

# Introduction to DSP: Systems & LTI Systems - Tutorial

1. Consider the following discrete-time signal,

$$x[n] = \begin{cases} -2, & n = -2 \\ 0, & n = -1 \\ 1, & n = 0 \\ 3, & n = 1 \\ -1, & n = 2 \\ 1, & n = 3 \\ 0, & \text{Otherwise} \end{cases}$$

Compute the following signals.

(a)  $x[-n] = 1$

(b)  $x[n+3] = 1$

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

(d)  $x[-n-2]$

2. Find if the following systems satisfy the properties of linearity, time-invariance, causality, and stability. Compute the impulse response of the systems that are linear and time-invariant.

(a)  $y[n] = \sum_{k=0}^{\infty} x[n-k]$

(b)  $y[n] = \sum_{k=-3}^2 x[n+k] \cdot x[n-k]$

(c)  $y[n] = y[n-1] + 0.1 \cdot x[n]$

(d)  $y[n] = n \cdot x[n] + (n-1) \cdot x[n-1]$

3. Compute of the output an LTI system with the following impulse response

$$h[n] = \begin{cases} 0, & n < 0 \\ 3, & n = 0 \\ 2, & n = 1 \\ 1, & n = 2 \\ 0, & n > 2 \end{cases}$$

(a)  $x[n] = \delta[n] + \delta[n - 3]$

(b)  $x[n] = u[n]$

(c)  $x[n] = \sin(0.5\pi n) u[n]$

(d)  $x[n] = 1, \forall n$

(e)  $x[n] = (0.5)^n, \forall n$



(f)  $x[n] = (0.5)^n u[n], \forall n$