Title: Data Structures & Algorithms

Code Number: CS2103

Credit Hours: 3 (3+1)

Prerequisites: CS1202 Computer Programming

Semester: 3rd

Course Objectives

The course will enable students to:

1. Classify and analyze different categories of data structures and algorithms
2. Implement common searching algorithms, sorting algorithms, linear and non-linear data structures
3. Design solution of searching problems with data structures principles

Contents

Unit 1: Programming Methodologies:

1. An Introduction to Data Structure
2. Algorithm, Modular Programming
3. Top-Down Algorithm Design
4. Bottom-Up Algorithm Design
5. Structured Programming
6. Analysis of Algorithm
7. Time-Space Trade Off
8. Big "OH"

Unit 2: Memory Management:

1. Memory Allocation
2. Dynamic Memory Allocation
3. Free Storage List, Garbage Collection
4. Dangling Reference
5. Reference Counters
6. Storage Compaction

Unit 3: The Stack:

1. Operations Performed on Stack
2. Stack Implementation
3. Stack Using Converting Infix to Postfix Expression
4. Evaluating Postfix Expression

Unit 4: The Queue:

1. Algorithms for Queue Operations
2. Other Queues
3. Circular Queue
4. Deques
5. Applications of Queue

Unit 5: Linked List

1. Linked List

2. Representation of Linked List
3. Advantages and Disadvantages
4. Operation on Linked List
5. Types of Linked List
6. Singly Linked List
7. Stack Using Linked List
8. Queue Using Linked List
9. Queue Using Two Stacks
10. Polynomials Using Linked List
11. Doubly Linked List
12. Circular Linked List
13. Priority Queues

Unit 6: Sorting Techniques:

1. Complexity of Sorting Algorithms
2. Bubble Sort
3. Selection Sort
4. Insertion Sort
5. Shell Sort
6. Quick Sort
7. Merge Sort
8. Radix Sort
9. Heap
10. External Sorting

Unit 7: Searching and Hashing:

1. Linear or Sequential Searching
2. Binary Search
3. Interpolation Search
4. Fibanocci Search
5. Hashing

Unit 8: The Trees:

1. Basic Terminologies
2. Binary Trees
3. Binary Tree Representation
4. Operations on Binary Tree
5. Traversing Binary Trees Recursively
6. Traversing Binary Tree Non-Recursively
7. Binary Search Trees
8. Threaded Binary Tree
9. Expression Trees
10. Decision Tree
11. Fibanocci Tree
12. Selection Trees
13. Balanced Binary Trees
14. AVL Trees

15. M-Way Search Trees
16. 2-3 Trees
17. 2-3-4 Trees
18. Red-Black Tree
19. B-Tree
20. Splay Trees
21. Digital Search Trees

Unit 9: Graphs:

1. Basic Terminologies
2. Representation of Graph
3. Operations on Graph
4. Breadth First Search
5. Depth First Search
6. Minimum Spanning Tree
7. Shortest Path

Lab Work Outline

All the concepts of the theory part will be covered in the laboratory.

Teaching-Learning Strategies:

The pedagogical approach to this course relies on face-to-face teaching in a university classroom environment. The lectures are delivered using multimedia support and on a whiteboard. Students are engaged and encouraged to solve real world problems using computer-aided tools.

Assignments/Types and Number with calendar:

A minimum of four assignments to be submitted before the written exams for each term.

Assessment and Examinations:

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Sessional Assessment	25%	It is continuous assessment. It includes classroom participation, attendance, assignments and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Recommended Books:

1. Horowitz Sahni, "*Fundamentals of Data Structures in C++"*, 1999.
2. Lipshutz, "*Data Structures", Schaum Outline Series*," 1999.
3. M. Tanenbaum, "*Data structures using C and C++",* 2001