ENEE 222: 4/30 Class

Material: Lecture videos **20.1**, **20.2**

1. Consider a filter with input-output relationship

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

If the input sequence is given by

$$x[n] \;=\; 2^{-n}\,, \qquad n \in \mathbf{Z}$$

which of the following equations describes the output for all n?

A. $y[n] \;=\; 3 \cdot 2^{-n}$

B. $y[n] \;=\; 3 \cdot 2^{-n+4}$

C. $y[n] \;=\; 3 \cdot 2^{-n-4}$

D. $y[n] \;=\; 0$

2. The (complex) frequency response of the filter in item **1** above is given by

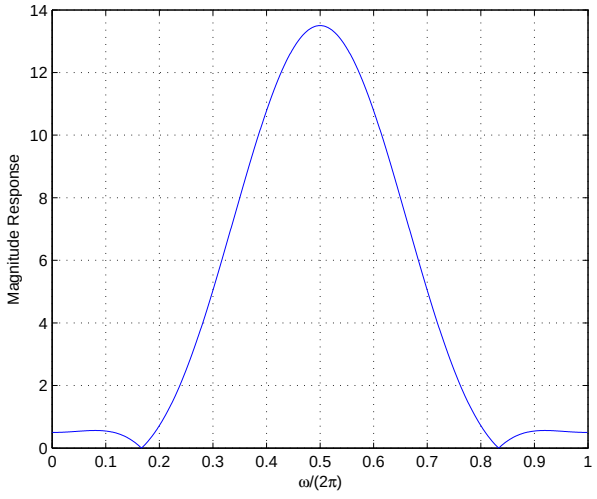
A. $H(e^{j\omega}) \;=\; e^{j2\omega}(4 - 3\cos\omega + \cos 2\omega)$

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

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



For one of the following values of ω, the input sequence

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

produces the same output sequence regardless of the choice of A. What is that value of ω?

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

4. (HW 25 ⊃ i) In what follows (including items **5** and **6**), consider the FIR filter given by

$$y[n] \;=\; x[n] + \sqrt{3}x[n-1] - \sqrt{3}x[n-3] - x[n-4] \;, \qquad n \in \mathbf{Z}$$

Determine the filter output sequence $y[\,\cdot\,]$ when the input is given by $x[n] = a^n$ at all times n.

5. (HW 25 iii) Express the filter's complex frequency response in the form

$$H(e^{j\omega}) = je^{-j(\omega M/2)}F(\omega) \;,$$

where $F(\omega)$ is a real-valued sum of sines.

6. (HW 25 ii) In MATLAB, compute and plot the magnitude and phase response of the filter at 1024 equally spaced frequencies in $[0, 2\pi)$.