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

P. Pages : 2

Time : Three Hours

0282

AU - 3277

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. Cellphone is strictly prohibited in exam.
9. Use of pen Blue/Black ink/refill only for writing the answer book.

1. What are the various engineering applications of optimization? Give a description of various search methods like grid search, simplex search, random search with their important features used in optimization problem. **13**

2. Determine the optimum dimensions of cylindrical tank with maximum height of 2 meter and maximum diameter of 1 meter. The tank volume is to be 0.8 m^3, the thickness of the tank wall to be 3 cm. Density of the material of construction is 8000 kg/m^3, the cost of material is Rs. 5 per kg and the cost of welding is Rs. 20 per kg. **13**

3. a) Give the classification of optimization problem. **7**

   b) Minimise, using Lagrange multiplier method, **7**
   $$F(x_1, x_2) = x_1 + x_2$$
   subject to $h(x_1, x_2) = x_1^2 + x_2^2 - 1 = 0$.

4. Using the simplex method **13**
   Maximize $y = x_1 + 3x_2 - x_3$
   Subject to $x_1 + 2x_2 + x_3 = 4$
   $$2x_1 + x_2 \leq 5$$
   $$x_1, x_2, x_3 \leq 0$$

5. Explain the followings in detail :- **13**
   i) Integer and mixed integer programming.
   ii) Dynamic programming.

6. a) Explain the advantages of linear programming methods and limitations of linear programming models. **7**

   b) XYZ chemical company produces two products A1 and A2 that are produced and sold on weekly basis. The weekly production can not exceed 25 for product A1 and 35 for product A2 because of limited facilities. The company employs total of 60 workers. Product A1 requires 2 man weeks of labour where as product A2 requires only 1. Profit margin on A1 is Rs. 60 and on A2 is Rs. 40. Formulate it as Linear programming problem and solve for maximum profit. **7**

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7. Use graphical method to solve the following problem :   13

Maximize $z = 2x_1 + 5x_2$

Subject to, $x_1 + 4x_2 \leq 24$

$\qquad 3x_1 + x_2 \leq 21$

$\qquad x_1 + x_2 \leq 9$

$\qquad x_1, x_2 \geq 0$

8. a) Discuss the basics of artificial neural network and its utility in optimization problems.   7

   b) Explain how does the traditional methods of optimization differs from genetic algorithms based methods.   6

9. a) Explain with the help of neat sketches the concepts of convex set, convex function with mathematical statements.   6

   b) Determine the following functions are convex, concave or neither   7

     i) $f(x) = x^3 + x^4$

     ii) $f(x) = x^4 + 6x^2 + 12x$

10. Prove that the following problem has an unbounded solution :   13

Minimize $f = -3x_1 - 2x_2$

Subject to $x_1 - x_2 \leq 1$

$\qquad 3x_1 - 2x_2 \leq 6$

$\qquad x_1 \geq 0, \ x_2 \geq 0$

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