Data Structures and Analysis of Algorithms: (IT22232)

Teaching Scheme	Examination Scheme									
Credits: 4	**HA**	**SCE**	**PPT**	**GD**	**CIE**	**ESE**	**PR**	**OR**	**TW**	**TOTAL**
Lecture's/Week(L): 3 Hrs/week Practical/Week(P): 2 Hrs/week Tutorial/Week(T): 0 Hrs/week	-	20	-	-	20	40	20	-	-	100

Prerequisites:

- Fundamentals of data structures
- Discrete Mathematics
- Object oriented programming

Course Objectives:

- To study nonlinear data structures such as trees, graphs.
- To study the representation, implementation and applications of non-linear data structures.
- To choose the appropriate data structure for modeling a given problem.
- To know the basics of computational complexity analysis and various algorithm design strategies.
- To provide students with solid foundations to deal with a wide variety of computational problems.
- To analyze an algorithmic strategy and identify the computing requirements appropriate for its solutions.
- To understand basic concepts of P, NP class problems and parallel algorithms.

Course Outcomes:

After studying this course, students will be able to:

- Explore and compare various tree structures, their operations and traversal algorithms.
- Apply fundamental graph theory concepts and utilize graph algorithms to explore and traverse graphs efficiently.
- Apply the principles of hashing and collision resolution techniques and implement hash tables to achieve efficient data storage and retrieval.
- Analyze greedy algorithms and dynamic programming algorithms for various optimization problems.
- Comprehend the principles and techniques of the backtracking and Branch and Bound Method as a problem-solving paradigm.
- Analyze and classify computational problems based on their complexity class membership.

Unit I: Trees

Concepts: Non-linear data structures, tree terminology.
Types of Trees: Binary trees, Binary Search Trees (BST), AVL trees, Red-Black trees.
Operations: Traversals (in-order, pre-order, post-order), insertion, deletion, searching.
Applications: Expression trees, Huffman coding.

Unit II: Graphs

Concepts: Directed, undirected, and weighted graphs.
Representations: Adjacency matrix and list.
Traversal Algorithms: Depth-First Search (DFS) and Breadth-First Search (BFS).
Topological sorting

Unit III: Hash tables and heap

Hashing: Hash functions, collision resolution (Linear probing & chaining, Quadratic probing, Rehashing).
Heap: Max-heap and Min-heap, Heap sort.
Applications: Efficient data storage and retrieval.

Unit IV: Greedy Method

Concepts: Greedy algorithm principles.
Key Algorithms: Prim's and Kruskal's Minimum Spanning Tree, Dijkstra's Shortest Path.
Applications: Optimization problems.

Unit V: Dynamic programming and backtracking

Dynamic Programming: 0/1 Knapsack Problem, Longest Common Subsequence, Floyd-Warshall Algorithm.
Backtracking: General method, N-Queens Problem, Subset Sum Problem.
Graph Coloring: Backtracking approach for minimal coloring.

Unit VI: Branch and Bound and Computational Complexities

Branch and Bound: Least cost search and FIFO methods for 0/1 Knapsack.
Traveling Salesman Problem (TSP): Solving TSP using Branch and Bound and Dynamic Programming.
Computational Complexity: Basics of P, NP, NP-complete, and NP-hard problems.

Textbooks:

1. Horowitz and Sahani, "Fundamentals of computer Algorithms", Galgotia. ISBN 81-7371-612-9.
2. Data Structures and Algorithms in C++" by Goodrich, Tamassia, Goldwasser
3. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithms" PHI, ISBN:81-203-2141-3.
4. "Data Structures: A Pseudocode approach with Java" by R. Gillberg, B. Forouzan

Reference Books:

1. Brassard & Bratley, ―Fundamentals of Algorithmics‖, Prentice Hall India/Pearson Education, ISBN 13-9788120311312
2. 2.AnanyLevitin, "Introduction to the Design & Analysis of Algorithm ",Pearson ISBN 81- 7758-835-4
3. "Data Structures using C and C++" by Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum
4. "Data Structures and Algorithms in Java" by Adam Drozdek

Online Resources:

1. NPTEL course- Data Structures And Algorithms, IIT Delhi by Prof. Naveen Garg, https://nptel.ac.in/courses/106102064
2. NPTEL course -Programming, Data Structures And Algorithms, IIT Madras ,Prof. Hema A Murthy, Prof. Shankar Balachandran, Prof. N. S. Narayanaswamy, https://archive.nptel.ac.in/courses/106106127/3.
3. NPTEL course -Programming, Data Structures And Algorithms Using Python, Prof. Madhavan Mukund, Chennai Mathematical Institute, https://archive.nptel.ac.in/courses/106106145/
4. Infosys Springboard course- Data Structures and Algorithms, https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842032404848640104 70_shared/o