Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210252: Advanced Data Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem(online): 50 Marks End-Sem(paper): 50 Marks

Prerequisite:

- Data Structures and algorithms
- Basic Mathematics, Geometry, linear algebra, vectors and matrices.

Course Objectives:

- To develop a logic for graphical modelling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, student will be able to–

- To apply appropriate advanced data structure and efficient algorithms to approach the problems of various domain.
- To design the algorithms to solve the programming problems.
- To use effective and efficient data structures in solving various Computer Engineering domain problems.
- To analyze the algorithmic solutions for resource requirements and optimization
- To use appropriate modern tools to understand and analyze the functionalities confined to the data structure usage.

Course Contents

Unit I	Trees	09 Hours

Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, **binary tree traversals-** inorder, preorder, post order, level wise -depth first and breadth first, Operations on binary tree. Binary Search Tree (BST), BST operations, Threaded binary tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary tree, in order traversal of in-order threaded binary tree. **Case Study**- Use of binary tree in expression tree-evaluation and Huffman's coding

Unit II	Graphs	09 Hours

Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Introduction to Greedy Strategy, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, Topological ordering.

Case study- Data structure used in Webgraph and Google map.

Unit III	Hashing	09 Hours

Hash Table- Concepts-hash table, hash function, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing.
Dictionary- Dictionary as ADT, ordered dictionaries.
Skip List- representation, searching and operations- insertion, removal.

Unit IV	Search Trees	09 Hours

Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Introduction to Dynamic Programming, Weight balanced tree, Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree.

Unit V	Indexing and Multiway Trees	09 Hours

Indexing and Multiway Trees- Indexing, indexing techniques, Types of search tree- Multiway search tree, B-Tree, B+Tree, Trie Tree, Splay Tree, Red-Black Tree, K-dimensional tree, AA tree.
Set- Set ADT, realization of Set and operations.
Heap-Basic concepts, realization of heap and operations, Heap as a priority queue, heap sort

Unit VI	File Organization	09 Hours

Sequential file organization- concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.
External Sort- Consequential processing and merging two lists, multiday merging- a k way merge algorithm.

Books:

Text:

1. Horowitz, Sahani, Dinesh Mehata, –Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, –File Structures", Pearson Education, ISBN:81-7758-37-5
3. Peter Brass, –Advanced Data Structures", Cambridge University Press, ISBN: 978-1-107-43982-5

References:

1. A. Aho, J. Hopcroft, J. Ulman, –Data Structures and Algorithms", Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, –File Structures an Object Oriented Approach with C++", Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, –Data Structures, Algorithms and Applications in C++", Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, –Data Structures and Algorithms", The McGraw-Hill Companies, ISBN - 9780070667266.
5. Goodrich, Tamassia, Goldwasser, –Data Structures and Algorithms in Java", Wiley Publication, ISBN: 9788126551903.