# ECE-320, Practice 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 thes

**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 $a = 3$

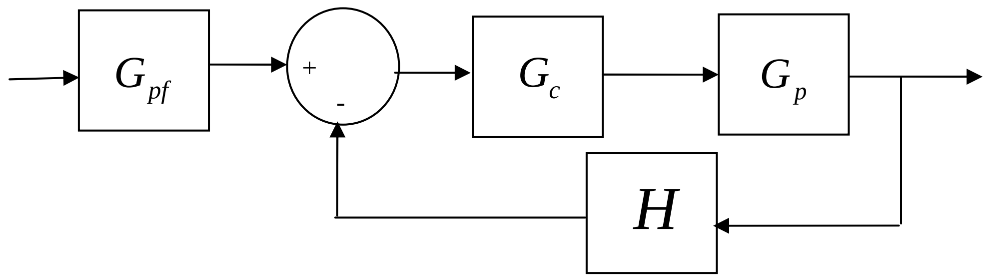
to be

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

For what frequencies will the sensitivity function be 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 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

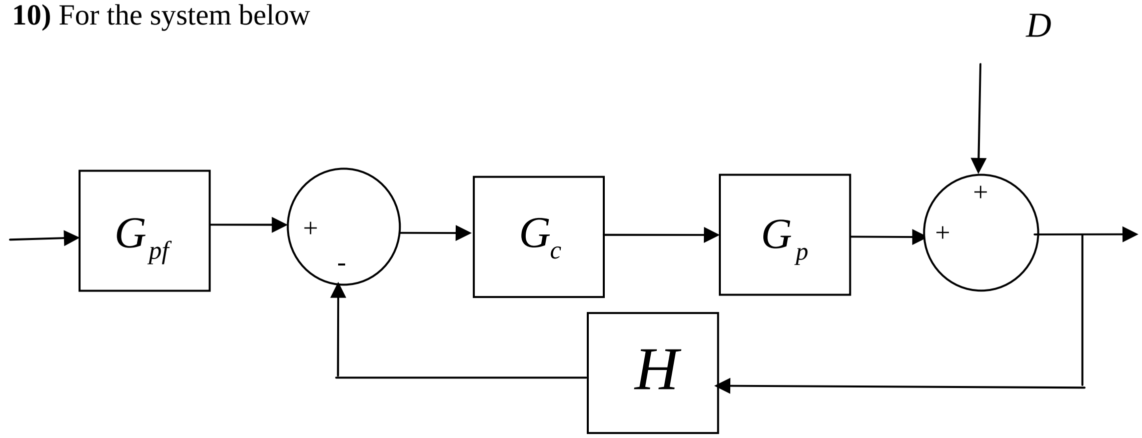
c) make $|H(j\omega)|$large  d) do nothing, we cannot change the sensitivity

**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

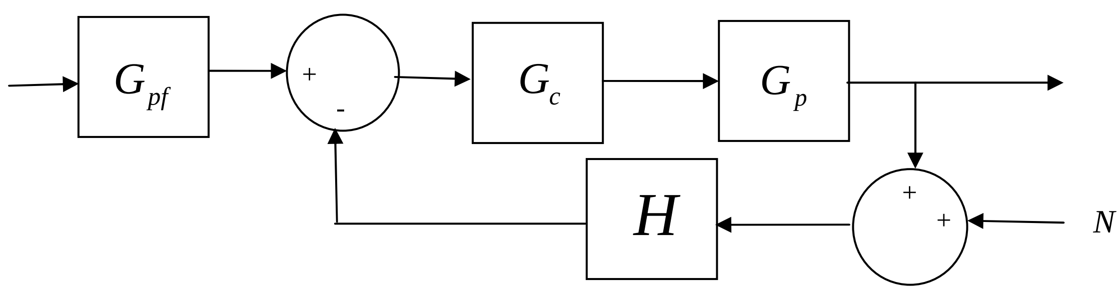



to reduce the effects of the external disturbance $D$ on the system output, we should

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

**12)** Consider the characteristic equation $\Delta(s) = s^3 + 2ks^2 + s + 1$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 0$ b) no value of $k$ c) $0 < k < 0.5$ d) $k > 0.5$

**13)** Consider the characteristic equation $\Delta(s) = s^3 + s^2 + s + 2k$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 0$ b) no value of $k$ c) $0 < k < 0.5$ d) $k > 0.5$

**14)** Consider the characteristic equation $\Delta(s) = ks^3 + s^2 + s + 1$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 1$ b) no value of $k$ c) $0 < k < 0.5$ d) $0 < k < 1$ e) $k > 0.5$

**15)** Consider the characteristic equation $\Delta(s) = s^4 + 3s^3 + 2s^2 + s + k$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 1$ b) no value of $k$ c) $0 < k < 5/9$ d) $k > 5/9$ e) all $k > 0$

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