Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME- SEMESTER II– EXAMINATION – SUMMER 2015

Subject Code: 2723010 **Date: 30/05/2015**

Subject Name: Advance Process Optimization

Time: 2:30 PM – 5:00 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)** What is Optimization? ñEvery design decision is outcome of optimizationò Justify the statement with examples. **06**

(b) Write necessary any sufficient conditions for an extreme value of single variable objective function. Find location of global minimum of $y = x^2 - e^{1/x^2}$. Show all candidate locations. **08**

Q.2 **(a)** Maximize P with respect to x_i when it is subject to the restrictions that **10**

$$
\begin{aligned}
&11x_1 + 3x_2 - 2x_3 \geq P \\
&4x_1 + 5x_2 + x_3 \geq P \\
&6x_1 + 10x_2 + 5x_3 \geq P \\
&x_1 + 8x_2 + 12x_3 \geq P \\
&x_1 + x_2 + x_3 = 1 \\
&x_i \geq 0
\end{aligned}
$$

(b) What is Degree of Freedom? Discuss its importance in development of mathematical model. **04**

OR

(b) Find the minimum of $y = \frac{2}{x_1 x_2} + \frac{3}{x_2} + 4x_1 x_2^{\,2}$. **04**

Q.3 **(a)** Compare two-point equal interval search, dichotomous search, golden section search and fibonacci search technique of region elimination with working equations of each. **07**

(b) Minimize given multivariable function, using single variable technique. **07**

$f(x) = x_1^{\,4} - 2x_1^{\,2}x_2 + x_2^{\,2} + x_1^{\,2} - 2x_1 + 5$

OR

Q.3 **(a)** 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 technique. **07**

(b) Discuss role of Quadratic Programming for optimization in chemical engineering with examples. **07**

Q.4 A manufacturer requires an alloy consisting of 40 % tin, the remainder being made up of lead and zinc in equal proportions. This alloy can be made up by mixing a number of available tin-lead-zinc alloys, the properties and cost of which are tabulated below. Find the cost of the chipset blend and the amount of each type of alloy which should be purchased per unit weight of alloy produced. **14**

		Available alloys				
		1	2	3	4	5
Analysis	% lead	10	10	40	60	30
	% zinc	10	30	50	30	30
	% tin	80	60	10	10	40
Cost	Rs / kg	41	43	58	60	76

OR

Q.4 Find the maximum of the Linear function **14**

$$y = 6x_1 + 5x_2$$

Subject to the Linear restrictions

$$-2x_1 - 5x_2 \le -20$$
$$5x_1 + x_2 \le 5$$
$$3x_1 + 11x_2 \le 33$$

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

Q.5 **(a)** We are locating the maximum of the function $y = 100 - (10 - x_1)^2 - (5 - x_2)^2$ within 1 % accuracy using pattern search (sequential simplex) method. Table given under is the incomplete first stage search of the problem with a = 2. Complete the first stage search and carry out the calculation up to five vertex rejection-regeneration of the second search stage. **07**

Point j	$x_{1,j}$	$x_{2,j}$	y_j	Point rejected	Rule for rejection	Points in simplex		
1	0.0000	0.0000	-25.0000					
2	1.9314	0.5174	14.8040	Starting simplex		1	2	3
3	0.5174	1.9314	0.6640					
4	2.4488	2.4488	36.4708	1	1	4	2	3
5	3.8628	1.0348	46.6120	3	1	4	2	5
6	4.3802	2.9662	64.2815	2	1	4	6	5
7	5.7942	1.5522	70.4239	4	1	7	6	5
8	6.3116	3.4836	84.0962	5	1	7	6	8
9	7.7256	2.0696	86.2399	6	1	7	9	8
10	8.2430	4.0010	95.9150	7	1	10	9	8
11	6.8290	5.4150	89.7725	9	1	10	11	8

(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.

OR

Q.5 **(a)** For unconstrained multi-variable optimization problem, discuss step by step procedure for newtonôs method highlighting strengths and limitations. **07**

(b) Discuss scope of optimization in shell and tube heat exchanger design. **07**