

M.Tech. First Semester (Chemical Engg.) (CBS)
13004 : Mathematical Modelling & Optimization : 1 CE 4

P. Pages : 2

Time : Three Hours



AW - 3717

Max. Marks : 80

- Notes :
1. All question carry marks. as indicated.
 2. Answer **any six** question.
 3. Due credit will be given to neatness and adequate dimensions.
 4. Assume suitable data wherever necessary.
 5. Diagrams and Chemicals equations should be given wherever necessary.
 6. Illustrate your answer necessary with the help of neat sketches.
 7. Discuss the reaction, mechanism wherever necessary.
 8. Use of cell phone is not allowed in the exam.
 9. Use of pen Blue/Black ink/refill only for writing the answer book.

1. Minimize using Lagrange Multiplier method 14
$$f(x_1, x_2, x_3) = \frac{1}{2} (x_1^2 + x_2^2 + x_3^2)$$

Subject to constraint

$$g_1(x_1, x_2) = x_1 - x_2$$
$$g_2(x_1, x_2, x_3) = x_1 + x_2 + x_3 - 1$$
2. Find the dimensions of cylindrical tin (top and bottom) made up of sheet to maximize its volume such that the total surface area is 24π . 13
3. A manufacture produces 2 types of models M_1 and M_2 . Model 1 requires 4 hour grinding and 2 hour polishing. Model 2 requires 2 hour grinding and 5 hour polishing. Manufacturer have 2 grinders and 3 polishers. profit M_1 and M_2 model are Rs. 3 and Rs. 4 whatever is produced in week is sold in the market. How should the manufacturer allow to get production capacity to the two type of model so that he can make the maximum profit in a week. 14
4. We are considering to get something of value from waste stream of process this stream (20,000 lit/day) contains chemical A (0.01 kg/lit) which can be hydrolyzed in aqueous solution to give chemical R (1 Rs/kg transform). Product rate can be record from a solution that negligible cost while unreacted A goes to waste. From the information below calculate the size of mixed reactor and conversion level which will maximize:
a) The profit
b) The rate of return on investment 13
Data : - On annual basis cost of reactor and supporting equipment including depreciation, interest charges is Rs. $225\sqrt{V}$, V is volume in liters. Labour and and operating cost is Rs. 20/day. 300 operating days in a year. The hydrolysis reaction is first order with respect to A with rate constant $K = 0.25$.
5. How will you classify the unconstrained minimization method? 13
Discuss the random search, grid search, univariate search and simple search method used in optimization problem.

6. a) Find maximum of the following function using Newton's Method:- 7

$$f(x) = 2 \sin x - \frac{x^2}{10}$$
 Use an initial guess. $x_0 = 2.5$
- b) Minimize $f(x) = 4x_1^2 + 5x_2^2$ 6
 Subject to $2x_1 + 3x_2 = 6$
 solve by substitution method.
7. a) Explain the basics of artificial neural network and its applicability in optimization problems. 7
 b) Discuss optimization of fuzzy system. 6
8. Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1 x_2 + x_2^2$ 13
 Starting from the point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$
 Use steepest descent method.
9. Minimize using Simplex method 13

$$f = -4x_1 + x_1^2 - 2x_1 x_2 + 2x_2^2$$
 Subject to

$$2x_1 + x_2 \leq 6$$

$$x_1 - 4x_2 \leq 0$$

$$x_1 \geq 0, x_2 \geq 0$$
10. A box with square base and open top is to hold 1000 cm^3 . Find the dimensions that required the least material for box. 13
