

UNIVERSITY OF MADRAS
M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE
SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	Advanced Data Structures and Algorithms		
Core-I – Theory	I Year & I Semester	Credit:4	436C1A

Objectives:

- Define the basic concepts of algorithms and analyze the performance of algorithms.
- Discuss various algorithm design techniques for developing algorithms.
- Discuss various searching, sorting and graph traversal algorithms.
- Understand NP completeness and identify different NP complete problems.
- Discuss various advanced topics on algorithms.

Outcomes:

1.	Analyze programming problem statements.	K1, K2
2.	Comprehend and select algorithm design approaches in a problem specific manner.	K2, K3
3.	Choose appropriate data structures for a specific problem	K3, K4
4.	Utilize necessary mathematical abstractions to solve problems	K5, K6
5.	Come up with analysis of efficiency and proofs of correctness	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.

UNIT II: Insertion and deletion and merging with 1) binary search tree, 2) AVL tree, 3) Red Black tree, 4) B tree, 5) B+ tree and Comparison of previous tree structures. Fibonacci Heap, Fibonacci Heap Operations: Find minimum, merge, insert, extract minimum, decrease key and delete, Complexity analysis of the above data structure operations.

UNIT III: Representations of Graphs, Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra 's Algorithm, Divide and conquer: General method, applications - Quick sort, Merge sort, Strassen's matrix multiplication, External Sort: External merge sort, K-Way Merge sorting

UNIT IV: Greedy method: General method, applications-Job sequencing with deadlines, 0/1, knapsack problem, Huffman Codes, Dynamic Programming: General method, applications-Matrix chain multiplication, 0/1 knapsack problem, Traveling salesperson problem, Reliability design.

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UNIT V: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles. Branch and Bound: General method, applications - Traveling salesperson problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution. NP-Hard and NP-Complete problems

Recommended Texts:

1. Peter Brass; Advanced Data Structures; CAMBRIDGE UNIVERSITY PRESS;2008
2. S. Dasgupta, C. Papadimitrou, U Vazirani; Algorithms; Mc Graw Hill;2022
3. J. Klienbergr and E. Tardos, Algorithm Design, Pearson Education Limited;2013.
4. Ellis Horowitz, Sartaj Sahni, Rajasekharan, Fundamentals of Algorithms, 2nd Edition, Universities Press, 2009.

Reference Books:

1. Sartaj Sahni, Data Structures Algorithms and Applications in C++, 2nd Edition, Universities Press, 2007.
2. Aho V Alfred, Hapcroft E John, Ullman D Jeffry, Data Structures and Algorithms, Pearson Education, 2001.
4. Adam Drozdek, Thomson, Data Structures and Algorithms in JAVA, 3rd Edition, Cengage Learning, 2008.
5. Horowitz, Sahni, Mehta, Fundamentals of Data Structures in C++, 2nd Edition, Universities Press, 2007.

Web References:

1. <https://nptel.ac.in/courses/106102064>

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	S	S	S	L	M
CO 2	S	L	S	M	S	L	M	M	S	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	M	M	S	L	S	M	S	S	S

S-Strong M-Medium L-Low