Q 5.2

2. Consider a stable LTI system with input $x[n]$ and output $y[n]$. The input and output satisfy the difference equation

$$y[n-1] - \frac{10}{3}y[n] + y[n+1] = x[n].$$

(a) Plot the poles and zeros of the system function in the z-plane.
(b) Determine the impulse response $h[n]$.

Q 5.9

9. Consider an LTI system with input $x[n]$ and output $y[n]$ for which

$$y[n-1] - \frac{5}{2}y[n] + y[n+1] = x[n].$$

The system may or may not be stable or causal. By considering the pole–zero pattern associated with this difference equation, determine three possible choices for the impulse response of the system. Show that each choice satisfies the difference equation. Indicate which choice corresponds to a stable system and which choice corresponds to a causal system.

Q 5.10

10. If the system function $H(z)$ of an LTI system has a pole–zero diagram as shown in Figure P10 and the system is causal, can the inverse system $H_i(z)$, where $H(z)H_i(z) = 1$, be both causal and stable? Clearly justify your answer.

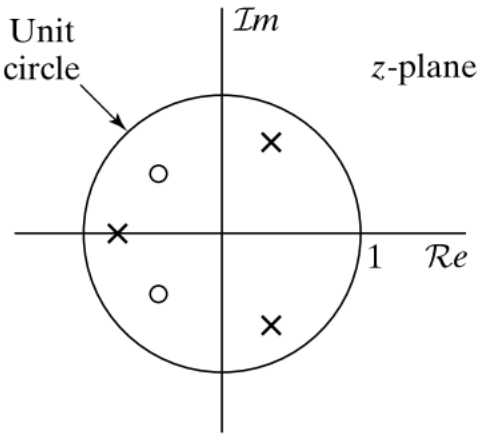

Figure P10

Q 5.52

5.52. Consider a causal sequence $x[n]$ with the z-transform

$$X(z) = \frac{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)\left(1 - \frac{1}{5}z\right)}{\left(1 - \frac{1}{6}z\right)}.$$

For what values of α is $\alpha^n x[n]$ a real, minimum-phase sequence?

Q 5.28

5.28. A causal LTI system has the system function

$$H(z) = \frac{(1 - e^{j\pi/3}z^{-1})(1 - e^{-j\pi/3}z^{-1})(1 + 1.1765z^{-1})}{(1 - 0.9e^{j\pi/3}z^{-1})(1 - 0.9e^{-j\pi/3}z^{-1})(1 + 0.85z^{-1})}.$$

(a) Write the difference equation that is satisfied by the input $x[n]$ and output $y[n]$ of this system.

(b) Plot the pole–zero diagram and indicate the ROC for the system function.

(c) Make a carefully labeled sketch of $|H(e^{j\omega})|$. Use the pole–zero locations to explain why the frequency response looks as it does.

Q 5.8

5.8. A causal LTI system is described by the difference equation

$$y[n] = \frac{3}{2}y[n-1] + y[n-2] + x[n-1].$$

(a) Determine the system function $H(z) = Y(z)/X(z)$ for this system. Plot the poles and zeros of $H(z)$, and indicate the ROC.
(b) Determine the impulse response of the system.
(c) You should have found the system to be unstable. Determine a stable (noncausal) impulse response that satisfies the difference equation.

Q 5.24

24. A stable system with system function $H(z)$ has the pole–zero diagram shown in Figure P24. It can be represented as the cascade of a stable minimum-phase system $H_{min}(z)$ and a stable all-pass system $H_{ap}(z)$.

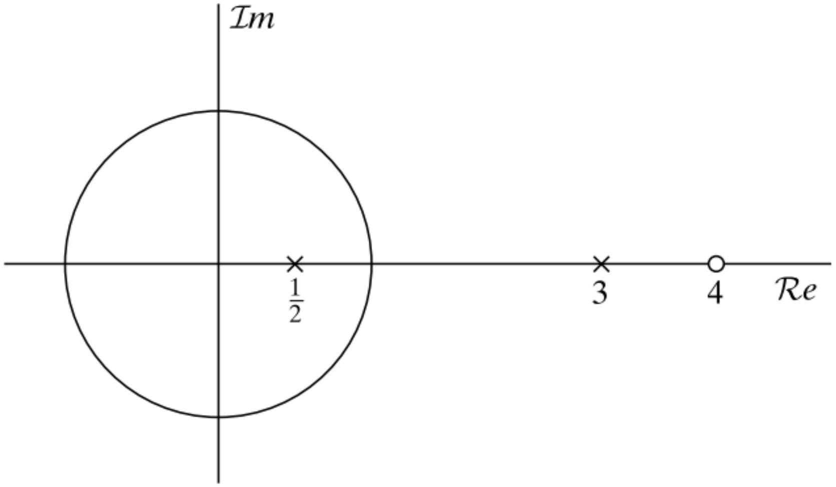

Figure P24 Pole–zero diagram for $H(z)$.