Entrance Examination Syllabus for Admission to Ph.D. in Computer Science

The Syllabus for Examination includes:

Part-1: *This part contains **object type questions** of one hour duration.* The objective type questions covers all the basic subjects studied during Masters Degree. The subjects covered are: Discrete Mathematics, Principles of Programming Languages, Data Communications and Computer Networks, Operating Systems, Systems Software, Database Management Systems, Software Engineering, Computer Organization and Architecture, Computer Graphics and Multimedia, Internet tools and Web technology. The syllabus is the standard syllabus (NET/SLET Examination prescribed syllabus) which is adopted commonly in all the Universities/Institutes.

Part-2: This part contains descriptive type questions of two hours duration. The following are the three major subjects identified for answer. The candidate has to choose any one subject.

1. Foundations of Computer Science
2. Data Structures.
3. Analysis and Design of Algorithms.

The syllabus is enclosed for your reference.

Part-3: Technical Interview.

SYLLABUS

SECTION-1: FOUNDATIONS OF COMPUTER SCIENCE

UNIT - I   **12 Hours**

Review of Sets, Propositions, Relations, Functions, Graphs, Introduction to Probability theory: Introduction, Sample space-random variables - probability distributions, expected values, joint distributions, variance, covariance

UNIT - II   **12 Hours**

Theory of Computation: Introduction: Strings and their properties, 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

UNIT - III   **12 Hours**

Context Free Languages: Context Free Grammar and Push Down Automata, equivalence of PDA and CFG, Deterministic PDA, Normal forms, Applications of CFG

UNIT - IV   **12 Hours**

Turing machines and Linear Bounded Automata: TM model, Representation and Design of TM, Halting problem, Universal TM and modifications, Linear bounded automata.

Text Books:
1.   Introduction to Automata Theory, Languages and Computation- JD Ullman et al.
2.   Elements of Discrete Mathematics – C L Liu, McGraw-Hill
3.   Probability and Statistics with Reliability, Queuing and Computer Science applications, K. S. Trivedi, Prentice Hall of India.

Reference Books:
1.   Gems of Theoretical Computer Science - U.Schoninz, R J Pruim
2.   Elements of the Theory of Computation - Hary R Lewis, Christor H Papadi metrion.
3.   Theory of Computer Science- KLP Mishra and N Chandrashekar, PHI

SECTION-2: DATA STRUCTURES AND ALGORITHMS,

UNIT-I   **12 Hours**

Review of Abstract Data Types: Arrays, Polynomial, Sparse Matrices, Strings, Stacks & Queues, Multiple Stacks & Queues –Application of Stacks-Postfix, Prefix representation and Evaluation, Application of Queue- Priority Queue, Simulation

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

UNIT-II   **12 Hours**

Trees: Introduction - Binary Trees - Binary Tree Traversal & Tree Iterators- Additional Binary Tree Operations - Threaded binary Trees - Binary Search Trees - Selection Trees - Forests - Set Representation - An Object-Oriented System of Tree Data Structures - Counting Binary Trees Graphs, Complexity Analysis

UNIT-III   **12 Hours**

Graphs: Elementary Graph Operations - Minimum Cost Spanning Trees - Shortest Paths & Transitive Closure.
Sorting: Motivation - Insertion Sort - Quick Sort -Merge Sort - Heap Sort - Sorting on Several Keys - List & Table Sort - Summary of Internal Sorting - External Sorting Hashing
Complexity Analysis of each algorithms

UNIT-IV   **12 Hours**

Symbol Table: Static Hashing - Dynamic Hashing, Heap Structures - Min-Max Heaps, Binomial Heaps and Complexity Analysis of each algorithm.
Introduction to advanced data structures: Optimal Binary Search Trees-AVL Trees - 2-3 Trees - 2-3-4 Trees - Red-Black Trees - B-Trees

Text Book:
[1] Fundamentals of Data Structures in C, ELLIS HOROWITZ, SARTAJ SAHNI and DINESH MEHTA, 1995

Reference Books:
[1] Data structures and Algorithms, AHO, HOPCROFT and ULLMAN, Addison Wesley, 1983.
[2] Data structures using C and C++ - Langsam, Augenstein, Tanenbaum, PHI

SECTION-3: ANALYSIS AND DESIGN OF ALGORITHMS

UNIT - I   **12 Hours**

Introduction: Algorithm specification and Characteristics, Performance Analysis
Strategies:
Divide and Conquer: General method, Binary search, Maximum and Minimum, Merge sort, Quick sort, Selection sort, Strassen's Matrix multiplication

UNIT - II   **12 Hours**

Greedy: General method, Knapsack problem, Job sequencing with dead lines, MST, Optimal storage on tapes, Optimal merge pattern, Single source shortest path.

UNIT - III   **12 Hours**

Dynamic Programming: General method, Multistage graph, All Pair Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack.

UNIT - IV   **12 Hours**

Backtracking: General method, 8-Queens problem, Sum of Subsets, Graph Coloring.
Lower Bound Theory: Comparison trees, Lower bound thro' reduction, NP-hard and NP-complete problems.

TEXT BOOKS:

1.   Fundamentals of Computer Algorithms, Horowitz and Sahni, Galgotia Publications
2.   The Design and Analysis of Computer Algorithms, Aho, Hop croft & Ullman   - Addison Wesley Publishing Company.

Question Paper Pattern for Entrance Examination

Part-A: *Object type questions.* Answer all the questions.   5**0 Marks**

Part-B: Answer any ONE Section in full. There are **FIVE** **questions**, taken from each unit with an internal choice. Each question carries **TEN** marks.   **05 * 10 = 50 Marks**

    Section-1: FOUNDATIONS OF COMPUTER SCIENCE

    Section-2: DATA STRUCTURES

    Section-3: ANALYSIS AND DESIGN OF ALGORITHMS

Part-C: Technical Interview

    A technical interview involves discussion on Research issues, Problem analysis and solving skills and Programming skills. The interview carries **TWENTY FIVE** marks.