Name: **Enrolment No:**	

UPES

End Semester Examination, Dec 2024

Course: Systems Analysis and Optimization **Semester:** VII

Program: Int BBA-MBA **Time: 03 hrs.**

Course Code: DSIT8007 **Max. Marks: 100**

Instructions:

SECTION A

10Qx2M=20Marks

S. No.		Marks	CO
Q 1	Define system characterization	**2**	**CO1**
Q 2	Explain the concept of model development.	**2**	**CO1**
Q 3	**Transportation Problem** JKL Logistics, based in Surat, India, needs to determine the optimal transportation plan to minimize the total transportation cost. They have three warehouses (W1, W2, and W3) and four retail stores (S1, S2, S3, and S4). The supply capacities for W1, W2, and W3 are 500, 600, and 700 units respectively. The demand requirements for S1, S2, S3, and S4 are 300, 400, 500, and 600 units respectively. The transportation costs per unit from each warehouse to each store are given in a cost matrix. Formulate the linear programming model for this transportation problem.	**2**	**CO4**
Q 4	What is the role of sensitivity analysis in system optimization?	**2**	**CO1**
Q 5	**10. Blending Problem** MNO Chemicals, located in Nagpur, India, needs to determine the optimal blend of two chemicals (C1 and C2) to minimize the total cost while meeting quality standards. The costs per unit for C1 and C2 are ₹50 and ₹70 respectively. The blend must contain at least 40% of C1 and 60% of C2. They need to produce a total of 1000 units of the blend. Formulate the linear programming model for this blending problem.	**2**	**CO4**
Q 6	Explain the significance of trade-off analysis in multidisciplinary system optimization.	**2**	**CO4**
Q 7	Describe the process of integer programming.	**2**	**CO2**
Q 8	Define and differentiate between linear and non-linear programming.	**2**	**CO3**
Q 9	**Production Scheduling** XYZ Electronics, based in Delhi, India, needs to determine the optimal production schedule for two products (X and Y) to maximize their total profit. The profit per unit for products X and Y are ₹1.50 and ₹2.00 respectively. They have a total production capacity of 1500 units. The minimum production requirements are 300 units for product X and 400 units for product Y. The maximum production capacity for product Y is 800 units. Formulate the linear programming model for this production scheduling problem.	**2**	**CO3**

<table>
<tr><td>Q 10</td><td>Explain the importance of model validation in system optimization.</td><td>2</td><td>CO2</td></tr>
<tr><td colspan="4">SECTION B
4Qx5M= 20 Marks</td></tr>
<tr><td>Q 11</td><td>Resource Allocation
PQR Services, located in Kolkata, India, needs to allocate a limited number of 60 employees to different projects (P, Q, and R) to minimize the total labor cost. The labor costs per employee for projects P, Q, and R are ₹200, ₹250, and ₹300 respectively. The minimum allocation for project P is 15 employees, the maximum allocation for project Q is 25 employees, and the minimum allocation for project R is 20 employees. Formulate the linear programming model for this resource allocation problem.</td><td>5</td><td>CO4</td></tr>
<tr><td>Q 12</td><td>Cargo Loading
LMN Transport, based in Ahmedabad, India, wants to load containers with different items to maximize the total cargo value. They have three containers with capacity limits of 1200, 1000, and 800 units respectively. They have three items available, with 700 units of item 1, 600 units of item 2, and 500 units of item 3. The values per unit for items 1, 2, and 3 are ₹50, ₹60, and ₹70 respectively. Formulate the linear programming model for this cargo loading problem.</td><td>5</td><td>CO4</td></tr>
<tr><td>Q 13</td><td>Workforce Scheduling
STU Enterprises, located in Jaipur, India, needs to schedule shifts for their employees to minimize total labor costs. They have three shifts (morning, afternoon, and night) with different labor costs per hour: ₹100, ₹120, and ₹150 respectively. The minimum number of employees required for each shift is 20, 25, and 15 respectively. They have a total of 70 employees available. Formulate the linear programming model for this workforce scheduling problem.</td><td>5</td><td>CO3</td></tr>
<tr><td>Q 14</td><td>Supply Chain Optimization
VWX Industries, based in Lucknow, India, needs to optimize its supply chain by determining the production quantities of two raw materials and two finished products to minimize total costs. They must produce at least 600 units of raw materials, with a maximum production capacity of 1200 units for finished products. Raw material A has a maximum production capacity of 400 units, while raw material B has a maximum production capacity of 500 units. The costs per unit for raw materials A and B, and the finished products are ₹0.15, ₹0.25, and ₹0.35 respectively. Formulate the linear programming model for this supply chain optimization problem.</td><td>5</td><td>CO4</td></tr>
<tr><td colspan="4">SECTION-C
3Qx10M=30 Marks</td></tr>
<tr><td>Q 15</td><td>A. Explain four strategic decisions in supply chain management.
B. A company produces three products, X, Y, and Z, which require the use of three machines, M1, M2, and M3. The production time (in hours) for each unit of product on each machine is given in the table below:
<table><tr><th>Product</th><th>M1</th><th>M2</th><th>M3</th></tr><tr><td>X</td><td>2</td><td>4</td><td>16</td></tr></table></td><td>10</td><td>CO1</td></tr>
</table>

	<table><tr><td>Y</td><td>3</td><td>2</td><td>10</td></tr><tr><td>Z</td><td>4</td><td>8</td><td>12</td></tr></table> The company has 400 hours of machine time available on M1, 300 hours of machine time available on M2, and 600 hours of machine time available on M3. The profit per unit of each product is $20 for X, $40 for Y, and $60 for Z. Formulate a linear programming model to maximize the company's total profit and find what is the total profit.		
Q 16	**Investment Allocation** ABC Investments, located in Chandigarh, India, wants to allocate funds to different investment options (stocks, bonds, and real estate) to maximize their total return. The returns per unit for stocks, bonds, and real estate are ₹0.08, ₹0.05, and ₹0.10 respectively. They have a total investment budget of ₹1,000,000. The minimum investment requirements are ₹200,000 for stocks and ₹300,000 for real estate, and the maximum investment for bonds is ₹400,000. Formulate the linear programming model for this investment allocation problem.	**10**	**CO3**
Q 17	**7. Diet Planning** DEF Nutrition, based in Bhopal, India, needs to create a diet plan that meets the nutritional requirements at the minimum cost. They have three food items (F1, F2, and F3) with different costs and nutritional values. The costs per unit for F1, F2, and F3 are ₹10, ₹15, and ₹20 respectively. The nutritional requirements are at least 50 units of protein, 60 units of carbohydrates, and 40 units of fats. The nutritional values per unit for F1, F2, and F3 are: F1 (10 protein, 5 carbohydrates, 2 fats), F2 (5 protein, 10 carbohydrates, 3 fats), and F3 (2 protein, 5 carbohydrates, 10 fats). Formulate the linear programming model for this diet planning problem.	**10**	**CO4**
SECTION-D **2Qx15M= 30 Marks**			

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<tr>
<td>Q 18</td>
<td>A. Please explain any one method used to determine the location of a facility.
B. A hospital network wants to determine the best location for a new medical clinic that will serve four existing hospitals. The coordinates of the hospitals and their patient demand are given in the table below:

<table>
<tr><th>Hospital</th><th>X Coordinate</th><th>Y-Coordinate</th><th>Patient Demand</th></tr>
<tr><td>H1</td><td>20</td><td>40</td><td>10000</td></tr>
<tr><td>H2</td><td>60</td><td>80</td><td>15000</td></tr>
<tr><td>H3</td><td>100</td><td>20</td><td>20000</td></tr>
<tr><td>H4</td><td>40</td><td>100</td><td>12000</td></tr>
</table>
The company has identified the potential locations of the facility. The transportation cost per unit to each potential facility are given in the table below. Using the Centre of Gravity method, determine the location of the new facility that minimizes transportation costs.

<table>
<tr><td>Facility</td><td>Transportation cost per unit</td><td>Location (x, y)</td></tr>
<tr><td>F1</td><td>₹40</td><td>(40, 40)</td></tr>
<tr><td>F2</td><td>₹60</td><td>(60, 40)</td></tr>
<tr><td>F3</td><td>₹100</td><td>(80, 60)</td></tr>
</table>
</td>
<td>15</td>
<td>CO4</td>
</tr>
<tr>
<td>Q 19</td>
<td>Advertising Budget Allocation
GHI Marketing, located in Patna, India, wants to allocate their advertising budget to different media channels (TV, radio, and online) to maximize their total reach. The reach per unit for TV, radio, and online are 1000, 800, and 1200 respectively. They have a total advertising budget of ₹500,000. The minimum allocation for TV is ₹100,000 and for online is ₹150,000, and the maximum allocation for radio is ₹200,000. Formulate the linear programming model for this advertising budget allocation problem. Please solve the formed problem.</td>
<td>15</td>
<td>CO4</td>
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