
ASSIGNED: Mar. 12, 2015. **READ:** Sects. 8.1 & 8.2.1-8.2.3.

DUE DATE: Mar. 19, 2015. **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 $\{1, 2, 3, 1\} \circledast \{4, 3, 2, 2\}$:
- [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]).
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- [20] 2. Let $x[n] = \{1, 1, 1, 1, 1, 1\}$. 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 $x_{\text{NEW}}[n]$.
- [5] (d) Show how to compute $x_{\text{NEW}}[n]$ *directly* from $x[n]$. HINT: Aliasing.
- The result of this problem will be useful in deriving the Fast Fourier Transform (FFT).
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- [20] 3. Download `p7.mat`. In Matlab, type `>>load p7.mat` to get sampled signals `X1,X2,X3,H`.
- `X1` was sampled at $1000 \frac{\text{SAMPLE}}{\text{SECOND}}$. 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.
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- [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())`.
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- [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").
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- "A cynic is someone who, when he smells roses, looks around for a coffin"—Oscar Wilde.
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