Jaypee University of Engineering & Technology, Guna
T-2 (Even Semester 2022)
18B11CI412 –Algorithms and Problem Solving

Maximum Duration: 1 Hour 30 Minutes   Maximum Marks: 25

Notes:
1. This question paper has 5 questions.
2. Write relevant answers only.
3. Do not write anything on question paper (Except your Er. No.).


Q1. (a) There are sorting algorithms that run faster than $O(n \log n)$ time but they require special **[02]** assumptions about the input sequence to be sort. Name these sorting algorithms and explain the special assumptions about the input sequence to be sort by algorithms.

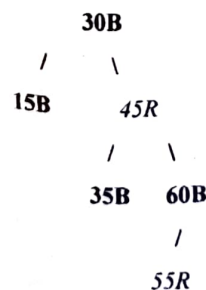**(b)** Illustrate the operation of *COUNTING-SORT* on the array A=[6,0,2,0,1,3,4,6,1,3,2].   **[03]**

Q2. (a) Why can't a Red-Black tree have a black node with exactly one black child and no red **[01]** child?

(b) What is Binary Search Tree (BST)? Construct a BST for the following numbers: **[02]** 47, 55, 23, 17, 39, 11, 50, 9, 19, 74, 33, 28 .Show all the steps.

(c) Given the following BST, show its value after deleting 95.   **[02]**

```
              95
             /   \
           40     113
          / \     / \
        15  42  110 125
         /      \
        41       112
```
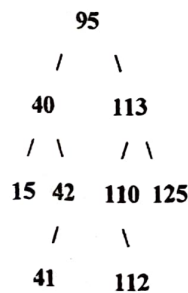
Q3. (a) Show the result of inserting 50 into the Red-Black tree depicted below: (Mark the red **[02]** nodes with an "R" and the black nodes with "B" and show the black nulls at the leaves)
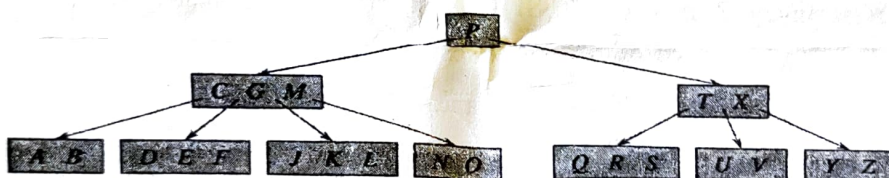
```
              30B
             /   \
           15B    45R
                  /   \
                35B   60B
                       /
                     55R
```

(b) Show the result of inserting 29 into the Red-Black tree depicted below: [03]

```
           25B
          /   \
       18B     34R
              /   \
           30B    36B
           /
         28R
```
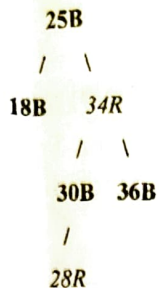
Q4. (a) Draw all instance of B-tree after successively inserting keys **B, Q, L** and **F** into a given B- [02] tree. The minimum degree t for this B-tree is 3, so a node can hold at most 5 keys.

```
              G M P X
        /    /    |    \      \
  A C D E  J K  N O  R S T U V  Y Z
```
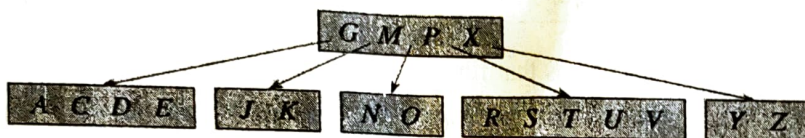
(b) Draw all instance of B-tree after successively deleting keys **L, C, G, E** and **B** from given [03] B-tree. The minimum degree t for this B-tree is 3, so a node can hold at most 5 keys.

```
                      P
            /       |        \
         C G M              T X
       /   |   \   \       /   |   \
   A B  D E F  J K L  N O  Q R S  U V  Y Z
```

Q5. What do you mean by spanning tree of a graph? Find the minimum spanning tree of the [05] following graph using suitable algorithm which grows multiple trees (i.e., a forest) at the same time and trees are merged together using safe edges.

```
           16
     1 ――――――――― 2
    /| 21    11 /|\ 5
   / |        / | \
 19 |      6 |  6  3
   | 33   /   |  |  \ 10
   | /   14   |  |   \
   5 ――――――――― 4
          18
```