Time: 3 Hours **Marks: 80**

1) Question No. 1 is compulsory.
2) Answer any three out of the remaining five questions.
3) Figures to the right indicate full marks.
4) Illustrate answers with neat sketches wherever required.

Q1 a) How optimisation problems can be classified **(4)**

b) Explain dual and primal relationship **(4)**

c) Illustrate difference in linear and nonlinear optimization problem with suitable example. **(4)**

d) State methods of normalization and explain any one. **(4)**

e) Explain Taguchi's loss function **(4)**

Q2 a) Solve the following problem by simplex method **(10)**

Maximize $Z = 40x_1 + 50x_2$

Subject to $2x_1 + 3x_2 <= 3$

$8x_1 + 4x_2 <= 5$

$x_1, x_2 >= 0$

b) A shop keeps a stock of products of a particular brand. Previous experience shows the daily demand pattern for the product with associated probabilities, as below. Use the following sequence of random numbers to simulate the demand for the next 10 days. And estimate the average daily demand based on simulated data. **(10)**

Daily Demand (no.s)	0	10	20	30	40	50
Probability	0.01	0.2	0.15	0.5	0.12	0.02

Use Random Numbers : 25, 39, 65, 76, 12, 05, 73, 89, 19, 49

Q3 a) Use the method of Lagrangian multipliers to solve the following NLP problem. Does the solution maximize or minimize the objective function ? Optimize $Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$ subject to the constraint $g(x) = x_1 + x_2 + x_3 = 20$ and $x_1, x_2, x_3 \geq 0$ **(10)**

b) A company has two plants, each of which produces and supplies two products: A and B. The plants can each work up to 16 hours a day. In plant 1, it takes three hours to prepare and pack 1,000 gallons of A and one hour to prepare and pack one quintal of B. In plant 2, it takes two hours to prepare and pack 1,000 gallons of A and 1.5 hours to prepare and pack a quintal of B. In plant 1, it costs Rs 15,000 to prepare and pack 1,000 gallons of A and Rs 28,000 to prepare and pack a quintal of B, whereas in plant 2 these costs are Rs 18,000 and Rs 26,000, respectively. The company is obliged to produce daily at least **(5)**

10 thousand gallons of A and 8 quintals of B. Formulate this problem as an LP model to find out as to how the company should organize its production so that the required amounts of the two products be obtained at the minimum cost

c) State various Linear programming methods and state its suitability with illustration **(5)**

Q4 a) What are the various non-traditional optimisation techniques? Explain any one with illustration. **(10)**

b) Discuss in brief some applications of Optimization in Engineering **(5)**

c) A manufacturing firm produces two types of products: A and B. The unit profit from product A is Rs 100 and that of product B is Rs 50. The goal of the firm is to earn a total profit of exactly Rs 700 in the next week. Formulate goal programming model. **(5)**

Q5 a) Explain multi attribute decision making with suitable illustration. **(10)**

b) Find the maxima and minima of the function **(5)**
$f(x) = -x^3 + 3x^2 + 9x + 10 \ , -2 < x < 4$

c) Explain concept of Dynamic programming **(5)**

Q6 a) Explain design of experiments. Explain its application and state its importance. **(10)**

b) What we mean by full factorial and fractional factorial experiments. **(5)**

c) Explain the terms Local optimum, global optimum and saddle point. **(5)**

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