INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**DATA STRUCTURES**				
Course Code	ACSB03				
Programme	B.Tech				
Semester	III	CSE | IT | ECE | CE | ME			
	IV	AE | EEE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	0	3	3	1.5
Chief Coordinator	Dr. K Suvarchala, Associate Professor				
Course Faculty	Mrs. K Radhika, Assistant Professor Mr. Ch. Suresh Kumar Raju, Assistant Professor Mrs. Y Harika Devi, Assistant Professor Mr. N Poornachandra Rao, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand various data representation techniques in the real world.
II	Implement linear and non-linear data structures.
III	Analyze various algorithms based on their time and space complexity
IV	Develop real-time applications using suitable data structure
V	Identify suitable data structure to solve various computing problems.

COURSE OUTCOMES (COs):

CO 1	Understand the concept of data structures and apply algorithm for solving problems like sorting, searching, insertion and deletion of data.
CO 2	Understand linear data structures for processing of ordered or unordered data.
CO 3	Explore various operations on dynamic data structures like single linked list, circular linked list and doubly linked list.
CO 4	Explore the concept of non linear data structures such as trees and graphs.
CO 5	Understand the binary search trees, hash function, and concepts of collision and its resolution methods.

COURSE LEARNING OUTCOMES (CLOs):

ACSB03.01	Understand algorithms and data structures in terms of time and space complexity of basic operations.
ACSB03.02	Choose a suitable algorithm to organize the data in ascending or descending order.
ACSB03.03	Explore an algorithm to find the location of an element in a given list.
ACSB03.04	Compare the time complexities of various searching and sorting algorithms.
ACSB03.05	Implementation of stack and queues using an underlying array.
ACSB03.06	Understand application of stacks in arithmetic expression conversion and evaluation.
ACSB03.07	Understand working of circular queues and double ended queue.
ACSB03.08	Understand dynamic data structures and their real time applications.
ACSB03.09	Understand the basic insertion and deletion operations associated with linked list.
ACSB03.10	Organize the data in various linked representation format.
ACSB03.11	Understand the concept of non-linear data structures viz. trees and graphs.
ACSB03.12	Application of trees, graphs and graph traversal techniques.
ACSB03.13	Compare and Contrast the operations of binary search trees and AVL trees.
ACSB03.14	Understand the concept of M-way search trees, operations and applications.
ACSB03.15	Understand the implementation of hashing using hash table and hash function.
ACSB03.16	Describe the concept of collision and its resolving methods in applications.
ACSB03.17	Strengthen the knowledge of data structures and algorithms for employability.

TUTORIAL QUESTION BANK

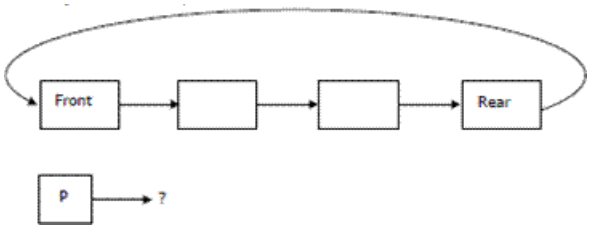
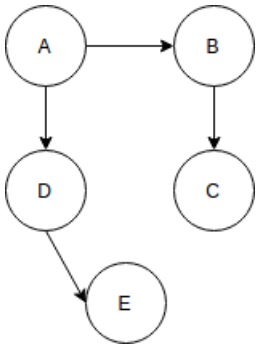
MODULE- I				
INTRODUCTION TO DATA STRUCTURES, SEARCHING AND SORTING				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	Draw the diagram showing classification of data structures?	Remember	CO 1	ACSB03.01
2	List out various linear and non-linear data structures?	Understand	CO 1	ACSB03.01
3	Define data structure?	Remember	CO 1	ACSB03.01
4	What is an array and explain how the elements of an array can be accessed?	Remember	CO 1	ACSB03.01
5	What is stack and list the operations that can be performed on stack?	Remember	CO 1	ACSB03.01
6	What is searching and list the types of searching techniques.	Remember	CO 1	ACSB03.02
7	Write the best case and worst case complexity of ordered linear search?	Remember	CO 1	ACSB03.02
8	Define linear search? What is best case efficiency of linear search? What are the various applications of linear search?	Remember	CO 1	ACSB03.02
9	Write the disadvantage of linear search compared to other searching techniques?	Remember	CO 1	ACSB03.02
10	Given a list arr = {2, 5, 7, 55, 72}, key = 72, write the procedure for finding the element 72 using linear search?	Remember	CO 1	ACSB03.02
11	Write the worst case time complexity of binary search?	Remember	CO 1	ACSB03.02
12	Write any two applications of binary search?	Remember	CO 1	ACSB03.02
13	Define queue and write the operations that can be performed on queue?	Understand	CO 1	ACSB03.01
14	What is sorting and list different sorting techniques that can be used to sort the list of elements?	Understand	CO 1	ACSB03.03
15	Define a Nonlinear data structure and name any two Non linear data structure.	Remember	CO 1	ACSB03.01
16	Why we use sequential search write any two cases?	Understand	CO 1	ACSB03.02
17	Consider a list arr = {1, 2, 4, 3}. Bubble sort is used to sort the elements of a list. Find out the number of iterations that will be required to sort the list?	Understand	CO 1	ACSB03.03
18	Write the best, average and worst case time complexities of selection sort?	Remember	CO 1	ACSB03.03
19	Write the worst case time complexity of bubble when the input array is already sorted?	Understand	CO 1	ACSB03.03
20	Write the best, average and worst case time complexities of quick sort?	Remember	CO 1	ACSB03.03
Part - B (Long Answer Questions)				
1	Write short notes on different sorting techniques.	Understand	CO 1	ACSB03.03
2	Define a data structure, draw and explain the classification of data structures.	Understand	CO 1	ACSB03.01
3	Write a function that generates first N Fibonacci numbers.	Understand	CO 1	ACSB03.02
4	Explain linear search procedure for the following list of elements and assume the key element is 96. 12, 23, 34, 45, 55, 62, 71, 85, 96	Understand	CO 1	ACSB03.02
5	List out linear and non-linear data structures? Write an algorithm to print GCD of two numbers?	Understand	CO 1	ACSB03.02
6	Define sorting? Write the procedure for bubble sort using a suitable example?	Understand	CO 1	ACSB03.03
7	Explain Binary Search procedure for the following list of elements and assume the key element is 85. 12, 23, 34, 45, 55, 62, 71, 85, 96	Understand	CO 1	ACSB03.02
8	Explain the following two comparison sort algorithms with an example and write their time complexities? i. Bubble sort ii. Selection sort	Understand	CO 1	ACSB03.03
9	Explain Binary Search procedure for the following list of elements and assume the key element is 49. 12, 23, 34, 45, 55, 62, 71, 85, 96	Understand	CO 1	ACSB03.02
10	Sort the given list of elements using insertion sort.14, 33,27,10,35,19,42,44.	Understand	CO 1	ACSB03.03

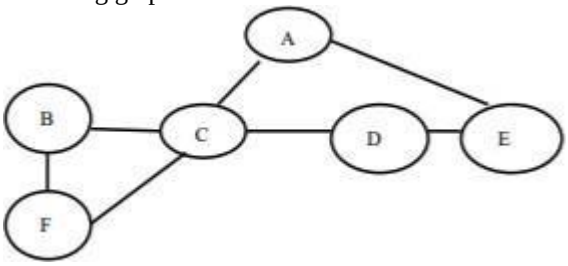
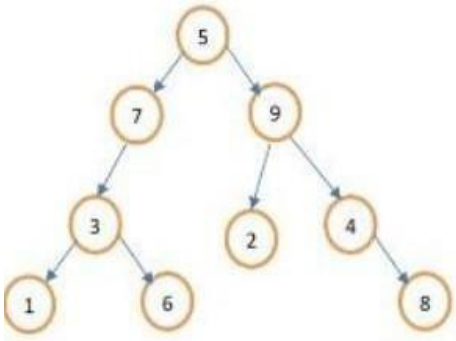
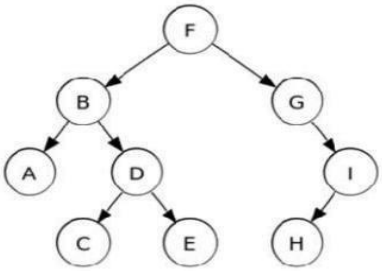
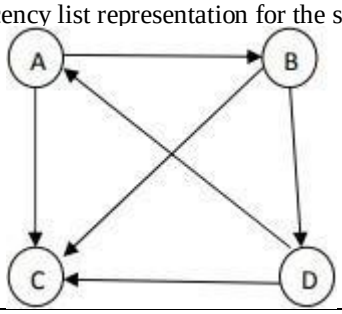
11	Write the name of the sorting technique which is used in playing cards game? Write a procedure for sorting a given list of numbers using that technique? 14, 25, 36, 74, 85, 6, 53, 62, 41	Understand	CO 1	ACSB03.03
12	Write the algorithm for bubble sort and explain with an example.	Understand	CO 1	ACSB03.03
13	Explain the procedure, advantages and disadvantages of linear and binary search with a suitable example?	Understand	CO 1	ACSB03.02
14	Compare the time complexities of various searching and sorting algorithms?	Understand	CO 1	ACSB03.04
15	Write an algorithm to search for an employee ID in an array(Hint: use linear search)	Understand	CO 1	ACSB03.02
16	Explain bubble sort by sorting the following list of elements . **5** ,**1,** 4, 2, 8.	Understand	CO 1	ACSB03.03
17	What is the idea behind Selection sort and sort the following list of elements using that idea. Aarray A = [7 , 5 , 4 , 2] needs to be sorted in ascending order.	Understand	CO 1	ACSB03.03
18	Sort the given list of elements using selection sort.14, 33,27,10,35,19,42,44.	Understand	CO 1	ACSB03.03
19	Define selection sort and write pseudo code for selection sort	Understand	CO 1	ACSB03.03
20	Explain insertion sort with an example and compare time complexity of insertion sort with other sorting algorithms.	Understand	CO 1	ACSB03.03
	Part - C (Problem Solving and Critical Thinking Questions)			
1	If there are 22,049 data elements being searched, what is the maximum number of "looks" it will take with binary search to find the data element being search for.	Understand	CO 1	ACSB03.02
2	Explain the importance of data structures and discuss typical algorithm complexities of different problems? Write the best, average and worst case analysis of linear search and binary search algorithms.	Understand	CO 1	ACSB03.02
3	Suppose an array A with elements indexed 1 to n is to be searched for a value x. Write pseudo code that performs a forward search, returning n + 1 if the value is not found.	Understand	CO 1	ACSB03.02
4	Searching in a phone book: A phone book is stored in a text file, containing names of people, their city names and phone numbers. Choose an appropriate data structure to search a person's phone number based on his / her first name and city.	Understand	CO 1	ACSB03.02
5	Sorting a phone book: Given a text file containing people's names, their city and phone numbers. Write a program which prints all the details in an alphabetical order of People Name.	Understand	CO 1	ACSB03.03
6	What is a binary search and write the pseudo code for binary search.	Understand	CO 1	ACSB03.02
7	Given an array A of non-negative integers of size m. Your task is to sort the array in non-decreasing order and print out the original indices of the new sorted array.	Understand	CO 1	ACSB03.03
8	Consider the following list of integers: [12,9,3,14,5,66,7,80,9,10] and arrange the elements in descending order using insertion sort.	Understand	CO 1	ACSB03.03
9	Consider the following list of integers: [1,9,33,47,5,6,7,80,9,10] and write the procedure for finding the element '7' using binary search.	Understand	CO 1	ACSB03.02
10	Define insertion sort and write the pseudo code for insertion sort.	Understand	CO 1	ACSB03.03
	MODULE-II			
	LINEAR DATA STRUCTURES			
	Part – A (Short Answer Questions)			
1	Define stack.	Understand	CO 2	ACSB03.05
2	Define queue.	Understand	CO 2	ACSB03.06
3	List the applications of stack.	Understand	CO 2	ACSB03.07
4	List the applications of queue.	Understand	CO 2	ACSB03.05
5	List the types of queues.	Remember	CO 2	ACSB03.06
6	List the various operations performed on stacks.	Understand	CO 2	ACSB03.07
7	List the various operations performed on linear queues.	Remember	CO 2	ACSB03.05
8	List the various operations performed on double ended queues.	Understand	CO 2	ACSB03.06
9	State the name of the data structure, in which deletion can be done from one end and insertion can take place only at the other end?	Understand	CO 2	ACSB03.07

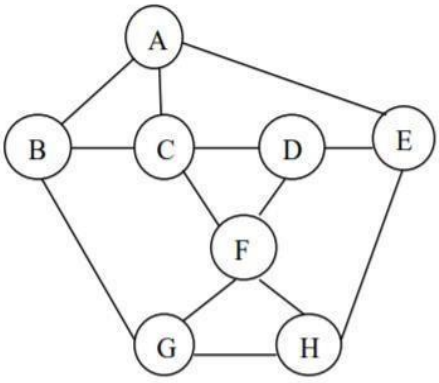
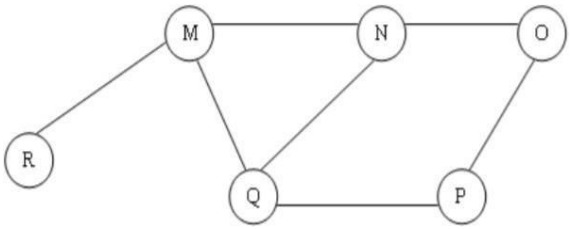
10	Identify the data structure, in which elements can be inserted or deleted at/from both the ends, but not in the middle?	Understand	CO 2	ACSB03.05
11	List out any two applications of double ended queue?	Remember	CO 2	ACSB03.06
12	Write the conditions for linear queue full and empty?	Remember	CO 2	ACSB03.07
13	State the disadvantages of linear queue?	Understand	CO 2	ACSB03.05
14	Write the conditions for stack overflow situation?	Understand	CO 2	ACSB03.06
15	Write the conditions for stack underflow situation?	Understand	CO 2	ACSB03.07
16	List the representation three types of expressions.	Remember	CO 2	ACSB03.05
17	Consider the following operation performed on a stack of size 5. Push(1); Pop(); Push(2); Push(3); Pop(); Push(4); Pop(); Pop(); Push(5); After the completion of all operation, find the number of elements present in stack?	Remember	CO 2	ACSB03.06
18	If the elements “A”, “B”, “C” and “D” are placed in a stack and are deleted one at a time, write the order of removal?	Remember	CO 2	ACSB03.07
19	State the data structure which is required to check whether an expression contains balanced parenthesis or not?	Remember	CO 2	ACSB03.06
20	Write the prefix form of an infix expression p + q – r * t	Remember	CO 2	ACSB03.07
	Part - B (Long Answer Questions)			
1	Discuss the various operations performed on stack with examples.	Understand	CO 2	ACSB03.05
2	Write down the algorithm to convert an infix expression to postfix form.	Understand	CO 2	ACSB03.06
3	Describe the operations of a stack using arrays.	Understand	CO 2	ACSB03.07
4	Write an algorithm for postfix expression evaluation.	Understand	CO 2	ACSB03.05
5	Write the functional difference between stacks and queues.	Understand	CO 2	ACSB03.06
6	Compare between linear queue and circular queue? Write down algorithms for insert and delete operations in a circular queue?	Understand	CO 2	ACSB03.07
7	Define a double ended queue (DEQUE). Explain input restricted and output restricted DEQUE.	Understand	CO 2	ACSB03.05
8	Explain the concept of a linear queue. Write algorithms for performing insert, delete operations using arrays.	Understand	CO 2	ACSB03.06
9	Write the procedure for Circular Queue full and empty conditions.	Understand	CO 2	ACSB03.07
10	Write the equivalent prefix and postfix expression for the given infix expression: (a * b) / 2 – (c / d – e)	Understand	CO 2	ACSB03.05
11	Convert following infix expression into postfix form: (A+B) * (C-D/E)* G+H	Understand	CO 2	ACSB03.06
12	Evaluate the following postfix notation of expression (Show status of stack after execution of each operations): 5 20 1 5 - * 25 2 * +	Understand	CO 2	ACSB03.07
13	Convert the following infix expression to postfix expression using a stack using the usual precedence rule: x + y * z + (p * q + r) * s	Understand	CO 2	ACSB03.05
14	Find the result of evaluating the postfix expression 5, 4, 3, +, *, 4, 9, 3, /,+,*	Understand	CO 2	ACSB03.06
15	Convert following infix expression into postfix form: A + (B*C-D/E*G) + H	Understand	CO 2	ACSB03.07
16	Implement an algorithm to DEQUEUE delete from front operation	Understand	CO 2	ACSB03.05
17	Implement an algorithm to DEQUEUE delete from rear operation	Understand	CO 2	ACSB03.06
18	Implement an algorithm to DEQUEUE insert at front operation	Understand	CO 2	ACSB03.07
19	Implement an algorithm to DEQUEUE insert at rear operation	Understand	CO 2	ACSB03.06
20	Write the conditions for Queue full and empty conditions.	Understand	CO 2	ACSB03.07
	Part - C (Problem Solving and Critical Thinking Questions)			
1	The following postfix expression with single digit operands is evaluated	Understand	CO 2	ACSB03.05

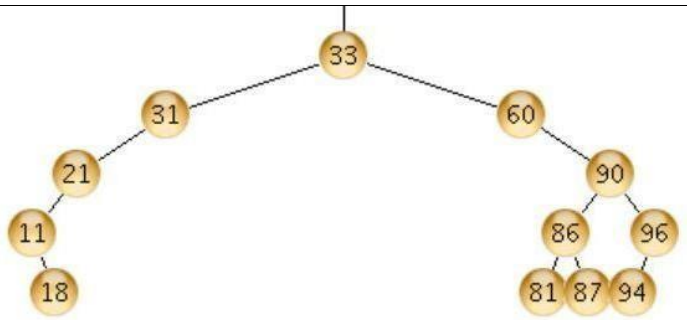
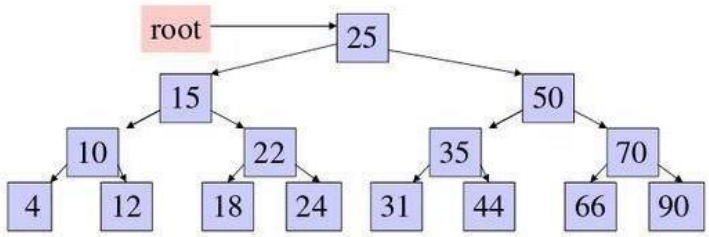
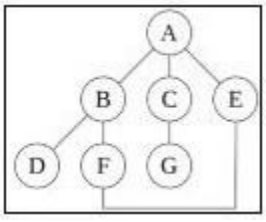
	using stack. 8 2 3 ^ / 2 3 * + 5 / * - Note that ^ is exponential operator. Find the top two elements of the stack after the first * is evaluated?			
2	Transform the following expression to postfix expression using stacks.(A+B)*(C*(D-E)+F)-G	Understand	CO 2	ACSB03.06
3	Convert the following expression A + (B * C) - ((D * E + F) / G) into postfix form.	Understand	CO 2	ACSB03.07
4	To implement a queue using PUSH, POP and REVERSE operation, show how to implement ENQUEUE and DEQUEUE operations using a sequence of given operations?	Understand	CO 2	ACSB03.05
5	The following postfix expression containing single digit operands and arithmetic operators + and * is evaluated using a stack. 5 2 * 3 4 + 5 2 * * + Show the content of the stack after evaluating the above expression.	Understand	CO 2	ACSB03.06
6	Evaluate the following postfix operation using a stack. 8 2 3 ^ / 2 3 * + 5 1 * - Where ^ is the exponentiation operator.	Understand	CO 2	ACSB03.07
7	Convert the following expression from infix to postfix notation. ((A + B) * C – (D – E) ^ (F + G))	Understand	CO 2	ACSB03.05
8	Assume that the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x, +, -. The postfix expression corresponding to the infix expression a + b × c - d ^ e ^ f is	Understand	CO 2	ACSB03.06
9	Evaluate the postfix expression 1 2 + 3 * 6 + 2 3 + /	Understand	CO 2	ACSB03.07
10	Evaluate the postfix expression 6 2 3 + - 3 8 2 / + * 2 * 3 +	Understand	CO 2	ACSB03.05
	MODULE –III			
	LINKED LISTS			
	Part - A (Short Answer Questions)			
1	Write the advantages of linked lists?	Remember	CO 3	ACSB03.08
2	List out types of linked lists?	Remember	CO 3	ACSB03.08
3	Write the advantages of double linked list over single linked list?	Understand	CO 3	ACSB03.10
4	Write the applications of linked lists?	Remember	CO 3	ACSB03.08
5	Find the time complexity to count the number of elements in a linked list?	Remember	CO 3	ACSB03.09
6	Define a Node in single linked list?	Understand	CO 3	ACSB03.08
7	Write any two operations that is performed more efficiently by arrays than singly linked list?	Understand	CO 3	ACSB03.09
8	Consider a single linked list, list out any two operations that can be implemented in O(1) time?	Remember	CO 3	ACSB03.09
9	Write the advantages of linked lists?	Remember	CO 3	ACSB03.10
10	List out types of linked lists?	Remember	CO 3	ACSB03.09
11	Identify the operation which is difficult to perform in a circular single linked list?	Understand	CO 3	ACSB03.09
12	Write the asymptotic time complexity to insert an element at the second position in the linked list?	Remember	CO 3	ACSB03.09
13	Identify the variant of linked list in which none of the node contains a NULL pointer?	Remember	CO 3	ACSB03.09
14	In a circular linked list, how many pointers requires modification if a node is inserted?	Understand	CO 3	ACSB03.10
15	Identify the searching technique for which linked lists are not suitable data structures?	Remember	CO 3	ACSB03.10
16	In worst case, find the number of comparisons needed to search a singly linked list of length n for a given element?	Remember	CO 3	ACSB03.10
17	State the name of data structure in which data elements is logically adjacent to each other?	Understand	CO 3	ACSB03.10
18	Write the disadvantages of double linked list over single linked list?	Remember	CO 3	ACSB03.10
19	Write the time complexity of enqueue() and dequeue() operations of a linked list implementation of a linear queue?	Remember	CO 3	ACSB03.10
20	Write an example of a non-contiguous data structure?	Understand	CO 3	ACSB03.10

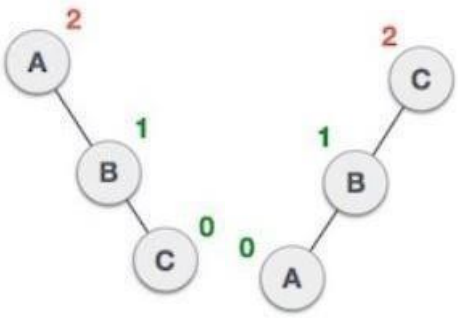
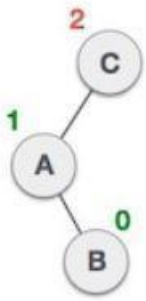
Part – B (Long Answer Questions)				
1	Write a program to implement the following operations of a single linked list: i. Creating a list ii. List traversal	Understand	CO 3	ACSB03.09
2	A node can be inserted at various places in a linked list. Write algorithms for inserting a new node in a single linked list at: i. At the front of the linked list ii. After a given node iii. At the end of the linked list	Understand	CO 3	ACSB03.09
3	Write a program to count the number of nodes present in a single linked list?	Understand	CO 3	ACSB03.09
4	Write a program to search for an element present in a single linked list?	Understand	CO 3	ACSB03.09
5	Write a program to delete a node from the middle position of the single linked list?	Understand	CO 3	ACSB03.09
6	Discuss sparse matrix representation using linked list	Understand	CO 3	ACSB03.09
7	Explain how to implement polynomial ADT using linked list. Discuss its Advantages and Disadvantages.	Understand	CO 3	ACSB03.09
8	Write an algorithm to add two polynomials using linked list.	Understand	CO 3	ACSB03.09
9	Describe how a polynomial is represented using singly linked lists			
10	List various operations of linked list and explain how to insert a node anywhere in the list	Understand	CO 3	ACSB03.09
11	Write a program to reverse a single linked list of length n?	Understand	CO 3	ACSB03.09
12	Write a program to implement the following operations of a double linked list: i. Creating a list ii. Inserting a node at the beginning	Understand	CO 3	ACSB03.09
13	Write a program to implement the following operations of a circular single linked list: i. Creating a list ii. Deleting a node at the end	Understand	CO 3	ACSB03.09
14	Write a program to merge two sorted linked list into a third linked list using recursion?	Understand	CO 3	ACSB03.09
15	Write a function to delete a given node in a double linked list?	Understand	CO 3	ACSB03.09
16	Write a program to show how to reverse a single linked list.	Understand	CO 3	ACSB03.09
17	Write a program to search for an element present in a Doubled linked list?	Understand	CO 3	ACSB03.09
18	difference between circular and doubly linked list in data structure with example	Understand	CO 3	ACSB03.09
19	Write a program to insert element in circular linked list	Understand	CO 3	ACSB03.09
20	Write an algorithm for insertion and deletion operations in circular linked list.	Understand	CO 3	ACSB03.09
Part – C (Problem Solving and Critical Thinking)				
1	Write a program to search for an element in the linked list without using recursion.	Understand	CO 3	ACSB03.10
2	Write a program to count the number of occurrences of an element in the linked list without using	Understand	CO 3	ACSB03.09
3	Write a program to print middle most node of a linked list.	Understand	CO 3	ACSB03.10
4	Write a program to swap nodes in a linked list without swapping data?	Understand	CO 3	ACSB03.09
5	Write a program to modify the linked list such that all even numbers Appear before all the odd numbers in the modified linked list.	Understand	CO 3	ACSB03.10
6	Write a program to split a circular linked list into two halves?	Understand	CO 3	ACSB03.10
7	Define a node in a linked list? Explain the difference between creation of single linked list node and double linked list node?	Understand	CO 3	ACSB03.10
8	Write a program to display node values in reverse order for a double linked list?	Understand	CO 3	ACSB03.09

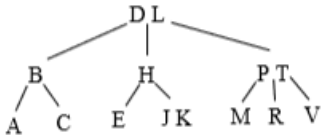
9	Write a program to find intersection & union of 2 linked lists.			ACSB03.10
10	A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. Find the node to which p should point such that both the operations enQueue and deQueue can be performed in constant time? 	Understand	CO 3	ACSB03.10
	MODULE -IV			
	NON LINEAR DATA STRUCTURES			
	Part – A (Short Answer Questions)			
1	Write the children for node 'w' of a complete-binary tree in an array representation?	Remember	CO 4	ACSB03.11
2	Write the advantages of linked list representation of binary trees over arrays?	Remember	CO 4	ACSB03.11
3	Write the different tree traversal algorithms in linked list representation?	Remember	CO 4	ACSB03.11
4	State the graph traversal technique which is similar to level order tree traversal?	Remember	CO 4	ACSB03.11
5	Write the recursive algorithm for pre-order traversal?	Understand	CO 4	ACSB03.12
6	Write the name of the tree traversal technique which would print the numbers in an ascending order in a binary search tree?	Remember	CO 4	ACSB03.12
7	Define a full binary tree and complete binary tree?	Understand	CO 4	ACSB03.11
8	Write the time complexity for finding the height of the binary tree?	Understand	CO 4	ACSB03.11
9	Write the worst case and average case complexities of a binary search tree?	Understand	CO 4	ACSB03.11
10	Write the number of edges present in a complete graph having n vertices?	Understand	CO 4	ACSB03.12
11	Write the different ways used to represent a graph in computer?	Remember	CO 4	ACSB03.12
12	Write the DFS traversal of the given graph? 	Understand	CO 4	ACSB03.12
13	Write the maximum number of edges present in a simple directed graph with 7 vertices if there exists no cycles in the graph?	Understand	CO 4	ACSB03.12
14	State the difference between pre-order traversal and post-order traversal?	Understand	CO 4	ACSB03.12
15	Write the applications of trees?	Remember	CO 4	ACSB03.12
16	Define binary search tree and its operations?	Understand	CO 4	ACSB03.12
17	Define strictly binary tree with an example?	Understand	CO 4	ACSB03.12
18	Write any two applications of priority queue?	Remember	CO 4	ACSB03.12
19	Write the advantages of priority queue?	Remember	CO 4	ACSB03.12
20	Write the time complexity to insert a node based on position in a priority queue?	Understand	CO 4	ACSB03.12
	Part – B (Long Answer Questions)			
1	Construct a Binary Search Tree for the following data and do in-order, Preorder and Post-order traversal of the tree. 50, 60, 25, 40, 30, 70, 35,	Understand	CO 4	ACSB03.16

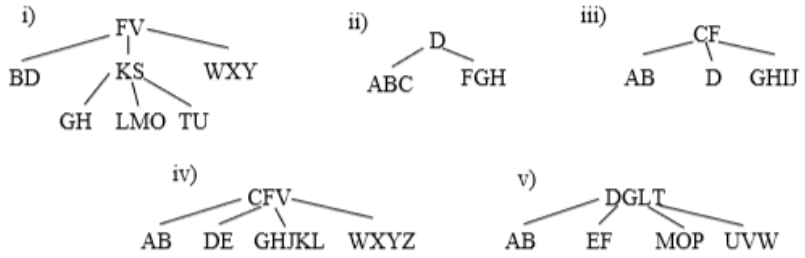
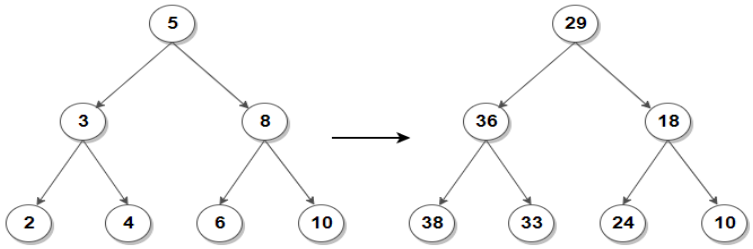
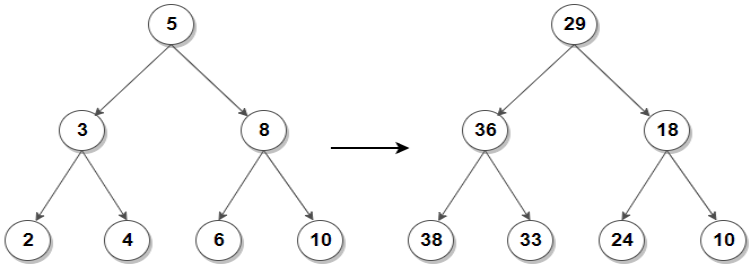
	10, 55, 65, 5			
2	Explain the breadth first search and depth first search tree traversal on the following graph. 	Understand	CO 4	ACSB03.16
3	Illustrate the output obtained after pre-order, in-order and post-order traversal of the following tree 	Understand	CO 4	ACSB03.16
4	Develop a program in Python to implement Depth First Search traversal of a graph using Adjacency Matrix.	Understand	CO 4	ACSB03.12
5	Construct a binary search tree by inserting following nodes in sequence: 68, 85, 23, 38, 44, 80, 30, 108, 26, 5, 92, 60. Write in-order, pre-order and post-order traversal of the above generated Binary search tree.	Understand	CO 4	ACSB03.12
6	Write the in-order, pre-order and post-order traversals for the given binary tree. 	Understand	CO 4	ACSB03.12
7	Define Adjacency Matrix? Draw the Adjacency Matrix of the following graph. Also give adjacency list representation for the same. 	Understand	CO 4	ACSB03.12

8	Explain the array and linked representation of a binary tree using a suitable example?	Understand	CO 4	ACSB03.11
9	Define a binary tree? Construct a binary tree given the pre-order traversal and in-order traversals as follows: Pre-Order Traversal: G B Q A C K F P D E R H In-Order Traversal: Q B K C F A G P E D H R	Understand	CO 4	ACSB03.12
10	Construct an expression tree for the following expression. A + (B + C* D + E) + F / G. Make a preorder traversal of the resultant tree.	Understand	CO 4	ACSB03.12
11	Explain the binary tree traversal algorithms with a suitable example?	Understand	CO 4	ACSB03.12
12	Write the basic tree terminologies and the properties of binary tree?	Understand	CO 4	ACSB03.11
13	Explain the breadth first search and depth first search graph traversal algorithms for the following graph? 	Understand	CO 4	ACSB03.11
14	Explain the following with example: i. Full binary tree ii. Strictly binary tree iii. Complete binary tree	Understand	CO 4	ACSB03.11
15	Write the applications of trees and graphs?	Understand	CO 4	ACSB03.12
16	The Breadth First Search algorithm has been implemented using the queue data structure. Discover breadth first search for the graph shown in Figure with starting node M 	Understand	CO 4	ACSB03.12
17	Define a binary search tree and write the properties of a binary search tree? Construct a binary search with the following keys: 8, 3, , 1, 6, 14, 4, 7, 13, 17, 5	Understand	CO 4	ACSB03.11
18	Write the procedure for finding an element 85 in a given binary search tree?	Understand	CO 4	ACSB03.11

				
19	Write a program for breadth first traversal of a graph?	Understand	CO 4	ACSB03.12
20	Write the in-order, pre-order and post-order traversal of a given tree? 	Understand	CO 4	ACSB03.12
Part – C (Problem Solving and Critical Thinking)				
1	Let G be a graph with n vertices and m edges. Find the tightest upper bound on the running time on depth first search of graph G. Assume that graph is represented using adjacency matrix.	Understand	CO 4	ACSB03.12
2	Let G be a undirected graph with n vertices and 25 edges such that each vertex has degree at least 3. Find the maximum possible value of n?	Understand	CO 4	ACSB03.12
3	In a binary tree, for every node the difference between the number of nodes in the left and right sub trees is at most two. If the height of the tree is h > 0, then find the minimum number of nodes in the tree?	Understand	CO 4	ACSB03.11
4	Write a program to find the number of occurrences of a number in a tree of numbers?	Understand	CO 4	ACSB03.11
5	Write breadth first search (BFS) traversal algorithm, based on a queue, to traverse a directed graph of n vertices and m edges?	Understand	CO 4	ACSB03.12
6	Consider the example  Find out the BFS and DFS	Understand	CO 4	ACSB03.12
7	Draw a directed graph with five vertices and seven edges. Exactly one of the edges should be a loop, and do not have any multiple edges.	Understand	CO 4	ACSB03.12
8	Given A Binary Tree. Write an efficient algorithm to delete entire binary tree.	Understand	CO 4	ACSB03.11
9	Given A Binary Tree. Write an efficient algorithm to print a left view of a binary tree.	Understand	CO 4	ACSB03.11
10	Given binary tree write a recursive solution to traverse the tree using post order traversal.	Understand	CO 4	ACSB03.12

	MODULE -V			
	BINARY TREES AND HASHING			
	Part - A (Short Answer Questions)			
1	Define binary search tree?	Understand	CO 5	ACSB03.11
2	Write the worst case and average case complexities of a binary search tree?	Remember	CO 5	ACSB03.11
3	Define an AVL tree and its operations?	Understand	CO 5	ACSB03.13
4	State the maximum height of an AVL tree with p nodes?	Remember	CO 5	ACSB03.13
5	State the data structure which checks the height of the left and the right sub-trees and assures that the difference is not more than 1?	Remember	CO 5	ACSB03.13
6	Write the formula for balance factor in AVL trees?	Remember	CO 5	ACSB03.13
7	List out the types of rotations performed in AVL trees?	Understand	CO 5	ACSB03.13
8	Explain how to perform left and right rotations on the right and left unbalanced AVL trees given below 	Understand	CO 5	ACSB03.13
9	Explain how to perform left-right rotation on the given unbalanced AVL tree? 	Understand	CO 5	ACSB03.13
10	Construct a binary search tree with the following keys 27, 14, 35, 10, 19, 31, 42 and write the procedure to search for a key 20?	Understand	CO 5	ACSB03.11
11	The height of a BST is given as h. Consider the height of the tree as the no. of edges in the longest path from root to the leaf. Find the maximum no. of nodes possible in the tree?	Remember	CO 5	ACSB03.13
12	In full binary search tree every internal node has exactly two children. If there are 100 leaf nodes in the tree, Find the no of internal nodes present in the tree?	Understand	CO 5	ACSB03.11
13	If a node having two children is to be deleted from binary search tree, then it is replaced by its which successor?	Remember	CO 5	ACSB03.11
14	State the run time for traversing all the nodes of a binary search tree with n nodes and printing them in an order?	Understand	CO 5	ACSB03.12
15	If n elements are sorted in a binary search tree, find the time complexity to search a key in the tree?	Remember	CO 5	ACSB03.11
16	Write the purpose of a hash table?	Understand	CO 5	ACSB03.15
17	State the techniques required to avoid collision?	Remember	CO 5	ACSB03.15
18	Define a hash function and list out popular hash functions?	Understand	CO 5	ACSB03.15

19	In simple chaining technique used in hashing, state which data structure is appropriate?	Remember	CO 5	ACSB03.15
20	Write the applications of hashing?	Understad	CO 5	ACSB03.15
	Part - B (Long Answer Questions)			
1	Define the properties of binary search trees? Write a program to construct a binary search tree with the given keys 8, 3, 10, 1, 6, 14, 4, 7, 13?	Understand	CO 5	ACSB03.11
2	List out the operations of a binary search tree and write the procedure to search for a key 45 in a given binary search tree containing elements 25, 15, 50, 10, 22, 35, 70, 4, 12, 18, 24, 31, 44, 66, 90?	Understand	CO 5	ACSB03.11
3	Write the procedure for inserting an element 60 in a given binary search tree containing elements 25, 15, 50, 10, 22, 35, 70, 4, 12, 18, 24, 31, 44, 66, 90?	Understand	CO 5	ACSB03.12
4	Explain the different possibilities that arise while deleting an element from a given binary search tree containing elements 50, 30, 70, 20, 40, 60, 80? i. Delete 20 ii. Delete 30 iii. Delete 50	Understand	CO 5	ACSB03.12
5	Define an AVL tree and write the steps used to follow while inserting an element 3 into an given AVL tree containing elements 13, 10, 15, 5, 11, 16, 4, 8.	Understand	CO 5	ACSB03.13
6	Draw a hash table with open addressing and a size of 9. Use the hash function (k mod 9). Insert the keys: 5, 29, 20, 0, 27 and 18 into the hash table (in that order).	Understand	CO 5	ACSB03.15
7	Define a B Tree and its properties? Construct a B tree of minimum degree 3 from the following elements 1, 2, 3, 4, 5, 6, 30, 40, 50, 60, 70, 80, 82, 84, 86.	Understand	CO 5	ACSB03.11
8	Write the procedure for insertion and deletion operation in a B tree with the following elements 10, 20, 30, 40, 50, 60, 70, 80, 90.	Understand	CO 5	ACSB03.12
9	Explain the collision resolution techniques separate chaining and open addressing with suitable example?	Understand	CO 5	ACSB03.16
10	Explain the following: i. Hashing ii. Hash table iii. Hash Function	Understand	CO 5	ACSB03.15
11	Insert the following sequence of elements into an AVL tree, starting with an empty tree: 10, 20, 15, 25, 30, 16, 18, 19. and delete 30 in the AVL tree that you got.	Understand	CO 5	ACSB03.13
12	Explain the collision resolution technique double hashing and linear probing with suitable example?	Understand	CO 5	ACSB03.16
13	Show the B-tree the results when deleting A, then deleting V and then deleting P from the following B-tree with a minimum branching factor of t =2 . 	Understand	CO 5	ACSB03.11
14	Which of the following are legal B-trees for when the minimum branching factor t = 3? For those that are not legal, give one or two sentence very clearly explaining what property was violated.	Understand	CO 5	ACSB03.11

				
15	Create binary search tree for the following elements (23, 32, 24, 36, 15, 12, 39, 2, 19).Discuss about the height of the above binary search tree.	Understand	CO 5	ACSB03.12
16	Explain with examples different cases of deletion of elements in a binary search tree?	Understand	CO 5	ACSB03.12
17	Explain how M-way search trees differ from binary seach trees with an example.	Understand	CO 5	ACSB03.14
18	Construct a M-way search tree of order 3 for the following nodes 20,70,110,210,130	Understand	CO 5	ACSB03.14
19	Given a BST, modify it such that every key is updated to contain sum of all greater keys present in BST using in-order traversal 	Understand	CO 5	ACSB03.14
20	Given a BST, modify it such that every key is updated to contain sum of all greater keys present in BST using Reverse in-order traversal 	Understand		ACSB03.14
Part – C (Problem Solving and Critical Thinking)				
1	The integers {1-1000} are stored in a binary search tree (BST). Suppose the search algorithm is implemented on the key 363, one of the following sequences is not a possible sequence of nodes that is examined. It is i. 2, 252, 401, 398, 330, 344, 397, 363 ii. 924, 220, 911, 244, 898, 258, 362, 363 iii. 925, 202, 911, 240, 912, 345, 245, 363 iv. 2, 399, 387, 219, 266, 382, 381, 278, 363	Understand	CO 5	ACSB03.12
2	If h is any hashing function and used to hash n keys into a table of size m, where m >= n, find the expected number of collisions involving a particular key x?	Understand	CO 5	ACSB03.15
3	Consider a hash table with 9 slots. The hash function is h(k) = k mod 9. The Collisions are resolved by chaining. The following 9 keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. Find the maximum,	Understand	CO 5	ACSB03.15

	minimum and average chain length in the hash table?			
4	A binary search tree contains the numbers 1, 2, 3, 4, 5, 6, 7, 8. When the tree is traversed in pre-order and the values in each node printed out, the sequence of values obtained is 5, 3, 1, 2, 4, 6, 7, 8. Find the post order traversal sequence of the tree?	Understand	CO 5	ACSB03.12
5	A hash table contains 10 buckets and uses linear probing to resolve collisions. The key values are integers and hash function used is key % 10. If the values 43, 165, 62, 123, 142 are inserted in the table, then find the location of the key value 142 in the table?	Understand	CO 5	ACSB03.15
6	Find the smallest number of keys that will force a B-tree of order 3 to have a height 2?	Understand	CO 5	ACSB03.11
7	Suppose that the computer you will be using has disk blocks holding 4096 bytes, the key is 4 bytes long, each child pointer (which is a disk block id) is 4 bytes, the parent is 4 bytes long and the data record reference (which is a disk block id along with a offset within the block) is 8 bytes. You have an application in which you want to store 1,000,000 items in your B-tree. What value would you select for t? (Show how you derived it.) What is the maximum number of disk pages that will be brought into main memory during a search? Remember that the root is kept in main memory at all times	Understand	CO 5	ACSB03.11
8	Show the B-tree that results when inserting R,Y,F,X,A,M,C,D,E,T,H,V,L,W,G (in that order)branching factor of t = 3. You need only draw the trees just before and after each split.	Understand	CO 5	ACSB03.12
9	Draw a hash table with open addressing and a size of 9. Use the hash function "k%9". Insert the keys: 5, 29, 20, 0, 27 and 18 into your table (in that order).	Understand	CO 5	ACSB03.15
10	A cosmetician wants to represent a list of her clients' records (by their ID). For each client we would like to mark whether he is a man or she is a woman. Suggest a data structure that supports the following operations in O(log n) time in the worst case, where n is the number of persons (men and women) in the data structure when the operation is executed: 1. Insert(k,c) - Insert a new client c with id = k to the data structure, at first mark the client as a woman. 2. Update(k) – Update client with ID = k to be a man. 3. FindDiff(k) – Find the difference between the number of women and the number of men (| #of women - #of men |) among all the clients with ID smaller than k	Understand	CO 5	ACSB03.17

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