

Ethics University
Ph.D. Entrance Examination Syllabus
Computer Science & Engineering (Paper-II)

Unit I: Programming and Object-Oriented Concepts

- **Programming Fundamentals:**

Procedural programming using C, C++, and Java

Data types, variables, arrays, functions, pointers, structures, unions

File handling and memory management

- **Object-Oriented Programming (OOP):**

Classes and objects

Constructors and destructors

Function and operator overloading

Inheritance, polymorphism, abstraction

Exception handling

Unit II: Data Structures

- **Linear Data Structures:**

Arrays, Linked Lists (single, double, circular), Multi-lists

Stack and Queue (including circular queue, deque)

- **Trees:**

Binary Trees, Tree traversals

Binary Search Tree (BST), AVL Trees

Red-Black Trees, Splay Trees

- **Advanced Structures:**

Skip Lists, Hash Tables

Priority Queues (Heap-based implementations)

- **Graphs:**

Representation of graphs

Depth-First Search (DFS), Breadth-First Search (BFS)

- **Searching & Sorting:**

Linear and binary search

Sorting techniques (Bubble, Selection, Insertion, Merge, Quick, Heap sort)

Unit III: Algorithms

- **Algorithm Analysis:**

Asymptotic notations (Big-O, Theta, Omega)

Time and space complexity

Recurrence relations and their solutions

Amortized analysis

- **Algorithm Design Techniques:**

Greedy algorithms

Dynamic programming

Divide and conquer

Backtracking

- **Core Algorithms:**

String matching algorithms

Graph algorithms: Minimum Spanning Tree (Prim's, Kruskal's), Shortest Path (Dijkstra, Bellman-Ford), Connected Components

- **Mathematical and Computational Problems:**

Series evaluation

Matrix operations

- **Algorithm Correctness and Efficiency**

Unit IV: Operating Systems

- **Process Management:**

Process states, scheduling algorithms (FCFS, SJF, Priority, Round Robin)

- **Synchronization:**

Critical section problem, semaphores, monitors

- **Deadlocks:**

Deadlock models, prevention, avoidance, detection and recovery

- **Memory Management:**

Paging, segmentation, virtual memory

- **Concurrency Control & Shared Memory**

- **File Systems:**

File organization and access methods

- **Performance Analysis:**

Local and global states, system performance evaluation

Unit V: Database Management Systems

- **Database Design:**

ER model, relational model

- **Storage & File Structures**

- **Query Processing:**

Relational algebra, SQL basics

Query optimization techniques

- **Transaction Management:**

ACID properties

Concurrency control (locking, timestamping)

Recovery mechanisms

- **Indexing and Hashing**

- **Advanced DBMS:**

Object-Oriented DBMS

Extended ER Model

Unit VI: Computer Organization and Architecture

- **Digital Logic Design:**

Combinational and sequential circuits

- **Computer Arithmetic:**

Fixed-point and floating-point arithmetic

- **Processor Design:**

Instruction sets, addressing modes

ALU design, control unit

- **Memory Organization:**

Cache memory, main memory

Memory hierarchy

- **Input/Output Organization**

- **Pipelining:**

Instruction pipelining and performance

Unit VII: Computer Networks

- **Network Models:**
ISO/OSI model, TCP/IP model
- **Data Communication:**
Transmission media, error detection and correction
- **LAN Technologies:**
Ethernet, Token Ring
- **Network Layer:**
Routing algorithms, congestion control
- **Transport Layer:**
TCP and UDP
- **Internet Protocols:**
IPv4 and IPv6
- **Application Layer Protocols**
- **Networking Devices:**
Hubs, switches, routers, gateways
- **Network Security:**
Basics of cryptography, firewalls, VPNs
- **Advanced Networks:**
High-speed networks, wireless networks, Virtual Private Networks

Recommended Readings

- Cormen et al. – *Introduction to Algorithms*
- Tanenbaum – *Operating Systems*
- Korth – *Database System Concepts*
- Stallings – *Computer Organization and Architecture*
- Forouzan – *Data Communications and Networking*
- Balagurusamy – *Programming in C/C++/Java*