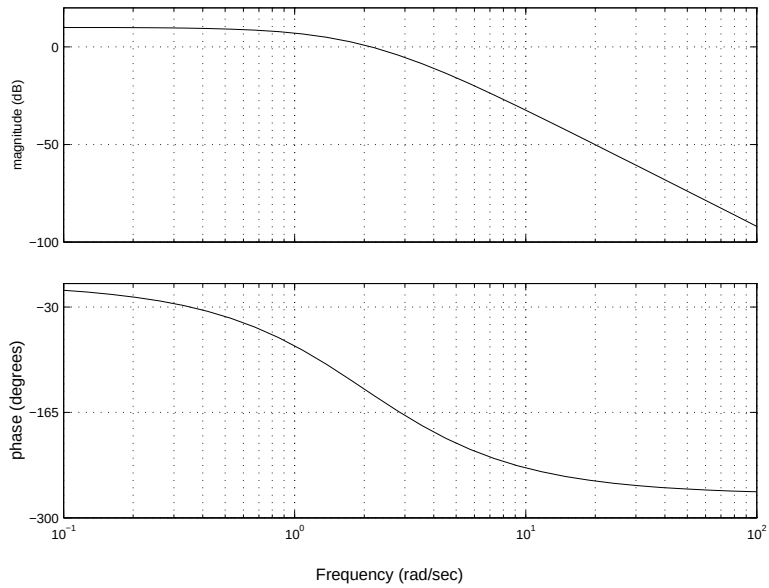
EEE 101 AY2001-2002 : Third Exam Sample Problems

1. Given the following Bode plot



a. Determine the form of the transfer function. Your answer must be in the following form.

$$G(s) \;=\; k\frac{\prod_{i=1}^{m}(s-z_i)^{r_i}}{\prod_{j=1}^{n}(s-p_j)^{q_j}}$$

b. Determine the numerical values of the constants in your transfer function. Write out the transfer function with the numerical values for the constants.

2. What are gain and phase margins of the system in question one?

3. Bode plots.

a. Draw the magnitude and phase plots of

$$G(s) \;=\; \frac{1}{(s+a)^n}$$

for $n \;=\; 1, 2, 3$. Label all relevant features of the graph, e.g. corner frequencies and asymptotes.

b. The following is the general form of the transfer function of a phase-lead/phase-lag controller where z and p are negative real numbers.

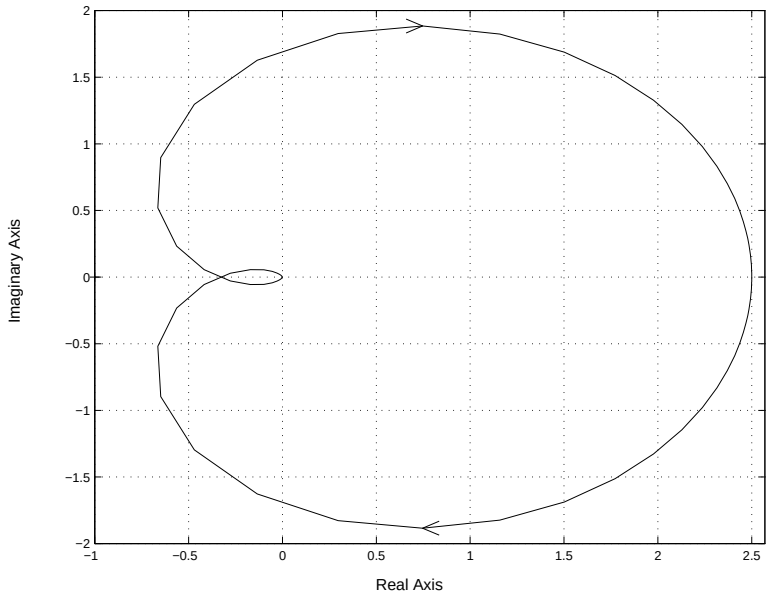
$$G_c(s) \;=\; k\frac{s-z}{s-p}$$

Draw the magnitude and phase plots of $G_c(s)$ for $|z| \;\ll\; |p|$ and for $G_c(s)$ for $|p| \;\ll\; |z|$. Which plots are for a phase-lead controller and which ones are for a phase-lag controller. Justify.

3. Given the closed-loop unity feedback system with the following open-loop transfer function $G(s)$.

$$G(s) = \frac{50}{s^3 + 9s^2 + 30s + 40}$$

The Nyquist plot of the open-loop transfer function $G(s)$ is



a. Determine the stability of the closed-loop system using Nyquist criterion.
b. Analytically determine the gain and phase margins of the system.