

Course: Major
Design and Analysis of Algorithms

Semester: I	Credits: 4	Subject Code: SMAJCDA123551	Lectures: 60
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Course Outcomes:			
At the end of the course, the learner will be able to:			
<ul style="list-style-type: none"> • CO1-Understand the correctness of algorithms using inductive proofs and analyze running times of algorithm using asymptotic analysis. • CO2-Explore and apply various algorithm design strategies (divide-and-conquer, transform-and-conquer for solving different problems. • CO3-Understand advanced design strategies like greedy, dynamic programming, backtracking and branch-bound techniques and applying it for solving problems. • CO4-Compare and contrast various algorithms with respect to their complexities. • CO5-Compare between different data structures and choose an appropriate data structure for a design situation. • CO6-Describe the classes P, NP, and NP Complete and be able to prove that a certain problem is NP-Complete. 			

Unit 1: Problem Solving and Algorithm Analysis'	15
<ul style="list-style-type: none"> • Problem solving and Algorithmic Analysis- Problem solving principles: Classification of problem, problem solving strategies, classification of time complexities (linear, logarithmic etc) • Algorithm Design Strategies -Divide and Conquer strategy and transform and conquer strategy • Asymptotic notations, lower bound and upper bound-Best case, worst case, average case analysis, amortized analysis. • Performance analysis of basic programming constructs. 	

Unit 2: Greedy and Dynamic Algorithm Strategies	15
<ul style="list-style-type: none"> • Greedy strategy-Principle, control abstraction, time analysis of control abstraction, Algorithms: Knapsack problem, scheduling algorithms-Job scheduling and activity selection problem, minimum-cost spanning trees and algorithms (Kruskal and Prim's) • Dynamic Programming-Principle, control abstraction, time analysis of control abstraction, binomial coefficients, Algorithms: Chain Matrix multiplication, single source shortest paths, Bellman- ford algorithm, all pairs shortest path, longest common subsequence, string editing, 0/1 knapsack problem, Traveling salesperson problem, Multistage Graphs 	

Unit 3: Backtracking and Branch and Bound Strategies	15
<ul style="list-style-type: none"> • Backtracking- General method, 8 Queen's problem, Sum of subsets problem Graph coloring problem, Hamiltonian cycle • Branch and Bound- FIFO, LIFO, LCBB, TSP problem, 0/1 knapsack problem 	



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Unit 4: Complexity Theory and Parallel and Concurrent Algorithms	15
<ul style="list-style-type: none"> Complexity Theory- The class of P, NP, NP-hard and NP- Complete problems, Significance of Cook's theorem Parallel Algorithms- Sequential and parallel computing, RAM & PRAM models, Amdahl's Law, Brent's theorem, parallel algorithm analysis and optimal parallel algorithms Concurrent Algorithms- Dining philosophers' problem 	

Reference Books:

- A. Aho, J. Hopcroft, & J. Ullman, *The Design and Analysis of Computer Algorithms*, Addison Wesley, 1974
- Donald Knuth, *The Art of Computer Programming-3 vols.*, various editions, 1973-81, Addison Wesley
- Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, *Computer Algorithms*, Galgotia.
- T. Cormen, C. Leiserson, & R. Rivest, *Algorithms*, MIT Press, 1990

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