Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 1721602 **Date: 18-06-2014**

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 mark.**

Q.1 **(a)** Find the global minimum of the function $y = 4x_1^{\ 2} + 5x_2^{\ 2}$ if it is subject to the restriction that $2x_1 + 3x_2 - 6 = 0$. **07**

(b) In performing a numerical search of the objective function $y = x_1^2 + 3x_2^2 + 5x_3^2$ 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 (2,-1,-1). Determine the position of the minimum along this direction and the value of the objective function at the minimum point. **07**

Q.2 **(a)** Explain the concept and working of Genetic Algorithm **07**

(b) Explain the concept and applications of Sequential Quadratic Programming. **07**

OR

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

Q.3 **(a)** A cross channel ferry is constructed so as to transport a fixed number of tons across each way per day. If the cost of construction of the ferry without the engine varies as the load, and the cost of the engines varies as the product of the load and the cube of the speed, prove that the total cost of construction is least when twice as much money is spent on the ferry as on the engines. **05**

(b) Using the Rosenbrock search technique, seek the minimum of the objective function $y = x_1^2 + 3x_2^2 + 5x_3^2$ using $s_1 = s_2 = s_3 = 1$, $\beta = 1/2$ and $\alpha = 3$. Carry out one stage of search and find directions for next iteration. **09**

OR

Q.3 **(a)** Explain Cellular Automata optimization technique and algorithm. **05**

(b) Define a suitable search region and a feasible initial base point for the complex method of search in minimizing $y = 5x_1^{\ 3} - 3x_1^{\ 2}x_2 + x_2^{\ 2}$ subject to the restrictions that **09**

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

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

Q.4 **(a)** List out limitations of Region Elimination methods. Compare different Region Elimination methods with working equations for each. **06**

(b) Find the maximum of $y = 10x_1^{\ 2} - 4x_1x_2 + 3x_2^{\ 2} + 5x_2x_3$ subject to $x_1 + 2x_2 \le 3$; $x_2 - x_3 \ge 2$; $x_1 \ge 1$. **08**

OR

Q.4 **(a)** Find the minimum of $y = t_1^2 + 2t_2 + \dfrac{3}{t_1 t_2}$ using geometric programming and also find the location of minimum. **06**

(b) Explain the concept of Quadratic programming and find the minimum of $y = 3x_1^2 + 2x_1x_2 + x_1x_3 + 2.5x_2^2 + 2x_2x_3 + 2x_3^2 - 8x_1 - 3x_2 - 3x_3$ subject to $x_1 + x_3 = 3$, $x_2 + x_3 = 0$. **08**

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

(b) Minimize Rosenbrock function $f(x) = 25(x_2 - x_1^{\,2})^2 + (1 - x_1^{\,2})$ with an initial point of (5, 2) using Hooke-Jeeves method. **07**

OR

Q.5 **(a)** Explain Bee colony optimization technique with algorithm and example. **07**

(b) A liquid phase, isothermal, reversible first order, exothermic reaction **07**

$$A \underset{k_2}{\overset{k_1}{\rightleftharpoons}} B$$

is to be carried out in a CSTR. The reactor space time is to be held constant at space time τ. The feed is pure A. Show that the choice of optimum temp which will maximize conversion of A is the one which will maximize $k_1\tau / 1 + k_2\tau$.

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