Menoufia University
Faculty of Engineering, Shebin El-Kom,
Basic Engineering science Department
Postgraduate Examination, 2016-2017
Date of Exam: 31/5/2017

Subject: Operations research (1)
Code : BES 603
Year : Postgraduate students
Time Allowed : 3 hours
Total Marks: 100 marks

Answer the following questions

1) State the necessary and sufficient conditions for the minimum of a function $\boldsymbol{f(x)}$.

2) Write the Taylor's series expansion of a function $\boldsymbol{f(x)}$.

3) Discuss the Lagrange multiplier method.

4) Determine whether each of the following quadratic forms is positive definite, negative definite, or neither:

   i) $f = -x_1^2 + 4x_1x_2 + 4x_2^2$

   ii) $f = -x_1^2 + 4x_1x_2 - 9x_2^2 + 2x_1x_3 + 8x_2x_3 - 4x_3^2$

5) Find the maximum and minimum values of the function

$$f(x) = 12x^5 - 45x^4 + 40x^3 + 5$$

6) Find the second-order Taylor's series approximation of the function

$f(x_1, x_2, x_3) = x_2^2x_3 + x_1e^{x_3}$ about the point $x^0 = \{1,0,-2\}^T$

7) Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius.

Minimize $f(x,y) = kx^{-1}y^{-2}$

Subject to $g(x,y) = x^2 + y^2 - a^2 = 0$

Using the Lagrange multiplier method

8) Minimize $f(x_1, x_2) = x_1^2 + x_2^2 - 2x_1 - 4x_2$

Subject to $g_1(x_1, x_2) = x_1 + 4x_2 - 5 \leq 0$

$g_2(x_1, x_2) = 2x_1 + 3x_2 - 6 \leq 0$

$g_3(x_1, x_2) = -x_1 \leq 0$

$g_4(x_1, x_2) = -x_2 \leq 0$

Starting from the point $x = \begin{Bmatrix} 1.0 \\ 1.0 \end{Bmatrix}$.

9) Minimize $z = 10x_1 + 5x_2 + 4x_3$

Subject to $3x_1 + 2x_2 - 3x_3 \geq 3$

$4x_1 + 2x_3 \geq 10$

$x_1, x_2, x_3 \geq 0$

Solve the primal problem by applying the dual simplex algorithm

With my best wishes

Dr. Eng. Rizk Masoud