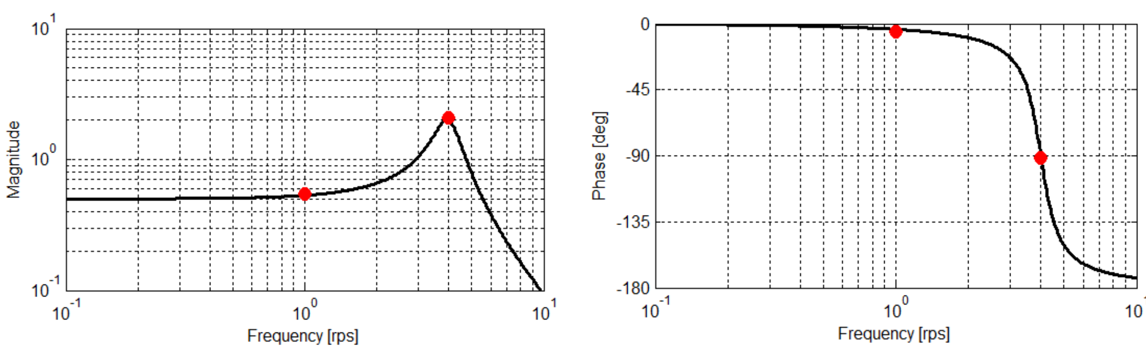
ESE 406/505 & MEAM 513 - SPRING 2012
HOMEWORK #8
DUE by Wednesday 21-Mar-2012 (Late Pass Monday 26-Mar-2012)

1. Download the file `HW08_Problem1.mdl`. Also download the file `HW08.m` and complete all the missing information. In particular, you will need to supply at least 5 data points that you obtain by running the simulation for at least 5 different input frequencies. These represent "experimental" frequency response measurements. You have reason to believe that the unknown systems have the following forms:

   A. $G(s) = \dfrac{A}{s^2 + 2\zeta\omega_n s + \omega_n^2}$

   B. $G(s) = \dfrac{Ae^{-Ts}}{(s+\omega)}$. You should take a few minutes to figure out what effect pure time will have on the magnitude and phase of a frequency response.

   After you make a good guess at the system dynamics, you should be able to get nice plots that look something like this (except your plots will have more data points):



   Next week, we will learn how to do more complicated experiments that give us good estimates of frequency response even when there is a lot of noise in the system.

2. Suppose you have a system which you think is reasonably well represented by the following dynamics: $G(s) = \dfrac{2}{(s+1)}$. You want to build a simple proportional feedback system, such as shown in `HW08_Problem1.mdl`. You use some of the analysis (not running the simulation) from the first half of the class to choose a feedback gain necessary to achieve a settling time of no more than 0.4 seconds. (What is this gain?) But when you do "experiments", you find that there is a high-frequency instability, evidently due to a high-frequency mode that you didn't know about in your model. You decide to remove the effects of this mode with a notch filter of the form discussed in class. Do some experiments with the simulation model to choose notch-filter parameters that yield a closed-loop response that is what you originally expected. Submit the final gain and notch filter parameters, plus a couple graphs to explain.