ECE301

HW 3

Due on Tuesday Oct. 13th

Please provide steps to explain your answer

T.A.: Jing Guo
email: guo349@purdue.edu

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

Question 1

a.) Consider the LTI system with input x(t) and output y(t).

$$y(t) = \int_{t-4}^{t} x(\tau)d\tau$$

1.) Determine and sketch the impulse response of the system.
2.) Is the system causal? Justify your answer by using the impulse response.
3.) Is the system stable?

b.) Consider the LTI system with input x(t) and impulse response h(t) given below

$$x(t) = u(t) - u(t-2)$$
$$h(t) = u(t) - u(t-2)$$

1.) Is the system stable?
2.) Determine and write a closed-form expression for the output $y(t)$.

Question 2

Consider the system with input $x[n]$ and output $y[n]$ with a period $T = 4$.
a.) Find Fourier series coefficients a_k, given,

$$x[0] = 2,\ x[1] = -1,\ x[2] = 1,\ x[3] = 2.$$

b.) Find Fourier series coefficients if the input is $x[n-2]$.
c.) Find Fourier series coefficients if the input is $x[n+2]$.

Question 3

Consider the continuous-time signal $x(t)$, and $\omega_0 = \pi/2$

$$x(t) = \begin{cases} 1.5 & 0 < t < 2 \\ -1.5 & 2 \leq t < 4 \end{cases}$$

a.) What is the Fundamental period T?
b.) What are the Fourier series coefficients?

Question 4

a.) Consider the following three continuous-time signals with a fundamental period $\frac{T}{2}$.

$$\begin{aligned} x(t) &= cos(3\pi t), \\ y(t) &= sin(3\pi t), \\ z(t) &= x(t)y(t), \end{aligned}$$

1.) Determine the Fourier series coefficients of $x(t)$.
2.) Determine the Fourier series coefficients of $y(t)$.
3.) Determine the Fourier series coefficients of $z(t)$.

b.) Consider the following three continuous - time signals with a fundamental period $\frac{T}{2}$.

$$\begin{aligned} x(t) &= cos(4\pi t), \\ z(t) &= x(t)x(t), \end{aligned}$$

1.) Determine the Fourier series coefficients of $x(t)$.
2.) Determine the Fourier series coefficient of $z(t)$.

Question 5

Consider the system with input $x[n]$, impulse repones $h[n]$, and output $y[n]$ with fundamental period 4,

$$h[n] = \frac{\delta[n-2]+\delta[n+2]}{2},$$

$$x[0] = 0,\ x[1] = 2,\ x[2] = 4, \text{ and } x[3] = 2,$$

a.) Is the system stable?
b.) Determine and write a closed-form expression for the output $y(t)$.
c.) Determine the Fourier series coefficients of x[n] and y[n].