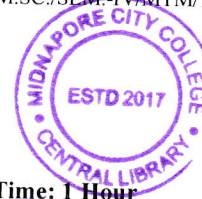


PG (CBCS)
M.SC. Semester- IV Examination, 2026
APPLIED MATHEMATICS
 PAPER: MTM 404A
(NON-LINEAR OPTIMIZATION)



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: 2×2=4
- Write down one advantage and one disadvantage of geometric programming problem.
 - Justify the statement: Bi-matrix game is the generalization of matrix game.
 - State Kuhn-Tucker stationary point necessary optimality theorem.
 - Define primal(minimization) and dual(maximization) problem in non-linear programming problem.

GROUP-B

2. Answer any **TWO** of the following questions: 2×4=8
- Define strategically equivalent bi matrix game. Prove that all strategically equivalent bi matrix games have the same Nash equilibrium.
 - State and prove weak duality theorem.
 - 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 $\theta(x^2) - \theta(x^1) \leq \nabla \theta(x^1)(x^2 - x^1)$ for each $x^1, x^2 \in \Gamma$.
 - State and prove Fritz-John saddle point sufficient optimality theorem.

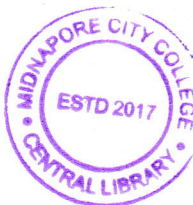
GROUP-C

3. Answer any **ONE** of the following questions: 1×8=8
- (i) Use the chance constrained programming to find an equivalent deterministic problem to following stochastic programming problem, when a_{ij} is a random variable:

$$\text{Minimize } F(x) = \sum_{j=1}^n c_j x_j$$
 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 $\text{Min } f(X) = 7x_1x_2^{-1} + 3x_2x_3^{-1} + 5x_1^{-3}x_2x_3 + x_1x_2x_3, x_i \geq 0, i = 1, 2, 3.$
- (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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