Roll No:													

BTECH
(SEM. IV) THEORY EXAMINATION 2025-26
DESIGN AND ANALYSIS OF ALGORITHM

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

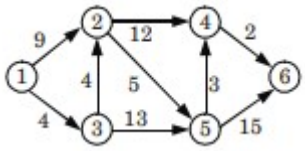
SECTION A

1. Attempt *all* questions in brief. **02 x 7 = 14**

Q no.	Question	CO	Level
a.	Find Big-O of:f(n) = n^3 + 4n log n + 6	1	K3
b.	What is the difference between time and space trade-off?	1	K2
c.	What is probabilistic balancing in Skip List?	2	K2
d.	Why is extract-min costly in Fibonacci Heap?	2	K3
e.	Define Convex Hull in computational geometry.	3	K1
f.	Differentiate between Greedy and Dynamic Programming	4	K2
g.	What is Algebraic Computation?	5	K1

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 21**

Q no.	Question	CO	Level
a.	Explain the concept of recurrence relations. Solve the recurrence relation using Master Theorem:T(n)=2T(n/2)+n. Also interpret its significance in algorithm efficiency.	1	K4
b.	Define B-Tree. Construct a B-Tree of order 5 by inserting:20, 10, 30, 5, 15, 25, 35, 40, 45. Show all node splits clearly.	2	K4
c.	By considering vertex '1' as source vertex, find the shortest paths to all other vertices in the following graph using Dijkstra's algorithms. Show all the steps. 	3	K3
d.	What is the Hamiltonian Cycle problem? Describe a backtracking algorithm to solve it and demonstrate its application with a step-by-step example.	4	K3
e.	Explain the concept of approximation ratio. Analyze the performance of an approximation algorithm for Vertex Cover problem.	5	K4

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	What is Max Heap property?. Construct a **Max Heap** from the following elements:[20, 15, 30, 5, 10, 25]. Explain each step clearly.	1	K4
b.	Compare comparison-based and non-comparison-based sorting algorithms. Give advantages and limitations of each.	1	K5

4. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Explain the structure of Binomial Trees. Prove that a Binomial Tree of degree k has 2^k nodes.	2	K4
b.	Define Red-Black Tree.Prove that a Red-Black Tree with n-internal nodes has height at most (2lg(n+1)).	2	K4

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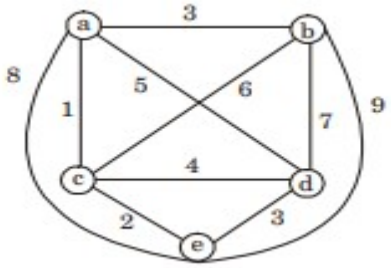
5. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Discuss Prim's and Kruskal's algorithm. Construct minimum spanning tree for the below given graph using Prim's algorithm (Source node = a). 	3	K3
b.	Explain the Divide and Conquer approach with Merge Sort. Analyze its time complexity.	3	K3

6. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Define the Traveling Salesman Problem (TSP) and explain how the Branch and Bound (B&B) technique provides an optimal solution. Using the cost matrix given below, find the minimum-cost Hamiltonian circuit step-by-step, including matrix reduction, lower bound calculation, and construction of the state-space tree. Given distance/cost matrix: **A B C D** **A** ∞ 10 15 20 **B** 5 ∞ 9 10 **C** 6 13 ∞ 12 **D** 8 8 9 ∞	4	K3
b.	Find all valid configurations for placing 4 queens on a board using the backtracking algorithm. Start by placing the first queen in the first row and proceed row-by-row	4	K3

7. Attempt any *one* part of the following: 07 x 1 = 07

Q no.	Question	CO	Level
a.	Explain why NP-Complete problems are considered intractable. Can all NP problems be solved in polynomial time? Justify.	5	K5
b.	Compare Fast Fourier Transform (FFT) and Dynamic Programming approaches for solving computational problems.	5	K4