DESIGN AND ANALYSIS ALGORITHMS

(Common to CSE, IT, CSE(AI&ML) & CSE(DS))

Course Code: 22CT1109

L	T	P	C
3	0	0	3

Course Outcomes: At the end of the Course the student shall be able to

CO1: Analyze the asymptotic performance of algorithms. (L3)

CO2: Apply divide-and-conquer and greedy methods to solve various problems.(L3)

CO3: Solve various optimization problems by applying dynamic programming techniques.(L4)

CO4: Apply backtracking and branch and bound methods to solve various problems.(L3)

CO5: Compare P, NP, NP-Hard and NP-Complete problems, and explain approximation algorithms.(L3)

UNIT-I (10 Lectures)

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations- Big Oh notation, Omega notation, Theta notation, Little Oh notation, and Little Omega notation. Disjoint Sets- disjoint set operations, union and find algorithms. Spanning trees, connected components and biconnected components.

Learning Outcomes: At the end of the module, students will be able to:

1. Explain various asymptotic notations (L2)
2. Analyze worst-case running times of various algorithms (L4)
3. Explain disjoint set operations (L2)

UNIT-II (10 Lectures)

Divide And Conquer: General method, Applications-Binary search, Quick sort, Merge sort, Max-Min algorithm.

Greedy Method: General method, Applications- Fractional knapsack problem, Minimum cost spanning trees, Single source shortest paths problem, Huffman codes.

Learning Outcomes: At the end of the module, students will be able to:

1. Explain the divide-and-conquer and greedy paradigms. (L2)
2. Solve larger problems by dividing into smaller subproblems using divide-and-conquer technique (L3)
3. Solve various optimization problems by using greedy method (L3)

UNIT-III (10 Lectures)

Dynamic Programming: General method, Applications- 0/1 knapsack problem, Matrix chain multiplication, Longest common subsequence, All pairs shortest paths problem using Floyd's algorithm, Travelling salesman problem.

Learning Outcomes: At the end of the module, students will be able to:
1. Explain the principle of optimality (L2)
2. Develop recurrence equations for solving various optimization problems (L3)
3. Make use of top-down approach with memorization or bottom-up approach (L3)

UNIT-IV (10 Lectures)

Backtracking: General method, Applications- n-queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

Branch and Bound: General method, Applications: LC Branch and Bound, FIFO Branch and bound and respective solutions for 0/1 Knapsack Problem.

Learning Outcomes: At the end of the module, students will be able to:
1. Illustrate the merits of backtracking over exhaustive search (L2)
2. Solve various combinatorial problems using backtracking with the help of state-space trees (L3)
3. Apply Branch and Bound technique to solve 0/1 knapsack problem (L3)

UNIT-V (10 Lectures)

Complexity Classes: Basic concepts, non-deterministic algorithms, P, NP, NP-Hard and NP-Complete classes, Cook's theorem (without proof).

Approximation Algorithms- The vertex-cover problem, The traveling-salesman problem.

Learning Outcomes: At the end of the module, students will be able to:
1. Explain the guessing and verification stages in a non-deterministic algorithm (L2)
2. Classify different complexity classes (L2)
3. Explain approximation algorithms with examples (L2)

TEXTBOOKS:

1. Ellis Horowitz, Sartaj Sahni and Rajasekharam, *"Fundamentals of Computer Algorithms"*,2nd Edition, University Press, 2008.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest,and C.Stein *"Introduction to Algorithms*", 3rd Edition, PHI / Pearson Education, 2009.

REFERENCE BOOKS:

1. M.T.Goodrich and R.Tomassia, " *Algorithm Design Foundations, Analysis and Internet examples"*, 1st Edition, John wiley and sons, 2006.
2. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, *"Introduction to Design and Analysis of Algorithms A strategic approach"*, 2nd Edition , Tata McGraw Hill,2009.
3. Allen Weiss, *"Data structures and Algorithm Analysis in C++"*, 2nd Edition, Pearson education, 2009.
4. Aho, Ullman and Hopcroft, *"Design and Analysis of Algorithms"*, 3rd Edition, Pearson education,2008.

5. Anany Levitin, "*Introduction to the design and analysis of algorithms*", 3rd Edition, Pearson ,2012.

WEB REFERENCES:

1. http://cse.iitkgp.ac.in/~abhij/course/theory/Algo1/Autumn11/
2. http://web.stanford.edu/class/cs161/