

ECE 401 Signal and Image Analysis

Homework 6

UNIVERSITY OF ILLINOIS
Department of Electrical and Computer Engineering

Assigned: 11/13/2023; Due: 11/29/2023
Reading: *DSP First* Chapters 9 and 10

Problem 6.1

Consider the difference equation:

$$y[n] = x[n] - \frac{1}{2}x[n-1] + \frac{1}{4}x[n-2]$$

Find the frequencies, $\omega = \angle z_1$ and $\omega = \angle z_2$, of the two zeros.

Problem 6.2

A particular filter has the difference equation

$$y[n] = x[n] - 1.2e^{j3\pi/5}x[n-1] + 0.8e^{j2\pi/5}y[n-1]$$

Express the frequency response of this filter as

$$H(\omega) = \frac{e^{j\omega} - z_1}{e^{j\omega} - p_1}$$

for some zero z_1 and pole p_1 .

Problem 6.3

Remember that

$$G(z) = \frac{1}{1 - 0.8z^{-1}} \leftrightarrow g[n] = (0.8)^n u[n]$$

Use the linearity and time-shift properties of the Z-transform to find $h[n]$, where

$$H(z) = \frac{1 - 0.3z^{-1}}{1 - 0.8z^{-1}} = \frac{1}{1 - 0.8z^{-1}} - 0.3z^{-1} \frac{1}{1 - 0.8z^{-1}}$$

Problem 6.4

What is $h[n]$ if

$$H(z) = \frac{1}{(1 - e^{j0.1\pi}z^{-1})(1 - e^{-j0.1\pi}z^{-1})}$$