

# ECE 417 Multimedia Signal Processing

## Homework 1

UNIVERSITY OF ILLINOIS  
Department of Electrical and Computer Engineering

Assigned: Monday, 8/23/2021; Due: NOT DUE

### Problem 1.1

What is  $h[n]$  if

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

### Problem 1.2

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

### Problem 1.3

Suppose

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

Write a difference equation in which every term on the right-hand-side includes a factor of  $x[n-m]$  for some value of  $m$ , and every term on the left-hand-side includes a factor of  $y[n-k]$  for some value of  $k$ , such that your difference equation produces the output signal  $y[n] = \delta[n-6]$ .

### Problem 1.4

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

$$\mathcal{E} = \sum_{n=-\infty}^{\infty} (x[n] - a_1x[n-1] - a_2x[n-2])^2$$