

[This question paper contains 8 printed pages.]

Your Roll No.....

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Sr. No. of Question Paper : 4955

Unique Paper Code : 2342571201

Name of the Paper : Data Structures

Name of the Course : B.Sc. (P) / B.A. (P)

Year of Admission : 2022 & 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) Can you perform a binary search on the following list : (3)

2, 4, 1, 9, 3, 7

If not give reasons and modify this list so that binary search can be performed.

- (b) State true or false for the following statements and justify your answer: (3)

(i) Nodes of a binary tree may have 0 or 1 or 2 children.

(ii) Stacks use the FIFO access method.

(iii) A doubly linked list uses more memory than a singly linked list.

- (c) Considering root of the Binary tree at level 1, what is the maximum number of nodes : (3)

(i) In a Binary tree of height 4

(ii) At level 3

(iii) At lowest level

(d) What is a recursive function? Under which situations is it desirable to use a recursive function? (3)

(e) Why overflow error does not occur in a linked list? (3)

(f) What is the difference between one-dimensional and two-dimensional array? Give one example with code declaration of each. (3)

(g) Write the steps when binary search is applied on the following list to find 16: (3)

2 4 6 8 10 12 14

(h) List any three primitive operations considered in complexity analysis of algorithms. (3)

(i) Apply insertion sort for sorting the following data in ascending order. Show the outcome after each pass : (3)

9 7 11 85

SECTION B

2. (a) Write a program in C++ to implement multiplication of two matrices of order $n \times n$ taking input from the user. Show the output row-wise. (5)

(b) Consider the following sequence of operations performed on an initially empty doubly-linked list, where `addtohead()`, `addtotail()` and `deletefromhead()` are user defined functions to add a node to the front, add a node to the tail and delete a node from the front respectively :

(i) `addtohead (25)`

(ii) `addtohead (28)`

(iii) `addtotail (23)`

(iv) `addtotail (20)`

(v) `deletefromhead ()`

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

(5)

- (c) Create a binary tree whose following traversals are given: (5)

Inorder : x y z a p q r

Preorder : a y x z q p r

3. (a) Write a function in C++ to count the number of elements in a linked list. (5)

- (b) Create a Binary Search Tree using the following values : (5)

12, 45, 13, 67, 10, 34.

Using the above tree perform the following operations :

(i) Delete 12

(ii) Insert 8

Show the tree after each operation.

- (c) What will be the output after performing the following operations on an initially 5 empty stack of size 5. Show the contents of the stack after each operation:

push(10)

push(20)

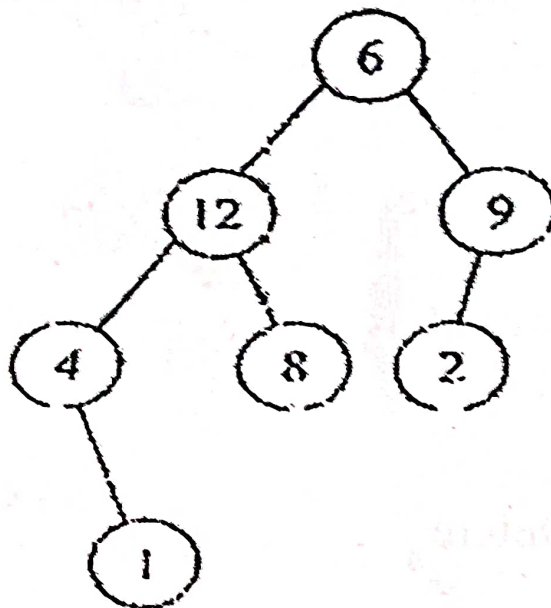
pop()

pop()

isempty()

(5)

4. (a) Traverse the following binary tree in preorder and inorder: (5)



- (b) Is the above tree in Q4(a) (5)

(i) A complete binary tree

(ii) Find the siblings of node 8

(iii) What is the height of the above binary tree

(iv) What is the degree of node 4

(v) What is the value of the root node

- (c) Give the Depth First Traversal of the tree in Q4a. (5)
5. (a) Write a recursive function in C++ to reverse an array of integers. Array size and elements must be taken as input from the user. (5)
- (b) What are the properties of stack data structure? Show how stacks are used to add two numbers a and b. (5)
- (c) Differentiate between a queue and a priority queue. Give one application of a priority queue. (5)
6. (a) What is a deque? How is it different from a queue? List all the operations that can be performed on a deque. (5)
- (b) What are the limitations of a queue when implemented as a linear array? Give an example to illustrate. How can this error be avoided? (5)
- (c) State true or false giving reasons to justify your answer :
- (i) Elements of an array can be of different data types.

- (ii) The time complexity of Insertion sort is $O(n \log n)$.
- (iii) An algorithm of complexity $O(n \log n)$ is faster than one with complexity $O(n^2)$.
- (iv) Master method can solve all recurrence relation.
- (v) A recursive method is always more efficient than an iterative method. (5)

7. (a) Write a program in C++ to implement insertion sort on an array of n elements. Take n and array elements as input from the user. (5)

(b) What is a recurrence relation? What is its significance in complexity analysis? Use recurrence tree method to solve the following recurrence relation :

$$T(n) = T(n-1) + n \quad (5)$$

(c) Use master's method to solve following recurrence relation :

$$T(n) = 3T(n/4) + n \log n \quad (5)$$