NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	MTech CSE (Cyber Security)
Course Code:	3CS5102
Course Title:	Data Structures and Algorithms
Course Type:	(√ **Core**/ □ Value Added Course / □ Department Elective / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	2022-23

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Course Learning Outcomes (CLOs):

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

1. summarize different data structures (BL2)
2. identify appropriate data structures and methodologies for efficient algorithm design (BL3)
3. interpret the applications of various data structures (BL4)
4. design and implement efficient algorithms using various approaches (BL6)

Syllabus:

Total Teaching hours: 30

Unit	**Syllabus**	**Teaching hours**
Unit-I	**Data Structures:** Linked List, Tree, Binary Heap, Binomial Heap, Fibonacci Heap, Disjoint set structures	06
Unit-II	**Divide and Conquer**: General Template, Various algorithm implementation like Binary search, Merge Sort, Quick Sort etc.	06
Unit-III	**Greedy Algorithms:** Making change, graphs and minimum spanning tree, shortest path, Knapsack problem, Scheduling, etc.	06
Unit-IV	**Dynamic Programming**: Introduction of Dynamic Programming, Principle of Optimality, Examples like Single source shortest paths, Knapsack problem, Chained matrix multiplication, Longest Common Subsequence, etc.	06
Unit-V	**Graph Algorithms**: Elementary algorithms, DFS, BFS, Backtracking, and Branch & Bound techniques with related examples	06

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

Suggested Readings/ References:

1. Gilles Brassard and Paul Bratley, Fundamentals of Algorithmics, PHI Publication.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest& Clifford Stein, Introduction to Algorithms, PHI Publication.
3. Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, University Press

4. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill
5. Robert L. Kruse, Data Structures and Program Design in C, PHI

Suggested List of Experiments:

Sr. No.	Title	Hours
1	Demonstrate applications of different data structures.	4
2	Implement merge sort and external merge sort with different input types (random, ascending order, descending order) and large input sizes. Evaluate the time complexity of each algorithm and visualize the same using graphical representation.	4
3	Implement a quick sort algorithm with the following ways to select pivot element and give your observations for the same with different input types and sizes as given in Practical 2. a. Always pick the first element as pivot b. Always pick the last element as pivot c. Pick a random element as pivot Pick median as pivot	4
4	Solve Make-Change problem using Greedy approach.	2
5	Implement Kruskal's algorithm to find MST using greedy approach.	4
6	Implement fractional knapsack problem using greedy approach.	4
7	Implement Assembly Line Scheduling problem using dynamic programming concepts.	2
8	Implement matrix chain multiplication using dynamic programming concepts.	2
9	Given two sequences X and Y, find the longest common subsequence (LCS) of X and Y using dynamic programming.	2
10	Implement 0-1 knapsack problem using dynamic programming.	2