



# VIT

Vellore Institute of Technology  
(Deemed to be University under section 3 of the U.G.A. Act, 1976)

Reg. No. :

## Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BCSE202L	Faculty Name	Prof. Uma Maheswari
Course Title	Data Structures and Algorithms	Slot	A1+TA1
		Class Nbr	CH2024250100604
Time	3 hours	Max. Marks	100

### General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

### Course Outcomes

1. Understand the fundamental analysis and time complexity for a given problem.
2. Articulate linear, non-linear data structures and legal operations permitted on them.
3. Identify and apply suitable algorithms for searching and sorting.
4. Discover various tree and graph traversals.
5. Explicate hashing, heaps and AVL trees and realize their applications.

### Section - I

Answer all Questions (7 × 10 Marks)

\*M - Marks

Q.No	Question	*M	CO	BL
01.	<p>You are developing a text-processing feature for a messaging application. The feature needs to handle messages where users can emphasize sections by enclosing them within parentheses. Any text inside the parentheses should be reversed. If there are nested parentheses, the innermost content should be reversed first, and then the outer sections. Your task is to Write a pseudo code using suitable data structure that takes a string as input and display the modified version with all parenthesized sections reversed and analyse its time complexity. The resulting string should not contain any parentheses.</p> <p><b>Input :</b> "(abc)(def)"</p> <p><b>Output:</b> "cbafed"</p> <p><b>Process</b></p> <p>Reverse (abc) to "cba".</p> <p>Reverse (def) to "fed". Since these parentheses are not nested, simply concatenate the results: "cbafed".</p> <p><b>Input:</b> "(a(b(cd)e)f)"</p> <p><b>Output:</b> "fbdcea"</p> <p><b>Process</b></p> <p>Reverse the innermost (cd) to "dc".</p> <p>Now the string becomes "(a(bdce)f)".</p> <p>Reverse (bdce) to "ecdb".</p> <p>The string becomes "(aecdbf)". Reverse the entire outer content to get "fbdcea".</p>	10	2	3

02. A research team is working on a divide-and-conquer search algorithm for large datasets. The dataset is recursively split into smaller chunks until a base case size is reached. Below are the recurrence relations for various scenarios. As a software engineer your task is to find the time complexity of the following recurrence relations. 10 1 3

- (i)  $T(n) = 16T(n/4) + n^3$ . (Use master method - 5 marks)  
 (ii)  $T(n) = 5T(n/4) + n^2$  (Use recursion tree method - 5 marks)

03. Imagine you're working on a financial application that manages large transactions, where each transaction amount can have multiple digits. Due to memory constraints, the digits of each transaction amount are stored individually in a doubly linked list, with the ones place at the head of the list. 10 2 3

For example, a transaction amount of 549 would be stored as:

List 1: 9 <-> 4 <-> 5

Similarly, another transaction amount of 265 would be stored as:

List 2: 5 <-> 6 <-> 2

After sum

4 <-> 1 <-> 8 (814)

To handle combined transaction data, you need to develop an algorithm that performs the following:

- (i) Initialize Lists (4 marks): Create two doubly linked lists to represent the transaction amounts.  
 (ii) Sum the Transactions (4 marks): Add the two transaction amounts by summing corresponding nodes, handling carry values as necessary.  
 (iii) Store the Result (2 marks): Store the final sum in a new doubly linked list, maintaining the same reverse order format for the digits.

04. Imagine you are developing a resource management tool for an educational institution that tracks and manages assets, such as books, electronic devices, furniture, and other inventory items. Each asset is assigned a unique identification number based on when it was acquired. To streamline tracking, you decide to represent these asset IDs in a binary tree structure, which allows you to organize and retrieve asset data efficiently. The asset IDs will be stored in level order. 10 4 2

The assets to be added to the tree are as follows: [15,10,20,8,12,17,25,78,13].

- (i) Construct the Binary Tree - Insert each asset ID into the tree in the given order to form a level-order binary tree structure. (2 marks)  
 (ii) Perform Traversals - Write routines to traverse the binary tree in the following ways: Pre-order, In-order, Post-order. (5 marks)  
 (iii) Display the Traversal Results - Show the order of asset IDs visited in each traversal. (3 marks)

05. Assume that you are organizing a sequence of product codes in a warehouse. Each product code is represented as an integer, and you want the products sorted according to the second digit (counting from the left) in each code in ascending order. If two product codes have the same second digit, the product with the smaller code should appear first. For codes with fewer than two digits, treat the "missing" second digit as -1. Write a pseudo code that sorts a list of numbers based on the second digit and analyze its time complexity. 10 3 2

Original Numbers: 15 24 138 29 413 81 9

Sorted Numbers: 9 81 413 138 24 15 29

06. Consider, you are working on agricultural land where you need to plant the flower seeds into pots. Each flower seed has a value. Plant the flower seeds with the values 157, 95, 137, 72, 14, 50, 10 into the correct pots. Assume you have only 9 pots and Resolve the collisions using the following methods and show all the steps .
- (i) Separate chaining (3 marks)
- (ii) Quadratic probing (3 marks)
- (iii) Double Hashing where first hash-function is  $h_1(k) = k \bmod 9$  and the second hash-function is  $h_2(k) = 1 + (k \bmod 11)$ . (4 marks)
07. Construct AVL trees with the following insertion and deletion operations
- Insertion : 15,20,25,10,30,35,23,28,27,22 (7 Marks)
- Deletion :27. (3 marks)
- After each insertion and deletion, demonstrate the process of maintaining balance in the AVL tree by applying necessary rotations. Describe each step involved in ensuring the tree remains balanced, and provide the final balanced AVL tree after all operations and rotations are completed.

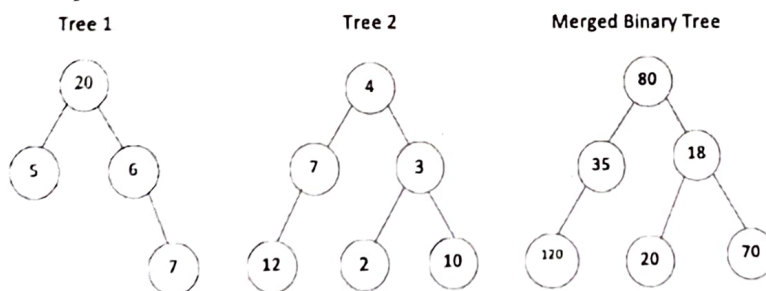
### Section - II

Answer all Questions (2 × 15 Marks)

\*M - Marks

- | Q.No | Question  | *M | CO | BL |
|------|---|----|----|----|
| 08.  | You are given two binary trees, Tree1 and Tree2. Your task is to write the pseudo code to create two binary trees (4 marks) and merge them into a merged binary tree by following these guidelines:   | 15 | 4  | 3  |
|      | i. When two binary trees have nodes at the same level and position (whether root, left, or right), the value of the node in the merged binary tree should be the product of the values of the corresponding nodes in Tree1 and Tree2. For example, if two nodes at a particular position in both trees hold the values 20 and 4 as given in example, the merged tree node at that same position will have the value $20 * 4 = 80$ . The merged tree should maintain the same structure, placing each node in the same level and position as the nodes in Tree1 and Tree2. Write the pseudocode to achieve this. (4 marks) |    |    |    |
|      | ii. If a node exists in only one of the tree at a particular level and position, the merged binary tree should include a node with its value multiplied by 10 at the same level and position of the corresponding tree. Write the pseudo code to achieve this. (4 marks)  |    |    |    |
|      | iii. When neither tree has a node at a particular level and position, the merged tree should include a null node. Write the pseudo code to achieve this.(3 marks)   |    |    |    |

Example,





- 09: A multinational company, "GlobalTech," is expanding its business operations across the World. 15 4 3
- As part of this expansion, executives and employees need to frequently travel between major cities like Beijing, Tokyo, Shanghai, Seoul, Singapore, Hong Kong, Los Angeles, and Sydney to attend meetings, conferences, and product launches.
- The path between the cities are (Beijing to Tokyo), (Beijing to Shanghai), (Beijing to Hong Kong), (Beijing to Singapore), (Tokyo to Seoul), (Tokyo to Los Angeles), (Tokyo to Shanghai), (Tokyo to Singapore), (Shanghai to Seoul), (Shanghai To Singapore), (Seoul to Los Angeles), (Seoul to Singapore), (Hong Kong to Shanghai), (Hong Kong to Singapore), (Singapore to Sydney), Since not all the cities are connected by direct flights, the company's travel management team wants to plan a travel using Breadth first search (BFS) and Depth first search(DFS) to travel all the cities. As a software developer help the team to
- Create the undirected graph using the above mentioned information (3 Marks)
  - Write the pseudo code for BFS (3 marks) iii) Perform the BFS and DFS for the drawn graph (6 marks) using adjacency matrix representation(3 marks).

**BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)**

