UCT501: DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	Cr
3	0	2	4.0

Course Objectives: The objective of course is to provide an understanding of various techniques/methods such as Greedy, Dynamic Programming, Branch and Bound and Backtracking. It provides an insight of good principles of algorithm design techniques, and analysis of algorithms.

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

Fundamental Algorithmic Strategies: Brute-Force, Heuristics, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, Travelling Salesman Problem.

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

Lab

Implementation of Different Algorithms based on various algorithmic strategies using C/C++

Course Learning Outcomes (CLOs) / Course Objectives (COs):

After completion of this course, the students will be able to:

1. Analyze the complexity of algorithms, to provide justification for the selection, and to implement the algorithm in a particular context.
2. Apply various algorithmic design paradigms such as greedy, dynamic, backtracking etc. to solve common engineering problems.
3. Identify basic properties of graphs and apply their algorithms to solve real life problems.

Text Books:

1. *Fundamental of Computer Algorithms,* E. Horowitz and S. Sahni.
2. *The Design and Analysis of Computer Algorithms,* A. Aho, J. Hopcroft and J. Ullman.

Reference Books:

1. *Introduction to Algorithms*, T. H. Cormen, C. E. Leiserson and R. L. Rivest.
2. *Computer Algorithms: Introduction to Design and Analysis*, S. Baase.
3. *The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3*, .D. E. Knuth.
4. *Quantum Computation and Quantum Information*, Michael A. Nielsen and Isaac L. Chuang.