National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Data Structures	Course Code:	CS2001
Degree Program:	BS (CS, SE, DS)	Semester:	Fall 2022
Exam Duration:	60 Minutes	Total Marks:	20
Paper Date:	12-Nov-2022	Weight	15
Section:	ALL	Page(s):	5
Exam Type:	Midterm-II		

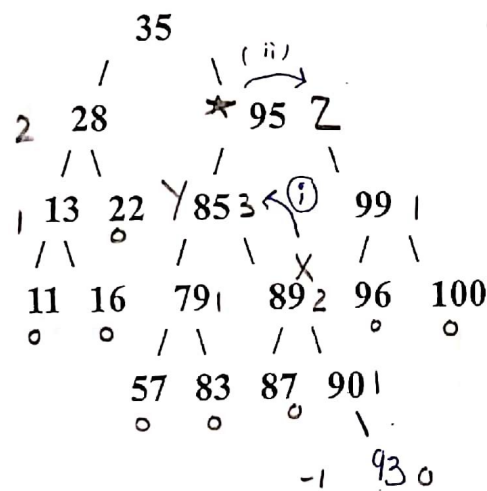Student: Name: _____ Roll No. _____ - _____ Section. � _

Instruction/Notes: Attempt all questions. Answer in the space provided. You can ask for rough sheets but will not be attached with this exam. **Answers written on rough sheet will not be marked.** Do not use pencil or red ink to answer the questions. In case of confusion or ambiguity make a reasonable assumption.

$8 + 7 = 15$

Question 1: [CLO: 1, 3]   (Marks: 5+5)

a) Insert the value **93** in the following AVL tree and redraw the tree after rebalancing. You must show all working with the names of imbalance cases, nodes, and rotations performed.
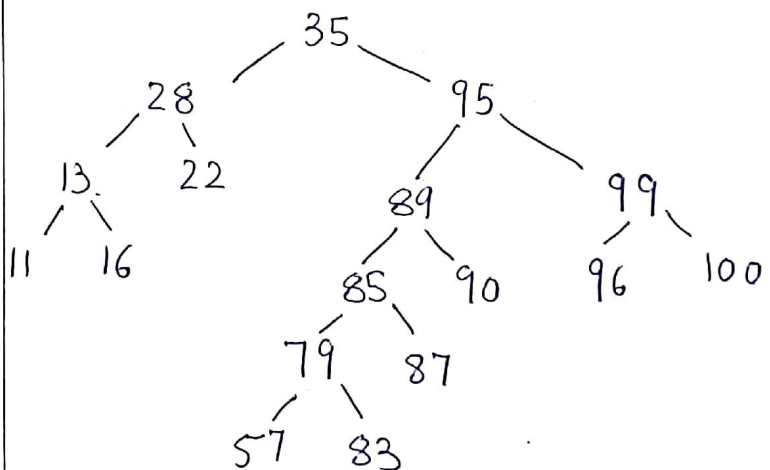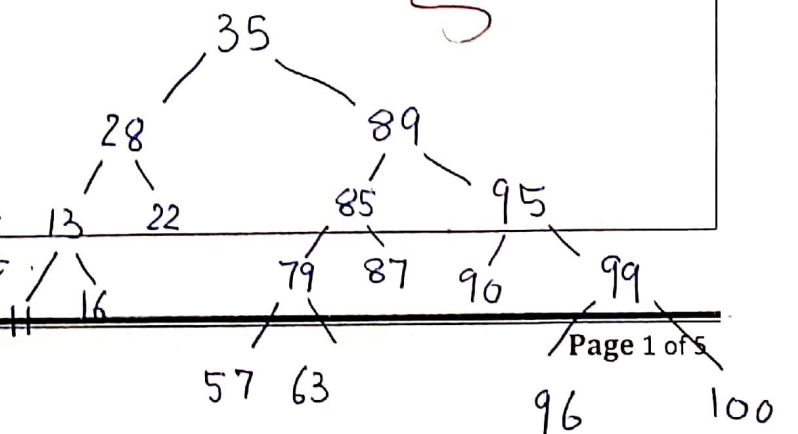

XYZ

```
            35
          /    \ (ii)
      2  28    * 95  Z
        / \    /    \
    1 13 22  Y 85 3  (i)  99  1
      / \   o / \  X  / \
    11 16  79 1 89 2 96 100
    o  o   / \  / \  o   o
         57 83 87 90 1
         o  o  o   \
                  -1  93 0
```

Y
Z

$Z = 95$
$Y = 85$
$X = 89.$

Imbalance Node:	95	
Imbalance Case:	left right case	
Rotations Performed:	i) rotate Y left	
	ii) rotate Z right	

Unbalanced node 95

left right case

left rotate Y = 85

```
              35
           /      \
        28         95
       /  \       /    \
     13   22    89      99
    / \        /  \    /  \
   11  16    85   90  96  100
           /   \
          79   87
         /  \
        57   83
```

right rotate Z

```
             35
          /      \
        28        89
       /  \      /    \
     13   22   85      95
    / \       /  \    /   \
   11  16   79   87  90    99
           /  \       /   \
         57   63     96   100
```

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b) For each of the scenarios given below, suggest the most appropriate data structure chosen from t.
list and give appropriate reason of your choice. LIFO.
(Arrays, linked-list (single, double, circular), Queue, Stack, tree(BST, AVL))

To create an index of important terms in a an electronic book	BST tree . 0 .5
To check whether a given seat number is reserved in a cinema or not	doubly linked list X
To implement play list in repeat mode of a music player	circular linked list . ✓
To implement undo and redo functionality in a text editor	Stack 0.5
To implement token system at bank.	Queue . ✓

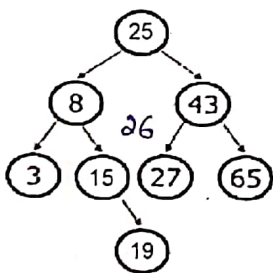## Question 2: [CLO: 3]   (Marks: 10)

Write a **RECURSIVE** C++ function FINDVALUE in an Integer-based AVL tree class that takes a positive integer value as input and find the node with the _smallest integer larger than or equal to_ the given input value. The function returns the node's data value and it must not take more than O(lgn) time.

EXAMPLE	
AVL- Tree	Input is 8, then the value returned is 8 _As 8 is the smallest integer larger than or equal to the given value 8_ Input is 26, then the value returned is 27 _As the integer 26 does not exists and 27 is the smallest integer larger than 26 in the given AVL tree_ Input is 22, then the value returned is 25 _As 22 does not exists and 25 is the smallest integer larger than 22_ Input is 67, then the value returned is -1 _As there is no integer equal to or larger than 67 in the given tree AVL tree_

AVL-Tree (with nodes): 25; 8, 26, 43; 3, 15, 27, 65; 19