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:	40
Submission Date:	26-02-2024	Weight	3
Section:	J and K	Page(s):	
Exam Type:	Assignment-2		

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.**
- **Don't mention question number only, write full statement.**
- **Late submission will have no credit.**

Questions 1: [5+5]

Write dual of the following problem. Solve the dual, and then find the optimal solution of primal from the solution of the dual. (Use **excel solver** for solution and write solution on answer sheet).

$$\text{Minimize } z = 50x_1 + 60x_2 + 30x_3$$

$$\begin{aligned} 5x_1 + 5x_2 + 3x_3 &\geq 50 \\ x_1 + x_2 - x_3 &\geq 20 \\ 7x_1 + 6x_2 - 9x_3 &\geq 30 \\ 5x_1 + 5x_2 + 5x_3 &\geq 35 \\ 2x_1 + 4x_2 - 15x_3 &\geq 10 \\ 12x_1 + 10x_2 &\geq 90 \\ x_2 - 10x_3 &\geq 20 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

Question 2: [5+5]

Consider the following LP model,

$$\text{Maximize } z = 3x_1 + 2x_2 + 5x_3$$

subject to

$$\begin{aligned} x_1 + 2x_2 + x_3 + x_4 &= 30 \\ 3x_1 + 2x_3 + x_5 &= 60 \\ x_1 + 4x_2 + x_6 &= 20 \\ x_2, x_2, x_3, x_4, x_5, x_6 &\geq 0 \end{aligned}$$

Construct the entire simplex tableau associated with the following basic variables and check it for optimality and feasibility.

$$\text{Basic variables} = (x_2, x_3, x_1), \text{Inverse} = \begin{pmatrix} \frac{1}{4} & -\frac{1}{8} & \frac{1}{8} \\ \frac{3}{2} & -\frac{1}{4} & -\frac{3}{4} \\ -1 & \frac{1}{2} & \frac{1}{2} \end{pmatrix}$$

Question 3: [5+5]

a. Solve the following LLP using dual simplex method.

$$\begin{aligned} & & \text{minimize } z = 2x_1 + x_2 \\ \text{subject to} & & x_1 + x_2 = 4 \\ & & 2x_1 - x_2 \geq 3 \\ & & x_1, x_2 \geq 0. \end{aligned}$$

b. Use generalized simplex method to solve the following LLP.

$$\begin{aligned} & & \max z = 5x_1 + 2x_2 \\ \text{subject to} & & 6x_1 + x_2 \geq 6 \\ & & 4x_1 + 3x_2 \geq 12 \\ & & x_1 + 2x_2 \geq 4 \\ & & x_1, x_2 \geq 0. \end{aligned}$$

Question 4: [6+4]

a. In the unbalanced transportation problem in Table 5.36, if a unit from a source is not shipped out (to any of the destinations), a storage cost is incurred at the rate of \$5, \$4, and \$3 per unit for sources 1, 2, and 3, respectively. Additionally, all the supply at source 2 must be shipped out completely to make room for a new product. Apply **Vogel's approximation** method and find the **optimal solution**.

1\$	2\$	1\$	**20**
3\$	4\$	**R\$**	**40**
2\$	3\$	3\$	**30**
30	**20**	**20**	

Description about **R: R is the sum of last four numeric digits of your roll number. For example, if your roll number is 21L-0930 then R= 0 + 9 + 3 + 0 = 12.**

b. Solve the above problem using **the Least cost method** and find the initial basic feasible solution. Compare the solution, which method provides better initial feasible solution.