VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of the UGC Act, 1956)

Reg. No. :

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

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|---|---|---|---|
| Programme | **B.Tech.** | Semester | **Fall Semester 2024-25** |
| Course Code | **BCSE202L** | Faculty Name | **Prof. Uma Maheswari** |
| Course Title | **Data Structures and Algorithms** | Slot | **A2+TA2** |
| | | Class Nbr | **CH2024250100605** |
| 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. | Consider a game where N people numbered 0 to N − 1 are sitting in a circle. Starting at person 0, a hot potato is passed to the next person at each step (in the direction of increasing person number, modulo N). After M passes, the person holding the hot potato is eliminated, and the game continues with the person sitting after the eliminated person picking up the hot potato. The last remaining person wins. Thus, if M = 1 and N = 5, the order of elimination is 1, 3, 0, 4, and the winner is 2. Based on this scenario, Write a pseudocode to create the list and find the solution for the game using circular linked list.<br>Initial State<br>Current circle: 0 → 1 → 2 → 3 → 4 → (back to 0)<br>Current person (holding the hot potato): 0<br>Elimination Steps(M=1)<br>Current person is **0**. We pass the hot potato to 1 (M=1) (0 → 1).<br>• Eliminate person 1.<br>• New circle: 0 → 2 → 3 → 4 → (back to 0)<br>Current person (next to 1) holding the hot potato: 2.<br>Current person is 2. We pass the hot potato to 3 (M=1)(2 → 3).<br>• Eliminate person 3.<br>• New circle: 0 → 2 → 4 → (back to 0)<br>Current person holding the hot potato: 4. The process continues in the same manner. | 10 | 2 | 3 |

02. (i) What will be the worst case time comple...

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for (int i = n / 2; i <= n; i++)
{ for (int j = 1; j <= n; j += n / 2)
{ for (int k = 1; k <= j; k *= 2)
{ x = x + 1; } } }
```

(ii) Write a recursive function that takes a string as input and returns the reversed string as output. Formulate the recurrence relation that describes the time complexity of the recursive string reversal function . Define T(n) for the time complexity where n is the length of the input string. Solve the recurrence relation you formulated to determine the overall time complexity of the function. (7 marks)

03. You are developing a scheduling application for a conference. The application allows participants to book time slots for meetings. Each meeting has a start and end time. However, sometimes participants accidentally schedule overlapping meetings, which can cause conflicts. Considering this scenario

(i) Write the pseudo code that automatically merges overlapping meeting time slots to ensure that the conference schedule remains organized and conflicts are minimized. ( 8 marks)

(ii) Analyze its time complexity (2 Marks)

You are given a list of meetings represented as intervals, where each meeting is defined by a start and an end time in the format [[start1, end1], [start2, end2], ...].

meetings = [[9, 10], [8, 9], [10, 12], [11, 13], [14, 16], [15, 18]]

Output: [[8, 10], [10, 13], [14, 18]]

10 3 3

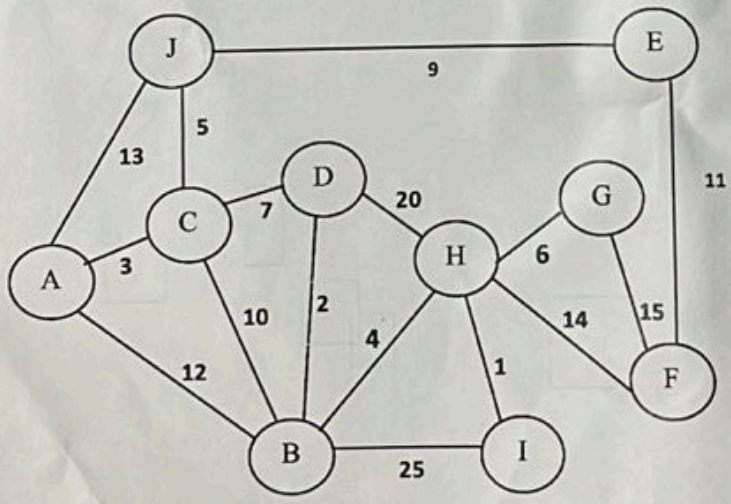
04. You are designing a GPS navigation system for a city. The city can be represented as a graph where intersections are nodes and the roads between them are edges. Each road has a distance (or weight) associated with it, representing how long it takes to travel that road. You need to use appropriate algorithm for finding the least-cost path to connect multiple nodes( assume staring vertex as 'A') on a map without forming any cycles.

(i) Represent the graph using adjacency matrix format. (2 marks)–7

(ii) Write an algorithm to calculate the minimum cost path.(3 marks)

(iii) Find the minimum cost and show all intermediate steps to calculate the minimum cost path for a given graph.(5 marks)

10 4 3



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|---|---|---|---|---|
| 05. | You are designing a salary management system for a company. The system... employee salaries efficiently. Each salary is represented as an integer, and you need to support various functionalities such as adding new employee salaries and calculating the total of all salaries that are smaller than or equal to the k-th smallest salary. Construct a binary search tree (BST) to manage employee salaries. The salaries are {10155,20344,9488,5045,35899,40333,70000,10000,15000} Construct the BST with the given salaries (2 marks)<br>Write a routine in such a way that your BST should support the following operations:<br>(i) Delete the root node(10155) of the constructed BST. (3 marks)<br>(ii) Calculate the sum of all salaries that are smaller than or equal to the k-th smallest salary. (5 marks) | | | |
| 06. | You are tasked with designing an online library management system that needs to efficiently handle the registration of book IDs. Each book has a unique ID number that needs to be stored in a hash table for quick retrieval.The hash function h(k) is given as k mod 8.<br>You need to insert the following book IDs into the hash table: 12345, 23456, 34567, 45678, 56789,98455,44451. For each insertion, show the probing process and updated hash tables using the following methods:<br>(i) Separate chaining (3 marks)<br>(ii) Linear probing (3 marks)<br>(iii) Quadratic probing (4 marks) | 10 | 5 | 2 |
| 07. | You are responsible to create and manage an AVL tree to store a sequence of characters. The created AVL tree should support insertion and deletion while ensuring that it remains balanced according to AVL tree properties.<br>Perform the following operations for the given data: M, N, C, Q, R, S, B, J, I, K, D<br>(i) Construct an AVL tree by inserting the given characters in the order provided. (7 marks)<br>(ii) After constructing the AVL tree, delete the character B. (3 marks)<br>After each insertion and deletion, please indicate any necessary rotations that are required to maintain the balance of the AVL tree. | 10 | 5 | |

**Section - II**

**Answer all Questions (2 × 15 Marks)** *M - Mark

| Q.No | Question | *M | CO |
|---|---|---|---|
| 08. | You are tasked with developing a software application for a ticket booking system at a cinema theater. The system needs to manage customer requests for purchasing tickets in a first-come, first-served manner. To achieve this, you decide to implement a queue data structure. You must implement the queue using two stacks. One stack will be used for enqueue operations, and the other stack will be used for dequeue operations.<br>The queue must support the following operations:<br>(i) Enqueue(int ticketID): Add a ticket request to the end of the queue. (4 marks)<br>(ii) Dequeue(): Remove and return the ticket request at the front of the queue. (4 marks)<br>(iii) Front(): Retrieve the ticket request at the front of the queue without removing it. (3 marks)<br>(iv) isEmpty(): Check if the queue is empty. (2marks)<br>(v) size(): Get the number of ticket requests currently in the queue.(2 marks) | 15 | 2 |

09. You are developing a real estate management system for a company that deals with buying, selling, and renting properties. The system maintains two separate databases (or binary trees) for different types of properties: Residential properties (T1) and commercial properties(T2). Each property is represented by a unique identifier (Property ID). Construct two binary trees and return a list of property IDs that are present in one tree but not in both and sort them in descending order. 15

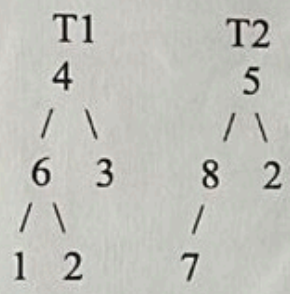
Write the pseudo code to

(i) Construct two binary trees T1 and T2(4 marks)

(ii) Find the unique nodes and display .(8 marks)

(iii) Sort the unique nodes in descending order(3 marks)

Example for finding unique nodes




output : Unique nodes: 4 6 3 1 5 8 7

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

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