**Course: Major**
**Design and Analysis of Algorithms**

| Semester: I | Credits: 4 | Subject Code:SMAJCDAA123551 | Lectures: 60 |
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**Course Outcomes:**

At the end of the course, the learner will be able to:

- 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 |
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- 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 |
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- 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 |
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- 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 |
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| • Complexity Theory- The class of P,NP, NP-hard and NP- Complete problems, Significance of Cook's theorem<br>• Parallel Algorithms- Sequential and parallel computing, RAM & PRAM models, Amdahl's Law, Brent's theorem, parallel algorithm analysis and optimal parallel algorithms<br>• 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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| Subject Expert (Outside SPPU) | Dr. Manisha Divate | Divate 25/05 |
| VC Nominee (SPPU) | Dr. Reena Bharathi | 15/7/23 |
| Industry Expert | Ms. Anjali Ingole | Ingole 15/7/23 |
| Alumni | Ms. Pooja Pandey | 15-7-23 |

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