Department of Electronic and Telecommunication Engineering
University of Moratuwa
Sri Lanka

EN1020 CIRCUITS, SIGNALS, AND SYSTEMS: TUTORIAL 01

February 1, 2025

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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) $x(t/3)$

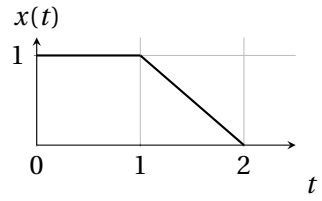

Figure 1:

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) $x[-2n+1]$

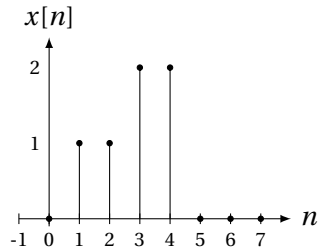

Figure 2:

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

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 $2\pi/\omega$.

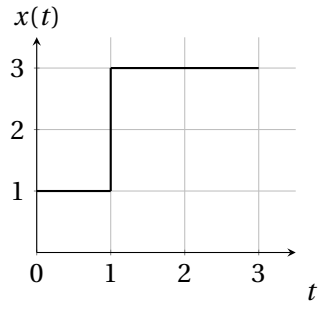

Figure 3:

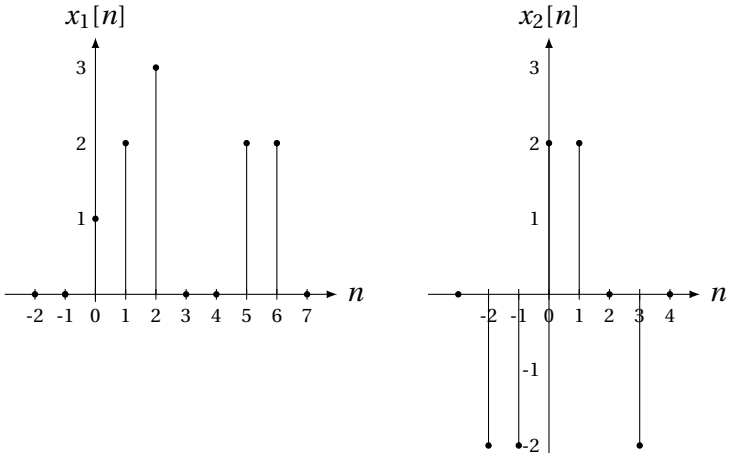

Figure 4:

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 than $x[n]$ 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) $x(t) = 2e^{j(t+\pi/4)}$

   (b) $x[n] = e^{j(\pi/4)n}$

   (c) $x(t) = \cos(t + \pi/4)$

   (d) $x(t) = \cos(t) + \sin(\sqrt{2}t)$

   (e) $x[n] = \cos^2(\pi n/8)$

10. Determine whether the following signals are energy signals, power signals, or neither.

    (a) $x(t) = e^{-at}u(t), a > 0$ (b) $x(t) = A\cos(\omega t + \theta)$ (c) $x[n] = 3u[n]$ (d) $x[n] = 3e^{j3n}$