ECE 301: Signals and Systems
Homework Assignment #1

Due on September 16, 2015

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Problem 1

Determine the values of P_∞ and E_∞ for each of the following signals:

(a) $x_1(t) = e^{-2t}u(t)$

(b) $x_2(t) = e^{j(2t+\pi/4)}$

(c) $x_3(t) = cos(t)$

(d) $x_1[n] = (\frac{1}{2})^n u[n]$

(e) $x_2[n] = e^{j(\pi/2n+\pi/8)}$

(f) $x_3[n] = cos(\frac{\pi}{4}n)$

Problem 2

A continuous-time signal $x(t)$ is shown in Figure 1. Sketch and label carefully each of the following signals:

(a) $x(4 - \frac{t}{2})$

(b) $[x(t) + x(-t)]u(t)$

(c) $x(t)[\delta(t + \frac{3}{2}) - \delta(t - \frac{3}{2})]$

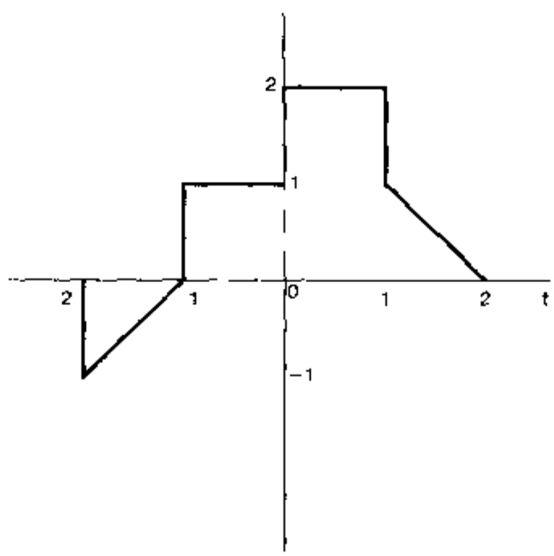

Figure 1: The continuous-time signal $x(t)$.

Problem 3

A discrete-time signal $x[n]$ is shown in Figure 2. Sketch and label carefully each of the following signals:

(a) $x[3n]$

(b) $x[n]u[3-n]$

(c) $x[n-2]\delta[n-2]$

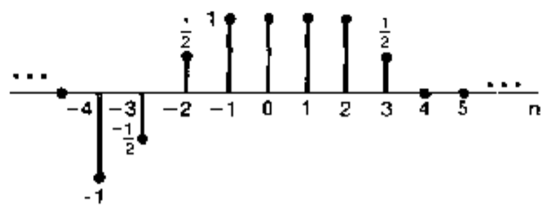

Figure 2: The discrete-time signal $x[n]$.

Problem 4

Determine and sketch the even and odd parts of the signals depicted in Figure 3. Label your sketches carefully.

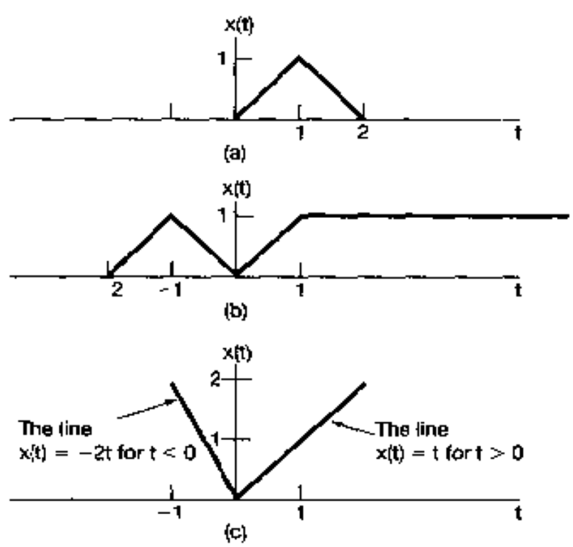

Figure 3: The continuous-time signal $x(t)$.

Problem 5

Let $x(t)$ be the continuous-time complex exponential signal

$$x(t) = e^{jw_0 t}$$

with fundamental frequency ω_0 and fundamental period $T_0 = 2\pi/\omega_0$. Consider the discrete-time signal obtained by taking equally spaced samples of $x(t)$ - that is,

$$x[n] = x(nT) = e^{j\omega_0 nT}$$

(a) Show that $x[n]$ is periodic if and only if T/T_0 is a rational number - that is, if and only if some multiple of the sampling interval exactly equals a multiple of the period of $x(t)$.

(b) Suppose that $x[n]$ is periodic - that is, that

$$\frac{T}{T_0} = \frac{p}{q} \tag{1}$$

where p and q are integers. What are the fundamental period and fundamental frequency of $x[n]$? Express the fundamental frequency as a fraction of $\omega_0 T$.

(c) Again assuming that $\frac{T}{T_0}$ satisfies equation (1), determine precisely how many periods of $x(t)$ are needed to obtain the samples that form a single period of $x[n]$.