Solution of EECS 316 Test 3 Su10

1. For a system with each forward and feedback transfer function pair below, determine whether the system can go unstable at a finite, positive value of K and circle the appropriate answer in each case.

(a) $\mathrm{H}_1(s) = \dfrac{10K}{s+8}$, $\mathrm{H}_2(s) = 1/s$

Cannot

(b) $\mathrm{H}_1(s) = \dfrac{25K}{s^2+8s+30}$, $\mathrm{H}_2(s) = \dfrac{3}{s+4}$

Can

(c) $\mathrm{H}_1(s) = \dfrac{25K}{s^2+8s+30}$, $\mathrm{H}_2(s) = \dfrac{3s}{s+4}$

Cannot

(d) $\mathrm{H}_1(s) = 9K\dfrac{s+100}{s^2+s+4}$, $\mathrm{H}_2(s) = \dfrac{1}{s+2}$

Can

(e) $\mathrm{H}_1(z) = \dfrac{10Kz}{z+0.8}$, $\mathrm{H}_2(z) = 1$

Cannot

(f) $\mathrm{H}_1(z) = \dfrac{10Kz}{z^2+0.8}$, $\mathrm{H}_2(z) = 1$

Can

(g) $\mathrm{H}_1(z) = 10K\dfrac{z}{z+0.8}$, $\mathrm{H}_2(z) = \dfrac{z+1.3}{z-0.2}$

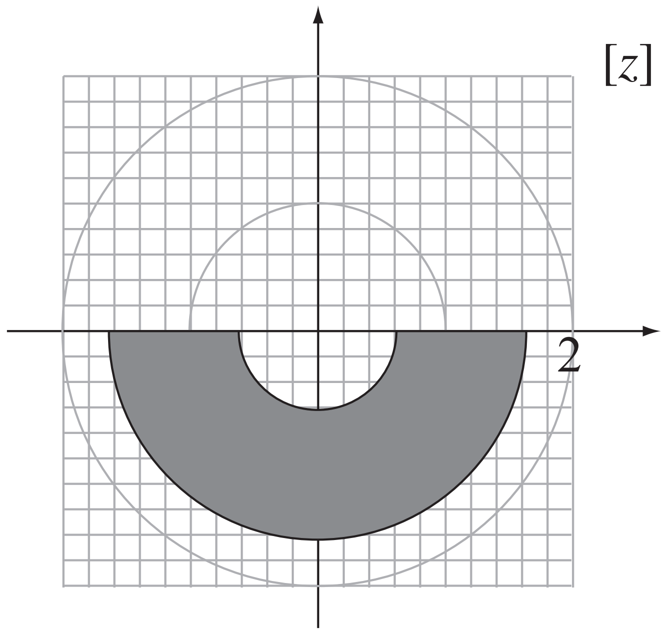
Can

(h) $\mathrm{H}_1(z) = \dfrac{10K(z^2-1)}{z^2+0.8}$, $\mathrm{H}_2(z) = z^{-1}$

Can

2. Using the mapping relationship $z = e^{sT_s}$ draw the region in the z plane that corresponds to the region

$-0.5/T_s < \sigma < 0.5/T_s$, $3\pi/T_s < \omega < 4\pi/T_s$ in the s plane. (Use the axes on the left to practice and draw the final graph on the right. Only the right-hand graph will be graded.)



3. Below are some forward-path transfer functions for some unity-gain-feedback tracking systems. In each case determine whether the system is stable or unstable. If the system is stable, then determine whether the steady state error in response to a step and a ramp will be zero, non-zero finite or infinite in magnitude. If the system is unstable, just skip to the next system without addressing the steady-state error.

(a) $H_1(s) = \dfrac{10}{s+8}$

Pole at -18, Stable, Non-Zero Finite, Infinite

(b) $H_1(s) = \dfrac{25}{s(s^2+8s+30)}$

Poles at -1.1219, -3.439 +/- j3.234, Stable

(c) $H_1(s) = \dfrac{25}{s^2+8s+30}$

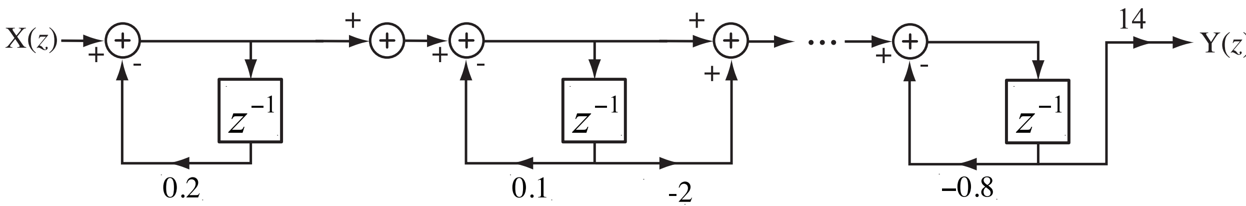
Poles at -4 +/- j6.245, Stable, Non-Zero Finite, Infinite

(d) $H_1(s) = 9\dfrac{s+100}{s^2+2s}$

Poles at -5.5 +/- j29.5, Stable, Zero, Non-Zero Finite

4. Draw a cascade realization of a system with a transfer function $\mathrm{H}(z)=14\frac{z(z-2)}{(z^2+0.3z+0.02)(z-0.8)}$.

$$\mathrm{H}(z)=14\frac{z(z-2)}{(z^2+0.3z+0.02)(z-0.8)}=14\frac{z(z-2)}{(z+0.2)(z+0.1)(z-0.8)}$$



Solution of EECS 316 Test 3 Su10

1. For a system with each forward and feedback transfer function pair below, determine whether the system can go unstable at a finite, positive value of K and circle the appropriate answer in each case.

(a) $\mathrm{H}_1(s) = \dfrac{25K}{s^2 + 8s + 30}$, $\mathrm{H}_2(s) = \dfrac{3}{s+4}$

Can

(b) $\mathrm{H}_1(s) = \dfrac{25K}{s^2 + 8s + 30}$, $\mathrm{H}_2(s) = \dfrac{3s}{s+4}$

Cannot

(c) $\mathrm{H}_1(s) = 9K\dfrac{s+100}{s^2 + s + 4}$, $\mathrm{H}_2(s) = \dfrac{1}{s+2}$

Can

(d) $\mathrm{H}_1(z) = \dfrac{10Kz}{z+0.8}$, $\mathrm{H}_2(z) = 1$

Cannot

(e) $\mathrm{H}_1(z) = \dfrac{10Kz}{z^2+0.8}$, $\mathrm{H}_2(z) = 1$

Can

(f) $\mathrm{H}_1(z) = 10K\dfrac{z}{z+0.8}$, $\mathrm{H}_2(z) = \dfrac{z+1.3}{z-0.2}$

Can

(g) $\mathrm{H}_1(z) = \dfrac{10K\left(z^2-1\right)}{z^2+0.8}$, $\mathrm{H}_2(z) = z^{-1}$

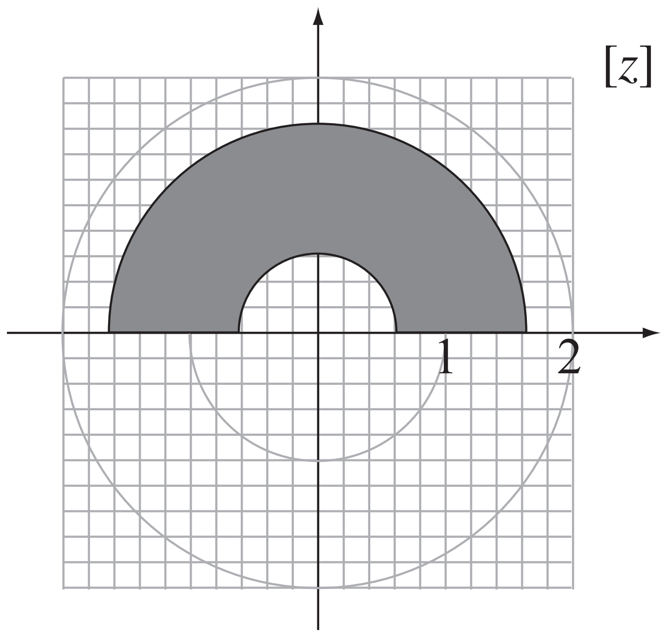
Can

(h) $\mathrm{H}_1(s) = \dfrac{10K}{s+8}$, $\mathrm{H}_2(s) = 1/s$

Cannot

2. Using the mapping relationship $z = e^{sT_s}$ draw the region in the z plane that corresponds to the region

$-0.5/T_s < \sigma < 0.5/T_s$, $-4\pi/T_s < \omega < -3\pi/T_s$ in the s plane. (Use the axes on the left to practice and draw the final graph on the right. Only the right-hand graph will be graded.)



3. Below are some forward-path transfer functions for some unity-gain-feedback tracking systems. In each case determine whether the system is stable or unstable. If the system is stable, then determine whether the steady state error in response to a step and a ramp will be zero, non-zero finite or infinite in magnitude. If the system is unstable, just skip to the next system without addressing the steady-state error.

(a) $\mathrm{H}_1(s) = 9\dfrac{s+100}{s^2+2s}$

Poles at -5.5 +/- j29.5, Stable, Zero, Non-Zero Finite

(b) $\mathrm{H}_1(s) = \dfrac{10}{s+8}$

Pole at -18, Stable, Non-Zero Finite, Infinite

(c) $\mathrm{H}_1(s) = \dfrac{25}{s(s^2+8s+30)}$

Poles at -1.1219, -3.439 +/- 3.234, Stable

(d) $\mathrm{H}_1(s) = \dfrac{25}{s^2+8s+30}$

Poles at -4 +/- j6.245, Stable, Non-Zero Finite, Infinite

4. Draw a cascade realization of a system with a transfer function $H(z)=11\frac{z(z+2)}{(z^2+0.7z+0.1)(z-0.6)}$.

$$H(z)=11\frac{z(z+2)}{(z^2+0.7z+0.1)(z-0.6)}=11\frac{z(z+2)}{(z+0.5)(z+0.2)(z-0.6)}$$