Ph.D. Computer Science

Duration	Two hours
Number of Questions	100
Part A	25 MCQs
Topics for Part A	Questions from Mathematics
Part B	45 MCQs
Topics for Part B	Test the knowledge of the candidate in Computer Science
Marks	1 mark for every correct answer and -1/4 for every incorrect answer

PART A:

- **Discrete Mathematics:** Sets, Relations, Functions, Boolean Algebra, Propositional logic, First Order Predicate Logic, Lattice.

- **Combinatorics:** Permutations, Combinations, Counting, Summation, Recurrence Relations, Binomial Theorem, Exponential Series, Pigeonhole Principle.
  Probability and Statistics: Conditional Probability, Mean, Median, Mode, Standard Deviation, Variance, Covariance, Random Variable, Distributions (Uniform, Normal, Exponential, Poisson, Binomial).

- **Vector Analysis:** Rectangular Cartesian Co-ordinates, Equations of a Line, Mid-point, Intersections, etc., Equations of a Circle, Distance Formulae, Pair of Straight Lines, Addition and Subtraction of Vectors, Scalar and Vector, Product of Two Vectors, Scalar Triple Product, Vector Triple Product.

- **Matrices:** Basic Concepts, Types of Matrices, Determinants, Transpose, Inverse and Rank of a Matrix, Matrix Algebra, Systems of Linear Equations, Eigen Values, and Eigen Vectors.

Part B

- **Programming in C:** Data Types & Qualifiers, Identifiers, Control Structures, Array and Pointers, Array of Pointers, Pointers to Array, Ragged Array, Strings, Structure, Union, Functions, Recursion, File Handling, Macros, Enumeration.

- **Data & File Structures:** Arrays, Sparse Matrix, Linked Lists, Doubly Linked Lists, Circular Linked Lists, Stack, Queue, Priority Queue, Postfix and Prefix Representation and Evaluation, Tree, Binary Search Tree, Heap Tree, AVL Trees, B Tree, B+ Tree, Graph Representation, Properties and Traversals, Inverted List, Multi-List, Hashing, and Tables.
  Design & Analysis of Algorithms: Asymptotic Notations, Asymptotic Analysis (best, worst, average cases) of Time and Space, Sorting, Searching, Recursion, Graph (Spanning tree, connected component, shortest path), Divide-and-Conquer Approach, Greedy Approach, Dynamic Programming, Complexity Classes – P, NP, NP-hard, and NP-Complete.

- **Operating Systems:** Processes, Threads, Inter-Process Communication, Concurrency, Synchronization (Semaphores, Critical Regions, Mutual Exclusion), Deadlock Handling (Bankers Algorithm), CPU Scheduling, Memory Management, and Virtual Memory (Paging and Segmentation), File Systems, I/O systems, Protection and Security, UNIX and Windows, Basic UNIX Commands, Shell Programming.

- **Computer Networks:** Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), OSI Model, TCP/IP Model, Encoding and Modulation, Multiplexing, Switching, Transmission Media, Flow Control, Error Detection and Correction, Multiple Access Protocols, IP Addresses, Routing Algorithms, Multicasting, Congestion Control, QoS, TCP/UDP, Application Layer Protocols. Database Management System: ER Model, Relational Model (Relational Algebra, Tuple and Domain Calculus), Database Design (Integrity Constraints, Normal Forms), SQL/PL-SQL, Transactions, and Concurrency Control, Distributed Databases, File Organization, and Indexing.

- **Computer Architecture and Organization:** Subsystems of a Computer, Instruction Formats, Addressing Modes, Processor Datapath Design, Control Unit Design, Pipelining, Memory Organization, I/O Organization, Interrupts and DMA, Parallelism.