Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER II EXAMINATION – SUMMER 2017

Subject Code: 2721602 **Date: 25/05/2017**

Subject Name: Chemical 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)**	Describe the steps for solving a general chemical process optimization problem. Also mention the common obstacles encountered when solving optimization problems.	**07**
	(b)	Minimize the function $f(x) = x^2 + x - 2\sqrt{x}$ using Golden section search or Fibonocci search method. Search between the interval [0 2].	**07**
Q.2	**(a)**	Determine whether the function is concave or convex: $f = x_1^2 + 3x_2^2 + 2x_1 + 6x_2 + 4$.	**03**
	(b)	An open rectangular box with square base is to be made from 192 m^2 of material. Calculate the dimension to maximize the storage volume?	**04**
	(c)	Determine the process of finding the optimum L/D ratio of a cylindrical storage vessel. Compare the result with design thumb rule of 3. State the assumptions clearly.	**07**
		OR	
	(c)	Explain the role of optimization in distillation column design.	**07**
Q.3	**(a)**	Minimize the function $f = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ using Powells method from the starting point [0 0]. Generate other starting points using Univariate method.	**10**
	(b)	Minimize the function $f = 4x_1^2 + x_2^2 - 2x_1x_2$ using Newton's method. Take starting point [1,1].	**04**
		OR	
Q.3	**(a)**	Minimize the following function using Simplex method. $f = 5x_1^2 + 8x_1x_2 + 5x_2^2 - 34x_1 - 38x_2 + 74$. Take the initial Simplex as $X_1 = [-2\ -2]$, $X_2 = [-3\ 0]$ and $X_3 = [-1\ -1]$. Assume $\alpha = 1$, $\beta = 0.5$ and $\gamma = 2$.	**08**
	(b)	Write a short note on Box complex method.	**06**

Q.4 **(a)** A small machine tool manufacturing company entered into a contract to supply 80 drilling machines at the end of the first month and 120 at the end of the second month. The unit cost of manufacturing a drilling machine in any month is given by $\$(50x + 0.2x^2)$, where x denotes the number of drilling machines manufactured in that month. If the company manufactures more units than needed in the first month, there is an inventory carrying cost of \$8 for each unit carried to the next month. Find the number of drilling machines to be manufactured in each month to minimize the total cost. Assume that the company has enough facilities to manufacture up to 200 drilling machines per month and that there is no initial inventory. Solve the above dynamic programming problem as a final value problem. **10**

(b) Find the dual of the following LPP: **04**

Minimize $Z = 10x_1 + 12x_2$

subject to:

$3x_1 + 7x_2 \leq 10$

$6x_1 + 4x_2 \geq 20$

$3x_1 + 5x_2 \leq 15$

$2x_1 - 3x_2 \geq 10$

$x_1 , x_2 \geq 0$

OR

Q.4 **(a)** Solve the following Linear Programming problem using Simplex method **08**

Maximize $Z = 5x_1 + 3x_2$

subject to:

$x_1 + x_2 \leq 2$

$5x_1 + 2x_2 \leq 10$

$3x_1 + 8x_2 \leq 12$

$x_1 , x_2 \geq 0$.

(b) Write short note on dynamic programming with an example. **06**

Q.5 **(a)** Explain multi objective optimization and its application. **07**

(b) Use Lagrange's multiplier technique to solve the following problem: **07**

Minimize: $f(x) = 0.5 (x_1^2 + x_2^2 + x_3^2)$

Subject to: $g_1(x) = x_1 – x_2 = 0.$

$g_2(x) = x_1 + x_2 + x_3 = 1.$

OR

Q.5 **(a)** Explain ant colony optimization technique in detail. **07**

(b) Minimize $f = - 4x_1 + x_1^2 + 2x_2^2 - 2x_1x_2$ **07**

subject to:

$2x_1 + x_2 \leq 6$

$x_1 - 4x_2 \leq 0$

$x_1 , x_2 \geq 0$

Formulate the problem to solve by quadratic programming technique.

****