**ASSIGNED:** Mar. 14, 2013. **READ:** Sects. 8.1 & 8.2.1-8.2.3.
**DUE DATE:** Mar. 21, 2013. **TOPICS:** Discrete Fourier Transform (DFT).

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

[40] 1. Compute the circular (or cyclic) convolution $\{1,2,3,1\}$Ⓒ$\{4,3,2,2\}$:
- [10] (a) Directly by computing linear convolution and aliasing (or another method).
- [30] (b) By multiplying their 4-point DFTs ([10] each), and a 4-point inverse DFT ([10]).

[20] 2. Let x[n]=$\{\underline{1},1,1,1,1,1\}$. Do the following in order:
- [5] (a) Compute the z-transform X(z). Substitute $z = e^{j2\pi k/4}$ in X(z) to get $X_k$.
- [5] (b) Simplify $X_k$ using $e^{j2\pi 4/4}$=1. $X_k$ should be periodic with period=4.
- [5] (c) Compute the 4-point inverse DFT of $X_k$. Call this $x_{\rm NEW}[n]$.
- [5] (d) Show how to compute $x_{\rm NEW}[n]$ *directly* from x[n]. HINT: Aliasing.

The result of this problem will be useful in deriving the Fast Fourier Transform (FFT).

[20] 3. Download `p7.mat`. In Matlab, type >>`load p7.mat` to get sampled signals `X1,X2,X3,H`.

`X1` was sampled at $1000\frac{\rm SAMPLE}{\rm SECOND}$. Compute an explicit expression for it in terms of a sum of four sinusoids with amplitudes and phase shifts. Use `fft` and show your work.

[10] 4. Download `p7.mat`. In Matlab, type >>`load p7.mat` to get sampled signals `X1,X2,X3,H`.

`X2` is the noisy signal from #5 of problem set #2 you filtered with a lowpass filter. Now *eliminate* the noise using `FX2=fft(X2)` and setting some of `FX2` to zero. Specify the exact Matlab commands you used. Don't forget to use `real(ifft())`.

[10] 5. Download `p7.mat`. In Matlab, type >>`load p7.mat` to get sampled signals `X1,X2,X3,H`.

`X3` is the convolution of some signal with the impulse response `H`. Use `fft` and `real(ifft())` to *deconvolve* `H` from `X3`. *Don't* use `deconv`. Describe the deconvolved signal (no, it's *not* "Matlab–Breakfast of Champions").

"A cynic is someone who, when he smells roses, looks around for a coffin"–Oscar Wilde.