Assignment – Module 2

1. Solve by graphical method

   Max. $5\,x_1 + 7\,x_2$

   s.t. $3\,x_1 + 4\,x_2 \leq 15$

   $2\,x_1 + 3\,x_2 \geq 12$

   $x_1 \geq 0;\ x_2 \geq 0$

   Max. $6\,x_1 + 7\,x_2$

   s.t. $7\,x_1 + 6\,x_2 \leq 42$

   $5\,x_1 + 9\,x_2 \leq 45$

   $x_1 \geq 0;\ x_2 \geq 0$

   Max. $x_1 + 2\,x_2$

   s.t. $x_1 - x_2 \geq -8$

   $5\,x_1 - x_2 \geq 0$

   $x_1 + x_2 \geq 8$

   $-x_1 + 6\,x_2 \geq 12$

   $5\,x_1 + 2\,x_2 \geq 68$

   $x_1 \leq 10$

   $x_1 \geq 0;\ x_2 \geq 0$

2. Maximize the function

   Max. $6\,x_1 + 8\,x_2$

   s.t. $5\,x_1 + 10\,x_2 \leq 60$

   $4\,x_1 + 4\,x_2 \leq 40$

$x_1 \geq 0; x_2 \geq 0$

Max. $3x_1 - x_2$

s.t. $4x_1 + 2x_2 \leq 8$

$3x_1 + x_2 \leq 10$

$x_1 \geq 0; x_2 \geq 0$

Max. $3x_1 + x_2$

s.t. $x_1 + x_2 \geq 1$

$-3x_1 + x_2 \geq 3$

$x_1 \geq 0; x_2 \geq 0$

Max. $x_1 + 2x_2$

s.t. $2x_1 - 3x_2 \leq 7$

$x_1 + 2x_2 \leq 10$

$x_1 \geq 0; x_2 \geq 0$

3. Minimize the function

Min. $4x_1 + 8x_2$

s.t. $7x_1 + x_2 \geq 7$

$2x_1 + 3x_2 \leq 6$

$3x_1 + 2x_2 \geq 6$

$x_1 + 4x_2 \geq 4$

$x_1 \geq 0; x_2 \geq 0$

Min. $x_1 + 2x_2$

s.t. $2x_1 - 3x_2 \leq 7$

$x_1 + 2\,x_2 \leq 10$

$x_1 \geq 0;\ x_2 \geq 0$

4. Formulate a linear programming problem to maximize the total income and determine the areas x_1 and x_2 under crop I and crop 2, respectively, in hectares given the following data

Water			Fertilizer		Income/ha
Crop	Units/ha required	Cost/Unit (Rs)	Units/ha required	Cost/Unit (Rs)	Rs.
1	w_1	p_1	f_1	q_1	h_1
2	w_2	p_2	f_2	q_2	h_2

The following are resource limitations.

Water availability is limited to W units.

Fertilizer availability is limited to F units.

Land availability is limited to A hectares.

Money available for investment is limited to B (Rs).

5. Two types of crops can be grown in a particular irrigation area each year. Each unit quantity of crop *A* can be sold for a price P_A and requires W_A units of water, L_A units of land, F_A units of fertilizer and H_A units of labor. Similarly crop *B* can be sold at a unit price of P_B and requires W_B, L_B, F_B and H_B units of water, land, fertilizer and labor respectively, per unit of crop. The available quantities of water, land, fertilizer & labor, and the requirements of the two crops are as given in the table below

Resource	Requirement per unit of		Maximum available resource
	Crop *A*	Crop *B*	
Water	2	3	60

Land	5	2	80
Fertilizer	3	2	60
Labor	1	2	40

The unit price P_A at which the crop A can be sold is 30 and the unit price P_B at which the crop B can be sold is 25.

i. Formulate a Linear Programming model for estimating the quantities of each of the two crops that should be produced in order to maximize the total income.

ii. Solve the LP problem

6. Identify the dual variables of the constraints of the problem in 2 and 3 in the final simplex table also solve the problems using dual variables.
7. Solve the problems 2 and 3 if x_1 is unrestricted in sign, solve the dual of the problems.
8. Solve the problems 2 and 3 if x_2 is unrestricted in sign.
9. Solve the problems 2 and 3 if both x_1 and x_2 are unrestricted in sign.