ECE 2050 Autumn 2023 Homework 7
Due Friday Oct 20, 5:00 pm
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BC:7.1 For each of the following LTI systems, find the z-domain transfer function, *and its zeros and poles*. For these expressions, $h[n]$ is the impulse response, $x[n]$ is the input signal and $y[n]$ is the output signal. Express your answer as either a z polynomial of finite order or as the ratio of two z polynomials of finite order. In all cases, assume that the input signal begins at $n = 0$ or later. Also assume that $y[n] = 0$ for $n < 0$. *State whether the system is FIR or IIR and briefly justify your answer.*

a.)

$$y[n] = 0.6y[n-1] - 0.25y[n-2] + x[n] + 3x[n-2]$$

b.)

$$h[n] = \left(\frac{\sin(3\pi(n-1)/4)}{\pi(n-1)}\right)(u[n] - u[n-3])$$

(hint: can you express $h[n]$ another way?)

c.)

$$y[n] = 3x[n] + 10x[n-2] + 8x[n-4]$$

d.)

$$h[n] = (-0.4)^n u[n] + 2(-0.75)^{n-1}u[n-1]$$

BC:7.2 For causal LTI systems with transfer functions listed below, find the zeros and poles and state whether or not each system is stable with a brief justification for why. If the system is stable, find the impulse response for the system.

a.)

$$\hat{H}_a(z) = \frac{2z^2 + 5.5z + 3.75}{z^2 + 0.35z - 1.125}$$

b.)

$$\hat{H}_b(z) = \frac{2z^2 + 2.5z + 3.75}{z^2 + 0.35z - 1.125}$$

c.)

$$\hat{H}_c(z) = \frac{2.5z^2 + 0.5z}{z^2 + 0.2z - 0.08}$$

d.)

$$\hat{H}_d(z) = 2 + 5z^{-2} - 12z^{-4}$$

e.)

$$\hat{H}_e(z) = \frac{1.5z^2 + 2z}{z^2 + 0.4z + 0.13}$$

BC:7.3 For an LTI system starting from rest, it is known that the input signal is

$$x[n] = u[n]$$

and the output signal is

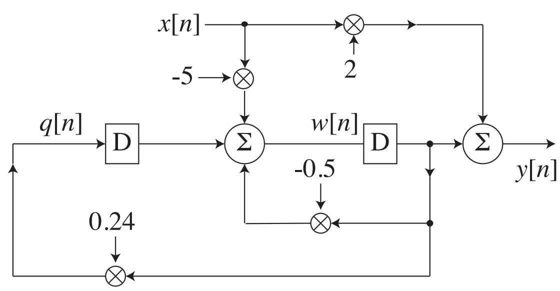
$$y[n] = \left(3.75 - \left(\frac{1}{3}\right)^{n-1} + 0.25\left(-\frac{1}{3}\right)^{n-1}\right)u[n-1]$$

a.) Find the transfer function, $\hat{H}(z)$ and express it as a finite order polynomial of z or a ratio of two finite order polynomials of z.

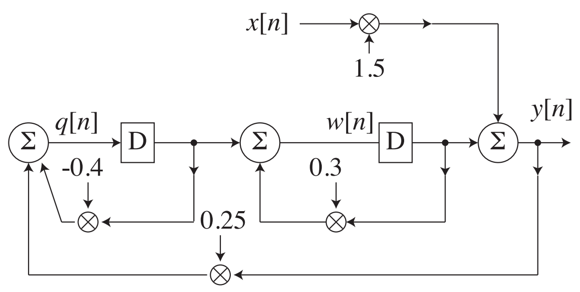
b.) Find the impulse response, $h[n]$

BC:7.4 For each of the flow diagrams below, convert the diagrams to the z-domain *assuming zero-state conditions* (the system starts from rest). Find the transfer function, $\hat{H}(z)$, for each system.

a.)



b.)



c.)