NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	BTech AI&ML
Course Code:	2CS510CC25
Course Title:	Design and Analysis of Algorithms
Course Type:	Core
Year of Introduction:	2025-26

L	T	Practical Component				C
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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to –

1. explain the notion of algorithmic complexity and logic of fundamental algorithms (BL2)
2. identify suitable data structures to solve a problem effectively andefficiently (BL3)
3. apply optimal solution approach for complex problems (BL3)
4. formulate appropriate algorithms for real-life problems. (BL6)

Unit	Contents	Teaching Hours (Total 30)
Unit-I	**Elementary Algorithmic:** Efficiency of Algorithms, average and worst-case analysis, Elementary Operation Analysis Techniques: Empirical, mathematical, Asymptotic analysis and related unconditional and conditional notations	05
Unit-II	**Analysis of Algorithms:** Analyzing control structures: sequencing, "For" loops, Recursive calls, "While" and "repeat" loops. Solving Recurrences: Intelligent guesswork, Homogeneous recurrences, non-homogeneous Recurrences, Change of variable, Range transformations, Master Theorem, Recurrence Tree	05
Unit-III	**Advanced Data Structures:** Binomial heaps, Fibonacci Heap, Disjoint set structures. **Divide-and-Conquer:** Multiplying large integers, Merge sort, quick sort, Strassen's matrix multiplication	05
Unit-IV	**Greedy Algorithms:** Activity Selection Problem, Fractional Knapsack problem, Huffman Coding, Graphs: Minimum spanning trees-Kruskal's algorithm, Prim's algorithm, Single Source Shortest paths: Dijkstra's algorithm	05
Unit-V	**Dynamic Programming:** The principle of optimality, 0/1 Knapsack Problem, Matrix Chain Multiplication, Longest Common Subservience, All pair shortest path: Floyd-Warshal's algorithm	06
Unit- VI	**Branch and Bound and Backtracking**: Travelling salesman problem, n-queen problem, Graph coloring problem.	04

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein, Introductionto Algorithms, Prentice Hall
2. Gilles Brassard & Paul Bratley, Fundamentals of Algorithmic, Prentice Hall
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekharan, Fundamentals of Computer Algorithms, Galgotia
4. Robert Sedgewick and Kevin Wayne - Algorithms, Addison Wesley
5. Rod Stephens - Essential Algorithms: A Practice Approach to Computer Algorithms Using Python and C#, Wiley.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Various applications of Arrays and Matrices	02
2	Working with Linked List	02
3	Searching (binary, ternary, and hash search)	02
4	Different applications of fundamental Sorting Algorithms	02
5	Use of Recursion	04
6	Divide and conquer applications and complexity computations	04
7	Applications of Greedy algorithms	04
8	Applications of Dynamic Programming	04
9	Working with tree algorithms	02
10	Working with Graph Algorithms.	04