**Material:** Lecture videos **21.1**, **21.2**

**1** Consider the FIR filter with input-output relationship

$$y[n] \;=\; x[n] - 3x[n-1] + 4x[n-2] - 3x[n-3] + x[n-4]$$

Its complex frequency response is given by

A. $H(e^{j\omega}) \;=\; e^{j2\omega}(4 - 3\cos\omega + \cos 2\omega)$

B. $H(e^{j\omega}) \;=\; e^{j2\omega}(4 - 6\cos\omega + 2\cos 2\omega)$

C. $H(e^{j\omega}) \;=\; e^{-j2\omega}(4 - 3\cos\omega + \cos 2\omega)$

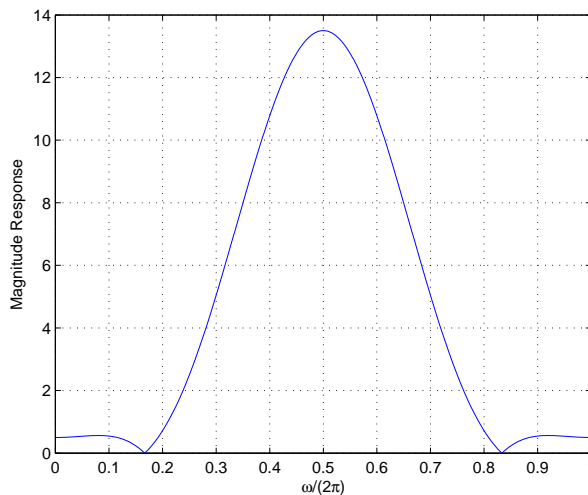D. $H(e^{j\omega}) \;=\; e^{-j2\omega}(4 - 6\cos\omega + 2\cos 2\omega)$

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

$$H(e^{j\omega}) \;=\; je^{-j3\omega/2}\left(6\sin(\omega/2) - 2\sin(3\omega/2)\right) \;,$$

then its input-output relationship is

A. $y[n] \;=\; x[n] - 3x[n-1] + 3x[n-2] - x[n-3]$

B. $y[n] \;=\; 2x[n] - 6x[n-1] + 6x[n-2] - 2x[n-3]$

C. $y[n] \;=\; -x[n] + 3x[n-1] - 3x[n-2] + x[n-3]$

D. $y[n] \;=\; -2x[n] + 6x[n-1] - 6x[n-2] + 2x[n-3]$

**3** The magnitude response $|H(e^{j\omega})|$ of a FIR filter is plotted below.



For one of the following values of $\omega$, the input sequence

$$x[n] \;=\; A\cos\omega n \;, \qquad n \in \mathbf{Z}$$

produces an output sequence which is the same regardless of the choice of $A$. What is that value of $\omega$?

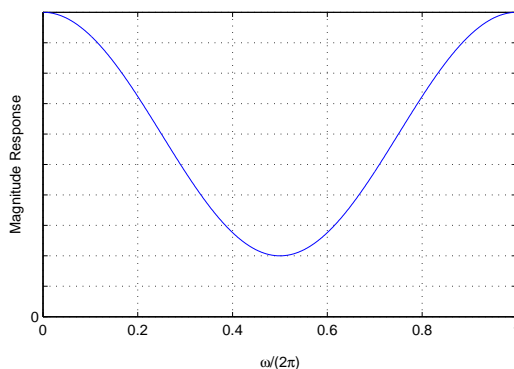A. $\pi/6$        B. $\pi/3$        C. $\pi/2$        D. $2\pi/3$

**4** The complex frequency response of a FIR filter is such that $H(e^{j\omega_0}) = \sqrt{3} - j$. If the filter input sequence is

$$x[n] = \cos \omega_0 n , \qquad n \in \mathbb{Z} ,$$

which of the following equations describes the output for all time indices $n$?

A. $y[n] = \sqrt{3} e^{-j\omega_0 n}$

B. $y[n] = 2\cos(\omega_0 n - \pi/6)$

C. $y[n] = 2\cos(\omega_0 n - \pi/3)$
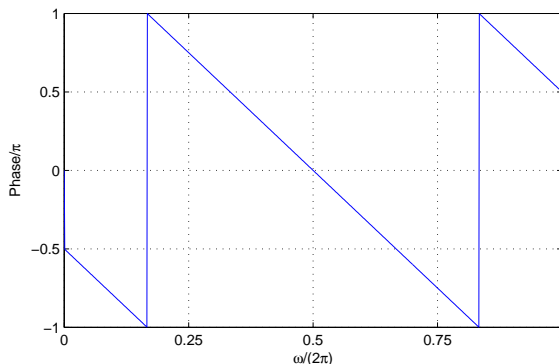
D. $y[n] = 2\cos(\omega_0 n + \pi/3)$

**5** The magnitude response $|H(e^{j\omega})|$ of a FIR filter is plotted below.



Which (only one) of the following input-output relationships is consistent with the given plot?

A. $y[n] = x[n] + x[n-2]$

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

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

D. $y[n] = x[n] + 3x[n-1] + x[n-2]$

**6** The phase response $\angle H(e^{j\omega})$ of a FIR filter is plotted below



Which of the following input-output relationships $(a, b \neq 0)$ is consistent with the given plot?

A. $y[n] = x[n] + ax[n-1] + ax[n-2] + x[n-3]$

B. $y[n] = x[n] + ax[n-1] + bx[n-2] + ax[n-3] + x[n-4]$

C. $y[n] = x[n] + ax[n-1] - ax[n-2] - x[n-3]$

D. $y[n] = x[n] + ax[n-1] - ax[n-3] - x[n-4]$