ADVANCED DATA STRUCTURES AND ALGORITHMS

Course Code: 13IT2104 **L P C**
4 0 3

Pre requisites:

1. Computer Programming through C.
2. Data Structures.
3. Design and Analysis of Algorithms.

Course Educational Objectives:

The main objective is to deliver the programming techniques which are advanced for solving the problems regarding memory allocation, utilization and also object oriented features. Student can get the grip on:

1. Advanced programming
2. Solving the problems regarding large data structures like stack, queue, trees, graphs
3. The Top-Down Splay Trees, Red-Black Trees, Deterministic Skip lists, AA-Trees, Treaps, *k*-d Trees.
4. Dynamic equivalence problem
5. Binomial Queues, Skew Heaps, Fibonacci Heaps

Course Outcomes:

At the end of the course **s**tudent will be able to

1. Get knowledge on how to develop algorithms, operations on queues and stacks.
2. Understand different searching, different sorting methods and graphs.
3. Understand disjoint set classes and graph algorithms.
4. Learn about Algorithm Design Techniques like Greedy Algorithms, Divide and Conquer.
5. Learn various advanced data structures and their implementations.

Unit-I

Lists, Stacks, Queues and Trees: Lists, Stacks and Queues: Abstract Data Types (ADTs), The List ADT, Vector and list in the STI, Implementation of vector, Implementation of list, The Stack ADT, The Queue ADT.

Trees: The Search Tree ADT – Binary Search Trees, AVI. Trees, Splay Trees, B-Trees.
Hashing: Hashing: General idea, Hash Function, Separate Chaining, Hash Tables Without Linked Lists, Rehashing, Extendible Hashing.

Unit-II
Priority Queues: Implementations, Binary Heap, Applications of Priority Queues, *d*-Heaps, Leftist Heaps, Skew Heaps, Binomial Queues.
Sorting: Sorting: A Lower Bound for Simple sorting Algorithms, Shellsort, Heapsort, Mergesort, Quicksort, Indirect Sorting, A General Lower Bound for sorting, Bucket Sort, External Sorting.

Unit-III
The Disjoint Set Class: Equivalence Relations, The Dynamic Equivalence Problem, Basic Data Structure, Smart Union Algorithms, Path Compression, Worst Case of Union-by-Rank and Path Compression, An Application.

Graph Algorithms: Definitions, Topological sort, Shortest-Path Algorithms, Network Flow Problems, Minimum Spanning Tree, Applications of Depth-First Search, introduction to NP-Completeness.

Unit -IV
Algorithm Design Techniques: Greedy Algorithms, Divide and Conquer, Dynamic Programming, Randomized Algorithms, Backtracking Algorithms.
Amortized Analysis: An Unrelated Puzzle, Binomial Queues, Skew Heaps, Fibonacci Heaps, Splay Trees.

Unit-V
Advanced Data Structures and Implementation: Top-Down Splay Trees, Red-Black Trees, Deterministic Skip lists, AA-Trees, Treaps, *k*-d Trees, Pairing Heaps.

Text Books:

1. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++*, 3rd Edition, Pearson Education, 2007.

References:

1. Sartaj Sahni, *Data Structures Algorithms and Applications in C++*, 2nd Edition, Universities Press, 2007.
2. Ellis Horowitz, Sartaj Sahni, Rajasekharan, *Fundamentals of Algorithms*, 2nd Edition, Universities Press, 2009.
3. Aho V Alfred, Hapcroft E John, Ullman D Jeffry, *Data Structures and Algorithms*, 1st Edition, Pearson Education, 2002.
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:

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