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

P. Pages : 2

Time : Three Hours

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Max. Marks : 80

Notes : 1. All question carry marks as indicated.
2. Answer **any six** questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Diagrams and chemical 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 cellphone is not allowed in exam.
9. Use of pen Blue/Black ink/refill only for writing the answer book.

1. How will you classify the unconstrained minimization methods? **13**
Discuss the random search, grid search, univariate search and Powell's method, used in optimization problem.

2. a) The volume of sell of product is found to be a function of number of news paper **8**
advertisement x_1 and number of minutes of TV time x_2, $f = 12x_1 x_2 - x_1^2 - 3x_2^2$. Each news paper advertisement or each minutes on TV cost Rs. 1000. How does the firm allocate Rs. 48,000 between two advertising media to optimize its sell.

    b) Minimize the following function by Lagrangian Multiplier method: **5**
$f(x) = 4x_1^2 + 5x_2^2$ subject to $2x_1 + 3x_2 = 6$.

3. Find the dimensions of cylindrical tin (top and bottom) mode up of sheet to maximize its **14**
volume such that the total surface area is 24π.

4. In room temperature a second order reaction proceed at a rate, **13**
$-r_A = K C_A^2$, $k = 1 \text{lit}/\text{mol}\cdot\text{hr}$, initial concentration $C_{A0} = 1 \text{mol}/\text{lit}$. We plan to make this product batch after batch and then day night in a batch reactor. How one should operate the unit for.
    a) For maximum production rate of product.
    b) For maximum rate of profit if unreacted reactant is discarded
    The shut down time in batches is in hour, cost of reactant is Rs. 100 per batch and value of productive fluid is Rs. $200 x_A$ per batch.

5. A manufacturer produces 2 types of models M_1 and M_2. Model 1 requires 4 hour grinding **14**
and 2 hour polishing. Model 2 requires 2 hour grinding and 5 hours polishing. Manufacturer have 2 grinders and 3 polishers. Profit on 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.

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6. a) Find the maximum of 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, $f(x) = 4x_1^2 + 5x_2^2$ subject to $2x_1 + 3x_2 = 6$ 6

Solve by substitution method.

7. Explain the following in detail. 13
   i) Integer and Mixed integer programming.
   ii) Dynamic programming.

8. A manufacturer produces four products, A, B, C and D by using two types of machines 13
(lathes and milling machines). The times required on the two machines to manufacture 1
unit of each of the four products, the profit per unit of the product, and the total time
available on the two types of machines per day are given below:

Machine	Time Required per unit for product				Total time Available per day (min)
	A	B	C	D	
Lathe Machine	7	10	4	9	1200
Milling Machine	3	40	1	1	800
Profit per unit (Rs.)	45	100	30	50	

Find the number of units to be manufactured of each product per day for maximizing the
profit.

9. Explain the followings in detail: 13
   i) Advantages and limitations of linear programming models.
   ii) Concept of convex set, concave set along with mathematical statements.

10. a) Explain the basics of artificial neural network and its applicability in optimization 6
problems.

b) Discuss the optimization of fuzzy systems. 7

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