Homework Assignment 8 - Due Nov. 12, 2011

Problem 7-1 (3 points)
A causal LTI FIR disrete-time system is characterized by an impuolse response $h[n] = a_1\delta[n] + a_2\delta[n-1] + a_3\delta[n-2] + a_4\delta[n-3] + a_5\delta[n-4] + a_6\delta[n-5]$. For what values of the impulse reponse samples will its frequency response $H(e^{j\omega})$ have constant group delay?

Problem 8-2 (3 points)
An FIR filter of length 3 is defined by a symmetric impulse response $h[n]$ with $h[0] = h[2]$. Let the input to this filter be a sum of two cosine sequences of angular frequencies 0.3 rad/samples and 0.6 rad/samples, respectively. Determine the impulse response coefficients so that the filter passes only the low frequency component of the input.

Problem 8-3 (3 points)
(a) Design a length-5 FIR bandpass filter with an antisymmetric impulse response h[n], satisfying the following magnitude response values: $|H(e^{j0.3\pi})| = 0.3$ and $|H(e^{j0.6\pi})| = 0.8$. (b) Determine the exact expression for the frequency response of the filter designed, and plot its magnitude and phase response using Matlab.

Problem 8-4 (3 points)
Consider a cascade of M sections of the first-order FIR lowpass filter represented by the transfer function

$$H_{LP} = \frac{1}{2}(1 + z^{-1})$$

Use Matlab to plot the magnitude responses for $M = 1, 2, 4, 10$ and measure the 3-dB cutoff frequency for each case. What do you notice?

Problem 8-5 (3 points)
Design a length-5 filter with a symmetric impulse response by choosing your favorite impulse response coefficient sample values. Use Matlab to plot the magnitude and phase response. Adjust the coefficient values and observe what happens.