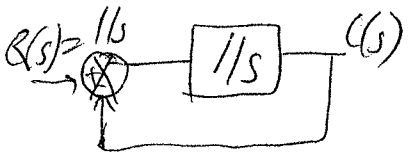
EE 450/550 Test # 1 - In Class - Oct 19

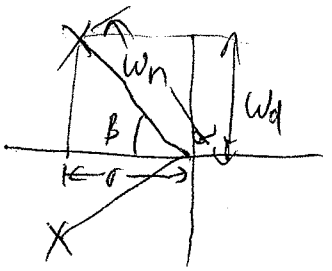
1. A unity feedback system has a feedforward transfer function $G(s) = \frac{1}{s}$. What is the steady-state response of the closed-loop system to a step input. (15)



$$\frac{C(s)}{R(s)} = \frac{1}{1+s} \Rightarrow C(s) = \frac{1}{s}\cdot\frac{1}{1+s}$$

$$c_{ss} = \lim_{s\to 0} sC(s) = \lim_{s\to 0} \frac{1}{1+s} = 1$$

2. For a second order underdamped system, sketch a sample root location, mark the natural frequenecy ω_n, undamped frequency ω_d, damping ratio ζ, and the attenuation σ. (15)



$\zeta = \cos\beta$

3. For a second order underdamped system, how does one decrease the settling time without affecting the natural frequency. (10)

$t_s \propto \frac{1}{\zeta\omega_n}$, increase damping ratio ζ.

4. Can a system with characteristic polynomial $s^2 + K = 0$ be stabilized for any values of K? If so, find those values. If not, why? (15)

A coefficient is missing for 's' term, by Routh this cannot be stabilized

5. What is the difference between amplitude and phase stabilization? (15)

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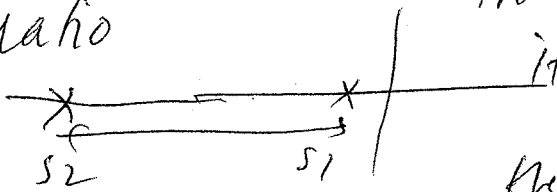
6. When can the response of a second order system look like a first order response? (15)

When roots are real and roots have a large ratio

Thumb rule:



if $\left|\frac{s_2}{s_1}\right| > 10$, ignore the effect of s_2.

7. How do the (a) poles and (b) zeros affect the transient response of a system? (15)

Poles affect the duration and type of response, zeros determine the shape of the response.