Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remedial Examination April 2010

Subject code: 710903

Subject Name: Engineering Optimization

Date: 08 / 04 / 2010 **Time: 12.00 noon – 02.30 pm**

Total Marks: 60

Instructions:

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

Q.1 **(a)** The efficiency of a screw jack is given by $\eta = \dfrac{\tan\alpha}{\tan(\alpha+\phi)}$ where ϕ is a constant .Prove that the efficiency will be maximum at $\alpha = 45^0 - \dfrac{\phi}{2}$ with $\eta_{max} = \dfrac{1-\sin\phi}{1+\sin\phi}$. **06**

(b) (i) Define a saddle point and indicate its significance. **06**
(ii)State the necessary and sufficient condition for the minimization of a convex programming problem with inequality constraints.

Q.2 **(a)** Minimize $f = x_1^2 + x_2^2 + 60x_1$ subject to the constraints **06**
$g_1 = x_1 - 80 \geq 0$
$g_2 = x_1 + x_2 - 120 \geq 0$ Using Kuhn-Tucker conditions.

(b) Find the dimensions of a cylindrical tin (with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 24\pi$. **06**

OR

(b) Find the optimum value of the function $f(x) = (x-2)^4$ and also state if the function attains a maximum or minimum. **06**

Q.3 **(a)** Determine whether the function is convex or concave **06**
$f(x_1, x_2) = 3x_1^3 - 6x_2^2$

(b) Find the condition that the quadratic form is positive definite, negative definite or neither **06**
$f = -x_1^2 + 4x_1x_2 + 4x_2^2$

OR

Q.3 **(a)** Minimize $f = 5x_1x_2^{-1}x_3^2 + x_1^{-2}x_2^{-1} + 10x_2^3 + 2x_1^{-1}x_2x_3^{-2}$ using geometric programming method. **06**

(b) Minimize the function $f = 100(x_1^2 - x_2)^2 + (1-x_1)^2$ using vector metric method. **06**

Q.4 **(a)** Find the dimensions of a triangle with maximum area when perimeter =15cm. **06**

(b) Using Newton's method minimize the function $f(x) = 3x - \cos x - 1$ correct to four decimal places, take $x_0 = 0.6$. **06**

OR

Q.4 **(a)** Perform two iterations using conjugate gradient method, for minimizing the function $f(x_1, x_2) = 2x_1^2 + x_2^2$ with the starting point $X_0 = [1, 1]^T$. **06**

(b) Minimize $f(x) = x^2 - 10x - 1; x - 1 \leq 0$ using interior penalty method. **06**

Q.5 **(a)** Analyze the function $f(x) = 12x^5 - 45x^4 + 40x^3 + 5$ and classify the stationary points as maxima, minima and points of inflection. **06**

(b) Find the volume of the largest rectangular parallelopiped that can be inscribed in the sphere $x^2 + y^2 + z^2 = 1$. **06**

OR

Q.5 **(a)** (I)Why SLP method is called the cutting plane method? **06**
(II)How can you identify an active constraint during numerical optimization?

(b) (I)What is normality condition in a geometric programming problem? **06**
(II)Define completely geometric programming problem?

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