Seat No.: _____ Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – WINTER • 2014

Subject code: 730801 **Date: 25-11-2014**

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)** (i) Define Constrained and Unconstrained optimization problems. **04**

(ii) Define objective function and design constraints. **03**

(b) A rocket is designed to travel a distance of 12s in a vertically upward direction. The thrust of the rocket can be changed only at the discrete points located at distances of 0, *s, 2s, 3s,* . . . ,11s. If the maximum thrust that can be developed at point / either in the positive or negative direction is restricted to a value of F_i. Formulate the problem as shown in Fig 1.0 for minimizing the total time of travel under the following assumptions. **07**

1. The rocket travels against the gravitational force.
2. The mass of the rocket reduces in proportion to the distance traveled.
3. The air resistance is proportional to the velocity of the rocket.

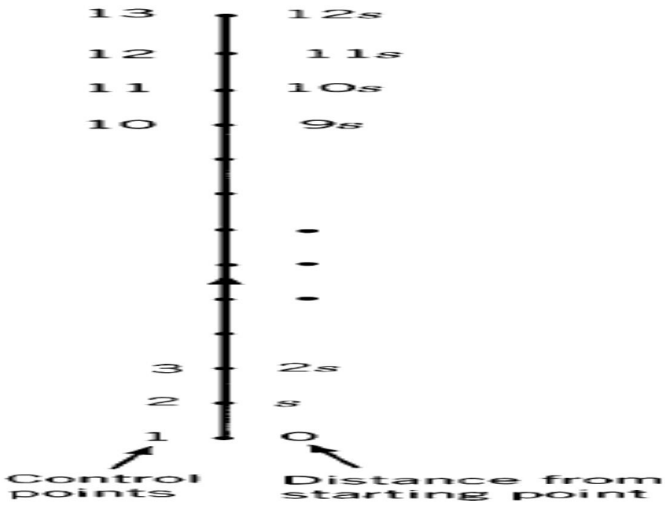

Fig 1.0

Q.2 **(a)** Minimize $f(y)=\frac{1}{2}\left(y_1^2+y_2^2+y_3^2+y_4^2\right)$ subject to **07**

$$g_1(y)=y_1+2y_2+3y_3+5y_4-10=0$$
$$g_2(y)=y_1+2y_2+5y_3+6y_4-15=0$$

Take n=4 and m=2.

(b) A beam of uniform rectangular cross section is to be cut from a log having a circular cross section of diameter *2a.* The beam has to be used as a cantilever beam (the length is fixed) to carry a concentrated load at the free end. Find the dimensions of the beam that correspond to the maximum tensile (bending) stress carrying capacity as shown in fig 2.0. **07**

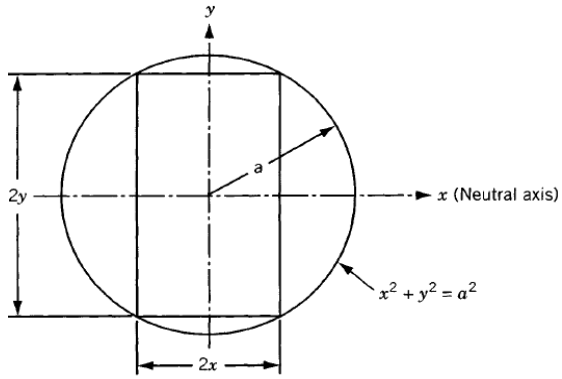

Fig 2.0 Cross section of the log.

OR

	(b)	A tank on a square base of side ó2aô consists of four vertical sides of height ó bô surmounted by a square pyramid of height ó hô. If the volume enclosed is ó Vô. Show that the area of canvas in the tank i $A = \frac{2V}{a} - \frac{8ah}{3} + 4a\sqrt{h^2 + a^2}$. Show that the least area of the canvas corresponding to a given volume V, if ó aô & ó hô can both vary will be given by, $a = \frac{\sqrt{5}}{2}h$	**07**
Q.3	**(a)**	State Kuhn-Tucker conditions giving a suitable example.	**07**
	(b)	Find the minimum of $f(x) = x(x-1.5)$ in the interval (0.0, 1.00) to within 10% of the exact value by using dichotomous search. Take $\delta = 0.001$ and $L_0 = 1.0$.	**07**

OR

Q.3	**(a)**	Explain Random Search Method.	**07**
	(b)	Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ starting from the point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ for a three iterations using steepest Descent Method. Use three iterations.	**07**
Q.4	**(a)**	Explain interior penalty function method of optimization.	**07**
	(b)	Explain stochastic geometric programming method.	**07**

OR

Q.4	**(a)**	Explain the Characteristics of Geometric Programming Method of Optimization	**07**
	(b)	Explain exterior penalty function method of optimization.	**07**
Q.5	**(a)**	Formulate the problem of minimum weight design of a helical spring under axial load as a geometric programming problem. Consider constraints on the shear stress, natural frequency, and buckling of the spring.	**07**
	(b)	Stating working principle of genetic algorithms, explain three operators of the same.	**07**

OR

Q.5	**(a)**	Discuss complementary Geometric Programming and explain degree of difficulty.	**07**
	(b)	Explain MATLAB Functions for Solving Optimization Problems in MATLAB Optimization Toolbox.	**07**

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