JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-I Semester (CSE/IT/ECE/CE/BT/BI)

COURSE CODE (CREDITS):10M11CI111 MAX. MARKS: 35

COURSE NAME: Advanced Data Structures

COURSE INSTRUCTORS: Saurav 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	You are given the heads of two singly linked lists that merge at some node and continue as a single list. Write a function that returns the **value** (or a reference to the node) at which the two lists merge. The linked lists must retain their original structure after the function returns.	CO1	5
Q2	Given an unsorted array, prove that building a heap from the array using the "insertion" method (Top-down method) has **O(nlogn)** time complexity.	CO2	5
Q3	Use the **Floyd-Warshall Algorithm** to find the Transitive closure path in a directed graph.	CO3	5
Q4	Analyze a binary counter that starts from 0 and supports only increment operations. Using the **potential method**, prove that the amortized cost per increment is O(1). Let the potential function Φ be the number of 1's in the counter. Show that: • Actual cost of increment: number of bits flipped • Amortized cost = Actual cost + $\Delta\Phi$ • Prove amortized cost ≤ 2	CO5	7
Q5	Design a stack that supports: • push(x): O(1) time • pop(): O(1) time • multipop(k): Pop k elements (or until stack empty) Using **aggregate analysis**, prove that a sequence of n operations (mix of push, pop, multipop) on an initially empty stack takes O(n) time total.	CO5	7

Q6	A company has built an MST connecting 5 offices with the following edge weights: Original MST edges: A-B: 5, B-C: 3, C-D: 7, D-E: 4 Total cost: 19 The company considers these changes: 1. Adding a new direct connection A-E with cost 6 2. Increasing cost of edge C-D from 7 to 9 due to maintenance 3. Adding a new office F with connections: A-F: 4, C-F: 2, E-F: 5 **Tasks:** 1. Should they add edge A-E to reduce cost? Show calculations. 2. If C-D cost increases to 9, should they keep it in MST? 3. Find new MST including office F and all connections 4. Calculate total cost savings/loss from all changes	CO6	6