JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech - V Semester (BI)

COURSE CODE(CREDITS): 18B11BI511 (03) MAX. MARKS: 35

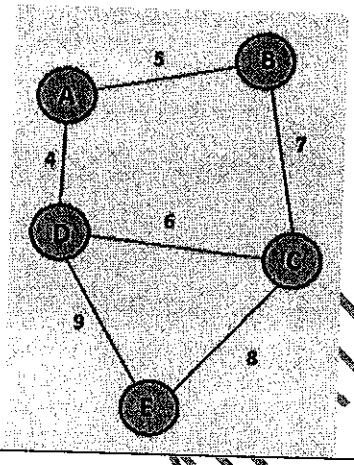
COURSE NAME: Design and Analysis of Algorithms

COURSE INSTRUCTOR: Dr. Tiratha Raj Singh MAX. TIME: 2 Hours

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems.

Q.No	Question	CO	Marks
Q1	A sorting algorithm has running time $T(n) = K \cdot n^2$. If the algorithm takes 25 ms to sort n = 500 elements, estimate the time required to sort n = 3000 elements.	I	3
Q2	Make a comparative analysis of any three sorting algorithms. Compute their respective complexity and make final conclusion about their performance.	III	3
Q3	(a) Define Minimum Spanning Tree (MST). (b) How do Prim's and Kruskal's algorithms differ? (c) Construct an MST using Kruskal's algorithm on the graph details below: Vertices = {A, B, C, D, E}; Edges with costs: A-B: 6, A-C: 3, B-C: 2, B-D: 5, C-D: 3, C-E: 4, D-E: 2	V	(1+1+3) = 5
Q4	Discuss in detail the concepts of NP, NP-Complete, and NP-Hard problems. Provide formal definitions and examples, and explain the significance of polynomial-time reductions in complexity theory. Further, explain why NP-Hard problems are considered at least as difficult as NP-Complete problems.	V	3
Q5	An algorithm has time complexity given by the recurrence $T(n)=2T(n/2) + n$, for $n>1$, $T(1)=1$ where n is a power of 2. 1. Find a closed-form expression for T(n). 2. Hence, compute the value of T(64).	II	(3+1) = 4
Q6	Consider 6 items with the following weights and profits: Items: ⟨I1, I2, I3, I4, I5, I6⟩, Weights (w): ⟨4, 8, 2, 6, 10, 12⟩, and Values (v): ⟨20, 40, 14, 30, 45, 50⟩. The capacity of the knapsack is W = 25. (i) Solve the problem using Fractional Knapsack (Greedy).	V	5

	(ii) Compute the total value gained.		
Q7	Explain the following terms in the context of algorithm analysis with suitable example of each: (a) Substitution method of recurrence relation (b) Space and Time Complexity (c) Bellman–Ford Algorithm (d) Adjacency Matrix Vs Incidence Matrix	I-IV	(2*4)=8
Q8	What is shortest path problem? Solve the following using a single source algorithm: 	IV	4