MAE384 Fall 2009 Homework #5

In all homework problems, the argument of a sinusoidal function is always in radian

1. Evaluate the integral

$$I = \int_0^6 x\cos(x^2)\,dx$$

using the Composite Simpson's 3/8 method with (i) $h = 0.2$, and (ii) $h = 0.05$. Compare your results with the exact value obtained from the analytic expression of I. **(3 points)**

2. Solve the initial value problem (u is a function of x)

$$\frac{du}{dx} = \sin(u)\cos(u) \quad , \quad u(0) = \pi/4 \,,$$

using Euler's explicit method with (i) $h = 0.5$, (ii) $h = 0.2$. In both cases, find the solution for the domain, $0 \le x \le 10$. Plot the numerical solutions against the analytic solution, $u(x) = \tan^{-1}(\exp(x))$. (Hint: In Matlab, the function for "arctan" is atan(x).) **(3 points)**

3. Solve the initial value problem

$$\frac{du}{dx} = -0.3u^2 + 0.1x^2u - 0.5 \quad , \quad u(1) = 3 \,,$$

using the 4th order Runge-Kutta method with $h = 0.2$ to obtain the value of $u(1.4)$. (Note: This requires just two steps: Step 1 from $x = 1$ to 1.2, and Step 2 from 1.2 to 1.4. See a relevant exercise in Example 8-5 in the textbook.) **(3 points)**