राष्ट्रीय प्रौद्योगिकी संस्थान पटना / NATIONAL INSTITUE OF TECHNOLOGY PATNA
संगणक विज्ञान एंव अभियांत्रिकी विभाग / DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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No:- **Date:**

CS032001: Design and Analysis of Algorithms **L-T-P-Cr: 3-0-2-4**

Pre-requisites: Data Structures, Knowledge of Programming languages.

Objectives:

- To provide a solid foundation in algorithm design and analysis.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Outcomes:

At the end of the course, a student should have:

Sl. No.	**Outcome**	**Mapping to POs**
1.	Acquire knowledge about analyzing worst-case running time of algorithms using asymptotic analysis.	PO1, PO2
2.	Apply the different algorithm design techniques for designing a solution of different applications.	PO3, PO4, PO9
3.	Analyse the performance of algorithms using different algorithmic design techniques.	PO1, PO2
4.	Evaluate the possibility of implementation of various algorithms based on design techniques.	PO2, PO4
5.	Design and innovate efficient algorithms in the field of computer science & engineering and industry related applications using the different algorithm design techniques.	PO12, PO3, PO4, PO5

Course Outcomes	**Program Outcomes**											
	PO-1 (Engineering knowledge)	PO-2 (Problem analysis)	PO-3 (Design/development of solutions)	PO-4 (Conduct investigations of complex problems)	PO-5 (Modern tool usage)	PO-6 (The engineer and society)	PO-7 (Environment and sustainability)	PO-8 (Ethics)	PO-9 (Individual and team work)	PO-10 (Communication)	PO-11 (Project management and finance)	PO-12 (Life-long learning)

UNIT I: Introduction: **7 Lectures**

Introduction to Algorithms, Analysis and Design Techniques, performance evaluation of algorithms, space & time complexity, notion of optimality, Master's Theorem. **Divide and Conquer:** General Concept, Finding the maximum and minimum, Quick Sort, Merge Sort, Binary Search, Strassen's matrix multiplication.

UNIT II: Greedy Algorithm: **8 Lectures**

General Concept, Motivation, Thirsty Baby Problem, Knapsack Problem (Fractional Knapsack), Job Sequencing with Deadline, Huffman's Codes, Minimum Cost Spanning Tree- Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path-Dijkstra's Algorithm.

UNIT III: Dynamic Programming: **8 Lectures**

General Concept, Matrix-Chain Multiplication, 0/1 Knapsack problem, Coin Changing Problem, Single Source Shortest Path- Bellman Ford Algorithm, All pairs shortest paths, Traveling salesman problem.

UNIT IV: Backtracking: **9 Lectures**

Basic idea, 8-Queens problem, Graph Coloring, Hamiltonian Cycles. **Branch-And-Bound:** Basic idea, LC search, the 15-puzzle problem, LC Branch-and-Bound, 0/1 Knapsack Problem.

UNIT V: Graph Algorithms: **7 Lectures**

Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components, Bi-Connected Components and DFS, Euler Tour.

UNIT VI: Introduction to NP-Completeness: **3 Lectures**

Basic concepts on NP- hard and NP-Complete Problems, Discussion on one NP- hard graph problem-CDP.

Text/Reference Books:

1) *Introduction to Algorithm*, 2e, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI.
2) *Beginning Algorithms* by Simen Harris, James Ross, Wiley India.
3) *Fundamentals of Computer Algorithms* by E. Horowitz and S. Sahni.
4) *Algorithm Design*, 1e, by J. Kleinberg, E. Tardos, Pearson Education.