Lovely Professional University, Punjab

Course Code	Course Title	Lectures	Tutorials	Practicals	Credits	
CSE205	DATA STRUCTURES AND ALGORITHMS	3	0	2	4	
Course Weightage	ATT: 5 CA: 50 ETP: 45	**Exam Category: X6: Mid Term Exam: Not Applicable – End Term Exam: Practical**				
Course Focus	EMPLOYABILITY,SKILL DEVELOPMENT					

Course Outcomes :Through this course students should be able to

CO1 :: understand the time and space complexity of programs and data-structures.

CO2 :: illustrate the importance of Linked List in context of real world problems

CO3 :: differentiate the Stack and Queue data structures for problem solving

CO4 :: use of recursion in iteration process and tree data structure

CO5 :: analyze the effectiveness of AVL Tree and Heap Data Structures

CO6 :: use of Graph and Hashing techniques in problem solving

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	DATA STRUCTURES	SEYMOUR LIPSCHUTZ	MCGRAW HILL EDUCATION

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	DATA STRUCTURES AND ALGORITHMS	ALFRED V. AHO, JEFFREY D. ULLMAN AND JOHN E. HOPCROFT	PEARSON

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	https://www.geeksforgeeks.org/data-structures/	Every data structure explained with the help of demo program
RW-2	http://www.cs.usfca.edu/~galles/visualization/Algorithms.html	Data structures visualization
RW-3	https://www.tutorialspoint.com/data_structures_algorithms/index.htm	Tutorials give a clear understanding of concepts in easy and simplified manner
RW-4	http://www.cs.auckland.ac.nz/software/AlgAnim/huffman.html	Huffman Encoding

Software/Equipments/Databases		
Sr No	**(S/E/D) (only if relevant to the course)**	**Salient Features**
SW-1	Dev C++ /Borland C++/Turbo C++	IDE to implement data structures in convenient and faster way

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	7

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples
Week 1	Lecture 1	Introduction(Basic Data Structures.)	T-1 R-1	RW-1 RW-3	Lecture 0, Introduction to data structures	Remembering basic concepts and algorithmic notations used in data structures, complexity of algorithms	Lecture cum demonstration, brain storming	Keeping files in a folder, directory structure
	Lecture 2	Introduction(Basic Concepts and Notations)	T-1 R-1	RW-1 RW-3	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum demonstration, brain storming	Moves on chess board
		Introduction(Complexity analysis: time space and trade off)	T-1 R-1	RW-1 RW-3	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum demonstration, brain storming	Moves on chess board
		Introduction(Omega Notation)	T-1 R-1	RW-1 RW-3	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum demonstration, brain storming	Moves on chess board
		Introduction(Theta Notation)	T-1 R-1	RW-1 RW-3	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum demonstration, brain storming	Moves on chess board

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Week 1	Lecture 2	Introduction(Big O notation)	T-1 R-1	RW-1 RW-3	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum demonstration, brain storming	Moves on chess board
	Lecture 3	Arrays(Linear arrays: memory representation)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
		Arrays(Array operations: traversal, insertion, deletion, sorting, searching and merging and their complexity analysis.)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
Week 2	Lecture 4	Arrays(Linear arrays: memory representation)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
		Arrays(Array operations: traversal, insertion, deletion, sorting, searching and merging and their complexity analysis.)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
	Lecture 5	Arrays(Linear arrays: memory representation)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
		Arrays(Array operations: traversal, insertion, deletion, sorting, searching and merging and their complexity analysis.)	T-1 R-1	RW-1 RW-3 SW-1	traversal, insertion and deletion operation in arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Placing a chair in between a row of chairs
	Lecture 6	Sorting and Searching (Bubble sort)	T-1 R-1	RW-1 RW-2 SW-1	Sorting elements of array	Analyzing how to apply appropriate sorting algorithm at appropriate place	Lecture cum demonstration, brain storming	Making students sit according to roll-nos. in a row
		Sorting and Searching (Insertion sort)	T-1 R-1	RW-1 RW-2 SW-1	Sorting elements of array	Analyzing how to apply appropriate sorting algorithm at appropriate place	Lecture cum demonstration, brain storming	Making students sit according to roll-nos. in a row
		Sorting and Searching (Selection sort)	T-1 R-1	RW-1 RW-2 SW-1	Sorting elements of array	Analyzing how to apply appropriate sorting algorithm at appropriate place	Lecture cum demonstration, brain storming	Making students sit according to roll-nos. in a row

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Week 3	Lecture 7	Linked Lists(Introduction)	T-1 R-1	RW-1 RW-3 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
		Linked Lists(Memory representation)	T-1 R-1	RW-1 RW-3 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
		Linked Lists(Allocation)	T-1 R-1	RW-1 RW-3 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
	Lecture 8	Linked Lists(Traversal)	T-1 R-1	RW-1 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
		Linked Lists(Insertion)	T-1 R-1	RW-1 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
	Lecture 9	Linked Lists(Traversal)	T-1 R-1	RW-1 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
		Linked Lists(Insertion)	T-1 R-1	RW-1 SW-1	Introduction to linked list and its creation	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
Week 4	Lecture 10	Linked Lists(Deletion)	T-1 R-1	RW-1 SW-1	Algorithm to traverse and delete nodes in linked list	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation
	Lecture 11	Linked Lists(Header linked lists: Grounded and Circular)	T-1 R-1	RW-1 SW-1	Different variant of linked list	Analyzing modification in the design of linked list to increase efficiency	Lecture cum demonstration, brain storming	Arrangement of coaches of a train
	Lecture 12	Linked Lists(Header linked lists: Grounded and Circular)	T-1 R-1	RW-1 SW-1	Different variant of linked list	Analyzing modification in the design of linked list to increase efficiency	Lecture cum demonstration, brain storming	Arrangement of coaches of a train
Week 5	Lecture 13	Linked Lists(Two-way lists: operations on two way linked lists)	T-1 R-1	RW-1 SW-1	Different variant of linked list	Analyzing modification in the design of linked list to increase efficiency	Lecture cum demonstration, brain storming	Arrangement of coaches of a train
	Lecture 14				Test - Code based 1			

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Week 5	Lecture 15	Stacks(Introduction: List and Array representations, Operations on stack (traversal, push and pop))	T-1 R-1	RW-1 RW-2 SW-1	Representing stack using linked list and array, push and pop operations	Understanding implementation of stack using array and linked list as per LIFO arrangement	Lecture cum demonstration, brain storming	Navigation of directory structure in windows
Week 6	Lecture 16	Stacks(Arithmetic expressions: polish notation, evaluation and transformation of expressions.)	T-1 R-1	RW-1 SW-1	Stack representation of arithmetic expressions expression using stack	Understanding prefix, infix and postfix notations preparation	Lecture cum demonstration, brain storming	Compiler design
	Lecture 17	Queue(Array and list representation)	T-1 R-1	RW-1 RW-2 SW-1	Representation of queue using arrays and linked list and operations	Understanding memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
	Lecture 18	Queue(operations (traversal, insertion and deletion))	T-1 R-1	RW-1 SW-1	Different versions of queue and its operations	Understanding memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
		Queue(Priority Queues)	T-1 R-1	RW-1 SW-1	Different versions of queue and its operations	Understanding memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
Week 7	Lecture 19	Queue(Deques)	T-1 R-1	RW-1 SW-1	Different versions of queue and its operations	Understanding memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
		SPILL OVER						
Week 7	Lecture 20				Spill Over			
	Lecture 21				Spill Over			
		MID-TERM						
Week 8	Lecture 22	Recursion(Introduction)	T-1 R-1	RW-1 SW-1	Introduction of recursion and problem of tower of Hanoi	Using recursive solutions for different problems	Lecture cum demonstration, brain storming	
		Recursion(Recursive implementation of Towers of Hanoi)	T-1 R-1	RW-1 SW-1	Introduction of recursion and problem of tower of Hanoi	Using recursive solutions for different problems	Lecture cum demonstration, brain storming	
	Lecture 23	Recursion(Merge sort)	T-1 R-1	RW-1 SW-1	Algorithm of merge sort using recursive method	Using recursive solutions for different problems	Lecture cum demonstration, brain storming	
	Lecture 24	Recursion(Quick sort)	T-1 R-1	RW-1 SW-1	Algorithm of Quick sort using recursive method	Using recursive solutions for different problems	Lecture cum demonstration, brain storming	

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Week 9	Lecture 25	Trees(Binary trees: introduction (complete and extended binary trees), memory representation (linked, sequential))	T-1 R-1	RW-1 SW-1	Introduction to tree data structure and its memory representation	Remembering nonlinear memory arrangements and its applications	Lecture cum demonstration, brain storming	
	Lecture 26	Trees(In-order traversal)	T-1 R-1	RW-1 SW-1	Tree traversal basics: in-order and pre-order tree traversal algorithm	Understanding node to node access	Lecture cum demonstration, brain storming	
		Trees(Pre-order traversal)	T-1 R-1	RW-1 SW-1	Tree traversal basics: in-order and pre-order tree traversal algorithm	Understanding node to node access	Lecture cum demonstration, brain storming	
	Lecture 27	Trees(Post-order traversal using recursion)	T-1 R-1	RW-1 SW-1	Tree traversal basics and post-order tree traversal algorithm	Understanding node to node access	Lecture cum demonstration, brain storming	
Week 10	Lecture 28	Trees(Binary Search Tree: introduction, searching, insertion and deletion)	T-1 R-1	RW-1 SW-1	Insertion, deletion of nodes and its algorithm in binary search tree	Understanding arrangements of data after manipulations	Lecture cum demonstration, brain storming	
	Lecture 29				Test - Code based 2			
	Lecture 30	AVL trees and Heaps(AVL trees Introduction)	T-1 R-1	RW-1 RW-2	Introduction to AVL trees and insertion	Applying another requirement to make more efficient arrangement of data in nonlinear data structure	Lecture cum demonstration, brain storming	
		AVL trees and Heaps(AVL trees Insertion)	T-1 R-1	RW-1 SW-1	Introduction to AVL trees and insertion	Applying another requirement to make more efficient arrangement of data in nonlinear data structure	Lecture cum demonstration, brain storming	
Week 11	Lecture 31	AVL trees and Heaps(AVL trees Deletion)	T-1 R-1	RW-1 RW-2	Deletion in AVL tree	Applying another requirement to make more efficient arrangement of data in nonlinear data structure	Lecture cum demonstration, brain storming	
	Lecture 32	AVL trees and Heaps (Heaps: Insertion)	T-1 R-1	RW-1 RW-2 SW-1	Introduction to heap and insertion operation	Understanding array representation of trees	Lecture cum demonstration, brain storming	
	Lecture 33	AVL trees and Heaps (Heaps: Deletion)	T-1 R-1		deletion operation and heap sort	Understanding array representation of trees	Lecture cum demonstration, brain storming	
		AVL trees and Heaps (HeapSort)	T-1 R-1		deletion operation and heap sort	Understanding array representation of trees	Lecture cum demonstration, brain storming	

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Week 12	Lecture 34	AVL trees and Heaps (Huffman algorithm)	T-1 R-1	RW-4	Compression algorithm for different strings	Applying technique for efficient use of resources to arrange	Lecture cum demonstration, brain storming	Making students sit according to roll-nos. in a row
	Lecture 35	Graphs(Graph Traversal: BFS, DFS)	T-1 R-1		Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum demonstration, brain storming	
	Lecture 36	Graphs(Warshall's algorithm)	T-1 R-1		Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum demonstration, brain storming	
Week 13	Lecture 37	Graphs(Shortest path algorithm Floyd Warshall Algorithm(modified warshall algorithm))	T-1 R-1		Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum demonstration, brain storming	
	Lecture 38				Test - Code based 3			
	Lecture 39	Hashing(Hashing introduction: hash functions, hash table)	T-1 R-1	RW-1	Hashing techniques and collision detection	Applying efficient searching	Lecture cum demonstration, brain storming	
Week 14	Lecture 40	Hashing(Open hashing (separate chaining))	T-1 R-1	RW-1	Hashing techniques and collision detection	Applying efficient searching	Lecture cum demonstration, brain storming	
		Hashing(Closed hashing (open addressing): linear probing, quadratic probing and double hashing.)	T-1 R-1	RW-1	Hashing techniques and collision detection	Applying efficient searching	Lecture cum demonstration, brain storming	
		SPILL OVER						
Week 14	Lecture 41				Spill Over			
	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

Scheme for CA:

CA Category of this Course Code is:C010203 (Total 4 tasks, 1 compulsory and out of remaining 2 best out of 3 to be considered)

Component	Iscompulsory	Weightage (%)	Mapped CO(s)
Test - Code based 2	NO	30	CO3, CO4
Test - Code based 3	NO	30	CO5, CO6
Test - Code based 1	NO	30	CO1, CO2

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Programming Practice	Yes	40	CO1, CO2, CO3, CO4, CO5, CO6

Details of Academic Task(s)

Academic Task	Objective	Detail of Academic Task	Nature of Academic Task (group/individuals)	Academic Task Mode	Marks	Allottment / submission Week
Programming Practice	To evaluate the overall learnings of students	Student have to solve assigned MCQs and Coding practice problems	Individual	Online	30	1 / 14
Test - Code based 1	To evaluate progress of individual student based upon basic data structures implementation and complexity	Mix of MCQs and Coding Problems	Individual	Online	30	4 / 5
Test - Code based 2	To evaluate progress of individual student based upon applicability of learned concepts	Mix of MCQs and Coding Problems	Individual	Online	30	9 / 10
Test - Code based 3	To evaluate progress of individual student based upon applicability of learned concepts	Mix of MCQs and Coding Problems	Individual	Online	30	12 / 13

Detailed Plan For Practicals

Practical No	Broad topic	Subtopic	Other Readings	Learning Outcomes
Practical 1	Array	Program to implement insertion and deletion operations in arrays		Implementation of array
Practical 2	Searching	Program to implement different searching techniques - linear and binary search		Implementation of searching techniques
Practical 3	Sorting	Program to implement different sorting techniques – bubble, selection and insertion sort		Implementation and analyzing how to apply appropriate sorting algorithm at appropriate place

Practical 4	Linked List	Program to implement searching, insertion and deletion operations in linked list		Implementation and analysis of different operations on linked list
Practical 5	Doubly Linked List	Program to implement searching, insertion and deletion operations in doubly linked list		Implementation and analysis of different operations on doubly linked list
Practical 6	Stack	Program to implement push and pop operations in stacks using both arrays and linked list		Understanding implementation of stack using array and linked list as per LIFO arrangement
Practical 7	Queues	Program to implement enqueue and dequeue operations in queues using both arrays and linked list		Understanding implementation of queue using array and linked list as per FIFO arrangement
Practical 8	Recursions	Program to demonstrate concept of recursions with problem of tower of Hanoi		Implementation of recursions
Practical 9	Recursive Sorting	Program to implement recursive sorting techniques - merge sort, quick sort		Implementation of merge and quick sorting
Practical 10	Tree	Program to create and traverse a binary tree recursively		Implementation of binary tree
Practical 11	Binary Search Tree	Program to implement insertion and deletion operations in BST		Implementation of different operations on BST
Practical 12	Heaps	Program to implement insertion and deletion operations in Heaps and Heap Sort		Implementation of heap
	SPILL OVER			
Practical 13	Spill Over			