

# ECE301

## HW 4

DUE ON TUESDAY NOV. 1ST

Please provide steps to explain  
your answer

T.A.: Jing Guo

email: [guo349@purdue.edu](mailto:guo349@purdue.edu)

**Office Hour change: MSEE180  
(9:30am - 10:30am Monday and  
Wednesday)**

## Question 1

Given the discrete-time signal  $x[n]$  is periodic with period 4. If its Fourier series coefficients  $\{a_k\}$  are given as below,

$$a_0 = 1, a_1 = \frac{1}{4} + j\frac{3}{4}, a_2 = \frac{1}{2}, a_3 = \frac{1}{4} - \frac{3}{4}j$$

Find the signal  $x[n]$ .

## Question 2

Consider an LTI system whose response to the input

$$x(t) = e^{-t}u(t)$$

is

$$y(t) = [2e^{-t} - 2e^{-4t}]u(t).$$

- Find the frequency response of this system,  $H(jw) = \frac{Y(jw)}{X(jw)}$
- Determine the system's impulse response.
- Determine whether the system is stable, Justify your answer.

## Question 3

- Determine the frequency response  $H(e^{jw})$  of the signal

$$h[n] = a^n \left( u[n] - u[n - 10] \right).$$

- Consider the signal

$$s[n] = a^n \sin \left( \frac{\pi n}{5} \right) \left( u[n] - u[n - 10] \right)$$

express  $S(e^{jw})$ , the Fourier transform of  $s[n]$ , in terms of  $H(e^{jw})$ , the frequency response of  $h[n]$  above.

## Question 4

When  $x(t) = e^{-2t}u(t)$  is the input to an LTI system with frequency response,  $H(jw) = \frac{Y(jw)}{X(jw)}$

$$H(jw) = \frac{5}{3 + jw}$$

then the output is  $y(t)$ .

- Find  $X(jw)$ .
- Find  $Y(jw)$ , then use  $Y(jw)$  to find  $y(t)$ ,

### Question 5

Given a frequency response  $H(e^{jw})$ , where  $w \in (-\pi, \pi)$ ,

$$H(e^{jw}) = \frac{1 + e^{-2jw}}{1 + \frac{9}{16}e^{-2jw}}$$

Determine the overall output  $y[n]$ , when the input is:

$$x[n] = 3 + 2\cos\left(\frac{\pi}{2}n\right) + \cos(\pi n)$$