# School of Computer Science and IT

# Syllabus for Ph.D. Entrance Examination

**Theory of Computation :**

Models of computation-Finite Automata, Pushdown Automata, Nondeterministic and NFA, DPDA and PDAs and Languages accepted by these structures. Grammars, Languages, Non-computability and Examples of non-computable problems-Turing Machine.

**Mathematical Foundations for Computer Science**

Introduction to Sets and Truth tables, relations and functions, Propositions and Compound Statements, Basic Logical Operations, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional, Probability, Relations, Quadratic Expressions, Descriptive Statistics, mean: Arithmetic, Geometric and Harmonic means, mathematical relationship among different means, median for raw data and grouped data, mode for raw data and grouped data, relationship among mean, median and mode, descriptive Statistics standard deviation, variance, coefficient of variation, quartiles, Matrices, Functions and Number system.

**Programming in C & Data structures:**

Recursion, Arrays, stacks, queues, linked lists, types of linked lists, trees, binary search trees, binary heaps, graphs, types of graphs traversals.

File structures: Fields, Records and files. Sequential, Direct, index-sequential and relative files. Hashing, Inverted lists and multi-lists.

**Algorithms and Analysis:** Sorting and searching algorithms. Analysis of algorithms, Interpolation and Binary search, Asymptotic notations – big ohm, mega and theta, Average case analysis of simple programs like finding of a maximum of n elements. Design of Algorithms (Divide and Conquer, Greedy method, Dynamic programming, Back tracking, Branch and Bound). Lower bound theory, nondeterministic algorithm,-non-deterministic programming constructs. NP-hard and NP-complete problems.

**Computer Organization and Architecture:** Boolean algebra and Minimization of Boolean functions, Combinational Circuit Design, Sequential Circuit Design. Hardwired and Micro programmed processor design, Instruction formats, Addressing modes, memory types and organizations, I/O Interface – PCI Bus, SCSI Bus, USB, and Data Transfer: Serial, Parallel, Synchronous, Asynchronous Modes of Data Transfer, Direct Memory Access (DMA), I/O Processor

**Computer Networks & Internet:**

Concept of Layering, OSI Model vs. TCP/IP Model, LAN technologies, Flow, and error control techniques, switching. IPv4 vs IPv6, routers and routing algorithms, TCP/UDP and sockets, congestion control. Application Layer Protocols (DNS, SMTP, POP, FTP, HTTP). Introduction to Wi-Fi, Network Security, Cryptography, Digital Signatures & Certificates, Firewalls, and Future Internet.

**Database Management Systems:**

Overview of Relational Model - Relational Calculus - - ER Diagrams – Entities, Attributes-Relationships. The Relational Model Integrity Constraints - Relational Algebra- Selection and

Projection- Set Operation - Normalization Concepts. SQL queries - Triggers – Cursor - Transactions - Transaction Processing Concepts. - Concepts of Indexing and Hashing.

**Operating Systems:** Memory Management : Virtual memory, paging, fragmentation. Concurrent Processing : Mutual exclusion, Critical regions, Semaphores. Scheduling : CPU scheduling, I/O scheduling, resource scheduling, Deadlock and scheduling algorithms. Banker's algorithm for deadlock handling.

**Software Engineering :**

Software life cycle models, Agile software development, Extreme programming, requirement analysis, software design, Evolutionary Software Process Models, black box testing, white box testing, scrum, SDLC.