Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 714704 Date: 13-06-2013

Subject Name: Optimization Theory and Practice

Time: 10.30 am – 01.00 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 Chemical company manufactures two chemicals A and B which are sold to the manufacturers of soap and detergents. On basis of the next monthôs demand, the management has decided that the total production for chemicals A and B should be at least 350 kilograms. Moreover, a major customerôs order for 125 kg of product A must also be supplied. Product A requires 2 hours of processing time per kilogram and product B requires one hour of processing time per kilogram. For the coming month, 600 hours of processing time are available. **14**

The company wants to meet the above requirements at minimum total production cost. The production costs are Rs 2 per kilogram for product A and Rs 3 per kilogram for product B.

A company wants to determine its optimal product mix and the total minimum cost relevant thereto.

1) Formulate the above as a linear programming problem.
2) Solve the problem with simplex method.
3) Does the problem have multiple optimal solutions? Why?

Q:2 **(a)** Explain the various steps of Grid Search Method used to optimize non linear unconstrained problem. **07**

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

OR

(b) Explain the Particle Swam Optimization Technique. **07**

Q:3 **(a)** A uniform column of hollow circular cross section having vertical length *l* is to be constructed for supporting a water tank of mass M. It is required (1) to minimize the mass of the column (m) for economy, and (2) to maximize the natural frequency of transverse vibration of the system for avoiding possible resonance due to wind. Formulate the problem of designing the column to avoid failure due to direct compression and buckling. Assume the permissible compressive stress to be $\mathring{u}_{max}$. **07**

The natural frequency of the transverse vibration of the beam is given by

$$\omega = \left[\frac{3EI}{\left(M + \frac{33}{140} m \right) l^3} \right]^{1/2}$$

(b) Find the dimension of a box of largest volume that can be inscribed in a sphere of 3m radius. **07**

OR

Q:3 **(a)** Find the dimensions of a cylindrical tin(with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 48\pi$. Use Lagrange multiplier method. **07**

(b) The efficiency of a screw jack is given by **07**

$$\eta = \frac{\tan\alpha}{\tan(\alpha+\phi)}$$

Where, α is the lead angle and ϕ is a constant. Prove that the efficiency of the screw jack will be maximum when $\alpha = 45° - \phi/2$ with

$$\eta_{max} = \frac{1-\sin\phi}{1+\sin\phi}$$

Q:4 **(a)** Prove that the design vector $X = \{1,2\}^T$ satisfies the Kuhnï Tucker conditions for a constrained optimum for the following function. **07**

Minimize $f(X) = x_1^2 - 4x_1 + x_2^2 - 6x_2$

subject to

$x_1 + x_2 \le 3$

$-2x_1 + x_2 \le 2$

(b) Explain the search with fixed step size method and search with accelerated step size method to minimize one dimensional non linear problem. **07**

OR

Q:4 **(a)** Find the minimum of f(x) = x(x-1.2) in interval (0.0 1.5) compute six experiments and take $\delta = 0.001$. **07**

(b) With the help of flow chart explain the Fibonacci search method for minimization of non linear programming problem. **07**

Q:5 **(a)** Find the minimum of the following function in the interval [60, 150] using Golden section method in six steps. **07**

$$f(x) = (100 - x)^2$$

(b) Find the minimum of function $f(x) = 2x^2 + \frac{16}{x}$ using Newtonôs method for accuracy of 0.01 and initial value $x_1 = 1$. **07**

OR

Q:5 **(a)** Explain the algorithm of sequential linear programming method to solve non linear programming problem. **07**

(b) Which are the indirect methods used to find optimum solution of non linear programming constrained problems? Explain the algorithm of any one of them. **07**

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