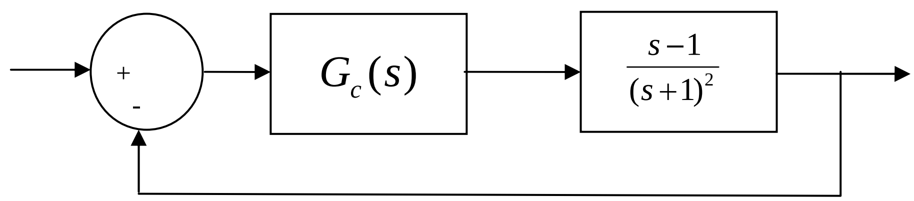
ECE-320, Practice Quiz #7

Problems 1-4 refer the following system, where we are going to use the Diophantine equations to place the closed loop poles. We assume we want the closed loop poles to be stable.



1) If we want the minimum order controller to place the closed loop poles (and have a type 0 system), the controller will have which of the following forms

a) $G_c(s) = \frac{B_0}{A_0}$ b) $G_c(s) = \frac{B_0 + B_1 s}{A_0 + A_1 s}$ c) $G_c(s) = \frac{B_0 + B_1 s + B_2 s^2}{A_0 + A_1 s + A_2 s^2}$

d) $G_c(s) = \frac{B_0 + B_1 s + B_2 s^2 + B_3 s^3}{A_0 + A_1 s + A_2 s^2 + A_3 s^3}$

2) If we use the minimum order controller to place the closed loop poles (and have a type 0 system), how many closed loop poles will the system have?

a) 1 b) 2 c) 3 d) 4

3) If we want the minimum order controller to place the closed loop poles and have a type 1 system, the controller will have which of the following forms?

a) $G_c(s) = \frac{B_0}{A_0}$ b) $G_c(s) = \frac{B_0 + B_1 s}{A_1 s}$ c) $G_c(s) = \frac{B_0 + B_1 s + B_2 s^2}{A_1 s + A_2 s^2}$

d) $G_c(s) = \frac{B_0 + B_1 s + B_2 s^2 + B_3 s^3}{A_1 s + A_2 s^2 + A_3 s^3}$

4) If we use the minimum order controller to place the closed loop poles and have a type 1 system, how many closed loop poles with the system have?

a) 1 b) 2 c) 3 d) 4

5) In using the Diophantine equation method to design a controller, if we want a type 1 system should one of the closed loop poles be located at 0?

a) True   b) False

6) Consider the system with plant $G_p(s) = \dfrac{1}{s-1}$. Assume we want to place the closed loop poles using the Diophantine equation method. If we want the smallest order controller that forces the system to be a type 1 system, how many closed loop poles do we need to specify?

a) 1   b) 2   c) 3   d) 4

7) Consider the system with plant $G_p(s) = \dfrac{2}{s-1}$. Assume we want to place the closed loop poles using the Diophantine equation method. If we want the smallest order ***strictly proper*** controller that forces the system to be a type 1 system, how many closed loop poles do we need to specify?

a) 1   b) 2   c) 3   d) 4

For problems 8-10 , consider a closed loop system with transfer function

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

8) 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

9) 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 thes

10) 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

11) 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

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

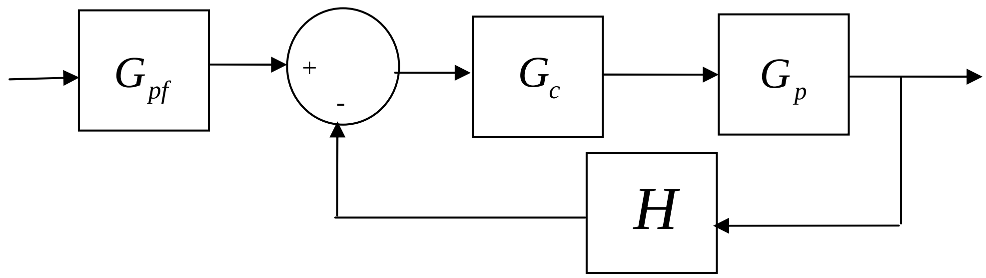
to be

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

For what frequencies will the sensitivity function be less 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 13-16 refer to the following system



13) 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

14) 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

15) 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

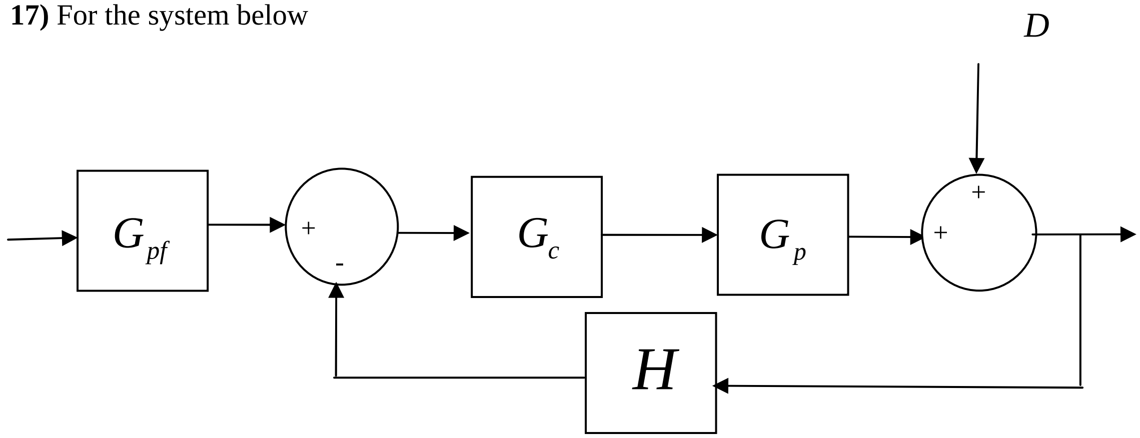
c) make $|H(j\omega)|$ large   d) do nothing, we cannot change the sensitivity

16) 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

17) For the system below

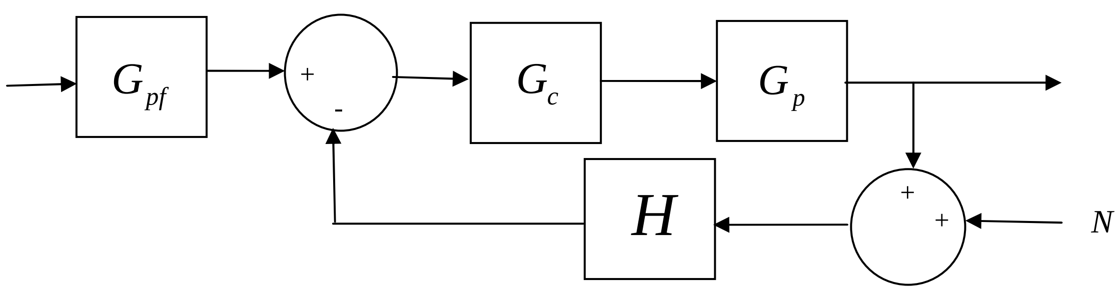


to reduce the effects of the external disturbance D on the system output, we should

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

18) 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

Answers: 1-b, 2-c, 3-c, 4-d, 5-b, 6-b, 7-c, 8-b, 9-b, 10-d, 11-b, 12-a, 13-a, 14-d, 15-a, 16-b, 17-a, 18-b