Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1721602 Date: 09/07/2012

Subject Name: Chemical Process Optimization

Time: 10:30 am – 13:00 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 maximized using region elimination method. **08**

(b) In performing a numerical search of the objective function **06**

$$y = x_1^2 + x_1x_2 + 16x_2^2 + x_3^2 - x_1x_2x_3$$

suppose that a one-dimensional search in the direction $\xi = \left\{\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}\right\}$ is required , starting from the base point (1,-2,-2). Determine the position of the minimum along this direction and the value of the objective function at the minimum point.

Q.2 **(a)** What should be the properties of a cone-roofed tank to obtain the greatest volume of storage for liquid? Take diameter and height of the lower cylinder section as 2R and L respectively and slant height of upper conical section to be S. **07**

(b) Explain Ant colony optimization with example. **07**

OR

(b) Explain the concept and algorithm of Differential Evolution technique with example. **07**

Q.3 **(a)** Define a suitable search region and a feasible initial base point for the complex method of search in minimizing $y = 5x_1^3 - 3x_1^2x_2 + x_2^2$ subject to the restrictions that **07**

$$3 + 2x_1 - 3x_2 \le 0$$
$$(x_1 - 1)^2 + (x_2 - 2)^2 \le 4$$

Setup a complex method of search and carryout two cycles of search.

(b) Using the Rosenbrock search technique, seek the minimum of the objective function $y = 6x_1^2 + x_2^2$ using $s_1 = s_2 = 1$, $\beta = 1/2$ and $\alpha = 3$, until no further movement is possible. **07**

OR

Q.3 **(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 $\delta = 0.5$, starting from the base point (2, -1, 1). A stage consists of a local exploration, together with an accelerated move. **07**

(b) Carryout eight cycle of 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}. **07**

Q.4 **(a)** Find the maximum of $y = 10x_1^2 - 4x_1x_2 + 3x_2^2 + 5x_2x_3$ subject to $x_1 + 2x_2 \le 3$; $x_2 - x_3 \ge 2$; $x_1 \ge 1$. **07**

(b) Find the global minimum of the function $y = 4x_1^2 + 5x_2^2$ if it is subject to the **07**

restriction that $2x_1 + 3x_2 - 6 = 0$.

OR

Q.4 **(a)** Find the minimum of cost function $y = 1000x_1 + \frac{8\times10^9}{x_1x_2} + 2.5\times10^5 x_2$ using geometric programming and also find the location of minimum. **07**

(b) Explain the concept of Geometric programming and find the minimum of $y = 8-(x_1+x_2)^2 - 4(x_2-1)^2$ subject to $x_1 + x_2 \geq 2$, $x_1 \geq 0$ and $x_2 \geq 0$ using it. **07**

Q.5 **(a)** Explain TABU search optimization technique with algorithm and example. **07**

(b) Explain the basics of Multi objective optimization(MOO). Classify the methods for MOO and discuss chemical engineering applications. **07**

OR

Q.5 Construct the dual system and solve it for maximize P with respect to x_i when it is subject to the restrictions that **14**

$$11x_1 + 3x_2 - 2x_3 \geq P$$
$$4x_1 + 5x_2 + x_3 \geq P$$
$$6x_1 + 10x_2 + 5x_3 \geq P$$
$$x_1 + 8x_2 + 12x_3 \geq P$$
$$x_1 + x_2 + x_3 = 1$$
$$x_i \geq 0$$

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