Advanced Data Structures & Algorithms

Code: CS32112CS	Course Type: Core	Semester: I
Evolution Scheme (TA-MSE-ESE): 20-30-100	Total Marks: 150	L-T-P (Credits): 3-0-0 (3)

Pre-Requisites: Basic Data Structures

Course Objective: Design and analysis of complex data structures and high-performance algorithms using advanced paradigms to solve computationally intensive optimization and decision problems.

Course Outcomes: At the end of the course, the student will be able to

CO-1	Understand the basic Complexity analysis & elementary data structures
CO-2	Understand the key data structures and Hashing Techniques
CO-3	Understand design and evaluate efficient solutions for complex optimization problems
CO-4	Understand how to design and evaluate optimized solutions for sorting, geometric, and graph-connectivity problems.

Course Articulation Matrix:

PO	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
CO-1	3	2	1	-	-
CO-2	3	2	1	-	1
CO-3	3	2	-	-	3
CO-4	3	2	1	1	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus:

Unit-1: Complexity analysis & elementary data structures, Asymptotic Notations: Properties of Big-O, Omega, Theta, Definition by Limits, Inequalities, Recursive Equation, Recursion Tree, Masters Theorem, NP Hard and NP Complete Data Structures: Arrays, Stack, Queue and Linked Lists.

Unit-2: Heap structures and Trees, Heaps: Min-Max heaps, Binomial heaps, Fibonacci heaps, Trees: Binary Search Trees, Red-Black Trees, AVL Trees, Splay Trees, B+ Tree, B Tree, 2-3 Tree, 2-3-4 Tree, Hashing: Hashing Function, Linear Probing, Quadratic Probing, Double Hashing, Chaining.

Unit-3: Programming paradigms, Greedy: Fractional Knapsack, Minimum Spanning Trees, Dijkstra, Huffman Coding, Job Sequencing, Dynamic Programming: 0/1 Knapsack, Floyd-Warshal, Matrix Chain Multiplication, Bellman-Ford, Multistage Graph, TSP, Branch and Bound: TSP, Job Shop Scheduling, Integer Linear programming.

Unit-4: Decision Problems and D&C Paradigm, Backtracking: DFS, Strongly Connected Components, Bi-Connected Graphs, Graph Coloring, Sum of Subsets, N-Queens Problem, Divide and Conquer: Quick Sort, Merge Sort, Binary Search, Convex Hull.

Learning Resources:

Text Books:

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to Algorithms (4th ed.). MIT Press.

2. E. Horowitz, S. Sahni, and D. P. Mehta, *Fundamentals of Data Structures in C++*, 2nd ed. Bangalore, India: Universities Press/Silicon Press, 2007.

3. Lipschutz, S. (2014). *Data Structures* (Revised 1st ed.). Tata McGraw Hill.

4. Pai, G. A. V. (2008). *Data Structures and Algorithms: Concepts, Techniques and Applications*. Tata McGraw Hill.

References:

1. G. Brassard and p. Bratley, algorithmics: theory and practice, printice –hall, 1988.

2. Horowitz, E., Sahni, S., & Rajasekaran, S., Fundamentals of Computer Algorithms (2nd ed.). Universities Press 2008.

3. Mark Allen Weiss- Data Structure and Algorithms Analysis in C++, Pearson education 2002.

4. Aho Ullman-- Data Structure and Algorithms Analysis in C++, Pearson education 2002.