**ENEE 222: 5/09 Class**

**Material:** Lecture videos *23.2*, **24.1**, **24.2**

**1.** Let $\mathbf{b}$ and $\mathbf{s}$ be arbitrary vectors of length 6 and 9, respectively. If $\mathbf{0}_i$ denotes a vector of $i$ zeros, which of the following circular convolutions produces the vector

$$[\mathbf{b} * \mathbf{s}\,;\, \mathbf{0}_2] \;?$$

A. $[\mathbf{b}\,;\, \mathbf{0}_8] \circledast [\mathbf{s}\,;\, \mathbf{0}_5]$

B. $[\mathbf{b}\,;\, \mathbf{0}_9] \circledast [\mathbf{s}\,;\, \mathbf{0}_6]$

C. $[\mathbf{b}\,;\, \mathbf{0}_{10}] \circledast [\mathbf{s}\,;\, \mathbf{0}_7]$

D. $[\mathbf{b}\,;\, \mathbf{0}_{11}] \circledast [\mathbf{s}\,;\, \mathbf{0}_8]$

**2.** Which (one or more) of the following signal sequences can be determined by *circularly* convolving two vectors of the same (finite) length?

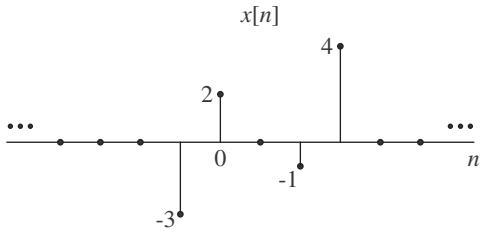
A. The response of a FIR filter to any input sequence of finite duration.

B. The response of a FIR filter to any input sequence of infinite duration.

C. The response of a FIR filter to any periodic input sequence.

D. The impulse response of the cascade connection of any two FIR filters.

**3.** Consider the finite-duration sequence $x[\,\cdot\,]$ plotted below.




Which of the following equations describes $x[n]$?

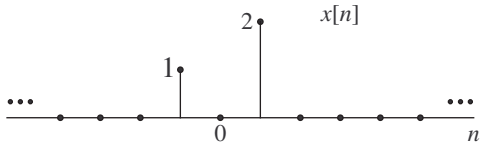
A. $x[n] = -3\delta[n+1] + 2\delta[n] - \delta[n-1] + 4\delta[n-2]$

B. $x[n] = -3\delta[n+1] + 2\delta[n] - \delta[n-2] + 4\delta[n-3]$

C. $x[n] = -3\delta[n-1] + 2\delta[n] - \delta[n+1] + 4\delta[n+2]$

D. $x[n] = -3\delta[n-1] + 2\delta[n] - \delta[n+2] + 4\delta[n+3]$

**4.** 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. $y[n] \;=\; 2h[n-1] + h[n+1]$

**5.** When the input

$$x[0:4] \;=\; [\;1\quad -3\quad 4\quad -1\quad 2\;]^T\;; \qquad x[n] \;=\; 0 \;\text{ for all other } n$$

is applied to a FIR filter, the output is given by

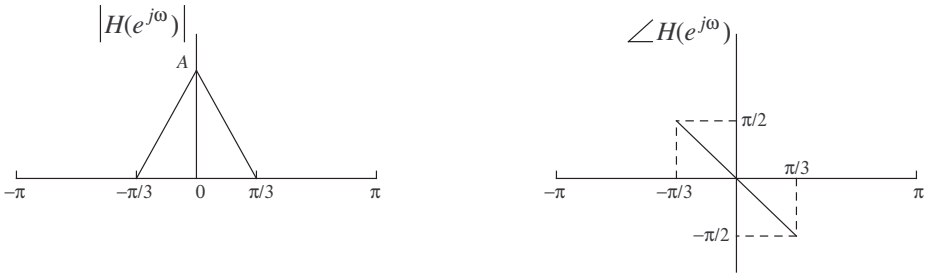
$$y[0:7] \;=\; \mathbf{c}\;; \qquad y[n] \;=\; 0 \;\text{ for all other } n$$

If the input

$$\tilde{x}[0:8] \;=\; [\;1\quad -3\quad 4\quad -1\quad 0\quad 6\quad -8\quad 2\quad -4\;]^T\;; \qquad \tilde{x}[n] \;=\; 0 \;\text{ for all other } n$$

is applied to the same filter, determine the output $\tilde{y}[\,\cdot\,]$.

**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 $y[\,\cdot\,]$ is 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 $0 \le \omega_0 \le \pi/3$, then

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

C. If, for all $n$, $x[n] \;=\; \cos(\omega_0 n)$, where $\pi/3 < \omega_0 \le \pi$, 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.