

# Nirma University

## Institute of Technology

Semester End Examination (IR/RPR) / SPE, February - 2022

B. Tech. in Computer Science and Engineering, Semester-V

2CS503 Design and Analysis of Algorithms

Roll /  
Exam No.

Supervisor's initial  
with date

Time: 2 Hours

Max. Marks: 50

Instructions:

1. Attempt all questions.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume suitable data wherever applicable and clearly mention them.
5. CLO\_ and BL\_ have been mentioned against each question to map it as per Course Learning Objective and Bloom's taxonomy.

Q 1 Answer the following: [15]

Q 1 (a) What is the time complexity of the following code fragments: [3]  
CLO1  
BL4,5

```
(1)
for (int i = 1; i <= n; i++) {
    for (int j = 1; j <= m; j++) {
        // code
    }
}
```

```
(2)
for (int i = 1; i <= n; i++) {
    // code
}
for (int i = 1; i <= n; i++) {
    for (int j = 1; j <= n; j++) {
        // code
    }
}
```

```
for (int i = 1; i <= n; i++) {
    // code
}
```

```
(3)
for (int i = 1; i <= n; i += 2) {
    // code
}
```

**OR**

Q 1 (a) Consider the following code fragment. What is its time complexity? [3]  
CLO1  
BL4,5

```
void f(int n)
{
    if (n == 1) return;
    f(n-1);
}
```

```

    f(n-1);
}

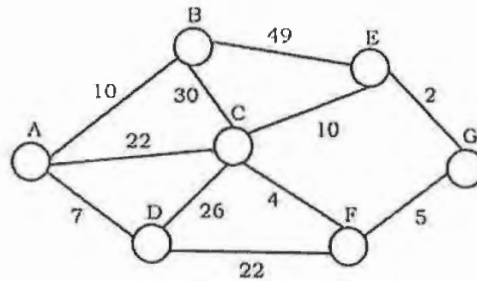
```

Justify your answer and discuss in detail.

- Q 1 (b) Given an array of  $n$  numbers, the task is to calculate the maximum subarray sum, i.e., the largest possible sum of a sequence of consecutive values in the array. The numbers/values can be negative. Write  $O(n^3)$ ,  $O(n^2)$  and  $O(n)$  algorithms (i.e., 3 algorithms, the first one should run in  $O(n^3)$ , the second should run in  $O(n^2)$  and the third algorithm should run in  $O(n)$  time) for this task. [12]

**OR**

- Q 1 (b) Write Prim's algorithm to find minimum spanning tree (MST). Find MST using Prim's algorithm for the following graph. Show computation for each step. [12]



- Q 2 Answer the following: [20]

- Q 2 (a) Write an algorithm for merge sort and discuss its time complexity analysis. [6]

- Q 2 (b) Find longest common subsequence for input sequences "AGGTAB" and "GXTXAYB" using dynamic programming (DP). Show computation for each cell in the DP table. Also write algorithms for (1) filling in the DP table and (2) displaying LCS. [14]

- Q 3 Answer the following: [15]

- Q 3 (a) In the assignment problem, assume 4 agents and 4 tasks. Assume the following cost matrix. [11]

Agents/Tasks	T1	T2	T3	T4
Agent 1	9	2	7	8
Agent 2	6	4	3	7
Agent 3	5	8	1	8
Agent 4	7	6	9	4

Find an optimal assignment using branch and bound algorithm. Show computation for each step.

- Q 3 (b) Assume any  $O(n)$  function that is first increasing and then decreasing. It is guaranteed that the consecutive values of the function are not equal. Suppose you wish to find a position  $k$  such that  $f(x) < f(x+1)$  when  $x < k$ , and  $f(x) > f(x+1)$  when  $x \geq k$ . Write an algorithm to find  $k$ . The time complexity of the algorithm should not be more than  $O(n \log n)$ . [4]

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