EE 123 DIGITAL SIGNAL PROCESSING, Spring 2009
Homework # 5, Due February 26, Thursday

1. Evaluate the integral (6.89) in Oppenheim and Schafer, 2nd ed.

2. Problem 6.42, Oppenheim and Schafer, 2nd ed.

3. Problem 6.45, Oppenheim and Schafer, 2nd ed.

4. Consider the IIR filter studied in Homework 3:

$$H(z) = \frac{0.3549 + 0.2002z^{-1} + 0.7031z^{-2} + 0.2002z^{-3} + 0.3549z^{-4}}{1 + 1.2522z^{-1} + 1.9448z^{-2} + 0.9774z^{-3} + 0.5595z^{-4}}.$$

   a) Use the MATLAB function `pzmap` to plot the poles and zeros. Then, use the pole/zero pairing rule discussed in class to determine which of the two cascade realizations you found in Homework 3 is preferable.

   b) Use the MATLAB function `tf2sos` to verify your answer to part (a).

   c) Repeat parts (a) and (b) for the filter:

$$H(z) = \frac{0.03 + 0.0045z^{-1} + 0.0365z^{-2} + 0.0365z^{-3} + 0.0045z^{-4} + 0.03z^{-5}}{1 - 2.8648z^{-1} + 4.1582z^{-2} - 3.4122z^{-3} + 1.5981z^{-4} - 0.3374z^{-5}}.$$

5. A periodic signal $\tilde{x}[n]$ with a period of $N = 4$ is given by

$$\tilde{x}[0] = 1, \quad \tilde{x}[1] = 3, \quad \tilde{x}[2] = 5, \quad \tilde{x}[3] = 2.$$

   a) Find the discrete Fourier series coefficients $\tilde{X}[k]$.

   b) Repeat for the periodic signal $\tilde{y}[n]$, given by:

$$\tilde{y}[0] = 1, \quad \tilde{y}[1] = 1, \quad \tilde{y}[2] = 0, \quad \tilde{y}[3] = 0.$$

   c) Calculate the periodic convolution of $\tilde{x}[n]$ and $\tilde{y}[n]$, and find the Fourier series coefficients of the resulting sequence. Does your answer check with the product $\tilde{X}[k]\tilde{Y}[k]$?