

# Nirma University

## Institute of Technology

Semester End Examination (IR/RPR), December - 2022

M. Tech. in Computer Science and Engineering /

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 Do as directed.**

[18]

**A** Write an algorithm to search an element from the given set of elements (08)

**CLO2** with best-case time complexity of  $O(1)$  and worst-case time complexity

**BL4** of  $O(\lg n)$ . Show the tracing of your search algorithm on a suitable example with seven numbers.

**B Solve the following recurrence relations.**

(10)

**CLO1** 1)  $T(n) = 10T(n/10) + \sqrt{n}$

**BL3** 2)  $T(n) = 4T(n/4) + n^2$

**Q.2 Answer the following.**

[16]

**A** Let  $f(n) = n^2 + 20n + 15$  and  $g(n) = n^2$ . Is  $f(n) \in O(g(n))$ ? Justify your answer. (04)

**CLO1**

**BL3**

**B** Using mathematical induction prove for any natural number  $n$  that (04)

**CLO1**  $1 + 3 + 5 + \dots + 2n - 1 = n^2$

**BL3**

**C** Write a sorting algorithm that has time complexity of  $n \lg n$  for best- (08)

**CLO2** case, average-case and worst-case.

**BL4**

**Q.3 Answer the following. [16]**

**A** Write a recursive algorithm for generating Fibonacci series and derive its time complexity. **(06)**

**CLO1**

**BL4**

**B** Write an algorithm for selection sort and present its running time analysis. Trace your algorithm on the following set of elements. **(10)**

**CLO1**

**BL3** 8, 4, 6, 9, 2, 3, 1

## SECTION - II

**Q.4 Answer the following. [18]**

**A** Find the optimal order of multiplying following matrices using dynamic programming approach (complete trace expected).  $A_{Total} = A_1 A_2 A_3 A_4 A_5 A_6$  **(12)**

**CLO3**

**BL3** where  $A_1: 20 \times 5$ ,  $A_2: 5 \times 15$ ,  $A_3: 15 \times 3$ ,  $A_4: 3 \times 6$ ,  $A_5: 6 \times 16$ ,  $A_6: 16 \times 2$

**B** Differentiate between NP-hard and NP-Complete problems. **(06)**

**CLO2**

**BL2**

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

**A** Find longest common subsequence in given two strings A and B using dynamic programming approach (complete trace expected), where **(12)**

**CLO3**

**BL3**  $A = abccddab$  and  $B = abcabcbabb$ .

**B** Give an example for which greedy algorithm fails to give an optimal solution. **(04)**

**CLO2**

**BL5**

**Q.6 Answer the following. [16]**

**A** What is assembly line scheduling problem? Write an algorithm to solve assembly line scheduling problem using dynamic programming **(08)**

**CLO3**

**BL4** approach. Derive time complexity of your algorithm.

**B** Write an algorithm for Depth First Search (DFS) in a graph with a trace on a suitable example. **(08)**

**CLO2**

**BL3**