Seat No.: ___________ Enrolment No.: ___________

C U SHAH UNIVERSITY

Faculty of Technology and Engineering

M.TECH. MECH.(CAD/CAM) SEM.-II UNIVERSITY EXAM MAY 2015

Subject Code: 5TE02AOT1
Subject Name: ADVANCED OPTIMIZATON TECHNIQUES
Time: 3 hrs **Total Marks: 70**
Instructions:

1. **Make suitable assumptions whenever necessary.**
2. **Figures to the right indicate full marks.**
3. **Question one & four is compulsory.**

Section –I

Q-1 Attempt the following.

	1.	What is Engineering optimization?	01
	2.	What is the difference between design variables and preassigned parameters?	02
	3.	Find the point of extrema of the function $f(x,y) = x^2 - y^2$	02
	4.	Differentiate between: Posynomial and Polynomial	02
Q-2	(a)	State the necessary and sufficient condition for the minimum of a convex programming problem with inequality constraints. What it its significance?	04
	(b)	Determine the maximum and minimum values of the function $f(x) = 8x^5 - 15x^4 + 10x$	05
	(c)	The efficiency of a screw jack is given by $\eta = \tan\alpha/\tan(\alpha+\Phi)$, where Φ is a constant. Prove that efficiency will be maximum at $\alpha = 45° - \Phi/2$ with $\eta_{max} = (1-\sin\Phi)/(1+\sin\Phi)$.	05
		OR	
Q-2	(a)	Write the different application of optimizations.	04
	(b)	Find the extreme points of the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$	05
	(c)	Define a saddle point and Find the conditions that the quadratic $ax^2 + 2hxy + by^2 + 2fx + 2gy + c$ may be concave or convex.	05
Q-3	(a)	Minimize $f(x_1, x_2) = (x_1-3)^2 + (x_2-8)^2$ subjected to: $-x_1^2 + x_2 \leq 2$, $3x_1 + x_2 \leq 12$ using by using Kuhn-Tucker conditions	07
	(b)	Explain step wise procedure for the Fibonacci method.	07
		OR	
Q-3	(a)	Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius is $x^2+y^2+z^2=1$ and volume $f(x,y,z) = 8xyz$. Use Lagrange's Multipliers Method.	07
	(b)	Using golden section method find the point of minima of function $f(x) = x^2 - 2.6x + 2$, $-2 \leq x \leq 3$. Chose $\delta = 0.01$, $l = 0.2$	07

Section –II

Q-4 Attempt the following.

1. Define golden ratio. 01
2. Define Stochastic programming 02
3. How genetic algorithm is useful for the optimization of a function? 02
4. Define experiment, Interval of uncertainty and unimodal function. 02

Q-5 (a) Find the value of x and y which minimize $f(x,y) = 2x^{-1}y^{-1} + (3/2)\, y^{-2} + 2xy^2$ by using Geometric Programming Technique. 05

(b) Design tensile rod of the length L=300 mm to carry a tensile load of 7.5 kN for minimum cost, out the following materials: Consider FOS=4. 05

Material	Mass Density (kg/m^3)	Material Cost (Rs/kg)	Yield strength (MPa)
30 C 8 Steel	7800	26	400
40 Cr1 steel	7680	30	520
Titanium Alloy	4800	560	90

(c) Explain the following terms associated with GA: Reproduction, crossover and mutation. 05

OR

Q-5 (a) Minimize $f(x) = 0.25x^4 - x^2 - 5x + 1$ in the interval $0 \leq x \leq 3$ by using Newton-Rapson method. Take $\epsilon = \delta = 0.01$. 04

(b) Minimize: $f(x) = (x_1+2)^3 + 3x_2 + 1$ subject to $x_1 \geq 2$, $x_2 \geq 0$ by using interior penalty method. 05

(c) What is the significance of gradient of a objective function and constraints? State the properties of gradient vector. 05

Q-6 (a) Minimize: $f(x_1, x_2) = x_1^2 + 2x_2^2 - 4x_1 - 2x_1x_2$ starting with $(1,1)^T$,using conjugate gradient method. 07

(b) Minimize $f(x) = x_1^2 + 3x_2^2 - 2x_1x_2 + 4x_2 + 5$ using Steepest Decent Method starting from the point x_1 (4.2, -2.0), Take $\epsilon = 0.01$ and M=100. 07

OR

Q-6 (a) Using quadric interpolation method find minimum $f(x) = x^3 - 3x + 2$ in the interval $0 \leq x \leq 3$,Take $\epsilon = 0.1$ 07

(b) Minimize: $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting with $(0,0)^T$,using powell method. 07