Assignment no 05: Chapter 6

Note: You can check the exercises after the book Chapter.
In our assignment, we are using the first edition of "Signals and Systems: A MATLAB Integrated Approach" By Oktay Alkin.

6.1. Consider the triangular waveform shown in Fig. P.6.1.

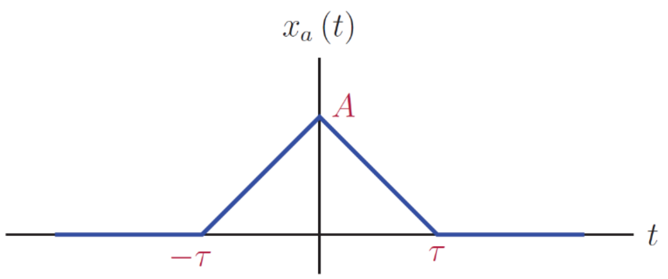


Figure P. 6.1

Its Fourier transform is

$$X_a(f) = A\tau \, \text{sinc}^2(f\tau)$$

Let $A = 1$ and $\tau = 1$ s. The signal $x_a(t)$ is impulse-sampled using a sampling rate of $f_s = 5$ Hz.

- **a. Sketch** the impulse-sampled signal $x_s(t)$.
- **b. Find** an expression for $X_s(f)$.
- **c. Sketch** $X_s(f)$ for $-10 \le f \le 10$ Hz.

6.2. An analog signal $x_a(t)$ has the Fourier transform shown in Fig. P.6.2.

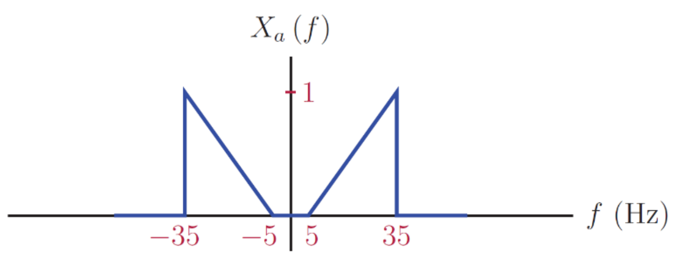


Figure P. 6.2

The signal is impulse sampled using a sampling rate of $f_s = 100$ Hz to obtain the signal $x_s(t)$.

Sketch the spectrum $X_s(\omega)$.

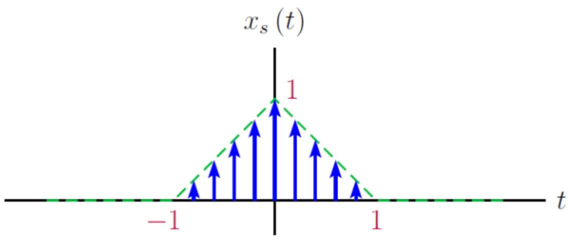
6.8. A sinusoidal signal $x_a(t) = \sin(2\pi f_a t)$ with a frequency of $f_a = 1$ kHz is sampled using a sampling rate of $f_s = 2.4$ kHz to obtain a discrete-time signal $x[n]$.

- **a.** Manually **sketch** the signal $x_a(t)$ for the time interval $0 < t < 5$ ms.
- **b. Show** the sample amplitudes of the discrete-time signal $x[n]$ on the sketch of $x_a(t)$.

Answers

6.1. Answer

a.



b. Using $A = 1$ and $\tau = 1$ the transform of the original signal $x_a(t)$ is

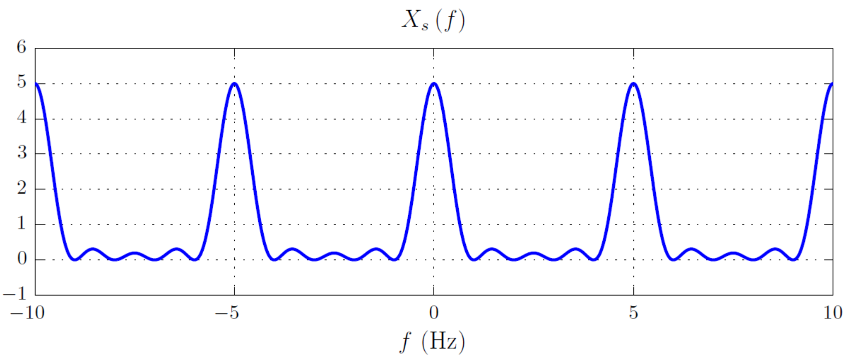
$$X_a() = \mathrm{sinc}^2(f)$$

The transform of the impulse sampled signal $x_s(t)$ is

$$X_s() = \frac{1}{T_s} \sum_{k=-\infty}^{\infty} X_a(f - kf_s)$$

$$= 5 \sum_{k=-\infty}^{\infty} \mathrm{sinc}^2(f - 5k)$$

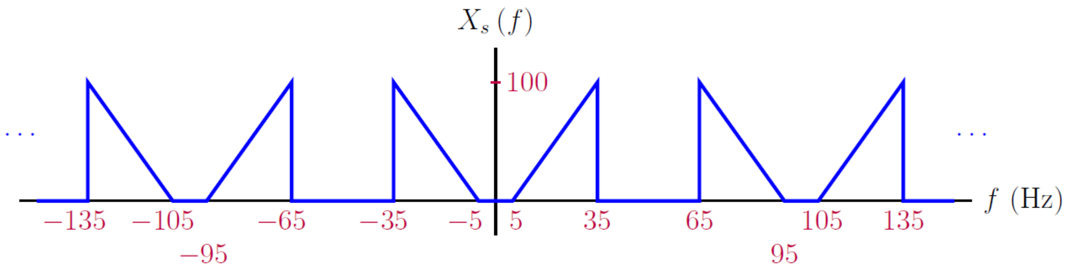
c.



6.2. Answer

$$X_s() = \frac{1}{T_s} \sum_{k=-\infty}^{\infty} X_a(f - k f_s)$$

$$= 100 \sum_{k=-\infty}^{\infty} X_a(f - 100k)$$



6.8. Answer