Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–II • EXAMINATION – SUMMER - 2017

Subject Code: 2723010 **Date: 29/05/2017**

Subject Name: Advanced Process Optimization

Time: 02:30 PM To 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) Explain the concept of region elimination methods. What are the limitations of this technique? Explain the golden section search method. **07**

(b) A length of wire is to cut in two parts. One portion is to be bent into the form of a circle, and the other into the form of a square. In what ratio must the wire be cut if the sum of the areas enclosed by the circle and square is to the least possible? **07**

Q.2 (a) 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. Optimum temp which will maximize conversion of A is the one which will maximize $k_1\tau / 1 + k_2\tau$.

If the reaction temperature is between 400-500 ˚K and $E_1/R = 10000$, $E_2/R = 20000$, $k_1^0 = e^{25}$, $k_2^0 = e^{30}$, $\tau = 1$ min find the optimum temperature within ± 1 ˚K using Fibonacci Search Technique.

(b) Find the minimum of $y = \frac{2}{x_1 x_2} + \frac{3}{x_2} + 4x_1 x_2^2$ using geometric programming and also find the location of minimum. **07**

OR

(b) Find the minimum of $y = 4x_1^2 + 5x_2^2$ subject to $2x_1 + 3x_2 = 6$. **07**

Q.3 (a) Explain the basics of Multi Objective Optimization (MOO) and discuss chemical engineering applications. **07**

(b) Giving the examples of Integer and mixed integer programming, list out methods to solve them discussing strength and weakness. **07**

OR

Q.3 The original problem is to find the minimum of the function $y = 3x_1 + 5x_2$ **14**

Subject to the restrictions

$$x_1 + 3x_2 \geq 14$$
$$2x_1 - x_2 \geq 2$$
$$x_1 - 4x_2 \leq 2$$
$$x_1 + x_2 \leq 20$$

with $x_1 \geq 0$ and $x_2 \geq 0$

- Construct the dual for this problem and solve it. (Don't solve the original problem)
- Relate original problem solution with the last simplex table of the dual.

Q.4 **(a)** Explain the interpretations with examples for **07**

- Zero coefficient in column.
- No positive ratio.
- Identical values of smallest positive ratio.

while solving any linear programming problem using Simplex method.

(b) Discuss role of Quadratic programming and successive quadratic programming for optimization in chemical engineering with examples. **07**

OR

Q.4 **(a)** 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 = 0.2 and one of the vertex at the point {-1, 2, -2}. **07**

(b) Find the minimum of the function $y = 3x_1 + 5x_2$ **07**

Subject to the restrictions

$$x_1 + 3x_2 \geq 14$$
$$2x_1 - x_2 \geq 2$$
$$x_1 - 4x_2 \leq 2$$
$$x_1 + x_2 \leq 20$$

with $x_1 \geq 0$ and $x_2 \geq 0$

Q.5 **(a)** Write necessary any sufficient conditions for an extreme value of multivariable objective function and find out stationary point for **07**

$$y = 3x_2^2 + x_1^4 + 2x_2^4$$

(b) 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 as S. **07**

OR

Q.5 **(a)** Explain Optimization using the application of Thermal Cracker or Design of an Ammonia Reactor. **07**

(b) Explain the pattern search (Sequential Simplex) algorithm along with the working equations. **07**

****