



VIT
Vellore Institute of Technology

Vellore Institute of Technology
Approved by the Government of Tamil Nadu, Coimbatore, 1984 (1984-1985)

Final Assessment Test – June 2023

Course: **BCSE202L - Data Structures and Algorithms**

Class NBR(s): **5837/5840/5842/5847/5849/5851/5855/6304/6331**

Slot: **A1+TA1**

Time: **Three Hours**

Max. Marks:

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE

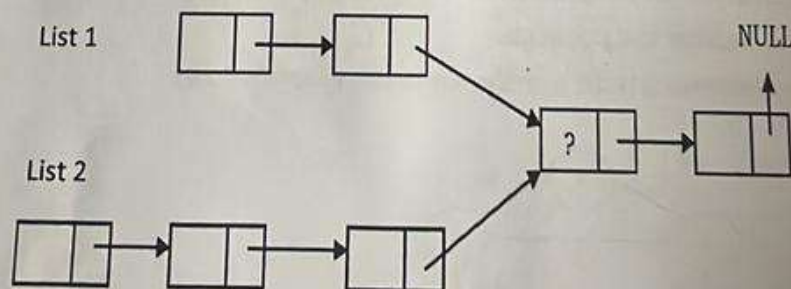
Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) Find the asymptotic complexity for the function $T(n)$ by using Recursive Tree Method, where $T(n) = 2T\left(\frac{n}{4}\right) + \sqrt{n}$ [5]
- b) Compute the time complexity of the program by showing all the steps involved. [5]

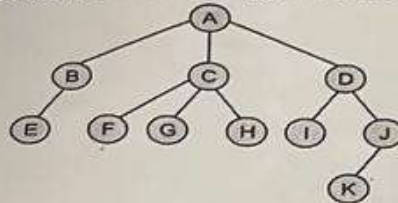
```
void function(int n) {
    int i, j, k, count = 0;
    for(i=n/2; i<=n; i++)
        for(j=1; j + n/2<=n; j= j+1)
            for(k=1; k<=n; k= k * 2)
                count++;
}
```

2. a) Reversing elements of a stack using push and pop operations only. Write a Pseudocode for find its time and space complexity. [4]
- b) Suppose there are two singly linked lists both of which intersect at some point as shown in the picture below. The head (or start) pointers of both the lists are known, but the intersecting node is not known. List1 may have n nodes before it reaches the intersection point, and List2 may have m nodes before it reaches the intersection point where m and n may be $m = n$, $m < n$ or $m > n$. Give a Procedure for finding the intersection node. Give its time and space complexity. (Note: In the below image the ? node is the intersection node). [6]

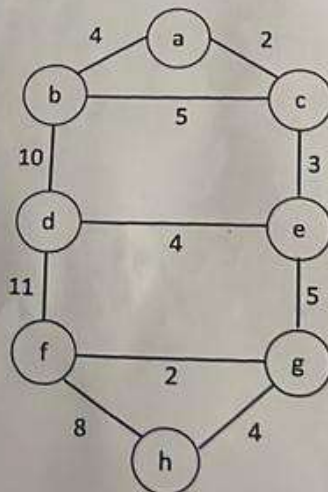


3. Write an algorithm for Counting Sort. Illustrate the operation of Counting sort on the array $A = \{4, 3, 1, 4, 2, 7, 9, 2, 6, 4\}$ step by step.

4. a) Devise an algorithm/pseudocode for printing all the elements of BST which are between K_1 and K_2 where K_1 and K_2 are integers. [6]
- b) Write a pseudocode to convert a general tree into a binary tree and apply the pseudocode to convert the following general tree into a binary tree. [4]



5. For the given infix expression $(a + b * c) + ((d * e + f) * g)$ Perform the following tasks:
- a) Build an Expression tree to represent the expression. [5]
- b) Convert it to prefix notation using a stack. [5]
6. What is the difference between the Breadth-First Search (BFS) and Depth-First Search (DFS) algorithms in graph traversal? Consider a directed graph with n nodes and m edges where each node is either black or white, how would you find the number of connected components that contain at least one black node? Which algorithm would you use and what steps would you take to solve this problem? Write the procedure for the same.
 Note: A connected component is a subgraph in which any two vertices are connected to each other by paths, and which is connected to no additional vertices in the subgraph.
7. Discuss and demonstrate how Dijkstra's algorithm can be applied to the following scenario: Imagine you are a delivery driver in a city with 9 locations. The locations are connected by roads with different travel times. You need to deliver a package from location 'a' to location 'h' as quick as possible. Estimate the total time required to deliver the package.
 Note: The travel time between locations are shown in the graph below:



8. Using the hash function $h(k) = k \bmod 13$, insert the keys 12, 24, 36, 49, 59, 72 and 84 into a hash table. Resolve the collisions that occur using both linear probing and double hashing methods. Compare the performance of these two methods while searching for an element in the hash table and determine which method is more effective.
9. a) Is there a min-heap/max-heap with seven distinct elements so that the in-order traversal of it gives the elements in sorted order? Explain your answer with justification. [5]
- b) Write an algorithm/pseudocode for deleting an arbitrary element from min heap. [5]
10. Construct an AVL tree by inserting the following keys in the given order: 14, 17, 11, 7, 53, 4. Show the tree after each insertion. Then perform the following operations on the AVL tree:
- search for the key 11,
 - delete the key 17, and
 - insert the key 8.
- Show the tree after each operation.

