JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT TEST -3 EXAMINATION- 2025

M. Tech-II (CSE/IT)

COURSE CODE (CREDITS): 10M11CI211 (3)

MAX. MARKS: 35

COURSE NAME: Advanced Algorithms

COURSE INSTRUCTORS: Dr. Aman Sharma

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	1.00	Tag
Q1	You are given the following directed graph with 5 vertices (numbered 0 to 4) and weighted edges:	CO 4	Mark 12
	Edge (from → to) Weight		
	$ \begin{vmatrix} 0 \to 1 & 6 \\ 0 \to 2 & 7 \end{vmatrix} $	Mary State Control	No areas
	$ \begin{vmatrix} 0 \to 2 & 7 \\ 1 \to 2 & 8 \end{vmatrix} $		
	$ \begin{vmatrix} 1 \to 2 & 8 \\ 1 \to 3 & 5 \end{vmatrix} $		
	$1 \rightarrow 4$ -4		
	$2 \rightarrow 3$ -3		
	$2 \rightarrow 4$ 9		
	$3 \rightarrow 1$ -2		003-03
	$4 \rightarrow 0$ 2		
	$4 \rightarrow 3$ 7		
	Ford algorithm. Show the distance array after each iteration. (3 marks) e) Explain how the Bellman-Ford algorithm detects negative weight cycles. Would this graph trigger such a detection? Justify your answer. (2 mark)		
	Given the recurrence: (n) = 2T(n/2) + n		
>	a) Identify which method (Substitution, Recursion Tree, or Master's Theorem) is most efficient to solve this recurrence and justify your choice briefly. (2 mark) b) Using the selected method, determine the asymptotic time complexity of T(n). (2 mark)		
)2	2.1		
	You are given the text: "ABABDABACDABABCABAB" and the pattern: "ABABCABAB"	3	13

b) Compute the hash value of the pattern and the initial window of the text using a simple hash function: Hash(s) = (sum of ASCII values of characters in s) mod 101. Then, check whether the hash values match. (2 marks) c) Briefly explain how Rabin-Karp handles spurious hits (when hash values match but the actual strings don't). Why is this step important? (2 marks) 2.2 a) List any three key characteristics that define a good algorithm. (2 mark) b) Define the following asymptotic notations and explain what each represents in the context of algorithm analysis: i) Big-O (O) ii) Big-O (Omega) iii) Big-O (Theta) (3 markt) c) For the Binary Search algorithm, state its best-case, average-case, and worst-case time complexities. (2 mark) c) Pii) NP iii) NP-complete iv) NP-hard (2 marks) b) Give one example problem from each of the following classes: i) P ii) PP ii) NP-complete iii) NP-hard (1.5 marks) c) What would be the implication for computational theory and real-world applications if P = NP is proven true? (4.6 marks) Q4 You are given the following undirected, weighted graph: Vertices: {A, B, C, D, E} Edges with Weightes: A = B (2) A = C (3) B = C (1) B = D (4) C = D (5) C = E (6) D = E (7) a) Define a tree and explain the concept of a Minimum Spanning Tree (MST). (1.5 marks) b) Use Prim's Algorithm to construct the MST starting from vetex A. List the order in which edges are selected. (1.5 marks) c) Use Kruskal's Algorithm to construct the MST. Show how cycle detection is handled using the Union-Find method. (1.5 marks) d) Explain one real-world application of MST algorithms. (0.5 mark)					
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