ECE-320,

Practice Quiz #5

For all of the following problems, assume we are using a two-sided z-transform.

1) The z-transform of a sequence $x(n)$ is defined as

a) $X(z)=\sum_{k=-\infty}^{\infty} x(k)z^{k}$ b) $X(z)=\sum_{k=-\infty}^{\infty} x(k)z^{-k}$

2) The z-transform of the sequence $x(n)=3^{n}u(n)$ is

a) $\frac{z}{3-z}$ b) $\frac{1}{z-3}$ c) $\frac{1}{3-z}$ d) $\frac{z}{z-3}$ e) none of these

3) The z-transform of $x(n)=u(n)$ is

a) $\frac{z}{z-1}$ b) $\frac{1}{z-1}$ c) $\frac{1}{1-z}$ d) $\frac{z}{1-z}$ e) none of these

4) The z-transform of $x(n)=u(n-1)$ is

a) $\frac{z}{z-1}$ b) $\frac{1}{z-1}$ c) $\frac{1}{1-z}$ d) $\frac{z}{1-z}$ e) none of these

5) The z-transform of the sequence $x(n)=\delta(n)$ is

a) 1 b) z c) z^{-1} d) 0 e) none of these

6) The z-transform of the sequence $x(n)=\delta(n-1)$ is

a) 1 b) z c) z^{-1} d) 0 e) none of these

7) The z-transform of the sequence $x(n)=3^{n-1}u(n)$ is

a) $\frac{3z}{z-3}$ b) $\frac{1}{3}\frac{z}{z-3}$ c) $\frac{1}{3}\frac{z^2}{z-3}$ d) $\frac{3z^2}{z-3}$ e) none of these

8) The z-transform of the sequence $x(n) = 3^{n+1}u(n-1)$ is

a) $\frac{3}{z-3}$ b) $\frac{3z}{z-3}$ c) $\frac{9z}{z-3}$ d) $\frac{9}{z-3}$ e) none of these

9) The z-transform of the sequence $x(n) = 3^{n-1}u(n+1)$ is

a) $\frac{3z^2}{z-3}$ b) $\frac{1}{3}\frac{z}{z-3}$ c) $\frac{1}{9}\frac{z^2}{z-3}$ d) $\frac{1}{3}\frac{z^2}{z-3}$ e) none of these

10) The z-transform of the sequence $x(n) = 2^n u(n)$ converges provided

a) $2 < |z|$ b) $|z| < 2$

11) The z-transform of the sequence $x(n) = \left(\frac{1}{3}\right)^n u(n-1)$ converges provided

a) $\frac{1}{3} < |z|$ b) $|z| < \frac{1}{3}$

12) For z-transform $Y(z) = \frac{1}{z-2}$, the inverse z-transform is

a) $y(n) = 2^n u(n)$ b) $y(n) = 2^{n-1}u(n-1)$ c) $y(n) = 2^{n+1}u(n+1)$ d) $y(n) = 2^{n-1}u(n)$ e) none of these

13) For z-transform $Y(z) = \frac{1}{z-2}$, the inverse z-transform is

a) $y(n) = \frac{1}{2}\delta(n) - \frac{1}{2}2^n u(n)$ b) $y(n) = -\frac{1}{2}\delta(n) + \frac{1}{2}2^n u(n)$

14) Which of the following transfer functions represents an (asymptotically) unstable systems? (circle all of them)

a) $G(z) = \frac{z}{z+0.8}$ b) $G(z) = \frac{z}{z-0.8}$ c) $G(z) = \frac{z}{z+1.2}$ d) $G(z) = \frac{z}{z-1.2}$

15) Which of the following systems will have a smaller settling time?

a) $G(z) = \frac{z}{z-0.9}$ b) $G(z) = \frac{z}{z-0.7}$ c) $G(z) = \frac{z}{z+0.5}$ d) $G(z) = \frac{z}{z+0.1}$

16) Which of the following systems will have a smaller **settling time?**

a) $G(z) = \frac{1}{(z-0.2+j0.2)(z-0.2-j0.2)}$ b) $G(z) = \frac{1}{(z-0.1+j0.5)(z-0.1-j0.5)}$ c) $G(z) = \frac{1}{(z+0.5)}$

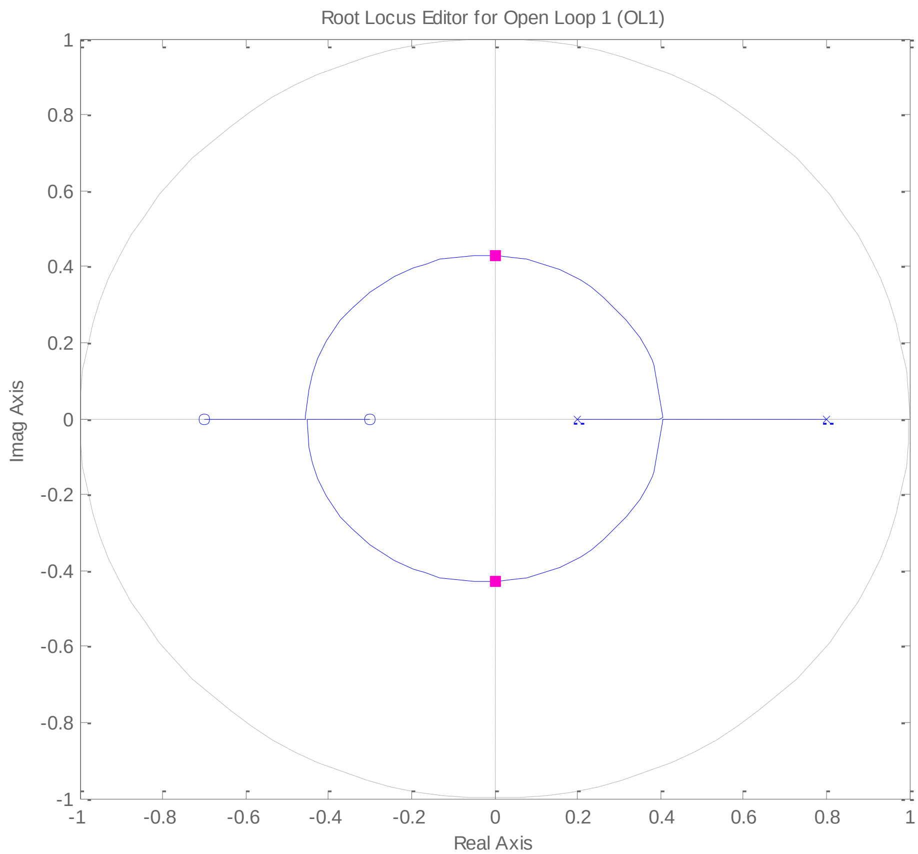
17) Consider a continuous-time system with plant transfer function $G_p(s) = \frac{1}{s+2}$. If we sample the system and then convert it to a discrete-time transfer function, the equivalent discrete-time transfer will be

a) $G_p(z) = \frac{z}{z-e^{-2T}}$ b) $G_p(z) = \frac{z}{z+e^{-2T}}$ c) $G_p(z) = \frac{z}{z+e^{+2T}}$ d) $G_p(z) = \frac{z}{z-e^{+2T}}$ e) none of these

18) Consider a continuous-time stable system with a plant transfer function $G_p(s)$ that is modeled as a discrete-time transfer function $G_p(z)$ assuming a zero order hold. As the sampling interval T gets smaller, the poles of $G_p(z)$

a) move closer to the unit circle (the system becomes less stable)
b) move closer to the origin (the system becomes more stable)
c) do not move

Problems 19 and 20 refer to the following root locus plot for a discrete-time system



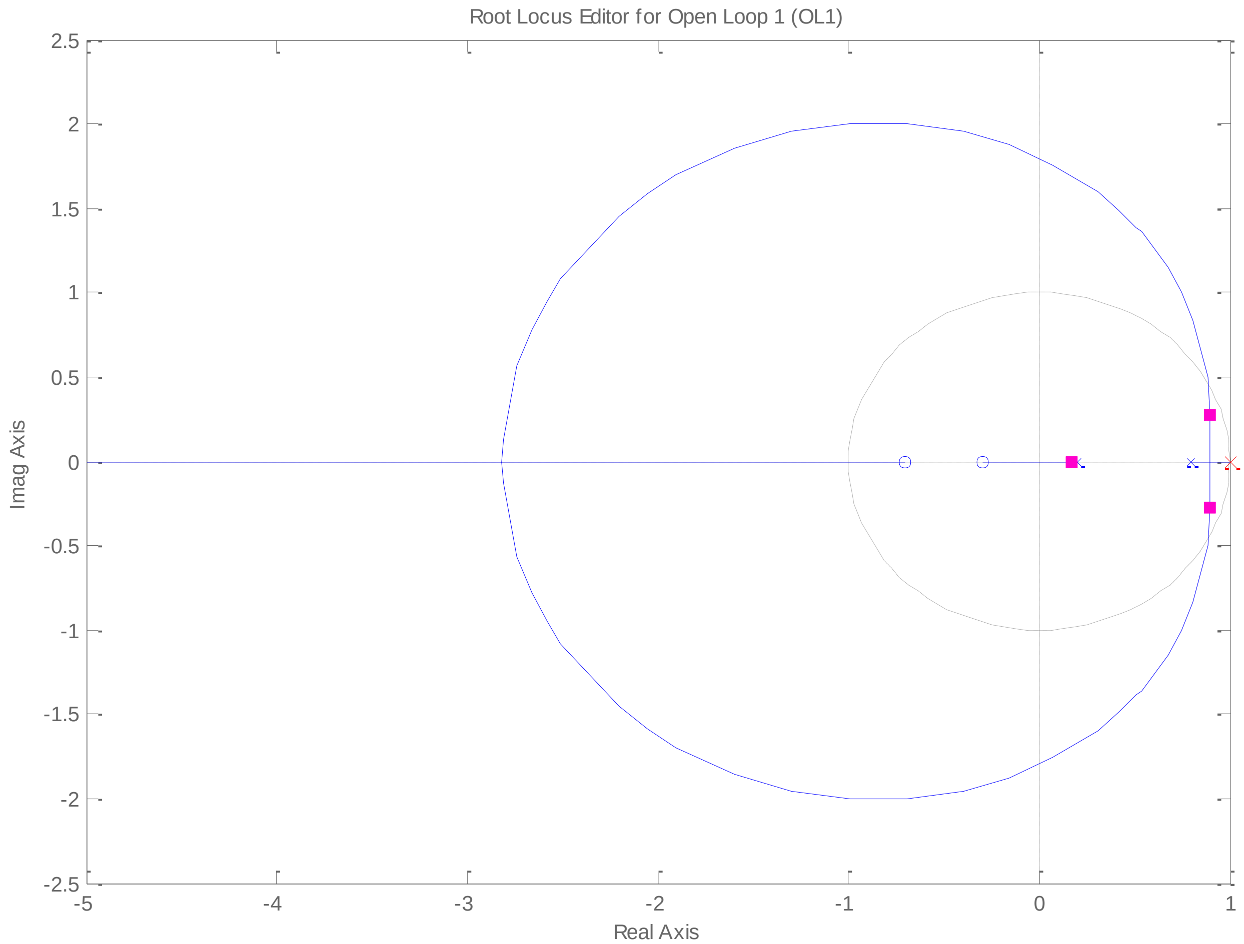
19) Are there any values of *k* (the variable parameter) for which the system is stable?

a) yes   b) no   c) there is not enough information to answer

20) As *k* increases, the close loop poles of the system

a) move to the left   b) move to the right   c) do not move at all

Problems 21-23 refer to the following root locus plot for a discrete-time system



21) With the closed loop pole locations shown in the figure, is the closed loop system stable?

a) yes b) no c) not enough information

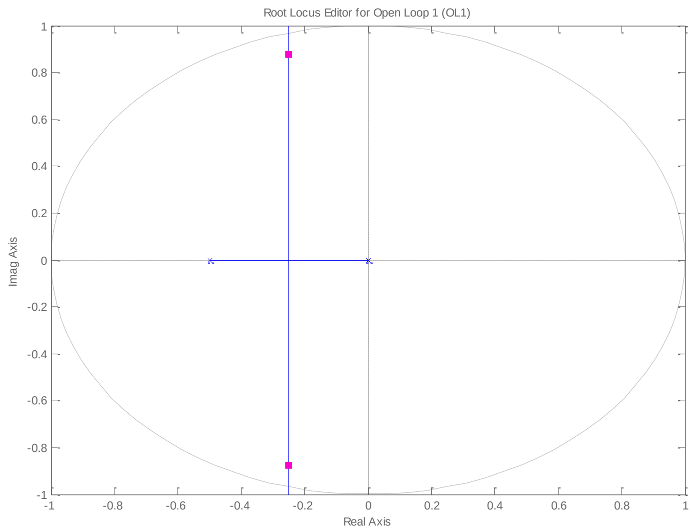
22) Is there any value of k for which the closed loop system is stable?

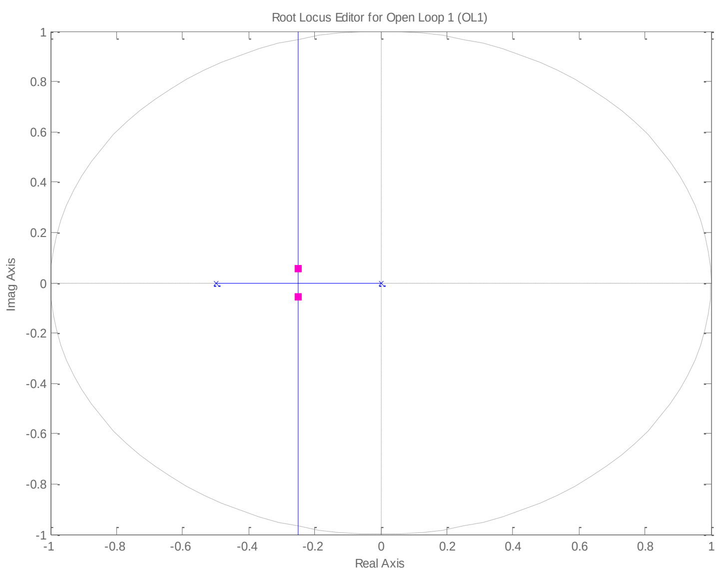
a) yes b) no c) not enough information

23) Is this a type one system?

a) yes b) no c) not enough information

Problems 24 and 25 refer to the following two root locus plot for a discrete-time system





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

a) The system on the left b) the system on the right c) the settling time will be the same

25) Is this a type 1 system?

a) yes b) no c) not enough information

For problems 26-28, consider a closed loop system with transfer function

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

26) 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

27) 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

28) 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

29) 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) $\omega < 4 \text{ rad/sec}$ b) $\omega > 4 \text{ rad/sec}$ c) $\omega > 16 \text{ rad/sec}$ d) $\omega < 16 \text{ rad/sec}$ e) none of these

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

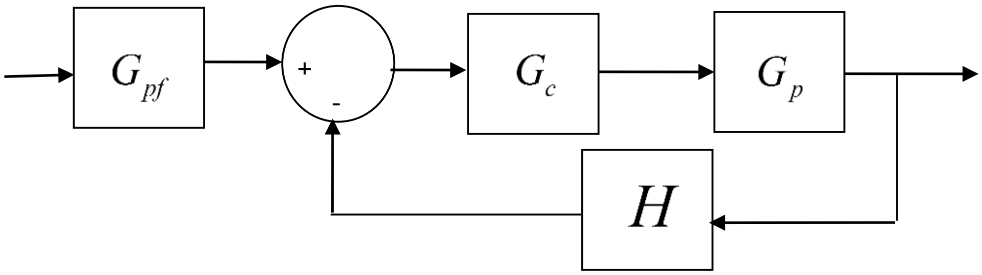
to be

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

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

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

Problems 31-34 refer to the following system



31) 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

32) 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

33) 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

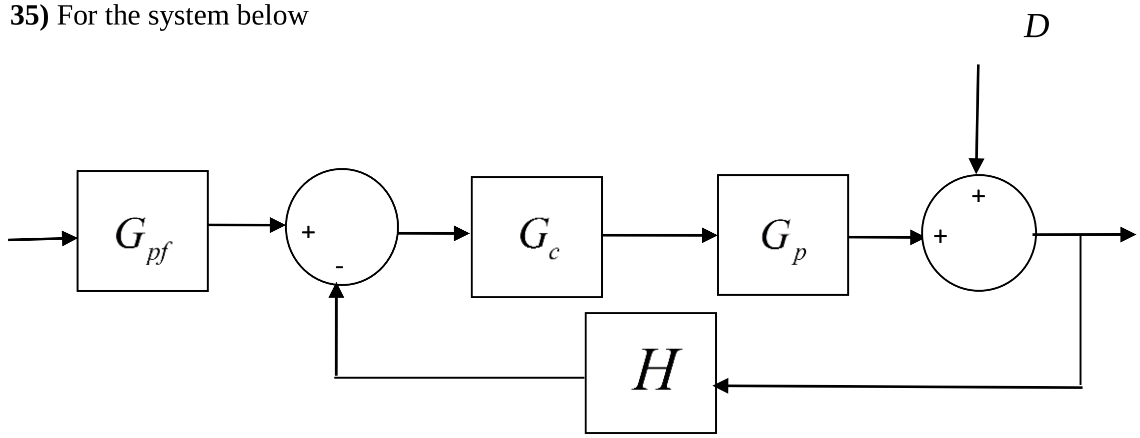
c) make $|H(j\omega)|$ large d) do nothing, we cannot change the sensitivity

34) 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

35) For the system below

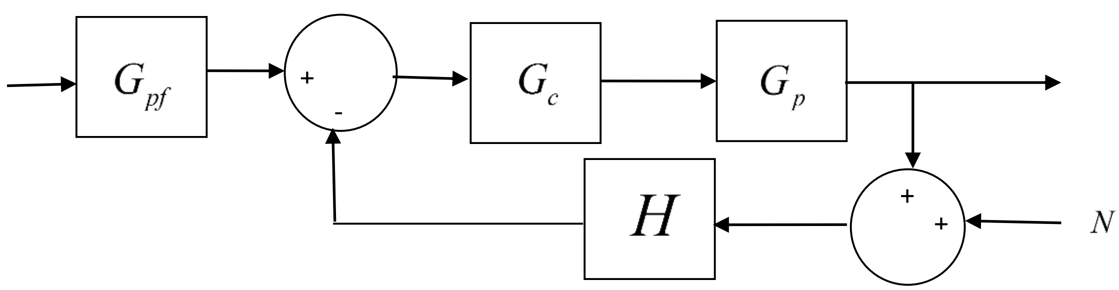


to reduce the effects of the external disturbance D on the system output, we should

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

36) 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: 1b, 2-d, 3-a, 4-b, 5-a, 6-c, 7-b, 8-d, 9-c, 10-a, 11-a, 12-b, 13- b, 14-c,d, 15-d, 16-a, 17a, 18-a, 19-a, 20-a, 21-a, 22-a, 23-a, 24-b, 25-b, 26-b, 27-b, 28-d, 29-b, 30-a, 31-a, 32-d, 33-a, 34-b, 35-a, 36-b