

Dr. Latif and Raja Latif and Muhammad Latif and Abdul Latif

Contents

Marks: 15; Time: 20 Minutes

NAME:.....

I.D.#:

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SERIAL# SECTION #: (check one)

		1	5	7
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NOTE: SHOW ALL STEPS OF THE SOLUTION.

NO CREDIT FOR ANSWERS WITHOUT COMPLETE SOLUTION.

The questions are not in any order of difficulty at all.

Only the nonprogramable calculators are allowed.

Write the simplified answer of each question at the end of each question.

**Q.1.** (Marks : 8). (78Rolf7). Use Gauss-Jordan elimination Method (Method of Matrix Reduction:Reduced Row Echelon Form) only to solve the following system of linear equations:

$$\begin{cases} 2x - 4y + 6z = 20 \\ 3x - 6y + z = 22 \\ 2x - 5y + 2z = 18 \end{cases}$$

**Solution.** The augmented matrix for this system is

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

ROW OPERATIONS:

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

ROW OPERATIONS:

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

ROW OPERATIONS:

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

ROW OPERATIONS:

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

ROW OPERATIONS:

$$\left[ \begin{array}{ccc|c} x & y & z & const. \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \end{array} \right]$$

$x = \dots, y = \dots, z = \dots$

**Q.2.** (Marks : 8). (516BZ23). Use the **SIMPLEX METHOD** to solve the following problem.

$$\begin{aligned} &\text{MAXIMIZE } P = 4x_1 + 3x_2 + 2x_3 \\ &\text{subject to } \begin{cases} 3x_1 + 2x_2 + 5x_3 \leq 23 \\ 2x_1 + x_2 + x_3 \leq 8 \\ x_1 + x_2 + 2x_3 \leq 7 \\ x_1 \geq 0 \\ \phantom{x_1} \phantom{x_2} \phantom{x_3} \geq 0 \\ \phantom{x_1} \phantom{x_2} \phantom{x_3} \geq 0 \end{cases} \end{aligned}$$

**Solution.**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

**ROW OPERATIONS:**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

**ROW OPERATIONS:**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

**ROW OPERATIONS:**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

**ROW OPERATIONS:**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

**ROW OPERATIONS:**

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & cnst \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \\ - & - & - & - & - & - & - & : & - \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & : & \dots \end{bmatrix}$$

Max  $P = \dots$ ,  $x_1 = \dots$ ,  $x_2 = \dots$ ,  $x_3 = \dots$ .

**Q.3.** (Marks : 4). (334BZ33). Write (Set up but do not solve) the **DUAL Problem** associated with the following problem:

[Rewrite the given linear programming problem as a maximization problem with constraints involving inequalities of the form  $\leq$  (with the exception of the inequalities  $y_1 \geq 0, y_2 \geq 0$ , and  $y_3 \geq 0$ )]

**MINIMIZE**  $C = 16x_1 + 8x_2 + 4x_3$

$$\text{subject to } \begin{cases} 3x_1 + 2x_2 + 2x_3 \geq 16 \\ 4x_1 + 3x_2 + x_3 \geq 14 \\ 5x_1 + 3x_2 + x_3 \geq 12 \\ x_1 \geq 0 \\ \phantom{x_1} \phantom{x_2} \phantom{x_3} \geq 0 \\ \phantom{x_1} \phantom{x_2} \phantom{x_3} \geq 0 \end{cases}$$

The Dual Form is the following **Standard Maximum Problem:**

**MAXIMIZE**  $G = \dots$

subject to

$$\begin{cases} \dots \leq \dots \\ \dots \leq \dots \\ \dots \leq \dots \\ y_1 \geq 0 \\ y_2 \geq 0 \\ y_3 \geq 0 \end{cases}$$