Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – II[nd] - Examination – June/July- 2011

Subject code: 1721602

Subject Name: Chemical Process Optimization

Date:24/06/2011 **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)** Minimize Rosenbrock function $f(x) = 25(x_2 - x_1^2)^2 + (1 - x_1^2)$ with an initial point of (5, 2) using any numerical technique of your choice. **07**

(b) For minimization of objective function $y = 3x_1^2 + 2x_1x_2 + 2x_2^2$, search for the minimum starting from base point (3, 2). Use a set of conjugate directions for search. **07**

Q.2 **(a)** What should be the properties of a cone roofed tank to obtain the greatest volume of storage for the fixed surface area? Take the diameter and the height of the lower cylindrical section to be 2R and L, respectively, and the slant height of the upper conical section is S. **07**

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

OR

(b) Write algorithm steps for simple GA for optimization and explain its working with flow chart. Discuss effects of population size, number of generations, crossover probability and mutation probability on performance of GA. **07**

Q.3 **(a)** Explain the concept and algorithm of Differential Evolution with example. **07**

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

OR

Q.3 **(a)** Write working equations of Discreet Fibonacci Technique and Search for an minimum value of a discreet function f(x) as given under: **07**

x	f	x	f	x	f	x	f
2	141	8.1	155	11	62	20	89
2.2	142	8.2	96	12	64	25	91
3	143	8.5	87	13	74.5	25.5	92
5	145	8.8	78	14	75	26	97
6	150	9.1	69	15	78	26.2	98
7	153	9.9	60	16	80	26.3	99
8	154	10.1	51	16.5	83	26.6	103

(b) Explain the interpretations with examples for **07**

- No positive ratio.
- Identical values of smallest positive ratio.

while solving any linear programming problem using simplex method.

Q.4 **(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**

OR

Q.4 **(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) In performing a numerical search of the objective function **07**

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

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.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) A complete stage of the Rosenbrock method gives the following results in the search for a minimum: **07**

x_1	x_2	y	Result		d_1	d_2	s_1	s_2
			ξ_1	ξ_2				
3	7	55			0	0	$\sqrt{2}$	$\sqrt{2}$
4	8	103	Failure		0	0	$-1/\sqrt{2}$	$\sqrt{2}$
2	8	38		Success	0	$\sqrt{2}$	$-1/\sqrt{2}$	$3\sqrt{2}$
1.5	7.5	29	Success		$-1/\sqrt{2}$	$\sqrt{2}$	$-3/\sqrt{2}$	$3\sqrt{2}$
-1.5	10.5	35		Failure	$-1/\sqrt{2}$	$\sqrt{2}$	$-3/\sqrt{2}$	$-3/\sqrt{2}$

- Determine the directions used in this stage of search.
- Check the last two rows of the table and correct it if there are any mistakes.
- Find out directions to be used in next stage search.

OR

Q.5 Find the minimum of the function $y = 3x_1 + 5x_2$ **14**

Subject to the restrictions

$$x_1 + 3x_2 \ge 14$$
$$2x_1 - x_2 \ge 2$$
$$x_1 - 4x_2 \le 2$$
$$x_1 + x_2 \le 20$$

with $x_1 \ge 0$ and $x_2 \ge 0$

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