# Nirma University

## Institute of Technology

Semester End Examination (IR), February - 2022

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

2MAOE26 Operations Research

Roll No. ____ Supervisor's initials with date: ____

Time: 2 hours Max. Marks: 50

**Instructions: 1. Attempt all questions.**

**2. Figures to right indicate full marks.**

**Q:1** CO1, L3, L4, L6

A pharmaceutical company has 100 kg of A, 180 kg of B and 120 kg of C available per month. They can be use these materials to make three basic pharmaceutical products namely 5-10-5, 5-5-10 and 20-5-10, where the numbers in each case represent the percentage of weight of A, B and C respectively in each of the products. The cost of these raw materials given below: **[14]**

| Ingredient | Cost per kg (Rs) |
|---|---|
| A | 80 |
| B | 20 |
| C | 50 |
| Inert ingredients | 20 |

Selling prices of these products are Rs 40.5, Rs 43 and Rs 45 per kg respectively. There is a capacity restriction of the company for the product 5-10-5, so that they cannot produce more than 30 kg per month. Determine how much of each of the products they should produce in order to maximize their monthly profit.

**OR**

**Q:1** CO1, L3, L5

Use Two-phase simplex method to solve the following LP problem. **[14]**

Minimize: $Z = x_1 + x_2$

Subject to constraints: $2x_1 + x_2 \geq 4$

$x_1 + 7x_2 \geq 7$ and $x_1, x_2 \geq 0$

**Q:2**

**[A]** CO1, L3,L5

Solve graphically the following NLP problem **[04]**

Maximize $Z = 2x_1 + 3x_2$

Subject to constraints: $x_1^2 + x_2^2 \leq 20$

$x_1 x_2 \leq 8$ and $x_1, x_2 \geq 0$

**[B]** CO2, CO3, L4,L6

A cement factory manager is considering the best way to transport cement from his three manufacturing centers P, Q, R to depots A, B, C, D, E. The weekly production and demands along with transportation costs per ton are given bellow: **[10]**

| | A | B | C | D | E | Supply (Tones) |
|---|---|---|---|---|---|---|
| P | 4 | 1 | 3 | 4 | 4 | 60 |
| Q | 2 | 3 | 2 | 2 | 3 | 35 |
| R | 3 | 5 | 2 | 4 | 4 | 40 |
| Demand (Tones) | 22 | 45 | 20 | 18 | 30 | |

What should be the distribution programme?

**Q:3** CO2, CO3, L4,L6

A city corporation has decided to carry out road repairs on main four arteries of the city. The government has agreed to make a special grant of Rs 50 lakh towards the cost with a condition that the repairs be done at the loest cost and quickest time. If the conditions warrant, then a supplementary token grant will also be considered favourably. The corporation has floated tenders and five contractors have sent in their bids. In order to expedite work, one road will be awarded to only one contractor. **[10]**

| | | Cost of Repairs (Rs lakh) | | | |
|---|---|---|---|---|---|
| | | R1 | R2 | R3 | R4 |
| Contractors/Road | C1 | 9 | 14 | 19 | 15 |
| | C2 | 7 | 17 | 20 | 19 |
| | C3 | 9 | 18 | 21 | 18 |
| | C4 | 10 | 12 | 18 | 19 |
| | C5 | 10 | 15 | 21 | 16 |

(1) Find the best way of assigning the repair work to the contractors and the costs.
(2) If it is necessary to seek supplementary grants, what should be the amount sought?
(3) Which of the five contractors will be unsuccessful in his bids?

**Q:4** CO4, L4,L5, L6

The following maintenance job has to be performed periodically on the heat exchangers in a refinery: **[12]**

| Activity | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Predecessors | - | A | B | B | B | C | C | F,G | D,E,H | I |
| Duration in hours | 14 | 22 | 10 | 16 | 12 | 10 | 6 | 8 | 24 | 16 |

(1) Draw an arrow diagram of the project.
(2) Find out critical path and duration of critical path.
(3) Find the total float and free float for each task.