

Lovely Professional University, Punjab

Course Code	Course Title	Course Planner	Lectures	Tutorials	Practicals	Credits
CSE205	DATA STRUCTURES AND ALGORITHMS	12427::Harjeet Kaur	3	1	0	4
Course Weightage	ATT: 5 CA: 25 MTT: 20 ETT: 50	Exam Category: 13: Mid Term Exam: All MCQ – End Term Exam: MCQ + Subjective				
Course Orientation	COMPETITIVE EXAMINATION (Higher Education), KNOWLEDGE ENHANCEMENT, PLACEMENT EXAMINATION(Mass Recruiters)					

Course Outcomes :Through this course students should be able to

CO1 :: use different operations on arrays including traversing insertion, deletion, searching and sorting with their corresponding complexity analysis.

CO2 :: differentiate arrays and linked list and to perform various operations on single, doubly and header linked list.

CO3 :: modify structure of arrays and linked list to make it a queue and stack.

CO4 :: describe how trees are represented in memory and used by algorithms.

CO5 :: construct heap and apply heap sort and create AVL tree with appropriate rotations.

CO6 :: apply BFS and DFS techniques on graphs and to understand basic concept of hashing.

	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	http://www.thegeekstuff.com/2012/01/advanced-c-pointers/	Pointer to pointer, pointer to functions, array of pointers
RW-2	http://cslibrary.stanford.edu/103/	Linked List
RW-3	http://www.cs.auckland.ac.nz/software/AlgAnim/huffman.html	Huffman Encoding
RW-4	http://www.cs.usfca.edu/~galles/visualization/Algorithms.html	Data structures visualization
RW-5	https://www.cs.auckland.ac.nz/software/AlgAnim/hash_tables.html	Hashing

An instruction plan is only a tentative plan. The teacher may make some changes in his/her teaching plan. The students are advised to use syllabus for preparation of all examinations. The students are expected to keep themselves updated on the contemporary issues related to the course. Upto 20% of the questions in any examination/Academic tasks can be asked from such issues even if not explicitly mentioned in the instruction plan.

Audio Visual Aids (AV)		
Sr No	(AV aids) (only if relevant to the course)	Salient Features
AV-1	http://nptel.ac.in/video.php?subjectId=106102064	Data structures audio video tutorials

Software/Equipments/Databases		
Sr No	(S/E/D) (only if relevant to the course)	Salient Features
SW-1	Dev C++ software (http://www.bloodshed.net/dev/devcpp.html), Borland C++	Efficient implementation of various data structures involving the use of pointers.

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-4 AV-1	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-4 AV-1	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum discussion, brain storming	moves on chess board
		Introduction(Complexity analysis: time space and trade off)	T-1 R-1	RW-4 AV-1	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum discussion, brain storming	moves on chess board
	Lecture 3	Introduction(Omega Notation)	T-1 R-1	RW-4 AV-1	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum discussion, brain storming	moves on chess board

An instruction plan is only a tentative plan. The teacher may make some changes in his/her teaching plan. The students are advised to use syllabus for preparation of all examinations. The students are expected to keep themselves updated on the contemporary issues related to the course. Upto 20% of the questions in any examination/Academic tasks can be asked from such issues even if not explicitly mentioned in the instruction plan.

Week 1	Lecture 3	Introduction(Theta Notation)	T-1 R-1	RW-4 AV-1	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum discussion, brain storming	moves on chess board
		Introduction(Big O notation)	T-1 R-1	RW-4 AV-1	Applications of different types of data structures and time space trade off	Understanding how to apply suitable data structure for given application	Lecture cum discussion, brain storming	moves on chess board
Week 2	Lecture 4	Arrays(Linear arrays: memory representation)	T-1	RW-1 RW-4 SW-1 AV-1	Introduction and memory representation of arrays	Remembering of contiguous memory allocation.	Lecture cum demonstration, brain storming	Sitting arrangement of students in class in a line.
		Arrays(Traversal)	T-1	RW-4 SW-1 AV-1	Traversal 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(Insertion)	T-1	RW-4 SW-1 AV-1	Insertion 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(Deletion)	T-1	RW-4 SW-1 AV-1	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(Searching)	T-1	RW-4 SW-1 AV-1	Searching (linear search, binary search) element in array	Analyzing how to apply appropriate searching algorithm at appropriate place	Lecture cum demonstration, brain storming	Searching a person sitting in a row of chairs
		Arrays(Merging and their complexity analysis.)	T-1	RW-4 SW-1 AV-1	Merging elements of arrays	Understanding manipulation of elements in an array	Lecture cum demonstration, brain storming	Merging two sections of a class for giving lecture
	Lecture 6	Sorting and Searching (Bubble sort)	T-1	RW-4 SW-1 AV-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
Week 3	Lecture 7	Sorting and Searching (Insertion sort)	T-1	RW-4 SW-1 AV-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	RW-4 SW-1 AV-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

Week 3	Lecture 8	Linked Lists(Introduction)	T-1 R-1	RW-2 RW-4 SW-1 AV-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-2 RW-4 SW-1 AV-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-2 RW-4 SW-1 AV-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(Traversal)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Algorithm to traverse nodes in linked list	Understanding linked representation of memory and dynamic allocation	Lecture cum demonstration, brain storming	Chain, slides management in presentation.
	Lecture 9	Linked Lists(Insertion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Algorithm to traverse and insert nodes in linked list	Applying management of dynamic memory allocation on insertion operation	Lecture cum demonstration, brain storming	Chain, slides management in presentation.
Week 4	Lecture 10	Linked Lists(Deletion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Algorithm to traverse and delete nodes in linked list	Applying management of dynamic memory allocation on deletion operation	Lecture cum demonstration, brain storming	Removal of damaged link from a chain.
	Lecture 11	Linked Lists(Header linked lists: Grounded and Circular)	T-1 R-1	RW-2 RW-4 SW-1 AV-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(Two-way lists: operations on two way linked lists)	T-1 R-1	RW-2 RW-4 SW-1 AV-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				Test 1			
	Lecture 14	Stacks(Introduction: List and Array representations, Operations on stack (traversal, push and pop))	T-1 R-1	RW-4 SW-1 AV-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 5	Lecture 15	Stacks(Arithmetic expressions: polish notation, evaluation and transformation of expressions.)	T-1 R-1	RW-4 SW-1 AV-1	Stack representation of arithmetic expressions and transformation of infix to postfix expression using stack	Understanding prefix, infix and postfix notations preparation and transformation of infix to postfix expression using stack	Lecture cum demonstration, brain storming	Compiler design
		Stacks(Evaluation and transformation of expressions)	T-1 R-1	RW-4 SW-1 AV-1	Stack representation of arithmetic expressions and transformation of infix to postfix expression using stack	Understanding prefix, infix and postfix notations preparation and transformation of infix to postfix expression using stack	Lecture cum demonstration, brain storming	Compiler design
Week 6	Lecture 16	Stacks(Towers of Hanoi)	T-1 R-1	RW-4 SW-1 AV-1	Arrangement of disc as per Tower of Hanoi using recursive method	Applying how to call recursive function	Lecture cum demonstration, brain storming	Loading unloading process
		Stacks(Merge sort)	T-1 R-1	RW-4 SW-1 AV-1	Merge sort using recursive method	Applying recursive function to sort elements of array	Lecture cum demonstration, brain storming	Making students sit according to roll-nos. in a row
	Lecture 17	Queues and Recursion(Array and list representation)	T-1 R-1	RW-4 SW-1 AV-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
		Queues and Recursion (operations (traversal, insertion and deletion))	T-1 R-1	RW-4 SW-1 AV-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	Queues and Recursion (Priority Queues)	T-1 R-1	RW-4 SW-1 AV-1	Different versions of queue and its operations	Applying memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
		Queues and Recursion (Dequeues)	T-1 R-1	RW-4 SW-1 AV-1	Different versions of queue and its operations	Applying memory management as per FIFO arrangement	Lecture cum demonstration, brain storming	Process scheduling algorithms
Week 7	Lecture 19	Queues and Recursion (Function Call)	T-1 R-1	RW-4 SW-1 AV-1	Algorithm of Quick sort using recursive method	Applying recursive function to sort elements of array	Lecture cum demonstration, brain storming	Process scheduling algorithms
		Queues and Recursion (Recursion implementation and Complexity issues.)	T-1 R-1	RW-4 SW-1 AV-1	Algorithm of Quick sort using recursive method	Applying recursive function to sort elements of array	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	Trees(Binary trees: introduction (complete and extended binary trees), memory representation (linked, sequential))	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to tree data structure and its memory representation	Remembering non linear memory arrangements and its applications	Lecture cum demonstration, brain storming	Directory structure and file system, Web site link structure
	Lecture 23	Trees(Pre-order traversal using Stack)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Tree traversal basics and pre-order tree traversal algorithm	Understanding node to node access as per NLR algorithm	Lecture cum demonstration, brain storming	Directory structure and file system, Web site link structure
		Trees(In-order traversal using Stack)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Tree traversal basics and in-order tree traversal algorithm	Understanding node to node access as per LNR algorithm	Lecture cum demonstration, brain storming	Directory structure and file system, Web site link structure
	Lecture 24	Trees(Post-order traversal using Stack)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Tree traversal basics and post-order tree traversal algorithm	Understanding node to node access as per LRN algorithm	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
Week 9	Lecture 25	Trees(Binary Search Tree-searching)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to binary search tree	Understanding arrangement of data efficiently	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
	Lecture 26	Trees(Binary Search Tree-Insertion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Insertion of nodes and its algorithm in binary search tree	Understanding arrangements of data after manipulations	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
	Lecture 27	Trees(Binary Search Tree-deletion)	T-1 R-1	RW-2 RW-4 SW-1	Deletion of nodes and its algorithm in binary search tree	Understanding arrangements of data after manipulations	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
Week 10	Lecture 28				Test 2			

Week 10	Lecture 29	AVL trees and Heaps(AVL trees Introduction)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to AVL trees and insertion	Applying another requirement to make more efficient arrangement of data in non linear data structure	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
	Lecture 30	AVL trees and Heaps(AVL trees Insertion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to AVL trees and insertion	Applying another requirement to make more efficient arrangement of data in non linear data structure	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
Week 11	Lecture 31	AVL trees and Heaps(AVL trees Deletion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Deletion in AVL tree	Applying another requirement to make more efficient arrangement of data in non linear data structure	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
	Lecture 32	AVL trees and Heaps (Heaps: Insertion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to heap, insertion and deletion algorithm, Heapsort	Understanding array representation of trees	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
		AVL trees and Heaps (Heaps: Deletion)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to heap, insertion and deletion algorithm, Heapsort	Understanding array representation of trees	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
		AVL trees and Heaps (HeapSort)	T-1 R-1	RW-2 RW-4 SW-1 AV-1	Introduction to heap, insertion and deletion algorithm, Heapsort	Applying array representation of trees	Lecture cum discussion, brain storming	Directory structure and file system, Web site link structure
	Lecture 33	AVL trees and Heaps (Huffman algorithm)	T-1 R-1	RW-3 RW-4 SW-1 AV-1	Compression algorithm for different strings	Applying technique for efficient use of resources to arrange	Lecture cum discussion, brain storming	Compression in Fax machine
Week 12	Lecture 34	Graphs(Warshall's algorithm)	T-1 R-1	RW-2 RW-4 SW-1	Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum discussion, brain storming	Maps and Navigation
	Lecture 35	Graphs(Shortest path algorithm Floyd Warshall Algorithm(modified warshall algorithm))	T-1 R-1	RW-4 SW-1 AV-1	Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum discussion, brain storming	Maps and Navigation

Week 12	Lecture 36	Graphs(Graph Traversal: BFS, DFS)	T-1 R-1	RW-4 SW-1 AV-1	Operations on graphs and shortest path algorithm	Understanding node to node movement within graphs	Lecture cum discussion, brain storming	Maps and Navigation
Week 13	Lecture 37				Test 3			
	Lecture 38	Hashing(Hashing Introduction)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
		Hashing(Hash Functions)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
		Hashing(Hash Table)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
	Lecture 39	Hashing(Closed hashing (open addressing))	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
		Hashing(Linear Probing)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
		Hashing(Quadratic Probing)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
		Hashing(Double Hashing)	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms
Week 14	Lecture 40	Hashing(Open hashing (separate chaining))	T-1 R-1	RW-4 RW-5 SW-1 AV-1	Hashing techniques and collision detection	Applying compression that provide security as well as efficient use of resources	Lecture cum discussion, brain storming	Dictionary lookup and security algorithms

		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:A0203 (2 best out of 3)

Component	Weightage (%)	Mapped CO(s)
Test 1	50	CO1, CO2
Test 2	50	CO3, CO4
Test 3	50	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
Test 1	To evaluate progress of individual student based upon basic data structures and complexity	Subjective test with mix of analytic and descriptive type questions as per contents delivered from lecture 1 to 12. All questions should be of 5 marks each or in multiples of 5.	Individual	Offline	30	4 / 5
Test 2	To evaluate progress of individual student based upon algorithms and concep	Subjective test with mix of analytic and descriptive type questions as per contents delivered from lecture 14 to 27. All questions should be of 5 marks each or in multiples of 5.	Individual	Offline	30	8 / 9
Test 3	To evaluate progress of individual student based upon applicability of learned concepts	Subjective test with mix of analytic and descriptive type questions as per contents delivered from lecture 29 to 36. All questions should be of 5 marks each or in multiples of 5.	Individual	Offline	30	12 / 13

Plan for Tutorial: (Please do not use these time slots for syllabus coverage)

Tutorial No.	Lecture Topic	Type of pedagogical tool(s) planned (case analysis,problem solving test,role play,business game etc)
Tutorial1	Problems and MCQs on basic data structures	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Data-Structures-Basics
Tutorial2	Problems and MCQs specific to operations on arrays and its applications	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Arrays-and-Pointers
Tutorial3	Problems and MCQs specific to operations on linked list and its applications	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Linked-Lists
Tutorial4	Problems and MCQs specific to operations on linked list and its applications	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Linked-Lists
Tutorial5	Problems and MCQs specific to Stacks, Queues and Recursions	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Stacks-and-Queues
Tutorial6	Problems and MCQs specific to Stacks, Queues and Recursions	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Recursion
Tutorial7	MCQs on compexity	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Algorithm-Complexity
After Mid-Term		
Tutorial8	Logics to be discussed - 1. Array rotation 2. Given a sorted and rotated array find if there is a pair with a given sum 3. K'th Smallest/Largest Element in Unsorted Array 4. Find the subarray with least average 5. Sort an array in wave form 6. Sort an array by frequency 7. Count all distinct pairs with difference equal to k	https://www.geeksforgeeks.org/array-data-structure/
Tutorial9	Logics to be discussed - 1. Get nth node of the linked list 2. Get nth node from the end of the linked list 3. Get the middle node of the linked list 4. Detect loop in the linked list 5. Reverse a linked list 6. Remove duplicates from the linked list 7. Rotate a linked list 8. Union and intersection of two linked lists	https://www.geeksforgeeks.org/data-structures/linked-list/
Tutorial10	Problems and MCQs on binary tree and BST	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Trees
Tutorial11	Problems and MCQs on AVL	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Trees
Tutorial12	Problems and MCQs on Heap and Huffman	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Trees
Tutorial13	Problems and MCQs on Graphs	https://compscibits.com/mcq-questions/Data-Structures-and-Algorithms/Graphs
Tutorial14	Problems and MCQs on Hashing	https://www.sanfoundry.com/data-structure-questions-answers-hash-tables/ , https://www.geeksforgeeks.org/data-structure-gq/hash-gq/