ECE113: Digital Signal Processing

Homework 2
Due: Jan 19, 11pm, 2022

Instructions

1. Read Chapters 3 and 4.
2. For each of the questions below please submit your answers and plots (if any) as a combined PDF file.

Chapter 3

Periodic Sequences

1. **Problem 3.17.**

   Find the period of the sequence

   $$x(n) = \cos\left(\frac{\pi}{3}n + \frac{\pi}{6}\right).\sin\left(\frac{\pi}{6}n + \frac{\pi}{8}\right)$$

2. **Problem 3.35.** Consider the sequence $x(n) = e^{j\frac{5\pi}{12}n} + e^{j\frac{\pi}{12}n}$. Show that it can be written in the form

   $$x(n) = A.e^{j\omega_0 n}.\cos(\omega_1 n)$$

   for some positive real number A, and for some $\omega_0 > \omega_1$. Is $x(n)$ periodic.

Chapter 4

Discrete-Time Systems

3. **Problem 4.4.** Determine whether each of the following systems is time-invariant:
   1. $y(n) = x(-n^2)$.
   2. $y(n) = x(3n - 2)$.
   3. $y(n) = x(-n/4)$ when $n = 0, \pm 4, \pm 8, \ldots$, and $y(n) = 0$ otherwise.
4. **Problem 4.11.** True or False? Explain or give counter-examples:

1. Every causal system is relaxed.
2. Every relaxed system is causal.
3. LTI systems that are causal are also relaxed.

5. **Problem 4.25.** Let $y(n) = x(n^2 - 1)$. Is the system linear? time-invariant? causal? stable?