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Reg. No. :

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BCSE202L**	Faculty Name	**Prof. Valarmathi Sudhakar**
Course Title	**Data Structures and Algorithms**	Slot	**E1+TE1**
		Class Nbr	**CH2024250100997**
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

CO1 Understand the fundamental analysis and time complexity for a given problem.

CO2 Articulate linear, non-linear data structures and legal operations permitted on them.

CO3 Identify and apply suitable algorithms for searching and sorting.

CO4 Discover various tree and graph traversals.

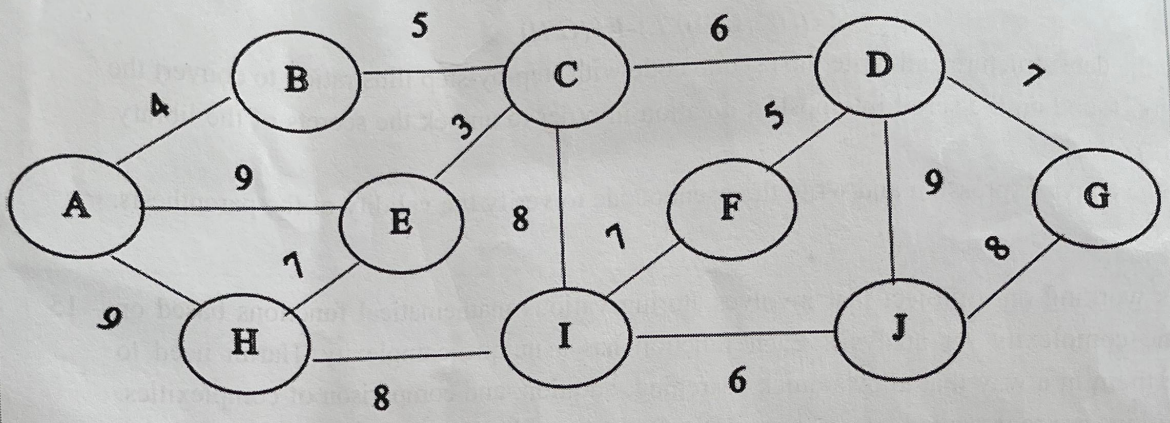
CO5 Explicate hashing, heaps and AVL trees and realize their applications.

Section - I

Answer all Questions (7 × 10 Marks) *M - Marks

Q.No	Question	*M	CO	BL
01.	**Algorithm ABC(Arr[],n)** 1. Begin 2. Count = 0 3. for (i = 0; i < n - 1; i++) 4. for (j = i + 1; j < n; j++) 5. if (Arr[i] > Arr[j]) 6. Count++ 7. end if 8. end for 9. end for 10. return Count 11. End a) For the given input array Arr = [1, 9, 6, 4, 5] and n = 5 print the output of Algorithm ABC(). (2 Marks) b) Find the time complexity of Algorithm ABC(). (2 Marks) c) Prepare an efficient Algorithm XYZ() in terms of time complexity to accomplish the same task as Algorithm ABC(). (4 Marks) d) Determine the time complexity of Algorithm XYZ(). (2 Marks)	10	1	2

02.	a) You are managing a shipping queue represented as a singly linked list, where each node contains an integer quantity of products. Write a pseudo code that rearrange the queue so that high-quantity (≥10) and low-quantity (<10) shipments alternate, with the first node keeping its original position. For example, given shipments 5 → 15 → 12 → 8 → 3 → 20, the reordered queue should be 5 → 15 → 8 → 12 → 3 → 20, preserving the order within high and low quantities. (5 Marks) b) A ride in a theme park operates with a specific seating arrangement, where each seat is represented as a node in a data structure. The seating and repositioning norms are as follows: i) if the given N is positive, then the provided sequence should be rotated clockwise. ii) if the given N is negative, then the provided sequence should be rotated counter clockwise. For example, if the seating sequence is [A, B, C, D] and N = 2, the resulting arrangement is [C, D, A, B] Conversely, if N = -1 for the same sequence, the arrangement becomes [D, A, B, C]. To simulate the repositioning of riders, choose an appropriate data structure and write a proper pseudocode to manage the situation. (5 Marks)	10	2	2
03.	Given an array of integers(**Freq_Array**) representing the sales counts of different products over a week. For example : **Freq_Array**=[4,4,5,3], this means that the sale count frequency for certain items is 4,4,5, and 3. Sort the Freq_Array based on the following conditions: a. Count the frequency of each integer in the array. b. Sort the integers based on their frequencies in decreasing order. If two or more integers have the same frequency, sort them in their increasing order. Write a pseudocode to sort the array based on the specified conditions and return the sorted array. Analyze the time complexity of your pseudocode. Example: Input [5, 5, 5, 4, 4, 4, 4, 3] Output:[4, 4, 4, 4, 5, 5, 5, 3]	10	3	3
04.	A media player contains a playlist consisting of n songs, $P = \{S_1, S_2 \ldots, S_n\}$. Each song S_i is a node in the list with a reference to both its previous and next songs. Each song S_i is connected to S_{i+1}, and S_n is connected to S_1. The media player wants to manage his playlist by performing some of the operations in the playslist. The operations are given below. i). Write a pseudocode to create a playlist with the given song sequence. For ex: P, Q, R, S, and T (3 Marks) ii). Write the necessary pseudocode for switching from current song Si to Si-1. For ex: In the above sequence, your pseudocode should change the song from S to R. (2 Marks) iii). Write a pseudocode to delete the given song T from the list with the necessary steps. (2 Marks) iv). Write a pseudocode to insert the songs X and Y between P and Q in the list and then traverse the entire list in the reverse order. (3 Marks)	10	2	3

05.	Mumbai is a city composed of n neighborhoods, $N_1, N_2, \ldots, N_n$. The city can be represented as an undirected graph $G = (N, E)$, where N is the set of vertices, with each vertex N_i representing a neighborhood i. E is the set of edges, with each edge e_{ij} representing a potential road between neighborhoods N_i and N_j. Each edge e_{ij} has an associated weight w_{ij}, representing the cost of building the road between N_i and N_j. The city planners aim to connect these neighborhoods with a network of roads such that every neighborhood is reachable from every other neighborhood. The goal is to find a subset of edges $E' \subseteq E$ that connects all cities without forming cycles and with the minimum total weight.  a) Find a subset of edges that connects all cities by sorting the edges using suitable algorithm with necessary steps. (8 Marks) b) List the applications of the minimum spanning tree. (2 Marks)	10	4	3
06.	A mathematician is working with a large collection of polynomials and frequently needs to evaluate these polynomials at various values. For efficiency, he decided to store precomputed results of polynomial evaluations for specific inputs. For instance, he might have polynomials of the following type: $f(x) = x^2 + 2x+1$. Compute f(x) by substituting the value for x as 1,2,3,4,5,6,7,12 and store the f(x) in hash table of **size 10** by using division method. a) Store $f(x)$ in the hash table using linked list (4 Marks) b) Store the data using quadratic probing whenever collision occurs.(6 marks)	10	5	2
07.	A tech company manages priority tasks using an AVL tree, where task priorities are inserted and deleted while maintaining balance. The following task priorities are inserted sequentially: **40, 20, 60, 10, 30, 50, 70, 25, 35**. After all insertions, the following deletions occur: **20, 70**. Based on the data, answer the following: a. Construct the AVL tree after all insertions. (2 Marks) b. For each insertion, identify if any imbalance occurs and specify the type of rotation needed to restore balance. (3 Marks) c. After each deletion, determine whether an imbalance occurs or not and if imbalance exists explain the required rotation(s) to maintain the AVL property. (3 Marks) d. What is the final height of the AVL tree after all insertions, deletions, and rotations? (2 Marks)	10	5	4

Section - II

Answer all Questions (2 × 15 Marks)

*M - Marks

Q.No	Question	*M	CO	BL
08.	**a).** During a mission to unlock the secrets of an ancient library, a team of cryptographers discovers a scroll containing a complex mathematical expression. This expression is the key to deciphering the library's hidden messages. However, the expression is written in infix notation, which the ancient library's decoding machine cannot directly process. The machine only understands postfix notation. The expression found on the scroll is: $A+((B*(C/D))/E)-F+(G/H)$ Identify the data structure and write the pseudo code with step-by-step illustration to convert the expression found on the scroll into postfix notation in order to unlock the secrets of the library. (10 Mark) **b).** Use the above expression and write the pseudocode to verify the validity of the parenthesis. (5 Marks)	15	2	3
09.	Harini is working on a project that involves storing various mathematical functions based on their time complexity for analysis. Each function has a unique complexity. Harini need to organize them in a way that allows quick searching, addition, and comparison of complexities. The functions are represented in a sequence Big-O notation like $O(n^2)$, $O(\log n)$, $O(1)$, $O(n)$, $O(n \log n)$, $O(2^n)$, and $O(n^3)$. a) Construct a Binary Search Tree(BST) for the given sequence of time complexities functions. Each node of the tree stores a time complexity function. Illustrate the same with a suitable algorithm (9 Marks) b) Arrange all the given functions in decreasing order of time complexity. (2 Marks) c) Delete the node with the time complexity $O(\log n)$ with the necessary steps and present the resultant BST (4 Marks)	15	4	4

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

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