# EE3210 Signals & Systems

Due on Nov. 2, 2021, 12:00 PM

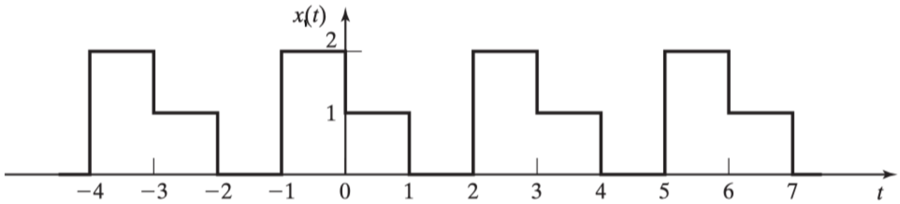
## Homework #1

1. Total mark is 100 points (= 20 points per problem $\times$ 5 problems)
2. Submission due by Nov. 2, 2021, noon, 12:00 PM.
   - We will accept late submission only until Nov 5, 2021.
   - Late submission penalty; -5 points per day
3. Online submission through Canvas
   - Scan or taking a photo of your anwser sheet, then upload to Canvas

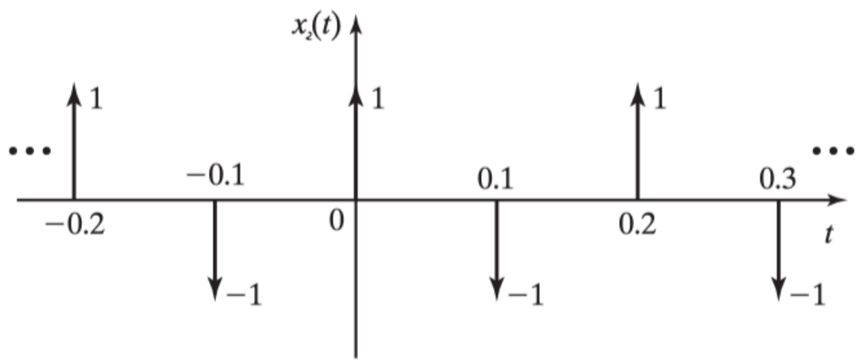
# Problem 1

Calculate the Fourier Series (FS) coefficients of the following signals in both complex exponential series and trigonometric series form.

a) $x_1(t)$ with period $T = 3$.




b) Modified impulse train $x_2(t)$ with period $T = 0.2$.



# Problem 2

a) For the given signal $x(t)$, find the fundamental frequency and the FS coefficients in the complex exponential form.

$$x(t) = \sum_{k=-\infty,\text{even k}}^{\infty} \left[u\left(t-k\right) - u\left(t-1-k\right)\right]$$

b) For the given FS coefficients, find the original signal $x(t)$ using synthesis formula.

$$w_0 = \pi, C_0 = 2, C_1 = 1, C_3 = \frac{1}{2}e^{\frac{j\pi}{4}}, C_{-3} = \frac{1}{2}e^{\frac{-j\pi}{4}}, \quad C_k = 0 \quad \text{for any other } k.$$

# Problem 3

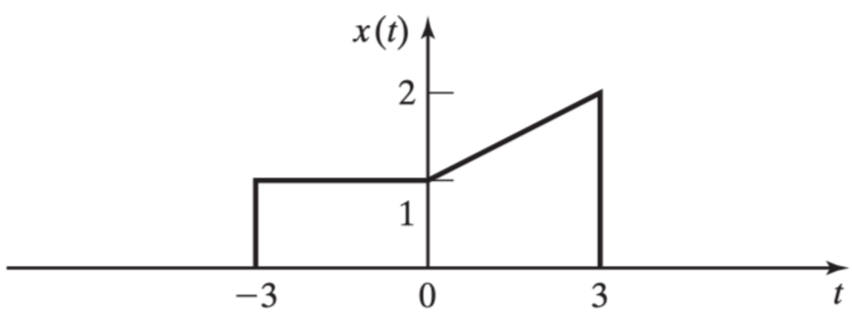
a) Sketch $x(2t-4)$, where $x(t)$ is defined as

$$x(t) = 4(t+2)u(t+2) - 4t\ u(t) - 4u(t-2) - 4(t-4)u(t-4) + 4(t-5)u(t-5).$$

b) Sketch $x(-2t-4)$, where $x(t)$ is defined as

$$x(t) = 5u(t+2) - u(t) + 3u(t-2) - 7u(t-4).$$

c) Plot the even and odd part of the following signal.



# Problem 4

Find the impulse response $h(t)$ of the following systems by substituting $x(t) = \delta(t)$ and determine whether the given system is causal or not.

a)

$$y(t) = x\,(t-7)$$

b)

$$y(t) = \int_{-\infty}^{t} x\,(\tau - 7)\, d\tau$$

c)

$$y(t) = \int_{-\infty}^{t} \left[ \int_{-\infty}^{\sigma} x\,(\tau - 7)\, d\tau \right] d\sigma$$

# Problem 5

Let us consider LTI systems with the following impulse responses $h(t)$. For each system, determine whether the system is causal or stable.

a)
$$h(t) = e^{t} u\left(-t\right)$$

b)
$$h(t) = e^{t} u\left(t\right)$$

c)
$$h(t) = e^{-t} u\left(t-1\right)$$

d)
$$h(t) = e^{(t-1)} u\left(t-1\right)$$

e)
$$h(t) = e^{t} u\left(1-t\right)$$

f)
$$h(t) = e^{t} u\left(-t\right) \sin\left(-5t\right)$$

g)
$$h(t) = e^{-t} u\left(t\right) \sin\left(5t\right)$$