

**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**

Third Semester

**Electronics and Instrumentation Engineering**

(Common to Electronic Instrumentation and Control Engineering)

**24ESIT301 - DATA STRUCTURES**

Regulations - 2024

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

- |   | <i>Marks</i> | <i>K-<br/>Level</i> | <i>CO</i> |
|---|--------------|---------------------|-----------|
| 1. When inserting an element in the middle of an array-based list, which of the following operations takes the most time on average?<br>(a) Accessing an element (b) Deleting an element at the end<br>(c) Inserting an element at the beginning (d) Traversing the list                            | 1            | K3                  | CO1       |
| 2. In a doubly linked list, a node is deleted. Which pointers must be updated to maintain the structure?<br>(a) Only the previous node's next pointer<br>(b) Only the next node's prev pointer<br>(c) Both previous node's next and next node's prev pointers<br>(d) No pointer needs to be updated | 1            | K2                  | CO1       |
| 3. During infix to postfix conversion, which of the following operators should be popped from the stack last if the stack contains operators +, *, ^ (from bottom to top)?<br>(a) + (b) * (c) ^ (d) Depends on operand order  | 1            | K3                  | CO2       |
| 4. In a circular queue, what condition indicates that the queue is full when using an array of size n?<br>(a) rear == n - 1 (b) front == rear<br>(c) (rear + 1) % n == front (d) (front + 1) % n == rear  | 1            | K2                  | CO2       |
| 5. If a binary search tree has n nodes, what is the maximum number of comparisons required to find an element in the worst case?<br>(a) log <sub>2</sub> n (b) n (c) n/2 (d) n <sup>2</sup>   | 1            | K2                  | CO3       |
| 6. In an AVL tree, if the balance factor of a node becomes +2, which rotation(s) may be required?<br>(a) Right rotation or Left-Right rotation (b) Left rotation or Right-Left rotation<br>(c) Only Left rotation (d) No rotation required  | 1            | K2                  | CO3       |
| 7. In Dijkstra's algorithm, which of the following statements is true?<br>(a) It can handle negative edge weights<br>(b) It always uses recursion for traversal<br>(c) It finds the shortest path using a greedy approach<br>(d) It uses depth-first search internally                              | 1            | K2                  | CO4       |
| 8. A topological sort can be performed only on:<br>(a) Undirected graphs (b) Weighted graphs<br>(c) Directed acyclic graphs (DAGs) (d) Connected graphs   | 1            | K1                  | CO4       |
| 9. Which sorting algorithm is most suitable when the input is partially sorted?<br>(a) Quick Sort (b) Merge Sort (c) Insertion Sort (d) Heap Sort   | 1            | K1                  | CO5       |
| 10. In open addressing, when using linear probing, what problem can still occur even if the table is not full?<br>(a) Rehashing (b) Primary clustering (c) Secondary clustering (d) Infinite loop   | 1            | K1                  | CO6       |

**PART - B (12 × 2 = 24 Marks)**

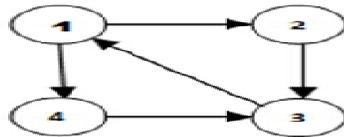
Answer ALL Questions

11. Consider a 20x5 two-dimensional array mark which has its base address = 1000 and the size of an element = 2. Compute the address of the element, marks[18][ 4] assuming that the elements are stored in row major order. 2 K3 CO1
12. Design a music playlist feature where users can add, remove, and navigate through songs in their playlist. How would you implement the ability to add a song to any position in the playlist using a linked list? 2 K3 CO1
13. Following is a pseudo code of a function that takes a number as an argument, and uses a stack S to do processing. 2 K2 CO2

```
void fun(int n)
{
    Stack S;
    while (n > 0)
    {
        push(&S, n%2);
        n = n/2;
    }
    while (!isEmpty(&S))
        cout<<pop(&S);
}
```

What does the above function do in general?

14. The circular Queue of capacity (n-1) is used in an array of n elements. Assume that insert and deletion functions are performed using REAR and FRONT as the variable index of Array, respectively. Initially, REAR=FORWARD=0. Mention the condition for finding the Queue is full and empty. 2 K3 CO2
15. Define threaded binary tree. 2 K1 CO3
16. Given a binary tree with nodes containing unique integer values, the result of a pre-order traversal is A, B, C and an in-order traversal is C, B, A, reconstruct the tree structure. 2 K3 CO3
17. Is the directed graph below strongly connected? List any two simple paths of a given graph. 2 K3 CO4



18. A telecommunications company wants to connect several cities with the minimum length of cables. How to model this problem using a graph, and which algorithm to find the optimal solution? 2 K3 CO4
19. Match the following: 2 K2 CO5

Part I	Part II
1. To sort set of data that are too large to be loaded entirely into memory	a. Bubble Sort
2. Sort set of cards in our hands.	b. Quick Sort
3. Sorting TV programming channels based on audience viewing time	c. Insertion Sort
4. Ordering sports scores	d. Merge Sort

20. A search algorithm repeatedly divides the array into halves but gives wrong results on unsorted input. Identify the flaw and correct it. 2 K3 CO5
21. In a hash table, if the load factor is 0.75 and the table size is 100, what is the total number of entries currently in the table? 2 K3 CO6
22. A Priority Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements '1' and '7' are inserted into the heap. Find the level-order traversal of the heap after the insertion of new elements. 2 K3 CO6

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

23. a) Consider the two linked lists A and B containing the following data: 11 K3 CO1  
A: 2,5,9,14,15,7,20,17,30  
B: 14,2,9,13,37,8,7,28  
Write a programs to create  
(a) Linked list C that contains only those elements that are common in linked list A and B.  
(b) Linked list D which contains all elements of A as well as B ensuring that there is no repetition of elements.

**OR**

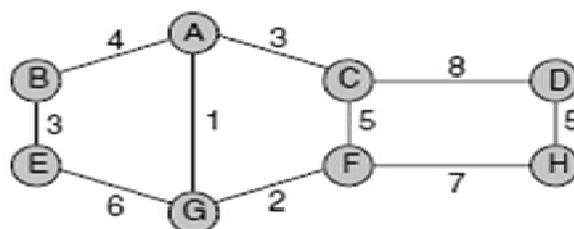
- b) Create a double linked list to manage the student database management in a class with each node containing the following data: (a) Student Name (b) Register Number (c) CGPA (d) Link to the next node. Write algorithms with proper diagrams and visual illustration for Insertion of nodes, search based on Student Name and display the CGPA of all students in a class. 11 K3 CO1
24. a) (i) Draw the circular Queue structure in each case when the following operations are performed on an empty circular Queue (assume the size of the Queue is 6). 6 K3 CO2  
(a) Add A, B, C, D, E, F  
(b) Delete two letters  
(c) Add G  
(d) Add H  
(e) Delete four letters  
(f) Add I  
(ii) Write pseudo code for PUSH() and POP() operations on Stack using Array. 5 K3 CO2

**OR**

- b) Convert the following infix expression to a postfix expression using Stack operations. Give a proper visual illustration of the conversion. Subsequently evaluate the expression using Stack operation by substituting P = 4, Q = 7, R = 3, S = 18, T = 9, U = 20, V = 8.  $(P+Q)*R+(S-T)/U+V$ . 11 K3 CO2
25. a) Demonstrate binary search tree and how does it differ from binary trees? Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty binary search tree. Show the result of deleting the root. 11 K3 CO3  
(i) Find the result of in-order, pre-order and post-order traversals  
(ii) Perform deletion of root node  
(iii) Insert 10, 12, 13 and 9 into the tree.

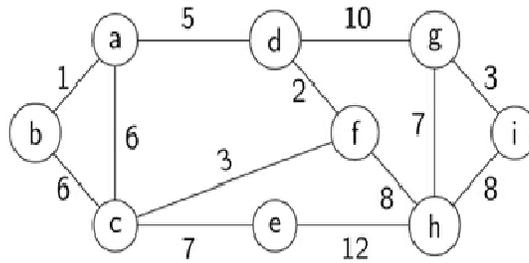
**OR**

- b) Construct an AVL tree for the sequence of insertions: 11 K3 CO3  
30, 10, 20, 40, 50, 25, 35, 45, 60, 55, 70  
Then perform deletions of 40, 25, and 55.  
Show intermediate rotations and final balanced AVL tree.
26. a) Find the minimum spanning tree of the graph using Prim's Algorithm 11 K3 CO4



**OR**

- b) Calculate the shortest distance and shortest path from vertex 'b' to 'i' using Dijkstra's algorithm. 11 K3 CO4



27. a) A hospital's digital system maintains sorted patient IDs for faster retrieval. When doctors query a patient's record, the system uses binary search. However, some new entries are inserted at the end without sorting due to software delay. Trace the binary search process for the following IDs:  
Sorted IDs = [1001, 1010, 1020, 1030, 1040, 1050],  
Query ID = 1040.  
Show how the output changes if an unsorted element (e.g., 999) is appended at the end. Explain why binary search fails in this case and identify how the algorithm's invariant is violated. 11 K3 CO5

**OR**

- b) Write pseudo code and perform a quick sort for the following input: 5, 6, 11, 4, 14, 12, 2, 10, 16, 9. 11 K3 CO5
28. a) Show the max-heap that results from running buildheap on the values 10, 5, 12, 3, 2, 1, 8, 7, 9, 4 stored into an array. Show the heap that result from deleting the maximum value from the max-heap. 11 K3 CO6

**OR**

- b) Discuss the concept of hashing and its importance in data retrieval. Given a hash table of size 10, and the following keys [23, 12, 32, 45, 67, 89, 36, 78, 90], use the modulo operation as a hash function. Perform the following: 11 K3 CO6
- (i) Insert the keys into the hash table using separate chaining to resolve collisions. Show the final structure of the hash table.
  - (ii) Now, use open addressing with linear probing to resolve collisions. Show the final structure of the hash table.
  - (iii) Discuss the pros and cons of separate chaining versus open addressing.