[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4935 **H**

Unique Paper Code : 2342571201

Name of the Paper : Data Structures

Name of the Course : **B.A. (Prog) / B.Sc. (Programme) NEP**

Year of Admission : 2022

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) Sort an array of elements A = {13,12,14,6,7} using insertion sort. Write the elements of the array after each step. How many comparisons will be needed to sort the array. (4)

P.T.O.

(b) Solve the recurrence given $T(n) = 3T(n/2)+n^2$ using the masters method. (4)

(c) List two differences between each of the following :–

(i) Array and Linked List

(ii) Stack and Queue (4)

(d) Identify and write the name of the Data Structures suitable for the following applications (4)

Application 1: Storing high score entries for a game

Application 2: Undo/Redo Functionality in text editors

Application 3: To manage traffic flow in the transportation systems

Application 4: To find a specific element in a sorted collection of elements

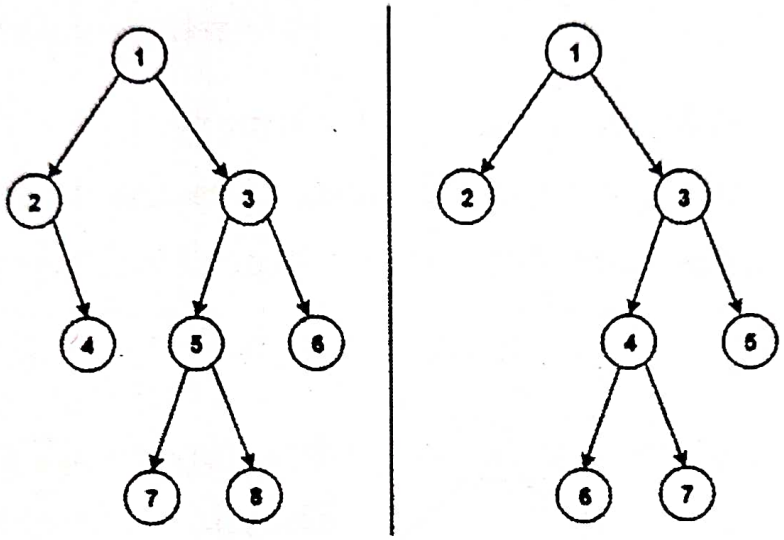
(e) In the array implementation of a circular queue how are front and rear indices modified upon insertion and deletion of an element. Write the conditions for the following :

(i) Full Queue

(ii) Empty Queue (4)

(f) What is an abstract data type (ADT)? Give two advantages of using ADT in data structure? (4)

(g) What is a height balanced tree? Are the following binary trees height balanced trees? Justify your answer. (4)



(i) (ii)

(h) Give two advantages of a doubly linked list over a singly linked list. (2)

Section B

2. (a) Write a C++ program to create a singly linked list of integers. Write functions to insert and delete an element from the front of the list. (6)

(b) Consider an initially empty doubly linked list. Show the updated doubly linked list after each operation. (5)

Insert AtStart(30)

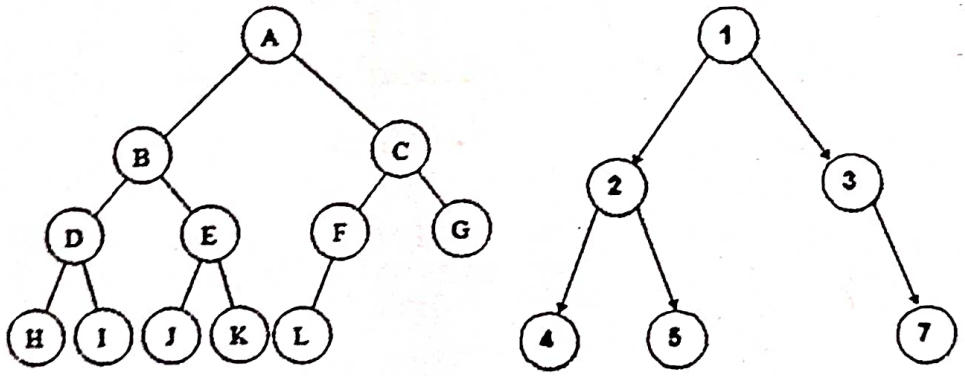
InsertAtStart(18)

Delete(33)

InsertAtEnd(8)

DeleteAtStart()

(c) What is a complete binary tree? Consider the following binary trees. Are the following binary trees complete binary trees? Justify your answer. (4)



(i) (ii)

3. (a) Sort the given array A={7,1,2,0,2,3,4,5,1,6,3} using counting sort. Show the array contents after each step. (6)

(b) Write a recursive program in C++ to calculate x^n, taking x and n input from the user. (5)

(c) Give two differences between static arrays and dynamic arrays. Write the syntax of declaring a dynamic array in C++. (4)

4. (a) Consider a queue with a maximum size of 6 elements. Currently the queue has three elements A,D and F with Front=2 Rear=4 as shown in figure.

figure: Queue

Write the output and status of queue after each of the following operation :

(i) enqueue(L)

(ii) enqueue(K)

(iii) dequeue()

(iv) front()

(v) enqueue(X)

(vi) size() (6)

(b) Write a C++ program to implement a stack using linked list. Give necessary declarations for the stack. Write functions for push and pop operations. (5)

(c) List two real life applications of a priority queue. What are the two types of priority queues? (4)

5. (a) Construct a binary search tree with the following numbers.

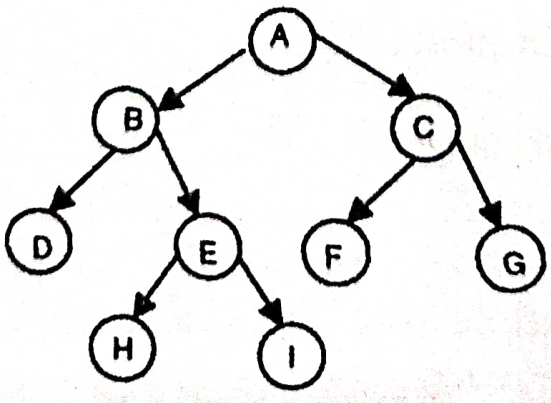
51, 14, 61, 5, 20, 57, 90, 3, 7, 35, 60, 25

Write the steps required to delete the root node from the binary search tree. Show the resultant tree. (6)

(b) Write two properties of a heap data structure. Differentiate between min heap and max heap. Give two applications of the heap data structure. (5)

(c) Prove that running time $T(n) = n^3 + 20n + 1$ is $O(n^3)$. What would be the value of c and n_o? (4)

6. (a) Write the preorder, inorder and post order tree traversal of the following binary tree. (6)



Binary Tree

(b) Let us consider the following series of operations on an initially empty double

ended Queue(Deque).

insertFront(13)

insertFront(15)

front()

eraseFront()

eraseFront()

size()

Write the output and contents of the deque after each operation. (5)

(c) What will be the time complexity of delete operation (dequeue()) of a linear queue, when the queue is implemented using

(i) stack

(ii) array

Give justifications for your answer. (4)

7. (a) Consider the given series of operations to be performed on an initially empty stack of size 5 :

push(9)

Pop()

Pop()

push(7)

push(12)

empty()

Show the output and stack contents after each stack operation. (6)

(b) What is the advantage of using a circular linked list over a singly linked list? Enumerate four different operations that can be performed on a circular linked list. (5)

(c) Write and explain the time complexity of performing the following operations on one dimensional array.

(i) Deleting an element at a given index

(ii) Searching an element in an array of n elements (4)