Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 60032

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – FEB. 2025
First Semester
Information Technology
P23IT101 – ADVANCED DATA STRUCTURES AND ALGORITHMS
(Regulation 2023)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

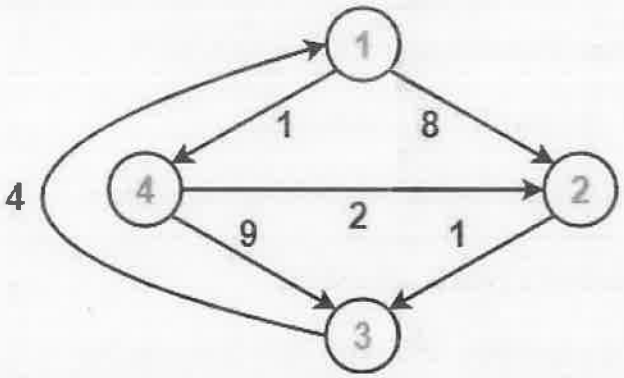
(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Define Big-O notation and give an example.	2	K1	CO1
2.	How is the recursion-tree method used in solving recurrences?	2	K2	CO1
3.	What is hashing, and how does it help in efficient data retrieval?	2	K2	CO2
4.	How is an interval tree different from a regular binary search tree?	2	K2	CO2
5.	Define a strongly connected component in a directed graph.	2	K1	CO3
6.	How does the Bellman-Ford algorithm detect the presence of negative cycles in a graph?	2	K2	CO3
7.	What are the key characteristics of a greedy algorithm?	2	K2	CO4
8.	What is the Huffman coding algorithm, and how does it ensure an optimal prefix-free code?	2	K2	CO4
9.	Write the significance of the prefix function in the KMP algorithm.	2	K1	CO5
10.	What is the difference between P, NP, and NP-complete problems?	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Use a recursion tree to determine a good asymptotic upper bound on the recurrence $T(n) = T(n/2) + n^2$. Use the substitution method to verify your answer.	13	K4	CO1
		(OR)			
	b)	Use the master method to give tight asymptotic bounds for the following recurrences: $T(n) = 2T\left(\frac{n}{4}\right) + \sqrt{n}$.	13	K3	CO1
12.	a)	Write an algorithm to reverse a singly linked list using both iterative and recursive methods. Explain the time and space complexity of each approach.	13	K3	CO2
		(OR)			
	b)	Show the resulting red-black tree after inserting the keys 41, 38, 31, 12, 19, 8, 25, 15, 13, 79, and 95 into an empty red-black tree, step by step.	13	K3	CO2
13.	a)	Write an algorithm for Depth-First Search (DFS) and illustrate with a diagram how it can be implemented using a stack.	13	K3	CO3
		(OR)			
	b)	Use the Floyd-Warshall algorithm to find the shortest path distance between all pairs of vertices in a graph. Provide the algorithm and explain its time complexity.	13	K3	CO3



14.	a)	Determine the cost and structure of an optimal binary search tree for a set of n D 7 keys with the following probabilities:								13	K4	CO4

i	0	1	2	3	4	5	6	7
Pi		0.04	0.06	0.08	0.02	0.10	0.12	0.14
qi	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05

(OR)

	b)	What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers? a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21 Can you generalize your answer to find the optimal code when the frequencies are the first n Fibonacci numbers?	13	K4	CO4
15.	a)	Suppose that all characters in the pattern P are different. Show how to accelerate NAIVE-STRING-MATCHER to run in O(n) time on an n-character text T.	13	K3	CO5
		(OR)			
	b)	Draw a state-transition diagram for the string-matching automaton for the pattern P = aabab over the alphabet $\sum$={a,b} and illustrate its operation on the text string T = aaababaabaababaab.	13	K3	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	A regional bank is implementing a new system for managing customer accounts, transactions, and loan records. To ensure efficient access to large volumes of data, the bank decides to use a B-tree as the primary data structure for indexing customer records. Each customer record includes the following information: customer ID, name, account balance, and account type. In the context of the bank's customer management system, analyze how a B-tree would be utilized for indexing customer records.	15	K4	CO2
		(OR)			
	b)	A tech company is planning a business trip for its sales representatives to meet clients across several cities. The sales team needs to visit a specific set of cities, starting and ending at the company's headquarters, while minimizing travel distance to reduce costs and time spent on the road. The cities involved are located in different regions, and the company has access to the distance matrix that details the travel distances between each pair of cities. As the planning team analyses the logistics of the trip, they realize that this scenario can be modeled as the Traveling Salesman Problem (TSP). Given the complexity of the problem, they need to determine an effective approach to find a near-optimal route that satisfies the constraints of the sales trip. Discuss how a tech company's business trip planning is related to the Traveling Salesman Problem.	15	K4	CO5