

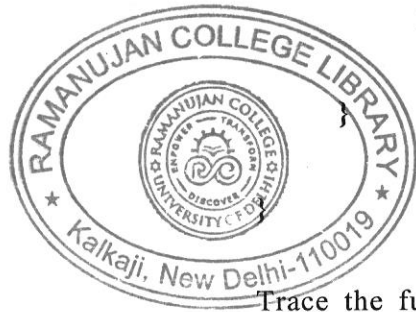
4664

12

**mysteryFunction (n - 1);**

**cout << n << " ";**

**mysteryFunction (n-1);**



Trace the function calls and show the sequence of outputs.

- (c) A stack is implemented using an array with a maximum size of 5. The following operations are performed on the stack in sequence: (5)

**PUSH (10), PUSH (20), POP (), PUSH (30),  
PUSH (40)**

Explain what happens at each step, the final contents of the stack, and how overflow or underflow conditions are handled.

(200)

[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4664**

**J**

Unique Paper Code : 2344002003

Name of the Paper : DATA STRUCTURES USING  
C++

Name of the Course : **GENERIC ELECTIVE  
(COMMON PROGRAM)**

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

**Instructions for Candidates**

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt **any 4 (four)** questions from **Section B**.
4. All parts of a question must be answered together.

P.T.O.

## SECTION - A

1. (a) Find the asymptotic notation (Big O) for the following nested loop: (3)

```
for (int i = 0; i < n; i++) {
    for (int j = 0; j < n; j++) {
        int x=5;
    }
}
```

- (b) Write a function in C++ for inserting an element at the beginning of a singly linked list. (3)

- (c) Evaluate the following expression using stacks: (3)

$$5+2* (3-4+2/3) *4+2$$

Show stack after each step.

- (d) Consider the following array: (3)

- (b) Construct a min-heap from the array: [10, 20, 15, 30, 40] and show heap at each step. (5)

7. (a) Consider the following array of student scores in descending order of registration: [90, 70, 50, 80, 60, 85]

Applying the insertion sort method, execute the sorting process to sort the scores in ascending order. (5)

- (b) Given the following recursive function, determine the output when the input is  $n = 3$ . (5)

```
#include <iostream>
```

```
using namespace std;
```

```
void mysteryFunction (int n) {
```

```
    if (n > 0) {
```

- (c) Write a program to merge two sorted arrays (or lists) into a single sorted list. (5)

**Input:**

List 1: 1, 3, 5

List 2: 2, 4, 6

6. (a) A hash table of size 10 is implemented using open addressing with linear probing for collision resolution. The hash function used is: (10)

$$h(k) = k \bmod 10$$

Insert the following keys into the hash table in the given order:

22, 42, 32, 52, 62

Show the status of the hash table after all insertions. Indicate each step clearly and explain how collisions are handled using linear probing.

$A = [5, 12, 18, 23, 31, 42, 56, 64, 77, 89]$

Search for 33 using binary search on the array show each step clearly.

- (e) An integer array  $A[4][5]$  is stored in **row-major order**. The **base address** of the array is 2000 and every element takes 4 bytes of memory. Find the address of element  $A[2][3]$ . (3)

- (f) Consider the following sequence of elements: (3)

40, 20, 60, 10, 30, 50, 70

Construct a **Binary Search Tree (BST)** by inserting the elements one at a time. Draw the tree **after each insertion** to show its construction step by step.

- (g) Write a recursive function to calculate factorial of a number. (3)
- (h) What will be the output of the following code in C++? (3)

```
#include <iostream>
```

```
#include <stack>
```

```
using namespace std;
```

```
int main() {
```

```
    stack<int> s;
```

```
    s.push(10);
```

```
    s.push (20);
```

```
    s.push (30);
```

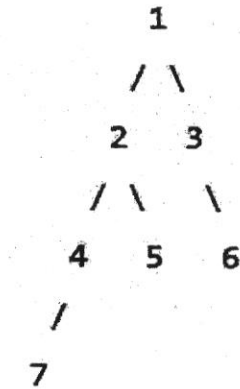
```
    cout << s.top() << endl;
```

```
    s.pop();
```

```
    cout << s.top() << endl;
```

```
    return 0;
```

```
}
```



Perform the following tree traversals and write down the order of nodes visited for each:

(i) In-order Traversal

(ii) Pre-order Traversal

(iii) Post-order Traversal

(b) Delete node 2 in the above tree and show the resultant tree after deletion. (4)

(i) Describe how **BFS** would assist in identifying the shortest path from the beginning room (root node) to the target room (leaf node) within the maze.

(ii) Describe how **DFS** can be utilized to traverse the maze and obtain a path to the destination room.

(b) Consider the following traversals of a binary tree: (5)

• **Preorder traversal:** 10, 5, 1, 7, 40, 50

• **Inorder traversal:** 1, 5, 7, 10, 40, 50

Construct the Binary Tree using the above traversals.

5. (a) Consider the following tree: (6)

(i) Mansi has a list of recipe names stored in her cooking app. When she wants to find a recipe by checking each name one by one, she uses a basic method that doesn't need the list to be in any order. But when she sorts the list alphabetically and then looks for a specific recipe by skipping over large sections, she uses a faster method. What are the names of these two search methods, and which one is faster for large lists? (3)

(i) Convert the following infix expression to postfix:  
(A + B)\* (C-D) (3)

### Section B

2. (a) Perform the following operations on an Array: (10)

(i) **Insert the elements:** 10, 20, 30, 40, 50.

(ii) **Delete the element 30 from the list.**

(iii) **Display the current list of elements after the insertions and deletions.**

Perform the same operations as above on **linked list** (consider inserting the nodes from the end).

After performing the operations on both the array and the linked list, **compare** the time complexity of insertions, deletions, and access in both the array and linked list.

- (b) Consider the following circular queue with a capacity of 6: (5)

**Front [2, 4, 6, 8, Empty, Empty] Rear**

Perform the following operations:

- (i) Enqueue 10 into the queue.
- (ii) Enqueue 12 into the queue.
- (iii) Dequeue an element.
- (iv) Enqueue 14 into the queue.
- (v) Dequeue an element.

3. (a) Define AVL Trees. What is the balance factor of a node in an AVL tree, and how is it used to keep the tree balanced? (10)

Insert the following sequence of keys into an initially empty AVL tree:

**30, 20, 40, 10, 25, 22**

Draw the AVL tree after each insertion, clearly indicating any rotations executed to preserve the AVL property.

- (b) Consider the following sequence of integers:

(5)

A = 4, 2, 2, 8, 3, 3, 1

Perform Counting Sort on the array.

4. (a) Develop a navigation scheme for a maze, modelled as a binary tree. Each of the tree nodes is associated with a room, and edges form potential routes among rooms. The goal is to find the shortest way to cover the maze. (10)

P.T.O.