Homework #9, EECS 206,Fall 2003. Due **Friday November 21**

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- Reading: Text Ch. 6.
- Relevant practice problems on the DSP CDROM: 6.2, 6.9-6.26, 6.29, 6.30, 6.34

Skill Problems

1. [0] Text 6.1. Concept(s): ***response of FIR filter to complex exponential***

   The answer is $y[n] = 1.176e^{-\jmath\,0.63}e^{\jmath\,0.4\pi n}$.

2. [0] Text 6.2. Concept(s): ***response of squaring system to complex exponential***

   The answer is $y[n] = A^2 e^{\jmath\,2\phi} e^{\jmath\,2\hat{\omega}n}$. This is *not* of the form $\mathcal{H}(\hat{\omega})\,Ae^{\jmath\,\phi}e^{\jmath\,\hat{\omega}n}$.
   (The nonlinearity changed the frequency.)

3. [25] Text 6.4. Concept(s): ***frequency response of FIR filter***

4. [20] Text 6.6. Concept(s): ***frequency response and steady-state response of FIR filter***

5. [15] Text 6.9. Concept(s): ***difference equation from frequency response*** ***(DSP FIRST: #6.8)***

6. [10] Text 6.13b. Concept(s): ***frequency response of cascade of LTI systems*** ***(DSP FIRST: #6.12b)***

7. [10] By factoring, find the coefficients of two first-order FIR filters so that, when cascaded, they yield the following overall frequency response:

   $$\mathcal{H}(\hat{\omega}) = 2 - 5e^{-\jmath\,\hat{\omega}} + 3e^{-\jmath\,2\hat{\omega}}.$$

8. [20] Consider the cascade system

   $$x[n] \to \boxed{h_1[n]} \to \boxed{\mathcal{H}_2(\hat{\omega})} \to y[n]\,,$$

   where $h_1[n] = \delta[n] - \delta[n-1] + \delta[n-3]$ and $\mathcal{H}_2(\hat{\omega}) = 1 + 2e^{-\jmath\,\hat{\omega}} + e^{-\jmath\,2\hat{\omega}}$.

   (a) [5] Determine the overall frequency response $\mathcal{H}(\hat{\omega})$ of this system. Simplify your answer as much as possible.

   (b) [5] Determine and plot the overall impulse response $h[n]$ of this system.

   (c) [5] Determine the difference equation for this system.

   (d) [5] Determine the steady-state response of this system to a unit step function input.

9. [5] Text 6.21a. Concept(s):***sinusoidal response from frequency response*** ***(DSP FIRST: #6.20a)***

10. [10] The 6-periodic signal $x[n]$ having 6-point DFT given by $X[k] = [2,\ 0,\ \jmath,\ 3,\ -\jmath,\ 0]$ for $k = 0, 1, \ldots, 5$ is the input to a FIR filter with frequency response $\mathcal{H}(\hat{\omega}) = 2 - e^{-\jmath\,\hat{\omega}}$. Determine the output signal $y[n]$.

No Mastery Problems