

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-II Remedial Examination December 2010****Subject code: 721602****Subject Name: Chemical Process Optimization****Date: 20 /12 /2010****Time: 02.30 pm – 05.00 pm****Total Marks: 60****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** It is required to replace a length of piping within a process plant. Since the site is cramped, the pipe run must be brought in to the site in lengths and welded in situ. Obviously, to reduce the cost of welding, the pipe lengths should be brought in, in sections which are as long as possible, if the head room is low and the pipe has to be carried horizontally, what lengths should be introduced if the restriction is the passage of the pipe around the corner from 10 ft wide corridor in to a 6 ft wide corridor. **06**

- (b)** Write necessary any sufficient conditions for an extreme value of multivariable objective function and find out stationary point for **06**

$$y = 1 + 8x + 2x^2 - \frac{10}{3}x^3 - \frac{1}{4}x^4 + \frac{4}{5}x^5 - \frac{1}{6}x^6$$

- Q.2 (a)** Search for the minimum of the objective function $y = 6x_1^2 + 3x_2^2$ using invariant approach. Terminate the search after each of the coordinate directions has been searched two times. **06**

- (b)** You are assigned to design an open-topped rectangular tank whose total area is to be 108 m². If a maximum volume is required, formulated the problem and solve it. **06**

OR

- (b)** An open top box is to be made out of a piece of cardboard measuring 2mX2m by cutting off equal surfaces from the corners and turning up the side. Find height of the box for maximum volume. **06**

- Q.3 (a)** Carry out three 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 $\delta = 0.5$, starting from the base point (2,-1,1). A stage consists of a local exploration, together with an accelerated move. **06**

- (b)** In performing a numerical search of the objective function **06**

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

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.3 (a)** Find the minimum of the objective function $y = x_1^2 + 3x_2^2 + 5x_3^2$ starting from the point {2,3,-5} using the Powell method. **06**

- (b)** Minimize function $f(x) = 100(x_2 - x_1^2)^2 + (1 - x_1^2)$ with an initial point of 2, 2) using Rosenbrock method up to finding the direction for second stage of search. **06**

- Q.4 (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 or Fibonacci search technique. **06**

- (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. **06**

OR

Q.4 (a) Explain the fundamentals of Genetic Algorithm optimization technique with strengths and limitations in brief. **06**

(b) Minimize the function $y = (x - 3)^2$ subject to the restriction $x \geq 1$. **06**

Q.5 Maximize P with respect to x_i when it is subject to the restrictions that **12**

$$11x_1 + 3x_2 - 2x_3 \geq P$$

$$4x_1 + 5x_2 + x_3 \geq P$$

$$6x_1 + 10x_2 + 5x_3 \geq P$$

$$x_1 + 8x_2 + 12x_3 \geq P$$

$$x_1 + x_2 + x_3 = 1$$

$$x_i \geq 0$$

OR

Q.5 Find the maximum of the function **12**

$$y = 6x_1 + 5x_2$$

Subject to the restrictions

$$-2x_1 - 5x_2 \leq -20$$

$$5x_1 + x_2 \leq 5$$

$$3x_1 + 11x_2 \leq 33$$

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