Data Structures and Algorithms

Course Title: Data Structures and Algorithms
Course No: CSC206
Nature of the Course: Theory + Lab
Semester: III

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: This course includes the basic foundations in of data structures and algorithms. This course covers concepts of various data structures like stack, queue, list, tree and graph. Additionally, the course includes idea of sorting and searching.

Course Objectives:

- To introduce data abstraction and data representation in memory
- To describe, design and use of elementary data structures such as stack, queue, linked list, tree and graph
- To discuss decomposition of complex programming problems into manageable sub-problems
- To introduce algorithms and their complexity

Course Contents:

Unit 1: Introduction to Data Structures & Algorithms (4 Hrs.)

1.1 Data types, Data structure and Abstract date type
1.2 Dynamic memory allocation in C
1.3 Introduction to Algorithms
1.4 Asymptotic notations and common functions

Unit 2: Stack (4 Hrs.)

2.1 Basic Concept of Stack, Stack as an ADT, Stack Operations, Stack Applications
2.2 Conversion from infix to postfix/prefix expression, Evaluation of postfix/ prefix expressions

Unit 3: Queue (4 Hrs.)

3.1 Basic Concept of Queue, Queue as an ADT, Primitive Operations in Queue
3.2 Linear Queue, Circular Queue, Priority Queue, Queue Applications

Unit 4: Recursion (3 Hrs.)

4.1 Principle of Recursion, Comparison between Recursion and Iteration, Tail Recursion
4.2 Factorial, Fibonacci Sequence, GCD, Tower of Hanoi(TOH)
4.3 Applications and Efficiency of Recursion

Unit 5: Lists (8 Hrs.)

5.1 Basic Concept, List and ADT, Array Implementation of Lists, Linked List
5.2 Types of Linked List: Singly Linked List, Doubly Linked List, Circular Linked List.
5.3 Basic operations in Linked List: Node Creation, Node Insertion and Deletion from Beginning, End and Specified Position
5.4 Stack and Queue as Linked List

Unit 6: Sorting (8 Hrs.)

6.1 Introduction and Types of sorting: Internal and External sort
6.2 Comparison Sorting Algorithms: Bubble, Selection and Insertion Sort, Shell Sort
6.3 Divide and Conquer Sorting: Merge, Quick and Heap Sort
6.4 Efficiency of Sorting Algorithms

Unit 7: Searching and Hashing (6 Hrs.)

7.1 Introduction to Searching, Search Algorithms: Sequential Search, Binary Search
7.2 Efficiency of Search Algorithms
7.3 Hashing : Hash Function and Hash Tables, Collision Resolution Techniques

Unit 8: Trees and Graphs (8 Hrs.)

8.1 Concept and Definitions, Basic Operations in Binary Tree, Tree Height, Level and Depth
8.2 Binary Search Tree, Insertion, Deletion, Traversals, Search in BST
8.3 AVL tree and Balancing algorithm, Applications of Trees
8.4 Definition and Representation of Graphs, Graph Traversal, Minimum Spanning Trees: Kruskal and Prims Algorithm
8.5 Shortest Path Algorithms: Dijksrtra Algorithm

Laboratory Works:

The laboratory work consists of implementing the algorithms and data structures studied in the course. Student should implement at least following concepts;

- Dynamic memory allocation and deallocation strategies
- Stack operations and Queue operations
- Array and Linked List implementation of List
- Linked List implementation of Stack and Queues
- Sorting, Searching and Hashing algorithms
- Binary Search Trees and AVL Tress
- Graph Representation, Spanning Tree and Shortest Path Algorithms

Text Books:

1. Y Langsam , MJ Augenstein and A.M , Tanenbaum Data Structures using C and C++ , Prentice Hall India, Second Edition 2015

Reference Books:

1. Leen Ammeral, Programmes and Data Structures in C, Wiley Professional Computting
2. G.W Rowe, Introduction to Data Structure and Algroithms with C and C++ , prentice Hall India
3. R.L Kruse, B.P. Leung, C.L. Tondo, Data Structure and Program Design in C Prentice-Hall India