

**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

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