**Full Name:** ____________________________________________

**EEL 4750 / EEE 5502 (Fall 2021) – HW #3** **Due: 4:00 PM ET, Sept. 21, 2021**

## Concept Questions 3

**Question #1:** Complete the Canvas questions here: `https://ufl.instructure.com/courses/437179/assignments/4812576`

## Theory Questions 3

**Question #1:** Consider the following impulse response

$$H(z) = \frac{1}{(1-\alpha z^{-1})(1-\beta z^{-1})}$$

Assume the system is stable. For each of the following values of $\alpha$ and $\beta$, determine (i) region of convergence, (ii) the corresponding impulse responses, and (iii) if the system is causal, anti-causal, or acausal.

(a) $\alpha = 0.1$ and $\beta = 2$

(b) $\alpha = 0.2$ and $\beta = 0.7$

(c) $\alpha = 2$ and $\beta = 0.5$

**Question #2:** In the questions below, let $X(z) = \mathcal{Z}\{x[n]\}$, $H(z) = \mathcal{Z}\{h[n]\}$, $Y(z) = \mathcal{Z}\{y[n]\}$.

(a) Given a signal $x[n]$ and impulse response $h[n]$, let $y[n]$ be defined by

$$y[n] = x[n] * h[n]$$

Use the definition of the Z-transform (i.e., do not use tables) to show that

$$Y(z) = X(z)H(z)$$

(b) Given a signal $x[n]$ and impulse response $h[n]$. Let the correlation $a[n]$ be given by

$$A[n] = x[-n] * h[n]$$

Show that $A(z) = X(z^{-1})H(z)$ (not using tables)

(c) Use your previous property and the Z-transform table properties to show that

$$a[n] = x[-n] * x[n-M]$$

has a Z-transform $A(z) = X(z^{-1})X(z)z^{-M}$.

## Implementation Questions 3

**Question #1:** For the following Z-transforms, compute the corresponding impulse response for `n=0:10` and observe the pole-zero plot (created using the provided `pzplot` function). Use MATLAB's `filter` function with an impulse input ($x[n] = \delta[n]$) to get the impulse response. Assume all systems are causal.

(a) $H_1(z) = 1 - z^{-1} + 0.5z^{-2}$

(b) $H_2(z) = 1 + jz^{-6}$

(c) $H_3(z) = \dfrac{1}{1 - (0.72)^{-1}z^{-1}}$

(d) $H_4(z) = \dfrac{1}{1 + (0.72)z^{-1}}$

(e) $H_5(z) = \dfrac{z^{-6}}{(1 - e^{j\pi/4}z^{-1})(1 - e^{-j\pi/4}z^{-1})}$

(f) $H_6(z) = \dfrac{1 - 0.72z^{-1}}{1 - 1.9559z^{-1} + 1.4520z^{-2} - 0.1737z^{-3}}$

**Question #2:** For each system in Question #1, determine if the system is stable or unstable. (Note: Remember that you are only plotting 10 impulse response samples in Question #1)