EE 123 DIGITAL SIGNAL PROCESSING, Spring 2009
Homework # 1, Due January 29, Thursday

1. The input-output model of a discrete-time system is given as

   $$y[n] - 1.1y[n-1] + 0.3y[n-2] = x[n] = (0.6)^n u[n], \quad y[-1] = y[-2] = 0,$$

   where $u[n]$ is the unit step function.

   a) Use the time-domain approach based on the characteristic polynomial and the mode functions to find the solution $y[n]$ of the system.

   b) Use MATLAB to write a for loop to simulate $y[n]$ for $n = 0, ..., 10$, and plot the resulting $y[n]$.

2. Problem 2.42, Oppenheim and Schafer, 2nd ed.

3. Problem 2.60, Oppenheim and Schafer, 2nd ed.

4. Problem 2.71, Oppenheim and Schafer, 2nd ed.

5. Consider the moving average filter:

   $$y[n] = \frac{1}{7}\sum_{k=0}^{6} x[n-k].$$

   a) Calculate and plot the frequency response $H(e^{j\omega})$ of this filter and determine the frequencies ω for which $H(e^{j\omega}) = 0$.

   b) Let $x[n] = \cos(\omega_1 n)u[n]$ where ω_1 is one of the frequencies calculated in part (a) and $u[n]$ is the unit step function. Assuming zero initial conditions, calculate the resulting output signal $y[n]$.