National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	**Operations Research**	**Course Code:**	**MT 4031**
	Degree Program:	**BS**	**Semester:**	**Spring 2024**
	Exam Duration:		**Total Marks:**	**50**
	Submission Date:	**20-02-2024**	**Weight**	**3**
	Section:	**J and K**	**Page(s):**	
	Exam Type:	**Assignment-I**		

Reference book: Hamdy A. Taha, Operations Research, An Introduction (10th Edition)

Instruction:

- **Clearly write your name, roll no, section, Course title and assignment title on the first page.**
- **Use A4 size sheets only. Use both sides of paper.**
- **Write question no. as given in Assignment.**
- **Late submission will have no credit.**

Questions 1: Formulate the following as a linear programming problem, solve it graphically and using GEOGEBRA. [15]

a. A carpenter has 6 units of wood and 28 hours of labour time that he wants to utilize in the production of two items. His experience suggests restricting to make bookshelves and coffee tables only. Each unit of bookshelf uses 2 units of wood and 7 hours of time, whereas each unit of coffee table requires 1 unit of wood and 8 hours of labour time. The prices of a bookshelf and a coffee table are \$120 and \$80 respectively. How many units of each item should he produce to make the maximum amount.

b.

$$\text{Max } Z = 1170x + 1110y$$

$$\text{subject to} \quad \begin{aligned} 9x + 5y &\geq 500 \\ 7x + 9y &\geq 300 \\ 5x + 3y &\leq 1500 \\ 7x + 9y &\leq 1900 \\ 2x + 4y &\leq 1000 \end{aligned}$$

$$x, y \geq 0$$

Question 2: Determine the optimum solution for the following LP by enumerating all the basic solutions. [5]

$$\text{Max } Z = x_1 + x_2$$

$$\text{subject to} \quad \begin{aligned} x_1 + 5x_2 &\leq 5 \\ 2x_1 + x_2 &\leq 4 \end{aligned}$$

$$x_1, x_2 \geq 0.$$

Questions 3: Formulate the following as a linear programming problem. Use Excel Solver to solve it. [5]

A pet store has determined that Hamster should have at least 70 units of Protein, 100 units of carbohydrates and 20 units of fats daily. The store carries 6 types of feed given in the table below. What blend of feeds will satisfy the requirement at minimum cost.

Food	Protein	Carbs	Fats	Cost $ (oz)
A	20	50	4	2
B	30	30	9	3
C	40	20	11	5
D	40	25	10	6
E	45	50	9	8
F	30	20	10	8

Question 4:

a. Show graphically and algebraically that the following LLP has an alternative optimal solution. [10]

$$\text{Max } Z = 2x_1 + 3x_2$$

subject to

$$6x_1 + 9x_2 \leq 100$$
$$2x_1 + x_2 \leq 20$$
$$x_1, x_2 \geq 0.$$

Question 5:

a. Solve the problem by M technique and Two phase method. [10+5]

$$\text{Max } Z = 6x_1 + 4x_2$$

subject to

$$x_1 + x_2 \leq 5$$
$$x_2 \geq 8$$
$$x_1, x_2 \geq 0.$$

b. Solve the following LP

$$Max\ Z = 5x_1 + 12x_2 + 4x_3$$

subject to

$$x_1 + 2x_2 + x_3 = 10$$
$$2x_1 - x_2 + x_4 = 8$$
$$x_1, x_2, x_3 \geq 0.$$