DEPARTMENT OF INFORMATION TECHNOLOGY, NITK SURATHKAL

MID-SEMESTER EXAMINATION, NOVEMBER 2022

IT202: DATA STRUCTURES AND ALGORITHMS - I

Class: III SEM B.TECH. (IT) **Time: 2.5 Hr.**
Date: 24/01/2023 **Marks: 50**

Register No. | 2 | 1 | 1 | 0 | 0 | 9 | 3 | |

NOTE: 1. Answer all questions

2. All the subcomponents of the same question should be answered together

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[In case of any doubts in any question, make suitable assumptions, state and justify them, and proceed; no algorithms/pseudo code/programming is required for any question]

1. An initial array is given as: 6, 1, 4, 3, 2, 2.
Demonstrate the ***insertion sort*** and the ***counting sort*** algorithms and show all the intermediate steps in the following formats.
For ***insertion sort***, in case of swap between the elements, write the swapping indices as (index X, index Y), e.g., (5, 6), else write ×.
For ***counting sort***, show the initialization of the input, output and temporary storage arrays, their intermediate changes, and final arrays.

Insertion sort:

Initial array:					
6	1	4	3	2	2
0	1	2	3	4	5

Iteration 1 (1 step)						**Any swap?**

Iteration 2 (2 steps)						**Any swap?**

Iteration 3 (3 steps)						**Any swap?**

Iteration 4 (4 steps)						**Any swap?**

Iteration 5 (5 steps)						Any swap?

Counting sort:

Input array A =

6	1	4	3	2	2

Output array B =

Temporary array C =

1	2	3	4	5	6

(5 + 5)

2. (a) Construct a binary search tree (BST) with the following keys. No need to show the intermediate trees, just show one final tree. State your assumptions if any.
   10, 5, 17, 2, 3, 12, 15, 2, 30, 33
   (b) What is an ***AVL tree***? Explain with an example.
   (c) Construct an ***AVL tree*** using the following keys in the given sequence. Show all the intermediate tress and the heights of the vertices:
   7, 21, 6, 22, 5, 25, 2, 28, 1, 26
   (d) What is the *postorder traversal* of the final tree obtained from 2(c)?

(2 + 2 + 5 + 1)

3. Consider an **array-based DEQUE** (no restriction) of size 10 [index: 0 - 9].
   Draw the initially empty array and show the changes in the array-based DEQUE after the following queue operarions. Assume that the *front* and *rear* index positions both are -1 initially. For each step, show the changes of *front* and *rear* index positions in the array.

   insertRear(10), insertRear(30), insertFront(15), insertFront(40), deleteRear(), deleteRear(), deleteRear(), insertFront(50), insertRear(55), deleteFront()

(10 × 1)

4. (a) Construct a B-tree with the following node structure (minimum 1 key, maximum 2 keys) for the following set of key values: 1, 3, 8, 10, 17, 22, 35, 28, 19, 20, 9, 21. Assume that the tree is initially empty and values are inserted in the given order. Show all the intermediate trees.

   (b) After constructing the tree, perform the following operations. Show all the intermediate trees.
   Delete 3
   Delete 17

Delete 8
Delete 22

(6 + 4)

5 (a) The ***inorder*** and ***preorder traversal*** of a tree is given below:
Inorder: DBMINEAFCJGK
Preorder: ABDEIMNCFGJK
Construct the corresponding ***binary tree***.

(b) Evaluate the following *postfix* expression using stack showing all the intermediate steps.
3 5 7 4 – 2 ^ / * +

(5 + 5)

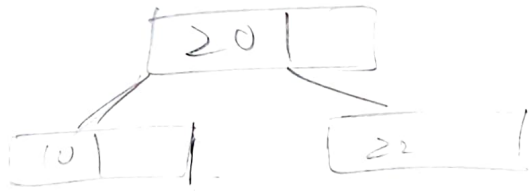
postfix

A B D E I M N C F G J K

3 5 3 2

3 5 1

3 4 5



1, 9, 10, 19, 20, 21, 22, 28, 35