PHYSICS 102
CLASSICAL MECHANICS LAB
FALL 2015

Assignment Five

Due Wednesday, November 11, 7:00 pm.
Revised: Due Wednesday, November 18, 7:00 pm.

[1.] Write a program to do the simple harmonic oscillator with a damping force and a sinusoidal drive force $F(t) = F_0 \cos \omega t$. To help debug your program, show that it works in the following special cases by working out and comparing with the exact results. (You have already demonstrated you have a working (debugged) code in the absence of friction and driving force in the previous assignment, so you do not need to check those pieces out.)

a. Check your coding of the friction term γ by running with spring constant $k = 0$, drive force $F_0 = 0$, initial position $x_0 = 0$, and initial velocity $v_0 = 10$ m/s. Set the mass $m = 2.5$ kg and $\gamma = 1$ kg/s. What is the analytic solution $x(t)$? Plot your numerical result and the analytic solution together.

b. Check your coding of the drive force term by running with spring constant $k = 0$, friction coefficient $\gamma = 0$, initial position $x_0 = 0$, and initial velocity $v_0 = 0$ m/s. Set the mass $m = 3$ kg and $F_0 = 2$ N with $\omega = 0$. What does $\omega = 0$ mean about the force? What is the analytic solution $x(t)$? Plot your numerical result and the analytic solution together.

c. Finally, let's check the formulae in class for the shifted frequency and the decay of the amplitude when you turn on friction. by running your code for $F_0 = 0$ N, $m = 4$ kg, $k = 3$ kg/s^2, $\gamma = 2.5$ kg/s. Plot your numerical result and the analytic solution together.