(c) Find saddle points(s), if any, for the following game with payoff matrix :

$$\begin{bmatrix} 10 & -8 \\ -7 & 5 \end{bmatrix}$$

Hence, or otherwise solve the game.

6. (a) Consider a game with following payoff matrix :

$$\begin{array}{c} \\ \text{Player P1} \end{array} \begin{array}{c} \text{Player P2} \\ \begin{bmatrix} -3 & -2 & 6 \\ 2 & 0 & 2 \\ 5 & -2 & -4 \end{bmatrix} \end{array}$$

Determine the saddle point(s), the optimal strategies for each player, and the value of the game.

(b) Solve the following using Principle of Dominance:

$$\begin{array}{c} \\ \text{Player P1} \end{array} \begin{array}{c} \text{Player P2} \\ \begin{bmatrix} -3 & 1 & 2 \\ 1 & 2 & 1 \\ 1 & 0 & -2 \end{bmatrix} \end{array}$$

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4577 **I**

Unique Paper Code : 2352203502

Name of the Paper : DSC-5 : LINEAR PROGRAMMING

Name of the Course : **B.A. (Prog.) with Mathematics as Major**

Semester : V – DSC

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

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

1. (a) Find all the Basic feasible solutions of the following system of equations :

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

$2x_1 + x_2 + x_3 + 2x_4 = 3$

(b) Solve the following LPP graphically

Maximize $z = 40x_1 + 30x_2$

Subject to

$x_1 + 2x_2 \leq 40$

$4x_1 + 3x_2 \leq 120$

$x_1, x_2 \geq 0$

(c) Define a convex set. Test the convexity for the sets $S_1 = \{(x, y): y^2 \leq 4x\}$.

2. (a) Solve the following LPP using Simplex method

Maximize $-5x_1 + 4x_2 + x_3$

subject to $x_1 + x_2 - 3x_3 \leq 8$

$2x_2 - 2x_3 \leq 7$

$-x_1 - 2x_2 + 4x_3 \leq 6$

$x_1, x_2, x_3 \geq 0$

	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	

(b) Solve the problem of assigning six different machines to six different jobs. The cost is estimated as follows. Determine the optimum assignment schedule.

	A	B	C	D	E	F
1	9	22	58	11	19	27
2	43	78	72	50	63	48
3	41	28	91	37	45	33
4	74	42	27	49	39	32
5	36	11	57	22	25	18
6	3	56	53	31	17	28

(c) Certain equipment needs 5 repair jobs which have to be assigned to 5 machines. The estimated time (in hours) that a mechanic requires to complete the repair job is given in the table. Assuming that each mechanic can be assigned only one job, determine the minimum time assignment.

	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	13

5. (a) Find initial basic feasible solution by using North-West comer rule, Least Cost method and Vogel's approximation method. Compare the three solutions.

(b) Solve the following LPP using simplex method

Minimize $2x_1 + 4x_2 - 4x_3 + 7x_4$

subject to $8x_1 - 2x_2 + x_3 - x_4 \leq 50$

$3x_1 + 5x_2 + 2x_4 \leq 150$

$x_1 - x_2 + 2x_3 - 4x_4 \leq 100$

$x_1, x_2, x_3, x_4 \geq 0$

(c) Solve the following LPP using simplex method

Maximize $-2x_1 - 4x_2 + x_3$

subject to $x_1 + x_2 - 3x_3 \leq 8$

$4x_1 - x_2 + x_3 \geq 2$

$2x_1 + 3x_2 - x_3 \geq 4$

$x_1, x_2, x_3 \geq 0$

3. (a) Solve the following LPP using simplex method

Minimize $-3x_1 + 4x_2$

subject to $x_1 + x_2 \leq 4$

$2x_1 + 3x_2 \geq 18$

$x_1, x_2 \geq 0$

(b) Consider the following primal problem :

Minimize $Z = CX$

Subject to

$AX \geq b$

$X \geq 0.$

Find the dual of the primal problem and show that dual of dual is primal.

(c) Find the dual of the following linear programming problem :

Minimize $x_1 + 5x_2 + 7x_3$

subject to $2x_1 - 8x_2 + 4x_3 \geq 10$

$3x_1 - 9x_2 + 2x_3 = 5$

$x_1, x_2 \geq 0, x_3$ Unrestricted

4. (a) A Company has four warehouses, I, II, III and IV. 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:	I	II	III	IV
No. of units:	15	16	12	13

and the customer's requirements are

Customer's :	A	B	C
No. of units :	18	20	18

The table below shows the costs of transporting one unit from warehouse to the customer

	I	II	III	IV
A	8	9	6	3
B	6	11	5	10
C	3	8	7	9

Find the optimal schedule and minimum total transport cost.

(b) Solve the following Cost minimization problem.

	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	