4th Semester	**RIT4C002**	**Design and Analysis of Algorithms**	**L-T-P 3-0-0**	**3 CREDITS**

Objectives of the course

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Module-I (08 Hrs)

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.

Module-II: (12 Hrs.)

Fundamental Algorithmic Strategies: Brute-Force: : Linear search, selection sort, Greedy: Huffman coding, Fractional knapasack problem, Activity selection Problem,Dynamic Programming: matrix chain multiplication, Longest common subsequence, Travelling Salesman Problem, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Module-III: (08 Hrs.)

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.

Module-IV: (10 Hrs.)

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems(Clique Decision, Node cover Decision and Chromatic Number Decision problem) and Reduction techniques.

Module-V: (10 Hrs.)

Advanced Topics: Approximation algorithms: Node cover problem, Travelling sales man problem, Randomized algorithms: Quick sort, n-queen problem, Min cut, Class of problems beyond NP – P SPACE

Books:

- Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
- Fundamentals of Algorithms – E. Horowitz et al.
- Design and Analysis of Algorithms, M.R.Kabat, PHI Learning
- Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
- Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
- Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Course Outcomes

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms .
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.
6. Explain the ways to analyze randomized algorithms (expected running time, probability of error).
7. Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).