Code No: 56021

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, November/December - 2020
ENGINEERING OPTIMIZATION
(Common to ME, AE)

Time: 2 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) A manufacturing firm produces two products, *A* and *B*, using two limited resources. The maximum amounts of resources 1 and 2 available per day are 1000 and 250 units, respectively. The production of 1 unit of product *A* requires 1 unit of resource 1 and 0.2 unit of resource 2, and the production of 1 unit of product *B* requires 0.5 unit of resource 1 and 0.5 unit of resource 2. The unit costs of resources 1 and 2 are given by the relations $(0.375 - 0.00005u_1)$ and $(0.75 - 0.0001u_2)$, respectively, where u_i denotes the number of units of resource *i* used (i = 1, 2). The selling prices per unit of products A and B, p_A and p_B, are given by
$p_A = 2.00 - 0.0005x_A - 0.00015x_B$
$p_B = 3.50 - 0.0002x_A - 0.0015x_B$
where x_A and x_B indicate, respectively, the number of units of products *A* and *B* sold. Formulate the problem of maximizing the profit assuming that the firm can sell all the units it manufactures.

b) What is optimization? Give engineering applications of optimization. [10+5]

2. Minimize the function
$$f(x) = 0.65 - [0.75/(1 + x^2)] - 0.65\, x \tan^{-1}(1/x)$$
using the golden section method with n = 6 [15]

3. $f(x)=x_1^2 - x_1x_2+3x_2^2$ Use univariant method by taking starting point as (1, 2). Show calculations only for two cycles. [15]

4. Minimize $f(x_1,x_2)=x_1- x_2+2x_1^2+2x_1x_2+x_2^2$ starting from X_0= (0,0) using Conjugate Gradient (Fletcher–Reeves) Method. [15]

5.a) Consider the following problem:
Minimize $f(x_1,x_2)=(x_1-1)^2+x_2^2$
subject to
$g_1(x_1,x_2) = x_1^3-2x_2\le 0$
$g_2(x_1,x_2)=x_1^3+2x_2 \le 0$
Determine whether the constraint qualification and the Kuhn-Tucker conditions are satisfied at the optimum point.

b) State the Kuhn–Tucker conditions. [10+5]

6. When $n=k+1$, *solve the problem*:
Minimize $z(x)=7x_1x_2^{-1}+3x_2x_3^{-2} +5x_1^{-3}x_2x_3+x_1x_2x_3$ and $x_1x_2x_3\ge 0$ by geometric programming method. [15]

7. A manufacturer produces four products, A, B, C, and D, by using two types of machines (lathes and milling machines). The times required on the two machines to manufacture 1 unit of each of the four products, the profit per unit of the product, and the total time available on the two types of machines per day are given below:

Machine	Time required per unit (min) for product:				Total time available per day (min)
	A	B	C	D	
Lathe machine	7	10	4	9	1200
Milling machine	3	40	1	1	800
Profit per unit ($)	45	100	30	50	

Find the number of units to be manufactured of each product per day for maximizing the profit.
Note: This is an ordinary LP problem and is given to serve as a reference problem for illustrating the sensitivity analysis. [15]

8. Find the minimum of the following function using simulated annealing: [15]

$$f(x)=500-20x1-26x2-4x1x2+4x12+3x22$$

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