

Syllabus of the Ph.D. Qualifier Test

Paper I

Part A: Data Structures, Algorithms and Programming

Linked lists, Stacks, Queues, Trees, Binary search tree – height balanced tree, AVL tree, red-black tree, Hash table, Graphs – representations.

Asymptotic notation and complexity analysis; Recurrence relations – solving by iterative method.

Searching algorithms: Linear search, Binary search, Hashing.

Sorting algorithms: Bubble sort, Insertion sort, Merge sort, Quick sort, Heap sort.

Basic notions of algorithm design techniques: Greedy, Divide-and-conquer, Dynamic programming.

Graph Algorithms: BFS, DFS, Minimum spanning trees, Single-source shortest path.

Basics of C Programming: Input/Output, Control flows, Functions, Arrays, Structures, Pointers, Recursive functions. Programming to solve basic data structures.

Books:

1. Classic Data Structures (2nd Edition), Prentice Hall of India
2. Introduction to Algorithms (3rd Edition), Prentice Hall of India.
3. Programming in C, Kernighan and Ritchie, Prentice Hall of India.

Part B: Computer Organization and Architecture

Instruction set architecture: Instruction types, Representations, Addressing modes.

Arithmetic: Representation of fixed and floating-point numbers, 2's complement arithmetic.

Control unit: Organization of a CPU, Register-transfer level specifications.

Memory system: Memory organization, Concept of memory hierarchy, Cache memory, Page table, TLB, Virtual memory.

Input-output systems: Interrupt-driven I/O, Polling and Vectored interrupt, Basic concept of DMA transfer.

Books:

1. Computer Architecture and Organization; J P Hayes, McGraw Hill
2. Computer Organization and Architecture, William Stallings, Prentice Hall of India

Part C: Operating Systems

Basic components of operating system.

Hardware requirements: Privileged mode and privileged instructions, Handling of hardware and software interrupts.

Processes and IPC: Basic concepts, Process state transition diagram, Context switch, Mutual exclusion problem, Semaphores - definition and implementation.

Process scheduling: Preemptive and non-preemptive, FCFS, SJF and Round-robin.

Memory management: Logical and physical addresses, Paging and virtual memory, Page fault handling.

Book:

1. Operating system concepts, A. Silberschatz, P.B. Galvin and G. Gane, McGraw Hill.

Paper II (Option A)

Part A: Information System Development

Software process and process models.

Requirements analysis and specification

Software design processes: Function-oriented design with data flow diagrams, Object-oriented modeling with the Unified Modeling Language (UML).

Software testing: Black box, white box and grey box testing strategy. Testing techniques: Unit testing, Integration testing and System testing.

Software project management: People management, Process improvement – GQM, CMMI, Software cost estimation – COCOMO.

Books:

1. Ian Sommerville, Software Engineering, 8th Edn., 2007, Addison Wesley.
2. M. Fowler and K. Scott, UML Distilled, 2000, Addison Wesley.

Part B: Database Management Systems

Entity relationship diagrams; Integrity constraints; Relational algebra, Normalization – 1NF, 2NF, 3NF and BCNF.

SQL queries, Fundamentals of Indexing: B-Tree and B+ Tree. Fundamentals of Transactions – ACID property, Degree of consistency, Recovery, Concurrency control – Serializable schedule.

Book:

1. Database System Concepts (5th Edition), Avi Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

Paper II (Option B)

Networking and Internet Technology

Basics of data communication: Spectrum and Bandwidth of signals, Attenuation and Noise, Nyquist rate, Bit rate, Capacity of a channel - Nyquist and Shannon limits.

Encoding techniques: NRZ, NRZ-L, Manchester, Differential Manchester, Multiplexing techniques (TDM and FDM), Synchronous and Asynchronous communications.

Flow control: Stop-and-wait, Sliding window, ARQ techniques - Stop-and-wait, Go-back-N, Selective-Repeat.

Data link layer issues: Framing, Contention protocols – CSMA, CSMA/CD, CSMA/CA, Ethernet.

Network layer issues: Routing protocols - Flooding, Random routing, Distance vector and link state protocols, IPv4 - addressing, fragmentation.

ARP, Subnetting.

Transport layer issues - TCP (basic operation), Flow control, Congestion control, UDP (basic operation), Socket.

Configuration and management protocols: DHCP (sequence of commands), SNMP (commands, MIB).

Application layer protocols: Telnet, SMTP, POP3, HTTP

DNS, Concepts of proxy and firewall, Security – Basic cryptographic concepts, IPSec, SSL.

Basic topics on HTML.

Books:

1. Data Communication and Networking, W. Stalling, Pearson Education
2. Computer Networking: Forouzan, Addison Wesley