

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Applied Mathematics and Computational Sciences

MSc THEORETICAL COMPUTER SCIENCE V SEMESTER

CONTINUOUS ASSESSMENT TEST 1 Date: 28-08-2025

23XT54 - DESIGN AND ANALYSIS OF ALGORITHMS

Time: 1 Hour 30 min.

Maximum Marks: 40

INSTRUCTIONS:

1. Answer **ALL** questions. Each question carries 20 Marks.
2. Subdivisions (a)(i) and (a)(ii) carries 2 marks each, subdivision (b) carries 6 marks each and subdivision (c) carries 10 marks each.
3. Subdivisions (a) and (b) will be with no choice and Subdivision (c) may be with choice but not in more than 1 question.
4. Course Outcome Table :

Qn.1	CO1	Qn.2	CO2
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- 1) i) How will you find and eliminate duplicate element in a sorted array using divide and conquer?
L6
 - ii) Solve the recurrence relation using the recursion tree and specify the time complexity
 $T(n)=5T(n/2)+n^2$
L2
 - b) Write algorithm for Karatsuba large integer multiplication and analyze the time complexity. When multiplying two 4 bit numbers, find out how many multiplications, additions and subtractions are required and specify whether (i)high school multiplication or (ii) Karatsuba's multiplication is good.
L4
 - c) These are the co-ordinates of points at time t which gives the position of hot air balloons { (2,4), (5, 7), (8, 5), (6, 10), (9,15)}. Perform only a single iteration on the set of points and display the closest set of points after the first merge operation. Is it possible to reduce the number of comparisons in the merge operation to be less than $7n$? if yes give the procedure (algorithm not required) if no, state reasons.
L5
2. a) i) You want to shift your house. In kitchen, many cylindrical containers of various heights and widths are available whose sizes are given as follows {(2,10), (8,30), (5, 20), (6, 15), (10, 25)}. How will you arrange these containers (i.e bigger container can accommodate smaller container) such that you can store them all with minimum number of containers? What

is the time complexity?

L5

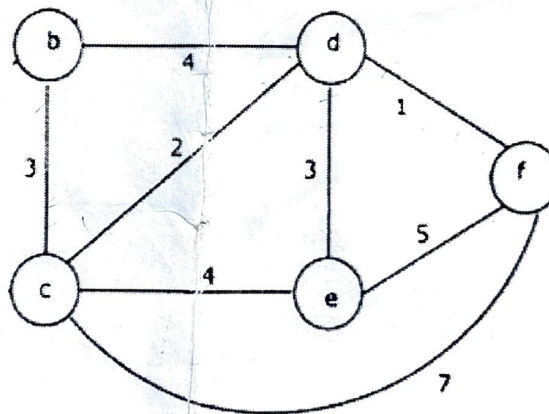
- ii) Consider a DAG $G=(V,E)$, where there exist a single source vertex (S) and a single destination vertex (D) with many intermediate vertices in between. Let T be the topological ordering, How will you find that there is an ordering from S to D with length 'k'? L6

b) Write the procedure to traverse the Huffman tree to extract codes and find the time complexity and construct Huffman tree for the following characters.

Letter	:	P	R	S	M	K	Q	Z
Frequency	:	12	7	18	10	9	5	2

L3

- c) What is the importance of cut edges in the construction of minimum cost spanning tree using Prim's algorithm? Using the algorithm find a MST for the following graph.



Suppose for a graph G, let T be the minimum spanning tree. Now, consider an edge $e=(u,v)$ is inserted into the graph G. What will happen to T? From this step, how will you find MST?

L4