MAMT-10/MSCMT-10/MAT-301

June - Examination 2026

M.A./M.Sc. (Final) Examination

MATHEMATICS

Mathematical Programming

Paper : MAMT-10/MSCMT-10/MAT-301

[*Time: **3** Hours*] [*Maximum Marks: **80***]

Note :- The question paper is divided into three Sections A, B and C. Write answers as per the given instructions in each section. Use of non-programmable scientific calculator is allowed in this paper.

Section-A **8×2=16**

(Very Short Answer Type Questions)

Note :- Answer **all** questions. As per the nature of the question delimit your answer in one word, one sentence or maximum up to **30** words. Each question carries **2** marks.

1. (i) Define Hyperplane.

   (ii) Write principal minor test for positive and negativeness of quadratic form.

   (iii) Define Integer programming problem.

   (iv) What do you mean by branch and bound technique?

   (v) Write the quadratic form in the matrix form

   $$Q(X) = x_1^2 + 2x_2^2 - 7x_3^2 - 4x_1x_2 + 6x_1x_3 - 5x_2x_3$$

   (vi) Define Lagrange's functions for nonlinear programming problem.

   (vii) Write advantage of convex programming problem over the general nonlinear programming problem.

   (viii) State Bellman's Principle of Optimality.

Section-B **4×8=32**

(Short Answer Type Questions)

Note :- Answer **any four** questions. You have to delimit your each answer maximum up to **200** words. Each question carries **8** marks.

2. Prove that $f(x) = \frac{1}{x}$ is strictly convex for $x > 0$ and strictly concave for $x < 0$.

3. Explain Cutting Plane Algorithm.

4. Obtain the necessary and sufficient conditions for the optimum solution of the following nonlinear programming problem

   Minimize $Z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$

   subject to $x_1 + x_2 + x_3 = 15$

   $$2x_1 - x_2 + 2x_3 = 20, \quad x_1,\ x_2,\ 2x_3 \geq 0$$

5. Use method of Lagrangian multipliers to solve the following nonlinear programming problem :

Optimize $f(X) = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$

subject to $x_1 + x_2 + x_3 = 20$

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

6. Derive the dual of the quadratic programming problem :

Min $f(X) = C^T X + \frac{1}{2} X^T GX$

subject to $AX \geq b$

Where A is an m × n real matrix and G is an n × n real positive semidefinite a symmetric matrix.

7. Prove that the set of all optimum solutions (global maximum) of the general convex programming problem is a convex set.

8. Use dynamic programming to solve

Min. $z = \sum_{i=1}^{n} x_i$

subject to $\prod_{i=1}^{n} x_i = b$

and $x_i \geq 0$, i = 1, 2, ..., n

9. Use dynamic programming to solve

Max. $z = x_1 + 9x_2$

Subject to $2x_1 + x_2 \leq 25$

$x_2 \leq 11$

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

Section-C **2×16=32**

(Long Answer Type Questions)

Note :- Answer **any two** questions. You have to delimit your each answer maximum up to **500** words. Each question carries **16** marks.

10. Solve the following linear programming problem by using revised simplex method :

Max z $3x_1 + 6x_2 + 2x_3$

S.t $3x_1 + 4x_2 + x_3 \leq 2$

$x_1 + 3x_2 + 2x_3 \leq 1$

$x_1, x_2, x_3 \geq 0$

11. Solve the following Integer programming problem using branch and bound algorithm :

Max $Z = 2x_1 + 6x_2$

s.t $3x_1 + x_2 \leq 5$

$4x_1 + 4x_2 \leq 9$

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

12. Use Kuhn-Tucker conditions to solve the following nonlinear programming problem :

Minimize $f(x_1, x_2) = (x_1 - 2)^2 + (x_2 - 1)^2$

subject to $x_1^2 - x_2 \leq 0$

$x_1 + x_2 \leq 2$

$x_1, x_2 \geq 0$

13. Solve the following quadratic programming problem by Beale's Method :

Maximize $f(x_1, x_2) = 2x_1 + 3x_2 - 2x_1^2$

subject to $x_1 + 4x_2 + x_3 = 4$

$x_1 + 2x_2 + x_4 = 2$

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