# 23CS21T1 - ADVANCED DATA STRUCTURES & ALGORITHM ANALYSIS

(Common to CSE, CSE (DS), CSE (AI&ML), AI&DS, and IT)

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| Course Category: | Professional Core | Credits: | 3 |
| Course Type: | Theory | Lecture-Tutorial-Practical: | 3-0-0 |
| Prerequisite: | Data Structures, Algorithms, and Strong programming skills in at least one high-level language | Sessional Evaluation:  Univ. Exam Evaluation:  Total Marks: | 30  70  100 |
| Objectives: | * To provide knowledge on advance data structures frequently used in Computer Science domain. * To develop skills in algorithm design techniques popularly used. * To understand the use of various data structures in the algorithm design. | | |

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| Course Outcomes | Upon successful completion of the course, the students will be able to: | |
| CO1 | Illustrate the working of the advanced tree data structures and their applications (L2). Analyze algorithms with respect to space and time complexities (L4). |
| CO2 | Understand the Graph data structure, traversals and apply them in various contexts. (L2) |
| CO3 | Use greedy methods and dynamic programming to solve optimization problems.(L3) |
| CO4 | Use backtracking and branch and bound for solving scheduling, resource allocation, and pathfinding problems.(L3) |
| CO5 | Understand the fundamental concepts of NP-Hard and NP-Complete problems (L2) and will be able to analyze NP-Hard problems in graph theory. (L4) |
| Course Content | UNIT-I  **Introduction**: Introduction to Algorithm Analysis, Space and Time Complexity Analysis, Asymptotic Notations.  **AVL Trees**: Creation, Insertion, Deletion operations and Applications.  **B Trees:** Creation, Insertion, Deletion operations and Applications.  UNIT-II  **Heap Trees (Priority Queues):** Min and Max Heaps, Operations and Applications.  **Graphs:** Terminology, Representations, Basic Search and Traversals, Connected Components and Bi connected Components, applications.  **Divide and Conquer**: The General Method, Quick Sort, Merge Sort, Strassen’s matrix multiplication, Convex Hull.  UNIT-III  **Greedy Method**: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths - Dijkstra’s.  **Dynamic Programming**: General Method, All pairs shortest paths, Optimal Binary Search Trees, 0/1Knapsack, String Editing, Travelling Salesperson problem.  UNIT-IV  **Backtracking:** General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem.  **Branch and Bound:** The General Method, 0/1 Knapsack Problem, Travelling Sales person problem.  UNIT-V  **NP Hard and NP Complete Problems:** Basic Concepts, Cook’s theorem (Without Proof).  **NP Hard Graph Problems:** Clique Decision Problem (CDP), Traveling Salesperson Decision Problem (TSP)  **NP Hard Scheduling Problems:** Scheduling Identical Processors. | |
| Text Books &  References  Books | **TEXT BOOKS:**   1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press 2. Fundamentals of algorithms, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran 2nd Edition University Press.   **REFERENCE BOOKS:**   1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia 2. An introduction to Data Structures with Applications, Trembley & Sorenson, McGraw-Hill 3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997. 4. Data Structures using C : Langsam, Augenstein & Tanenbaum, Pearson, 1995 5. Algorithms + Data Structures &Programs:,N.Wirth, PHI 6. Data structures in Java: Thomas Standish, Pearson Education Asia | |
| E-Resources | 1. <https://www.tutorialspoint.com/advanced_data_structures/index.asp> 2. <http://peterindia.net/Algorithms.html> 3. Abdul Bari, 1. Introduction to Algorithms (youtube.com) | |