

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.003: Signals and Systems—Fall 2003

PROBLEM SET 1

Issued: September 4, 2003

Due: September 12, 2003

Reading Assignments:

Lectures #1-2 & PS#1: Chapter 1 of Oppenheim and Willsky (O&W), including review of complex numbers (see p. 71)

Lectures #3-4 & PS#2: Chapter 2 of Oppenheim and Willsky (O&W)

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

(E1) Problem 1.54

Problems to be turned in:

Problem 1 Answer the questions asked in Problem 1.49 of O&W for each of the following complex numbers:

(a) $(\sqrt{3} + j)^5 e^{-j\pi/3}$

Problem 2 Consider the signal $x(t)$ depicted in Figure P1.21 on p.60 of O&W. Sketch and carefully label each of the following two signals:

(a) $x\left(1 - \frac{t}{3}\right)$

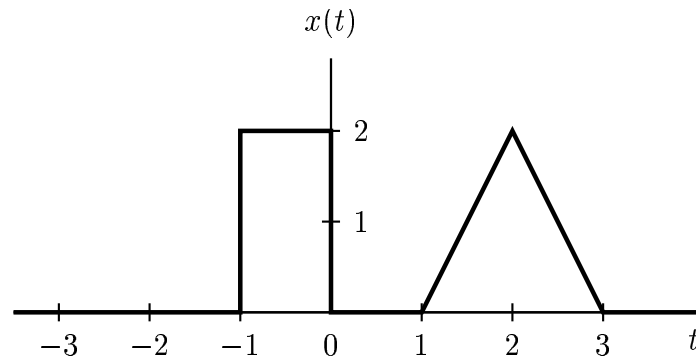
(b) $x(t - 2) \left[\delta\left(t - \frac{1}{2}\right) + u(3 - t)\right]$

Problem 3 Consider the signal $x[n]$ depicted in Figure P1.22 on p.60 of O&W. Sketch and carefully label each of the following two signals:

(a) $x[2 - n]$

(b) $x[2n + 1]$

Problem 4 Determine and sketch the even and odd part of the following signal. Label your sketch carefully.



Problem 5 Determine whether or not each of the following signal is periodic. If the signal is periodic, determine its fundamental period.

(a) $x(t) = [\sin(4t - 1)]^2$

(b) $x[n] = \cos(4n + \pi/4)$

(c) $x[n] = (-1)^n \cos(2\pi n/7)$

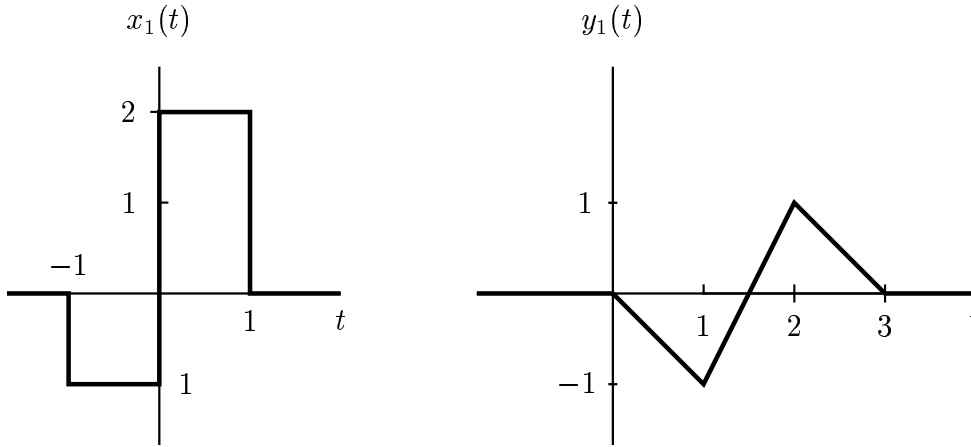
Problem 6 Answer the same set of system property questions as described at the bottom of page 61 of O& W (i.e., determine which of the listed properties hold) for each of the following systems:

(a) $y(t) = x(t + 3) - x(1 - t)$

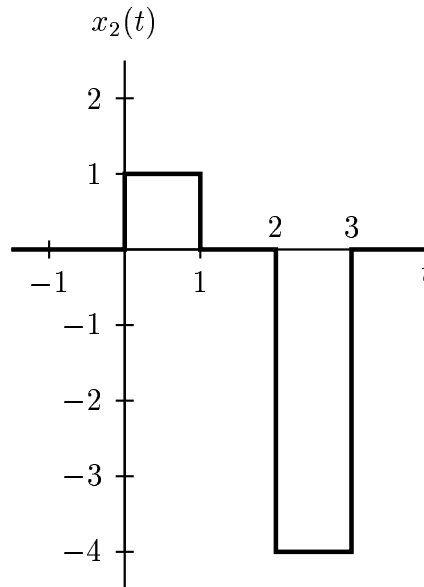
(b) $y[n] = \begin{cases} (-1)^n x[n], & x[n] \geq 0 \\ 2x[n], & x[n] < 0 \end{cases}$

(c) $y[n] = \sum_{k=n}^{\infty} x[k]$

Problem 7 Consider an LTI system whose response to signal $x_1(t)$ is the signal $y_1(t)$, where these signals are depicted below:



Determine and provide a labeled sketch of the response to the input $x_2(t)$ depicted below.



The following problem is from *Computer Explorations in Signals and Systems Using MATLAB Second edition* by Buck, Daniel, and Singer (BDS). You may want to look at BDS Section 1.1 to be familiar with Matlab. Please submit your code as a part of your solution.

Problem 8 BDS Section 1.3

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.