DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SUBJECT: SYLLABUS FOR THE Ph.D. ENTRANCE EXAMINATION

1. **Data Structures**
   Linear Data Structures, Stacks, Queues, Circular Queues, Links Lists, Sorting, Insertion Sort, Merge Sort, Quick Sort Searching, Binary Search, Selection, Graphs- Minimum Spanning Tree, Shortest Path, all pairs Shortest Path, Binary Trees - Representation, Operations: Insert, Delete, Traversal: Preorder, Inorder, Postorder.

2. **Design and Analysis and Algorithm**
   BFS, DFS, DFS numbering and applications, Directed acyclic graphs, Directed acyclic graphs, Shortest paths: unweighted and weighted, Single source shortest paths: Dijkstra Algorithm, Minimum cost spanning trees: Prim's algorithm, Minimum cost spanning trees: Kruskal's Algorithm, Divide and conquer: counting inversions, nearest pair of points, Priority queues, heaps, Intractability: NP completeness.

3. **Operating System**
   Processor management: inter process communication, mutual exclusion, semaphores, wait and signal procedures, process scheduling and algorithms, critical sections, threads, multithreading; Memory management: contiguous memory allocation, virtual memory, paging, page table structure, demand, paging, page replacement policies, thrashing, segmentation, Deadlock : Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms; Device management: devices and their characteristics, device drivers, device handling, disk scheduling algorithms and policies, File management: file concept, types and structures, directory structure, cases studies, access methods and matrices, file security, user authentication.

4. **Formal Language & Automata**
   Alphabet, Strings, Languages, Finite Representation of languages, Regular Expressions, Context-free Grammars (CFGs) -Formal definition, sentential forms, leftmost and rightmost derivations, the language of a CFG. Derivation tree or Parse tree - Definition, Relationship between parse trees and derivations. Parsing and ambiguity, Ambiguity in grammars and Languages. Regular grammars. Finite automata (FA) -its behavior; DFA - Formal definition, simplified notations (state transition diagram, transition table), Language of a DFA. NFA -Formal definition, Language of an NFA, Removing, epsilon-transitions. Equivalence of OFAs and NFAs. closure properties of Regular languages - Closure under Boolean operations, reversal, homomorphism, inverse homomorphism, etc. Pumping lemma, proving languages to be non-regular.

5. **Computer Networks**
   Networks Software; Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, Service Primitives: Reference models; The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Models: Network standardization; Traditional Methods, Routing in Packet Networks; Traffic Management at packet level, Real-time Transport Protocol, Design issues of Network layer; Nature of the service provided, Internal organization, Routing, Congestion control, Internetworking: Principles of Routing; Types of routing algorithms, Classes of routing algorithms, Properties of routing algorithms, Optimality principle: Routing algorithms; Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Link state routing, Comparison of routing algorithms: Congestion; Factors of congestion, Comparison of flow control and congestion control, General principles of congestion control, Closed loop solution: IP protocol (IPV4), SDN.

6. **Computer Organization and Architecture**
   Arithmetic and Logic Unit, Introduction to memory Unit, control unit and Instruction Set, Working with an ALU, Concepts of Machine level programming, Assembly level programming and High level programming, Various addressing modes and designing of an Instruction set, Subroutine and subroutine call, stack for handling subroutine call and return, Introduction to CPU design, Instruction interpretation and execution, Micro-operation and their RTL specification, Hardwired control CPU design, Microprogrammed control CPU design, Concepts of semiconductor memory, CPU-memory interaction, organization of memory modules, Cache memory and related mapping and replacement policies, Virtual memory, Interrupt controlled I/0 transfer, DMA controller, Secondary storage and type of storage devices, Introduction to buses and connecting I/0 devices to CPU and memory, Introduction to RISC and CISC paradigm, Design issues of a RISC processor.

7. **Distributed System**
   Basic Algorithms in Message Passing System, Leader Election in Rings, Distributed Models of Computation, Causality & Logical Time, Logical Time, Global State & Snapshot and Distributed Mutual Exclusion-Non-Token and Quorum based approaches, Size of Vector Clock, Matrix Clocks, Virtual Time and Physical Clock Synchronization, Global State and Snapshot Recording Algorithms, Distributed Mutual Exclusion and Non-Token based Approaches, Consensus & Agreement, Check pointing & Rollback Recovery, Token Based Distributed· :Mutual Exclusion Approaches, Consensus and Agreement Algorithms, Check pointing & Rollback Recovery, Deadlock Detection, Deadlock Detection in Distributed Systems, Distributed Shared Memory, Distributed Minimum Spanning Tree, Termination Detection, Message Ordering & Group Communication, Fault Tolerance and Self-Stabilization, Termination Detection in Distributed System, Message Ordering and Group Communication, Fault tolerance, Self-Stabilization.

8. **Database Management Systems**
   Introduction to RDBMS, Structured Query Language (SQL), Relational Algebra. Entity-Relationship Model, Relational Database Design, Application Development. Case Studies. Storage and File Structure, Indexing and Hashing. Query Processing, Query Optimization. Transactions (Serializability and Recoverability), Concurrency Control. Recovery Systems. Course Summarization.