ICE503 DSP-Homework#5

1. Prove the convolution property in z-transform.

$$\mathrm{x}_1[n] * \mathrm{x}_2[n] \overset{\mathbb{Z}}{\leftrightarrow} \mathrm{X}_1(z)\mathrm{X}_2(z), \qquad \text{ROC contains } R_{\mathrm{x}_1} \cap R_{\mathrm{x}_2}$$

2. The block diagram of a causal LTE system is shown in Figure 1.

   (a) Write the rational polynomials of the system $H(z)$.

   (b) Use partial fraction to find the LCCDE $h[n]$ of this system.

   (c) Write the difference equation that characterizes the system with $x[n]$ and $y[n]$.

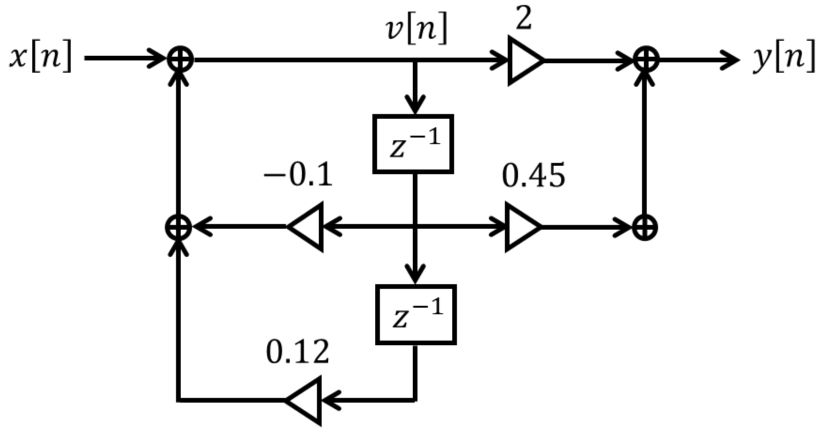

Figure 1: The block diagram of an LTE system

3. When the input to an LTE system is

$$x[n] = \left(\frac{1}{2}\right)^n \mu[n] + 2^n \mu[-n-1]$$

   the output is

$$y[n] = 6\left(\frac{1}{2}\right)^n \mu[n] - 6\left(\frac{3}{4}\right)^n \mu[n]$$

   (a) Find the ZT of $x[n]$ and $y[n]$, and indicate their ROC.

   (b) Find the rational polynomials of the system $H(z)$, plot the pole(s) and zeros(s) and indicate the ROC.

   (c) Determine whether the system is causal and stable.

(d) Find the impulse response $h[n]$ of the system.

(e) Write the difference equation that characterizes the system.

4. MATLAB simulation:

In the question 2(b), you might have sketched the pole(s) and zeros(s) of the system $H(z)$, and you might have found the difference equation in the question 2(e)

(a) Use zplane function to plot the pole(s) and zeros(s) of the system $H(z)$

(The result should be the same as your answer in question 2(b).)

(b) Use freqz function to calculate a 100-point frequency response vector and the corresponding angular frequency vector, then plot the magnitude and phase response of the frequency response vector.