AEM 685: Midterm # 1

Due on 09/28/2015

Important: Please work independently. You are allowed to use Matlab, Maple, Mathematica, your notes and books.

Problem 1: Minimize the following problem using BFGS method without scaling of design variables.

$$Minimize\ f(x_1, x_2) = 3 * \sin(0.5 + 2500x_1x_2) * \cos(x_1)$$

$$\text{Sub to: } 0.5 \leq x_1 \leq 5$$

$$0 \leq x_2 \leq 0.0008$$

Start the optimization using $x_1 = 0.5$ and $x_2 = 0.0007$ as an initial guess for design variables.

Use Eq. (3.35) and Eq. (3.37) from the course-book for scaling the design variables during the implementation of BFGS method. Compare the number of iterations required to satisfy the convergence criteria, $\|\nabla f\|_2 \leq 1e-04$. You have to submit the Matlab program along with the contour plot showing iteration history for three options: 1) optimization without scaling, 2) optimization with scaling using Eq. (3.35), and 3) optimization with scaling using Eq. (3.37).

(40 points)

Problem 2: For the optimization problem,

$$Minmize \quad f(x_1, x_2) = -x_1x_2$$

$$Subject\ to \quad g(x_1, x_2) = \frac{x_1^2}{9} + \frac{x_2^2}{4} - 1 \leq 0$$

$$0 \leq x_1 \leq 3$$

$$0 \leq x_2 \leq 2$$

obtain the stationary point problem using Karesh-Khun-Tucker necessary condition (first-order). Prove that the obtained solution is minima by proving sufficient condition (second-order condition). (35 points)

Problem 3: Solve the following linear programming problem:

$$Minimize\ f = -2712.5x_1 - 1705x_2$$

Sub to: $1.5x_1 + x_2 \leq 46$

$$x_1 + x_2 \leq 30$$

$$4x_1 + 6x_2 \leq 251$$

$$x_1 \geq 0.5$$

$$x_2 \geq 1$$

(25 points)