

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013****Subject code: 714704****Date: 08-01-2014****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) 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) Explain the different steps of exterior penalty method for non linear constrained optimization. **07**

- Q:2** (a) Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ from the starting point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using Powell's method. **07**
- (b) Minimize $f(x_1, x_2) = 4x_1^2 - 5x_1x_2 + 3x_2^2 - 8x_1 + 10$ from the starting point $X_1 = \begin{Bmatrix} 2 \\ 1 \end{Bmatrix}$ using Steepest Descent method (minimum four iteration). **07**

OR

- (b) Minimize $f(x_1, x_2) = x_1^2 + x_2^2 - 2x_1 - 4x_2 + 5$ from the starting point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using Univariate method ($\epsilon = 0.01$). **07**
- Q:3** (a) Find the minimum of $f(x) = x^2 - \sin(x)$ in the interval (0,1) and $\delta=0.001$ use Dichotomous method and perform six experiments. **07**
- (b) Find the maximum of $f(x) = \frac{0.5}{\sqrt{1+x^2}} - \sqrt{1+x^2} \left(1 - \frac{0.5}{1+x^2} \right) + x$ **07**
- With Quasi-Newton method, Starting point 0.6, finite difference step size of 0.001 and accuracy of 0.001.

OR

- Q:3** A small city of 15,000 people requires an average of 3 lakhs of gallons of water daily. The city is supplied with water purified at a central water works, where water is purified by filtration, chlorination and addition of two chemicals softening chemical X and health chemical Y. Water works plans to purchase two popular brands of products, product A and product B, which contain these two elements. One unit of product A gives 8 kg of X and 3 kg of Y. One unit of product B gives 4 kg of X and 9 kg of Y. To maintain the water at a minimum level of softness and meet a minimum in health protection, it is decided that 150 kg of X and 100 kg of Y chemicals that make up each product must be added daily. At a cost of Rs. 8/- and Rs. 10/- per unit respectively for A and B, what is the optimum quantity of each product that should be used to meet consumer standard? **14**
- Q:4** (a) Explain the genetic algorithm for optimization. **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 $\alpha = 45^\circ - \phi/2$ with $\eta_{\max} = (1 - \sin \phi) / (1 + \sin \phi)$.

OR

- Q:4** (a) Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius. Solve the problem by direct substitution method. 07
(b) Draw the flowchart for implementing the Hooke and Jeeve's method of non linear optimization. 07

- Q:5** (a) The doctor advises a patient visited him that the patient is weak in his health due to shortage of two vitamins, i.e., vitamin X and vitamin Y. He advises him to take at least 40 units of vitamin X and 50 units of Vitamin Y every day. He also advises that these vitamins are available in two tonics A and B. Each unit of tonic A consists of 2 units of vitamin X and 3 units of vitamin Y. Each unit of tonic B consists of 4 units of vitamin X and 2 units of vitamin Y. Tonic A and B are available in the medical shop at a cost of Rs. 3 per unit of A and Rs. 2,50 per unit of B. The patient has to fulfill the need of vitamin by consuming A and B at a minimum cost. Write the primal and dual form of this LPP. 07
(b) Explain the seven engineering applications of optimization. 07

OR

- Q:5** (a) Draw the flowchart for implementing Fibonacci search method. 07
(b) Derive the necessary and sufficient conditions for the minimum of a single variable function. Also state the necessary and sufficient conditions for maximum of multivariable function. 07
