

Following shall be the course contents for the Eligibility Test for Ph.D. in Computer Science & Engineering

DISCRETE MATHEMATICAL STRUCTURES AND ITS APPLICATIONS IN COMPUTER SCIENCE

Formal Methods: Induction and Analogy, Abstraction, deduction.

Sets, sequences, empty set, power set, operations on sets, Venn diagram, ordered pair, principle of inclusion and exclusion.

Introduction to mathematical logic, statements and notations, well-formed formulas, tautologies, tautological implications, normal forms, the theory of Inference for statement calculus, predicate logic.

Graph Terminology, Degrees of Nodes, Isomorphic Graphs, Dijkstra's Shortest Path Algorithm, Planar Graphs, Eulerian Graphs, Hamiltonian Graphs, Traveling Salesman Problem.

Trees, Introduction, Rooted and Other Trees, Representation of Prefix Codes, representation of Arithmetic Expression, Representation of Prefix Codes, Spanning Trees, Traversing Binary Trees, Binary Search Trees.

Relations, matrix and graph representation of relation, properties of relations, partitions. Equivalence Relations, Compatibility Relations, Composition of Binary Relations, Transitive and symmetric closures, partially ordered set, lattices.

Functions, Matrix representation of functions, composition of function, inverse function.

Algebraic Structures, General properties of algebraic systems, groupoids, semigroup, monoids, group, rings. Applications of algebra to control structure of a program. Homomorphism, congruences, admissible partitions. Groups and their graphs.

DATA STRUCTURES AND ALGORITHMS

Introduction to data structure, String storage representation and manipulation. Marcov algorithm and primitive data structures.

Concepts of non primitive data structures. Linear data structure. Array, stack, queue, their applications and implementations using sequential storage representation and linked representation.

Linear linked list, double linked list, circular linear linked list and generalised lists and applications.

Concept of non-linear data structures, Tree, graph, set and their representation, Binary Tree, Threaded tree, different techniques of tree traversal, breadth first search, depth first search, application of tree and graph such that Polish notation, concepts of heap.

Sorting, searching algorithms and comparative study of different sorting and searching techniques such that selection sort, heap sort, bubble sort, quick sort, merge sort and radix sort. Linear search and binary search, hashing. External sorting.

DATA BASE SYSTEM

Introduction to database systems. A historical perspective, file systems v/s DBMS, advantages of a DBMS, Data abstraction, models, instances and schemes. Data independency. Data definition and manipulation languages. Database manager, administration and users. Overall system structure.

Entities and entity sets. Relationships and relationship sets. Attributes, mapping, keys, E-R diagram and its conversion to tables. Design of an E-R database scheme.

Structure of relational database. The relational algebra. The tuple and domain relational calculus. Modification of databases and views.

Query languages, SQL and query by examples. Security of databases against misuse. Domain constraints, referential integrity, functional dependencies, assertions and triggers. Pitfall in relational database design. Normalization using functional, multi valued and join dependencies. Domain key normal form. Alternative approaches to database design.

Data storage, Physical storage media, files organization, organisation of records into blocks, sequential files, mapping relational data to files, data dictionary storage, buffer management,

Basic concept of indexing and hashing, properties of indexes, index specification in SQL,. B+ - Tree and B-Tree index files. Hash base indexing, static hash functions, dynamic hash function.

OPERATING SYSTEM AND SYSTEM PROGRAMMING

Introduction to operating system, operating system functions, batch processing systems, multiprogramming systems, time sharing systems, real time operating systems.

Process management, process concept, process scheduling, operation on processes, cooperating processes, interprocess communication.

CPU scheduling, scheduling algorithms – first come first served, shortest job first, priority based, round robin, multilevel queue, multilevel feedback queue.

Process synchronization, critical section problem, semaphores, monitors. Deadlocks, deadlock prevention, deadlock avoidance, deadlock detection.

Memory management, contiguous allocation, paging, segmentation, virtual memory, demand paging, page replacement, page replacement algorithms – first in first out algorithm, optimal algorithm, least recently used algorithm.

File concepts, directory structure, file protection, allocation of disk space.

I/O systems, I/O hardware – polling, interrupts, direct memory access. Disk scheduling, disk scheduling algorithms – first come first served algorithm, shortest seek time first algorithm, SCAN algorithm, C-SCAN algorithm, C-LOOK algorithm.

Protection and security in an operating system, access matrix, capabilities.

Assemblers, loaders, Linkers, Macro-Assemblers, Compiler's phases and passes.