

ASSIGNED: Mar. 05, 2015. **READ:** Sects. 5.4-5.6. All of Chap. 7.

DUE DATE: Mar. 12, 2015. **TOPICS:** Frequency response.

Please **box** your answers. Show your work. Turn in all Matlab plots and Matlab code.

- [20] 1. We are given that $3+4\cos(\frac{\pi}{2}n + \frac{\pi}{4}) \rightarrow [y[n] + y[n-1] = x[n] - x[n-1]] \rightarrow y[n]$.
- [10] (a) Compute the frequency response $H(e^{j\omega})$. [10] (b) Compute the output $y[n]$.
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- [20] 2. Designing MA and ARMA filters for rejecting two interfering sinusoids:
- [10] (a) Design a filter $x[n] \rightarrow [y[n] = x[n] + ax[n-1] + bx[n-2] + ax[n-3] + x[n-4]] \rightarrow y[n]$ that rejects sinusoids of frequencies 100 and 500 Hertz in a DSP system at $1200 \frac{\text{SAMPLE}}{\text{SECOND}}$.
- [10] (b) Use $y[n] + cy[n-1] + dy[n-2] + ey[n-3] + fy[n-4] = x[n] + ax[n-1] + bx[n-2] + ax[n-3] + x[n-4]$. Design a more selective filter that rejects sinusoids of frequencies 100 and 500 Hz.
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- [20] 3. Given $y[n] = 0.5x[n] + 0.29(x[n+1] + x[n-1]) - 0.042(x[n+3] + x[n-3]) + 0.005(x[n+5] + x[n-5])$.
- [10] (a) Compute an expression for $H(e^{j\omega})$. Express as a sum of 3 cosines and a constant.
- [05] (b) Plot the gain $|H(e^{j\omega})|$ at the points $\omega = \frac{2\pi k}{200}, 0 \leq k \leq 99$. Turn in this plot.
- [05] (c) Describe in words what this system does to a signal $x[n]$.
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- [20] 4. Download `p6.mat`. In Matlab, type `>>load p6.mat` to get sampled signals `X1,X2`.
- [05] (a) Listen to `X1` using `sound(X1,24000)`. Describe it.
- [05] (b) Plot the spectrum of `X1` using the Matlab command from problem set #1. Compare to the spectrum plot from problem set #1. Note the vertical scale.
- [10] (c) Design an ARMA notch filter that eliminates the sinusoidal interference. Give the Matlab command using `filter` that implements it.
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- [20] 5. Download `p6.mat`. In Matlab, type `>>load p6.mat` to get sampled signals `X1,X2`.
- [05] (a) Listen to `X2` using `sound(X2,24000)`. Describe it.
- [05] (b) Plot the spectrum of `X2` using the Matlab command from problem set #1. Compare to the spectrum plot from problem set #1. Note the vertical scale.
- [10] (c) Design an ARMA comb filter that eliminates the periodic interference. This filter should actually be simpler than the ARMA notch filter used in #4. Give the Matlab command using `filter` that implements it.

“Football embodies the worst of America—violence punctuated by committee meetings”—George Will
