

**A-1017**

Total Pages : 4

Roll No. ....

**MAT-603**

**M.Sc. Math (MSCMT)**

**Operations Research**

Examination, 2026 (Feb.)

Time : 2:00 Hrs.

Max. Marks : 70

*Note :-* This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. *Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.*

**Section-A**

**Long Answer Type Questions**      2×19=38

*Note :-* Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *Two* (02) questions only.

1. Define basic feasible solution. Find out the basic feasible solution for the system of linear equations :

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( 1 )

P.T.O.

$$2x_1 + 3x_2 - x_3 + 4x_4 = 8$$

$$x_1 - 2x_2 + 6x_3 - 7x_4 = -3$$

$$x_1, x_2, x_3, x_4 \geq 0$$

2. Use two-phase method to :

$$\text{Maximize : } Z = 10x_1 + 20x_2$$

Subject to the constraints :

$$2x_1 + x_2 = 1,$$

$$x_1 + 2x_2 = 5$$

and  $x_1 \geq 0, x_2 \geq 0.$

3. Define with examples the following :

(i) Degenracy in linear programming

(ii) Two phase method

4. In the given LPP :

$$\text{Minimize : } Z = 3x + 6y + z$$

Subject to the constraints :

$$x + y + z \geq 6;$$

$$x + 5y - z \geq 4$$

$$x + 5y + z \geq 24;$$

$$x, y, z \geq 0$$

Solve the Linear Programming Problem (LPP) and analyze the impact of modifying the requirement vector from [6, 4, 24] to [6, 2, 12] on the optimal solution.

5. Solve the following LPP by graphical method.

Minimize :  $Z = 20x_1 + 10x_2$

Subject to :  $x_1 + 2x_2 \leq 40$

$$3x_1 + x_2 \geq 30,$$

$$4x_1 + 3x_2 \geq 60,$$

$$x_1, x_2 \geq 0$$

### Section–B

#### Short Answer Type Questions 4×8=32

**Note** :- Section ‘B’ contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *Four* (04) questions only.

1. Using the graphical method solve the following LPP :

Minimize :  $Z = 2x + 3y$

Subject to the constraint :

$$x + y \leq 30$$

$$x - y \geq 0$$

$$y \geq 3$$

$$0 \leq x \leq 20,$$

$$0 \leq y \leq 12$$

2. Obtain the dual problem of the following primal problem :

Minimize :  $Z = x_1 - 3x_2 - 2x_3$

Subject to the constraints :

$$3x_1 - x_2 + 2x_3 \leq 7,$$

$$2x_1 - 4x_2 \geq 12,$$

$$-4x_1 + 3x_2 + 8x_3 = 10$$

and  $x_1 \geq 0$ ,  $x_2 \geq 0$  and  $x_3$  is unrestricted.

3. Solve the following LPP using branch and bound method :

Maximize :  $Z = 7x_1 + 9x_2$

Subject to the constraints :

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

$$7x_1 + x_2 \leq 35$$

$$x_2 \geq 7,$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

and  $x_1, x_2 \in \mathbb{Z}$ .

4. Prove that in a general transportation problem with  $m$  supply nodes and  $n$  demand nodes, the number of basic variables in any feasible solution is  $m + n - 1$ .
5. Define balanced transportation problem with example.
6. Minimize the function  $f(x, y) = x^2 + y^2$  subject to the constraint  $x + y = 1$ .
7. Derive the necessary conditions for the non-linear programming problem.

Minimize :

$$Z = f(x, y) = 3e^{2x_1+1} + 2e^{2x_2+5}$$

Subject to the constraint :

$$x_1 + x_2 = 7$$

$$x_1 \geq 0$$

$$x_2 \geq 0$$

8. Prove that intersection of two convex sets is also a convex set.

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