

Homework #8, EECS 206, Fall 2002. Due **Fri. Nov. 15**, by 4:30PM

## Notes

- Review the HW policies on HW1!
- **Final Exam:** Mon., Dec 16, 4-6 PM, in Chem. 1800.  
An alternate time (earlier that day or perhaps the following day) will be determined soon and a web-based signup will be available for those with conflicts.
- **Quiz 4** will be Nov. 12-14. It covers up through Lab 5.
- Reading: Text Ch. 6.
- Relevant practice problems on the DSP CD: 6.2, 6.9-6.26, 6.29, 6.30, 6.34

## Skills and Concepts

- filters, convolution, frequency response

## Problems

1. [25] Text 5.11. (cascade of LTI FIR systems)  
(d) [10 pts] Determine the output signal  $y[n]$  when the input signal is  $x[n] = u[n - 3]$ , where  $u[n]$  denotes the unit step function.
2. [0] Text 6.1. (response of FIR filter to complex exponential)
3. [0] Text 6.2. (response of squaring system to complex exponential)
4. [25] Text 6.4. (frequency response of FIR filter)
5. [20] Text 6.6. (frequency response and steady-state response of FIR filter)
6. [15] Text 6.8. (difference equation from frequency response)
7. [10] By factoring, find the coefficients of two first-order FIR filters so that, when cascaded, they yield the following overall frequency response:
 
$$\mathcal{H}(\hat{\omega}) = 2 - 5e^{-j\hat{\omega}} + 3e^{-j2\hat{\omega}}.$$
8. [20] Consider the cascade system
 
$$x[n] \rightarrow \boxed{h_1[n]} \rightarrow \boxed{\mathcal{H}_2(\hat{\omega})} \rightarrow y[n],$$
 where  $h_1[n] = \delta[n] - \delta[n - 1] + \delta[n - 3]$  and  $\mathcal{H}_2(\hat{\omega}) = 1 + 2e^{-j\hat{\omega}} + e^{-j2\hat{\omega}}$ .
  - (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 6.20a. (sinusoidal response from frequency response)
10. [10] The 6-periodic signal  $x[n]$  having 6-point DFT given by  $X[k] = [2, 0, j, 3, -j, 0]$  for  $k = 0, 1, \dots, 5$  is the input to a FIR filter with frequency response  $\mathcal{H}(\hat{\omega}) = 2 - e^{-j\hat{\omega}}$ . Determine the output signal  $y[n]$ .
11. [0] What room is the final exam in?