1ª Lista de Exercícios – Capítulo 4

4.1. The signal

$$x_c(t) = \sin(2\pi(100)t)$$

was sampled with sampling period $T = 1/400$ second to obtain a discrete-time signal $x[n]$. What is the resulting signal $x[n]$?

4.2. The sequence

$$x[n] = \cos\left(\frac{\pi}{4}n\right), \qquad -\infty < n < \infty,$$

was obtained by sampling a continuous-time signal

$$x_c(t) = \cos(\Omega_0 t), \qquad -\infty < t < \infty.$$

4.3. The continuous-time signal

$$x_c(t) = \cos(4000\pi t)$$

is sampled with a sampling period T to obtain a discrete-time signal

$$x[n] = \cos\left(\frac{\pi n}{3}\right).$$

(a) Determine a choice for T consistent with this information.
(b) Is your choice for T in Part (a) unique? If so, explain why. If not, specify another choice of T consistent with the information given.

4.4. The continuous-time signal

$$x_c(t) = \sin(20\pi t) + \cos(40\pi t)$$

is sampled with a sampling period T to obtain the discrete-time signal

$$x[n] = \sin\left(\frac{\pi n}{5}\right) + \cos\left(\frac{2\pi n}{5}\right).$$

(a) Determine a choice for T consistent with this information.
(b) Is your choice for T in Part (a) unique? If so, explain why. If not, specify another choice of T consistent with the information given.

4.21. A complex-valued continuous-time signal $x_c(t)$ has the Fourier transform shown in Figure P4.21-1, where $(\Omega_2 - \Omega_1) = \Delta\Omega$. This signal is sampled to produce the sequence $x[n] = x_c(nT)$.

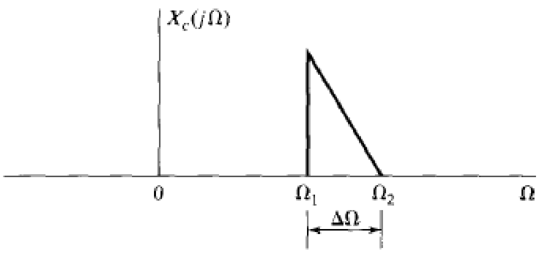

Figure P4.21-1

(a) Sketch the Fourier transform $X(e^{j\omega})$ of the sequence $x[n]$ for $T = \pi/\Omega_2$.
(b) What is the *lowest* sampling frequency that can be used without incurring any aliasing distortion, i.e., so that $x_c(t)$ can be recovered from $x[n]$?
(c) Draw the block diagram of a system that can be used to recover $x_c(t)$ from $x[n]$ if the sampling rate is greater than or equal to the rate determined in Part (b). Assume that (complex) ideal filters are available.

4.22. A continuous-time signal $x_c(t)$, with Fourier transform $X_c(j\Omega)$ shown in Figure P4.22-1, is sampled with sampling period $T = 2\pi/\Omega_0$ to form the sequence $x[n] = x_c(nT)$.

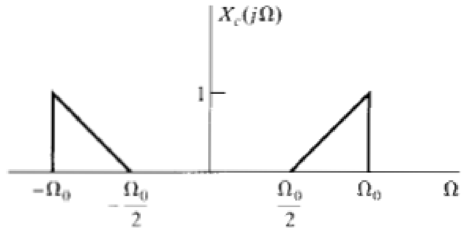

Figure P4.22-1

(a) Sketch the Fourier transform $X(e^{j\omega})$ for $|\omega| < \pi$.

(b) The signal $x[n]$ is to be transmitted across a digital channel. At the receiver, the original signal $x_c(t)$ must be recovered. Draw a block diagram of the recovery system and specify its characteristics. Assume that ideal filters are available.

(c) In terms of Ω_0, for what range of values of T can $x_c(t)$ be recovered from $x[n]$?