

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)

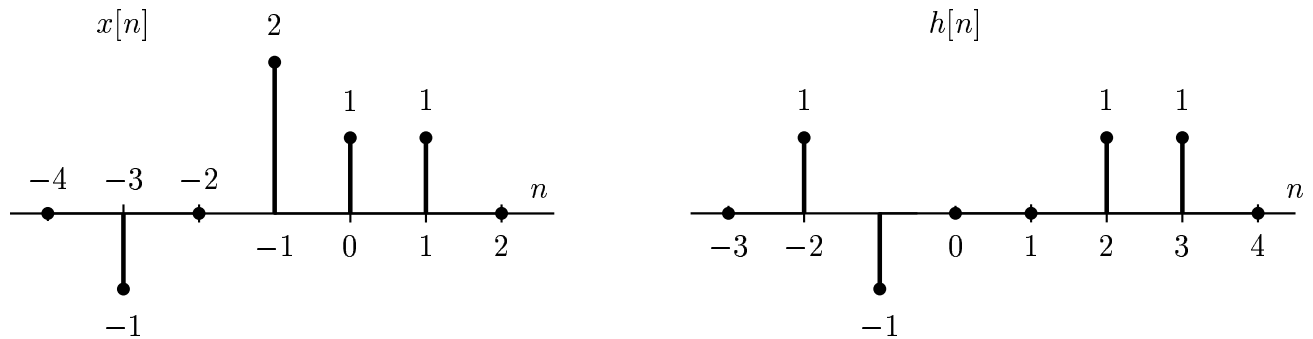
(E2) O&W 2.33 (a-(i))

(E3) O&W 2.44 (a)

Problems to be turned in:

Problem 1 Compute the convolution $y[n] = x[n] * h[n]$ of each of the two following pairs of signals:

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

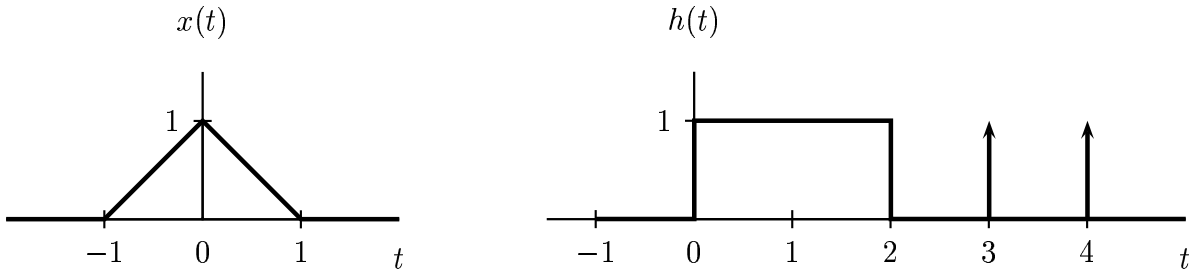


(b). $x[n] = u[n + 4] - u[n - 1]$, $h[n] = 2^n u[2 - n]$.

Problem 2 Compute the convolution $y(t) = x(t) * h(t)$ 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:



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

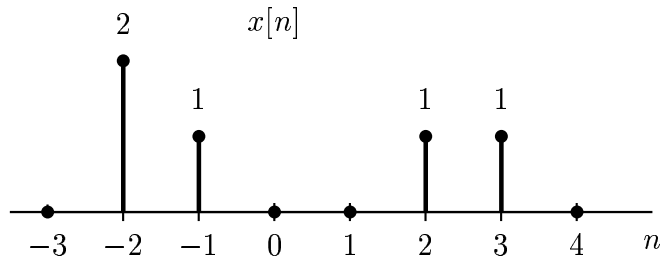
(c). $h[n] = [1 - (0.99)^n]u[n]$

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

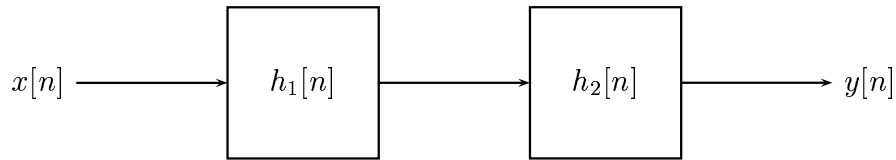
Problem 4 Consider the LTI system initially at rest and described by the difference equation

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

Find the response of this system to the input depicted below



Problem 5 Consider the cascade of LTI systems with unit sample responses $h_1[n]$ and $h_2[n]$ depicted below:

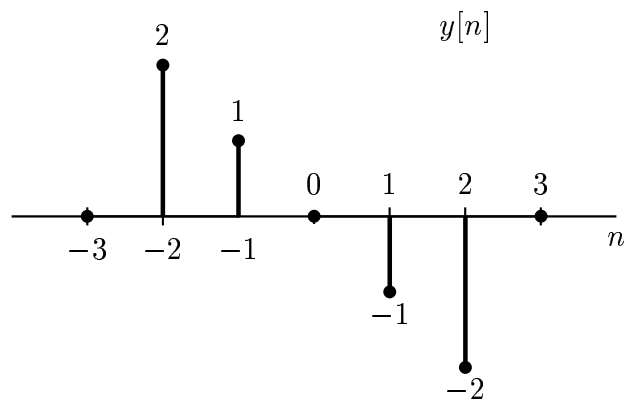


Suppose we are given the following information:

- $h_2[n] = \delta[n] - \delta[n - 1]$
- 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.