3/4 B.Tech. SECOND SEMESTER
DESIGN & ANALYSIS OF ALGORITHMS

CS6T5 **Required** **Credits: 4**
Lecture: 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period /week **Semester end examination: 70 marks**

Course context and Overview: Introduction to fundamental techniques for designing and analyzing algorithms, including asymptotic analysis; divide-and-conquer algorithms and recurrences; greedy algorithms; data structures; dynamic programming; graph algorithms; and randomized algorithms.

Objectives: Introduction to proofs, Discrete Mathematics and Probability.

1. The objective of this course is to study paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.

2. The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them.

3. Formulate the time order analysis for an algorithm, the space needs for the implementation of an algorithm and prove the correctness of an algorithm.

4. Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Learning Outcomes:

Ability to:

1. Understand the basic notation for analyzing the performance of the algorithms.
2. Apply brute force and exhaustive search techniques for solving appropriate problems.
3. Use divide-and-conquer, decrease-and-conquer and transform-and-conquer techniques for solving suitable problems.
4. Use greedy approach to solve an appropriate problem for optimal solution.
5. Apply dynamic programming approach to solve suitable problems.
6. Understand the limitations of algorithm power and study how to cope with the limitations of algorithm power for various problems.

UNIT-I

INTRODUCTION –Notion of Algorithm, Fundamentals of Algorithmic Problem Solving-Understanding the problem, deciding on appropriate data structures, Algorithm Design techniques, Methods of specifying an algorithm, proving an algorithm's correctness,
Analyzing and coding an Algorithm. Fundamentals of the Analysis of Algorithm Efficiency: Analysis framework and Asymptotic Notations and Basic Efficiency Classes.

UNIT-II

BRUTE FORCE AND EXHAUSTIVE SEARCH

Selection sort, Bubble sort, Sequential search, Brute-Force String Matching.Exhaustive search- Travelling salesman problem, knapsack problem and Assignment problem.

UNIT-III DIVIDE-AND-CONQUER

Mergesort, Quicksort, Binary Search, Binary Tree Traversals and Related Properties, Multiplication of large integers, Strassen's Matrix Multiplication.

UNIT-IV

DECREASE-AND-CONQUER & TRANSFORM-AND-CONQUER

DECREASE-AND-CONQUER :Insertion Sort, Topological Sorting, Decrease-by-Constant-Factor Algorithms: fake-coin problem, Josephus problem. TRANSFORM-AND-CONQUER :Presorting, Heaps and heap sort, Horner's rule.

UNIT-V

GREEDY TECHNIQUE

Prim's Algorithm, Kruskal's Algorithm: Disjoint Subsets and Union-Find Algorithms, Dijkstra's Algorithm, Huffman trees.

UNIT-VI

DYNAMIC PROGRAMMING

The Knapsack Problem and Memory Functions, Optimal Binary Search Trees, Warshall's and Floyd's Algorithms.

UNIT-VII

LIMITATIONS OF ALGORITHM POWER

Decision Trees: Decision Trees for Sorting Algorithms and Decision Trees for Searching Sorted Array. P, NP, and NP-complete Problems.

UNIT-VIII

COPING WITH THE LIMITATIONS OF ALGORITHM POWER

Backtracking: n-queens problem, Hamiltonian Circuit problem, Subset-sum problem. Branch-and-Bound: Assignment Problem, Knapsack Problem and Travelling Salesman problem.

Learning Resources

Text Book:

Introduction to The Design & Analysis of Algorithms, Anany Levitin, 2nd Edition, PearsonEducation, 2007.

Reference Book:

Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 2nd Edition, PHI, 2006.