ICE503 DSP-Homework#5

1. Consider the impulse response of the moving-average filter is given by

$$\mathrm{h[n]} = \begin{cases} \frac{1}{M}, & 0 \le n \le M-1 \\ 0, & otherwise \end{cases}.$$

   Determine the DTFT of the moving-average filter $\mathrm{H}(\mathrm{e}^{j\omega})$.

2. Consider a signal that is the sum of two real exponentials;

$$\mathrm{x[n]} = \left(\frac{1}{2}\right)^n u[n] + \left(-\frac{1}{3}\right)^n u[n],$$

   the z-transform is? (Hint: $\mathrm{G(z)} = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$)

3. 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 $y[n]$.

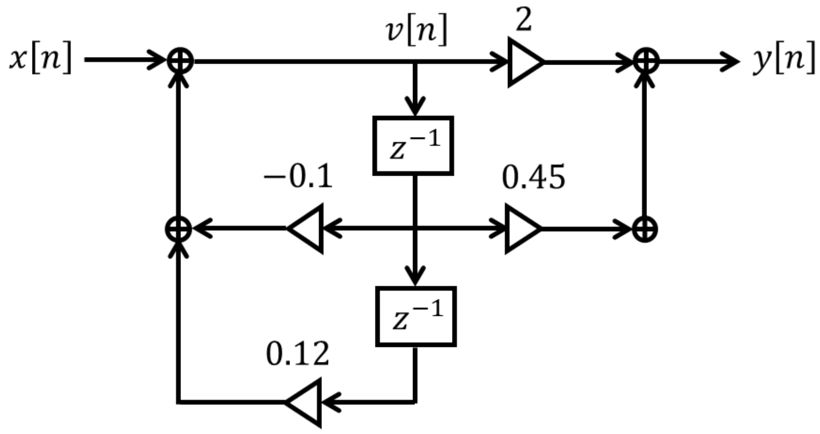

Figure 1: The block diagram of an LTE system

4. 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.

5. MATLAB simulation:

Consider the system in z domain is:

$$\mathrm{H(z)} = \frac{1 - 2z^{-1}}{1 - \frac{3}{4}z^{-1}}$$

Sketch the pole(s) and zeros(s) of the system.

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

(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.