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

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 11055 • **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:

$x + 2y + z = 7$

$2x - y + 3z = 9$

$3x + y + 2z = 10$

(b) Find the inverse of the matrix A using elementary row operations.

$$A = \begin{bmatrix} 2 & 1 & 3 \\ 3 & 2 & 1 \\ 1 & 3 & 2 \end{bmatrix}$$

2. (a) Determine whether the vectors

$$v_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \quad v_2 = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, \quad v_3 = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$$

are linearly independent.

(b) For the above problem, perform post optimality analysis if the coefficient of x_2 in the objective function changes from 3 to 6. Determine the new optimal solution if possible.

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

Minimize $Z = 3x_1 + 5x_2$

Subject to :

$2x_1 + 3x_2 \geq 12$

$x_1 + 2x_2 \geq 8$

$x_1, x_2 \geq 0$

(b) Solve the following linear programming problem graphically :

Maximize $Z = 4x + 5y$

Subject to :

$$x + y \leq 6$$

$$2x + y \leq 8$$

$$x \geq 0,\ y \geq 0$$

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

Maximize $Z = 4x_1 + 3x_2$

Subject to :

$$2x_1 + x_2 \leq 6$$

$$x_1 + 2x_2 \leq 4$$

$$x_1,\ x_2 \geq 0$$

(b) Find the rank of the matrix

$$B = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 6 & 4 \\ 1 & 4 & 3 \end{bmatrix}$$

3. (a) A factory manufactures two types of toys, T1 and T2. Toy T1 requires 1 hour of cutting and 2 hours of polishing. Toy T2 requires 2 hours of cutting and 1 hour of polishing. The factory has 80 hours available for cutting and 100 hours for polishing. The profit on each T1 is Rs. 30 and on each T2 is Rs. 40. Formulate a linear programming model to maximize profit.

(b) Solve the above linear programming problem graphically.

4. (a) A dietitian wants to mix two foods, F1 and F2. Each unit of F1 contains 3 units of Vitamin A and 2 units of Vitamin B. Each unit of F2 contains 1 unit of Vitamin A and 4 units of Vitamin B. The minimum daily requirement is 9 units of Vitamin A and 12 units of Vitamin B. If the cost per unit of F1 is Rs. 25 and F2 is Rs. 20, formulate a linear programming model to minimize cost.

(b) Solve the above linear programming problem graphically.

5. (a) Calculate the determinant of the matrix

$$C=\begin{bmatrix}3 & 1 & 2\\ 1 & 4 & 1\\ 2 & 1 & 3\end{bmatrix}$$

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

$3x + 2y = 7$

$x + y = 3$

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

$$\begin{bmatrix}7 & 5 & 9\\ 4 & 6 & 8\\ 5 & 7 & 6\end{bmatrix}$$

Formulate the linear programming model to minimize the total cost.