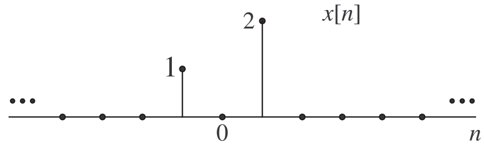
## ENEE 222: 12/03 Class

**Material:** Lecture videos **24.1**, **24.2**

**1** The finite-duration sequence $x[\cdot]$ shown below is the input to a linear time-invariant filter with impulse response $h[\cdot]$.




Which of the following equations describes the filter output?

A. $y[n] = 2\delta[n+1] + \delta[n-1]$

B. $y[n] = 2\delta[n-1] + \delta[n+1]$

C. $y[n] = 2h[n+1] + h[n-1]$

D. $y[n] = 2h[n-1] + h[n+1]$

**2** If the impulse response of a FIR filter is given by

$$h[n] = 3\delta[n] - \delta[n-2] + \delta[n-3] - 3\delta[n-5] ,$$

which of the following is the filter's coefficient vector?

A. $\mathbf{b} = [3 \quad -1 \quad 1 \quad -3]^T$

B. $\mathbf{b} = [-3 \quad 1 \quad -1 \quad 3]^T$

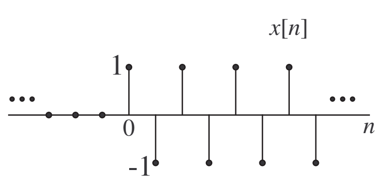
C. $\mathbf{b} = [3 \quad 0 \quad -1 \quad 1 \quad 0 \quad -3]^T$

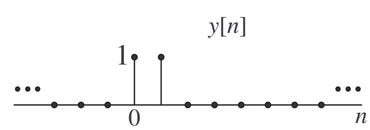
D. $\mathbf{b} = [-3 \quad 0 \quad 1 \quad -1 \quad 0 \quad 3]^T$

**3** You are given the following input-output pair for a linear-time invariant system:

$$x[n] = \begin{cases} 0, & n < 0 \\ (-1)^n, & n \geq 0 \end{cases} \qquad \Longrightarrow \qquad y[n] = \delta[n] + \delta[n-1] ,$$

as depicted below.




The system's impulse response is given (for all $n$) by

A. $h[n] = (-1)^n$

B. $h[n] = \delta[n] + \delta[n-1]$

C. $h[n] = \delta[n] + 2\delta[n-1] + \delta[n-2]$

D. $h[n] = \delta[n] - \delta[n-2]$

**4** Let $\mathbf{h}$ be the impulse response of a FIR filter, and $\mathbf{x}$ denote the filter input sequence. In which (one or more) of the following cases is it true that

$$\mathbf{h} * \mathbf{x} \;=\; \lambda \mathbf{x}\ ,$$

where $\lambda$ is a scaling constant?

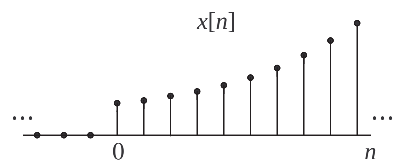
A. $\mathbf{h}$ is arbitrary; $x[n] \;=\; 3^n$ for all $n$

B. $\mathbf{h}$ is arbitrary; $x[n] \;=\; \cos(\pi n/6)$ for all $n$

C. $\mathbf{h}$ is arbitrary; $x[\,\cdot\,] \;=\; \delta[\,\cdot\,]$

D. $h[\,\cdot\,] \;=\; \delta[\,\cdot - 5]$; $\mathbf{x}$ is periodic with period $L = 5$

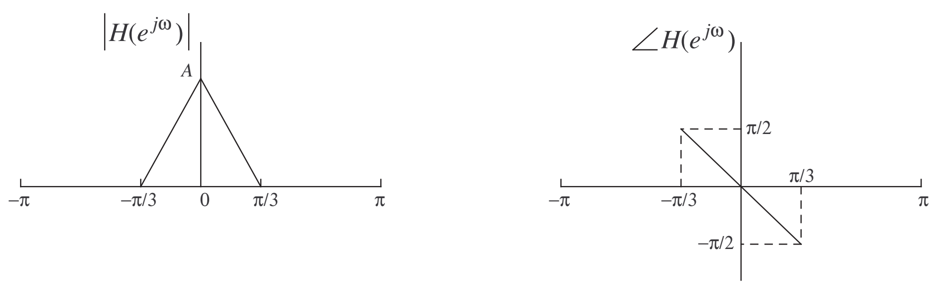
**5** Let $x[n] = 0$ for $n < 0$; and $x[n] = a^n$ for $n \geq 0$.




If $x[\,\cdot\,]$ is the input to a FIR filter of order $M = 5$, whose system function is given by $H(z)$, what is the smallest time index $n_0$ such that $y[n] = H(a)a^n$ for all $n \geq n_0$?

A. 0 B. 4 C. 5 D. 6

**6** A linear time-invariant system has frequency response $H(e^{j\omega})$ as depicted below.




Which (one or more) of the following statements regarding the system input $x[\,\cdot\,]$ and output $y[\,\cdot\,]$ are true?

A. If $x[\,\cdot\,] \;=\; \delta[\,\cdot\,]$, then $y[\,\cdot\,]$ has finite duration.

B. If, for all $n$, $x[n] \;=\; \cos(\omega_0 n)$, where $0 \leq \omega_0 \leq \pi/3$, then

$$(\forall n) \qquad y[n] \;=\; A\left(1 - \frac{3\omega_0}{\pi}\right)\cos\left(\omega_0\left(n - \frac{3}{2}\right)\right)$$

C. If, for all $n$, $x[n] \;=\; \cos(\omega_0 n)$, where $\pi/3 < \omega_0 \leq \pi$, then $y[n] \;=\; 0$ (for all $n$ also).

D. If $x[\,\cdot\,]$ is periodic with period $L = 5$, then $y[\,\cdot\,]$ is constant in time.