Nirma University

Institute of Technology

Semester End Examination (RPR), May 2022

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

3CS1109 COMPLEXITY THEORY AND ALGORITHMS

Roll / Exam No. _____ Supervisor's initial with date _____

Time: 3 Hours Max. Marks : 100

Instructions:
1. Attempt all questions.
2. Figures to right indicate full marks.
3. Use section-wise separate answer book.
4. Draw neat sketches wherever necessary.
5. Assume suitable data wherever required and specify them clearly.

SECTION – I

Q-1. Do as directed. **[16]**

A CO1 BL3 **Solve the following recurrence relation (Any Two).** **12**

i. $T(n) = 36T(n/6) + \sqrt{n}$

ii. $T(n) = T(\sqrt{n}) + 1$

iii. $T(n) = 3T(n/3) + n$

B CO2 BL2 Compare and contrast: Backtracking and Dynamic Programming. **4**

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

A CO3 BL3 Find a longest common subsequence in given two strings A and B using dynamic programming approach (complete trace expected), where A=abcdacd and B=dcadcabb. 8

B CO2 BL6 Develop a recursive algorithm for selection sort (iterations not to be used at all) and trace it on a suitable example with seven numbers. 8

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

A CO2 BL6 Develop an algorithm for Breadth First Search (BFS) in a graph with a trace on a suitable example. 8

B CO1 BL5 Write loop(s) that has/have running time of $\Theta(n^4)$. 6

OR

B CO1 BL5 Write loop(s) that has/have running time of $O(2^n)$. 6

C Differentiate between least cost branch and bound (LC-B&B) and 4

CO2 BL2	FIFO branch and bound (FIFO-B&B) techniques with a suitable example.	

SECTION – II

Q-4. Answer the following. **[16]**

A CO1 BL1	Formally define various complexity classes viz. P, NP, NP-COMPLETE and NP-HARD and discuss importance of these classes in context of algorithmic complexity theory.	8
B CO2 BL6	Develop an algorithm for quick sort. Present recurrence relation for quick sort and discuss its best case and worst-case scenarios with timing analysis.	8

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

A CO3 BL3	Find the optimal order of multiplying following matrices using dynamic programming approach (complete trace expected). $A_{Total}=A_1A_2A_3A_4A_5$ where A_1:15x5, A_2:5x25, A_3:25x12, A_4:12x70, A_5:70x7	10

OR

A CO3 BL5	Use Backtracking Technique and write an algorithm to solve 8-queen puzzle problem. Also evaluate its time complexity.	10
B CO2 BL4	For an efficient implementation of Kruskal's Algorithm (for minimum spanning tree), which is the most suitable data structure to detect cycle. Justify your answer with a suitable example and give proper complexity analysis.	6

Q-6. Answer the following. **[18]**

A CO3 BL6	Develop an algorithm to solve fractional Knapsack problem using *Greedy Strategy*. Trace your algorithm on following data for knapsack capacity=18, to maximise the value in knapsack.	10

Item	Weight	Value
1	4	5
2	6	9
3	7	10
4	8	11
5	9	13
6	10	16

B CO1 BL5	Let $f(n) = n^2 + 7n + 6$ and $g(n) = n^3$. Is $f(n) \in O(g(n))$? Justify your answer.	4
C CO1 BL5	"Dynamic programming always gives an optimal solution." State true or false with a justification. Also, provide an example to support your answer.	4