ECE 401 Signal and Image Analysis
Homework 5

UNIVERSITY OF ILLINOIS
Department of Electrical and Computer Engineering

Assigned: Monday, 11/2/2020; Due: Monday, 11/9/2020
Reading: *DSP First* Sections 10.11-10.12

Problem 5.1

What is $h[n]$ if

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

Problem 5.2

Consider a second-order resonator with a resonant frequency of $F_1 = 500$Hz and a bandwidth of $B_1 = 400$Hz, sampled at $F_s = 16000$samples/second. What are $H(z)$ and $h[n]$?

Problem 5.3

Suppose

$$x[n] = \frac{1}{\sin(0.3\pi)} e^{-0.1(n-6)} \sin\left(0.3\pi(n-5)\right) u[n-6]$$

Write a difference equation in terms of $y[n]$ and $x[n]$ that will result in $y[n] = \delta[n-6]$.

Problem 5.4

Suppose $x[n]$ is a signal with autocorrelation coefficients $R[0] = 1$, $R[1] = 0.5$, and $R[2] = 0.5$. Find coefficients a_1 and a_2 that will minimize $\mathcal{E}$, which is defined as

$$\mathcal{E} = \sum_{n=-\infty}^{\infty} \left(x[n] - a_1 x[n-1] - a_2 x[n-2]\right)^2$$