Data Structures and Algorithms: End-Term-Examination: May 2018

Total Duration: 150 minutes **Total Marks: 150**

Please Note the following:

1) **Marks are proportional to the time duration; answer ALL questions.**
2) **Make and State Assumptions if required.**
3) **Show the workout in the answer script. Without workout the answer will not be evaluated.**

Q1. Explain each of the following cases of an AVL Tree with an example:
(A) Right-Left-Rotation (B) Left-Right-Rotation **[Marks 7.5 +7.5 = 15]**

Q2. (A) Insert the following Key-values into an AVL tree: **53, 71, 34, 41, 87** Show the Height and Balancing-Factor values at each node **after inserting the Key-value 87**; If AVL property is lost, make the required rotations and redraw the AVL Tree; **[Marks 5]**

(B) Now insert Key-value: **45**; if AVL Tree property is lost, make the required rotations and redraw the AVL Tree; **[Marks 5]**

(C) Now insert Key-value: **77**; if AVL Tree property is lost, make the required rotations and redraw the AVL Tree; **[Marks 10]**

Q3. Insert the following Key-values into a 2-3-Tree:
53, 71, 34, 41, 87, 45, 77 and show the 2-3-Tree **[Marks 5]**
Now add 47, 50, 21 and 37 and show the 2-3-Tree **[Marks 10]**

Q4. Assume that a main program called a function: Quick-Sort (US [], N) where the Unsorted array has the following Key-values: **53, 71, 34, 41, 87, 45, 77, 47;** also assume that Quick-Sort function uses the "**first element**" of the array as the pivot. Now, show the workout of Quick-Sort algorithm till the US array is sorted. **[Marks 20]**

Q5. A scheme for storing binary trees in an array X is as follows. Indexing of X starts at 1 instead of 0. the root is stored at X[1]. For a node stored at X[i], the left child is stored in X[2i] and the right child in X[2i+1]. Use this scheme to store the following values in the binary tree: **55, 33, 88, 99, 11, 44, 66, 22, 77, 110 and also draw the tree.** **[Marks 8]**
1 2 3 4 5 6 7 8 9 10

Q6. The Pre-order and In-order traversal sequence of a binary search tree are as follows:
Preorder: G B Q A C K F P D E R H
Inorder : Q B K C F A G P E D H R
Find the **Postorder** traversal of the generated binary tree using above sequences. **[Marks 12]**

Q7. Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 2020? **[Marks 8]**

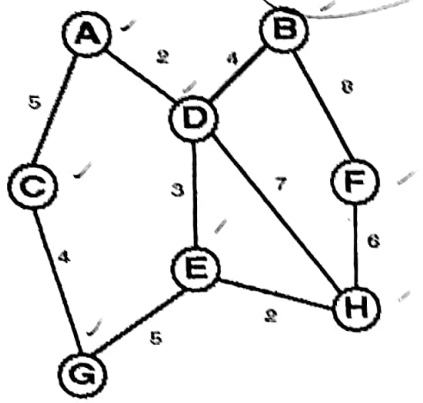
(A) $h(i) = i^2 \bmod 10$
(B) $h(i) = i^3 \bmod 10$
(C) $h(i) = (11 * i^2) \bmod 10$
(D) $h(i) = (12 * i) \bmod 10$

Q8. Given the values **{2341, 4234, 2839, 430, 22, 397, 3920}**, a hash table of **size 7**, and hash function **h(x) = x mod 7**, show the resulting tables after inserting the values in the given order with each of these collision strategies. **[Marks 4X3=12]**

(1) Linear Probing (2) Quadratic probing

(3) Double hashing with second hash function: **h'(x) = (2x - 1)mod 7**

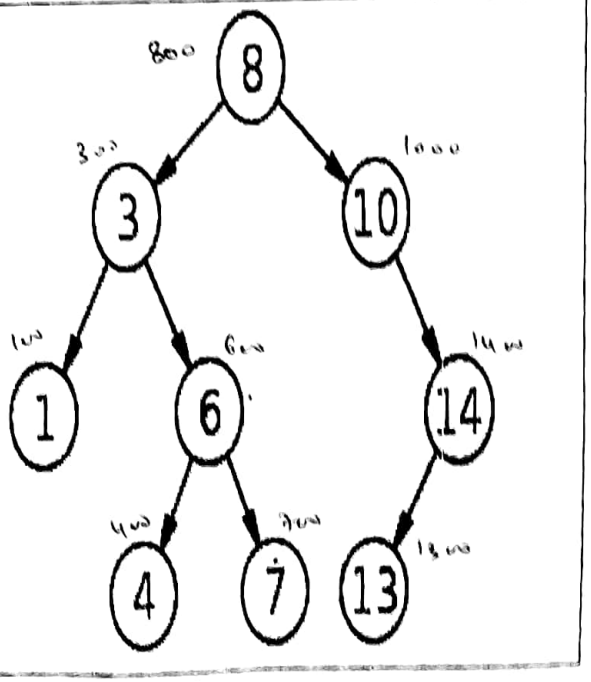
Q9. Write the Adjacency-List and find the possible order of visiting the nodes of the following graph, starting with node **'A' and** using Breadth First Search algorithm. **[Marks 3+7=10]**



Q10. Apply the following algorithm on the given BST in right and find the returned value from this algorithm **[Marks 10]**

```
FindValTree(root)
begin
        left, right, val, rootval : Integer

       IF(root <> NULL) THEN
        begin
              // Get the root value
              rootval = root(data)
              left = findValTree(root(left)
              right = findValTree(root(right)
              IF(left > right) THEN
                        val = left
              ELSE
                        val = right
              IF(rootval> val) THEN
                        val = root_val
         end
    RETURN val
end
```



Q11. Palindromes are the strings that spell the same in the reverse order too. To check whether a string is a palindrome or not, (i) what is the data structure that you will use **[Marks 5]** and (ii) write the algorithm of your solution **[Marks 15]**.