2025
SRMUJ
4^{th} Semester Examination
M.Sc.
Mathematics
MTM-404 (B)
Special-paper OR: Advanced Optimization-II

Full Marks: 40 **Time: 2 hours**

The figures in the margin indicate full marks. Candidates are required to give their answers as far as practicable. Notations have their usual meaning.

1. Answer any four of the following questions: **4 × 2**

(a) Define concave function. Give the geometrical interpretation of it (with figure).

(b) Write a primal quadratic minimization problem and then find its dual problem.

(c) What do you mean by theorems of alternative?

(d) State separation theorem on nonlinear programming.

(e) What is chance constrained programming technique?

(f) Define degree of difficulty of a geometric programming. Define the various degree of difficulty.

2. Answer any four of the following questions: **4 × 8**

(a) (i) Let θ be a numerical differentiable function on an open convex set $\Gamma \subset \mathbb{R}^n$. Prove that a necessary and sufficient condition for which θ be convex on Γ is that $[\nabla\theta(x^2) - \nabla\theta(x^1)](x^2 - x^1) \geq 0$, for each $x^1, x^2 \in \Gamma$.

(ii) What is differentiable convex function? Give the geometrical interpretation of it. 5 + 3

(b) (i) State and prove Fritz john stationary point sufficient optimality theorem.

(ii) Consider a 3-person game in which each player has two alternatives to choose and from in which the possible outcomes are given by

P_2

P_1		
	$(1, -1, 0)$	$(0, 1, 0)$
	$(2, 0, 0)$	$(0, 0, 1)$

P_2

P_1		
	$(1, 0, 1)$	$(0, 0, 0)$
	$(0, 3, 0)$	$(-1, 2, 0)$

Using mixed strategies method find the unique inner Nash equilibrium solution of this game.
5 + 3

(c) (i) What is Particle Swarm optimization? Write its main criteria for mathematical model.

(ii) Explain the three types of operators involved in the simplest form of genetic algorithm.

(iii) Give the geometrical interpretation of Farkas' theorem. 3 + 3 + 2

(d) (i) State and prove uniqueness theorem.

(ii) Using the chance constrained programming technique to find an equivalent deterministic LPP to the following Stochastic programming problem.

$$\text{Minimize } F(x) = \sum_{j=1}^{n} c_j x_j$$
$$\text{subject to } \sum_{j=1}^{n} a_{ij} x_j \leq b_j, x_j \geq 0\,; \quad i, j =, 2, \ldots, n$$

where c_j is a random variable. 3 + 5

(e) Depict the solution procedure for solving constrained geometric programming problem (the problem is to considered by you). 8

(f) Solve the following quadratic problems by using Beale's method: 8

$$\text{maximize } Z = 10x_1 + 25x_2 - 10x_1^2 - x_2^2 - 4x_1x_2$$
$$\text{subject to the constraints} \quad x_1 + 2x_2 \leq 10$$
$$x_1 + x_2 \leq 9$$
$$x_1, x_2 \geq 0.$$