



K L Deemed to be University

**Department of Computer Science and Engineering-Honors -- KLVZA
Course Handout
2021-2022, Even Sem**

Course Title	:DATA STRUCTURES
Course Code	:21SC1202
L-T-P-S Structure	: 3-0-2-4
Pre-requisite	:
Credits	: 5
Course Coordinator	:Ashok Bekkanti
Team of Instructors	:
Teaching Associates	:

Syllabus :

Algorithm Analysis: Mathematical Background, Model, Analyze, Running Time Calculations. Sorting: Introduction to Sorting Algorithm, Insertion Sort, Shell sort, Heap sort, Merge sort, Quick sort, Bucket Sort, External Sorting. Dynamic Memory implementation of linear datastructures: Singly Linked list, doubly linked list, circularly linked list, Applications of data structures: Polynomial Manipulation, Implementation of Stacks and Queues using Linked Lists, Circular Queue, Deque(Double ended queue), Applications of Stacks and Queues. Priority Queues (Heaps): Model, Simple Implementations, Binary Heap, Applications of Priority Queues. Hashing: Introduction to Hashing, Hash Function, Separate Chaining, Hash Tables without Linked Lists, Rehashing, Hash Tables in the Standard Library, Extendible Hashing. Trees: Introduction to trees, Binary Trees, Tree Traversals, The Search Tree: Binary Search Trees, AVL Trees, Splay Trees, B-Trees, Red black trees. Graph Data Structure: Introduction to Graph data structure – basic terminologies- transitive closure - representation of graphs: adjacency matrix, linked list- Graph traversals: Breadth First Search, Depth First Search)- minimal spanning trees: Prim's & Kruskal's Algorithm

Text Books :

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2010 , Second Edition, PearsonEducation.
2. Ellis Horowitz, Fundamentals of Data Structures in C: Second Edition, 2015

Reference Books :

1. A.V.Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures And Algorithms", Pearson Education, First Edition Reprint2003.
2. Horowitz, Sahni, Anderson Freed, "Fundamentals of datastructures in C" , Second Edition-2007.
3. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Ed ition, 2005
4. Robert Kruse, C.L. Tondo, Bruce Leung, Shashi Mogalla, "Data Structures & Program Design in C", FourthEdition-2007.

MOOCs :

1. <https://nptel.ac.in/courses/106102064>
2. <https://nptel.ac.in/courses/106101060/4>
3. <https://www.edx.org/course/algorithms-and-data-structures-1>
4. <https://in.udacity.com/course/intro-to-algorithms--cs215>
5. <https://www.coursera.org/learn/data-structures?action=enroll>

COURSE OUTCOMES (COs):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy
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			Level (BTL)
CO1	Understand various sorting algorithms and analyze the efficiency of the algorithms	PO1,PO2	4
CO2	Implement and evaluate Linear Data Structures and Demonstrate their applications.	PO2,PO3,PO1	4
CO3	Implement and evaluate tree data structures and Understand hashing techniques	PO1,PO2,PO3	4
CO4	Understand graph data structures and apply graphs to solve problems	PO1,PO2	3
CO5	Design, Develop and evaluate common practical applications for linear and nonlinear data structures.	PO9,PO10,PO3	5

COURSE OUTCOME INDICATORS (COIs)::

Outcome No.	Highest BTL	COI-1	COI-2	COI-3	COI-4	COI-5
CO1	4	Btl-4 Mathematical background, model and running time calculations	Btl-4 Introduction to sorting. Demonstrate and Implement Insertion Sort, Shell Sort, and Heap Sort	Btl-4 Introduction to Divide and Conquer Approach. Demonstrate and Implement Merge Sort and Quick Sort	Btl-4 Demonstrate External sorting and Bucket Sorting. Analyze its Efficiency	
CO2	4	Btl-4 Introduction to Dynamic Memory Allocation and List-based implementation. Illustrate implementation of different Lists and its applications	Btl-4 List based implementations of Stack and Enumerate its applications	Btl-4 List based implementations of Queue and Enumerate its applications	Btl-4 Model of priority queues and Implementation of Binary Heap and Demonstrate applications	
CO3	4	Btl-4 Introduction to Hashing table, Hashing function, Separate chaining and open addressing	Btl-4 Double hashing, Extendible hashing and Rehashing	Btl-4 Tree traversal and Search trees construction and implementation	Btl-4 Demonstrate Red-Black tree, Splay tree and B-tree	
CO4	3	Btl-4 Introduction to Graph data structure – Basic terminologies.	Btl-4 Graph Traversing techniques – Demonstrate Breadth First	Btl-5 Minimum spanning tree – Prim's algorithm	Btl-4 Minimum spanning tree – Kruskal's algorithm	

		Transitive closure and representation of graphs	Search and Depth First Search			
CO5	5	Btl-5 Recall the linear and nonlinear data structures	Btl-5 Exemplify the linear and nonlinear data structures with real time applications	Btl-5 Use the linear and nonlinear data structures with real time applications	Btl-5 Appraise and Differentiate the linear and nonlinear data structures based on their properties	Btl-5 Discriminate the significance of both linear and nonlinear data structures with respect to real world applications

PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES (POs/PSOs)

Po No.	Program Outcome
PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.				
PSO1	An ability to design and develop software projects as well as Analyze and test user requirements.				
PSO2	An Ability to gain working Knowledge on emerging software tools and technologies.				

Lecture Course DELIVERY Plan:

Sess.No.	CO	COI	Topic	Book No[CH No][Page No]	Teaching-Learning Methods	Evaluation Components
1	CO1	COI-1	Introduction to data structures- Mathematical background, Model	Ref Book [1], CH 3.1 Page no 57- 58	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
2	CO1	COI-1	Algorithm Analysis - Running time calculations	Ref Book [1], CH 2.1 Page no 31- 36	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
3	CO1	COI-2	Insertion Sort Analysis and Implementation	Ref Book [1], CH 7.2 Page no 235 -237	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
4	CO1	COI-2	Shell Sort Analysis and Implementation	Ref Book [1], CH 7.4 Page no 238- 240	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
5	CO1	COI-2	Quick Sort	Ref Book [1], CH 7.7 Page no 252- 262	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
6	CO1	COI-3	Quick Sort Implementation	Ref Book [1], CH 3.1 Page no 57- 58	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
7	CO1	COI-3	Merge Sort Analysis and Implementation	Ref Book [1], CH 7.6 Page no 246 - 250	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
8	CO1	COI-4	Demonstrate Bucket Sort	Ref Book [1], CH 7.5 Page no 242- 245	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1

Sess.No.	CO	COI	Topic	Book No[CH No][Page No]	Teaching-Learning Methods	Evaluation Components
9	CO1	COI-4	Demonstrate External Sorting	RefBook [1], [1], CH 7.11, Page no 250-252	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
10	CO2	COI-1	Singly Linked List - Creation, Insertion, Deletion, Display	Ref Book [1], CH 3.1 Page no 57- 58	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
11	CO2	COI-1	Doubly Linked list -Creation, Insertion, Deletion, Display	Ref Book [1], CH 3.2 Page no 59- 68	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
12	CO2	COI-1	Circular Linked list - Creation, Insertion, Deletion, Display	Ref Book [1], CH 3.2 Page no 59- 68	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
13	CO2	COI-2	Stack Using Singly Linked list	Ref Book [1], CH 3.3 Page no 78- 101	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
14	CO2	COI-2	Queue Using Singly Linked List	Ref Book [1], CH 3.3 Page no 78- 101	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
15	CO2	COI-2	Infix to Postfix Expression Conversion	Ref Book [1], CH 3.3 Page no 78- 93	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
16	CO2	COI-2	Infix to Postfix Expression Conversion Implementation	Ref Book [1], CH 3.3 Page no 78- 93	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
17	CO2	COI-2	Evaluation of postfix expression, Balancing symbols	Ref Book [1], CH 3.3 Page no 88- 90	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
18	CO2	COI-3	Types of Queue – Circular Queue	Ref Book [1],	Chalk,Talk	ALM,End Semester Exam,Home

Sess.No.	CO	COI	Topic	Book No[CH No][Page No]	Teaching-Learning Methods	Evaluation Components
				CH 3.4 Page no 95- 101		Assignment,SEM-EXAM1
19	CO2	COI-3	Types of Queue – Deque	Ref Book [1], CH 3.4 Page no 95- 101	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
20	CO2	COI-4	Binary Heap	T. Book [1], CH 3.4 Page no 95-108	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM1
21	CO3	COI-1	Hashing - Hash function, Separate chaining	Ref Book [1], CH 5.3 Page no 168 -172	Chalk,PPT,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
22	CO3	COI-1	Linear probing and Quadratic probing	Ref Book [1], CH 5.4 Page no 173- 180	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
23	CO3	COI-2	Double hashing	Ref Book [1], CH 5.4 Page no 180- 181	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
24	CO3	COI-2	Rehashing and Extendible hashing	Ref Book [1], CH 5.4 Page no 168-180	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
25	CO3	COI-3	Binary Tree - Tree traversals, Expression tree construction	Ref Book [1], CH 4.2 Page no 108 - 116	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
26	CO3	COI-3	Binary Search Tree – Construction, Insertion, Deletion	Ref Book [1], CH 4.3 Page no 116- 123	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
27	CO3	COI-3	Binary Search Tree Implementation	Ref Book [1], CH 4.3 Page no 116- 123	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2

Sess.No.	CO	COI	Topic	Book No[CH No][Page No]	Teaching-Learning Methods	Evaluation Components
28	CO3	COI-3	AVL Tree – Rotations and Operations	Ref Book [1], CH 4.4 Page no 127- 138	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
29	CO3	COI-3	AVL Tree Implementation	Ref Book [1], CH 4.4 Page no 127- 138	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
30	CO3	COI-3	Heap Sort Analysis and Implementation	Ref Book [1], CH 7.5 Page no 242- 245	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
31	CO3	COI-4	B – Tree Construction	T. Book [1], CH 4.7 Page no 134-138	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
32	CO3	COI-4	Splay tree operations	Ref Book [1], CH 4.5,Page no 138 - 141	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
33	CO3	COI-4	Construction of Red-Black trees	Ref Book [1], CH 4.6, Page no 134- 140	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
34	CO4	COI-1	Graphs Representation – Adjacency Matrix	Ref Book [1], CH 9.1 Page no 300- 302	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
35	CO4	COI-1	Graphs Representation – Linked List	Ref Book [1], CH 9.1 Page no 300- 302	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
36	CO4	COI-1	Transitive Closure	Ref Book [1], CH 9.1 Page no 299- 300	Chalk,Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
37	CO4	COI-2	Graph Traversal – BFS, DFS	Ref Book [1],	Chalk,Talk	ALM,End Semester Exam,Home

Sess.No.	CO	COI	Topic	Book No[CH No][Page No]	Teaching-Learning Methods	Evaluation Components
				CH 9.2 Page no 302 - 306		Assignment,SEM-EXAM2
38	CO4	COI-3	Minimum Spanning Tree – Prim's Algorithm	Ref Book [1], CH 9.5 Page no 330- 332	Chalk, Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2
39	CO4	COI-4	Minimum Spanning Tree - Kruskal's Algorithm	Ref Book [1], CH 9.5 Page no 332 – 335	Chalk, Talk	ALM,End Semester Exam,Home Assignment,SEM-EXAM2

Lecture Session wise Teaching – Learning Plan

SESSION NUMBER : 1

Session Outcome: 1 Students come to know the types of data structures

Session Outcome: 2 Students come to know asymptotic notations and complexity analysis

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Introducing about Data Structures and Syllabus and LTPS Structure	1	Chalk	--- NOT APPLICABLE ---
20	Lecture 1: Explain the classification of Data Structures - Linear & Non-Linear.	2	Chalk	--- NOT APPLICABLE ---
20	Lecture 2: Mathematical Background. Definitions of Asymptotic notations $O(n)$, $\Omega(n)$ and $\Theta(n)$ – Best, Average and Worst Case Ref: chapter-2 of Data structures and algorithm analysis in C by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 2

Session Outcome: 1 Students are come to know about running time calculations

Session Outcome: 2 Students can identify the incremental order of time complexity

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods

5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	<p>Lecture-1:</p> <p>Running time calculations, A simple example General rules</p> <p>Ask the students to find the running time of following problems.</p> <p>I) Problem</p> <pre>for(i=0; i < n-1 ; i++) Printf("%d", i+75);</pre> <p>II) Problem</p> <pre>for(i=0; i < n-1 ; i++) { For (j=0; j < i; j++) Printf("*"); Printf("\n"); }</pre> <p>III) Problem</p> <pre>For(i=0; i < n ; i++) { For (j=0; j < i; j++) Printf("*"); Printf("\n"); }</pre> <p>Ref: chapter-2 of Data structures and algorithm analysis in C by Mark Allen Weiss</p>	2	Chalk	--- NOT APPLICABLE ---
20	<p>Lecture-2:</p> <p>Deliver a mathematical calculation of running time of sample algorithm and ask the students to analyze it.</p> <p>Algorithm: Time taken</p> <ol style="list-style-type: none"> 1) Start ----- 0 2) Input: Read 'n' ----- 1 3) initialize: sum=0, i=1 ----- 2 4) Process: sum = sum + i ----- n 5) i = i + 1 ----- n 6) if (i <= n) go to step 4 ----- n 7) print 'sum' ----- 1 8) Stop ----- 0 <p>Total time in function $f(n) = 3n + 4$</p> <p>Ref: chapter-2 of Data structures and algorithm analysis in C by Mark Allen Weiss</p>	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 3

Session Outcome: 1 Students able to understand insertion sort

Session Outcome: 2 Students can implement insertion sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE

20	Subtopic -1 (Lecture): Explain How insertion sort works and analyze its time complexity with an example	2	Chalk	--- NOT APPLICABLE ---
10	Practice session 1: Consider there are 10 group of members in cinema hall for taking tickets from counter, arrange the group of members in a line according to the height of a persons. The height of persons is given in centimeters as follows. 165, 173, 195, 150, 179, 184, 139, 145, 169, 151. After each iteration, draw the elements in array.	3	Chalk	--- NOT APPLICABLE ---
10	Practice session -2: Delhi City, where peace prevails most of the time. Not everyone is a huge fan of peace, though. Certainly not Mr. Rajesh, whose identity is not known to us - yet. Mr. Rajesh has somehow managed to bring zombies to Bangalore City to attack and destroy the city. If he sees a zombie , he marks them in his list with their power. After generating the entire list of power of these creatures, he decides to arrange this data. All the zombies arranged in ascending sorted manner of their power. The powers are given as: 12, 43, 10, 72, 55, 32, 21, 63, 18, 31 Implement insertion sort program to arrange the powers in ascending order.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 4

Session Outcome: 1 Students come to know about shell sort

Session Outcome: 2 Students can implement shell sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Subtopic -1 (Lecture): Explain how shell sort works using shell's original sequence: N/2, N/4, ..., 1 (repeatedly divide by 2). Explain Hibbard, Sedgwick increments.	2	Chalk	--- NOT APPLICABLE ---
20	Practice session 1: Ask the students to implement shell sort by using insertion sort independently for each pass. Algorithm: 1) Read “n” elements as input in array. 2) Process /* Identify and print the each passes elements */ 3) Display the sorted as elements output.	3	Chalk	--- NOT APPLICABLE ---
10	Subtopic -2 (Lecture): Analyze the time complexity of shell sort. Discuss what	4	Chalk	--- NOT APPLICABLE

	disadvantages of insertion sort does the shell sort overcome. [Classic Data Structures 2Nd Ed. By Samanta, SamantaDebasis]			---
5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 5**Session Outcome: 1** Students able to understand the quick sort**Session Outcome: 2** Students able to analyze the time complexity of quick sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Sub-topic 1(Lecture): Explain Quick sort algorithm with best case derivation	2	Chalk	--- NOT APPLICABLE ---
10	Practice session 1: Ask the students to sort the following data using quick sort: 55,11,22,99,55,33, 77,88, 33 and then analyze the Best case for Quick sort	3	Chalk	--- NOT APPLICABLE ---
10	Sub-topic 2 (Lecture): Explain Quick sort algorithm with worst case derivation.	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 6**Session Outcome: 1** Students able to implement quick sort algorithm

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Practice session 1: Ask the students to sort the following data using quick sort: 55,11,22,99,55,33, 77,88, 33 and then analyze the worst case for Quick sort	4	Chalk	--- NOT APPLICABLE ---
20	Practice session 2: (LTC) Ask the Students to analyze the following code for quick sort using the system. https://www.geeksforgeeks.org/quick-sort/	4	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE

SESSION NUMBER : 7

Session Outcome: 1 Students come to understand the concept and implementation of merge sort

Session Outcome: 2 Students able to analyze the time complexity of merge sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Subtopic-1(lecture): Explain Merge sort and its basics with an example	2	Chalk	--- NOT APPLICABLE ---
20	Practice session - 1: Here is an array of ten integers: 5 3 8 9 1 7 0 2 6 4 Draw this array after the TWO recursive calls of merge sort are completed, and before the final merge step has occurred.	3	Chalk	--- NOT APPLICABLE ---
10	Subtopic-2(lecture): Analyze the complexity of merge sort algorithm. MergeSort(arr[], l, r) If $r > 1$ 1. Find the middle point middle $m = (l+r)/2$ 2. Call mergeSort for first half: Call mergeSort(arr, l, m) 3. Call mergeSort for second half: Call mergeSort(arr, m+1, r) 4. Merge the two halves sorted in step 2&3: Call merge(arr, l, m, r)	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 8

Session Outcome: 1 Students able to understand the basic concept of bucket Sort

Session Outcome: 2 Students able to analyze the time complexity

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Sub topic – 1 (Lecture): Explain Bucket Sort and its Basic concept	2	Chalk	--- NOT APPLICABLE ---

20	Practical session – 1: Ask the students to sort the following data using bucket sort: 55,11,22,99,55,33, 77,88, 33	3	Chalk	--- NOT APPLICABLE ---
10	Sub topic –3 (Lecture): Analyze the complexity of bucket sort algorithm	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 9**Session Outcome: 1** Students able understand the external sorting**Session Outcome: 2** Students able to analyze the time complexity of external sorting

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE ---
10	Sub-topic-1(lecture): Explain External sorting and two phases of external sorting (1. Sort phase 2. Merge phase) with an example.	2	Chalk	--- NOT APPLICABLE ---
10	Practice session - 1: Ask the students to write an algorithm to sort the elements using External sorting technique and also analyze its time complexity.	3	Chalk	Quiz/Test Questions
20	Practice Session-2: Ask the students to write and execute a C program to solve the following example. N = 14, M = 3 (14 records on tape Ta1, memory capacity: 3 records.) T1: 17, 3, 29, 56, 24, 18, 4, 9, 10, 6, 45, 36, 11, 43 [Donald Knuth, The Art of Computer Programming, Volume 3: Sorting and Searching, Second Edition. Addison-Wesley]	3	Chalk	Quiz/Test Questions
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 10**Session Outcome: 1** Students come to know about singly linked list operations**Session Outcome: 2** Students able to implement singly linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE

20	Lecture: Explain singly linked list operations with diagram's Ref: chapter-3 of Data structures and algorithm analysis in C by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session 1: Suppose the Personnel file of a small company contain the following data for all its employees SSN (social security number), Name and salary. A Linked list is used to store the data. Ask the students to write a function to sort the records based on SSN? struct node { int train_no; char train_name[20], source[20], destination[20]; float AC1_fare, AC2_fare, AC3_fare, SL_fare, Gen_fare; } t[20]; Ref : "Data Structures "by Forozan	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 11

Session Outcome: 1 Students come to know about doubly linked list operations

Session Outcome: 2 Students able to implement doubly linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE ---
20	Lecture: Explain doubly linked list operations with diagram's Ref: chapter-3 of Data structures and algorithm analysis in C by	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session-1: In a browsing center, the customer Kishore is sitting in a computer and browses the face book. Once he opened the face book, he wants to have a page of his friend Hari and gave a friend request and come back to his home page and open his other friend Lalitha's page and read all her status and going on doing like this. Implement this as an operation of creation, insertion, deletion and searching of friends using Double Linked List.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 12

Session Outcome: 1 Students come to know about circular linked list operations

Session Outcome: 2 Students able to implement circular linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Lecture: Explain Insertion of elements at begin, at the given position and at end operations of SLL, Circular SLL, and DLL Ask the students to execute deletion at begin and end operation on SLL, Circular SLL, and DLL	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session-1: In a Coco game, Krishna, Vasu, Shiva, Ganesh, Sathesh, Naveen and Anand are playing at an University ground. The rally tag is given to Anand. Anand stood and ran around the players and push Krishna as his tag. Imitate it as a circular linked list of Single and Double direction list and display all the players name in the list. Also Find how is the shortest person in the list.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 13**Session Outcome: 1** Students can understand stack operations**Session Outcome: 2** Students able to implement stack using linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Lecture Linked list implementation of stacks	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session Ask the students to write and execute a program to implement Stack	3	Chalk	Quiz/Test Questions
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 14**Session Outcome: 1** Students come to know about queue operations**Session Outcome: 2** Students able to implement queue using linked list

Time(min)	Topic	BTL	Teaching-Learning	Active Learning

			Methods	Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Lecture Linked list implementation of queue	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session: In a railway station an engine is connected with the N number of Bogies which are connected in one direction from engine to the last bogie. Implement this as an operation of creation, insertion, deletion and searching of a bogie using Single Linked List	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 15

Session Outcome: 1 Students come to know about operations of stack

Session Outcome: 2 Students able to convert infix to postfix Expression

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Lecture: Explain how to convert an infix expression to postfix using stacks	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session 1: Convert the given infix expression $(a^*(b+c))+(b/d)^*$ a into postfix expression . Suppose that we are using the usual Stack concept to convert the expression from infix to postfix notation. What is the maximum number of symbols that will appear on the stack at one time during the conversion of this expression? Reference : http://cs.nyu.edu/courses/Fall12/CSCI-GA.1133-002	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 16

Session Outcome: 1 Students able to implement infix to postfix expression conversion

Session Outcome: 2 Students able to analyze the time complexity of infix to postfix expression conversion

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods

5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE ---
20	Lecture: Explain how to convert an infix expression to postfix using stacks	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session 1: The first input will be a single integer N denoting the number of test cases to take. After this there will be exactly N lines, each line a valid infix string. The string will be a valid postfix expression consisting of integers, binary operators (+, -, *, / and \$) and parenthesis. Every integer, operator and parenthesis will be compulsorily separated by a SPACE. The symbol „?“ denotes the end of expression. Reference : http://cs.nyu.edu/courses/Fall12/CSCI-GA.1133-002	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 17

Session Outcome: 1 Students able to evaluate postfix expressions using stack

Session Outcome: 2 Students able to use the recursion and to know types of recursions

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Explain the evaluation of postfix expression using stack	2	Chalk	--- NOT APPLICABLE ---
10	Practice Session 1: Ask the students to write a program for evaluating the following postfix expression using stack 1 2 3 * + 4 – Reference : http://scriptasylum.com/	3	Chalk	Quiz/Test Questions
10	Explain about balancing symbols	2	Chalk	--- NOT APPLICABLE ---
10	Practice Session 2: Given an expression string exp, write a program to examine whether the pairs and the orders of “{“, “}”, “(“, “)”, “[“, “]” are correct in exp	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 18

Session Outcome: 1 Students able to understand the types of queues- Circular Queue

Session Outcome: 2 Students able to solve real-time problems using queues

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Practice session-1: Use queue concept to implement the following to print 15 files. In the situation where there are multiple users or a networked computer system, you probably share a printer with other users. When you request to print a file, your request is added to the print queue. When your request reaches the front of the print queue, your file is printed. This ensures that only one person at a time has access to the printer and that this access shows the served user leaves the queue first.- Circular queue implementation.	3	Chalk	--- NOT APPLICABLE ---
20	Practice session-2: Use Queue data structure to print binary numbers from 1 to n. 1) Create an empty queue of strings 2) Enqueue the first binary number “1” to queue. 3) Now run a loop for generating and printing n Binary Numbers. a) Dequeue and Print the front of queue. b) Append “0” at the end of front item and enqueue it. c) Append “1” at the end of front item and enqueue it. Input: n=5 Output: 1,10,11,100,101	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 19

Session Outcome: 1 Students able to understand the application of queues- Double ended queue

Session Outcome: 2 Students able to implement real-time problems using queues

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Practice session-1: Given an integer m, size of double ended queue, and n operations, implement the double ended queue. Queries are defined as below. <ul style="list-style-type: none"> • 1 x --> insert an element x to the front end • 2 x --> insert an element x to the rear end • 3 --> delete an element from front end • 4 --> delete an element from rear end 	3	Chalk	--- NOT APPLICABLE ---

10	<p>Practice session-2:</p> <p>Use Queue data structure to print binary numbers from 1 to n.</p> <ol style="list-style-type: none"> 1) Create an empty queue of strings 2) Enqueue the first binary number “1” to queue. 3) Now run a loop for generating and printing n Binary Numbers. <ol style="list-style-type: none"> a) Dequeue and Print the front of queue. b) Append “0” at the end of front item and enqueue it c) Append “1” at the end of front item and enqueue it. <p>Input: n=5 Output: 1,10,11,100,101</p>	3	Chalk	Quiz/Test Questions
10	Ask the students to execute practice session-2.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 20

Session Outcome: 1 Students come to know about priority queues

Session Outcome: 2 Students able to implement binary heap

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Explain the concept of Priority queues and their applications	2	Chalk	--- NOT APPLICABLE ---
10	<p>Practice Session 1:</p> <p>Consider a bank with one service counter. The persons will stand in a queue. For example if customer 1 needs 30 mins to finish and customer 2,3 needs only 2 mins each, servicing the customer 1 and then 2,3 leads to unnecessary delay and thereby the decreases the efficiency.</p> <p>Eg: , , , is the queue along with service time of each customer. Now remove the one with low service time. Do this until all the customers are serviced and show the queue configuration at each instant.</p>	3	Chalk	--- NOT APPLICABLE ---
20	<p>Subtopic -1:</p> <p>Types of priority queues 1. Ascending PQ-Element with least priority removed first 2.Descending PQ- Element with highest priority removed first.</p> <p>Subtopic 2- Operations on Priority Queue</p> <ol style="list-style-type: none"> 1. Creation 2. Insertion 	2	Chalk	--- NOT APPLICABLE ---

	3. Deletion 4. Display			
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 21

Session Outcome: 1 Students come to know about the concept of separate chaining

Session Outcome: 2 Students able to resolve collisions using separate chaining

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Subtopic -1 (Lecture): Explanation of separate chaining using hashing technique. Initialization routine for separate chaining hash table. Reference: Data structures by Mark Allen Weiss.	2	Chalk	--- NOT APPLICABLE ---
10	Subtopic -2 (Lecture): Explanation of separate chaining using hashing technique. Initialization routine for separate chaining hash table. Reference: Data structures by Mark Allen Weiss.	2	Chalk	--- NOT APPLICABLE ---
10	Practice session: Ask the students to construct hash table using separate chaining for the following elements of table size 15, design your own hash function. 23,27,98,6,17,51,77,72,36,53. Ask the students to implement initialization function	3	Chalk	Quiz/Test Questions
10	Practice session: Ask the students to implement the following operations on hash table using separate chaining 1.insert () 2. search () Reference: Data structures by Mark Allen Weiss.	4	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 22

Session Outcome: 1 Students able to resolve collisions using different collision resolution techniques

Session Outcome: 2 Students able to implement linear probing, quadratic probing

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE ---

10	Sub topic -1 (Lecture): Explanation of Open Addressing and different types of strategies to resolve Collision. Explanation of Linear probing and its implementation. Reference: Data structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
10	Sub topic -1 (Lecture): Explanation of quadratic probing and its implementation. Reference: Data structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Practice session 1: *Ask the students to insert keys {43, 55, 27, 73, 67} in to hash table of size 11 Reference :Data Structures by Mark Allen Weiss.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 23

Session Outcome: 1 Students able to resolve collisions using different collision resolution techniques

Session Outcome: 2 Students able to implement double hashing

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Sub topic -1 (Lecture): Explanation of Open Addressing and different types of strategies to resolve Collision. Explanation of double hashing and its implementation. Reference: Data structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Practice session 1 *Ask the students to insert keys {18, 41, 22, 44, 59, 32, 31, 73} in to hash table of size 13 Reference: http://www.eecs.yorku.ca/course_archive/2004-05/W/2011N/Notes/hash_tables_2.pdf *Implement double hashing to insert keys.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 24

Session Outcome: 1 Students able to resolve collisions using different collision resolution techniques

Session Outcome: 2 Students able to implement linear probing, quadratic probing, double hashing

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE

20	Sub topic -1 (Lecture): Explanation of rehashing concept and its importance Ask the students to construct hash table with the keys 19, 28, 93, 72, 10, 31, 63, 54. Reference: Data structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Sub topic -1 (Lecture): Explanation of extendible hashing concept and its importance Ask the students to construct hash table with the keys 94, 82, 39, 29, 61, 13, 36, 45. Reference: Data structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 25**Session Outcome: 1** Students come to know about tree traversals**Session Outcome: 2** Students able to solve real world practical problems on expression tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Subtopic – 1 (Lecture): Explain expression tree construction, and tree traversals – In-order, Pre-order, and Post-order	2	Chalk	--- NOT APPLICABLE ---
10	Practice session 1: Ask the students to construct a binary tree for the given elements 77,44,58,19,29,25,31,12. And print inorder, preorder, and postorder.	3	Chalk	--- NOT APPLICABLE ---
10	Explain Expression Tree construction. Practice session -2: Ask the students to construct an expression tree for the following expression $(A+B)*(C-D)/(E^F)$ could be represented thus [E^F means E raised to the F power] [Data Structures and Algorithm Analysis in C, Mark Allen Weiss, 4th chapter question]	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 26**Session Outcome: 1** Students come to know about construction of binary search tree**Session Outcome: 2** Students able to perform binary search tree operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods

5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Subtopic-1(lecture): Explain Tree terminology, Binary Tree – Construction and display.	2	Chalk	--- NOT APPLICABLE ---
20	Practice session -1: Ask the students to construct a binary search tree for the given elements 21, 32, 19, -23, 15, 65, 48, 7, 9, 55.	3	Chalk	Quiz/Test Questions
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 27

Session Outcome: 1 Students able to implement binary search tree operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	2	Chalk	--- NOT APPLICABLE ---
20	Subtopic – 1 (Lecture): Explanation of BST Tree - Construction and Display Write function to perform the following operations on a BST: 1. Tree Traversals (Inorder, Preorder and Postorder) 2. Insert a node in BST. Finding the minimum and maximum in BST using recursive and iterative approaches.	2	Chalk	--- NOT APPLICABLE ---
20	Practice session 1: Ask the students to write function in BST to perform the following: 4. Deleting a child (leave) node. 5. Deleting a sub tree node that has one child. 6. Deleting a sub tree node that has two child nodes.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 28

Session Outcome: 1 Students come to know about AVL tree rotations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---

10	Sub-topic-1 (Lecture): Explain AVL Tree and advantages of AVL Tree in the data organization. Reference: Data Structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Practice session -1: a. Construct an AVL tree with the following data 25, 99, 101, 15, 7, 32, 10 b. Find balancing factor of node 7. c. Find resultant AVL tree after deleting root. Reference:www.sanfoundry.com	3	Chalk	--- NOT APPLICABLE ---
10	Sub-topic-3 (Lecture): Need for rebalancing the AVL Tree using Single rotation. Discussion of single left rotation and single right rotation. Construct an AVL tree with the following node values: 13, 10, 7, 30, 35, 5, 3 and identify the single left rotations and single right rotations. Reference:www.cprograms.com	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 29

Session Outcome: 1 Students able to implement operations on AVL tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Sub-topic – 1 (Lecture) AVL tree ADT creation along with required function prototypes. Reference: Data Structures by Mark Allen Weiss	2	Chalk	--- NOT APPLICABLE ---
20	Practice Session-1 Ask students to implement an AVL Tree with necessary functions. Reference: Data Structures by Mark Allen Weiss	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 30

Session Outcome: 1 Students able to implement heap sort

Session Outcome: 2 Students able to analyze time complexities of heap sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE

10	Subtopic-1(lecture): Explain Heap order property and two phases of heap sort (1. Heap Creation 2. Sorting via deletion) with an example Explain Max and Min Heap: Heap Property: All nodes are either greater than or equal to or less than or equal to each of its children. If the parent nodes are greater than their child nodes, heap is called a Max-Heap, and if the parent nodes are smaller than their child nodes, heap is called Min-Heap.	2	Chalk	--- NOT APPLICABLE ---
20	Practice session - 1: Ask the students to write an algorithm to sort the elements using heap sort technique and also analyse its time complexity. Analysis time Complexity of Heap Sort	3	Chalk	Quiz/Test Questions
10	Practice session - 2: Suppose we are sorting an array of eight integers using heapsort, and we have just finished some heapify (either maxheapify or minheapify) operations. The array now looks like this: 16 14 15 10 12 27 28 How many heapify operations have been performed on root of heap?	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 31

Session Outcome: 1 Students come to know about B tree construction

Session Outcome: 2 Students able to perform insert and delete operation on B tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Subtopic – 1 (Lecture): Explain construction of B tree (BST) with an example. Give the importance of M-way search tree	2	Chalk	--- NOT APPLICABLE ---
20	Practice session 1: Ask the students to construct B tree with the keys 23, 85 34, 51, 45, 10, 28, 41, 67, 19, 7, 30 and order 4	3	Chalk	Quiz/Test Questions
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 32

Session Outcome: 1 Students comes to know about splay tree construction

Session Outcome: 2 Students are able to perform splay tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Sub-topic-1 (Lecture) Explain selective splaying. zig-zig and zig-zag rotations and how it overcomes normal splaying. Reference: Data Structures by Mark Allen Weiss.	2	Chalk	--- NOT APPLICABLE ---
20	Practice session -1: Create splay Tee with following keys with root 38. 1,32,3,4,8,65,42,34,81,9,32,56,54,38,66,77,44 apply splaying at node 54. Reference: Data Structures by Mark Allen Weiss.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 33

Session Outcome: 1 Students comes to know about red black tree construction

Session Outcome: 2 Students are able to perform red black tree operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Sub topic – 1 (Lecture): Explain Red Black tree and its properties	2	Chalk	--- NOT APPLICABLE ---
10	Sub topic – 2 (Lecture): Explain Insert operation of Red Black tree(ReColoring)	2	Chalk	--- NOT APPLICABLE ---
20	Sub topic – 3 (Lecture): Explain Insert operation of Red Black tree(Rotation)	2	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	2	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 34

Session Outcome: 1 Students come to understand the representing of graphs

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE

20	Explanation of Graph representation – adjacency matrix	2	Chalk	--- NOT APPLICABLE ---
20	Practice session1: represent the given graph in adjacency matrix	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 35

Session Outcome: 1 Students come to understand the representing of graphs

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Explanation of Graph representation –adjacency list representation	2	Chalk	--- NOT APPLICABLE ---
20	Practice session1: represent the given graph in list representation.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 36

Session Outcome: 1 Students come to understand the transitive closure

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Explain Definitions of DAG, Transitive closure	2	Chalk	--- NOT APPLICABLE ---
10	Lecture: Example applications of graphs such as the airport system, Traffic flow modeling etc.	2	Chalk	Quiz/Test Questions
10	Practice Session: Ask students to find transitive closure for the given graph	3	Chalk	--- NOT APPLICABLE ---

5	Conclusion and Summary	2	Talk	--- NOT APPLICABLE ---
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SESSION NUMBER : 37

Session Outcome: 1 Students come to know about graph traversal – BFS and DFS

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Explain Definitions of graph traversals and introduce graph traversal technique – BFS, DFS	2	Chalk	--- NOT APPLICABLE ---
20	Practice session1: Find BFS and DFS for the given graph	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 38

Session Outcome: 1 Students able to derive minimum spanning tree from a given graph

Session Outcome: 2 Students able to use prim's algorithm.

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
20	Lecture: Explain the Minimum spanning tree. Explain Prim's algorithm with the help of weighted graph	1	Chalk	--- NOT APPLICABLE ---
20	Practice session: Apply Prim's algorithm on a weighted graph to get minimum spanning tree	3	Chalk	Quiz/Test Questions
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

SESSION NUMBER : 39

Session Outcome: 1 Students able to understand the use and applications of minimum spanning tree

Session Outcome: 2 Students able to understand Kruskal's minimum spanning tree algorithm.

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
5	Recap / Introduction	1	Chalk	--- NOT APPLICABLE ---
10	Explain what is spanning tree and minimum spanning tree. Explain applications of minimum spanning tree	2	Chalk	--- NOT APPLICABLE ---
20	Explain about Krushkal's minimum spanning tree algorithm and how it used to find minimum spanning tree using diagrams.	2	Chalk	--- NOT APPLICABLE ---
10	Ask the students to analyze the time complexity of Krushkal's algorithm.	3	Chalk	--- NOT APPLICABLE ---
5	Conclusion and Summary	1	Talk	--- NOT APPLICABLE ---

Tutorial Course DELIVERY Plan: NO Delivery Plan Exists

Tutorial Session wise Teaching – Learning Plan

No Session Plans Exists

Practical Course DELIVERY Plan:

Tutorial Session no	Topics	CO-Mapping
1	Insertion Sort and Shell Sort	CO5
2	Quick sort	CO5
3	Merge Sort	CO5
4	Singly Linked List	CO5
5	Doubly Linked List and Circular Linked List	CO5
6	Stack	CO5
7	Queue	CO5
8	Stack Applications	CO5
9	Hashing	CO5

Tutorial Session no	Topics	CO-Mapping
10	Binary Search tree	CO5
11	AVL Tree	CO5
12	Graphs	CO5

Practical Session wise Teaching – Learning Plan

SESSION NUMBER : 1

Session Outcome: 1 Students able to implement insertion sort and shell sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
40	Implement Insertion Sort https://www.hackerrank.com/contests/17cs1102/challenges/3-a-implement-insertion-sort	3	Chalk	--- NOT APPLICABLE ---
30	Quick Sort https://www.hackerrank.com/contests/17cs1102/challenges/4a-quick-sort	3	Chalk	--- NOT APPLICABLE ---
30	Merge Sort https://www.hackerrank.com/contests/17cs1102/challenges/merge-sort-6	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 2

Session Outcome: 1 Students able to implement quick sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
40	Implement Shell Sort https://www.hackerrank.com/contests/17cs1102/challenges/3b-implement-shell-sort	3	Chalk	--- NOT APPLICABLE ---
30	Insertion Sort https://www.codechef.com/DSCA2019/problems/NSECDS03	3	Chalk	--- NOT APPLICABLE ---
30	Quick sort 1 – Partition https://www.hackerrank.com/challenges/quicksort1/problem	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 3

Session Outcome: 1 Students able to implement merge sort technique

Time(min)	Topic	BTL	Teaching-Learning	Active Learning
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			Methods	Methods
35	Quick Sort https://www.codechef.com/DSCA2019/problems/NSECDS06/	3	Chalk	--- NOT APPLICABLE ---
35	Max Power https://www.hackerearth.com/practice/algorithms/sorting/quick-sort/practice-problems/algorithm/increasing-subsequence-fbb63e3c/	3	Chalk	--- NOT APPLICABLE ---
30	Maximum Sum of Building Speed https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/maximum-sum-of-building-speed-00ab8996/	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 4

Session Outcome: 1 Students able to implement singly linked list operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Inserting a Node Into a Sorted Doubly Linked List https://www.hackerrank.com/challenges/insert-a-node-into-a-sorted-doubly-linked-list/problem?h_r=internal-search	3	Chalk	--- NOT APPLICABLE ---
35	Delete duplicate-value nodes from a sorted linked list https://www.hackerrank.com/challenges/delete-duplicate-value-nodes-from-a-sorted-linked-list/problem?h_r=internal-search	3	Chalk	--- NOT APPLICABLE ---
30	Find the middle of a given linked list using recursion https://www.hackerearth.com/problem/algorithm/find-the-middle-of-a-given-linked-list-using-recursion/	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 5

Session Outcome: 1 Students able to implement doubly linked list and circular linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Reverse a List https://www.hackerrank.com/challenges/fp-reverse-a-list/problem?h_r=internal-search	3	Chalk	--- NOT APPLICABLE ---
35	Reverse a doubly linked list https://www.hackerrank.com/challenges/one-month-preparation-kit-reverse-a-doubly-linked-list/problem?h_r=internal-search	3	Chalk	--- NOT APPLICABLE ---
30	Circular Doubly Linked list https://www.hackerearth.com/problem/algorithm/hiddent-doubly-linked-liste8c1fead/	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 6

Session Outcome: 1 Students able to implement stack using singly linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Maximum Element https://www.hackerrank.com/challenges/maximum-element/problem?isFullScreen=true	3	Chalk	--- NOT APPLICABLE ---
35	Equal Stacks https://www.hackerrank.com/challenges/equal-stacks/problem?isFullScreen=true	3	Chalk	--- NOT APPLICABLE ---
30	Waiter https://www.hackerrank.com/challenges/waiter/problem?isFullScreen=true	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 7

Session Outcome: 1 Students able to implement queue using singly linked list

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Max in Queue https://www.hackerearth.com/practice/data-structures/trees/heaps/priority-queues/practice-problems/algorithms/queues-content-problem/	3	Chalk	--- NOT APPLICABLE ---
35	Code Queue https://www.codechef.com/problems/KCOPROG4	3	Chalk	--- NOT APPLICABLE ---
30	Circular Queue using Arrays https://www.hackerrank.com/contests/17cs1102/challenges/7a-circular-queue-using-arrays	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 8

Session Outcome: 1 Students able to implement stack applications

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Postfix Expression Evaluation https://www.hackerrank.com/contests/17cs1102/challenges/8-c-postfix-expression-evaluation/problem	3	Chalk	--- NOT APPLICABLE ---
35	Infix to Postfix https://www.codechef.com/problems/INFPOS03	3	Chalk	--- NOT APPLICABLE ---
30	Check for balanced parentheses in an expression https://www.hackerrank.com/contests/the-great-programming-challenge/challenges/check-for-balanced-parentheses-in-an-expression	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 9

Session Outcome: 1 Students able to implement different hashing techniques

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Unusual construction https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/unusual-construction-3ec2e03f/	3	Chalk	--- NOT APPLICABLE ---
35	Count Pairs https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/count-pairs-9-d69fcde3/	3	Chalk	--- NOT APPLICABLE ---
30	Pairs of elements https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/t-rex-and-the-pairs-0a045ce2/	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 10**Session Outcome: 1** Students able to implement binary search tree operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Preorder Traversal https://www.hackerrank.com/challenges/one-week-preparation-kit-tree-preorder-traversal/problem?h_r=internal-search	3	Chalk	--- NOT APPLICABLE ---
35	Binary Search Tree : Insertion https://www.hackerrank.com/challenges/binary-search-tree-insertion/problem	3	Chalk	--- NOT APPLICABLE ---
30	Binary Search Trees https://www.hackerrank.com/challenges/30-binary-search-trees/problem	3	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 11**Session Outcome: 1** Students able to implement avl tree operations

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	AVL Tree https://www.codechef.com/problems/UCS616A2	3	Chalk	--- NOT APPLICABLE ---
35	Chef and Tree https://www.codechef.com/problems/CHEFTRE	3	Chalk	--- NOT APPLICABLE ---
30	Chef and Average on a Tree https://www.codechef.com/problems/L56AVG	3	Chalk	--- NOT APPLICABLE

SESSION NUMBER : 12

Session Outcome: 1 Students able to implement graph traversing techniques

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Analyze why topological sorting can be applicable to Directed acyclic Graphs(DAG). Apply topological sorting for the given graph	3	Chalk	--- NOT APPLICABLE ---
35	Construct the weighted directed graph represented by the adjacency matrix given below. A non-zero value at [row, column] indicates that the vertex in the row is adjacent to the vertex in the column and apply DFS to the graph	3	Chalk	--- NOT APPLICABLE ---
30	Apply prim's algorithm to find minimum spanning tree from node1 to all other nodes for the following graph	3	Chalk	--- NOT APPLICABLE ---

Skilling Course DELIVERY Plan:

Skilling session no	Topics/Experiments	CO-Mapping
1	Insertion Sort and Shell Sort	CO1
2	Insertion Sort and Shell Sort	CO1
3	Quick Sort	CO1
4	Quick sort	CO1
5	Merge Sort	CO1
6	Merge Sort	CO1
7	Singly Linked List	CO2
8	Singly Linked List	CO2
9	Doubly Linked List and Circular Linked List	CO2
10	Doubly Linked List and Circular Linked List	CO2
11	Stack	CO2
12	Stack	CO2

Skilling session no	Topics/Experiments	CO-Mapping
13	Queue	CO2
14	Queue	CO2
15	Stack Applications	CO2
16	Stack Applications	CO2
17	Hashing	CO3
18	Hashing	CO3
19	Binary Search tree	CO3
20	Binary Search tree	CO3
21	AVL Tree	CO3
22	AVL Tree	CO3
23	Graphs	CO4
24	Graphs	CO4

Skilling Session wise Teaching – Learning Plan

SESSION NUMBER : 1

Session Outcome: 1 Insertion Sort and Shell Sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Merge Sort: Counting Inversions https://www.hackerrank.com/challenges/ctci-merge-sort/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---
35	Insertion Sort - Part 1 https://www.hackerrank.com/challenges/insertionsort1/problem	5	Chalk	--- NOT APPLICABLE ---
30	DESORT https://www.codechef.com/problems/DSORT	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 2

Session Outcome: 1 Insertion Sort and Shell Sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Frog Sort https://www.codechef.com/problems/FROGS	5	Chalk	--- NOT APPLICABLE ---
35	Problem Sort https://www.codechef.com/problems/PROBLEMS	5	Chalk	--- NOT APPLICABLE ---
30	Suffix Sort https://www.codechef.com/problems/ICM0001	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 3**Session Outcome: 1 Quick Sort**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Sorting Tool https://www.codechef.com/problems/KJCP01	5	Chalk	--- NOT APPLICABLE ---
35	Willows Sort https://www.codechef.com/problems/WISORT	5	Chalk	--- NOT APPLICABLE ---
30	Radix Sort https://www.codechef.com/problems/RDX	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 4**Session Outcome: 1 Quick sort**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Insertion Sort - Part 2 https://www.hackerrank.com/challenges/insertionsort2/problem	5	Chalk	--- NOT APPLICABLE ---
35	Correctness and the Loop Invariant https://www.hackerrank.com/challenges/correctness-invariant/problem	5	Chalk	--- NOT APPLICABLE ---
30	Merge Sorted Array https://leetcode.com/problems/merge-sorted-array/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 5

Session Outcome: 1 Merge Sort

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Sam Height https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/alice-and-marks-hsbc-b18d5d0/	5	Chalk	--- NOT APPLICABLE ---
35	Median Game https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/median-game-june-easy-19-3722be60/	5	Chalk	--- NOT APPLICABLE ---
30	Friendly Neighbors https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/choose-one-c4672347/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 6**Session Outcome: 1 Merge Sort**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Different queries https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/jumbled-queries-afb23321/	5	Chalk	--- NOT APPLICABLE ---
35	Let's swap https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/practice-problems/algorithm/lets-swap-5075ade8/	5	Chalk	--- NOT APPLICABLE ---
30	Specialty of a sequence https://www.hackerearth.com/practice/algorithms/sorting/quick-sort/practice-problems/algorithm/lex-finds-beauty-0d0bc1b6/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 7**Session Outcome: 1 Singly Linked List**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Print the Elements of a Linked List https://www.hackerrank.com/challenges/print-the-elements-of-a-linked-list/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---
35	Linked list https://www.codechef.com/problems/REC_05	5	Chalk	--- NOT APPLICABLE ---
30	Insert a Node at the Tail of a Linked List https://www.hackerrank.com/challenges/insert-a-node-at-the-tail-of-a-linked-list/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 8

Session Outcome: 1 Singly Linked List

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Delete a Node https://www.hackerrank.com/challenges/delete-a-node-from-a-linked-list/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---
35	Remove Kth Node https://www.hackerearth.com/problem/algorithm/remove-kth-node/	5	Chalk	--- NOT APPLICABLE ---
30	Compare two linked lists https://www.hackerrank.com/challenges/compare-two-linked-lists/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 9**Session Outcome: 1 Doubly Linked List and Circular Linked List**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Remove Friends https://www.hackerearth.com/practice/data-structures/linked-list/singly-linked-list/practice-problems/algorithm/remove-friends-5/	5	Chalk	--- NOT APPLICABLE ---
35	Cycle Detection https://www.hackerrank.com/challenges/detect-whether-a-linked-list-contains-a-cycle/problem?	5	Chalk	--- NOT APPLICABLE ---
30	Reverse a linked list https://www.hackerrank.com/challenges/reverse-a-linked-list/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 10**Session Outcome: 1 Doubly Linked List and Circular Linked List**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Merge two sorted linked list https://www.hackerrank.com/challenges/merge-two-sorted-linkedlists/problem	5	Chalk	--- NOT APPLICABLE ---
35	Insert a node at the head of a linked list https://www.hackerrank.com/challenges/insert-a-node-at-the-head-of-a-linked-list/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---
30	Get Node Value https://www.hackerrank.com/challenges/get-the-value-of-the-node-at-a-specific-position-from-the-tail/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 11**Session Outcome: 1 Stack**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Sudhanva and Books https://www.hackerrank.com/challenges/waiter/problem?isFullScreen=true	5	Chalk	--- NOT APPLICABLE ---
35	Simple stack https://www.hackerearth.com/problem/algorithm/simple-stack/	5	Chalk	--- NOT APPLICABLE ---
30	Stack operations https://www.hackerearth.com/practice/data-structures/stacks/basics-of-stacks/practice-problems/algorithm/stakth-1-e6a76632/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 12**Session Outcome: 1 Stack**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Stack using arrays https://www.hackerearth.com/problem/algorithm/stack-using-arrays-2/	5	Chalk	--- NOT APPLICABLE ---
35	Mayank and his stacks https://www.hackerearth.com/problem/algorithm/mayank-and-his-stacks/	5	Chalk	--- NOT APPLICABLE ---
30	Queues and Stacks https://www.hackerrank.com/challenges/30-queues-stacks/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 13**Session Outcome: 1 Queue**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Chefs in Queue https://www.codechef.com/problems/CHFQUEUE	5	Chalk	--- NOT APPLICABLE ---
35	Dr Phil goes to the ranch https://www.codechef.com/problems/CAC202	5	Chalk	--- NOT APPLICABLE ---
30	Queue Problem https://www.hackerearth.com/problem/algorithm/queue-problem-jatinj-1addbbb7/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 14**Session Outcome: 1 Queue**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Aniruddha's Queue https://www.hackerearth.com/practice/basic-programming/implementation/basics-of-implementation/practice-problems/algorithm/aniruddhas-queue-4/	5	Chalk	--- NOT APPLICABLE ---
35	queue-using-two-stacks https://www.hackerrank.com/challenges/queue-using-two-stacks/problem?isFullScreen=true	5	Chalk	--- NOT APPLICABLE ---
30	Long ATM Queue https://www.hackerearth.com/practice/data-structures/arrays/1-d/practice-problems/algorithm/long-atm-queue-3/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 15**Session Outcome: 1 Stack Applications**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Transform the expression https://www.hackerearth.com/problem/algorithm/transform-the-expression-2/	5	Chalk	--- NOT APPLICABLE ---
35	Check for balanced parentheses in an expression https://www.hackerrank.com/contests/the-great-programming-challange/challenges/check-for-balanced-parentheses-in-an-expression	5	Chalk	--- NOT APPLICABLE ---
30	Balanced Brackets https://www.hackerrank.com/contests/cs1300-odd-2014/challenges/evaluate-expression/problem	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 16**Session Outcome: 1 Stack Applications**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Stack and Queue https://www.hackerearth.com/practice/data-structures/stacks/basics-of-stacks/practice-problems/algorithm/staque-1-e790a29f/	5	Chalk	--- NOT APPLICABLE ---
35	Disk tower https://www.hackerearth.com/practice/data-structures/stacks/basics-of-stacks/practice-problems/algorithm/disk-tower-1-1e790a29f/	5	Chalk	--- NOT APPLICABLE ---

	structures/queues/basics-of-queues/practice-problems/algorithm/disk-tower-b7cc7a50/			
30	Infix to Postfix https://www.codechef.com/problems/INFPOS03	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 17**Session Outcome: 1 Hashing**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Plot the Curve https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/lets-plot-this-47a575ed/	5	Chalk	--- NOT APPLICABLE ---
35	Similar Chocolates https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/notebook-pages-dbad75a5/	5	Chalk	--- NOT APPLICABLE ---
30	Maximum Sum https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/maximum-subarray-sum-of-subarrays-7f33aefa/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 18**Session Outcome: 1 Hashing**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Festivals https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/suzakus-festivals-14dacd7c/	5	Chalk	--- NOT APPLICABLE ---
35	Bob and String https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/bob-and-string-easy/	5	Chalk	--- NOT APPLICABLE ---
30	ICPC Team Management https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/icpc-team-management/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 19**Session Outcome: 1 Binary Search tree**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Skill Session https://www.codechef.com/problems/ONP	5	Chalk	--- NOT APPLICABLE ---
35	Count Number of Leaf Nodes in a tree https://www.hackerearth.com/problem/algorithm/count-leaf-nodes-in-a-binary-tree/	5	Chalk	--- NOT APPLICABLE ---
30	Tree: Inorder Traversal https://www.hackerrank.com/challenges/tree-inorder-traversal/problem?h_r=internal-search	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 20

Session Outcome: 1 Binary Search tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Monk and his Friends https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-his-friends/	5	Chalk	--- NOT APPLICABLE ---
35	Tree: Post-order Traversal https://www.hackerrank.com/challenges/tree-postorder-traversal/problem	5	Chalk	--- NOT APPLICABLE ---
30	Create BST https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/create-bst/	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 21

Session Outcome: 1 AVL Tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Balanced Tree https://www.hackerearth.com/problem/algorithm/balanced-tree/	5	Chalk	--- NOT APPLICABLE ---
35	Construct AVL Tree for the following sequence of numbers - 52 , 64 , 76 , 5 , 18 , 33 , 55 , 34 , 11 , 20, 48	5	Chalk	--- NOT APPLICABLE ---
30	Construct an AVL tree with the following node values: 13, 10, 7, 30, 35, 5, 3 and identify the single left rotations	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 22

Session Outcome: 1 AVL Tree

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Explain AVL Tree and advantages of AVL Tree in the data organization. What is a balancing factor? And its importance to improve the efficiency of tree organization. Representing AVL tree as balanced binary search tree.	5	Chalk	--- NOT APPLICABLE ---
35	Construct AVL Tree for the following sequence of numbers -50, 20 , 60 , 10 , 8 , 15 , 32 , 46 , 11 , 48. Explain the process of deleting the node 32	5	Chalk	--- NOT APPLICABLE ---
30	Construct AVL Tree for the following sequence of numbers - 50 , 20 , 60 , 10 , 8 , 15 , 32 , 46 , 11 , 48	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 23**Session Outcome: 1 Graphs**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	BFS: Shortest Reach in a Graph https://www.hackerrank.com/challenges/ctci-bfs-shortest-reach/problem	5	Chalk	--- NOT APPLICABLE ---
35	DFS Edges https://www.hackerrank.com/challenges/dfs-edges/problem	5	Chalk	--- NOT APPLICABLE ---
30	Kruskal (MST): Really Special Subtree https://www.hackerrank.com/challenges/kruskalmstrsub/problem	5	Chalk	--- NOT APPLICABLE ---

SESSION NUMBER : 24**Session Outcome: 1 Graphs**

Time(min)	Topic	BTL	Teaching-Learning Methods	Active Learning Methods
35	Prim's (MST) : Special Subtree https://www.hackerrank.com/challenges/primsmstsub/problem	5	Chalk	--- NOT APPLICABLE ---
35	Finding pairs https://www.hackerearth.com/practice/algorithms/graphs/depth-first-search/practice-problems/algorithm/find-pairs-4-699bc085/	5	Chalk	--- NOT APPLICABLE ---
30	Build a graph https://www.hackerearth.com/practice/algorithms/graphs/graph-	5	Chalk	--- NOT APPLICABLE ---

representation/practice-problems/algorithm/build-a-graph-
5f5c6b4a/

WEEKLY HOMEWORK ASSIGNMENTS/ PROBLEM SETS/OPEN ENDED PROBLEM-SOLVING EXERCISES etc:

Week	Assignment Type	Assignment No	Topic			Details		co
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COURSE TIME TABLE:

	Hour	1	2	3	4	5	6	7	8	9
Day	Component									
Mon	Theory	V-S2,V-S28,V-S32	V-S2,V-S30	V-S3,V-S4,V-S12	V-S3,V-S4,V-S12	V-S16	V-S15	--	--	-
	Tutorial	--	--	--	--	--	--	--	--	-
	Lab	V-S13,V-S29	V-S13,V-S29	V-S7	V-S7	V-S1,V-S19	V-S1,V-S19	V-S26,V-S32	V-S26,V-S32	-
	Skilling	V-S8,V-S10,V-S21,V-S22,V-S25,V-S31	V-S8,V-S10,V-S21,V-S22,V-S25,V-S31	V-S20,V-S27	V-S20,V-S27	V-S18	V-S18	--	--	-
Tue	Theory	V-S7,V-S28	V-S7,V-S28,V-S31	V-S1,V-S6,V-S23,V-S26	V-S1,V-S6,V-S26	V-S13,V-S15,V-S17	V-S15,V-S17	---	---	-
	Tutorial	--	--	--	--	--	--	---	---	-
	Lab	V-S14,V-S30	V-S14,V-S30	V-S8	V-S8	V-S2,V-S20	V-S2,V-S20	---	---	-
	Skilling	V-S5,V-S10,V-S21,V-S22,V-S24	V-S5,V-S10,V-S21,V-S22,V-S24	V-S3,V-S16,V-S19,V-S27,V-S29	V-S3,V-S16,V-S19,V-S27,V-S29	V-S11,V-S18	V-S11,V-S18	---	---	-
Wed	Theory	V-S4,V-S16,V-S21,V-S24	V-S5,V-S6,V-S16	V-S7,V-S8,V-S9	V-S8,V-S9	V-S10,V-S11,V-S19	V-S3,V-S11,V-S19	---	---	-
	Tutorial	--	--	--	--	--	--	---	---	-
	Lab	V-S9,V-S23	V-S9,V-S23	V-S3,V-S25	V-S3,V-S25	V-S15	V-S15	---	---	-

Thu	Skilling	V-S17,V-S28,V-S29,V-S30,V-S32	V-S17,V-S28,V-S29,V-S30,V-S32	V-S13,V-S26,V-S31	V-S13,V-S26,V-S31	V-S2,V-S12	V-S2,V-S12	---	---	-
	Theory	V-S5,V-S25,V-S32	V-S2,V-S5,V-S18,V-S19,V-S20,V-S32	V-S8,V-S21,V-S27	V-S21,V-S27	--	--	---	---	-
	Tutorial	--	--	--	--	--	--	---	---	-
	Lab	V-S10,V-S31	V-S10,V-S31	V-S4,V-S24	V-S4,V-S24	V-S16	V-S16	---	---	-
Fri	Skilling	V-S6,V-S14,V-S28	V-S6,V-S14,V-S28	V-S12,V-S13,V-S16,V-S23,V-S30	V-S12,V-S13,V-S16,V-S23,V-S30	V-S1,V-S7,V-S8,V-S9,V-S20	V-S1,V-S7,V-S8,V-S9,V-S20	---	---	-
	Theory	V-S9,V-S11,V-S23	V-S23,V-S29	V-S1,V-S10,V-S12,V-S22	V-S10,V-S22,V-S26,V-S27	V-S18,V-S20	V-S14,V-S18,V-S20	---	---	-
	Tutorial	--	--	--	--	--	--	---	---	-
	Lab	V-S5,V-S22	V-S5,V-S22	V-S17,V-S28	V-S17,V-S28	V-S11	V-S11	---	---	-
Sat	Skilling	V-S14,V-S17,V-S25	V-S14,V-S17,V-S25	V-S4,V-S7,V-S19,V-S24	V-S4,V-S7,V-S19,V-S24	V-S6,V-S15	V-S6,V-S15	---	---	-
	Theory	V-S13,V-S14,V-S17,V-S25,V-S29,V-S31	V-S13,V-S14,V-S22,V-S25,V-S29,V-S31	V-S24,V-S30	V-S24,V-S30	--	--	---	---	-
	Tutorial	--	--	--	--	--	--	---	---	-
	Lab	V-S6,V-S21	V-S6,V-S21	V-S18,V-S27	V-S18,V-S27	V-S12	V-S12	---	---	-
Sun	Skilling	V-S9,V-S15,V-S23,V-S26,V-S32	V-S9,V-S15,V-S23,V-S26,V-S32	V-S2,V-S3,V-S4,V-S11	V-S2,V-S3,V-S4,V-S11	V-S1,V-S5	V-S1,V-S5	---	---	-
	Theory	--	--	--	--	--	--	--	--	-

Tutorial	--	--	--	--	--	--	--	--	-
Lab	--	--	--	--	--	--	--	--	-
Skilling	--	--	--	--	--	--	--	--	-

REMEDIAL CLASSES:

Supplement course handout, which may perhaps include special lectures and discussions that would be planned, and schedule notified accordingly

SELF-LEARNING:

Assignments to promote self-learning, survey of contents from multiple sources.

S.no	Topics	CO	ALM	References/MOOCS
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DELIVERY DETAILS OF CONTENT BEYOND SYLLABUS:

Content beyond syllabus covered (if any) should be delivered to all students that would be planned, and schedule notified accordingly.

S.no	Advanced Topics, Additional Reading, Research papers and any	CO	ALM	References/MOOCS
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EVALUATION PLAN:

Evaluation Type	Evaluation Component	Weightage/Marks		Assessment Dates	Duration (Hours)	CO1	CO2	CO3	CO4	CO5
End Semester Summative Evaluation Total= 40 %	Skill Sem-End Exam	Weightage	8		120					8
		Max Marks	50							50
	End Semester Exam	Weightage	24		180	6	6	6	6	
		Max Marks	100			25	25	25	25	
	Lab End Semester Exam	Weightage	8		120					8
		Max Marks	50							50
In Semester Formative Evaluation Total= 26 %	Ratings on Global Platforms	Weightage	4		120					4
		Max Marks	50							50
	Skilling Continuous Evaluation	Weightage	4		120	1	1	1	1	
		Max Marks	50			12.5	12.5	12.5	12.5	
	ALM	Weightage	8		20	2	2	2	2	
		Max Marks	50			12.5	12.5	12.5	12.5	
	Home Assignment and Textbook	Weightage	4		20	1	1	1	1	
		Max Marks	50			12.5	12.5	12.5	12.5	

	Continuous Evaluation - Lab Exercise	Weightage	6		120					6
		Max Marks	50							50
In Semester Summative Evaluation Total= 34 %	Semester in Exam-I	Weightage	12		120	6	6			
		Max Marks	50			25	25			
	Semester in Exam-II	Weightage	12		120			6	6	
		Max Marks	50					25	25	
Lab In Semester Exam	Weightage	5			120					5
		Max Marks	50							50
Skill In-Sem Exam	Weightage	5			120	1	2	2		
		Max Marks	50			10	20	20		

ATTENDANCE POLICY:

Every student is expected to be responsible for regularity of his/her attendance in class rooms and laboratories, to appear in scheduled tests and examinations and fulfill all other tasks assigned to him/her in every course. In every course, student has to maintain a minimum of 85% attendance to be eligible for appearing in Semester end examination of the course, for cases of medical issues and other unavoidable circumstances the students will be condoned if their attendance is between 75% to 85% in every course, subjected to submission of medical certificates, medical case file and other needful documental proof to the concerned departments.

DETENTION POLICY :

In any course, a student has to maintain a minimum of 85% attendance and In-Semester Examinations to be eligible for appearing to the Semester End Examination, failing to fulfill these conditions will deem such student to have been detained in that course.

PLAGIARISM POLICY :

Supplement course handout, which may perhaps include special lectures and discussions

COURSE TEAM MEMBERS, CHAMBER CONSULTATION HOURS AND CHAMBER VENUE DETAILS:

Supplement course handout, which may perhaps include special lectures and discussions

Name of Faculty	Delivery Component of Faculty	Sections of Faculty	Chamber Consultation Day (s)	Chamber Consultation Timings for each day	Chamber Consultation Room No:	Signature of Course faculty:
Shaik Razia	L	6-MA	-	-	-	-
Shaik Razia	P	6-MA	-	-	-	-
Shaik Razia	S	6-MA	-	-	-	-
Haritha Donavalli	L	1-MA,8-MA	-	-	-	-
Haritha Donavalli	S	8-MA	-	-	-	-
Pavan Kumar Nidumolu	L	13-MA	-	-	-	-

Pavan Kumar Nidumolu	P	13-MA	-	-	-	-
Pavan Kumar Nidumolu	S	13-MA	-	-	-	-
Venkata Naga Ramesh Janjhyam	L	27-MA,5-MA	-	-	-	-
Venkata Naga Ramesh Janjhyam	P	27-MA,5-MA	-	-	-	-
Venkata Naga Ramesh Janjhyam	S	27-MA,5-MA	-	-	-	-
Zeelan CMAK	L	12-MA,29-MA	-	-	-	-
Zeelan CMAK	P	12-MA,29-MA	-	-	-	-
Zeelan CMAK	S	12-MA,29-MA	-	-	-	-
Dama Anand	L	31-MA	-	-	-	-
Dama Anand	P	31-MA	-	-	-	-
Dama Anand	S	31-MA	-	-	-	-
Siva Kumar Pathuri	L	11-MA,21-MA	-	-	-	-
Siva Kumar Pathuri	P	11-MA,21-MA	-	-	-	-
Siva Kumar Pathuri	S	11-MA,21-MA	-	-	-	-
Venkata Mandhala	L	19-MA	-	-	-	-
Venkata Mandhala	P	19-MA	-	-	-	-
Venkata Mandhala	S	19-MA	-	-	-	-
AZMIRA KRISHNA	L	9-MA	-	-	-	-
AZMIRA KRISHNA	P	9-MA	-	-	-	-
AZMIRA KRISHNA	S	9-MA	-	-	-	-
Karimunnisa Syed	L	2-MA,7-MA	-	-	-	-

Karimunnisa Syed	P	2-MA,7-MA	-	-	-	-
Karimunnisa Syed	S	2-MA,7-MA	-	-	-	-
U Harita	L	15-MA,30-MA	-	-	-	-
U Harita	P	30-MA,15-MA	-	-	-	-
U Harita	S	15-MA,30-MA	-	-	-	-
Ashok Bekkanti	L	10-MA,23-MA	-	-	-	-
Ashok Bekkanti	P	10-MA,23-MA	-	-	-	-
Ashok Bekkanti	S	23-MA,10-MA	-	-	-	-
Parasa Gayatri	P	8-MA,1-MA	-	-	-	-
Parasa Gayatri	S	1-MA	-	-	-	-
ARUMBAKA RAO	L	22-MA,16-MA	-	-	-	-
ARUMBAKA RAO	P	16-MA,22-MA	-	-	-	-
ARUMBAKA RAO	S	16-MA,22-MA	-	-	-	-
SONTI HARIKA	L	24-MA	-	-	-	-
SONTI HARIKA	P	24-MA	-	-	-	-
SONTI HARIKA	S	24-MA	-	-	-	-
THONTLA BINDU	L	28-MA	-	-	-	-
ANILA M	L	26-MA	-	-	-	-
ANILA M	P	26-MA	-	-	-	-
ANILA M	S	26-MA	-	-	-	-
Ashwini Pradhan	L	17-MA	-	-	-	-

Ashwini Pradhan	P	17-MA	-	-	-	-
Ashwini Pradhan	S	17-MA	-	-	-	-
YOGESH KAKDE	L	25-MA,18-MA	-	-	-	-
YOGESH KAKDE	P	25-MA,18-MA	-	-	-	-
YOGESH KAKDE	S	25-MA,18-MA	-	-	-	-
Basant Sah	L	4-MA	-	-	-	-
Basant Sah	P	4-MA	-	-	-	-
Basant Sah	S	4-MA	-	-	-	-
Nesarani A	L	20-MA	-	-	-	-
Nesarani A	P	20-MA	-	-	-	-
Nesarani A	S	20-MA	-	-	-	-
Agraharam Kumar	L	32-MA	-	-	-	-
Agraharam Kumar	P	32-MA	-	-	-	-
Agraharam Kumar	S	32-MA	-	-	-	-
Milan Dholey	L	28-MA	-	-	-	-
Milan Dholey	P	28-MA	-	-	-	-
Milan Dholey	S	28-MA	-	-	-	-
Lavanya Chunduri	L	3-MA,14-MA	-	-	-	-
Lavanya Chunduri	P	3-MA,14-MA	-	-	-	-
Lavanya Chunduri	S	3-MA,14-MA	-	-	-	-
Poranki V L R N Sudha	S	8-MA	-	-	-	-

GENERAL INSTRUCTIONS

Students should come prepared for classes and carry the text book(s) or material(s) as prescribed by the Course Faculty to the class.

NOTICES

Most of the notices are available on the LMS platform.

All notices will be communicated through the institution email.

All notices concerning the course will be displayed on the respective Notice Boards.

Signature of COURSE COORDINATOR

(Ashok Bekkanti)

Signature of Department Prof. Incharge Academics & Vetting Team Member

Department Of DBES-1

HEAD OF DEPARTMENT:

Approval from: DEAN-ACADEMICS

(Sign with Office Seal) [object HTMLDivElement]