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Code No. : 13266 N/O

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD*Accredited by NAAC with A++ Grade***B.E. (CSE & AIML) III-Semester Main & Backlog Examinations, Jan./Feb.-2024****Data Structures**

Time: 3 hours

Max. Marks: 60

*Note: Answer all questions from Part-A and any FIVE from Part-B***Part-A (10 × 2 = 20 Marks)**

Q. No.	Stem of the question	M	L	CO	PO
1.	<p>Consider the following C function that operates on an array of integers:</p> <pre>int example_algorithm(int arr[], int n) { int result = 0; for (int i = 0; i < n; i++) { for (int j = i; j < n; j++) { result += arr[i] * arr[j]; } } return result; }</pre> <p>Determine the time complexity of the given algorithm using Big O notation. Justify your answer by explaining how you arrived at the determined Big O notation.</p>	2	2	1	1,2
2.	What are the disadvantages of array data structure?	2	1	1	1,2
3.	<p>Analyze the following function of a Singly linked list and explain its functionality.</p> <pre>void myfunc(struct Node *first, struct Node *second) { struct Node *p = first; while (p->next != NULL) { p = p->next; } p->next = second; second = NULL; }</pre>	2	3	2	1,2

Contd... 2

4.	What are the advantages of circular queue when compared to a linear queue?	2 1 2 1,2
5.	Write the pre-order and post-order traversal for the following Binary search tree.	2 3 3 1,2
<pre> graph TD F((F)) --> B((B)) F --> G((G)) B --> A((A)) B --> D((D)) D --> C((C)) D --> E((E)) G --> I((I)) I --> H((H)) </pre>		
6.	Give the adjacency matrix and adjacency list representations for the following graph.	2 2 3 1,2
<pre> graph LR A --- B B --- C C --- G G --- F F --- E E --- D D --- A A --- E C --- E F --- E </pre>		
7.	What are the steps involved in the partitioning process within the Quick Sort algorithm. How does it rearrange the elements in the array?	2 1 4 1,2
8.	Sort the following data using Insertion Sort. Show the working procedure. 12, 45, 25, 15, 10, 38, 20	2 3 4 1,2
9.	Given the splay tree mentioned below. Perform the operation search(12) and draw the resultant splay tree.	2 3 5 1,2
<pre> graph TD 50((50)) --> 17((17)) 50 --> 76((76)) 17 --> 9((9)) 17 --> 23((23)) 9 --> 14((14)) 14 --> 12((12)) 23 --> 19((19)) 76 --> 54((54)) 54 --> 72((72)) 72 --> 67((67)) </pre>		
10.	What is the significance of a Red Black tree? Write its properties.	2 1 5 1,2
Part-B (5 × 8 = 40 Marks)		
11. a)	What is a sparse matrix? What is the efficient way to represent the elements of a sparse matrix? Design a C function to add two sparse matrices.	4 2 1 1,2,3
b)	Given an array of integers, Develop a C program to replace every element with the next greatest element (greatest element on the right side) in the array. Since there is no element next to the last element, replace it with -1. For example, if the array is {16, 17, 4, 3, 5, 2}, then it should be modified to {17, 5, 5, 5, 2, -1} Also determine the time complexity of the designed solution.	4 3 1 1,2,3

12. a)	Assume you are building a simplified employee data management system for a small company. The system needs to handle employee information, including adding new employees, deleting employee details and displaying relevant information. Implement a stack-based approach with push, pop and display operations to manage the employee data efficiently.	4	3	2	1,2,3
b)	Suppose you have a collection of information about students with attributes such as student_id, name and marks. Write a C program to input details of 'n' students and store their information in a circular linked list. Additionally, display the details of the student with the highest marks.	4	3	2	1,2,3
13. a)	Design a system to manage customer account data in a bank using a Binary Search Tree (BST). Each customer account is identified by an account number, and additional information such as customer name, balance, and account type is stored. Design the insertion process for adding a new customer account into the Binary Search Tree.	4	2	3	1,2,3
b)	What is minimum cost spanning tree? Show step by step representation to construct Prim's minimum cost spanning tree for the below graph. Assume '1' as source vertex. Write the algorithm for Prim's Algorithm.	4	3	3	1,2,3
14. a)	In the context of basketball team selections, you, being at the front of a line of n people, need to assist the coach in identifying the shortest person to be excluded from the team. The coach values height over skill and has decided to take only n-1 people. Design a C program that prompts the user to input the number of people in the line and their respective heights. Implement the merge sort algorithm to arrange the heights in ascending order, allowing the coach to easily identify and exclude the shortest person from the team. The program should output both the original order and the sorted order of people based on their heights.	4	3	4	1,2,3
b)	What are the different techniques used to handle collisions in hashing? Given the hash function $h = \text{key} \% 7$, where 7 is the size of the hash table. Insert the following data into hash table. Use linear probing to address the collisions. 15, 34, 42, 14, 22, 63, 48	4	2	4	1,2,3
15. a)	What is a splay tree? What are the different rotations performed while splaying a node in a splay tree?	4	1	5	1,2
b)	Construct an AVL tree by inserting the following data in the same order: CAT, BAT, CUP, CAN, RAT, HAT, TEA, BUT, BET, TIP, POT, COT . Show step by step construction with rotations wherever required and also show the Balance factor for every node.	4	3	5	1,2,3
16. a)	What are Asymptotic Notations? How are they used in analyzing the performance analysis of algorithms? Give examples.	4	2	1	1

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b)	Design an algorithm for converting an infix expression to postfix expression. Given an infix expression $(P+Q) - (R+S*T+U) / V$, Show the conversion to postfix with step by step representation of the stack content and output expression after each character is read.	4 2 2 1,2
17.	Answer any <i>two</i> of the following:	
a)	What is DFS? Which data structure is used to implement DFS? Represent the DFS for the following graph. Assume 'A' as source vertex. Also, write the algorithm for DFS.	4 3 3 1,2,3
b)	What is max heap? What is the process of creating a Max Heap and how it contributes to the Heap Sort algorithm?	4 1 4 1,2
c)	<p>A library database system manages a vast collection of books and requires an efficient data structure to store and retrieve information about the books based on their ISBN numbers. ISBN numbers are unique identifiers assigned to each book and follow a specific format. The system anticipates frequent searches for book details and wants to ensure optimal search and retrieval performance. The library system is considering the use of B-trees to organize the ISBN numbers effectively.</p> <p>Construct a B-Tree of order 5 for the following ISBN numbers: 26, 10, 18, 22, 16, 52, 62, 12, 29, 14, 38, 65, 75, 40. Show the step-by-step process of inserting these ISBN numbers into the B-Tree, ensuring that the properties of the B-Tree (such as the maximum and minimum number of keys per node) are maintained at each step.</p>	4 3 5 1,2,3

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	30%
iii)	Blooms Taxonomy Level – 3 & 4	50%
