Nirma University

Institute of Technology

Semester End Examination (RPR), May 2023

M. Tech. in Computer Science and Engineering, Semester-I /

M. Tech. in Computer Science and Engineering (Data Science), Semester-I

6CS201 – Complexity Theory and Algorithms

Roll / Exam No.		Supervisor's initial with date	

Duration: 3 Hours | Max. Marks: 100

Instructions:

1. **All questions are compulsory. (No Optional Questions)**
2. **Use section-wise separate answer book.**
3. Figures to right indicate full marks.
4. Assume suitable data if required and specify them clearly.
5. Draw neat sketches wherever necessary.

SECTION-I

Q.1 **Answer the following.** **[16]**

A **CO2** **BL4** Discuss Kruskal's minimum spanning tree (MST) algorithm and present its running time analysis. Show the complete trace of Kruskal's algorithm to find minimum spanning tree for the graph shown in Figure 1. **(10)**

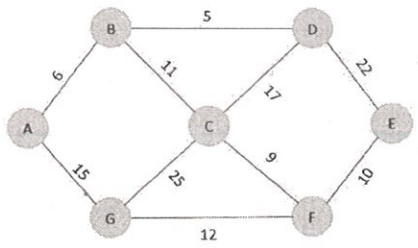

Figure 1: An undirected graph

B **CO1** **BL3** Illustrate working of Bubble sort algorithm by applying it on the following sequence of elements. **(06)**

Elements: 10, 30, 75, 65, 32, 20, 21, 9, 11

Q.2 **Answer the following.** **[16]**

A **CO2** **BL2** Explain each step for implementing divide and conquer approach with the help of a suitable sorting algorithm and derive its time complexity. **(08)**

B Given a set A of n activities with start time S_i and finish time F_i of an i^{th} activity. Design a greedy algorithm which computes the maximum size of mutually compatible activities. Trace your algorithm with a minimum of five activities. **(08)**
CO3
BL6

Q.3 Answer the following. **[18]**

A Let $f(n) = n^3 + 20n + 100$ and $g(n) = n^3$. Is $f(n) \in O(g(n))$? Justify your answer. **(04)**
CO1
BL5

B Use contradiction to prove that "If n is a composite integer, then n has a prime divisor less than $\sqrt{n}$." **(04)**
CO1
BL3

C Solve the following recurrence relations. **(10)**
CL01
1) $T(n) = 49T(n/7) + n^2$
BL3
2) $T(n) = T(2n/3) + 1$

SECTION-II

Q.4 Answer the following. **[20]**

A Find the optimal order of multiplying following matrices using dynamic programming approach (complete trace expected). $A_{Total}=A_1A_2A_3A_4A_5A_6$ where A_1:12x5, A_2:5x7, A_3:7x4, A_4:4x6, A_5:6x2, A_6:2x8 **(12)**
CO3
BL3

B Write an algorithm to find an optimal Huffman code using greedy approach. Trace your algorithm on the following set of frequency to find optimal Huffman code for each character. **(08)**
CO2
BL3

Character	A	B	C	D	E	F
Frequency	5	9	12	13	16	45

Q.5 Answer the following. **[16]**

A "Greedy Algorithm always gives an optimal solution." State True or False with a justification. Give an example to support your answer. **(04)**
CO1
BL5

B In which situation do you prefer Prim's algorithm rather than Kruskal's algorithm and vice-versa to find the minimum spanning tree for a given graph? **(04)**
CO2
BL3

C Write Dijkstra's algorithm to find the single-source shortest path from a graph. Also, discuss time complexity of Dijkstra's algorithm. **(08)**
CO2
BL4

Q.6	**Answer the following.**	**[14]**
A	Find longest common subsequence in given two strings A and B using dynamic programming approach (complete trace expected), where A=pqrsppqrrs and B=srqpsrqpr.	**(12)**
CO3		
BL3		
B	Differentiate between greedy and dynamic programming.	**(02)**
CO1		
BL2		