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question paper contains 8 printed pages.]

Your Roll No.....

o. of Question Paper : 1411 F

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.

P.T.O.

SECTION A

1. (a) How a binary heap is different from a binary search tree. Explain with a suitable example. (4)

(b) What is the difference between Big-O and Big-Theta notation? Explain. (4)

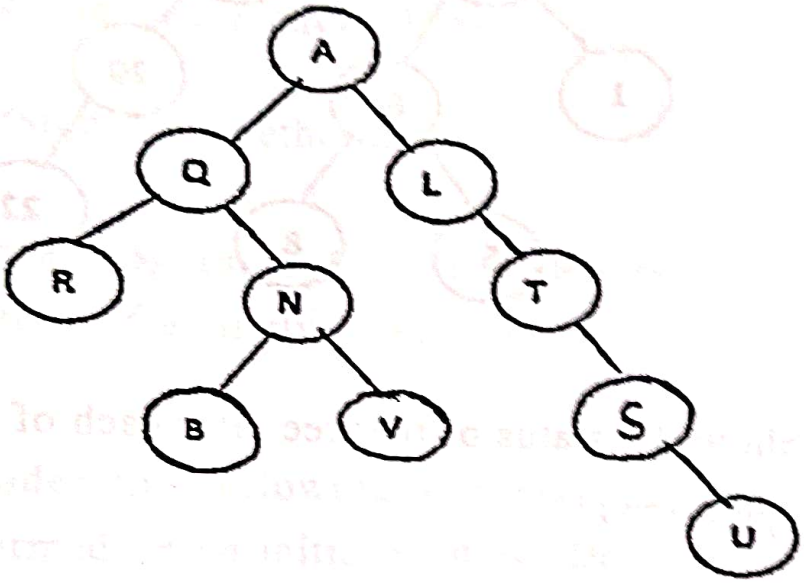
(c) When do we use Stack Data structure? Write a program in C++ for 'push' operation in array implementation of stack. Also discuss the stack overflow condition. (4)

(d) Write a program in C++ to compute the sum of first n natural numbers using recursion. (4)

(e) Create a binary search tree using the following key values;

12, 8, 23, 9, 14, 15 (4)

(f) Give the Breadth-First Traversal of the binary tree given below : (4)

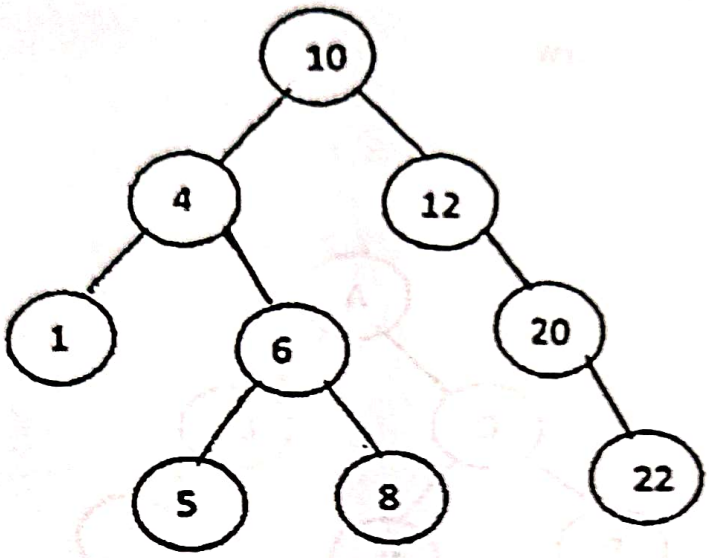


(g) What are height-balanced trees? Explain with the help of a suitable example. (3)

(h) Discuss the role of stacks in the implementation of recursion with the help of 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 11.

(ii) Delete node with value 10 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 4 from the resultant tree.

3. (a) Write a program in C++ to compute the factorial of a number with and without using recursion. (6)

(b) Solve the recurrence $T(n)=3T\left(\frac{n}{4}\right)+cn^2$ using Recursion-tree method. (5)

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

4. (a) Consider the following sequence of operations performed on an initially empty Deque :

InsertFront(10),

InsertFront(5),

EraseFront(),

InsertBack(7),

Front(),

EraseBack()

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

(b) Write a program in C++ for computing Fibonacci numbers via Binary Recursion. (5)

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

5. (a) Consider the functions given below, sort the functions in increasing order of asymptotic (big-O) complexity : (6)

$$f_1(n) = n^{0.999999} \log n$$

$$f_2(n) = 10000000\ n$$

$$f_3(n) = 1.000001^n$$

$$f_4(n) = 2^{1000000n}$$

$$f_5(n) = n\sqrt{n}$$

$$f_6(n) = n(n-1)/2$$

(b) Write a program in C++ for performing an enqueue operation for an array-based queue implementation. (5)

(c) Write a program in C++ to search for an element in a doubly linked list and delete it if found. (4)

6. (a) Explain how Master's theorem can be used for solving recurrences giving suitable example. (6)

(b) Compare and contrast priority queue and dequeue. Also, give one real-life application of priority queue. (5)

(c) Write a program in C++ to reverse a given array using recursion. (4)

7. (a) What is a circular linked list? How a circular linked list is different from a doubly linked list. Discuss different operations performed on a circular linked list. (6)

(b) Perform the insertion sort on the array {7,1,10,6,3}, show the steps after each iteration. Also, report the number of comparisons. (5)

(c) Explain any two Abstract Data Types. (4)