

ECE-320 Quiz #4

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 $a = 3$

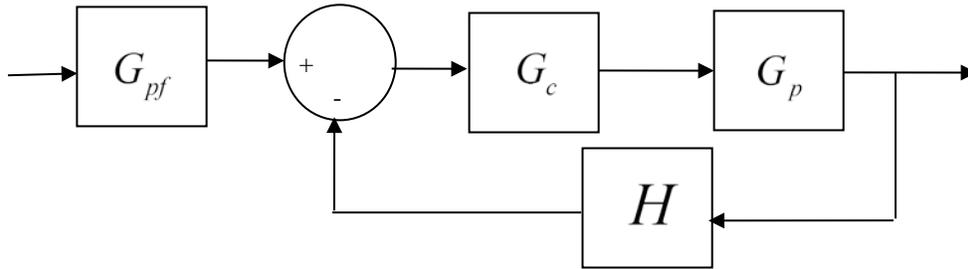
to be

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

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

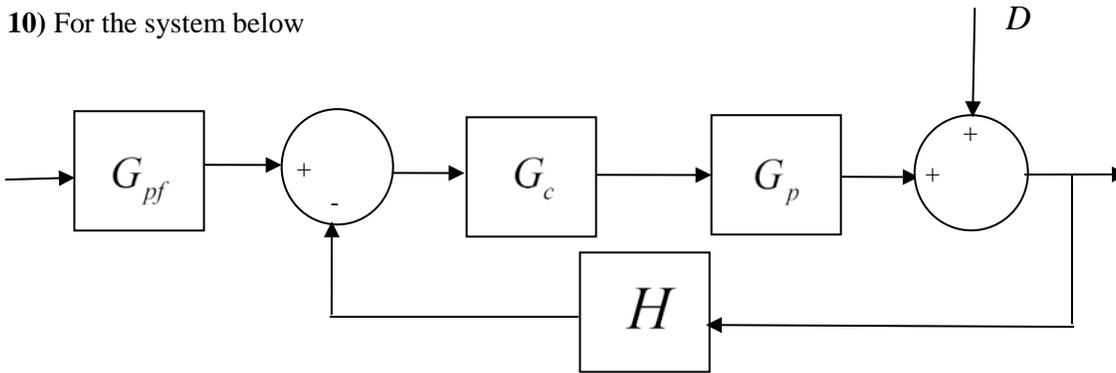
8) To reduce the sensitivity of the closed loop transfer function to variations in the controller G_c we should

- 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

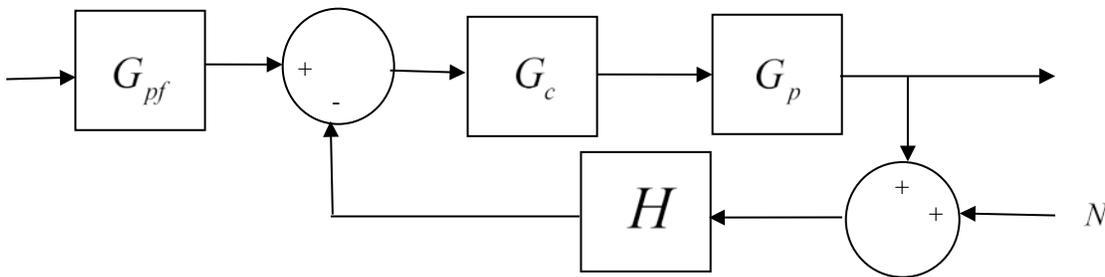
10) For the system below



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

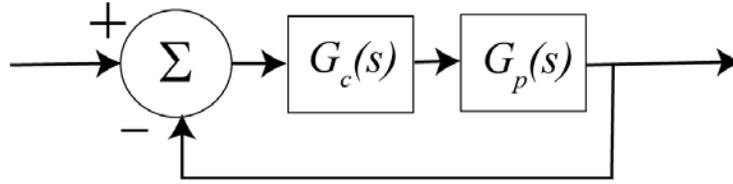
11) For the system below



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

For the problems 12-16, assume the closed loop system below and assume $G_p(s) = \frac{3}{(s+2)(s+3)}$



For each of the following problems sketch the root locus, including the direction travelled as the gain increases and the angle of the asymptotes and centroid of the asymptotes, if necessary.

12) Assume the proportional controller $G_c(s) = k_p$

13) Assume the integral controller $G_c(s) = \frac{k_i}{s}$

14) Assume the PI controller $G_c(s) = \frac{k(s+5)}{s}$

15) Assume the PD controller $G_c(s) = k(s+6)$

16) Assume the PID controller $G_c(s) = \frac{k(s+6+2j)(s+6-2j)}{s}$