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Indian Institute of Information Technology Lucknow

End-Semester Examination (May 2025)

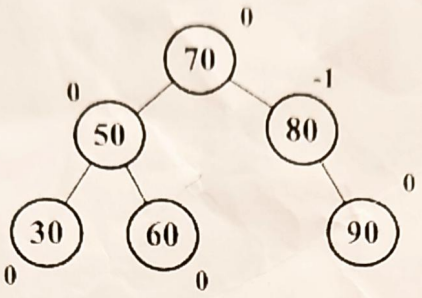
DST2301C - Data Structures

B.Tech. (CS/IT/CSAI/CSB) – 2nd Semester

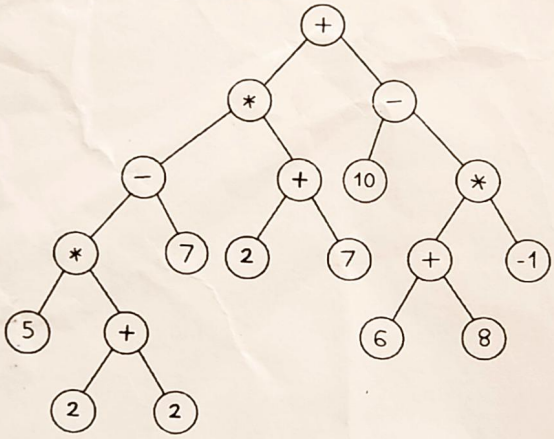
Date of Examination: 27/May/2025 **Max. Marks:** 70

Duration: 3 Hours

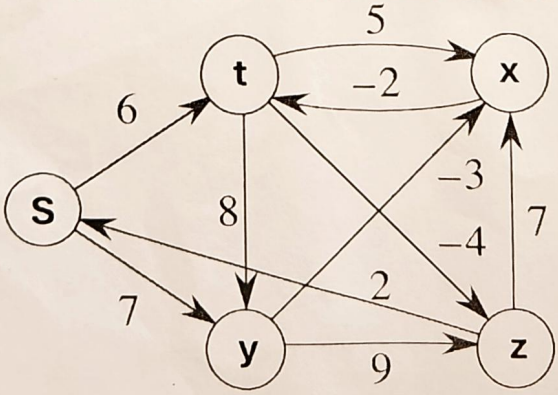
1. Perform the following operations on the AVL tree given below. Ensure that the tree remains AVL after each operation. Demonstrate all the steps clearly with all the necessary details during each operation. Insert(10), Insert(85), Insert(75), Delete(70), Insert(5), Insert(68), Insert(57), Delete(50), Delete(90), Insert(15) [10 Marks]



2. Write the In-order, Pre-order, and Post-order expression of the given binary tree. Evaluate the arithmetic expression, represented by the given binary tree, with the help of stack. [10 Marks]



3. Consider the given weighted directed graph. (i) Apply Bellman-Ford to identify the shortest paths from the source node S to all other nodes. (ii) Apply the Floyd-Warshall algorithm to identify the shortest paths among all pairs. Demonstrate all the intermediate steps in detail for both methods and write the shortest paths along with the cost. [10 Marks]



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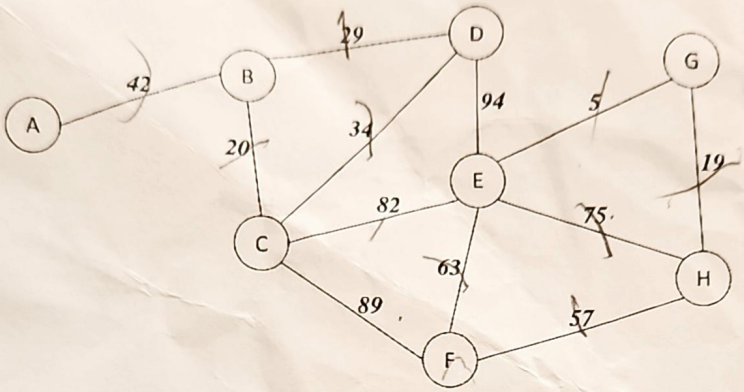
4. Consider inserting the keys 10, 22, 31, 4, 15, 28, 17, 88, 59 into a hash table of length m = 11 using hash function h(k) = k mod m. Illustrate the result of inserting these keys using linear probing, using quadratic probing with $c_1 = 1$ and $c_2 = 3$, and using double hashing with $h_1(k) = k \bmod m$ and $h_2(k) = 1+(k \bmod (m-1))$. [10 Marks]

5. What is the difference between a Binary Search Tree (BST) and AVL Tree. For the given elements, build a BST and AVL Tree, separately. Show all the intermediate steps.
12, 10, 9, 18, 17, 20, 2, 15, 10, 22, 5 [10 Marks]

6. Apply Kruskal's algorithm to create minimum spanning tree (MST) of the following graph. Write all vertices and edges considered in each step. Draw the final MST and the final minimum cost of the MST. Is there only one such tree? If No, find all possible MSTs. [5 Marks]



7. Write the pseudocode for Merge Sort technique and illustrate its functioning with an example. [5 Marks]

8. Consider an unsorted list of 10 numbers: [58, 20, 13, 45, 30, 74, 62, 39, 54, 86]. After two iterations of the Quick Sort algorithm, what will be the position of the element 30? Clearly demonstrate all the steps in each iteration. Always consider the last element of the list/sub-list as the pivot element. [5 Marks]

9. Consider a singly linked list having n nodes. The data items $d_1, d_2, \ldots, d_n$ are stored in the n nodes. Let Y be a pointer to the j^{th} node ($1 <= j <= n$) in which d_j is stored. A new data item d stored in a node with address Y is to be inserted. Give an algorithm to insert d into the list to obtain a list having items $d_1, d_2, d_3, \ldots\ldots, d_{j-1}, d, d_j, \ldots.. d_n$ in that order without using the header. [5 Marks]