**PHYS 320 Analytical Mechanics**
Fall 2018

Homework Assignment # 18

- ☞ Read Taylor Sections 6.1 - 6.4, 7.1
- ✪ Taylor Problems: 5.52
- ✪ Extra Questions:

I. Suppose a step function force, $F_{ext}(t) = F_o H(t)$, is applied to a damped oscillator at a time $t_o$ as described by the Heaviside function:

$$H(t,t_o) = \begin{cases} 0, & t < t_o \\ a, & t > t_o \end{cases}$$

The solution to the step force function applied to a damped SHO can be written as

$$x(t) = \frac{H(t,t_o)}{a}\left\{ e^{-\gamma(t-t_o)}[A_1\cos(\omega_d(t-t_o)) + A_2\sin(\omega_d(t-t_o))] + \frac{a}{\omega_o^2} \right\}$$

A. Verify by direct substitution that this is a solution to the damped driven oscillator equation for this $F_{ext}$.

B. Assuming $x(t < to) = 0$ and *w*ith initial conditions $x(t_o) = 0$ and $dx(t_o)/dt = 0$, find $A_1$ and $A_2$ . Plot the response, $x(t)$, of the oscillator using $\gamma = 0.2/s$, $\omega_o = 2\ rad/s$, $a = 2$, $F_o = 1N$, and $t_o = 2s$ from $t = 0$ to $t = 30\ s$ using Maple.

C. Next, consider the impulse function:

$$I(t_o,t_1) = H(t_o) - H(t_1) = \begin{cases} 0, & t < t_o \\ a, & t_o < t < t_1 \\ 0, & t > t_1 \end{cases}$$

where $\tau = t_1 - t_o$. Find the solution for $t > t_1$. .

Finally, plot the total response *for* $t_o = 0$, $\gamma = 0.2\ \omega_o$, and $\tau = 5(2\pi/\omega_d)$ using Maple.