Data and File Structures

Course Code: **MCA-102** **L T C**

Course Name: **Data and File Structures** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. There should be 10 questions of short answer type of 2.5 marks each, having at least 2 questions from each unit.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions to evaluate analytical/technical skills of candidate. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks, including its subparts, if any.
3. Examiners are requested to go through the Course Outcomes (CO) of this course and prepare the question paper accordingly, using Bloom's Taxonomy (BT), in such a way that every question be mapped to some or other CO and all the questions, put together, must be able to achieve the mapping to all the CO(s), in balanced way.

LEARNING OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Familiarization of fundamentals of data and file structures and their operations like, insertion, deletion, searching and sorting.
2. Understanding and implementation of data structures like arrays, linked lists, stacks, queues, trees, graphs and files.
3. Identification of a suitable data structure to model data used in real world applications.

PRE-REQUISITES:

1. Discrete Structures
2. Programming Skills

For basic understanding of programming concepts, the students are advised to study the courses/material available on following websites:

- Pre-requisite based Study Material available on Course Website (www.bvicam.in)
- Spoken Tutorial on C and C++ Programming (https://spoken-tutorial.org/tutorial-search/?search_foss=C+and+Cpp&search_language=English-USA)

COURSE OUTCOMES:

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Recall different type of data structures.	BTL1	PO1
CO2	Explain the fundamentals of an Abstract Data Type (ADT).	BTL2	PO1, PO2
CO3	Apply linear and nonlinear data structures to solve real time problems.	BTL3	PO1, PO2, PO3, PO4, PO6, PO10
CO4	Appraise and determine the correct data structure for any given real-world problem.	BTL5	PO1, PO2, PO3, PO4, PO6, PO10, PO11
CO5	Create innovative solutions for real world problems.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PO11

SYLLABUS:

UNIT - I

No. of Hours: 14 **Chapter/Book Reference:** TB1 [Chapters 1-4, 7]; TB2 [Chapters 3, 7]

Introduction to Linear Data Structures: Introduction and Classification of Data Structures, Abstract Data Types.

Arrays: Single Dimension, Multi Dimensions, Memory Representation, Address Calculation, Sparse Matrices- Types, Representation and Operations, Linear and Binary Search, Selection Sort, Bubble Sort, Insertion Sort, Radix Sort, Merge Sort, Shell Sort.

Linked List: Dynamic Memory versus Static Memory Allocation, Types and Operations- Singly Linked List, Doubly Linked List, Header Linked List, Circular Linked List, Applications - Polynomial Arithmetic.

Stacks and Queues: Introduction and Implementation, Types of Queues and Applications, Multi Stacks and Multi Queues, Applications of Stacks- Need, Evaluation and Conversion between Polish and Reverse Polish Notations, Quick Sort, Recursion.

UNIT - II

No. of Hours: 12 **Chapter/Book Reference:** TB1 [Chapter 5]; TB2 [Chapters 4, 6]

Non Linear Data Structures: Trees

Trees: Notations & Terminologies, Binary Trees, Binary Search Trees and Basic Operations, Tree Traversals (Recursive and Stack Based non-Recursive), Threaded Binary Tree, Tree Sort, Tries.

AVL Trees: Properties, Operations- Insertion and Deletion.

M-Way Trees: General Concept, B Trees, B+ Trees and B* Trees.

Heaps: Structural Properties, Heapify, Heap Sort, Priority Queue Implementation.

UNIT - III

No. of Hours: 10 **Chapter/Book Reference:** TB1 [Chapter 6]; TB2 [Chapter 9]

Non-Linear Data Structures: Graphs

Representation of Graphs: Adjacency Matrix and Linked Representation.

Graph Traversals: Breadth First Search, Depth First Search, Connected Components.

Spanning Trees: MST Algorithms - Kruskal's Algorithm, Prim's Algorithm.

Shortest Path Algorithms: Single Source and All Pairs- Dijkstra's Algorithm, Floyd-Warshall Algorithm, Topological Sort.

Case Studies: Dynamic Graphs, Social Network Graphs and Sparse Graphs.

UNIT - IV

No. of Hours: 09 **Chapter/Book Reference:** TB1 [Chapters 8, 10]; TB2 [Chapter 5]; TB3 [Chapters 4, 10-16]

Hashing and File Structures

Hashing: Hash Table, Hash Functions, Collision Resolution - Chaining and Open Addressing.

File Organization: Sequential, Index Sequential, Relative. Operations - Creating, Updating, and Retrieving from Sequential Files, Handling Sequential Files in C language, Seeking, Positioning, Reading and Writing Binary Files in C.

External Sorting: Merging Ordered Files and Unordered Files, Natural Merge, Balanced Merge, K-Way and Polyphase Merge.

TEXT BOOKS:

TB1. E. Horowitz and S. Sahni, "Fundamentals of Data Structures in C". Universities Press, Second edition, 2008.

TB2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education India, Fourth Edition, 2014.

TB3. Mary E. S. Loomis, "Data Management and File Structure", PHI, Second Edition, 2009.

REFERENCE BOOKS:

RB1. Y. Langsam, M. J. Augenstein and A.M. Tanenebaum, "Data Structures using C and C++", Pearson Education India, 2nd Edition, 2015.

RB2. Alfred V. Aho, John E. Hopcroft and D. Ullman, "Data Structures and Algorithms", Addison-Wesley, 1st Edition, 2002.

RB3. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Cengage Learning, 2nd Edition, 2004.

RB4. D. Malhotra and N. Malhotra, "Data Structures and Program Design using C", Laxmi Publications, Indian adapted edition from Mercury Learning and Information, USA, 1st Edition, 2018.

RB5. Schaum's Outline Series, "Data Structure", TMH, Special Indian Ed., 17th Reprint, 2014.

RB6. D. Samanta, "Classic Data Structures", PHI, 2nd Edition, 2009.

Data and File Structures Lab.

Course Code: **MCA-162** **L T/P C**

Course Name: **Data and File Structures Lab.** **0 2 1**

LEARNING OBJECTIVES:

In this course, the learners will be able to develop the working expertise related to the following:-

1. Implementing various data structures using a programming language.
2. Implementing different operations on data and file structures.

COURSE OUTCOMES:

After completion of this course, the learners will be able to:-

CO #	Detailed Statement of the CO	BT Level	Mapping to PO #
CO1	Illustrate basic data structures - arrays and linked lists.	BTL2	PO1, PO2
CO2	Build stacks and queues using arrays and linked lists.	BTL3	PO1, PO2, PO3
CO3	Discover sparse matrix, polynomial arithmetic, searching and sorting techniques and their applications.	BTL4	PO1, PO2, PO3, PO4
CO4	Appraise binary search tree to perform efficient search operations.	BTL4	PO1, PO2, PO3, PO4
CO5	Examine and implement graph algorithms.	BTL4	PO1, PO2, PO3, PO4, PO5, PO6, PO10
CO6	Develop an application making extensive use of binary files.	BTL6	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO9, PO10, PO11