BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA
PhD Entrance Test – 2026
SECTION-II: Information Technology - 35 Marks

Unit No.	Topics Covered - Syllabus
1	**Mathematical Foundation and Data Structures and Algorithms**: Sets, Propositions, Relations, Functions, Graphs, Introduction to Probability theory, Theory of Computation: Formal Languages, Types of Grammars and Languages, Chomsky classification of Languages, Recursive and recursively enumerable sets, Operations, Theory of Automata: Finite State Models, Minimization, Regular sets and Regular Grammars, Pumping Lemma, Closure properties, Applications of Finite automata, Context Free Grammar and Push Down Automata, equivalence of PDA and CFG, Deterministic PDA, Normal forms, Applications of CFG, Turing machines and Linear Bounded Automata. Abstract Data Types: Arrays, Polynomial, Sparse Matrices, Strings, Stacks & Queues, Multiple Stacks & Queues and its applications, Linked Lists: Singly Linked Lists, Reusable Linked List Class, Circular Lists, Linked Stacks & Queues, Polynomials, Equivalence Classes, Sparse Matrices, Doubly Linked Lists, Generalized Lists. Complexity Analysis. Trees: types, Graphs: Operations, complexity analysis, sorting: types, operations and its complexity analysis, Symbol Tables: Static Hashing - Dynamic Hashing, Heap Structures, Advanced data structures: Optimal binary search tree
2	**Computer Organisation and Architecture**: Boolean algebra and Minimization of Boolean functions, Flip-flops-types, Race condition and comparison. Design of combinational and sequential circuits. Representation of Integers: Octal, Hex, Decimal, and Binary. 2's complement and 1's complement arithmetic. Floating point representation. Combinational Circuit Design, Sequential Circuit Design. Hardwired and Micro- programmed processor design, Instruction formats, addressing modes, memory types and organizations, Interfacing peripheral devices, Interrupts. Microprocessor architecture, Instruction set and Programming (8086, P-III/P-IV). Microprocessor applications. Assembly language fundamentals (8085 based assembly language programming). Assemblers -2-pass and single-pass. Macros and macro-processors. Loading, linking, relocation, linkage editing. Text editors. Programming environments. Debuggers and program generators. Compilation and Interpretation. Bootstrap compliers. Phases of compilation process. Lexical analysis. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom-up parsers –Shift-reduce, operator precedence, and LR. YACC package on Unix system. Top-down parsers-left recursion and its removal. Recursive descent parser. Predictive parser. Intermediate codes-Quadruples, Triples, Intermediate code generation, Code generation, Code optimization.
3	**Computer Programming and Analysis & Design of Algorithms**: Programming language concepts, paradigms, and models. Programming in C: Elements of C-Tokens, identifiers, data types, operators in C. Control structures in C. Sequence, Selection, and iterations (s). Structured data types in C-arrays, struct, union, String, and pointers. I/O statements, User defined and built-in functions, Parameter passing. Object Oriented Programming Concepts: Class, Object, Instantiation, Inheritance, polymorphism and overloading, dynamic biding, reference semantics and their implementation. Algorithm specification and Characteristics, Divide and Conquer: General method, Binary search, Maximum and Minimum, Merge sort, Quick sort, Selection sort, Strassen's Matrix multiplication, Greedy: General method, Knapsack problem, Job sequencing with deadlines, MST, Optimal storage on tapes, Optimal merge pattern, Single source shortest path. Dynamic Programming: General method,

	Multistage graph, All Pair Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack., Backtracking: General method, 8-Queens problem, Sum of Subsets, Graph Colouring, NP-hard and NP- complete problems, time and space complexity.
4	**Operating System and Computer Networks** : Types of Operating Systems, Features and Functions of the Operating System, Process Management, Process Synchronization and Deadlocks, Memory Management, File System, Disk Management, Unix system, Filters and Commands, System Calls, Agreement Protocols for handling Processor Failures, Distributed Mutual Exclusion, Distributed Operating Systems, Local and Global states, Failure Handling and Recovery Mechanisms, Multiprocessor Operating Systems and related Thread Handlings, Token and Non-token based Algorithms, Network fundamentals : Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless Networks, Inter Networks. Topologies, Networking Devices. The OSI model, TCP/IP model. Protocols for –(i) Data link layer, (ii) Network layer, and (iii) Transport layer, TCP/IP protocols, Networks security, Network administration. Application layer protocols, Flow and error control techniques, Introduction to intelligent networking, Performance analysis of networks.
5	**Database Management System and Software Engineering:** Relational Database Design, E-R and E-E-R Model, Architecture, Relational model, Relational Algebra, Relational Calculus, Relational design, Normalization, 1NF, 2NF, 3NF, BCNF and 4NF. Indexing and Hashing, Storage and File Structures, Transaction Management, Concurrency Control. SQL: Joins, SQL/PL-SQL. Data mining and its algorithms, OLAP, OLTP. Advanced Database systems: Parallel Databases, Distributed Databases, NoSQL Databases, Spatial Database, Multimedia Databases, Mobile Databases and Web-enabled Database Systems. Software life cycle models: Prescriptive Models, Specialised process Models, Agile Development Process, Requirement Engineering, feasibility analysis, Domain specific modelling, Software Design, Systems Modelling Language, Software architecture and design patterns, user interface design, Software Coding, Testing, Testing strategies, Software reliability and Advanced testing techniques, Software Quality management, Software Metrics, Software Configuration, Software maintenance and reengineering, Software project management - Planning and managing the project, Aspect oriented programming.

Books:

1.	**Mathematical Foundation: Kenneth Rosen**
2.	**Data Structures and Algorithms Aho Ullman**
3.	**Computer Organisation and Architecture: John P. Hayes**
4.	**System Software: Dhamdhere Dhananjay**
5.	**Computer Programming: Rajaraman**
6.	**Analysis & Design of Algorithms: Hurwitz Sahani**
7.	**Operating System: William Stalling**
8	**Computer Networks: Tannenbaum**
9	**Database Management System: Korth**
10	**Software Engineering: Pressman**

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