(b) Solve the following linear programming problem graphically :

Maximize $Z = 2x + 3y$

Subject to:

$$x + y \leq 5$$
$$x + 2y \leq 8$$
$$x \geq 0, y \geq 0$$

7. (a) Solve the following linear programming problem using the simplex method:

Maximize $Z = 3x_1 + 2x_2$

Subject to :

$$x_1 + x_2 \leq 4$$
$$x_1 - x_2 \leq 2$$
$$x_1, x_2 \geq 0$$

(b) For the above problem, perform postoptimality analysis if the coefficient of x_1 in the objective function changes from 3 to 5. Determine the new optimal solution if possible.

8. (a) Write the dual of the following primal linear programming problem:

Maximize $Z = 4x_1 + 3x_2$

Subject to:

$$2x_1 + x_2 \leq 10$$
$$x_1 + x_2 \leq 8$$
$$x_1, x_2 \geq 0$$

(b) Solve the dual problem graphically and find the optimal value of the dual objective function.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 11054 **K**

Unique Paper Code : 613337003

Name of the Paper : Linear Programming

Name of the Course : **B.A. (VS) MM**

Semester : VII – NEP

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 any **five** questions.
3. **All** questions carry equal marks.

1. (a) Solve the following system of linear equations using the Gauss-Jordan elimination method:

$$\begin{aligned} 2x + y - z &= 8 \\ -3x - y + 2z &= -11 \\ -2x + y + 2z &= -3 \end{aligned}$$

(b) Find the inverse of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}$ using elementary row operations.

2. (a) Determine whether the vectors

$$\mathbf{v_1} = \begin{bmatrix}1\\2\\3\end{bmatrix}, \mathbf{v_2} = \begin{bmatrix}4\\5\\6\end{bmatrix}, \mathbf{v_3} = \begin{bmatrix}7\\8\\9\end{bmatrix}$$

are linearly independent.

(b) Find the rank of the matrix $B = \begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix}$.

3. (a) A company produces two products; A and B. Product A requires 2 hours of machining and 3 hours of assembling. Product B requires 3 hours of machining and 2 hours of assembling. The company has 100 hours of machining time and 120 hours of assembling time available. The profit per unit of A is Rs. 50 and for B is Rs. 60. Formulate a linear programming model to maximize profit.

(b) Solve the above linear programming problem graphically.

4. (a) A farmer wants to mix two types of fertilizers, F1 and F2. Each kg of F1 contains 2 units of nitrogen and 4 units of phosphorus. Each kg of F2 contains 3 units of nitrogen and 2 units of phosphorus. The soil requires at least 10 units of nitrogen and 12

units of phosphorus. If the cost per kg of F1 is Rs. 20 and F2 is Rs. 30, formulate a linear programming model to minimize cost.

(b) Solve the above linear programming problem graphically.

5. (a) Calculate the determinant of the matrix

$$C = \begin{bmatrix}2 & 1 & 1\\1 & 2 & 1\\1 & 1 & 2\end{bmatrix}.$$

(b) Solve the following system of equations using the matrix inversion method:

$$2x + y = 5$$

$$x + 2y = 4$$

6. (a) Consider an assignment problem with three workers and three jobs. The cost matrix is given below :

$$\begin{bmatrix}10 & 12 & 15\\9 & 10 & 8\\8 & 11 & 13\end{bmatrix}.$$

Formulate the linear programming model to minimize the total cost.