

Time: 3 Hrs

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.

- Q. 1** Explain briefly any four **20**
- a Robust design
  - b Engineering applications of optimization
  - c Integer Programming
  - d Genetic Algorithm
  - e Analytic Hierarchy Process (AHP) Method
- Q2** a Explain design of experiments. Explain its application and state its importance. **10**
- b A firm manufacture product P & Q which pass through machining and finishing departments. Machining has 90 hours available; finishing can handle up to 72 hours of work. Manufacturing one product P requires 6 hours in machining and 3 hours in finishing. Each product Q requires 3 hours in machining and 6 hours in finishing. If profit is Rs. 120/- per product P and Rs. 90/- per product Q. Formulate as goal programming problem to determine combination of product P & Q to realise profit of exactly Rs. 2100 **10**
- Q3** a Find the maximum and minimum value of  $y = 3x^5 - 5x^3$ . **10**
- b Solve LPP by simplex method **10**  
Maximize:  $Z = 40x_1 + 35x_2$  subjected to,  
 $2x_1 + 3x_2 \leq 60$   
 $4x_1 + 3x_2 \leq 96$   
 $x_1, x_2 \geq 0$

**Q4** a Solve following problem by big M method **10**  
Minimize  $Z = 600x_1 + 500x_2$  subjected to,  
 $2x_1 + x_2 \geq 80$   
 $x_1 + 2x_2 \geq 60$ , where  $x_1, x_2 \geq 0$ .

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 State methods of normalization and explain any one. **5**

**Q5** a Solve the following NLPP: Maximum  $Z = 4x_1 + 6x_2 - 2x_1x_2 - 2x_2^2$  **10**  
subjected to  $x_1 + 2x_2 = 2$ ,  $x_1, x_2 \geq 0$ .

b Explain concept of dynamic programming and bellman's principle of optimality **10**

**Q6** a Explain multi attribute decision making with suitable illustration **10**

b Explain briefly taguchi's loss function **5**

c A production process makes batteries for 9 +/- 0.25 volts applications at a cost of \$ 0.75 each. Determine: **5**

a. Complete expression for loss function

b. Loss when a part is made at 9.10 V

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