Academic Year: 2022-2023	Semester: 3rd
Course Name: Data Structures And Applications	Course Code: 21CS32
Total Contact hours: 40	Credits: 04
SEE Marks: 50; CIE: 50	Total Marks: 100
Course Plan Author: Prof. Manzoor Ahmed	Date: 10-10-2022

Course Prerequisites: Basic knowledge of C language etc.

Course Objectives:

1. Explain the fundamentals of data structures and their applications essential for implementing solutions to problems.
2. Illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.
3. Design and Develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists.
4. Explore usage of Trees and Graph for application development.
5. Apply the Hashing techniques in mapping key value pairs.

Course Outcomes:

1. Identify different data structures and their applications.
2. Apply stack and queues in solving problems.
3. Demonstrate applications of linked list.
4. Explore the applications of trees and graphs to model and solve the real-world problem.
5. Make use of Hashing techniques and resolve collisions during mapping of key value pairs.

CO Number	Course Outcome At the end of the course, student should be able to . . .	Blooms' Level
CO1	Identify different data structures and their applications.	L1,L2,L3
CO2	Apply stack and queues in solving problems.	L1,L2,L3
CO3	Demonstrate applications of linked list.	L1,L2,L3
CO4	Explore the applications of trees and graphs to model and solve the real-world problem.	L1,L2,L3
CO5	Make use of Hashing techniques and resolve collisions during mapping of key value pairs.	L1,L2,L3

Program Outcomes and Program Specific Outcomes

PO, PSO	*1.Engineering Knowledge;* *2.Problem Analysis;* *3.Design / Development of Solutions;* *4.Conduct Investigations of Complex Problems;* *5.Modern Tool Usage;* *6.The Engineer and Society;* *7.Environment and Sustainability;* *8.Ethics;* *9.Individual and Teamwork;* *10.Communication;* *11.Project Management and Finance;* *12.Life-long Learning;* *PSO1.: Graduates will have the ability to adapt, contribute and innovate ideas in the field of Artificial Intelligence and Machine Learning* *PSO2: To provide a concrete foundation and enrich their abilities to qualify for Employment, Higher studies and Research in various domains of Artificial Intelligence and Machine Learning such as Data Science, Computer Vision, Natural Language Processing with Ethical Values.* *PSO3: Graduates will acquire the practical proficiency with niche technologies and open-source platforms and to become Entrepreneur in the domain Artificial Intelligence and Machine Learning*

CO – PO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					2			2	1	1	
CO2	2	3	3	2					2			2	1	1	
CO3	2	3	3	2					1			2	1	1	
CO4	2	3	3	2					1			2	1	1	
CO5	2	2	2	1					1			2	1	1	

Course Content (Syllabus)

DATA STRUCTURES AND APPLICATIONS (Effective from the academic year 2021 -2022) SEMESTER – III			
Course Code	**21CS32**	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	40	**Exam Hours**	03 Hrs

Module-1

Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures.

Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays and Multidimensional Arrays.

Demonstration of representation of Polynomials and Sparse Matrices with arrays.

Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7, Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Textbook 3: Chapter 1: 1.3

Module-2

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.

Queues: Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues.

Textbook 1: Chapter 3: 3.1 -3.4, 3.6 Textbook 2: Chapter 6: 6.1 -6.4, 6.5, 6.7-6.13

Module-3

Linked Lists: Definition, classification of linked lists. Representation of different types of linked lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.

Textbook 1: Chapter 4: 4.1 – 4.4, 4.5.2, 4.7, 4.8, Textbook 2: Chapter 5: 5.1 – 5.9

Module-4

Trees 1: Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression.

Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9

Module-5

Trees 2: AVL tree, Red-black tree, Splay tree, B-tree.

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth FirstSearch.

Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

Textbook 1: Chapter 10:10.2, 10.3, 10.4, Textbook 2:7.10 – 7.12, 7.15 Chapter 11: 11.2, Textbook 1: Chapter 6 : 6.1–6.2, Chapter 8 : 8.1-8.3, Textbook 2: 8.1 – 8.3, 8.5, 8.7

Textbook 3: Chapter 15:15.1, 15.2,15.3, 15.4,15.5 and 15.7

Schedule of Instruction

Sl.no	Class no	Module	Topic	Reference (Book, Page no.)	Course Outcome	Delivery mode
1	2	**Module1:**	**MODULE-1** Introduction, Data Structures, Classifications (Primitive & Non Primitive),	T2, 1.1.9	CO1	PPTs
2	3		Data structure Operations, Review of Arrays	T2, 1.9-1.10 T2, 4.1-4.8	CO1	PPTs
3	4		Structures: Array of structures Self-Referential Structures	T1, 59 -63	CO1	PPTs
4	5		Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory	T1, 55 -56	CO1	PPTs Chalk & Talk
5	6		Dynamically allocated arrays and Multidimensional Arrays.	T2, 4.18-4.23	CO1	PPTs Chalk & Talk
6	7		Demonstration of representation of Polynomials	T1,64-71	CO1	PPTs Chalk & Talk
7	8		Demonstration of representation of Sparse Matrices with arrays.	T2, 4.37-4.38	CO1	PPTs Chalk & Talk
8	9		Revision of Module-1		CO1	Quiz
9	10	**Module2:**	**Stacks:** Definition, Stack Operations, Array Representation of Stacks	T2,6.1-6.6	CO2	Chalk & Talk
10	11		Stacks using Dynamic Arrays. Different representation of expression.	T1,112-113	CO2	Chalk & Talk
11	12		Stack Applications: Infix to postfix conversion, Infix to prefix conversion,	T1,132-138	CO2	Chalk & Talk
12	13		Evaluation of postfix expression, Recursion.	T1,129-131	CO2	Chalk & Talk
13	14		**Queues:** Definition, Array Representation of Queues	T2, 6.32-6.38	CO2	Chalk & Talk
14	15		Queue Operations, Circular Queues,	T1,114-120	CO2	Chalk & Talk
15	16		Queues and Circular queues using Dynamic arrays, Dequeues, Priority Q.	T2, 640-6.43	CO2	Chalk & Talk
16	17		Revision of Module-2		CO2	Brain Stroming
17	18	**Module3:**	**Linked Lists:** Definition, classification of linked lists. Representation of different types of linked lists in Memory	T2, 5.1-5.7	CO3	Chalk & Talk
18	19		Traversing, Insertion, Deletion, Searching,	T2, 5.8-5.31	CO3	Chalk & Talk

19	20		Sorting, and Concatenation Operations on Singly linked list	T1,149-155	CO3	Chalk & Talk
20	21		Doubly Linked lists, Circular linked lists, and header linked lists	T1,186-190	CO3	Chalk & Talk
21	22		Linked Stacks and Queues.	T1,156	CO3	Chalk & Talk
22	23		Applications of Linked lists – Polynomials,	T1,160-166	CO3	Chalk & Talk
23	24		Sparse matrix representation. Programming Examples.	T1,178-185	CO3	Chalk & Talk
24	25		Revision of Module-3		CO3	Quiz
25	26	**Module4:**	**Trees 1:** Terminologies, Binary Trees,	T2, 7.1-7.4	CO4	Chalk & Talk
26	27		Properties of Binary trees,		CO4	Chalk & Talk
27	28		Array and linked Representation of Binary Trees	T2,7.5	CO4	Chalk & Talk
28	29		Binary Tree Traversals - Inorder, postorder, preorder	T2, 7.13-7.19	CO4	Chalk & Talk
29	30		Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal	T1,216-220	CO4	Chalk & Talk
30	31			T1,221-222	CO4	Chalk & Talk
31	32		Searching operation on Binary search tree	T2, 7.25-7.34	CO4	Chalk & Talk
32	33		Application of Trees-Evaluation of Expression	T1,208	CO4	Chalk & Talk
33	34		Revision of Module-4		CO4	Brain stroming
34	35	**Module5:**	**Trees 2:** AVL tree, Red-black tree,	T2, 7.35-7.36	CO5	Chalk & Talk
35	36		Splay tree, B-tree.	T2,7.51-7.52	CO5	Chalk & Talk
36	37		**Graphs:** Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs	T2, 8.1	CO5	Chalk & Talk
37	38		Traversal methods: Breadth First Search	T1,281-282	CO5	Chalk & Talk
38	39		Depth First Search.	T1,279-281	CO5	Chalk & Talk
39	40		**Hashing:** Hash Table organizations, Hashing Functions	T3,464-467	CO5	Chalk & Talk
40	41		Static and Dynamic Hashing	T1,396-414	CO5	Chalk & Talk
41	42		Revision of Module-5		CO5	GD

**L – Lecture, V- Videos or any other mode*

Textbooks	
T1	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
T2	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
T3	Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
Reference books	
R1	Gilberg and Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.
R2	Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications,2nd Ed, McGraw Hill, 2013
R3	A M Tenenbaum, Data Structures using C, PHI, 1989
R4	Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

Web links and Video Lectures (e-Resources):	
1	https://sites.google.com/view/manzoorahmed/home
2	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
3	https://nptel.ac.in/courses/106/105/106105171/
4	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

Assessment Schedule:

Sl.No.	Assessment type	Contents	CO	Duration In Hours	Marks	Date & Time
1	**CIE Test 1**	Module1 & Module 2	CO1, CO2	1.5	40	
2	**CIE Test 2**	Module 3 & Module 4	CO3, CO4	1.5	40	
3	**CIE Test 3**	Module 5 & Module 1	CO5, CO1	1.5	40	
4	**Assignment 1**	Module1 & Module 2	CO1, CO2		10	
5	**Assignment 2**	Module 3 & Module 4	CO3, CO4		10	
6	**Seminar *(or any planned activtiy)***	Module 1	CO1		10	
7	**Quiz**	Module 1 to 5	CO 1 to 5		10	
8	**Semester End Examination**	Modules 1 to 5	CO1 to CO5	3	100	

Seminar: Group of 2 students
Module 1

The Average of total marks of three tests, two assignments, seminar and quiz will be out of 50 marks and final exam will be for 100 marks scaled down to 50 marks.

CIE + SEE = 50 + 50 = 100 marks

Faculty Incharge DAC Chairman