ECE113: DSP

Homework 6

Due 05/21/2021, 11:59pm

Problem 1: Problem 3.14 ((d), and (g) only) in R1

Problem 2: Problem 3.16 ((d) only) in R1

Problem 3: Problem 3.18 ((d) only) in R1

Problem 4: Problem 3.32 in R1

Problem 5: Problem 3.35 ((c) and (g) only) in R1.

(Hint: In Part (c), a "," is obviously missing between x(n-1) and x(n). For Part (g), note that x(n) does not have a Z-transform and you should instead use the fundamental property of Transfer Functions relating to how an LTI system responds to a sinusoidal sequence)

Problem 6: Problem 3.38 ((b) only) in R1

Problem 7: Problem 3.40 in R1

Problem 8: Problem 3.42 in R1

Problem 9: Problem 3.51 in R1

Problem 10: Problem 5.20 in R1

MATLAB:

P4.11 Determine the following inverse z-transforms using the partial fraction expansion method.

1. $X_1(z) = (1 - z^{-1} - 4z^{-2} + 4z^{-3})/(1 - \frac{11}{4}z^{-1} + \frac{13}{8}z^{-2} - \frac{1}{4}z^{-3})$. The sequence is rightsided.

4. $X_4(z) = z/(z^3 + 2z^2 + 1.25z + 0.25)$, $|z| > 1$

Note: For PFE, you can use the "residuez" function in MATLAB.

P4.21 A digital filter is described by the frequency response function

$$H(e^{j\omega}) = [1 + 2\cos(\omega) + 3\cos(2\omega)]\cos\left(\frac{\omega}{2}\right)e^{-j5\omega/2}$$

1. Determine the difference equation representation.
2. Using the **freqz** function, plot the magnitude and phase of the frequency response of the filter. Note the magnitude and phase at $\omega = \pi/2$ and at $\omega = \pi$.
3. Generate 200 samples of the signal $x(n) = \sin(\pi n/2) + 5\cos(\pi n)$, and process through the filter to obtain $y(n)$. Compare the steady-state portion of $y(n)$ to $x(n)$. How are the amplitudes and phases of two sinusoids affected by the filter?

Note:

For Part (1), you can use Euler equation along with the relationship between DTFT and Z-transform, i.e., the relationship between z and ω, to find the associated Transfer Function H(z) and from that, obtain the LCCDE.

For Part (3), you can use the "filter" function in MATLAB.