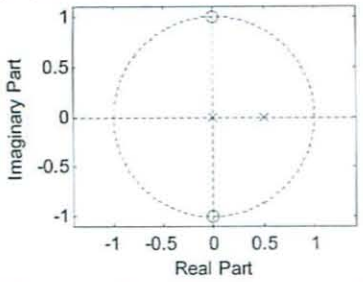
Name Answers

EE-3220-11 – Dr. Durant – Quiz 6
Winter 2014-'15, Week 6

1. (2 points) Make a list of zeros and a list of poles given this z-plane view of a system H(z).



Zeros: j, $-j$

Poles: 0, $\frac{1}{2}$

(-1/2) reverse zap

2. (2 points) Given the roots you listed above, write out H(z). Fully expand the numerator and the denominator.

$$H(z) = \frac{(z-j)(z+j)}{z(z-\frac{1}{2})} = \frac{z^2+1}{z^2-\frac{1}{2}\cdot z} = \frac{1+z^{-2}}{1-\frac{1}{2}z^{-1}}$$

3. (2 points) Recall that H(z) = Y(z) / X(z). Take the inverse z-transform of your result in 2 and solve for y(n) to determine the difference equation that implements the system H(z).

$$Y(z)\left(1-\tfrac{1}{2}z^{-1}\right) = X(z)\left(1+z^{-2}\right)$$
$$y(n) - \tfrac{1}{2}y(n-1) = x(n) + x(n-2)$$
$$y(n) = \tfrac{1}{2}y(n-1) + x(n) + x(n-2)$$

(-1/4) $y(n-1)$ on wrong side

4. (2 points) A voice signal sampled at 16 kHz is intermittently jammed with a loud, 2 kHz tone. Begin the design an IIR notch filter to suppress this tone. What are the radii and angles of the poles and zeros? Present angles in terms of π (e.g., 0.7π).

$F_s = 16$ kHz

$F = 2$ kHz

$\omega = \frac{F}{F_s}\cdot 2\pi = \frac{2}{16}\cdot 2\pi = \frac{\pi}{4}$

Zeros: $1\angle \pm\frac{\pi}{4}$

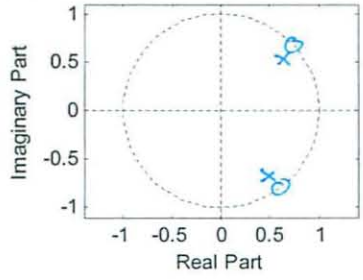
(-1/4) Forgot ±

Poles: $0.99\angle \pm\frac{\pi}{4}$

r close to but < 1

(-3/4) for poles not close

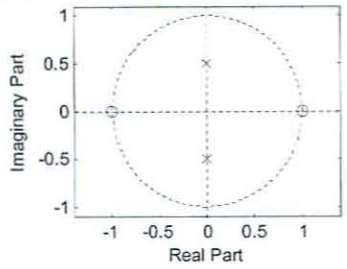
5. (2 points) Using the zeros and poles you calculated for your notch filter, complete this zero-pole plot.



Name Answers

EE-3220-21 – Dr. Durant – Quiz 6
Winter 2014-'15, Week 6

1. (2 points) Make a list of zeros and a list of poles given this z-plane view of a system H(z).



Zeros: 1, -1

Poles: $j/2$, $-j/2$

$(-\frac{1}{2})$ reverse zap

2. (2 points) Given the roots you listed above, write out H(z). Fully expand the numerator and the denominator.

$$H(z) = \frac{(z-1)(z+1)}{(z-j/2)(z+j/2)} = \frac{z^2-1}{z^2+1/4} = \frac{1-z^{-2}}{1+\frac{1}{4}z^{-2}}$$

3. (2 points) Recall that H(z) = Y(z) / X(z). Take the inverse z-transform of your result in 2 and solve for y(n) to determine the difference equation that implements the system H(z).

$$Y(z)\left(1+\tfrac{1}{4}z^{-2}\right) = X(z)\left(1-z^{-2}\right)$$
$$y(n) + \tfrac{1}{4}y(n-2) = x(n) - x(n-2)$$
$$y(n) = -\tfrac{1}{4}y(n-2) + x(n) - x(n-2)$$

$(-\frac{1}{4})$ $y(n-2)$ on wrong side

4. (2 points) A voice signal sampled at 6 kHz is intermittently jammed with a loud, 2 kHz tone. Begin the design an IIR notch filter to suppress this tone. What are the radii and angles of the poles and zeros? Present angles in terms of π (e.g., 0.7π).

$f_s = 6$ kHz

$F = 2$ kHz

$\omega = \frac{f}{f_s} \cdot 2\pi = \frac{2}{6} \cdot 2\pi = \frac{2\pi}{3}$

Zeros: $1\angle \pm \frac{2\pi}{3}$

Poles: $0.99\angle \pm \frac{2\pi}{3}$ ← close to but < 1

$(-\frac{1}{4})$ no ±

$(-\frac{3}{4})$ poles not close

5. (2 points) Using the zeros and poles you calculated for your notch filter, complete this zero-pole plot.