Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 710903N **Date: 19-06-2014**

Subject Name: Engineering Optimization

Time: 02:30 pm - 05:00 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)** In submarine telegraph cable the speed of signaling varies as $x^2 \log(1/x)$, where x is the ratio of the radius of the core to that of the covering. Show that the greatest speed is attained when this ratio is $1:\sqrt{e}$. **05**

(b) Analyze the function $f(x) = 12x^5 - 45x^4 + 40x^3 + 5$ and classify the stationary points as maxima, minima and point of inflection. **05**

(c) What is optimization? State five engineering applications of optimization **04**

Q.2 **(a)** State the Kuhn-Tucker conditions. **07**

Minimize $f(x_1, x_2) = (x_1 - 2)^2 + (x_2 - 1)^2$,

subject to the constraint,

$2 \geq x_1 + x_2$

$x_2 \geq x_1^2$

Check which of the vectors $X^* = [1.5, 0.5]^T$, $X^* = [1,1]$ satisfies the Kuhn Tucker conditions.

(b) Solve using the cutting plane the integer programming problem **07**

Max $Z = 7x_1 + 10x_2$

$s.t. - x_1 + 3x_2 \leq 6$

$7x_1 + x_2 \leq 35,\ x \geq 0$ And integer.

OR

(b) Find the minimum of the function $f(x) = 0.5 - x\exp(-x^2)$ by the Newton's method with the starting value of x_0 =1.0.Carry out five iterations. **07**

Q.3 **(a)** What is the Lagrange multiplier method? What is the significance of Lagrange multipliers? **07**

Find the dimension of a rectangular box of maximum capacity when the surface area is 216 m^2 ,Using the method of Lagrange multipliers.

(b) How do you test the positive, negative, or indefiniteness of a square $[A]$? **07**

Determine Whether matrix is positive definite, negative definite or indefinite by finding its Eigen values:

$$\begin{bmatrix} 3 & 1 & -1 \\ 1 & 3 & -1 \\ -1 & -1 & 5 \end{bmatrix}$$

OR

Q.3	**(a)**	Discuss the method of bracketing the minimum of a unimodal function in an interval.	**07**
	(b)	Minimize $f(X) = 2x_1^{-1}x_2^{-1} + \frac{3}{2}x_2^{-2} + 2x_1x_2^2$ by geometric programming technique.	**07**
Q.4	**(a)**	What is the difference between Fibonacci and golden section methods? Describe the method of Fibonacci stepwise.	**07**
	(b)	Define a saddle point and indicate its significance. Find the condition that the quadratic $ax^2 + 2hxy + by^2 + 2fx + 2gy + c$ may be concave or convex.	**07**
		OR	
Q.4	**(a)**	Minimize the function $f(x) = 5x^2 + 2x - 1$,using quadratic interpolation method.	**07**
Q.4	**(b)**	Minimize $f(x_1, x_2) = (x + 2/20)^2$ subject to , $\frac{1-x}{2} \le 0, \frac{x-2}{2} \le 0$ Using interior penalty function method.	**07**
Q.5	**(a)**	Minimize $f(x) = \sin(x) - x^2$ with $[0,1]$ as starting search range , .Using Golden Section Method.(Show five iterations)	**07**
	(b)	Find the minimum of the function $f(x_2, x_2) = 4x_1^2 + 3x_2^2 - 5x_1x_2 - 8x_1$ with starting point X=$[0,0]^T$ Using conjugate gradient method.	**07**
		OR	
Q.5	**(a)**	Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point X=$[0,0]^T$, using Steepest descent (Cauchyôs) method. (Show three iterations)	**07**
	(b)	Name and describe the main features of Genetic Algorithms (GA).	**07**

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