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B.Tech. V Semester (Main/Back) Examination, Nov. /Dec. - 2017
Electrical Engineering
5EE6.1A Optimization Techniques

Time : 3 Hours

Maximum Marks : 80
Min. Passing Marks : 26

Instructions to Candidates :

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly). Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Write a brief note of the following :

   i) Constraints

   ii) Linear programming problem

   iii) Geometric programming problems

   iv) Quadratic programming problems **(8)**

   b) A factory produces two grades of paper namely A4 and B4. It cannot produce more than 400 tons of grade A4 and 300 tons of B4 in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products A4 and B4 respectively with corresponding profits of Rs. 200 and Rs. 500 per ton. Formulate the linear programming problem. **(8)**

OR

1. a) What is optimization? Explain ten engineering applications of optimization techniques. **(8)**

   b) A company desires to devote the excess capacity of the three machines lathe, shaping and milling to make three products A, B and C. The available time per month in these machines are tabulated below :

Machine	Lathe	Shaping	Milling
Available time per month	200 hours	110 hours	180 hours

The time (in hours) taken to produce each unit of the products A, B and C on the machines is displayed in the table below :

Machine	Lathe	Shaping	Milling
Product A	5	2	4
Product B	2	2	Nil
Product C	3	Nil	3

The profit per unit of the products A, B and C are Rs. 20, Rs. 15 and Rs. 12 respectively. Formulate the mathematical model to maximize the profit. **(8)**

Unit - II

2. a) Find the extreme points of the function $f(x, y) = x^3 + 2y^3 + 3x^2 + 12y^2 + 24$, and determine their nature also. **(8)**

b) A rectangular sheet of metal has four equal portions removed at the corners and the sides are then turned up so as to form an open rectangular box. Show that when the volume contained in the box is maximum, the depth will be $\frac{1}{6}\left[(a+b)-\left(a^2-ab+b^2\right)^{1/2}\right]$ where a and b are original dimensions of rectangle. **(8)**

OR

2. a) Find the point on the plane x + 2y + 3z = 1, which is nearest to the point (–1, 0, 1) by Lagrange's multipliers method. **(8)**

b) A given quantity of metal is to be caste into a half cylinder. Show that, in order to have minimum surface area, the ratio of the length of the cylinder to the diameter of its semicircular ends is $\pi/(\pi+2)$. **(8)**

Unit - III

3. a) Solve graphically the problem

$$\begin{aligned} \textit{Max.} \quad & z = 3x + 4y \\ \textit{Subject to} \quad & 5x + 4y \le 200 \\ & 3x + 5y \le 150 \\ & 5x + 4y \ge 100 \\ & 8x + 4y \ge 80 \\ \textit{and} \quad & x, y \ge 0. \end{aligned}$$

(8)

b) Find the dual of the following LPP :

$$\begin{aligned} \textit{Min.} \quad & z_r = x_1 + x_2 + x_3 \\ \textit{Subject to} \quad & x_1 - 3x_2 + 4x_3 = 5 \\ & 2x_1 - 2x_2 \le -3 \\ & 2x_2 - x_3 \ge 5 \\ \textit{and} \quad & x_1, x_2 \ge 0,\ x_3 \text{ is unrestricted in sign} \end{aligned}$$

(8)

OR

3. Solve the following problem by using Big-M method :

$$\begin{aligned} &\text{Min.} && z = x_1 + x_2 \\ &\text{Subject to} && 2x_1 + x_2 \geq 4 \\ &&& x_1 + 7x_2 \geq 7 \\ &\text{and} && x_1, x_2 \geq 0. \end{aligned}$$ **(16)**

Unit - IV

4. Find the maximum of $f(x) = x(5\pi - x)$ in the interval [0, 20] by Golden section method. **(16)**

OR

4. State Kuhn-Tucker conditions, and apply them to solve

$$\begin{aligned} &\text{Minimize} && f(x, y, z) = x^2 + y^2 + z^2 + 20x + 10y \\ &\text{Subject to} && x \geq 40, \\ &&& x + y \geq 80, \\ &&& x + y + z \geq 120. \end{aligned}$$ **(16)**

Unit - V

5. Minimize $f(x_1, x_2) = x_1 - x_2$

Subject to $g(x_1, x_2) = 3x_1^2 - 2x_1x_2 + x_2^2 - 1 \leq 0$

Using the cutting plane method (upto two iterations). Take the convergence limit in step 5 as $\varepsilon = 0.02$. **(16)**

OR

5. Minimize $f(X) = x^2 + 2y^2$

Subject to $2x + 5y - 10 \leq 0$

by using exterior penalty method and find solutions (in table) for $r = 1, 5, 10, 50, 100, 500, 1000$ and $r \rightarrow \infty$.