

**BHARATI VIDYAPEETH  
( DEEMED to be UNIVERSITY), PUNE (INDIA)**

**Ph.D. Entrance Test – 2023  
Syllabus for All India Ph.D. Entrance Test in COMPUTER SCIENCE  
Section – II**

- 1. Mathematical Logic:** Propositional Logic and First Order Logic; Set Theory & Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra; Graph Theory: Basic concepts, Connectivity; spanning trees; covering; matching; Colouring; Planarity; Isomorphism; Numerical Methods: Basic matrix theory, LU decomposition for systems of linear equations; numerical solutions of non-linear algebraic equations by Secant, Bisection and Newton-Raphson Methods; Numerical integration by trapezoidal and Simpson's rules.
- 2. Digital Logic:** Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point); Computer Organization and Architecture: Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.
- 3. Programming and Data Structures:** Programming in C, C++, Java; Functions, Recursion, Parameter passing, Scope, Binding; Object oriented concepts, Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.
- 4. Algorithms:** Analysis, Asymptotic notation, Notions of time complexity, Worst and average case analysis; Design: Greedy approach, Divide-and-conquer; Tree and graph traversals, Hashing, Sorting, Searching. **Web technologies:** HTML, XML, basic concepts of client-server computing.
- 5. Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata. Compiler Design: Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization. Operating System: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security, Unix internals. Artificial Intelligence: Knowledge representation, state space search, expert systems.
- 6. Databases:** ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

7. **Computer Networks:** ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

**Reference Books :**

1. Discrete Mathematical Structures by Bernard Kolman , Robert Busby, Sharon C. Ross; Pearson
2. Modern Computer Architecture by Rafiquzzaman and Chandra; West
3. SQL, PL/SQL the Programming Language of Oracle by Ivan Bayross; BPB
4. Operating System Concepts by Silberschatz and Galvin; Wiley
5. Introduction to Design and Analysis of Algorithms by Anany Levitin ; Pearson
6. Data Structures with C (Schaum's Outline Series) by Seymour Lipschutz
7. Introduction to Automata Theory, Languages, and Computation by John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman; Pearson
8. Fundamentals of Database Systems by E. Navathe ; Pearson
9. Network security essentials by William Stallings ; Prentice Hall
10. Computer Networks 5<sup>th</sup> edition by A. Tanenbaum ; Pearson