Indian Statistical Institute Bangalore
MS-QMS (Semester II) Operations Research - II
Mid-Term - 2025-26
Time: 2 Hours Date: 26/02/2026
Answer all questions, you can score 40 marks. The value at the end of the question within the bracket represent the max marks.

Q1. In a city, there are 7 warehouses, labeled from 1 to 7. Each warehouse j holds goods valued at $w_j = [3, 5, 8, 7, 9, 13, 11]$ thousand units. A logistics company wants to choose exactly 3 warehouses to supply goods from, under the constraint that no two selected warehouses are adjacent (to prevent congestion on neighboring routes). Among the chosen warehouses, one will carry the heaviest load, i.e., its w_j value is the largest of the three selected. The company's goal is to minimize this largest (maximum) load. Formulate this problem as an integer linear programming model (ILP). [5]

Q2. A telecommunications company wants to lay fiber optic cables to connect 6 cities. The cost of laying cables between pairs of cities is given below. The company wants to minimize the total cost while ensuring that all cities are connected. Formulate a linear programming model for this network. [5]

Cites(Edges)	Cost
A-B	4
A-C	3
B-C	1
B-D	2
C-D	4
C-E	5
D-E	1
D-F	6
E-F	2

Q3. Solve the following ILP problem using the Gomory's cutting plane method. [10]
$Max\ z = 5x_1 + 8x_2$,
Subject to $x_1 + x_2 \leq 6, 5x_1 + 9x_2 \leq 45$, and x_1, x_2 are integers.

Q4. SAIL operates three production plants and wants to distribute 5 new machines among them to minimize its overall operating cost. Each

plant can effectively use between 0 and 3 machines; beyond 3 machines at any one plant, efficiency drops. The company has provided the total operating costs (in lakhs of rupees) for each plant depending on the number of machines allocated.

No. of Machines	Plant 1	Plant 2	Plant 3
0	10	15	20
1	10	14	18
2	9.2	13	17.5
3	8.5	12.5	17.5

Use dynamic programming to find the assignment of machines that minimizes the total cost. [10]

Q5. Discuss the Travelling Salesman Problem (TSP). How to deal with the sub-tour? Solve the following TSP. [10]

Cities	C1	C2	C3	C4
C1	∞	20	30	10
C2	12	∞	15	18
C3	14	17	∞	21
C4	16	18	20	∞