Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E -IIIrd SEMESTER–EXAMINATION – MAY- 2012

Subject code: 730403 **Date: 10/05/2012**

Subject Name: Optimization Techniques

Time: 10:30 am – 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is optimization? Explain linear and nonlinear optimization cases encountered in the communication systems application area. **07**

(b) Two airstrips are to be constructed in the jungle to service 3 remote oil fields. The first oil requires 25 tons of supplies per month. The second, which is 75kilometers east and 330kilometers north of the first, requires 14tons. The third, which is 225kilometers west and 40kilometers south of the first, needs 34tons per month. Formulate a location allocation model to locate and operate the airstrips to minimize the tons-kilometers flown per month. **07**

Q.2 **(a)** Explain Weierstrass theorem **07**

(b) Determine whether each of the following mathematical programs is a convex program. **07**

(i) Max $3x_1 - x_2 + 8\ln(x_1)$

Sub. To $4(x_1)^2 - x_1x_2 + (x_2)^2 \le 100$

$x_1 + x_2 = 4$

$x_1, x_2 \ge 0$

(ii) Min $3x_1 - x_2 + 8\ln(x_1)$

Sub. To $(x_1)^2 + (x_2)^2 \ge 10$

$x_1 + x_2 = 4$

$x_1, x_2 \ge 0$

OR

(b) Determine whether each of the following mathematical programs is a convex program. **07**

(i) Max $x_1 + 7x_2$

Sub. To $x_1x_2 \le 14$

$(x_1)^2 + (x_2)^2 = 40$

$x_1, x_2 \ge 0$

(ii) Min $x_1 + 7x_2$

Sub. To $x_1 + x_2 \le 14$

$x_1 - x_2 \ge 0$

$2x_1 + 5x_2 = 18$

$x_1, x_2 \ge 0$

Q.3 **(a)** Consider the following nonlinear program: **07**

Max $2x_1 + 7x_2$

Sub. To. $(x_1 - 2)^2 + (x_2 - 2)^2 = 1$

$x_1 \leq 2$

$x_2 \leq 2$

$x_1 \geq 0$

$x_2 \geq 0$

State the Karush-kuhn-Tucker conditions for this model.

(b) State the necessary and sufficient conditions for the unconstrained minimum of a function. **07**

OR

Q.3 **(a)** Consider the following nonlinear program: **07**

Min $(x_1)^2 + (x_2)^2$

Sub. To $x_1 + x_2 = 1$

$x_1 , x_2 \geq 0$

A global optimum is $x_1^* = x_2^* = ½$

State the Karush-kuhn-Tucker conditions for this model

(b) Give three reasons why the study of unconstrained minimization methods is important. **07**

Q.4 **(a)** Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $\mathbf{X_1} = \{^0_0\}$. **07**

(b) Explain the iterative procedure of Fletcher – Reeves method (Conjugate Gradient method). **07**

OR

Q.4 **(a)** Show that the Newton's method finds the minimum of a quadratic function in one iteration. **07**

(b) Explain the criteria used to terminate the iterative process of Steepest Descent method. **07**

Q.5 **(a)** Solve the following nonlinear programming problem using Lagrangean method: **07**

Max. $Z = 4x_1 - 0.02x_1^2 + x_2 - 0.02x_2^2$

Sub. To. $x_1 + 2x_2 = 120$

$x_1 , x_2 \geq 0$

(b) Use absolute value penalty functions to reduce the following constrained nonlinear program to an unconstrained penalty model: **07**

Min. $(x_1)^4 - x_1x_2x_3$

Sub. To $x_1 + x_2 + x_3 = 5$

$(x_1)^2 + (x_2)^2 \leq 9$

$x_3x_2 \geq 1$

OR

Q.5 **(a)** Solve the following nonlinear programming problem using Lagrangean method: **07**

Min. $Z = 2x_1^2 - 3x_2^2 + 18x_2$

Sub. To. $2x_1 + x_2 = 8$

$x_1 , x_2 \geq 0$

(b) Explain the procedure to solve successive quadratic programming problems. **07**

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