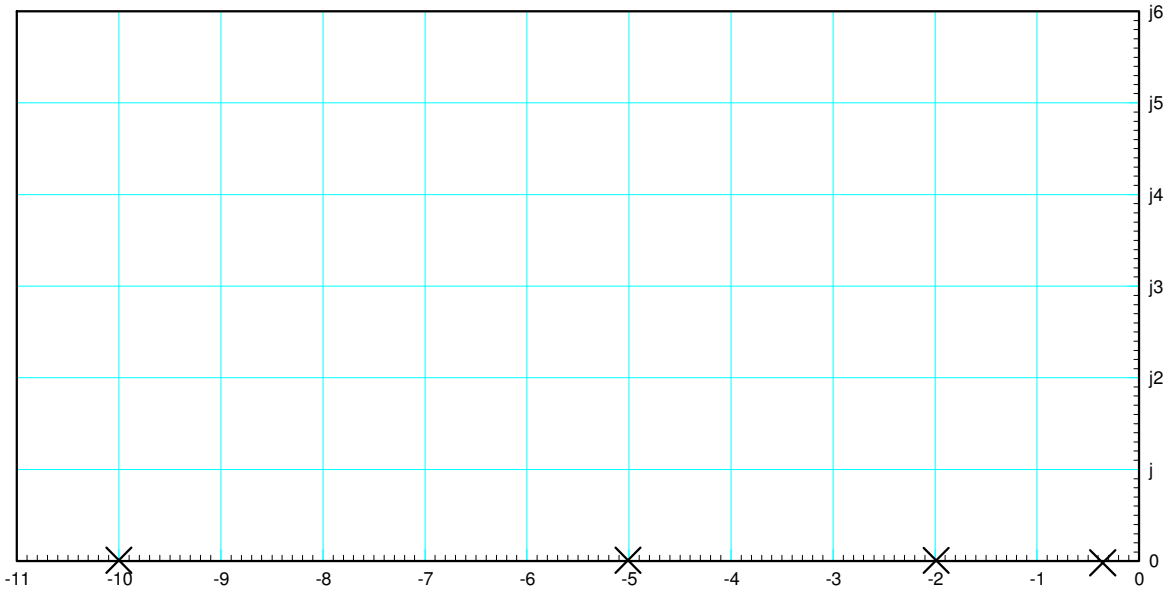
ECE 461/661 Handout #24

PID Compensation

Design a PID compensator for the following system

$$G(s) = \left(\frac{200}{(s+0.3)(s+2)(s+5)(s+10)} \right)$$

so that the damping ratio is 0.707 (45 degrees)



Solution

Handout for Lecture #24 for ECE 461/661 Controls Systems

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$$G(s) = \left(\frac{200}{(s+0.3)(s+2)(s+5)(s+10)} \right)$$

so that the damping ratio is 0.707 (45 degrees)

PID means

- Add a pole at s = 0 (I)
- Add two zeros wherever you like
- Add a gain, k, to meet the requirements

Pick the zeros to cancel the two slowest poles

$$K(s) = k\left(\frac{(s+0.3)(s+2)}{s} \right)$$

$$GK = \left(\frac{200k}{s(s+5)(s+10)} \right)$$

Option 1: Sketch the root locus. Find the spot on the root locus where the damping ratio is 0.707

Option 2: Search along the 0.707 damping line until the angles of GK(s) add up to 180 degrees

$$s = -1.9098 + j1.9098$$

$$\left(\frac{200k}{s(s+5)(s+10)} \right)_{s=-1.9098+j1.9098} = 2.4522 \angle 180^0$$

$$k = \frac{1}{2.4522} = 0.4078$$

$$K(s) = 0.4078\left(\frac{(s+0.3)(s+2)}{s} \right)$$