ECE351: Signals and Systems I - Fall 2023 - Dr. Thinh Nguyen
Homework 4
Due 10/25/2023

1. Exercise 12.9

2. A certain sound effect can be modeled using the following LTI system with the following frequency response:

$$H(e^{j\omega}) = \frac{\omega}{\omega^2 - \pi^2} \tag{1}$$

   (a) Let $x(t) = 1 + \sin^2 \pi t$, determine the appropriate values of c_i and ω_i so that $x(t) = \sum_i c_i e^{j\omega_i t}$.

   (b) Using the result in (a) and the property of an LTI system with an input as a linear combination of complex exponentials, determine the output $y(t)$.

   (c) Describe what happen if we feed $x(t) = \sin \pi t$ into the system?

3. Determine the DTFS representations of the following signals:

   (a) $x[n] = \cos(\frac{6\pi}{17}n + \frac{\pi}{3})$

   (b) $x[n] = 2\sin(\frac{14\pi}{19}n) + \cos(\frac{10\pi}{19}n) + 1$

   (c) $x[n] = \sum_{m=-\infty}^{\infty}(-1)^m(\delta[n - 2m] + \delta[n + 3m])$

4. Determine the time-domain signals represented by the following DTFS coefficients

   (a) $X[k] = \cos(\frac{8\pi}{21}k)$

   (b) $X[k] = \cos(\frac{10\pi}{19}k) + j2\sin(\frac{4\pi}{19}k)$

   (c) $X[k] = \sum_{m=\infty}^{\infty}(-1)^m(\delta[k - 2m] - 2\delta[k + 3m])$

5. Determine the FS representations of the following signals:

   (a) $x(t) = \sin(3\pi t) + \cos(4\pi t)$

   (b) $x(t) = \sum_{m=-\infty}^{\infty} \delta(t - \frac{m}{3}) + \delta(t - \frac{2m}{3})$

   (c) $x(t) = \sum_{m=-\infty}^{\infty} e^{j\frac{2\pi}{7}m}\delta(t - 2m)$

6. Determine the time-domain signals represented by the following FS coefficients:

   (a) $X[k] = j\delta[k - 1] - j\delta[k + 1] + \delta[k - 3] + \delta[k + 3], \omega_0 = 2\pi$

   (b) $X[k] = j\delta[k - 1] - j\delta[k + 1] + \delta[k - 3] + \delta[k + 3], \omega_0 = 4\pi$

   (c) $X[k] = (-\frac{1}{3})^{|k|}, \omega_0 = 1$