ENGR 2340 Dynamics
SDOF Harmonic Excitation

Consider the single degree-of-freedom, mass-spring-damper system

$$\ddot{x}(t) + 2\zeta\omega_n\dot{x}(t) + \omega_n^2 x(t) = F_0\cos(\omega_f t)$$

with IC's $x(0) = x_0$ and $\dot{x}(0) = v_0$

1) Plot the magnification factor (amplitude ratio), $X/(F_0/k)$, and the phase angle, ϕ, vs. the frequency ratio, $r = \omega_f / \omega_n$ for several values of the damping ratio, ζ = 0.1, 0.25, 0.5, sqrt(2)/2, 1.0, and 3.0. Write your own code or use the one in the course folder.

   They should look like:

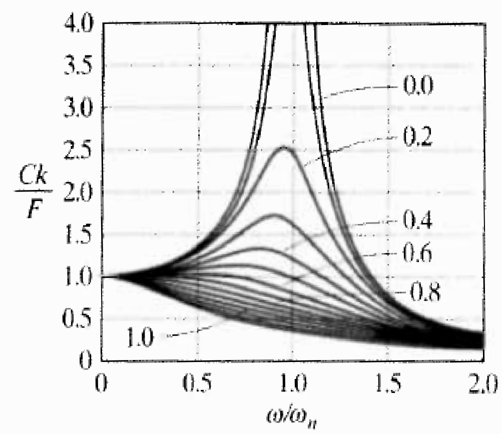

Figure 9.20 Amplitude response of spring-mass damper

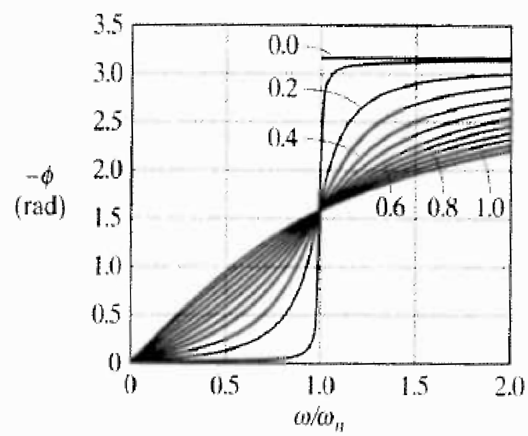

Figure 9.21 Phase shift in spring-mass damper

2) Discuss the following:

- How does an increasing the damping coefficient effect the magnification factor?
- What is meant 'dynamic amplification' in terms of response? How would this effect the design of a suspension system?
- Explain why does the mag factor decrease as r increases (past r = 1)?
- For $0 < \zeta <$ sqrt(2)/2, what is the maximum value of the mag factor? At what r value does it occur?
- What is the mag factor at r = 1. How could you use a measured value of it to estimate the damping in the system?
- Explain the appearance of the phase plot. What is m doing in relation to F(t) when r is small/large?