

THE KAVERY ENGINEERING COLLEGE
(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

First Semester

Computer Science and Engineering

PCST2401 - Advanced Data Structures and Algorithms

Regulations - 2024

Duration : 3 Hrs

Maximum : 100 Marks

PART - A (ANSWER ALL QUESTIONS) (Marks 10*2=20)

<i>Q.No</i>	<i>Questions</i>	<i>BLT</i>	<i>CO</i>	<i>Marks</i>
1.	Explain the significance of asymptotic notation in analyzing algorithms.	UN	1	2
2.	Compare substitution and recursion-tree methods for solving recurrences.	UN	1	2
3.	Outline the purpose of rotations in maintaining Red-Black Tree balance.	UN	2	2
4.	How is a key decreased in a Fibonacci Heap?	RE	2	2
5.	Define Breadth-First Search (BFS) and explain its primary mechanism for traversing a graph.	RE	3	2
6.	What is the All-Pairs Shortest Paths problem, and which algorithm is commonly used to solve it using dynamic programming?	RE	3	2
7.	Define dynamic programming and briefly explain its purpose.	RE	4	2
8.	Given a set of activities with start and finish times, apply the greedy strategy to select the maximum number of activities.	AP	4	2
9.	Explain how polynomial-time verification can be applied to check the solution of a given NP problem.	UN	5	2
10.	List and recall two NP-Complete problems.	RE	5	2

PART - B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)

<i>Q.No</i>	<i>Questions</i>	<i>BLT</i>	<i>CO</i>	<i>Marks</i>
11.	a i Compare Big O, Omega, and Theta notations, and give an example where each would be used.	UN	1	8
	ii Analyze the worst-case complexity of binary search and discuss when it occurs.	AN	1	5
	Or			
	b i Examine the steps involved in the substitution method for solving recurrences with an example.	AN	1	8
	ii Discover how data structures can impact the performance of algorithms.	AN	1	5
12.	a Explain the process of querying, inserting, and deleting elements in a binary search tree, with examples for each operation.	UN	2	13
	Or			
	b Illustrate an example that involves inserting a sequence of elements into a B-Tree. Illustrate each step and explain how the B-Tree properties are maintained during insertion.	UN	2	13

13. a Construct a minimum spanning tree using Kruskal's algorithm with your own example. AP 3 13
- Or
- b Build the shortest path between two given vertices using Dijkstra's algorithm? Explain the pseudo code with an example. AP 3 13
- ```

graph TD
 a ---|4| b
 a ---|3| c
 a ---|2| d
 b ---|6| e
 c ---|7| d
 d ---|4| e
 d ---|5| b

```
14. a i Construct the cost matrix in Matrix-Chain multiplication and interpret its significance. AN 4 7
- Or
- ii Inspect the core principles and components of dynamic programming with example. AN 4 6
- Or
- b Analyze the limitations of greedy algorithms in optimization problems using specific examples, including cases where greedy solutions may not yield optimal results. AN 4 13
15. a Examine the relationships between various NP-Complete problems and discuss the concept of problem transformations among them. AN 5 13
- Or
- b Dissect a known NP-Complete problem and detail the steps taken, including any reductions made to arrive at a solution. AN 5 13

*PART – C (Marks 1\*15 = 15)*

| Q.No  | Questions                                                                                                                                                                                                            | BLT | CO | Marks |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|-------|
| 16. a | Construct the Single-Source Shortest Paths in DAGs with necessary example.                                                                                                                                           | AP  | 3  | 15    |
| Or    |                                                                                                                                                                                                                      |     |    |       |
| b     | Consider a sequence of matrices $A_1, A_2, A_3, A_4$ with dimensions:                                                                                                                                                | AP  | 4  | 15    |
|       | <ul style="list-style-type: none"> <li>• <math>A_1 : 10 \times 20</math></li> <li>• <math>A_2 : 20 \times 30</math></li> <li>• <math>A_3 : 30 \times 40</math></li> <li>• <math>A_4 : 40 \times 30</math></li> </ul> |     |    |       |

Apply the Matrix-Chain Multiplication algorithm to determine the optimal order of matrix multiplication that minimizes the total number of scalar multiplications. Show all steps, including the calculation of the cost matrix and the optimal parenthesization of the product. Provide a detailed explanation of how the results are derived.