Assignment 3 (60 marks)

(Sensitivity, primal-dual, duality)

Q1) ABC produces two models of an assembled product that use milling, drilling, and grinding facilities respectively. The table below shows the details:

Resource	Unit Resource Requirements		Maximum Availability
	Model 1	Model 2	
Milling (m/c Hrs)	2	3	1200
Drilling (m/c Hrs)	2	1	1000
Grinding (m/c Hrs)	0	4	800
Unit Profit (Rs.)	30	40	

a) Find the optimum number of the models to be produced for the next plan period.
b) If the available Milling machine-hours increase to 1300 units, find the new optimum solution
c) If the available grinding machine-hours are reduced to 350 units, will you be able to determine the new optimum solution directly from the given information? Explain.
d) Does the solution is profitable?

Solve using either Simplex or graphically.

Q2) Convert the following simplex problem into a dual problem.

$$\text{Maximize } z = 5x_1 + 6x_2$$
$$\text{Subject to } \quad x_1 + 2x_2 = 5$$
$$-x_1 + 5x_2 \geq 3$$
$$4x_1 + 7x_2 \leq 8$$
$$x_1 \text{ unrestricted}, x_2 \geq 0$$

Q3) Consider the maximization problem in standard form.

Z	x_1	x_2	x_3	x_4	x_5	RHS
1	0	4	0	0	-4	8
0	0	1	0	1	-1	5
0	1	2	0	0	-2	6
0	0	3	1	0	-3	7

(a) What is the corresponding dual solution?
(b) Is the dual solution feasible? If not, why not?
(c) Show that, for any feasible dual solution the dual objective must be greater than or equal to 8. (Hint: Use weak duality).

Q4) Consider the following LP:

$$\text{Maximize } z = 5x_1 + 12x_2 + 5x_3$$
$$\text{Subject to } x_1 + 2x_2 + 5x_3 \leq 10$$
$$2x_1 - x_2 + 3x_3 = 8$$
$$x_1, x_2, x_3 \geq 0$$

An optimal primal table is given below:

Basic	x_1	x_2	x_3	x_4	R	Solution
z	0	0	3/5	29/5	-2/5+M	274/5
x_2	0	1	-1/5	2/5	-1/5	12/5
x_1	1	0	7/5	1/5	2/5	26/5

Find out the optimal dual solution by using complementary slackness condition

Q5) Solve the following LPP using primal-dual method.

Minimize $Z = 600x_1 + 500x_2$

Subject to $2x_1 + x_2 \geq 80$

$x_1 + 2x_2 \geq 60$

$x_1, x_2 \geq 0$

Q6) Solve the following LPP using primal-dual method.

Minimize $Z = x_1 + 2x_2 + 3x_3$

Subject to $3x_1 + 4x_2 \leq 5$

$5x_1 + x_2 + 6x_3 = 7$

$8x_1 + 9x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$