MCC/24/M.SC./SEM.-IV/MTM/1

PG (CBCS)

M.SC. Semester- IV Examination, 2026

APPLIED MATHEMATICS

PAPER: MTM 404A

(NON-LINEAR OPTIMIZATION)

Full Marks: 20 **Time: 1 Hour**

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **TWO** of the following questions: $2\times2=4$

   a) Write down one advantage and one disadvantage of geometric programming problem.

   b) Justify the statement: Bi-matrix game is the generalization of matrix game.

   c) State Kuhn-Tucker stationary point necessary optimality theorem.

   d) Define primal(minimization) and dual(maximization) problem in non-linear programming problem.

GROUP-B

2. Answer any **TWO** of the following questions: $2\times4=8$

   a) Define strategically equivalent bi matrix game. Prove that all strategically equivalent bi matrix games have the same Nash equilibrium.

   b) State and prove weak duality theorem.

   c) Let θ be a numerical differentiable function on an open convex set $\Gamma \subset R^n$. Prove that θ is convex if and only if $\theta(x^2) - \theta(x^1) \leqq \nabla\theta(x^1)(x^2 - x^1)$ for each $x^1, x^2 \in \Gamma$.

   d) State and prove Fritz-John saddle point sufficient optimality theorem.

GROUP-C

3. Answer any **ONE** of the following questions: $1\times8=8$

   a) (i) Use the chance constrained programming to find an equivalent deterministic problem to following stochastic programming problem, when a_{ij} is a random variable:

$$Minimize\ F(x) = \sum_{j=1}^{n} c_j x_j$$

$$\text{subject to } \sum_{j=1}^{n} a_{ij} x_j \leq b_i$$

$$x_j \geq 0, i, j = 1,2, \dots, n.$$

(P.T.O.)

(ii) Define fuzzy multi-objective non-linear programming problem with an example.

b) (i) Solve the geometric programming problem $Min\ f(X) = 7x_1x_2^{-1} + 3x_2x_3^{-1} + 5x_1^{-3}x_2x_3 + x_1x_2x_3, x_i \geq 0, i = 1, 2, 3.$

(ii) Discuss the relationship between Minimization problem, Local Minimization problem, Kuhn- Tucker stationary point problem, Fritz-John Stationary point problem, Kuhn- Tucker saddle point problem, Fritz-John Saddle point problem.

State Fritz-John saddle point necessary optimality theorem.

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