6.003: Signals and Systems—Fall 2003

Problem Set 2

Issued: September 11, 2003

Due: September 19, 2003

Reading Assignments:

Lectures #3-4 & PS#2: Chapter 2 of O&W
Lectures #5-6 & PS#3: Chapter 3 of O&W

Exercise for home study (not to be turned in, although we will provide solutions):

(E1) O&W 1.38 (a)
(E2) O&W 2.33 (a-i))
(E3) O&W 2.44 (a)

Problems to be turned in:

Problem 1  Compute the convolution \( y[n] = x[n] \ast h[n] \) of each of the two following pairs of signals:

(a) \( x[n] \) and \( h[n] \) are depicted below

(b) \( x[n] = u[n + 4] - u[n - 1], \) \( h[n] = 2^n u[2 - n] \).
Problem 2  Compute the convolution $y(t) = x(t) \ast h(t)$ for each of the following pairs of signals:

(a). $x(t) = e^{-t}u(t + 1)$, $h(t) = e^{2t}u(-t)$

(b). $x(t)$ and $h(t)$ are depicted below:

![Graph](image)

Problem 3  The following are impulse responses of either discrete-time or continuous-time LTI systems. Determine whether each system is causal and/or stable. Justify your answer:

(a). $h[n] = 2^n u[3 - n]$

(b). $h(t) = u(1 - t) - \frac{1}{2}e^{-t}u(t)$

(c). $h[n] = [1 - (0.99)^n]u[n]$

(d). $h(t) = e^{15t}[u(t - 1) - u(t - 100)]$

Problem 4  Consider the LTI system initially at rest and described by the difference equation

$$y[n] - \frac{1}{2}y[n - 1] = 2x[n] - x[n - 2].$$

Find the response of this system to the input depicted below

![Graph](image)
**Problem 5** Consider the cascade of LTI systems with unit sample responses $h_1[n]$ and $h_2[n]$ depicted below:

![Diagram](image)

Suppose we are given the following information:

- $h_2[n] = \delta[n] - \delta[n - 1]$
- If the input is $x[n] = u[n] - u[n - 2]$
  
  then the output is as depicted below

Find $h_1[n]$.

**Problem 6** O&W 2.66, with the following corrections:

- In part (a), replace (ii) with (ii) $x_1(t) = 0$ for $t < 0$ and $t > 4$
- In part (a), the correct statement of (iv) is (iv) $y_1(t) = x_1(t) * h_1(t)$ is as large as possible at $t = 4$

After working this problem, make sure to read the brief paragraph on the top of p.169.

**Problem 7** O&W 2.44 (d)
The following two problems are from *Computer Explorations in Signals and Systems Using MATLAB Second edition* by Buck, Daniel, and Singer (BDS). Please submit your code as a part of your solution.

**Problem 8**  BDS Section 2.1

**Problem 9**  BDS Section 2.2

**Reminder:** The first 20 problems in each chapter of O&W have answers included at the end of the text. Consider using these for additional practice, either now or as you study for tests.