J/E/TX

Reg. No: 23BDS0106

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Final Assessment Test – May 2024

Course: **CBS1003 - Data Structures and Algorithms**
Class NBR(s):**3580** Slot: **D1**
Time: **Three Hours** Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. Consider the following pseudocode for selection sort that takes input an unsorted array of element and outputs the sorted array.

```
for (i = 1, i ≤ n − 1; i++)
{
  lowindex = i; lowkey = A[i] → key;
   for (j = i + 1; j ≤ n; j++)
    if (A[j] → key < lowkey)
      {
        lowkey = A[j] → key;
        lowindex = j
      }
    swap (A[i], A[lowindex])
}
```

   i. Determine the total cost function to sort the given input array A and also estimate the time complexity of algorithm in best and worst case. **[6]**

   ii. Evaluate the proof of correctness of selection sort algorithm using loop invariant method. **[4]**

2. Formulate the recurrence relation to determine the complexity of Merge sort algorithm. Use the recursion tree method to solve the recurrence relation and use the substitution method to verify the complexity determined through recursion tree method.

3. Consider a Singly Linked List L. The insertion and deletion operations are defined as follows:

   Insert(L,X): when an element X is inserted, insert X at 4th position from the start node. If there are not enough number of element on the list insert the element at the end of list L.

   Delete(L,N): Delete an element from the beginning if N is even and delete an element from end of L if N is odd.

   Write the pseudocode to implement Insert () and Delete() operations on an empty list L. Use appropriate illustrations to demonstrate these operations.

4. Implement the following function using Queue.

int sumElements(Queue q_t)

The above function takes a queue q_t as a parameter, returns the sum of elements as output. Also, the q_t must be filled with same elements after calculating the sum. For instance, if the queue q_t is having five elements 4, 5, 6, 7, 8, then it should return the sum 30 and, q_t must have the same elements as it is having previously.

Note: You cannot perform the sum without dequeuing the elements. Also, you can use a temporary queue if needed. Also write the necessary routines like enqueuer() and dequeuer() which can be used in this process.

5. Construct a left skewed binary tree using the following data:

99,89,79,69,59,49,39,29,19,9.

Perform the necessary rotations to convert the above binary tree to balanced AVL tree.

6. a) Construct the Max heap using the following data: **[5]**

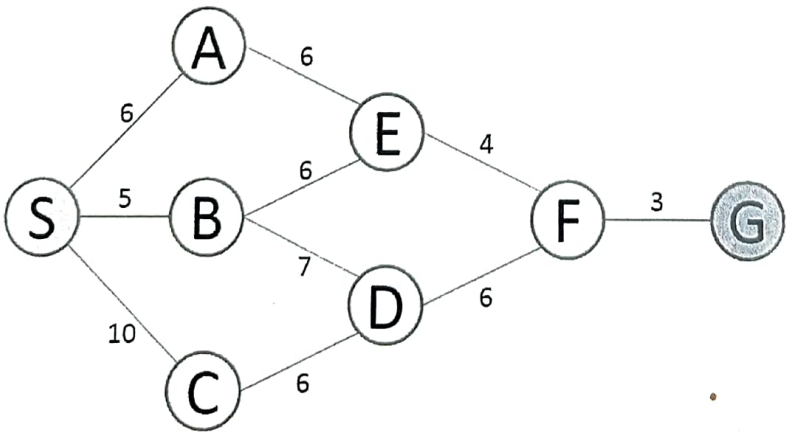
1,2,3,4,5,6,7,8,9,10

b) Devise the algorithm to construct an unique binary tree given the in-order and post-order traversals. Apply the same on the following data to construct the unique binary tree. **[5]**

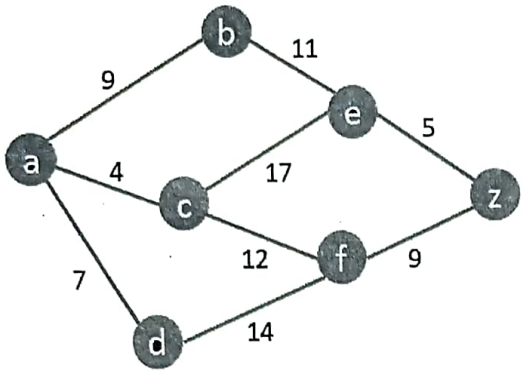
Inorder: P,M,R,A,U,O,D,I,B,O,E,T,N,A,D,N,I,A,I,N

Postorder: P,R,M,U,D,O,A, B,E,O,N,D,N,A,N,I,I,A,T,I

7. Construct the minimum spanning tree for the following undirected graph using Kruskal's algorithm.



8. Consider the following undirected graph.Determine the shortest path between source node 'b' to destination node 'f' using Dijkstra's algorithm.



9. State and describe the divide and conquer strategy based sorting algorithm that chooses the last element as the pivot element to sort the given sequence of elements. Apply the same to sort the following sequence of elements:

30,45,16,28,36,76,87,26,19,6

10. Construct a hash table of size 11 with the following set of keys:
7856, 5476, 3214, 2567, 4321, 3967, 2864, 4357, 8372, 7693, 3214.
The hash function is defined as follows:
   I. For each key Ki, Let Lki consists of first three digits of Ki and Rki consists of last three digits of Ki.
   II.. h(Ki)= (Rki - LKi) mod 11.

Perform the following operations on the hash table:
   I. Visualize the hash table after inserting all the given keys
   II. Determine the number of collisions with h(Ki)
   III. If separate chaining is used for collision resolution, for which index of the hash table may have the maximum chain length,
   IV. Determine the number of collisions, if cubic probing is used for collision resolution.

11. Explain various file organization techniques with suitable illustrations.

12. Write the Insertion Sort algorithm. Sort the following list of data using Insertion Sort technique.
25, 34, 16, 8, 14, 9, 3, 36, 48
Also search for the following keys 34 & 54 on the sorted list as well as unsorted list using Linear and Binary search. Write your observations.

⇔⇔⇔ J/E/TX⇔⇔⇔