Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 714704 **Date: 14/12/2015**

Subject Name: Optimization Theory and Practice

Time: 10:30 AM to 1:00 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 Explain the interior penalty and exterior penalty optimization techniques for single variable function $f(X) = \alpha x_1$, subjected to $g_1(X) = \beta - x_1$. **14**

Q:2 (a) Explain the various steps of unrestricted search methods used to optimize non linear one dimensional problem. **07**

(b) Explain the Particle Swam optimization method. **07**

OR

(b) How is the crossover operation performed in Genetic Algorithms(GA)? What is the purpose of mutation? How is it implemented in GA? **07**

Q:3 (a) Explain the various steps of Transformation technique to find the dimensions of a rectangular prism-type box that has the largest volume when the sum of its length, width, and height is limited to a maximum value of 60 m. and its length is restricted to a maximum value of 36 m. **07**

(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. . . 12s. If the maximum thrust that can be developed at point *i* either in the positive or negative direction is restricted to a value of F_i , formulate the problem of 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.

OR

Q:3 (a) Four identical helical springs are used to support a milling machine weighing 5000 lb. Formulate the problem of finding the wire diameter (d), coil diameter (D), and the number of turns (N) of each spring for minimum weight by limiting the deflection to 0.1 in. and the shear stress to 10,000 psi in the spring. In addition, the natural frequency of vibration of the spring is to be greater than 100Hz. The stiffness of the spring (k), the shear stress in the spring (τ), and the natural frequency of vibration of the spring (fn) are given by **07**

$$k = \frac{d^4 G}{8D^3 N}$$

$$\tau = K_s \frac{8FD}{\pi d^3} \quad f_n = \frac{1}{2}\sqrt{\frac{kg}{w}} = \frac{\sqrt{Gg}\, d}{2\sqrt{2\rho}\pi D^2 N}$$

(b) Explain The Lagrange multiplier method of optimization with sufficient and necessary conditions. **07**

Q:4 (a) Consider the following problem **07**

$$\text{minimize } f(x_1, x_2) = (x_1 - 1)^2 + x_2^2$$
$$g_1(x_1, x_2) = x_1^3 - 2x_2 \le 0$$
$$g_2(x_1, x_2) = x_1^3 + 2x_2 \le 0$$

Determine whether the constraint qualification and the Kuhn–Tucker conditions are satisfied at the optimum point.

(b) Explain the following terms related to Linear Programming Problem:

1. Unboundness of solution **02**
2. Degeneracy of solution **02**
3. Dual form of LPP **03**

OR

Q:4 A company manufactures three products namely *X*, *Y* and *Z*. Each of the product require processing on three machines, Turning, Milling and Grinding. Product *X* requires 10 hours of turning, 5 hours of milling and 1 hour of grinding. Product *Y* requires 5 hours of turning, 10 hours of milling and 1 hour of grinding, and Product Z requires 2 hours of turning, 4 hours of milling and 2 hours of grinding. In the coming planning period, 2700 hours of turning, 2200 hours of milling and 500 hours of grinding are available. The profit contribution of *X*, *Y* and Z are Rs. 10, Rs.15 and Rs. 20 per unit respectively. Find the optimal product mix to maximize the profit. **14**

Q:5 (a) Minimize $f(x) = 0.65 - [0.75/(1 + x^2)] - 0.65x \tan^{-1}(1/x)$ in the interval [0,3] by the Fibonacci method using n = 6. **07**

(b) Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ with the starting point (0, 0). Use univariate method. **07**

OR

Q:5 (a) **07**

$$\text{Minimize } f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2, \; X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

Using Powell's method

(b) Minimize $f(x) = 0.65 - [0.75/(1 + x^2)] - 0.65x \tan^{-1}(1/x)$ in the interval [0,3] by the Golden section method using n = 6. **07**