Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 1721602 Date: 03-12-2014

Subject Name: Chemical Process 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)** A log has the form of a frustum of cone 30 feet long, the diameters of its ends being 2 feet and 1 foot. A beam of square section is to be cut from the log. Find the length if the volume is maximum. **07**

(b) Find the global minimum and maximum of the function $y = x_2 - x_1^{\,2}$ if it is subject to the restriction that $1 - x_1^{\,2} - x_2^{\,2} = 0$ using the penalty function method. **07**

Q.2 **(a)** Write necessary any sufficient conditions for an extreme value of multivariable objective function and find out stationary point for **07**

$$y = 1 + 8x + 2x^2 - \tfrac{10}{3}x^3 - \tfrac{1}{4}x^4 + \tfrac{4}{5}x^5 - \tfrac{1}{6}x^6$$

(b) Explain the concept of Multi-objective optimization giving classification of techniques. **07**

OR

(b) Explain the concept and algorithm of Simulated Annealing technique with example. **07**

Q.3 **(a)** An open top box is to be made out of a piece of cardboard measuring 2m X 3m by cutting off equal surfaces from the corners and turning up the side. Find dimensions of the box for maximum volume. **07**

(b) Explain the basics of population based search techniques and discuss working of Genetic Algorithm for optimization. **07**

OR

Q.3 **(a)** Find the maximum of **07**

$$y = 10x_1^{\,2} - 4x_1x_2 + 3x_2^{\,2} + 5x_2x_3$$

subject to

$$x_1 + 2x_2 \le 3$$

$$x_2 - x_3 \ge 2$$

$$x_1 \ge 1$$

using lagrangian multipliers.

(b) Find the value of x in the interval (0,1) which minimizes the function $f = x(x - 1.5)$ with ± 0.05 using Golden Section search or Fibonacci search technique. **07**

Q.4 **(a)** Find the minimum of $y = \dfrac{2}{x_1x_2} + \dfrac{3}{x_2} + 4x_1x_2^{\,2}$ using geometric programming and also find the location of minimum. **07**

(b) Give example of MILP problem and present any one method to solve MILP problem. **07**

OR

Q.4 **(a)** Using Powellôs method to minimize $f(x) = x_1^{\,2} + \exp(x_1^{\,2} + x_2^{\,2})$. **07**

(b) Explain TABU search optimization technique with algorithm and example. **07**

Q.5 **(a)** Carry out two stages of a Hooke-Jeeves search for searching a minimum of the objective function $y = x_1^2 + 3x_2^2 + 5x_3^2$. Use δ = 0.5, starting from the base point (2, -1,1). A stage consists of a local exploration, together with an accelerated move. **07**

(b) Explain the concept and algorithm of Simulated Annealing technique with example. **07**

OR

Q.5 Carryout vertex rejection and regeneration in searching for the minimum of the objective function $y = x_1^{\ 2} + 3x_2^{\ 2} + 5x_3^{\ 2}$ using the Sequential Simplex method. Distance between vertices is a = 0.5 and one of the vertex at the point (0,0,0). Use a=0.01 for next iteration and carry out calculation up to three vertex rejection regeneration in second stage of search. **14**

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