EE 475 HW #9

1. Consider the prototype second order system with closed-loop TF $H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$.

Let s=j ω , set magnitude of H(j ω) to 1/sqrt(2), and solve for ω/ω_n in terms of ζ . This is the bandwidth BW to ω_n ratio. Make a plot of this vs ζ .

- 2. Similar to 1, but find $|H(j\omega)|^2$, take d/d ω , set to 0, solve for ω/ω_n in terms of ζ . This is resonance frequency ω_r to ω_n ratio. Make a plot of this vs ζ .
- 3. For the prototype second order system, the open loop TF is $G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s}$. Find

 $|G(j\omega)|^2$, set to 1, solve for ω/ω_n in terms of ζ . This is the gain cross-over frequency ω_{gc} to ω_n ratio. At this solution frequency, find the phase margin PM, plot PM as a function of ζ .

- 4. Redo A-7-14, but without the s² term on the numerator. Compare to the Nyquist plot with negative feedback.
- 5. B-7-14, 15, 16, 17, 28, 29 (refer to A-7-18)