Signals and Systems – Spring 2025

Problem Set 7

Issued: Apr. 8, 2025   Due: Apr. 22, 2025
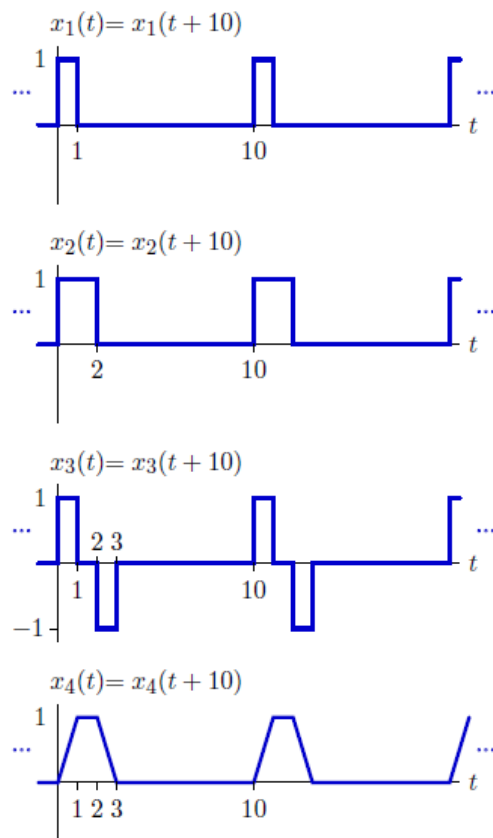
Reading Assignment:

  Chap. 3,   Chap. 4

Problem 1:   OWN Problem 3.44

Problem 2:   OWN Problem 3.48

Problem 3:   OWN Problem 3.58
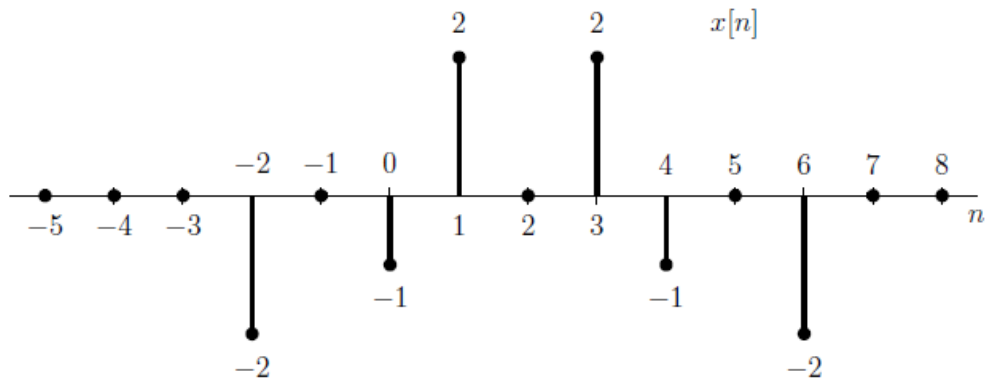
Problem 4:   OWN Problem 3.71

Problem 5:

Determine the Fourier series coefficients for each of the following periodic CT signals.

Problem 6:

Let $X(e^{j\omega})$ denote the Fourier transform of the signal $x[n]$ depicted below.

(a) Find $X(1) = X(e^{j0})$.

(b) Find α such that $e^{j\alpha\omega}X(e^{j\omega})$ is real.

(c) Evaluate $\int_{-\pi}^{\pi} X(e^{j\omega})d\omega$.

(d) Find $X(e^{j\pi})$.

(e) Determine and sketch the signal whose Fourier transform is $\Re\{X(e^{j\omega})\}$.

(f) Evaluate the following integrals:
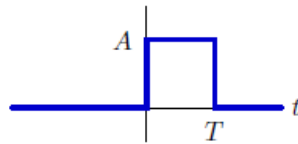
$$\int_{-\pi}^{\pi} |X(e^{j\omega})|^2 d\omega$$

Problem 7:

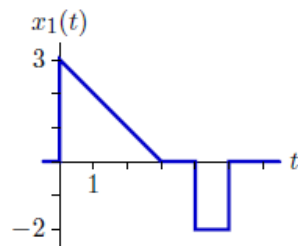Find the Fourier transforms of the following signals.

a. $x_1(t) = e^{-|t|}\cos(2t)$

b. $x_2(t) = \dfrac{\sin(2\pi t)}{\pi(t-1)}$

c. $x_3(t) = \begin{cases} t^2 & 0 < t < 1 \\ 0 & \text{otherwise} \end{cases}$

d. $x_4(t) = (1 - |t|)\, u(t+1)u(1-t)$

Problem 8:

We are given that the impulse response of a CT LTI system is of the form

where A and T are unknown. When the system is subjected to the input

the output $y_1(t)$ is zero at $t = 5$. When the input is

$$x_2(t) = \sin\left(\frac{\pi t}{3}\right) u(t),$$

the output $y_2(t)$ is equal to 9 at $t = 9$. Determine A and T. Also determine $y_2(t)$ for all t.