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Topics: Discrete-time LTI systems

1. A discrete-time signal $x[n]$ is shown in Fig 1. Sketch and label carefully each of the following signals :

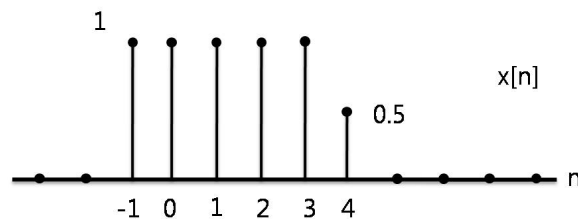


Figure 1:

- $x[n - 2]$
 - $x[4 - n]$
 - $x[2n]$
 - $x[n]u[2 - n]$
 - $x[n - 1]\delta[n - 3]$
2. For each of the following systems, determine whether the system is (1) stable, (2) causal, (3) linear, and (4) time invariant.
- $T(x[n]) = (\cos \pi n)x[n]$
 - $T(x[n]) = x[n^2]$
 - $T(x[n]) = x[n] \sum_{k=0}^{\infty} \delta[n - k]$
 - $T(x[n]) = \sum_{k=n-1}^{\infty} x[k]$
3. The impulse response of a linear time-invariant system is shown in Fig 2. Determine and carefully sketch the response of this system to the input $x[n] = u[n - 4]$.
4. Determine which of the following signals is periodic. If a signal is periodic, determine its period.
- $x[n] = e^{j(2\pi n/5)}$
 - $x[n] = \sin(\pi n/19)$
 - $x[n] = ne^{j\pi n}$
 - $x[n] = e^{jn}$

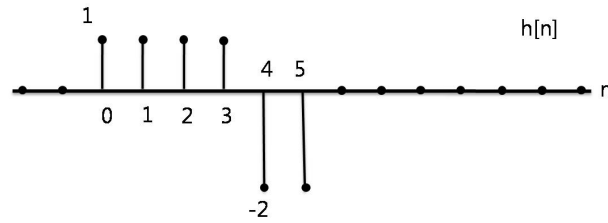


Figure 2: prob.1

5. The system L in Fig 3 is known to be linear. Shown are three output signals $y_1[n]$, $y_2[n]$, and $y_3[n]$ in response to the input signals $x_1[n]$, $x_2[n]$, and $x_3[n]$, respectively.

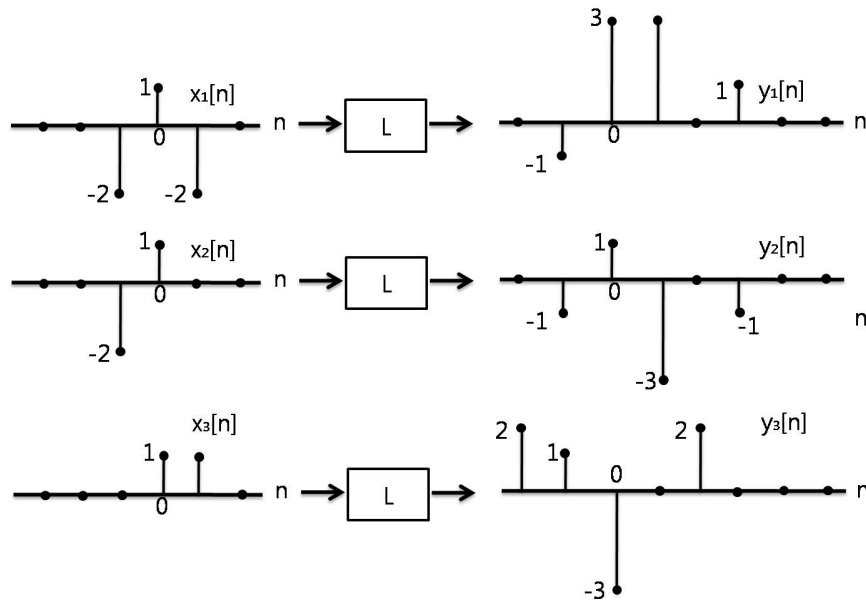


Figure 3: prob.3

- (a) Determine whether the system L could be time invariant.
 - (b) If the input $x[n]$ to the system L is $\delta[n]$, what is the system response $y[n]$?
6. The signals $x[n]$ and $y[n]$ shown in Fig 4. are the input and corresponding output for a causal LTI system.
- (a) Find the response of the system to the sequence $x_2[n]$ in Fig 5.
 - (b) Find the impulse response $h[n]$ for this LTI system.

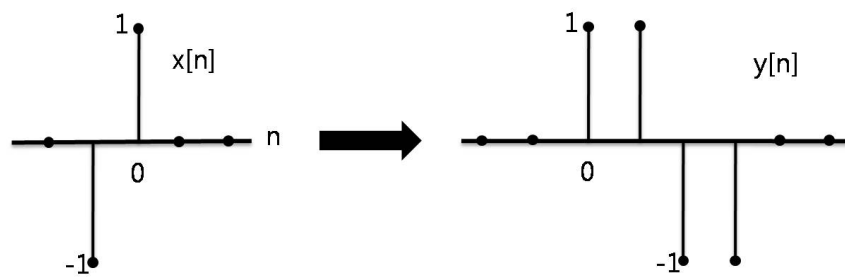


Figure 4:

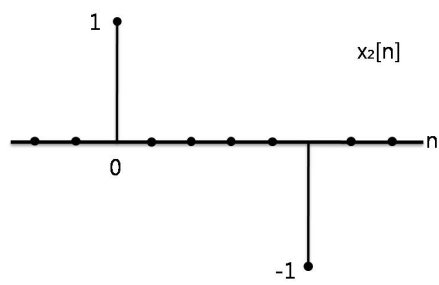


Figure 5: