

ECE 310: Problem Set 6**Due:** 5 pm, October 12, 2018

1. A causal LTI system is described by the difference equation: $y[n] - \frac{1}{2}y[n-1] = 3x[n]$.
 - (a) Determine the system's transfer function $H(z)$
 - (b) Determine the system's unit pulse response $h[n]$
 - (c) Determine the system's frequency response $H_d(\omega)$ (or $H(e^{j\omega})$).

2. An LTI system is described by the difference equation

$$y[n] = x[n-4] - x[n-8]$$

- (a) Compute and sketch (by hand) its magnitude and phase frequency response
 - (b) Determine its output to inputs
 - i. $x[n] = 2 \cos \frac{\pi n}{5} + \sin \left(\frac{\pi n}{4} + \frac{\pi}{10} \right)$
 - ii. $x[n] = 2 + 4 \cos \left(\frac{2\pi n}{3} + \frac{\pi}{4} \right) + 3 \cos \left(\frac{\pi n}{3} + \frac{\pi}{5} \right)$
3. The frequency response of an LTI system is

$$H_d(\omega) = \omega^2 e^{j \cos \omega}, \quad |\omega| \leq \frac{2\pi}{3}.$$

Determine the system output $y[n]$ for the following inputs:

- (a) $x[n] = 2 + 10e^{j(\frac{\pi}{8}n + 45^\circ)} - j^n$
 - (b) $x[n] = 4 + 10 \cos(\frac{3\pi}{4}n + 45^\circ) + 2j^n$.
4. The difference equation of a causal LTI system is given by

$$y[n] - \frac{1}{\sqrt{2}}y[n-2] = 2x[n].$$

Determine $y[n]$ for the input $x[n] = 3 + \cos(\frac{\pi}{8}) \sin(\frac{\pi n}{2}) + (-1)^n$.

5. The response of a real LTI system for the input

$$x[n] = 1 + \cos \left(\frac{\pi n}{8} + 23^\circ \right) + \sin \left(\frac{\pi n}{4} + 30^\circ \right)$$

is

$$y[n] = 4 + 2 \sin \left(\frac{\pi n}{8} + 23^\circ \right).$$

Determine the system response $\tilde{y}[n]$ for input

$$\tilde{x}[n] = 3 + 2 \sin \left(\frac{\pi n}{8} + 15^\circ \right) + 10 \cos \left(\frac{\pi n}{4} + 25^\circ \right).$$