

## Physics 321 – Spring 2005

Homework #7, Due at beginning of class Wednesday Mar 16.

- [8 pts] A “triangle wave” can be defined by  $F(t) = 1 - 2\omega|t|/\pi$  for  $-\pi/\omega < t < +\pi/\omega$ , with  $F(t)$  defined at all other values of the time  $t$  by the property of having period  $2\pi/\omega$ .
  - Find the Fourier series representation of the  $F(t)$ . Express your answer BOTH in exponential form and in the form of sines and/or cosines.
  - Solve the driven damped oscillator equation  $\ddot{x} + 2\beta\dot{x} + x = F(t)$  in the form of an infinite series. You will probably find the exponential form of your answer to part (a) more convenient.
  - Plot the solution  $x(t)$  over a time interval of two periods:  $0 < t < 4\pi/\omega$  for the case  $\beta = 0.1$ , with  $\omega = 1/3, 1, 2$ . (Make three separate plots—one for each choice of  $\omega$ .)

(In doing this problem, I would prefer that you keep the entire infinite series in your answers. But it would be acceptable to keep only the frequencies up through  $5\omega$ .)
- [4 pts] Marion & Thornton, problem 4-3 (same in 4th edition). Draw the phase space diagram ( $\dot{x}$  vs.  $x$ ) right below the potential energy plot, as is done in Figure 4-5 in the book, so it is easy to see the correspondence between the two diagrams.
- [4 pts] Marion & Thornton, problem 4-6 (same in 4th edition). Use conservation of energy to calculate  $\dot{\theta}$  as a function of  $\theta$ .
- [4 pts] Marion & Thornton, problem 4-8 (same in 4th edition).