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M.Sc 4th Semester Examination, 2020

Applied Mathematics with Oceanology and Computer Programming

Paper: MTM – 404

(Non-linear Optimization)

Full Marks: 50 Time: 2 hours

The figures in the right hand margin indicate marks

Answer **Q. No. 1** and any **three** questions from the rest

1. Answer any five questions $2 \times 5 = 10$

   (a) What is stochastic programming? Write two important methods for solving Stochastic programming problem.

   (b) How is the degree of difficulty defined for a geometric programming problem? Give an example of a geometric programming problem which has negative degree of difficulty.

   (c) Define Nash equilibrium solution and Nash equilibrium outcome in pure strategy for bimatrix game.

   (d) Define Pareto optimal solution in a multi-objective nonlinear programming problem.

   (e) State Kuhn-Tucker stationary point necessary optimality theorem.

   (f) What do you mean by complementary slackness conditions concerning on Wolfe's method?

   (g) Why is the prisoner's dilemma important?

2. (a) Solve the following quadratic problem by Beal's method: $6 + 4$

   Minimize $f(x) = 2x_1 + 3x_2 - 2x_1^2$

   Subject to the constraint

   $x_1 + 4x_2 \leq 4$

   $x_1 + x_2 \leq 2$

   $x_1,\ x_2 \geq 0$

   (b) Write the dual of the nonlinear programming problem

   Minimize $f(x) = -4x_1 - 2x_2 + x_1^2 + x_2^2$

   Subject to the constraint

   $2x_1 - x_2 \leq 7$

   $-x_1 + x_2 \leq -2$

   $x_1, x_2 \geq 0$

(Turn Over)

3. (a) Using Geometric Programming Technique, 6 + 4

 Minimize $f(x) = x_1^2 + x_2^2$

 Subject to the constraint $x_1 x_2 > 1\ x_1, x_2 \geq 0$

 (b) State and prove Slater's theorem of alternative.

4. Solve the following nonlinear programming problem using separable programming algorithm 10

 Minimize $f(x) = 3x_1 + 2x_2$

 Subject to the constraint

 $4x_1^2 + x_2^2 \leq 16$

 $x_1,\ x_2 \geq 0$

5. (a) Use chance constrained programming technique to find an equivalent deterministic LPP to the following stochastic programming problem: 5 + 5

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

$$\text{Subject to the constraints } p\left[\sum_{j=1}^{n} a_{ij}\, x_j \leq b_i\right] \geq p_i\,,\ x_j \geq 0,\ j = 1,2,\ldots n.$$

 Where a_{ij}'s are random variables and P_i 's are Specified probabilities.

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

6. Find the mixed Nash equilibrium points of the game 10

(3, 2)	(2, 1)
(0, 3)	(4, 4)

[Internal Assessment: 10 Marks]