Nirma University

Institute of Technology

Semester End Examination (IR), December 2025

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

6CS402CC25 – Data Structures and Algorithms

Roll / Exam No. 25MCD005

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 **Do as directed.** **[18]**

A **CLO3** **BL4** Write Prim's algorithm to find minimum spanning tree (MST) of an undirected graph G=(V,E). Discuss time complexity of your algorithm. **(08)**

B **CLO2** **BL3** Write a sorting algorithm using a divide and conquer approach whose best-case and worst-case running times are not the same. Present the running time analysis of your algorithm. **(10)**

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

A **CLO1** **BL3** Let $f(n) = 7n^2 + 50n + 178$ and $g(n) = n^2$. Is $f(n) \in O(g(n))$? Justify your answer. **(04)**

B **CLO1** **BL3** Using mathematical induction, prove that $1 * 2 + 2 * 3 + 3 * 4 + \ldots + n * (n + 1) = [n * (n+1) * (n +2)]/3$ for any natural number n. Here, "*" denotes multiplication operator. **(04)**

C **CLO2** **BL4** Write a searching algorithm that uses the divide-and-conquer technique. Present running time analysis of your algorithm. **(08)**

Q.3	**Answer the following.**	**[16]**
A **CLO1** **BL4**	Given an array of integers, write an algorithm to find the second largest element of the array using recursion. Present running time analysis of your algorithm.	**(06)**
B **CLO1** **BL3**	**Solve the following recurrence relations.** 1) $T(n) = T(n/2) + n$ 2) $T(n) = 9T(n/3) + n^2$	**(10)**

SECTION – II

Q.4	**Answer the following.**	**[18]**
A **CLO3** **BL3**	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_1:2x7, A_2:7x9, A_3:9x11, A_4:11x4, A_5:4x6, A_6:6x3	**(12)**
B **CLO4** **BL2**	Write an algorithm to decrease the key of a node x in a Binomial heap H to a new value k. Assume that k is not greater than x's current key.	**(06)**
Q.5	**Answer the following.**	**[16]**
A **CLO3** **BL4**	Find longest common subsequence in given two strings A and B using dynamic programming approach (complete trace expected), where A=pqrspqrspq and B=pqpqpaqp.	**(12)**
B **CLO3** **BL5**	"Greedy approach always gives an optimal solution for the given problem" – State True or False with a justification.	**(04)**
Q.6	**Answer the following.**	**[16]**
A **CLO4** **BL4**	Write an algorithm for Huffman encoding using greedy approach. Derive time complexity of your algorithm.	**(08)**
B **CLO4** **BL3**	Write Floyd's algorithm to find the shortest path between every pair of vertices of a graph. Present running time analysis of the algorithm.	**(08)**