

Devi Ahilya Vishwavidhyalaya, Indore, India Institute of Engineering & Technology	B.Tech III Year Computer science and Engineering (FullTime)
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Course Code & Name	Classroom Instruction (CI)		Lab Instruction (LI)	Term Work (TW) and Self Learning (SL)	Total No. of Hours per Semester	Total Credits (Total Hours/30)
5RCPC3 DESIGN & ANALYSIS OF ALGORITHMS	L	T	P	TW + SL	120	4
	30	10	20	60		

Learning Objectives:

After completing this course, students will be able to:

1. Understand fundamental concepts of algorithm design, analysis, and performance evaluation.
2. Analyze algorithms using time and space complexity, asymptotic notations, and recurrence relations.
3. Apply appropriate algorithm design paradigms such as divide-and-conquer, greedy, dynamic programming, and backtracking to solve computational problems.
4. Compare and evaluate different algorithms for sorting, searching, graph, string, and matrix-based problems.
5. Understand computational complexity classes and recognize NP-complete and NP-hard problems.

Prerequisite: Programming fundamentals, basic data structures, and discrete mathematics.

Course Outcomes (CO) and Program Outcomes (PO) Mapping:

CO No.	Course Outcome	Program Outcomes (PO)
CO 1	Analyze the performance of algorithms using asymptotic notations, growth of functions, and Recurrence relations.	PO 1, PO 2, PO 3, PO12
CO 2	Apply appropriate sorting and searching algorithms and evaluate their efficiency for Given problem constraints.	PO 1, PO 2, PO 3, PO 5, PO12
CO 3	Design and solve optimization problems using greedy, dynamic programming, backtracking, And branch-and-bound techniques.	PO 1, PO 2, PO 3, PO 5, PO12

CO 4	Implement and analyze algorithms for matrix Operations and string matching problems using standard algorithmic strategies.	PO 1, PO 2, PO 3, PO 5, PO12
CO 5	Classify and assess computational problems based on complexity classes (P, NP, NP-Complete, NP-Hard) and identify suitable Solution approaches.	PO 1, PO 2, PO 3, PO12

CO-PO Relationship Matrix:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	–	–	–	–	–	–	–	–	2
CO2	3	3	2	–	1	–	–	–	–	–	–	2
CO3	3	3	3	–	1	–	–	–	–	–	–	2
CO4	3	2	2	–	3	–	–	–	–	–	–	2
CO5	3	3	2	–	–	–	–	–	–	–	–	3

Unit 1

Fundamental issues related to analysis of algorithms. Types of algorithms and performance issues, Time and space complexity and asymptotic analysis. Mathematical preliminaries; functions and their growth rates. Recurrence relations, Methods for solving recurrences: Substitution method, the recurrence tree method, Master Method.

Unit II

Elementary sorting techniques and their analysis: Selection Sort, Insertion Sort and its analysis, The divide and conquer approach, Advanced sorting techniques: Merge sort and its analysis, Analysis of Heap sort algorithm, Analysis of Priority Queue algorithm, Analysis of Quick sort algorithm, Analysis of Radix sort and Bucket sort, Searching techniques: Linear search and Binary Search, Searching minimum and maximum elements.

Unit III

Greedy Method: Illustration of strategy using knapsack problem, Minimum-Cost Spanning Tree, Optimal Storage on Tapes, Single-Source Shortest Paths, Dynamic Programming: Illustration of strategy using All-Pairs Shortest Paths, 0/1 Knapsack Problem, The Traveling Salesperson Problem, Basic Traversal and Search Techniques, Backtracking : The 8-Queens Problem, Branch and Bound Techniques.

Unit IV

Matrix Multiplication problem, Strassen's Matrix Multiplication, Matrix chain multiplication Problem. String matching problem and applications. Selected Algorithms for string matching: The naive string-matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm.

Unit V

Non-deterministic Algorithm: Introduction, Nondeterministic Complexity, Computational classes: P, NP, NP-Complete and NP-Hard, Reducibility, Decision and optimization problems, Some NP and NP-hard problems, Hamiltonian Cycle, Traveling Salesperson (TSP), Satisfiability, and Clique problem

Text Books :

1. T1: T.H. coreman, C.E. Leiserson and R. L. Rivest, Inroduction to Algorithms, Prentice Hall of India, 1990.
2. T2:E. Horowitz, S. Sahni, S Rajasekaran, Computer Algorithm, Galgotia Publications.

Reference Books:

1. R1:A. V. Aho, J. E. Hopcroft & J. D. Ullman, The design and Analysis of Computer Algorithms, Addison Wesley 1974.
2. R2:Knuth, D, The art of computer programming , Vol. 1-2-3, Addison Wesley, 2/e, 1988

