[This question paper contains 8 printed pages.]

Your Roll No.....

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Sr. No. of Question Paper : 5831

Unique Paper Code : 2344002003

Name of the Paper : Data Structures using C++

Name of the Course : GE (NEP-UGCF2022)

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 **Four** Questions from **Section B**.
4. Due credit will be given for proper indentation and documentation of code.

P.T.O.

Section – A

1. (a) Letf(n) and g (n) be asymptotically positive functions. Prove or Disprove each of the following :

(i) $f(n) = 0(g(n>)$ implies $g(n) = 0(f(n))$.

(ii) $f(n) + g(n) = \Theta$ (min $(f(n) + g(n))$. (6)

(b) What are the conditions used to determine the overflow and underflow of a queue? How are these conditions handled in case of circular queue? (4)

(c) Consider the following code segment : (4)

```
for i <- 2 to m–1
    {
        for j <- 3 to i
            {
                sum <- sum + A[i][j]
            }
    }
```

Calculate the total computation time for the above code segment.

(d) Solve the following recurrence relation using Master's Theorem : (4)

$$T(n) = 3T(n/2)+n$$

(e) Write a formula f(n) to find the maximum and minimum number of nodes possible in a binary tree of height n. (4)

(f) Define a class Single_LL having info and address as members of the class. Create an array xyz using the inf o elements of Single_LL. (4)

(g) Compute the value of Postfix expression :

8 3 4 + – 3 8 2 / + * 2 ^ 3 +

Show the content of the stack after every step.

(4)

Section – B

(Attempt any **four***)*

2. (a) Consider the following circular queue capable of accommodating maximum six elements: The structure of a queue having three elements is shown below : (8)

Front = 2, Rear = 4

Queue: -- , -- , L, M, N, --

Index : 0 , 1 , 2, 3, 4, 5

Give the updated structure of the circular queue (as shown above) after each of the following operations :

(i) Add 0

(ii) Add P

(iii) Delete two elements

(iv) Add Q, R, S

(v) Delete three elements

(b) Construct a Binary Search Tree for the following keys in the given order. (7)

75 70 44 48 98 108 91 145

3. (a) Use array implementation to write the following Stack operations in C++ :

(i) PUSH

(ii) POP (8)

(b) Sort the following array using insertion sort:

A = {2, 13, 5, 18, 14}

Show the status of array after each iteration. (7)

4. (a) Write a C++ function to solve the Tower of Hanoi problem using recursion. The function should accept the number of disks as input parameters, and display the steps to solve the problem. (10)

(b) Write a function in C++ to remove duplicates from a sorted array. (5)

5. (a) Solve the following recurrence relations to find complexity value of T(n).

(i) $T(n) = T(n-1) + 3$ and $T(1)=1$ Using substitution method

(ii) $T(n) = 3T(n/2) + cn$ and $T(1)=c$ Using Recurrence tree method (8)

(b) For a binary tree T, the POSTORDER and INORDER traversal sequences are as follows :

INORDER – O, N, M, P, L, Q, A

POSTORDER – O, M, N, P, A, L, Q

(i) Construct a Binary Tree.

(ii) What is its pre-order traversal sequence? (7)

6. (a) Consider the following program given below : (9)

(i)
```
int f(int *p, int n)
    {
        if (n <= 1) return 0;
            else return max(f(p+1,n-1),p[0]-p[1]);
    }
int main( )
    {
        int a[] = {3, 5, 2, 6, 4} ;
            cout << " %d ", f(a, 5)) ;
    }
```

Note: max(x, y) returns the maximum of x and y. What is the output of the program?

(ii)
```
void fun1(int n)
    {
      int i = 0;
        if (n > 1)
            fun1(n – 1);
                for (i = 0; i < n; i++)
                    cout << " * ";
    }
```

Determine the number of times the star will be printed.

(b) How a binary heap is different from the binary search tree. Explain with the suitable example. (6)