7. (a) What do you understand by the Recursion-tree method for solving recurrences. Draw a Recursion tree for the recurrence $T(n)=T\left(\frac{n}{3}\right)+T\left(\frac{2n}{3}\right)+cn$. (6)

(b) Explain Master's theorem for solving recurrences giving a suitable example. (5)

(c) Write a C++ program to insert an element at the front of a singly linked list. (4)

[This question paper contains 8 printed pages.]

26 JUL 2023 **Your Roll No.....**

Sr. No. of Question Paper : 1263

Unique Paper Code : 2342571201

Name of the Paper : Data Structures

Name of the Course : **B.Sc. (Programme) and B.A. (Programme)**

Year of Admission : 2019 & onwards

Semester : II

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. Parts of the question must be answered together.

SECTION A

1. (a) Perform the insertion sort on the array {8,2,1,9,3}, show the steps after each iteration. Also, report the number of comparisons. (4)

(b) Explain the properties of a binary heap. How is it different from a binary search tree. (4)

(c) Differentiate between the following : (4)

(i) Arrays and Linked list

(ii) Queue and Priority queue

(c) Consider a function f() to compute Fibonacci numbers as defined below : (4)

f()

0 if n=0

1 if n=1

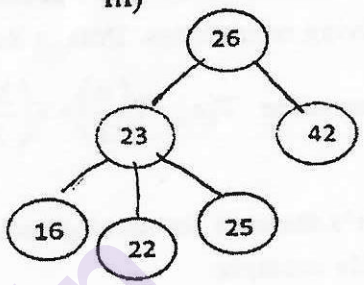
Fib(n)

Fib(n-1)+Fib(n-2) if n>=2

How many times will f() be called when n=4 ?

(d) Draw a binary search tree using the following key values; 16, 7, 23, 22, 14, 15 (4)

iii)



(b) Consider the following sequence of operations performed on a stack of size 5. Show the contents of the stack after each operation. (5)

push (10),

push (5),

pop (),

push (2),

push (16),

push (12)

push (22)

push (6)

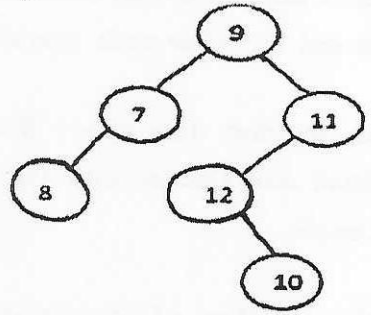
pop ()

(c) Write a C++ program to sum 'n' number of elements of an array using a recursive function. (4)

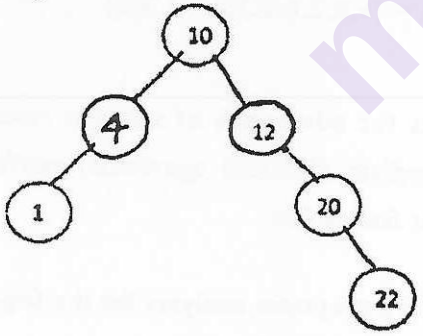
(c) Write any two real-life applications each of stack and queue. (4)

6. (a) For each of the following trees, specify whether it is a binary search tree or not. Give reasons for your answers. (6)

i)



ii)



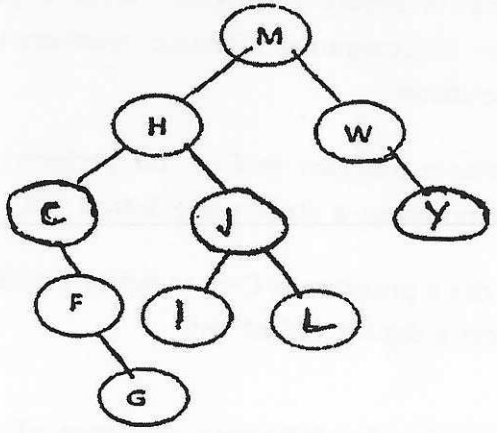
(e) What are the different operations that can be performed on a Dequeue. Explain using an example. (4)

(f) What are height-balanced trees? Explain using suitable example. (3)

(g) 'Stacks play a role in the implementation of recursion'. Justify the statement using a suitable example. (3)

SECTION B

2. Consider the following Binary Search Tree. (15)



Show the status of the tree after each of the following operations :

(i) Draw the tree after insertion of node with value 'K'.

(ii) Delete node with value 'H' from the resultant tree.

(iii) Write the pr-order traversal of the resultant tree.

(iv) Is the resultant tree a height-balanced tree? Give justification for your answer.

(v) Finally, delete the node with value 'M' from the resultant tree.

3. (a) What is Binary Recursion? Write a program in C++ for computing Fibonacci numbers via Binary Recursion. (6)

(b) Write a program in C++ for performing a push operation on a stack using linked list. (5)

(c) Write a program in C++ to delete a given element from a doubly linked list. (4)

4. (a) Consider the following sequence of operations performed on an initially empty doubly linked list : (6)

InsertBeginning(10),

InsertBeginning(5),

InsertEnd(7),

InsertEnd(2),

DeleteBeginning(),

Deletenode(2)

Show the contents of the list, links between the nodes, head and tail after each operation.

(b) What is an abstract data type? Differentiate between Stack and Queue with the help of a suitable example. (4)

(c) Illustrate the operation of counting-sort on the array A = {6,0,2,0,1,3,4,6,1,3,2} (5)

5. (a) What is the advantage of using a circular linked list? Explain different operations performed on a circular linked list. (6)

(b) Give the asymptotic analysis for the Big-O notation using a suitable example. (5)

P.T.O.