Enrollment No: _____ Exam Seat No: _____

C.U.SHAH UNIVERSITY

Summer Examination-2019

Subject Name: Advanced Optimization Techniques

Subject Code: 5TE02AOT1 **Branch: M.Tech Mechanical (CAD/CAM)**

Semester: 2 **Date: 29/04/2019** **Time: 02:30 To 05:30** **Marks: 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the Following questions** **(07)**

a. State two engineering applications of Optimization. **01**

b. Give one reasons why the study of unconstrained minimization method is important? **01**

c. What is Hessian matrix? **01**

d. Define a usable feasible direction **01**

e. What is the Lagrange multiplier method? **01**

f. What do you understand by Optimization? **01**

g. Define the term Global Optima. **01**

Q-2 **Attempt all questions** **(14)**

a. Show the mathematical formulation of an optimization problem and describe design vector, design constraint, and objective function with suitable example. **07**

b. Define saddle point. Determine the following function is concave or convex. **07**
$F(x,y,z) = 4x^2 + 2y^2 + z^2 + 10x + 14y + 6z - 10.$

OR

Q-2 **Attempt all questions** **(14)**

a. A tank on a square base of side 2a consists of four vertical sides of height 'b'. Surmounted by a square pyramid of height 'h'. if the volume enclosed is 'V'. Show that the area of canvas in the tanks is, **07**

$$A = \frac{2V}{a} - \frac{8ah}{3} + 4a\sqrt{(h^2 + a^2)}$$

Show that the least area of the canvas corresponding to a given volume V, if 'a' & 'h' can both vary will be given by,

$$a = \frac{\sqrt{5}}{2} h \ \& \ h = 2b$$

b. Describe Optimization as a part of Mechanical Design. **07**

Q-3		**Attempt all questions**	**(14)**
	a.	Find the dimension of a cylindrical tin (with top and bottom) made up of sheet of metal to maxima its volume such that total surface area is equal to 24π.	**07**
	b.	Minimize $f(x) = (100-x)^2$ over $60 \leq x \leq 150$ using Fibonacci method for n=5.	**07**
		OR	
Q-3	**a.**	What are the characteristics of a direct search method? Explain Golden section method of Optimization	**07**
	b.	Give the application of Optimization.	**07**

SECTION – II

Q-4		**Attempt the Following questions**	**(07)**
	a.	Define Fibonacci numbers.	**01**
	b.	Define Interval of uncertainty.	**01**
	c.	How genetic algorithm is useful for the optimization of a function?	**01**
	d.	What is concave and convex function?	**01**
	e.	What do you understand by 'penalty method'?	**01**
	f.	Define golden ratio.	**01**
	g.	List the modern methods of optimization.	**01**
Q-5		**Attempt all questions**	**(14)**
	a.	Min $f(x)= x_1^2 + 2x_2^2 + 3x_3^2$ subjected to Constraints $g_1= x1-x2 -2x3 \leq 12$ $g_2= x1 + 2x2-3x3 \leq 8$ using Kuhn-Tuker Conditions.	**07**
	b.	The efficiency of a screw jack is given by $n = \frac{\tan\propto}{\tan(\propto+\emptyset)}$ where $\emptyset$ *is* a constant prove that the efficiency will be maximum at $\propto = 45 - \emptyset$ with $nmax = \frac{\tan\propto}{\tan(\propto+\emptyset)}$.	**07**
		OR	
Q-5		**Attempt all questions**	
	a.	Using lagrange's method minimize $f(x) = x_1+x_2$ subjected to $g(x) = x_1^2 + x_2^2 = 1$.	**07**
	b.	Give the classification of Optimization problems.	**07**
Q-6		**Attempt all questions**	**(14)**
	a.	How genetic algorithm is useful for the optimization of a function?	**07**
	b.	Explain 'Relative and Global minima and maxima' with help of sketches. Determine the maximum and minimum values of the function $f(x) =12x^5-45x^4+40x^3+5$.	**07**
		OR	
Q-6		**Attempt all Questions**	
	a.	Min $f = x_1^2 + 2x_2^2 + 60 x$, subjected to $g_1 = x_1 – 80 >= 0$ $g_2 = x_1 + x_2 – 120 >= 0$ using Kuhn – Tucker method.	**07**
	b.	Explain the following terms associated with GA: Reproduction, crossover and mutation.	**07**