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

\[ \text{Zeros: } j, -j \]
\[ \text{Poles: } 0, \frac{1}{2}, -\frac{d}{2} \text{ (reverse z-plane) } \]

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

\[ H(z) = \frac{(z - j)(z + j)}{z(z - \frac{1}{2})} = \frac{z^2 + 1}{z^2 - \frac{1}{2}z} = \frac{1 + \frac{1}{2}z^{-2}}{1 - \frac{1}{2}z^{-1}} \]

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

\[ y(z)(1 - \frac{1}{2}z^{-1}) = x(z)(1 + z^{-2}) \]
\[ y(n) - \frac{1}{2}y(n - 1) = x(n) + x(n - 2) \]
\[ y(n) = \frac{1}{2}y(n - 1) + x(n) + x(n - 2) \]

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 \( \pi \) (e.g., 0.7\( \pi \)).

\[ F_s = 16 \text{ kHz} \]
\[ F = 2 \text{ kHz} \]
\[ \omega = \frac{F}{F_s} \cdot 2\pi = \frac{2}{16} \cdot 2\pi = \frac{\pi}{4} \]
\[ \text{Zeros: } 1 \pm \frac{\pi}{4} \]
\[ \text{Poles: } 0.99 \pm \frac{\pi}{4} \]
\[ \text{I} \text{ close to } b < 1 \]

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

[Diagram of zero-pole plot]
1. (2 points) Make a list of zeros and a list of poles given this z-plane view of a system \( H(z) \).

\[
\begin{align*}
\text{Zeros} & : & 1 & \quad \text{poles} & : & j/2 \\
& & -1 & \quad & -j/2
\end{align*}
\]

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

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

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 \( H(z) \).

\[
\begin{align*}
Y(z)(1+1/z^{-2}) &= X(z)(1-z^{-2}) \\
y(n) + \frac{1}{4}y(n-2) &= x(n) - x(n-2) \\
y(n) &= -\frac{1}{4}y(n-2) + x(n) - x(n-2)
\end{align*}
\]

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 \( \pi \) (e.g., 0.7\( \pi \)).

\[
\begin{align*}
P_s &= 6 \text{ kHz} \\
P &= 2 \pi \frac{1}{P_s} \\
\omega &= \frac{P}{P_s} \cdot 2\pi = \frac{2\pi}{6} = \frac{\pi}{3}
\end{align*}
\]

\[
\begin{align*}
\text{Zeros} & : & 0.99 < \pm \frac{2\pi}{3} \\
\text{poles} & : & 1 < \pm \frac{2\pi}{3}
\end{align*}
\]

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