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Date:

CS44115: Design and Analysis of Algorithms

L-T-P-Cr: 3-0-2-4

Pre-requisites: Data Structures, Knowledge of Programming languages.

Objectives:

- To provide a solid foundation in algorithm design and analysis.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Outcomes:

At the end of the course, a student should have:

Sl. No.	Outcome	Mapping to POs
1.	Analyze worst-case running times of algorithms using asymptotic analysis.	PO2, PO1
2.	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.	PO2, PO3
3.	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.	PO2, PO3
4.	Describe the greedy paradigm and explain when an algorithmic design situation calls for it.	PO2, PO3
5.	Analyzing capability for a given problem and decision about choosing efficient algorithm type to solve	PO2, PO3

UNIT I: Introduction:

9 Lectures

Algorithm, performance evaluation of algorithms, space & time complexity, notion of optimality, Master's Theorem. **Divide and Conquer:** General Concept, Finding the maximum and minimum, Quick Sort, Merge Sort, Binary Search, Strassen's matrix multiplication.

UNIT II: Greedy Algorithm:

8 Lectures

General Concept, Knapsack Problem (Fractional Knapsack), Job Sequencing with Deadline, Huffman's Codes, Minimum Cost Spanning Tree- Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path-Dijkstra's Algorithm.

UNIT III: Dynamic Programming:

8 Lectures

General Concept, Matrix-Chain Multiplication, Knapsack Problem DP solution, Activity selection problem DP solution, Single Source Shortest Path- Bellman Ford Algorithm, All pairs shortest paths, Traveling salesman problem.

UNIT IV: Backtracking:**9 Lectures**

Basic idea, 8-Queens problem, Graph Coloring, Hamiltonian Cycles. **Branch-And-Bound:** Basic idea, LC search, the 15-puzzle problem, LC Branch-and-Bound, 0/1 Knapsack Problem.

UNIT V: Graph Algorithms:**7 Lectures**

Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components, Bi-Connected Components and DFS, Euler Tour,

UNIT VI: Introduction to NP-Completeness:**3 Lectures**

Basic concepts on NP- hard and NP-Complete Problems, Discussion on one NP- hard graph problem- CDP.

Text/Reference Books:

- 1) *Introduction to Algorithm*, 2e, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI
- 2) *Beginning Algorithms* by Simen Harris, James Ross, Wiley India.
- 3) *Fundamentals of Computer Algorithms* by E. Horowitz and S. Sahni, Galgotia,