling

Section-B (50 Marks)

IV. Algorithms & Data Structures:

- Fundamental concepts
- Properties of algorithms
- Criteria for an Algorithm
- Parameters for selecting an algorithm
- Algorithm Representations
- Pseudo Code and Flow Charts
- Designing Algorithms
- Algorithm Analysis and Asymptotic Notations
- Classification of Lists
- Abstract Data Types
- Implementation of Stacks and Queues using ADTs
- Searching and Sorting Algorithms (Linear Search, Binary Search, Bubble Sort, Merge Sort, Quick Sort, Heap Sort)
- Stacks and Queues
- Hash Tables (Linear Probing, Bucketing, Chaining)
- Recursion
- Trees (Binary Trees, Binary Search trees, AVL Trees, Two Three Trees)
- Graphs
- Heuristic (Guided) Search
- Genetic Algorithms
- Encryption Algorithms (DES, RSA)

V. **Software Engineering:**

- Software Processes
- Software Process Models
- Agile Software Development
- Analysis Modeling & Requirements Engineering
- Design Concepts, Architectural Design, Design & Implementation
- Software Testing
- System Delivery and Maintenance
- Software Evolution Formal Specification
- Software Quality Assurance
- Introduction to Proofs of Correctness (LNO)
- Distributed Software Engineering
- Aspect-Oriented Software Engineering
- Project Management
- Process Improvement

VI. **Compiler Construction:**

- The difference among various types of Translators
- Phases of Compilers
- Classification of Compilers
- **Lexical Analysis:** Input buffering, Specification & Recognition of tokens, Regular expressions, Finite automata
- **Syntax Analysis:** Context-free grammars and their classification, LL(k) vs. LR(k) grammars, Top-down vs. Bottom-Up parsers, Parsing Techniques, FIRST and FOLLOW sets, Predictive Parsing using LL(1) grammars, Syntax error handling and recovery strategies
- **Syntax Directed Translation:** Synthesized attributes, Inherited attributes, Construction of syntax trees, Top-down translation
- **Semantic analysis:** Symbol tables, Type Expressions, Type Checking of statements
- Intermediate Code Generation
- **Code Generation:** (Issues in the design of code generation, the target machine, Run-time storage management, Register allocation)
- **Code optimization:** (Elimination of Redundant code, Folding of Constant, Loop optimization, Peephole optimization, Problems of optimization).

COMPUTER SCIENCE
PAPER-II

Section-A (50 Marks)

I. Computer Organization & Architecture:

- Fundamental concepts & Overview of a Computer System
- Evolution & Performance Languages
- Architectural levels
- Virtual machines & Processor types
- Metrics
- Machine instructions & Instruction execution cycle
- CISC vs. RISC
- Parallelism
- Internal/External data representation
- Computer Function and Interconnections
- Cache Memory, Internal Memory, External Memory
- Input /Output System
- Computer Arithmetic Microprocessor and its Bus Structure
- I/O Types, Types of Buses
- Memory Organization and Structure
- information flow and execution in Machine
- Instruction Representation
- Machine Instruction Characteristics
- Instruction Processing
- Processor Structure & Function
- Control Unit Operation
- Micro-programmed Control
- Instruction-Level Parallelism
- Superscalar Processors, Parallel Processing, Multi-Processor and Multi-core Systems.

II. Computer Communications & Networks:

- Basic Concepts and Classification of Networks
- Circuit switching, Packet switching
- Multiplexing (TDM, FDM)
- **Layering:** OSI and TCP/IP
- **Application Layer:** Network application architectures, HTTP, FTP, Email, DNS, P2P applications
- **Transport Layer:** Multiplexing in UDP and TCP, Connectionless Transport: UDP, Reliable data transfer and TCP, Congestion avoidance and control
- **Network Layer:** The Internet Protocol, IPv4 Datagram, Internet Address Classes, Special IP Addresses ARP, IPv6, ICMP, Network Address Translation (NAT), Internet Routing Protocols and Algorithms, X.25, Frame Relay and ATM, MPLS
- **Physical & Link Layer Functionalities:** Error Detection & Control, ARQ, Link layer addressing, LAN Technologies, Bridges and Hubs, Multiple Access)
- **Special topics:** Security, Overlay networks, naming, Content distribution networks, Peer to peer systems, DHTs, Network Attacks

III. Operating Systems Concepts:

- Roles of an Operating System
- Operating-System Evolution
- Structures and Operations
- Classification of Operating Systems
- Computing Environments
- Design and Components of OS
- Process Management
- Process Synchronization
- Deadlocks, Memory Management
- Virtual Memory Management
- File Systems (UNIX and Windows Systems)
- I/O Management

Section-B (50 Marks)

IV. Database Systems:

- Introduction to Database Systems
- Relational Data Model & Relational Database Constraints
- SQL
- Relational Algebra & Calculus
- ER Model, ER to Relational Mapping
- PL/SQL Stored Procedures & Triggers
- Functional Dependencies and Normalization
- Storage & Indexing, Indexing Structure
- XML documents & Web Services
- Query Processing & Evaluation, Query Optimization
- Transaction processing
- Object-Oriented Databases, Distributed Databases, Database Security
- Access Control

V. Digital Image Processing:

- The relation between Image Processing, Computer Graphics, Computer Vision and Artificial Intelligence
- Image Sensing and Acquisition Techniques
- Representing Digital Image
- Image Sampling and Quantization
- Image Storage and Operations
- Image Transformations (Translation, Scaling, Rotation, Shear)
- Image Histogram
- Image Enhancement (Contrast, Smoothing, Sharpening)
- Gray-scale and Color Images
- Color Models (RGB, CMYK and HIS)
- Image Restoration
- Noise Models
- Morphological Operators (Erosion, Dilation, Opening, Closing, Skeletonization, Thinning)
- Image Segmentation
- Point Detection, Line Detection, Edge Detection and Boundary Detection
- Image Compression

VI. **Web Engineering & Technologies:**

- Modeling techniques for web applications
- Introduction to web engineering
- requirement engineering, requirement, types of requirements, functional requirements, non-functional requirements
- Requirement engineering process (Elicitation and negotiation, Documentation, Validation and verification, Management)
- HTML (hypertext markup language)
- Software Architecture, Styles, Patterns, and frameworks
- Components of Web Architecture
- Classifications of web architecture
- Web Application layered architecture (client-server, n- layered, JSP model, struts, OOHDM)
- Integration Architecture
- Data Aspect architectures
- Cascading Style Sheet (CSS) & its properties
- JavaScript (Functionalities, Events, Variables, Operators)
- DOM (Document Object Model), XML, RSS, API
- Client-side programming using (HTML, XHTML, XML, JavaScript, and CSS)
- Server-side programming using PHP
- Web development process
- Web Application Development Methodologies
- Web site promotion and deployment
- Web applications Issues (Accessibility, testing, performance, operation, maintenance, security).