**Dept. of ECE**

**Fall 2018**

**Assignment-1**

**Course: Data Structure and Algorithm (CSE225)**

**Submission Date: 11/12/2018**

A) Consider a B+ tree where n = 4, i.e., the maximum number of keys in a node is 4 and the maximum number of pointers is 5 at internal nodes and 4 at leaf nodes. Assume that the B+ tree initially consists of a single node, which is both the root and the only leaf, that has the key 1.

Question 1. What is the minimum number of keys that may appear in a non-root internal node?

Question 2. What is the minimum number of keys that may appear in a non-root leaf node?

Question 3. Consider the set of keys S = {1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13}. Write down a sequence of inserting the keys of S such that at the end the resulting B+ tree has 3 levels and is as empty as possible, i.e., as many nodes as possible have the minimum number of nodes. Provide the B+ tree snapshots that correspond to the points right after node splits.

Question 4. Consider the set of keys S1 = {1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20}. Write down a sequence of inserting the keys of S1 such that at the end the resulting B+ tree is as full as possible, i.e., as many nodes as possible have the maximum number of nodes. Provide the B+ tree snapshots that correspond to the points right after a node split.

B) Consider the following AVL tree.

Question 1. Show the steps to delete the node with key=30 from the AVL tree.

**v**

h=5

h=4

Question 2. Show the steps to insert **two** nodes with key=6 into the above AVL tree.

Question 3. Prove that one restructure operation is enough to ensure that the whole tree is “balanced” for insertion.

Question 4. Is one restructure operation is enough to ensure that the whole tree is balanced for deletion? Explain

Question 5. If we allow the heights of the children in a binary tree to differ by at most 3, What is the height of the binary tree? Explain

Question 6. What is the time required to do restructure(x)? What is the time required to insert a node into an AVL tree? What is the time required to delete a node into an AVL tree. How many comparisons are required and how many restructure(x) operations are required?