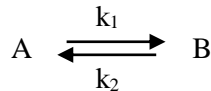


**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016**

**Subject Code: 2723010****Date: 27/05/2016****Subject Name: Advance Process Optimization****Time: 10:30 am to 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)** A liquid phase, isothermal, reversible first order, exothermic reaction**07**

is to be carried out in a CSTR. The reactor space time is to be held constant at space time  $\tau$ . The feed is pure A. Optimum temp which will maximize conversion of A is the one which will maximize  $\frac{k_1\tau}{1+k_2\tau}$ .

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

**(b)** Write necessary any sufficient conditions for an extreme value of single variable objective function and find out stationary point for**07**

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

**Q.2 (a)** Find the minimum of the Linear function**09**

$$y = -3x_1 + x_2 + x_3$$

Subject to the Linear restrictions

$$x_1 - 2x_2 + x_3 \leq 11$$

$$-4x_1 + x_2 + 2x_3 \geq 3$$

$$2x_1 - x_3 + 1 = 0$$

with  $x_1 \geq 0$ ,  $x_2 \geq 0$ , and  $x_3 \geq 0$ **(b)** Explain golden section search for single variable optimization and derive working equations for it.**05****OR****(b)** Find the optimum solution to the following LP by inspection**05**

$$\text{Minimize } y = x_1 - 3x_2 + 2x_3$$

Subject to the Linear restrictions

$$-2 \leq x_1 \leq 3$$

$$0 \leq x_2 \leq 4$$

$$2 \leq x_3 \leq 5$$

- Q.3 (a)** Find the optimum solution to the following: **07**
- Maximize  $y = x_1^2 + x_2x_3 - x_3^3$   
 Subject to the restriction  
 $-2x_1 + 3x_2 + x_3 \leq 3$   
 $x_1, x_2, x_3 \in \{0,1\}$
- (b)** The cost of purchase and installation of a steam pipe lagging may be represented as  $c_1 = ax + b$  and the cost of heat loss from the piping may be given as  $c_2 = c/x + d$ , both  $c_1$ , and  $c_2$  are expressed on same basis.  $a$ ,  $b$ ,  $c$  and  $d$  are all known constants, and  $x$  is the insulation thickness. Then the total cost  $y$  of the lagging system is the sum of these two costs,  $y = ax + b + c/x + d$ . This is a continuous convex function of single variable  $x$ . Find out the minimum cost of operation. **07**
- OR**
- Q.3 (a)** Solve the following by the branch and bound algorithm **07**
- Maximize  $y = 21x_1 + 11x_2$   
 Subject to the restriction  
 $7x_1 + 4x_2 + x_3 = 13$  ;  
 $x_1, x_2, x_3$  are non-negative integers.
- (b)** Search for minimum of the objective function  $y = x_1^2 + 3x_2^2 + 5x_3^2$ , starting from the base point  $(2, -1, 1)$ . **07**
- Q.4 (a)** Find the minimum of the objective function using sequential simplex method. **08**
- $y = x_1^2 + x_2^2 + 4x_3^2 + x_4^2$   
 Carry out eight cycles of vertex rejection and regeneration.
- (b)** Define a suitable search region and a feasible initial base point for the complex method of search in minimizing  $y = x_1^3 - 2x_1x_2 + x_2^4$  subject to the restrictions that  $x_1^2 + 2x_2^2 - 4 \leq 0$ . **06**
- Setup a complex method of search and carryout two cycles of search.
- OR**
- 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. **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. **08**
- Q.5 (a)** Using the Hooke-Jeeves search technique, seek the minimum of the objective function  $y = 8x_1^2 + 4x_1x_2 + 5x_2^2$  starting from the point  $(-4, -4)$ . **07**
- (b)** List the first four search directions for Powell's method to minimize  $f(x) = x_1^2 + \exp(x_1^2 + x_2^2)$ , starting at the point  $(2, 2)$ . **07**
- OR**
- Q.5 (a)** An open top box is to be made out of a piece of cardboard measuring 2m X 3m by cutting off equal surfaces from the corners and turning up the side. Find dimensions of the box for maximum volume. **06**
- (b)** Find the maximum of  $y = 6x_1x_2^{-1} + x_2x_1^{-2}$  subject to  $h(x) = x_1x_2 - 2 = 0$ ;  $g(x) = x_1 + x_2 \geq 1$ ; using direct successive QP from the initial point  $(2,1)$ . **08**

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