Amplitude and Phase: Second Order I Applet

You should open the applet Amplitude and Phase: Second Order I. This applet works exactly like the applet Amplitude and Phase: Second Order II shown in the previous video.

The applet illustrates the spring-mass-dashpot system being driven through the spring, which we studied earlier in the session. The mass $m = 1$ and the DE describing this system is

$$\ddot{x} + b\dot{x} + kx = k\cos(\omega t),$$

where we consider $\cos(\omega t)$ to be the input.

Unlike Amplitude and Phase: Second Order II, the resonant frequency and maximum gain changes as $b$ and $k$ are changed.

You should play with the applet. Check the box for the Bode plots. Now set $b = .7$ and play with the control for $k$. While you do this pay attention to what is happening in the amplitude response plot (the upper Bode plot).

Pick simple values of $b$ and $k$ and verify that there is practical resonance when $b < \sqrt{2k}$. In these cases, verify the amplitude response reaches its peak at the practical resonant frequency $\omega_r = \sqrt{k - b^2/2}$.

Verify that the practical resonant frequency is to the left of the natural frequency $\omega_0 = \sqrt{k/m}$ (remember $m = 1$). Notice that as $b$ decreases towards 0 the resonant frequency increases towards $\omega_0$. 