

# Homework #12: ECE 461/661

Gain & Lead Compensation with Bode Plots. Due Monday, November 30th

Problem 1 & 2: Assume

$$G(s) = \left( \frac{1.4427}{(s+0.1617)(s+1.04)(s+2.719)(s+5.05)} \right)$$

1) Design a gain compensator,  $K(s) = k$ , that results in

- A 50 degree phase margin

Also determine

- The resulting 0dB gain frequency,
- The closed-loop frequency response:  $\left( \frac{Gk}{1+Gk} \right)$

2) Design a lead compensator of the form

$$K(s) = k \left( \frac{s+a}{s+10a} \right)$$

that results in

- A 50 degree phase margin

Also determine

- The resulting 0dB gain frequency,
- The closed-loop frequency response:

Problem 3&4: Assume a 500ms delay is added

$$G(s) = \left( \frac{1.4427}{(s+0.1617)(s+1.04)(s+2.719)(s+5.05)} \right) e^{-0.5s}$$

3) Design a gain compensator,  $K(s) = k$ , that results in

- A 50 degree phase margin

Also determine

- The resulting 0dB gain frequency,
- The closed-loop frequency response:

4) Design a lead compensator of the form

$$K(s) = k \left( \frac{s+a}{s+10a} \right)$$

that results in

- A 50 degree phase margin

Also determine

- The resulting 0dB gain frequency,
- The closed-loop frequency response: