Department of Electrical and Computer Engineering
Stony Brook University

ESE 305/EEO 301 Signals and Systems (Summer 2024)

Homework 1
Due Date: May 31, 2024 (11:59PM via Brightspace in single PDF file.)

This assignment is to be done individually.

Problem 1: Chapter 1, Problem 1

1.1 Consider the signal $x(t) = 1+2\cos \pi t$. Plot roughly the signal for t in $[0, 5]$. Compute its sampled sequence with sampling period $T = 0.5$; that is, compute the values of $x(nT) = x(0.5n)$, for $n = 0, 1, \ldots, 9, 10$ denoted as $n = 0 : 10$. Plot $x(nT)$ with respect to time t and with respect to time index n.

Problem 2: Chapter 1, Problem 3

1.3 Consider the signal $x_1(t)$ shown in Figure 1.34(a). Plot $x_1(t-1)$, $x_1(-t+2)$, $x_1(t-1)+x_1(-t+2)$, $x_1(t-1)-x_1(-t+2)$, and $x_1(t-1)x_1(-t+2)$.

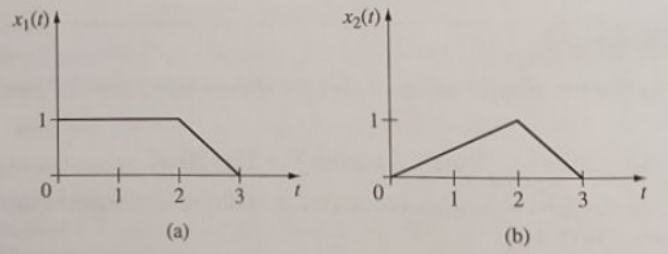

Figure 1.34

Problem 3: Chapter 1, Problem 6

1.6 Express the signals in Figure 1.35 in terms of step and ramp functions.

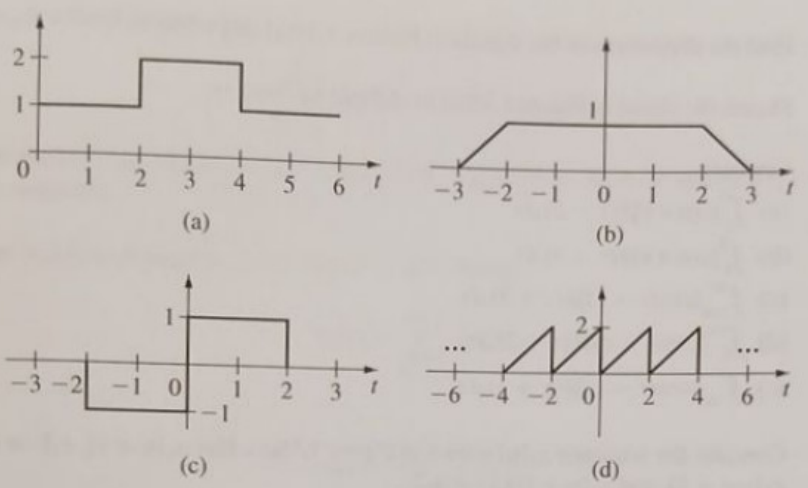

Figure 1.35

Problem 4: Chapter 1, Problem 7

1.7 Consider the signal in Figure 1.11(a). It starts from $t = 0$ and ends at $t = 2$ and is said to have time duration 2.

(a) Plot $x(2t)$. What is its time duration?

(b) Plot $x(0.5t)$, What is its time duration?

(c) Show that if $a > 1$, then the time duration of $x(at)$ is smaller than that of $x(t)$. This speeds up the signal and is called *time compression*.

(d) Show that if $0 < a < 1$, then the time duration of $x(at)$ is larger than that of $x(t)$. This slows down the signal and is called *time expansion*.

Problem 5: Chapter 1, Problem 14

1.14 Compute

(a) $\int_0^9 [\cos \pi\tau]\delta(\tau - 3)\, d\tau$

(b) $\int_5^9 [\cos \pi\tau]\delta(\tau - 3)\, d\tau$

(c) $\int_{-\infty}^{\infty} [\cos(t - \tau)]\delta(\tau + 3)\, d\tau$

(d) $\int_0^{\infty} [\cos(t - \tau)]\delta(\tau + 3)\, d\tau$

(e) $\int_{-\infty}^{0} [\cos(t - \tau)]\delta(\tau + 3)\, d\tau$

Problem 6: Chapter 1, Problem 15

1.15 Consider the sequence $x_1[n]$ shown in Figure 1.36(a). Plot $x_1[n + 1]$, $x_1[-n + 2]$, $x_1[n + 1] + x_1[-n + 2]$, and $x_1[n + 1]x_1[-n + 2]$.

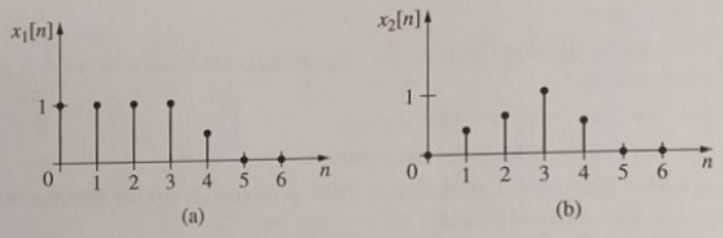

Figure 1.36

Problem 7: Chapter 1, Problem 24

1.24 Is the signal

$$x(t) = 2 + \sin 2t - 3\cos \pi t$$

periodic? Can it be expressed using complex exponentials?