

ECE-320,
Quiz #6

For problems 1-3, consider a closed loop system with transfer function

$$G_0(s) = \frac{s+a}{s^2+bs+k}$$

1) The sensitivity to variations in k , $S_k^{G_0}(s)$, is

- a) $\frac{k}{s^2+bs+k}$ b) $\frac{-k}{s^2+bs+k}$ c) 1 d) $\frac{k}{s+a} - \frac{k}{s^2+bs+k}$ e) none of these

2) The sensitivity to variations in b , $S_b^{G_0}(s)$, is

- a) $\frac{-b}{s^2+bs+k}$ b) $\frac{-bs}{s^2+bs+k}$ c) 1 d) $\frac{b}{s+a} - \frac{bs}{s^2+bs+k}$ e) none of these

3) The sensitivity to variations in a , $S_a^{G_0}(s)$, is

- a) $\frac{a}{s^2+bs+k}$ b) $\frac{-a}{s^2+bs+k}$ c) 1 d) $\frac{a}{s+a}$ e) none of these

4) Assume we compute the sensitivity of a system with nominal value $a = 4$ to be

$$S_a^{G_0}(s) = \frac{1}{s+a}$$

For what frequencies will the sensitivity function be less than $\frac{1}{\sqrt{32}}$?

- a) $\omega < 4$ rad/sec b) $\omega > 4$ rad/sec c) $\omega > 16$ rad/sec d) $\omega < 16$ rad/sec e) none of these

5) Assume we compute the sensitivity of a system with nominal value $a = 3$

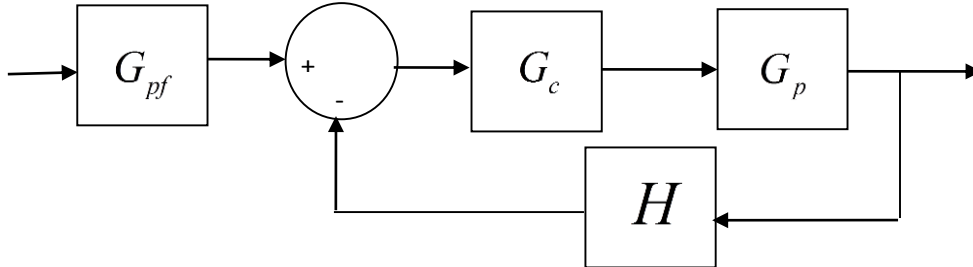
to be

$$S_a^{G_0}(s) = \frac{s+2}{s+1+a}$$

For what frequencies will the sensitivity function be greater than $\sqrt{\frac{10}{16}}$?

- a) $\omega < 4$ rad/sec b) $\omega > 4$ rad/sec c) $\omega > 16$ rad/sec d) $\omega < 16$ rad/sec e) none of these

Problems 6-9 refer to the following system



6) To reduce the sensitivity of the closed loop transfer function variations in the plant G_p , we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make G_{pf} large
- d) do nothing, we cannot change the sensitivity

7) To reduce the sensitivity of the closed loop transfer function to variations in the prefilter G_{pf} , we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make G_{pf} small
- d) do nothing, we cannot change the sensitivity

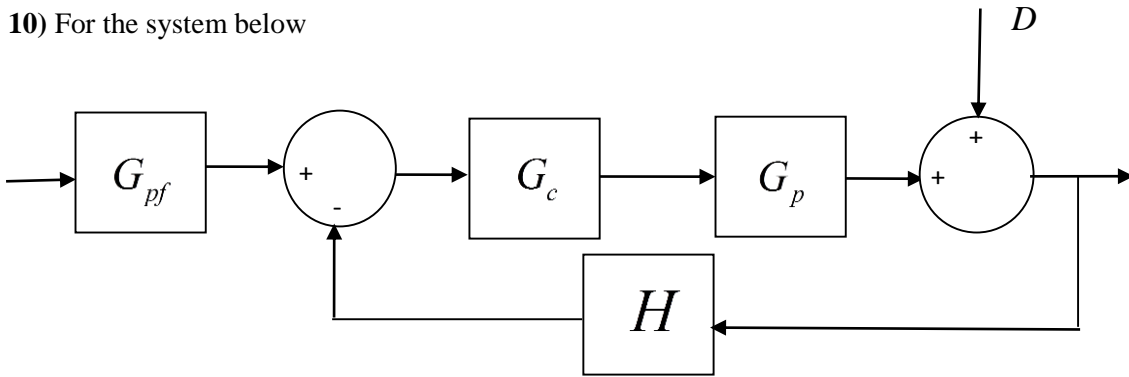
8) To reduce the sensitivity of the closed loop transfer function to variations in the controller G_c we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make $|H(j\omega)|$ large
- d) do nothing, we cannot change the sensitivity

9) To reduce the sensitivity of the closed loop transfer function to variations in the sensor H , we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make G_{pf} large
- d) do nothing, we cannot change the sensitivity

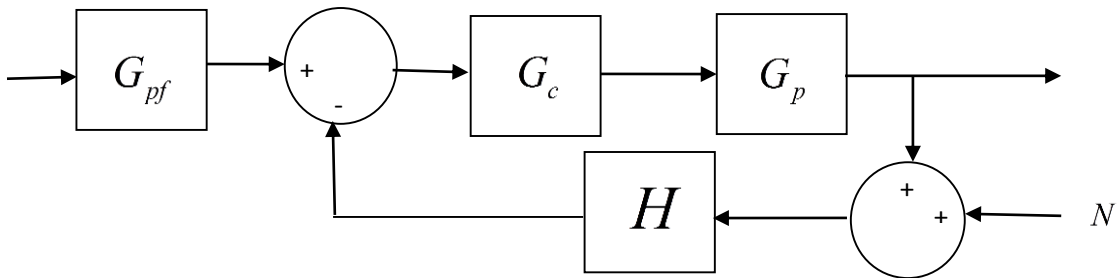
10) For the system below



to reduce the effects of the external disturbance D on the system output, we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make G_{pf} large
- d) do nothing, we cannot change the sensitivity

11) For the system below



to reduce the effects of sensor noise N on the closed loop system, we should

- a) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ large
- b) make $|G_c(j\omega)G_p(j\omega)H(j\omega)|$ small
- c) make $|H(j\omega)|$ large
- d) do nothing, we cannot change the sensitivity

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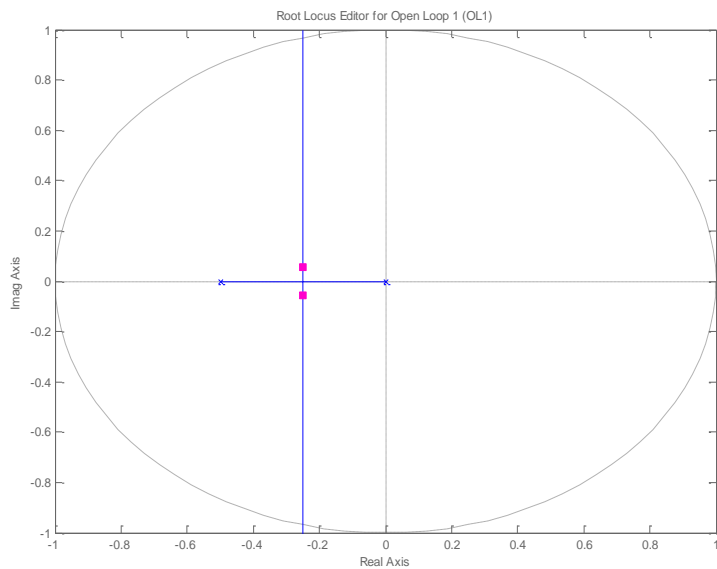
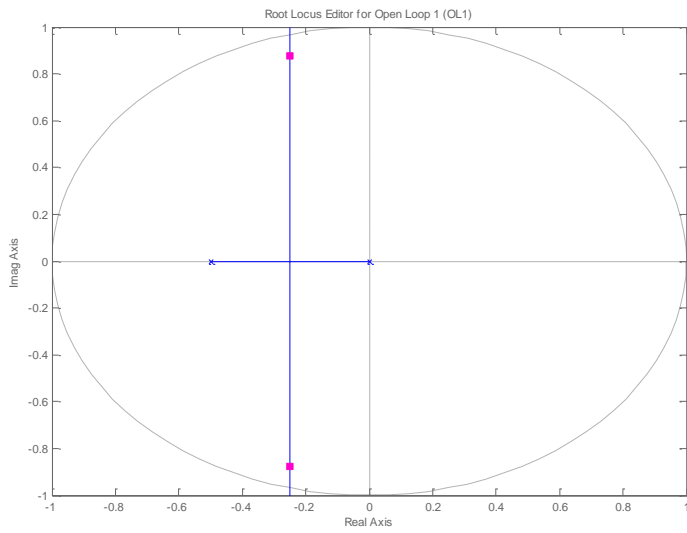
For the problems 12 - 14, assume a , b , c , d , e , and f are real-valued numbers, and write an expression for the magnitude of the following:

12) $Z = \frac{a + j\omega b}{c - j\omega d}$

13) $Z = \frac{a + b - j\omega c}{d + j\omega}$

14) $Z = \frac{a + j + j\omega c + j\omega d}{1 - j\omega e + f}$

Problems 15 and 16 refer to the following two root locus plot for a discrete-time system



15) For which system is the settling time likely to be smallest?

- a) The system on the top b) the system on the bottom c) the settling time will be the same

16) Is this a type 1 system?

- a) yes b) no c) not enough information