

Department of Electronic and Telecommunication Engineering
University of Moratuwa
Sri Lanka
EN1020 CIRCUITS, SIGNALS, AND SYSTEMS: TUTORIAL 01

February 24, 2023

Flip along y axis

1. A continuous time signal is given in Figure 1. Sketch and label the following signals.

(a) $x(t-2)$ (b) $x(t+1)$ (c) $x(-t+1)$ (d) $x(3t/2)$ (e) $x(t/3)$

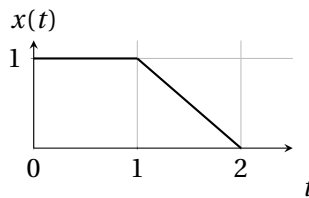
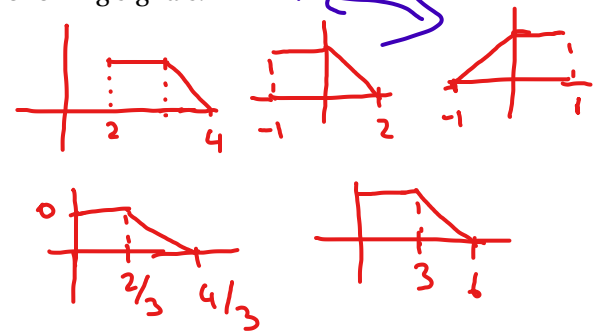


Figure 1:



2. A discrete time signal is shown in Figure 2. Sketch and label each of the following signals.

(a) $x[n+1]$ (b) $x[2n]$ (c) $x[-n]$ (d) $x[-n+2]$ (e) $x[-2n+1]$

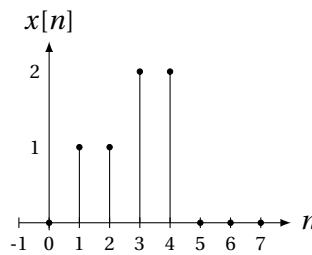
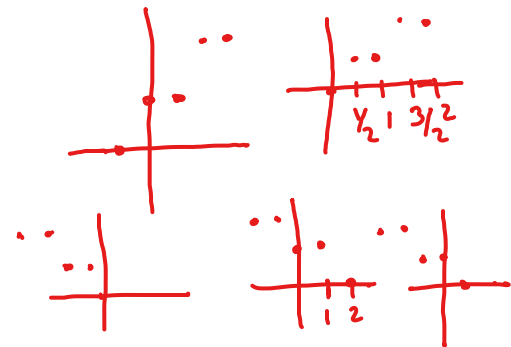


Figure 2:



3. Find the even and odd parts of the $x(t)$ signal given in Figure ??.

4. Using the discrete time signals $x_1[n]$ and $x_2[n]$ shown in Figure 4, represent each of the following signals by a graph.

(a) $y[n] = x_1[n] + x_2[n]$ (b) $y[n] = 2x_1[n]$ (c) $y[n] = x_1[n]x_2[n]$

5. Show that

$$\int_{-a}^a x(t) dt = \begin{cases} 2 \int_0^a x(t) dt, & \text{if } x(t) \text{ is even,} \\ 0, & \text{if } x(t) \text{ is odd.} \end{cases}$$

6. Show that the complex exponential signal $x(t) = e^{j\omega t}$ is periodic and that its fundamental period is $2\pi/\omega$.

e^{j\omega t} = cos(\omega t) + j sin(\omega t)

$u(t) = \cos(\omega t) + \sin(\omega t)$
 $u(t + 2\pi) = u(t)$ that
 $\therefore u(t)$ is periodic,
 $T_{\text{max}} = \frac{2\pi}{\omega}$

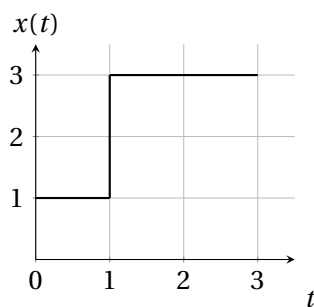


Figure 3:

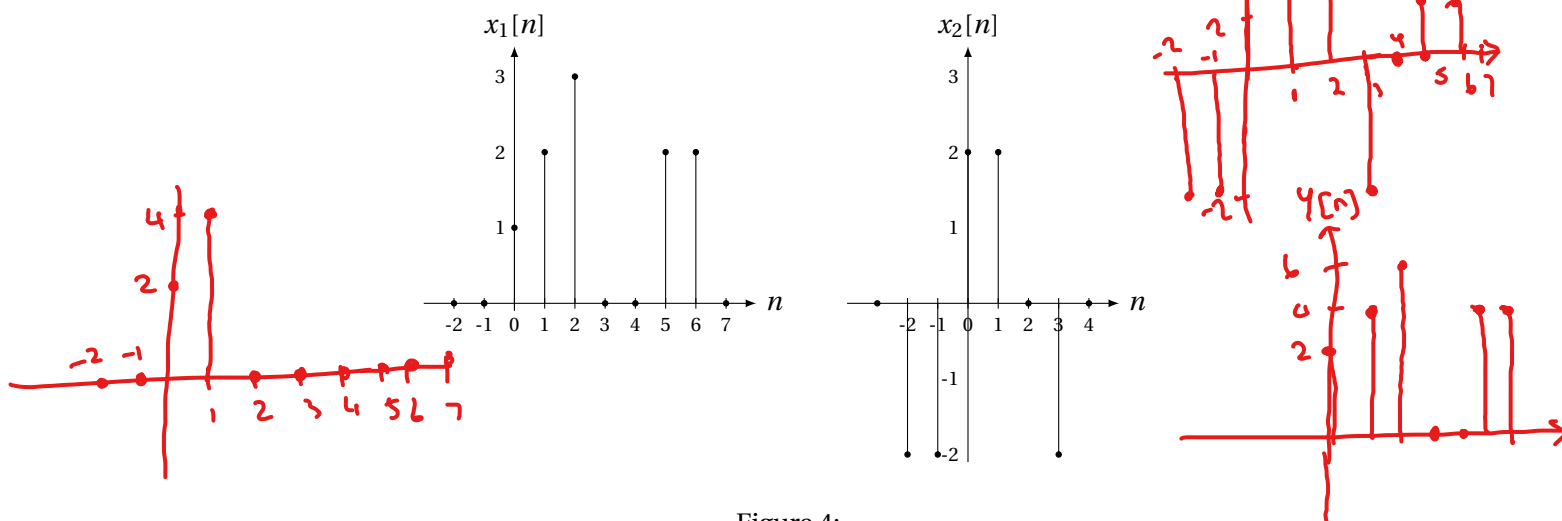


Figure 4:

7. Show that the complex exponential signal $x[n] = e^{j\omega n}$ is periodic only if $\omega/2\pi$ is a rational number.
8. Consider the sinusoidal signal $x(t) = \cos(15t)$.
 - (a) Find the value of sampling interval T such that $x[n]$ is a periodic sequence.
 - (b) Find the fundamental period of $x[n]$ if $T = 0.1\pi$ seconds.
9. Determine whether or not each of the following signals are periodic. If periodic, find the fundamental period.
 - (a) $x(t) = 2e^{j(t+\pi/4)}$ \checkmark
 - (b) $x[n] = e^{j(\pi/4)n}$ \checkmark
 - (c) $x(t) = \cos(t + \pi/4)$ \checkmark
 - (d) $x(t) = \cos(t) + \sin(\sqrt{2}t)$
 - (e) $x[n] = \cos^2(\pi n/8) = \frac{1}{2}(1 + \cos(\frac{\pi}{4}n)) \Rightarrow \checkmark$
10. Determine whether the following signals are energy signals, power signals, or neither.
 - (a) $x(t) = e^{-at}u(t), a > 0$ E
 - (b) $x(t) = A\cos(\omega t + \theta)$ P
 - (c) $x[n] = 3u[n]$ N
 - (d) $x[n] = 3e^{j3n}$ P