ASSIGNED: Mar. 07, 2013. **READ:** Sects. 5.4-5.6. All of Chap. 7.
DUE DATE: Mar. 14, 2013. **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+4cos($\frac{\pi}{2}n + \frac{\pi}{4}$) →$\boxed{y[n] + y[n-1] = x[n] - x[n-1]}$→y[n].

[10] (a) Compute the frequency response $H(e^{j\omega})$. [10] (b) Compute the output y[n].

[20] 2. Designing MA and ARMA filters for rejecting two interfering sinusoids:

[10] (a) Design a filter x[n]→$\boxed{y[n] = x[n] + ax[n-1] + bx[n-2] + ax[n-3] + x[n-4]}$→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.

[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 $\omega = \frac{2\pi k}{200}, 0 \le k \le 99$. Turn in this plot.
[05] (c) Describe in words what this system does to a signal x[n].

[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.

[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