**PROBLEM: 5.1**

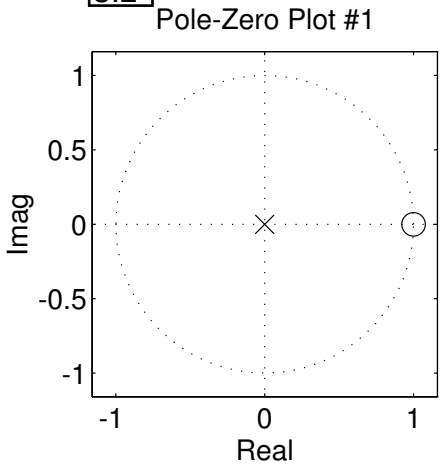
For each of the following systems (specified by either an $H(z)$ or a difference equation), determine all the poles and zeros and make a pole-zero plot.

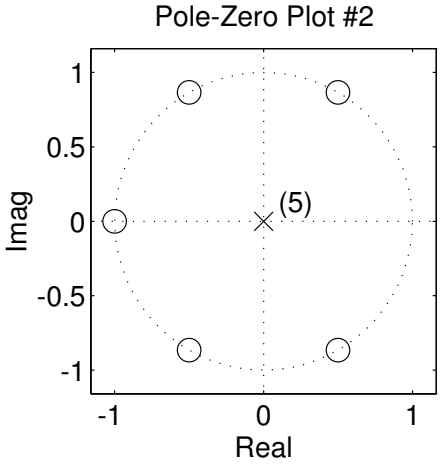
(a) $\mathcal{S}_a$ : $y[n] = 5x[n] - 10x[n-2] + 5x[n-4]$

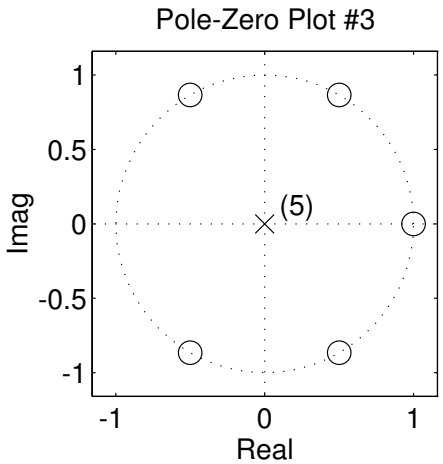
(b) $\mathcal{S}_b$ : $H(z) = \dfrac{3 + 3z^{-1} + 3^{-2}}{1 + 0.6z^{-1} + 0.81z^{-2}}$

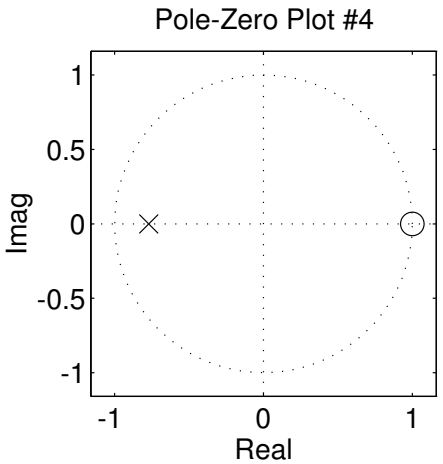
(c) $\mathcal{S}_c$ : $y[n] = -0.81y[n-2] + 4x[n-1] - 5x[n-2]$

**PROBLEM:** 5.2




For each of the pole-zero plots (#1, #2, #3 and #4), determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the pole-zero plot.

$\mathcal{S}_1$ : $y[n] = 0.77y[n-1] + x[n] + x[n-1]$

$\mathcal{S}_2$ : $y[n] = 0.77y[n-1] + 0.77x[n] - x[n-1]$

$\mathcal{S}_3$ : $H(z) = \dfrac{1 - z^{-1}}{1 + 0.77z^{-1}}$

$\mathcal{S}_4$ : $H(z) = 1 - z^{-1} + z^{-2} - z^{-3} + z^{-4} - z^{-5}$

$\mathcal{S}_5$ : $y[n] = \sum_{k=0}^{7} x[n-k]$

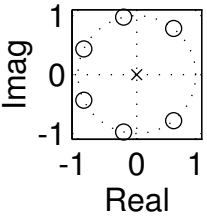
$\mathcal{S}_6$ : $H(z) = 3 - 3z^{-1}$

$\mathcal{S}_7$ : $y[n] = x[n] + x[n-1] + x[n-2] + x[n-3] + x[n-4] + x[n-5]$

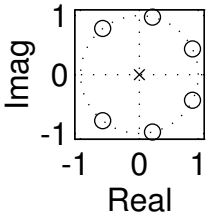
**PROBLEM:** 5.3

Match the frequency responses (#A–#E) with the correct pole-zero plots (#1 – #6). Poles are denoted with an **x** and zeros with an **o**.

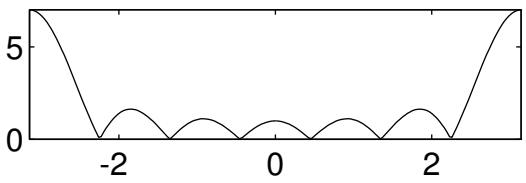
Pole-Zero Plot #1



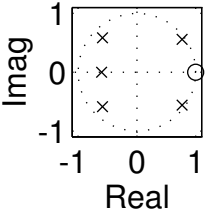

Pole-Zero Plot #2



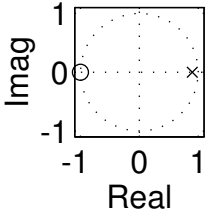

FREQ RESPONSE: A



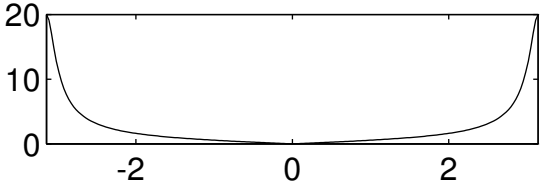

Pole-Zero Plot #3



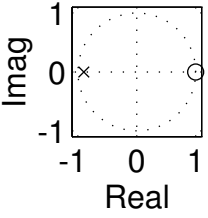

Pole-Zero Plot #4



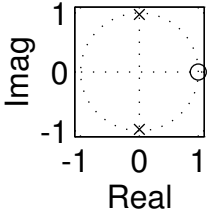

FREQ RESPONSE: B



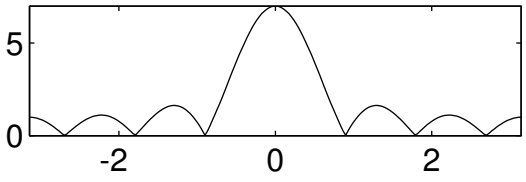

Pole-Zero Plot #5



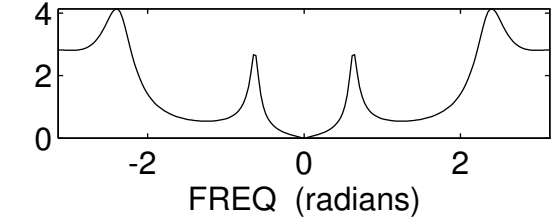

Pole-Zero Plot #6



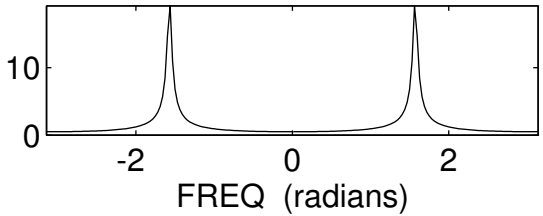

FREQ RESPONSE: C




FREQ RESPONSE: E



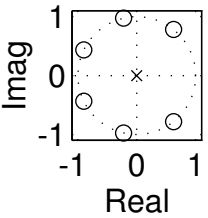

FREQ RESPONSE: D



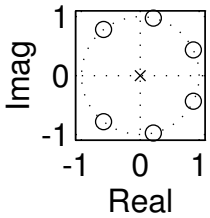
**PROBLEM:** 5.4

Match the impulses responses (#A–#E) with the correct pole-zero plots (#1 – #6). Poles are denoted with an **x** and zeros with an **o**.

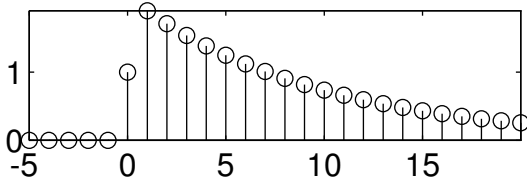
Pole-Zero Plot #1



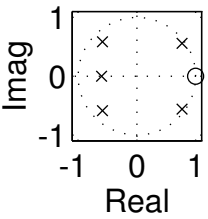

Pole-Zero Plot #2



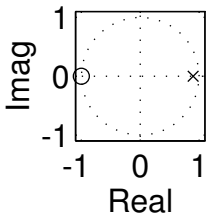

IMPULSE RESPONSE: A



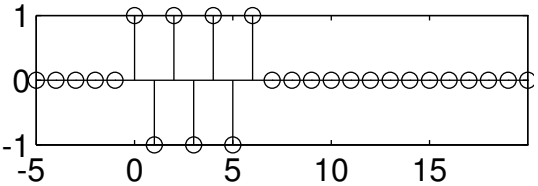

Pole-Zero Plot #3



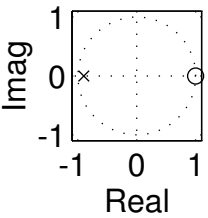

Pole-Zero Plot #4



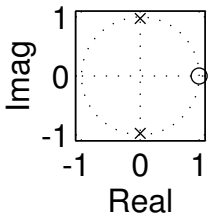

IMPULSE RESPONSE: B



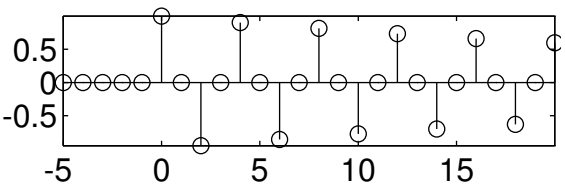

Pole-Zero Plot #5



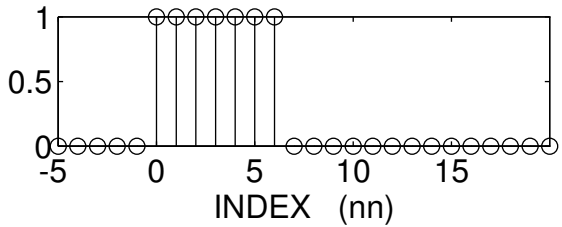

Pole-Zero Plot #6



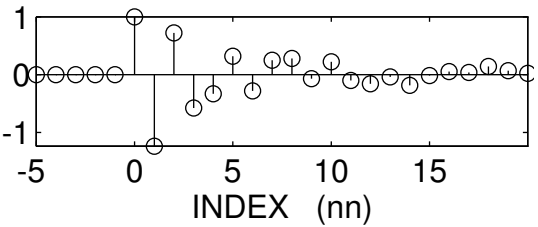

IMPULSE RESPONSE: C




IMPULSE RESPONSE: E




IMPULSE RESPONSE: D



**PROBLEM: 5.5**

Use the most convenient form of these system functions to determine the corresponding impulse responses of the following:

(a) $H_a(z) = \dfrac{1+z^{-1}}{1+0.5z^{-1}} = \dfrac{1}{1+0.5z^{-1}} + \dfrac{z^{-1}}{1+0.5z^{-1}} = 2 - \dfrac{1}{1+0.5z^{-1}}.$

(b) $H_b(z) = \dfrac{2-0.9z^{-1}}{1-0.9z^{-1}+0.81z^{-2}} = \dfrac{1}{1-0.9e^{j\pi/3}z^{-1}} + \dfrac{1}{1-0.9e^{-j\pi/3}z^{-1}}.$

(c) $H_c(z) = \dfrac{1+z^{-2}}{1+0.25z^{-2}} = 4 - \dfrac{1.5}{1-0.5e^{j\pi/2}z^{-1}} - \dfrac{1.5}{1-0.5e^{-j\pi/2}z^{-1}}.$

(d) $H_d(z) = 1+z^{-1}+z^{-2}+z^{-3} = \dfrac{1-z^{-4}}{1-z^{-1}}$