ME564 - Autumn 2014 **Due: 4:00:00pm Friday October 3rd, 2014**
Homework 1

Exercise 1-1 Compute the derivative of the following functions

(a) $f(x) = \sin(x^3)$

(b) $f(x) = e^{x^2}\sin(x)$

Exercise 1-2 Solve the following linear differential equation by hand:

$$\dot{x} = \lambda x, \quad x(0) = 1$$

Plot the solution for $t = 0$ to $t = 5$ for $\lambda = -2, -1, 0, 0.1, 0.2$. Please plot these all on the same figure using the `hold on` command in Matlab. Label your axes (`>> doc xlabel`, `>> doc ylabel`) and include a legend (e.g., `legend('lambda 1','lambda 2','lambda 3', ...)`).

Exercise 1-3 Compute the Taylor series expansion for $f(x) = x\sin(x)$ by hand.

Plot the function $f(x)$ and the three term expansion (i.e., the first three nonzero terms) from $x = -5$ to $x = 5$.

Exercise 1-4 Write down the solution to the following differential equation (by hand):

$$\ddot{x} - \lambda x = 0,$$

for an arbitrary initial position $x(0)$ and zero velocity $\dot{x}(0)$. What does the solution look like for $\lambda > 0$? How about for $\lambda < 0$? Please sketch solutions.

Exercise 1-5 Please solve the following differential equation (by hand):

$$\ddot{x} + \dot{x} - 2x = 0$$

with the following initial conditions:

$$x(0) = 2$$
$$\dot{x}(0) = -1.$$

What is the long-time behavior of this system?