ECE250: Signals and Systems

Practice Sheet 2

1. Let x[n] be a signal with x[n] = 0 for n < -3 and n > 3. Find the value of n for which the signal x[n + 4] is guaranteed to be zero. (CO1)

2. Check whether the following discrete-time signals are periodic or not. (CO1)

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

   (b) x[n]=$\cos(\frac{\pi}{6}n^2)$

   (c) x[n]= $\sin(\frac{4\pi}{7}n + 1)$

3. Find out the even and odd parts of the signal x[n] = $\delta[n]$. (CO1)

4. Determine whether or not each of the following signals is periodic. If the signal is periodic, specify the fundamental period. (C01)

   (a) x(t)= $e^{(1+j)t}$

   (b) x(t)= $2\cos(10t + 1) - \sin(4t - 1)$

   (c) x(t)= $\cos(2\pi t)u(t)$

   (d) x(t)= $\sin(\frac{2\pi}{3})t$

   where

   $u(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0. \end{cases}$

5. What is the fundamental frequency in rad/sec for a given Fig. 1? (CO1)

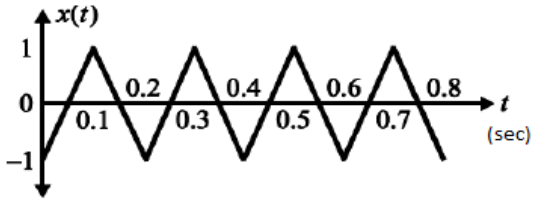

Fig. 1: Signal for Problem 5

6. The system described by the difference equation

$$y[n] - y[n-1] + y[n-2] = x[n] - x[n-1] \tag{1}$$

has $y[n] = 0$ for $n < 0$. If $x[n] = \delta[n]$, then $y[2]$ will be: (CO1,CO2)

7. Check whether the following systems are causal or not: (CO1,CO2)

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

   (b) $y(t) = x(1-t) + x(t-3)$

   (c) $y(n) = [\cos(3t)]x(t)$

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

8. Consider the signals x[n] and y[n] given in Fig. 2. Sketch and label the following signals: (CO1)

   (a) $x[4n]$

   (b) $x[4n+3]$

   (c) $x[n-2] + y[n+1]$

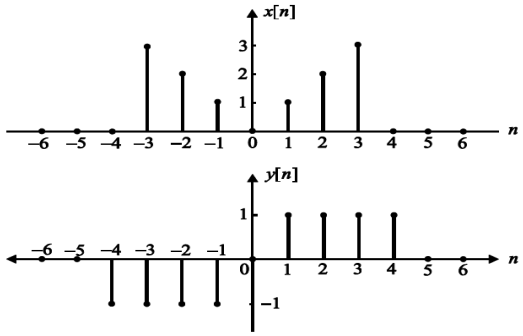

Fig. 2: Signal for Problem 8

9. In this chapter, we introduced a number of general properties of systems. In particular, a system may or may not be

   - Memoryless
   - Time Invariant
   - Linear
   - Causal
   - Stable

   Determine which of the properties hold and which do not hold for each of the following continuous-time systems. justify your answer. y(t) is the system output, and x(t) is the system input. (C02)

(a) $y(t) = \begin{cases} 0, & t < 0 \\ x(t) + x(t-3), & t \geq 0. \end{cases}$

(b) $y(t) = x(t/5)$

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

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

(e) $y(t) = \frac{dx(t)}{dt}$

10. Same as above question, Determine which of the properties hold and which do not hold for each of the following discrete-time systems. justify your answer. y[n] is the system output, and x[n] is the system input. (C02)

(a) $y[n] = x[-n]$

(b) $y[n] = x[n-1] - 4x[n-5]$

(c) $y[n] = nx[n]$

(d) $y[n] = x[2n+1]$

(e) $y[n] = \begin{cases} x[n], & n \geq 1 \\ 0, & n = 0, \\ x[n], & n \leq -1. \end{cases}$

11. Consider a continuous-time signal

$$x(t) = \delta(t+2) - \delta(t-2) \tag{2}$$

calculate the value of E_∞ for the signal (C01)

$$y(t) = \int_{-\infty}^{t} x(\tau) d\tau \tag{3}$$

12. A discrete-time system with an input $x[n]$ and output $y[n]$ is governed by following difference equation $y[n] + 4y[n-1] = x[n] + x^2[n]$ Check the stability and linearity properties of the system. (CO2)