ME 748: Optimum Design of Mechanical Elements and Systems
Spring 2007; Assignment-4

Due: 14^{th} March 2007; 5 pm in ECB 3108 **(Maximum extension of 2 days!!)**

Problem 1: Consider the minimization problem:

$$\min f(x,y) = 0.5x^2 + 2.5y^2$$

Starting the initial guess point $(x,y) = (5,1)$ determine the next two points if one uses the conjugate gradient method.

Problem 2: Solve the following problem graphically:

$$Min : f = (x_1 - 2)^2 + (x_2 + 1)^2$$

$$s.t.\ 2x_1 + 3x_2 - 4 = 0$$

Then, verify that the necessary and sufficient conditions are satisfied at the minima.

Problem 3: Find the point on the parabola $y = (1/5)(x-1)^2$ that is closest to $(1,2)$. Pose as an optimization problem, and solve. Verify that the necessary and sufficient conditions are satisfied at the minima.

Problem 4: Consider the problem:

$$Min : f = 2\pi x_1(x_1 + x_2)$$

$$s.t.\ \pi x_1^2 x_2 - 1000 = 0$$

Find the stationary point(s) by posing the optimality conditions and solving the resulting non-linear equations via the non-linear solver (fsolve).

Problem 5: Consider the spring problem defined by:

```
springSystem.initialNodeLocations = [0 0; 1 0; -1 -1; 2 -1; 2 1; -1 1];
springSystem.springConnectivity = [ 3 1; 2 1; 6 1; 5 2; 4 2];
springSystem.Forces = [1 0 20; 2 0 -20]; % Fx and Fy applied on node 1
springSystem.stiffness = [100 100 100 100 100]';
springSystem.freeNodes = [1 2];
```

If the two free nodes are allowed to move on a circle of radius 0.5, centered at (0.5, 0), find the equilibrium points for the two nodes (using fmincon). Also, find the magnitude of the two reaction forces (due to the constraints).