

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

P. Pages : 2

Time : Three Hours



AW - 3446

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 cell phone is not allowed in exam.
 9. Use of pen Blue/Black ink/refill only for writing the answer book.

1. An organic chemical is produced in a batch reactor the time required is successfully complete 1 batch product depends on amount charge to reactor and has been correlated to be $t = 2P^{0.4}$, P is the amount of product in pounds per batch, t is in hours. A certain amount of non-production time is associated with each batch of charging and discharging and minor maintenance of 14 hr/batch operating cost of batch system is 50 Rs/hr, while operating the capital cost including storage depend on size of each batch. It is on unknown basis to be $C_A = 800P^{0.7}$. The annual production is 3 lakh pounds per year and process can be operated 320 days per year. (24 hrs/day). The total raw material costs at this production is Rs. 4 lakh per year. Formulate the objective function using P as a variable Are there constant other than P? Give the relation for optimum value of P. 14
2. Explain the following methods of optimization : 13
 - i) Random search.
 - ii) Grid search.
 - iii) Univariate search.
 - iv) Simple search.
3. Minimize using Lagrange multiplier method : 13
$$f(x_1, x_2, x_3) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2)$$
subject to,
$$g_1(x_1, x_2) = x_1 - x_2$$
$$g_2(x_1, x_2, x_3) = x_1 + x_2 + x_3 - 1$$
4. The volume of sells of product is found to be a function of news paper advertisement x_1 and number of minutes of TV time advertisement x_2 . 13
$$f = 12x_1x_2 - x_1^2 - 3x_2^2$$
Each news paper advertisement or each minute advertisement on TV costs Rs. 1000. How does the firm allocate Rs. 48,000 between two advertising media to optimize its sell.
5. What do you mean by Neural Network Architecture? 13

Discuss in detail the classification of neural network architecture along with its applications.

6. 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
7. An electric company produces two products P_1 and P_2 products are produced and sold on weekly basis. The weekly production can not exceed 25 for product P_1 and 35 for product P_2 because of limited available facilities. The company employees of total 60 workers. Product P_1 requires 2 man week pf labour while P_2 requires one man week pf labour profit margin on P_1 is Rs. 60 and P_2 is Rs. 40. Formulate this problem as an linear programming problem and solve for maximum profit. 13
8. a) Determine the optimum dimension of cylindrical tank with maximum height of 1 m. The tank volume is 0.8 m^3 having thickness 3 cm. Density of material of construction is 8000 kg/m^3 . The cost of material is Rs. 5.0 per kg and welding cost is Rs. 20.0 per kg. 8
- b) A box with square base and open top is to hold 1000 cm^3 . Find the dimensions that require least material. 5
9. a) Minimize using substitution method 7
 $f(x) = 4x_1^2 + 5x_2^2$
 subject to $2x_1 + 3x_2 = 6$
- b) Maximize using Newton's method 6
 $f(x) = 2 \sin x - \frac{x^2}{10}$
 use an initial guess, $x_0 = 2.5$.
10. In room temperature, the second order reaction proceeds as $2A \rightarrow R$ at rate of 14
 $-r_A = K C_A^2$, $K = 1 \text{ lit / mol.hr}$.
 Initial concentration $C_{A0} = 1 \text{ mole / lit}$ we plan to make this product batch after batch as then day and night in a batch reactor. How should be operated the unit (a) for maximum production rate of r (b) for maximum rate of profit if unreacted A is discarded. The shut down time in batches is $t \text{ hr}$, cost of reactant is Rs. 100 per batch and value of productive fluid is Rs. $200 x_A$ per batch.
