MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

B.Tech. School of Computer Engineering

COURSE PLAN: THEORY COURSE

Department :	**School of Computer Engineering**			
Course Name & code :	**CSS 2101 Data Structures**		**Core**	
Semester & branch :	**III**	**Common all SCE**		
Name of the faculty :	**Dr V. Sivakumar**			
No of contact hours/week:	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

Course Outcomes (COs) to PO, PSO, BL Mapping

At the end of this course, the student should be able to:		No. of Contact Hours	Marks	Program Outcomes (POs)	PSOs	BL *(Recommended)*
CO1	Apply structures and recursion techniques to model and solve real-world problems.	12	21	1,2,3,5,12	1	3,4
CO2	Apply linked list techniques to implement dynamic data structures and solve real-world problems.	12	28	1,2,3,5,12	1,2	3,4
CO3	Implement stack and queue operations to address real-world computational scenarios.	9	25	1,2,3,5,12	1	3,4
CO4	Analyze tree-based data structures to evaluate their efficiency in solving hierarchical data problems.	11	19	1,2,3,5,12	1,2	3,4
CO5	Construct and evaluate graph representations and apply traversal algorithms.	4	7	1,2,3,5,12	1,2	3,4
	Total	**48**	**100**			

Course Articulation Matrix

CO	Engineering knowledge	Problem analysis	Design/development of solutions	Investigations of complex problems	Modern tool usage	Engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	Analyse and solve real world problems by applying a combination	Formulate & build optimised solutions for systems level software	Design & model applications for various domains using standard	Design & develop solutions for distributed processing &
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2							2	2			
CO2	3	2	2		2							2	2	2		
CO3	3	2	2		2							2	2			
CO4	3	2	2		2							2	2	2		
CO5	3	2	2		2							2	2	2		
Average Articulation Level	3	2	2		2							2	2	2		

ICT Tools used in delivery and assessment

Sl. No	Name of the ICT tool used	Details of how it is used
1	LMS	Used to share materials with students and conduct assignments.
2	PPT	Used to deliver lectures.
3	Epad	Used to conduct midterm and end-term examinations.

Mapping of Course Outcomes (COs)/Course Learning Outcomes (CLOs)

At the end of this course, the student should be able to:		No. of Contact Hours	Marks	Program Outcomes (POs)	Learning Outcomes (LOs)	BL *(Recommended)*
CLO1	Apply structures and recursion techniques to model and solve real-world problems.	12	21	1,2,3,5,12	1	3,4
CLO2	Apply linked list techniques to implement dynamic data structures	12	28	1,2,3,5,12	1,2	3,4

	and solve real-world problems.					
CLO3	Implement stack and queue operations to address real-world computational scenarios.	9	25	1,2,3,5,12	1	3,4
CLO4	Analyze tree-based data structures to evaluate their efficiency in solving hierarchical data problems.	11	19	1,2,3,5,12	1,2	3,4
CLO5	Construct and evaluate graph representations and apply traversal algorithms.	4	7	1,2,3,5,12	1,2	3,4
	Total	**48**	**100**			

 # Applicable to IET Accredited Courses (modules) Only

Delivery and Assessment Plan of LOs #

Learning Outcome (LO) mapped to the course		**Delivery and assessment Plan**
LO	**LO statement**	
C1	Apply knowledge of mathematics, statistics, natural science and engineering principles to the solution of complex problems. Some of the knowledge will be at the forefront of the particular subject of study	Get addressed during lecture delivery and tutorial hour of stated topics
C2	Analyse complex problems to reach substantiated conclusions using first principles of mathematics, statistics, natural science and engineering principles	Get addressed during lecture delivery and tutorial hour of stated topics
C3	Select and apply appropriate computational and analytical techniques to model complex problems, recognising the limitations of the techniques employed	Get addressed during lecture delivery and tutorial hour of stated topics
C4	Select and evaluate technical literature and other sources of information to address complex problems	Get addressed during lecture delivery and tutorial hour of stated topics

 # Applicable to IET Accredited Programs Only

Assessment Plan (As communicated from o/o AD-A, in every odd semester)

IN – SEMESTER ASSESSMENTS

Sl. No.	Assessment Mode		Assessment Method	**Time Duration	**Marks	**Weightage	Typology of Questions *(Recommended)*	**Schedule	**Topics Covered
1	Internal Assessment	1	Quiz	20 Minutes	5M	**Objective:** 5M 10 MCQs × ½ = 5 marks	Bloom`s taxonomy (B) level of the question will be L3 and above	11 Aug 2025 – 19 Aug 2025	L1-L12
		2	Quiz	20 Minutes	5M	**Objective:** 5M 10 MCQs × ½ = 5 marks	Bloom`s taxonomy (B) level of the question will be L3 and above	01 Sep 2025 – 08 Sep 2025	L13-L24
		3	Mid-Term Test	1 ½ Hours	30M	10 MCQs × ½ = 5	Bloom`s taxonomy (B) level of the question will be L3 and above	12 Sep 2025 – 18 Sep 2025	L1-L28
		4	Quiz	20 Minutes	5M	**Objective:** 5M 10 MCQs × ½ = 5 marks	Bloom`s taxonomy (B) level of the question will be L3 and above	13 Oct 2025 – 21 Oct 2025	L25-L33,SDL
		5	Quiz	20 Minutes	5M	**Objective:** 5M 10 MCQs × ½ = 5 marks	Bloom`s taxonomy (B) level of the question will be L3 and above	03 Nov 2025 – 08 Nov 2025	L34-L45,SDL

END – SEMESTER ASSESSMENT							
1	**Regular/Make–Up Exam**	180 Mins	50	Answer all 5 full questions of 10 marks each. Each question can have 3 parts of 2/3/4/5/6 marks.	Bloom's taxonomy (BT) level of the question should be L3 and above.	18th week of the semester	L1-L48,SDL

** *Individual faculty will be entering the details*

*** *Individual faculty shall identify the assessment method from FISAC Assessment method (Table 1 below) and fill in the details.*

NOTE: *Information provided in the Table 1 is as per the In-semester assessment plan notified by Associate Director (Academics).*

Lesson Plan

L No	Topics	CO Addressed
0	Discuss Syllabus & Course Handouts	
1	Introduction to Data Structures and their importance & Arrays	CO1
2	Array of Pointers, Pointer Arithmetic	CO1
3	T1-Arrays and Pointers Programming Exercises	CO1
4	Functions, Recursion: Basics and Function Recursion	CO1
5	Applications of Recursion (e.g., Factorial, Fibonacci, Tower of Hanoi)	CO1
6	Dynamic Memory Allocation: malloc, calloc, free, realloc	CO1
7	T2-Recursion and Memory Management Practice	CO1
8	Structures and Array of Structures	CO1
9	Linear Search and Binary Search Algorithms	CO1
10	Sorting Techniques – Insertion, Bubble Sort, Selection Sort	CO1
11	T3-Searching and Sorting Implementation- Practice Problems	CO1
12	Sparse Matrix – Representation and Operations (Simple Transpose and Fast Transpose)	CO1
13	Introduction to Linked Lists and Chains – Array vs Linked List	CO2
14	Singly Linked List - operations and implementation (Insertion, Traversing, Searching)	CO2
15	Singly Linked List - operations and implementation (Deletion, Display, Concatenating)	CO2
16	Doubly Linked Lists - operations and implementation (Insertion, Traversing, Searching)	CO2
17	Doubly Linked Lists - operations and implementation (Deletion, Display, Concatenating)	
18	T4-Problems on Singly and Doubly Linked Lists	CO2
19	Circular Linked Lists - operations and implementation (Insertion using First and Last Pointer)	CO2
20	Circular Linked Lists - operations and implementation (Deletion using First and Last Pointer)	
21	T5-Circular Linked Lists and Applications	CO2
22	Representing Polynomials as Singly Linked Lists, Adding Polynomials	CO2
23	Polynomials As Circularly Linked Lists	CO2
24	T6-Polynomial Operations using Linked Lists	CO2
25	Stacks – Introduction and Operations & Stack implementation using arrays and linked lists	CO3
26	Queues – Linear and Circular Implementations	CO3
27	Expression Evaluation – Infix, Prefix, Postfix	CO3
28	Expression Conversion Techniques	CO3
29	T7-Stack Applications – Expression Evaluation and Balancing the Symbols	CO3
30	Multiple Stacks	CO3
31	Priority Queues – Introduction and Representation	CO3
32	Double Ended Queues – Input/Output Restricted	CO3
33	T-8-Application of Queue Variants – Implementation Scenarios	CO3
34	Introduction to Trees - terminology and representation	CO4
35	Binary Trees - operations and expression trees	CO4
36	Binary Tree Traversals – Inorder, Preorder, Postorder (Iterative & Recursive Implementation)	CO4
37	T9-Binary Tree Traversal Exercises	CO4
38	Additional Binary Tree Operations	CO4
39	Threaded Binary Trees	CO4

40	Binary Search Tree – Search, Insert, Delete	CO4
41	T10-Threaded Binary Trees and BST Operations– Practice Problems	CO4
42	AVL Trees – Rotations and Balancing	CO4
43	T11-AVL Tree Rotations – Practice Problems	CO4
44	Red-Black Trees – Properties and Rotations	CO4
45	Introduction to Graphs - definitions and terminology & Graph Representations - adjacency matrix and adjacency list	CO5
46	Depth First Search (DFS)	CO5
47	Breadth First Search (BFS)	CO5
48	T12- Graph Traversal Practice (DFS, BFS) and Representation Conversion	CO5
SDL	**Exploring Real-Life Use Cases and Implementations of Stack and Queue Variants**	**CO3**
SDL	**Comparative Study of Binary Tree Variants in Real-World Applications**	**CO4**
SDL	**Graph Data Structures in Real-World Systems: Case Study Analysis**	**CO5**

Faculty members teaching the course (if multiple sections exist):

Faculty	Section	Faculty	Section
Mrs Ramya D Shetty	CSE A	Mrs Gangothri	CCE C
Dr D Cenitta	CSE B	Mrs Linda Varghese	CCE D
Dr V. Sivakumar	CSE C	Mr Shanmukharaja	AI ML-A
Mr Shiva Prasad	CSE D	Dr Diana Olivia	AI ML-B
Dr Anita Kini	IT A	Dr Kaliraj S	AI ML-C
Dr Ahamed Shafeeq BM	IT B	Dr V. Sivakumar	DSE-A
Dr Kaliraj S	IT C	Mr Shiva Prasad	DSE-B
Mrs Linda Varghese	IT D	Dr Vidya Kamath	DSE-C
Dr Venkatesh Bhandage	CCE A	Dr Gururaj	M & C
Dr Raghavendra S	CCE B		

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, A Structured Programming Approach Using C,(3e), Cengage Learning India Pvt. Ltd, India, 2007.
2. Ellis Horowitz, Sartaj Sahani, Susan Anderson and Freed, Fundamentals of Data Structures in C, (2e), Silicon Press, 2007.
3. Richard F. Gilberg, Behrouz A. Forouzan, Data structures, A Pseudocode Approach with C, (2e), Cengage Learning India Pvt. Ltd, India, 2009.
4. Tenenbaum Aaron M., Langsam Yedidyah, Augenstein Moshe J., Data structures using C, Pearson Prentice Hall of India Ltd., 2007.
5. Debasis Samanta, Classic Data Structures, (2e), PHI Learning Pvt. Ltd., India, 2010.
6. https://onlinecourses.swayam2.ac.in/cec25_hs62/preview [Introduction to Data Structures, Punjabi University, Patiala].

Submitted by: Dr V. SIVAKUMAR

(Signature of the faculty) V.Si

Date:

Approved by: 6/8/25

(Signature of Dean)

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