



**ΠΑΜΙΒΙΑ  
UNIVERSITY  
OF SCIENCE AND  
TECHNOLOGY**

**FACULTY OF COMPUTING AND INFORMATICS  
DEPARTMENT OF SOFTWARE ENGINEERING**

<b>QUALIFICATION:</b> BACHELOR OF COMPUTER SCIENCE, BACHELOR OF INFORMATICS	
<b>QUALIFICATION CODE:</b> 07BCMS, 07BAIT	<b>NQF LEVEL:</b> 5
<b>COURSE:</b> DATA STRUCTURES & ALGORITHMS 1	<b>COURSE CODE:</b> DSA521S
<b>DATE:</b> NOVEMBER 2025	<b>SESSION:</b> THEORY
<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 100

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
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<b>INSTRUCTIONS</b>
1. Answer <b>ALL</b> the questions 2. Read all the questions carefully before answering 3. Answers should be written in the space provided in the question paper 4. Number the answers clearly

**THIS QUESTION PAPER CONSISTS OF 11 PAGES**  
(Including this front page)

**PERMISSIBLE MATERIALS**

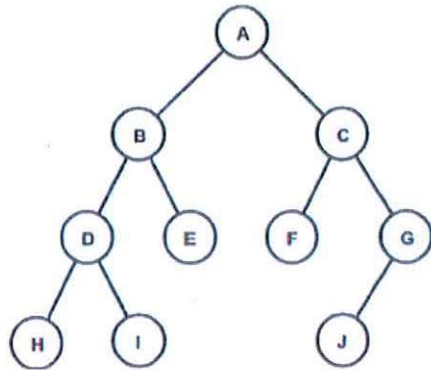
1. NON-PROGRAMMABLE CALCULATOR

**SECTION A: 10 MARKS**

**MULTIPLE CHOICE (Select the letter that corresponds to the correct answer.)**

1. Given a list of elements, 3,12,6,16,9 inserted into a data structure in that order. An element is deleted using a basic data structure operation. If the deleted element is 9, the data structure cannot be a?
  - A. Queue
  - B. Tree
  - C. Graph
  - D. None of the above
  
2. \_\_\_\_\_ is not a component of data structures and algorithms
  - A. Operations
  - B. Storage Structures
  - C. Cloud storage
  - D. None of the above
  
3. Which of the following operations can be performed on a singly-linked list, a doubly-linked list, and a circular list?
  - A. Insertion- adding an element to the list.
  - B. Deletion – removing an element from the list
  - C. Search – seek for an element in a given list
  - D. All of the above
  
4. Which of the following would you use to get the value in the third row and fourth column from a 2D array/matrix called twoDimenArray?
  - A. twoDimenArray[2][3]
  - B. twoDimenArray[3][4]
  - C. twoDimenArray[4][3]
  - D. None of the above
  
5. In Quick Sort, the pivot element is used to:
  - A. Sort the array immediately.
  - B. Partition the array into two sub-arrays.
  - C. Merge the sub-arrays into one sorted array.
  - D. Compare elements to find the maximum.
  
6. Which of the following cannot be used for searching in an unordered array?
  - A. Linear Search
  - B. Binary Search
  - C. Quick Search
  - D. Merge Sort

7. Given the following tree. Give its **inorder traversal** algorithm output.



- A. ABDHIECGFS
  - B. HDIBEAF CJG
  - C. HIDEBFSFCA
  - D. ABDHIECFGS
8. Two vertices in a graph are said to be adjacent vertices (or neighbours) of length \_\_\_\_\_ connecting them.
- A. At least 1
  - B. At least 2
  - C. At least less than 2
  - D. 1
9. If the node to be deleted has \_\_\_\_\_, we delete the node and attach the left subtree to the deleted node.
- A. Only a left subtree
  - B. Only a right subtree
  - C. No children
  - D. One child
10. Which of the following is an approach to traversing a graph?
- A. Binary search
  - B. Sequential search
  - C. Breadth First Search (BFS)
  - D. None of the above

**SECTION B: 10 MARKS**

**TRUE/FALSE (Determine whether the following statements are True or False)**

1. The time complexity of the front variable in the Queue data structure is Big  $O(n)$ .
  - A. True
  - B. False
  
2. A stack is an abstract data type where data is inserted from both ends, provided that the `isEmpty()` function is declared first and checked.
  - A. True
  - B. False
  
3. In a stack, the `pop()` operation removes the element at the bottom of the stack.
  - A. True
  - B. False
  
5. In a linked list, insertion can be done at the End, Middle, but not at the beginning.
  - A. True
  - B. False
  
6. Merge Sort is a divide-and-conquer algorithm that splits an array in half until subarrays contain only one element.
  - A. True
  - B. False
  
7. Binary search can be performed on both sorted and unsorted arrays.
  - A. True
  - B. False
  
8. In a full binary tree, every node has either zero or two children.
  - A. True
  - B. False
  
9. Linear Search returns the index of the target element if found.
  - A. True
  - B. False
  
10. A perfect binary tree has all leaf nodes at different levels.
  - A. True
  - B. False

**SECTION C: 80 MARKS**

**STRUCTURED QUESTIONS**

- Answer all the questions in the space provided.
- This section consists of 4 questions.

**1. Linear Data Structures**

**[25 MARKS]**

1.1. Discuss the difference between a Queue and an Array. (4)

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1.2. Consider the following data elements: DSA, INP, BST, BCMS, DPG, PRG. By way of a diagram, show how the above data can be stored in an array, conceptually. Your diagram must clearly show both the cells and their corresponding cell indices. (6)

1.3. Study the code fragment below and answer the following question.

```
mystery (marks[], size)
  FOR (outerCounter=0 to size-1)
    lowestIndiex= outerCounter

    FOR (innerCounter= outerCounter +1 to size-1)
      IF(marks[innerCounter] < marks[lowestIndiex] )THEN
        lowestIndiex= innerCounter

      ENDIF
    ENDFOR
    marks[outerCounter]= marks[lowestIndiex]
  ENDFOR
ENDmystery()
```

What is the final output of the algorithm if an array, **marks= {45, 75, 62, 18}** is passed to the function **mystery()**? (5)

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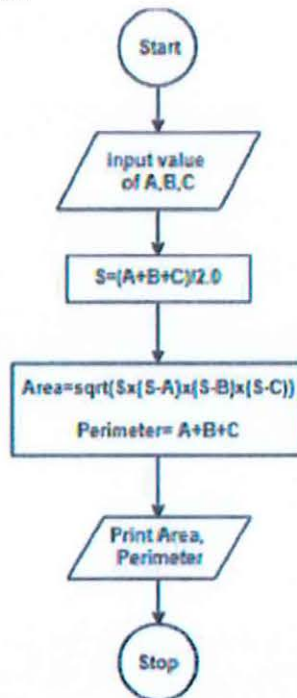
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1.4. Study the flow chart below.



Write a pseudocode corresponding to the Flowchart program (6)

1.5. Consider the function below and fill in the missing code fragments to display the content of a dynamic queue.

```

display()
{
  IF(front == ..... AND rear == ..... ) THEN      (1)
    DISPLAY "empty"
  ELSE
    temp = ..... (1)
    WHILE(temp != null)
      DISPLAY temp ->..... (1)
      temp=temp->next..... (1)
    ENDWHILE
  ENDIF
}

```

**2. Sorting Algorithms**

**[15 Marks]**

2.1. Discuss the differences between selection and insertion sort algorithms. (5)

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2.2. Here is an array that has just been partitioned by the first step of quicksort:

3, 0, 2, 4, 5, 8, 7, 6, 9

Which of these elements could be the pivot? (There may be more than one possibility!) (5)

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2.3. Consider an array of elements arr[5]= {5,4,3,2,1}. Perform the steps of insertion done while doing insertion sort in the array? (5)

**3. Searching Algorithms**

**[20 Marks]**

3.1. What is the difference between Linear Search and Binary and explain in which situations Linear Search is preferred over Binary Search (6)

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3.2. Given the array {6, 8, 17, 20, 23, 27, 37, 51, 57, 73, 89},

i. Write the pseudocode for the Binary Search algorithm to find the key 57. (6)

ii. How many elements will Binary Search need to check to find the key=57? (3)

iii. How many elements will Linear Search need to check to find the key 57? (3)

iv. Discuss what will happen if you binary search the key=38 in the array {20, 57, 6, 37, 73, 89, 23, 51, 17, 8, 27, 73} (2)

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**4. Non-Linear Data Structures**

**[30 Marks]**

4.1. Define the following terms:

4.1.1. Root node (1)

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4.1.2. Leaf node (1)

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4.1.3. Edge (1)

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4.1.4. Path (1)

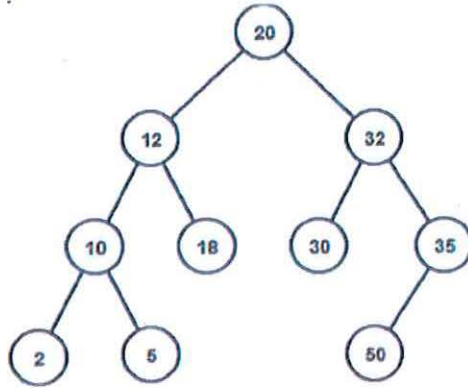
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4.1.5. Level of node (1)

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4.2. Given the following array {20, 30, 60, 100, 90, 50, 130, 210, 160, 110}. Construct a Binary Search Tree (BST) using a **Postorder** traversal. (5)

4.3. Study the BST below:

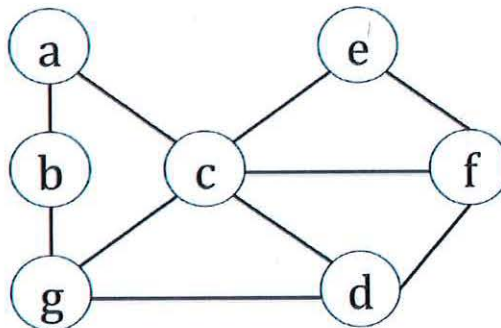


4.3.1. Delete the following nodes: 10, 32, and 50, and draw the new BST (5)

4.3.2. Find the maximum height/level of the BST after the operations in 4.2.1? (2)

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4.4. Consider the graph below, and answer the following questions:



4.4.1. Represent the graph as an adjacency matrix.

(5)

4.4.2. Use Depth-First Search to traverse the graph using a stack data structure, beginning with vertex a, and record the stack and visited vertices at each stage of the traversal.

(8)

\*\*\*\*\* End of the Paper \*\*\*\*\*