

U.G. 5th Semester Examination - 2025**MATHEMATICS****[MINOR]****Course Code : MATH-Mi-T-03****(Linear Programming Problem)****[NEP-2020]**

Full Marks : 40

Time : 2 Hours

*The figures in the right-hand margin indicate marks.**The notations and symbols have their usual meanings.*

1. Answer any **five** questions: $2 \times 5 = 10$
- a) What is the difference between basic solution and non-basic solution?
 - b) Express $X=(4,5)$ as linear combination of vectors $(1,3)$ and $(2,2)$.
 - c) Find a basis for E^3 that contains the vectors $(1,2,2)$ and $(2,0,1)$.
 - d) State fundamental theorem of L.P.P.
 - e) Show that $X = \{(x_1, x_2) : x_1^2 + x_2^2 = 9\}$ is not a convex set.
 - f) Under what condition LPP will have alternative optimum solution?

[Turn over]

- g) Which algorithms are used to find a initial basic solution of a transportation problem?
- h) Write a short note on variation in assignment problem.

2. Answer any **two** questions: $5 \times 2 = 10$

- a) Solve by simplex method

$$\text{Max } z = x_1 + x_2 + 3x_3$$

$$\text{Subject to: } 3x_1 + 2x_2 + x_3 \leq 3$$

$$2x_1 + x_2 + 2x_3 \leq 2$$

$$x_1, x_2 \text{ and } x_3 \geq 0$$

- b) Obtain the dual problem of the following LPP

$$\text{Max } z = 2x_1 + 5x_2 + 6x_3$$

$$\text{Subject to: } 5x_1 + 6x_2 - x_3 = 3$$

$$-2x_1 + x_2 + 4x_3 \leq 4$$

$$x_1 - 5x_2 + 3x_3 \leq 1$$

$$-3x_1 - 3x_2 + 7x_3 \leq 6$$

$$x_1, x_2, x_3 \geq 0$$

- c) Use duality to solve the problem.

$$\text{Minimize } z = 3x_1 + x_2$$

$$\text{Subject to: } 2x_1 + 3x_2 \geq 2$$

$$x_1 + x_2 \geq 1$$

$$x_1, x_2 \geq 0$$

- d) Solve the following assignment problem:

	I	II	III	IV	V
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

3. Answer any **two** questions: $10 \times 2 = 20$

- a) Solve the following transportation problem to maximize the profit:

	D ₁	D ₂	D ₃	D ₄	a _i
O ₁	15	51	42	33	23
O ₂	80	42	26	81	44
O ₃	90	40	66	60	33
b _j	23	31	16	30	

- b) Solve the following LPP by using two-phase simplex method:

$$\text{Max } z = 5x_1 + 8x_2$$

$$\text{Subject to: } 3x_1 + 2x_2 \geq 3$$

$$x_1 + 4x_2 \geq 4$$

$$x_1 + x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

- c) At a cattle breeding firm, it is prescribed that the food ration for one animal must contain at least 14, 22 and 1 unit of nutrients A, B and C respectively. Two different kinds of fodder are available. Each unit weight of these two contains the following amounts of the three nutrients:

	Fodder 1	Fodder 2
Nutrient A	2	1
Nutrient B	2	3
Nutrient C	1	1

It is given that the costs of unit quantity of fodder 1 and 2 are 3 and 2 monetary unit respectively. Pose a LPP in terms of minimizing the cost of purchasing the fodders for the above cattle breeding firm. Hence solve the problem graphically.
