EE150 Signal and System
Homework 9

Due on 27 Dec 23:59 UTC+8

Note:

- Please provide enough calculation process to get full marks.
- Please submit your homework to Gradescope.
- It's highly recommended to wirte every exercise on single sheet of page.

Exercies 1. (20pt)

Determine the Z-transform for each of following sequences. Sketch the pole zero plot and indicate the ROC.

(a) $6^n u[-n] + (\frac{1}{6})^n u[n-2]$

(b) $3^n \cos[\frac{\pi}{3}n + \frac{1}{3}\pi]u[n-1]$

(c) $n(\frac{1}{3})^{|n|}$

Exercies 2. (20pt)

The following facts are given about a real signal $x[n]$ with Z-transform $\chi(z)$

(a) $x[n]$ is left-sides

(b) $\chi(z)$ has two poles

(c) $\chi(z)$ has no zeros in finite z-plane

(d) $\chi(z)$ has a poles at $\frac{1}{6}e^{-j\pi/3}$

(e) $\chi(0) = 7$

Exercies 3. (20pt)

Consider the following system function corresponding to causal LTI systems:

$$H(z) = \frac{1}{(1 - \frac{1}{2}z^{-1} + \frac{1}{16}z^{-2})} + \frac{1}{(1 - \frac{2}{5}z^{-1} + \frac{1}{25}z^{-2})}$$

(a) For each system function, draw a direct-form block diagram.

(b) For each system function, draw a block diagram that corresponds to the cascade connection of two second-order block diagrams. Each second-order block diagram should be in direct form.

(c) For each system function, determine whether there exists a block diagram representation which is the cascade of four first-oder block diagrams with the constraint that all the coefficient multipliers must be real.

Exercies 4. (20pt)

A LTI system associate input $x[n]$ and output $y[n]$ with the differential equation:

$$y[n-1] - \frac{3}{2}y[n] + \frac{1}{2}y[n+1] = x[n]$$

The stability of system is uncertain. By considering the pole-zero pattern associated with the preceding difference equation, determine three possible choices for the unit impulse response of the system. Show that each choice satisfies the difference equation.

Exercies 5. (20pt)

Consider the system characterized by the differential equation:

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

(a) Determine the zero input response of this system where $y[-2] = -4, y[-1] = 0$

(b) Determine the zero state response of this system to the input $x[n] = 4\delta[n]$

(c) Determine the output of this system for $n \geq 0$ when
$x[n] = 4\delta[n], y[-2] = -4, y[-1] = 0$