Paper / Subject Code: 32625 / Department Optional Course-I: Optimization Techniques

1T01435 - T.E.(Mechanical) Engineering)(SEM-V)(Choice Base Credit Grading System) ((R- 19) (C Scheme) / 32625 - Department Optional Course-I: Optimization Techniques

QP CODE: 10039016 DATE: 04/12/2023

Time: 3 Hours **Total Marks:80**

Note:

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 Solve any four

a) How optimization problems can be classified (5)

b) Write the dual of the following primal LP problems (5)
Max $Z = 2x_1 + 5x_2 + 6x_3$
subject to (i) $5x_1 + 6x_2 - x_3 \leq 3$ (ii) $-2x_1 + 3x_2 + 4x_3 \leq 4$
(iii) $x_1 - 5x_2 + 3x_3 \leq 1$ (iv) $-3x_1 - 3x_2 + 7x_3 \leq 6$ and $x_1, x_2, x_3 \geq 0$

c) Illustrate difference in linear and nonlinear optimization problem with suitable example. (5)

d) State methods of normalization and explain any one. (5)

e) Explain Taguchi's loss function (5)

Q2 a) Solve the following problem by simplex method (10)
Maximize $Z = 30x_1 + 20x_2$
Subject to $x_1 + x_2 <= 40$
$x_1 - x_2 <= 20$
$x_1, x_2 >= 0$

b) A company manufactures around 200 bikes. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 to 204 bikes , whose probability distribution is as given below: (10)

Production/day	196	197	198	199	200	201	202	203	204
Probability	0.05	0.09	0.12	0.14	0.20	0.15	0.11	0.08	0.06

The finished bikes are transported in a specially designed three-storied lorry that can accommodate only 200 mopeds. Using the following 10 random numbers: 82, 89, 78, 24, 53, 61, 18, 45, 23, and 50, simulate production for 10 days
(a) What will be the average number of bikes made in 10 days?
(b) What will average number of bikes waiting in company to be transported in 10 days

Q3 a) Using the Lagrange's multiplier method solve the following NLPP (10)
Optimize $Z = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$
S.T. $x_1 + x_2 + x_3 = 15$
$x_1, x_2, x_3 \geq 0$

b) A company sells two different products A and B, making a profit of Rs 40 and Rs 30 per unit, respectively. They are both produced with the help of a common production process and are sold in two different markets. The production process has a total capacity of 30,000 man-hours. It takes three hours to produce a unit of A and one hour to produce a unit of B. The market has been surveyed and company officials feel that the maximum number of units of A that can be sold is 8,000 units and that of B is 12,000 units. Subject to these limitations, products can be sold in any combination. Formulate this problem as an LP model to maximize profit. (5)

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 200 and that of product B is Rs 150. The goal of the firm is to earn a total profit of exactly Rs 900 in the next week. The demand of A and B are upto maximum 30 and 40 quantities respectively. Formulate as a goal programming model. (5)

Q5 a) Following table shows the various alternatives of Material (M1, M2,..) for piston cyinder, and corresponding attributes as Cost (A1), tensile strength (A2), thermal conductivity (A3), and machinability index (A4) Suggest suitable material using SAW method. Assume equal weight of 0.25 for the all attributes, A1 as non-beneficial and rest all as beneficial attributes for the following case. (10)

No	Alternative	M1(Rs/kg)	A2 (MPa)	A3 (W/m-K)	A4
1	M1	300	110	142	100
2	M2	350	100	125	110
3	M3	375	120	100	105
4	M4	400	130	120	120
5	M5	315	125	135	115

b) Find the maxima and minima, if any, of the function $f(x) = 4x^3 - 18x^2 + 27x - 7$ (5)

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 concept of robust design (5)
