No. of Pages: 2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, MAY-JUNE 2019

Branch: Mechanical Engineering

Machine Design

01ME6122 Optimization Techniques for Engineering

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. Discuss about different type of constraint surfaces. (3)

   b. Find the dimensions of largest box that can be inscribed in a sphere of unit radius (6)

2. a. State five engineering applications of optimization. (2)

   b. Minimize $f = 9 - 8x_1 - 6x_2 - 4x_3 + 2x_1^2 + 2x_2^2 + x_3^2 + 2x_1x_2 + 2x_1x_3$ subject to $x_1 + x_2 + 2x_3 = 3$ using lagrangian multiplier method. (7)

3. a. State the ~~conditions for determining~~ whether a given function is concave ~~or convex.~~ (3)

   b. Find the second-order Taylor's series approximation of the function $f(x_1, x_2) = (x_1 - 1)^2 e^{x2} + x_1$ at the points (**a**) (0,0) and (**b**) (1,1). (6)

PART B

4. a. Minimize $f(x) = x^2 + \frac{54}{x}$ in the interval [0,5] using golden section search method conducting a minimum of four experiments. (7)

   b. State the rules for region elimination in single variable optimization. (2)

5. a. Minimize $f = 2x_1^2 + x_2^2$ by using the steepest descent method with the starting point (1, 2) (6)

   b. Explain the physical concept of gradient methods (3)

6. a. Explain the concept of exhaustive search method. (3)

   b. Minimize $f = 4x_1^2 + 3x_2^2 - 5x_1x_2 - 8x_1$ starting from point (0, 0) using conjugate gradient method. Perform four iterations. (6)

PART C

7. a. Minimize the Himmelblau function $f(x)= (x_1^2 +x_2-11)^2+ (x_1 +x_2^2-7)^2$ subject to $g_1(x)=26-(x_1-5)^2-x_2^2\geq 0$, $g_2(x)=20-4x_1-x_2\geq 0$, $x_1, x_2 \geq 0$ using Frank Wolfe algorithm. (12)

8. a. Minimize $3x_1-x_2$ subject to $-10x_1+6x_2\leq 15$, $14x_1 +18x_2\geq 63$; x_1,x_2 nonnegative integers (12)

9. a. Solve the following LP problem by dynamic programming: (12)

Maximize $f(x_1, x_2) = 10x_1 + 8x_2$

subject to
$2x_1 + x_2 \leq 25$
$3x_1 + 2x_2 \leq 45$
$x_2 \leq 10$
$x_1 \geq 0, x_2 \geq 0$