ECE113: Digital Signal Processing

Homework 3
Due: Jan 26 11:00pm, 2022

Instructor: Prof Abeer Alwan

Instructions

1. Read Chapters 5 and 6.

Chapter 5

Impulse Response Sequence

1. **Problem 5.11.**

   Which of the following LTI systems are FIR or IIR?

   (a) *h(n) = u(n) - u(n - 10)*
   (b) *h(n) = $(\frac{1}{2})^n$ u(n - 3)*
   (c) *{y(n) = $\frac{1}{2}$ y(n - 1) + x(n), relaxed}*

2. **Problem 5.17.**

   A system is described by the input-output relation

   $$y(n) = x(3n-1)\cos\left(\frac{\pi}{3}n\right)u(n+5)$$

   Is the system linear? causal? time-invariant? BIBO stable?

3. **Problem 5.31.**

   Find a difference equation to describe the input-output relation of the LTI system whose impulse response sequence is given by

   $$h(n) = \delta(n-1) + \frac{1}{3}\delta(n-2) - \frac{1}{4}\delta(n-3)$$

   (a) What is the response of the system to $x(n) = e^{j\frac{\pi}{3}n}u(n)$?
   (b) What is the response of the system to $x(n) = 2\cos\left(\frac{\pi}{6}n + \frac{\pi}{4}\right)u(n)$?

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Chapter 6

Linear Convolution

4. **Problem 6.3.** Evaluate the convolution sums:

   (a) $u(n) \star (\frac{1}{2})^n u(n-1)$

   (b) $u(-n) \star (\frac{1}{2})^n u(n-1)$

   (c) $u(2n) \star (\frac{1}{2})^n u(n)$

5. **Problem 6.11.** Evaluate

$$\left[\frac{1}{2}\delta(n+1) - \frac{1}{3}\delta(n)\right] \star \left(\frac{1}{2}\right)^{n-1}.u(n) \star \left(\frac{1}{3}\right)^{n}.u(n-2)$$