



# Signals and Systems

## Assignment 1

Spring 2020

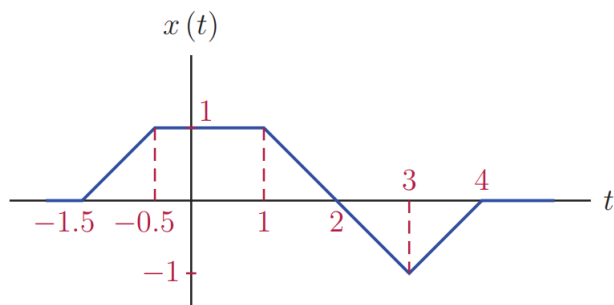
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### Question 1

For the signal  $x(t)$  shown in the figure, plot the following (step-by-step):

- (a)  $x(2t + 3)$
- (b)  $x(-2t)$
- (c)  $x(-3t - 4)$
- (d)  $x(\frac{t-1}{3})$



## Question 2

For each of the signals listed below, find the even and odd components  $Ev\{x(t)\}$  and  $Od\{x(t)\}$ .

(a)  $x(t) = e^{-5t} \cos(t) u(t)$

(b)  $x(t) = e^{-6|t|} \cos(t)$

(c)  $x(t) = \Pi(t - 3.5)$  (Solve by sketching) Hint:

$$\Pi(t) = \text{rect}(t) = \text{unit pulse} = u(t + 0.5) - u(t - 0.5)$$

### Question 3

Determine if each signal is periodic. If so, determine the fundamental period and the fundamental frequency.

(a)  $x(t) = \sin^2(4t - \frac{\pi}{4})$

(b)  $x(t) = e^{-2|t|} \sin(t)$

(c)  $x(t) = e^{3j(8t + \frac{\pi}{3})}$

(d)  $x(t) = \sin^3(5t)$

(e)  $x[n] = 3\sin(4\pi n)$

(f)  $x[n] = 3\sin(4n)$

(g)  $x[n] = e^{\frac{jn}{2}} + e^{\frac{jn}{3}}$

(h)  $x[n] = e^{\frac{jn\pi}{2}} + e^{\frac{jn\pi}{3}}$

(i)  $x[n] = \cos(\frac{\pi}{8}n^2)$

(j)  $x[n] = (-1)^n \cos(\frac{2\pi}{5}n)$

(k)  $x(t) = \sum_{n=-\infty}^{\infty} e^{-(2t-n)}$

## Question 4

Determine whether these systems are memoryless, causal, stable, time-invariant and linear. **Justify your answers! Answers without justifications are not accepted.**

Incorporate the following table (without any changes) in your answers. Fill in the table with zeros and ones.

	Memoryless	Causal	Stable	Time-Invariant	Linear
a					
b					
c					
d					
e					
f					
g					
h					

(a)  $y(t) = e^{x(t)}$

(b)  $y(t) = \cos(3t)x(t)$

(c)  $y(t) = \int_{-\infty}^{2t} x(\tau) d\tau$

(d)  $y(t) = \sin(x(t))$

(e)  $y[n] = x[4n + 1]$

(f)  $y[n] = (n - 2)x[n]$

(g)  $y[n] = x[n] \sum_{k=-\infty}^{\infty} \delta[n - (2k + 1)]$

(h)  $y[n] = \sum_{k=-\infty}^n x[k + 3]$

## Question 5

Determine whether the following systems are invertible. If so, find the invert system.

(a)  $y(t) = \frac{d}{dt}x(t)$

(b)  $y[n] = x[2n]$

(c)  $y(t) = x(2t)$

## Question 6

Determine the values of  $P_\infty$  and  $E_\infty$  for the following signals.

(a)  $x(t) = e^{-8t}u(t)$

(b)  $x(t) = e^{j(3t + \frac{\pi}{8})}$

(c)  $x[n] = \left(\frac{1}{3}\right)^n u[n]$

## Matlab Question 1

Using Matlab's *plot()* function, plot the following CT signals for  $t = -5$  to  $t = 5$  with 0.01 time steps.

(a)  $x(t) = e^{-4t}u(t)$

(b)  $x(t) = \cos(t)\left(u(t+2) - u(t-2)\right)$

## Matlab Question 2

Using Matlab's *stem()* function, plot the following DT signals for  $n = -20$  to  $n = 20$ .

(a)  $x[n] = 5\cos(3\pi n)$

(b)  $x[n] = 5\cos(3n)$

(c)  $x[n] = (\frac{1}{2})^n (u[n] - u[n - 10])$