[This question paper contains 5 printed pages.]

Your Roll No.....

Sr. No. of Question Paper	:	4283
Unique Paper Code	:	2353572006
Name of the Paper	:	Linear Programming
Type of the paper	:	DSE
Semester	:	IV
Programme	:	B.Sc. (Physical Science and Mathematical Science) with Operational Research

Duration : 3 hours

Maximum Marks : 90 Marks

Instruction for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt all question by selecting two parts from each question.
3. Part of the questions to be attempted together.
4. All questions carry equal marks.
5. Use of Calculator not allowed.

Q1 (a) Solve graphically the following linear programing problem

Maximize $z = x - 2y$

Subject to

$$x + y \leq 4$$
$$3x + y \geq 6$$
$$y \leq 2$$
$$x, y \geq 0$$

(7.5)

(b) Find the all basic feasible solutions of the following equations

$$2x_1 + 3x_2 + 4x_3 + x_4 = 6$$
$$x_1 + x_2 + 7x_3 + x_4 = 2$$

(7.5)

(c) Examine the convexity of the set $S = \{(x, y) \in R^2,\ y^2 \leq 4x\}$. (7.5)

Q2 (a) Use Simplex Method to solve the following Linear Programming Problem.

Maximize $z = 4x_1 + 10x_2$

Subject to

$$2x_1 + x_2 \leq 50$$
$$2x_1 + 5x_2 \leq 100$$
$$2x_1 + 3x_2 \leq 90$$
$$x_1, x_2 \geq 0$$

(7.5)

(b) Use Simplex Method to solve the following Linear Programming Problem.

Maximize $z = 10x_1 + 5x_2$

Subject to

$$4x_1 + 5x_2 \leq 100$$
$$5x_1 + 2x_2 \geq 80$$
$$x_1, x_2 \geq 0$$

(7.5)

(c) Using Artificial variable technique Method, solve the following Linear Programming Problem.

Minimize $z = x_1 - 2x_2 - 3x_3$

Subject to

$$-2x_1 + x_2 + 3x_3 = 2$$
$$2x_1 + 3x_2 + 4x_3 = 1$$
$$x_1, x_2, x_3 \geq 0$$

(7.5)

Q3 (a) Show that there is an unbounded solution to the following Linear Programming Problem.

Maximize $z = 4x_1 + x_2 + 3x_3 + 5x_4$

Subject to

$$4x_1 - 6x_2 - 5x_3 - 4x_4 \geq -20$$
$$-3x_1 - 2x_2 + 4x_3 + x_4 \leq 10$$
$$-8x_1 - 3x_2 + 3x_3 + 2x_4 \leq 20$$
$$x_1, x_2, x_3, x_4 \geq 0$$

(7.5)

(b) Obtain the Dual of the following Linear Programming Problem.

Minimize $z = x_1 + x_2 + x_3$

Subject to

$$x_1 - 3x_2 + 4x_3 = 5$$
$$x_1 - 2x_2 \leq 3$$
$$2x_2 - x_3 \geq 4$$
$$x_1, x_2 \geq 0,\ x_3 \text{ is unrestricted}$$

(7.5)

(c) A person requires 10, 12 and 12 units of chemicals A, B and C respectively for his garden. A Liquid product contains 5, 2 and 1 units of A, B and C respectively per jar. A dry product contains 1, 2 and 4 units of A, B and C per carton. If the liquid product sells for Rs 3 per jar and the dry product sells for Rs. 2 per carton, how many of each should he purchase in order to minimize the cost and meet the requirement? Give the Mathematical Formulation of the problem. (7.5)

Q4 (a) Solve the following transportation problem. (7.5)

Warehouse	I	II	III	IV	Supply
w_1	3	4	5	6	6
w_2	2	4	4	3	10
Demand	4	6	8	6	

(b) A Company has four warehouses, a, b, c and d. It is required to deliver a product from these warehouses to three customers A, B and C. The warehouses have the following amounts in stock.

Warehouse:	**a**	**b**	**c**	**d**
No. of units:	**150**	**40**	**180**	**170**

and the customer's requirements are

Customer's :	**A**	**B**	**C**
No. of units :	**200**	**180**	**110**

The table below shows the costs of transporting one unit from warehouses to the customer's.

	a	b	c	d
A	20	25	28	31
B	32	28	32	41
C	18	35	24	32

Find the optimal schedule and minimum total transport cost. (7.5)

(c) For the following Cost minimization problem. Find initial basic feasible solution by using North-West corner rule, Least Cost method and Vogel's approximation method. compare the three solutions. (7.5)

	A	B	C	D	Supply
I	19	14	23	11	11
II	15	16	12	21	13
III	30	25	16	39	19
Demand	6	10	12	15	

Q5 (a) A department head has four tasks to be performed and three subordinates, the subordinates differ in efficiency. The estimates of the time, each subordinate would take to perform task, is given below. How should he allocated the tasks one to each subordinate, so as to minimize the total man-hours? (7.5)

Subordinate	1	2	3
I	9	26	15
II	13	27	6
III	35	20	15
IV	18	30	20

(b) A Company is faced with the problem of assigning six different machines to six different jobs. Determine the optimum assignment schedule. The cost is estimated as follows. (7.5)

	a	b	c	d	e	f
1	31	62	29	42	15	41
2	12	19	39	55	71	40

3	17	29	50	41	22	22
4	35	40	38	42	27	33
5	19	30	29	16	20	23
6	72	30	30	50	41	20

(c) Five teachers are capable of teaching anyone of the 5 different subjects. Class preparation time-hours for different topics varies from teacher to teacher and is gives in the table below. Each teacher is assigned only one topic so as to minimize the total course preparation time for all the topics. (7.5)

	I	II	III	IV	V
A	11	17	8	16	20
B	9	7	12	6	15
C	13	16	15	12	16
D	21	24	17	28	26
E	14	10	12	11	15

Q6 (a) Solve the game matrix $A=\begin{bmatrix} 0 & -2 & -1 & 0 \\ 3 & 5 & 6 & -1 \\ 5 & -1 & -3 & -2 \end{bmatrix}$ using dominance. (7.5)

(b) Find the range of values p and q so that the entry (2,2) is a saddle point in the following games (7.5)

$$\begin{array}{cc} & \begin{matrix} \text{Player B} \\ B_1 \quad B_2 \quad B_3 \end{matrix} \\ \text{Player A} & \begin{matrix} A_1 \\ A_2 \\ A_3 \end{matrix}\begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 6 \end{bmatrix} \end{array}$$

(c) Find the solution of the following payoff matrix, graphically:

$$A=\begin{bmatrix} -1 & 7 \\ 4 & -1 \\ 2 & 1 \\ 3 & -2 \end{bmatrix}$$ (7.5)