Problem: 1.3, 1.6

1.3. 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)** $x_3[n] = \cos(\frac{\pi}{4}n)$

1.6. Determine whether or not each of the following signals is periodic:

(a) $x_1(t) = 2e^{j(t+\pi/4)}u(t)$ **(b)** $x_2[n] = u[n] + u[-n]$

(c) $x_3[n] = \sum_{k=-\infty}^{\infty}\{\delta[n-4k] - \delta[n-1-4k]\}$

1.21. A continuous-time signal $x(t)$ is shown in Figure P1.21. Sketch and label carefully each of the following signals:

(a) $x(t-1)$ (b) $x(2-t)$ (c) $x(2t+1)$
(d) $x(4-\frac{t}{2})$ (e) $[x(t)+x(-t)]u(t)$ (f) $x(t)[\delta(t+\frac{3}{2})-\delta(t-\frac{3}{2})]$

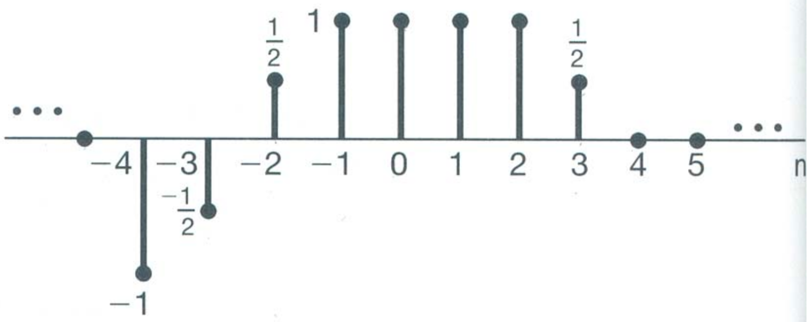


Figure P1.22

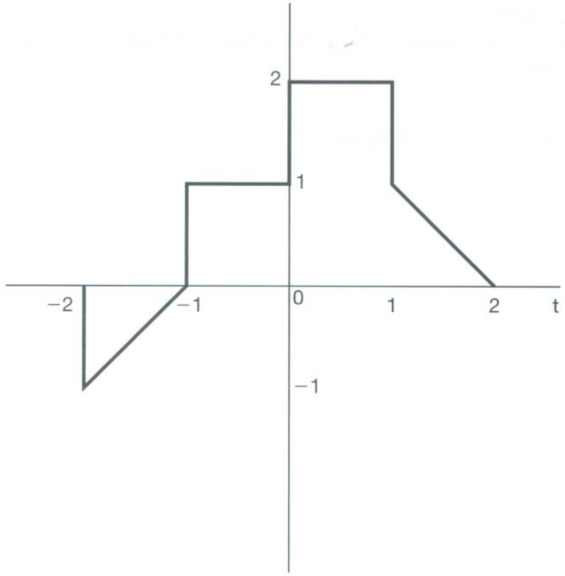


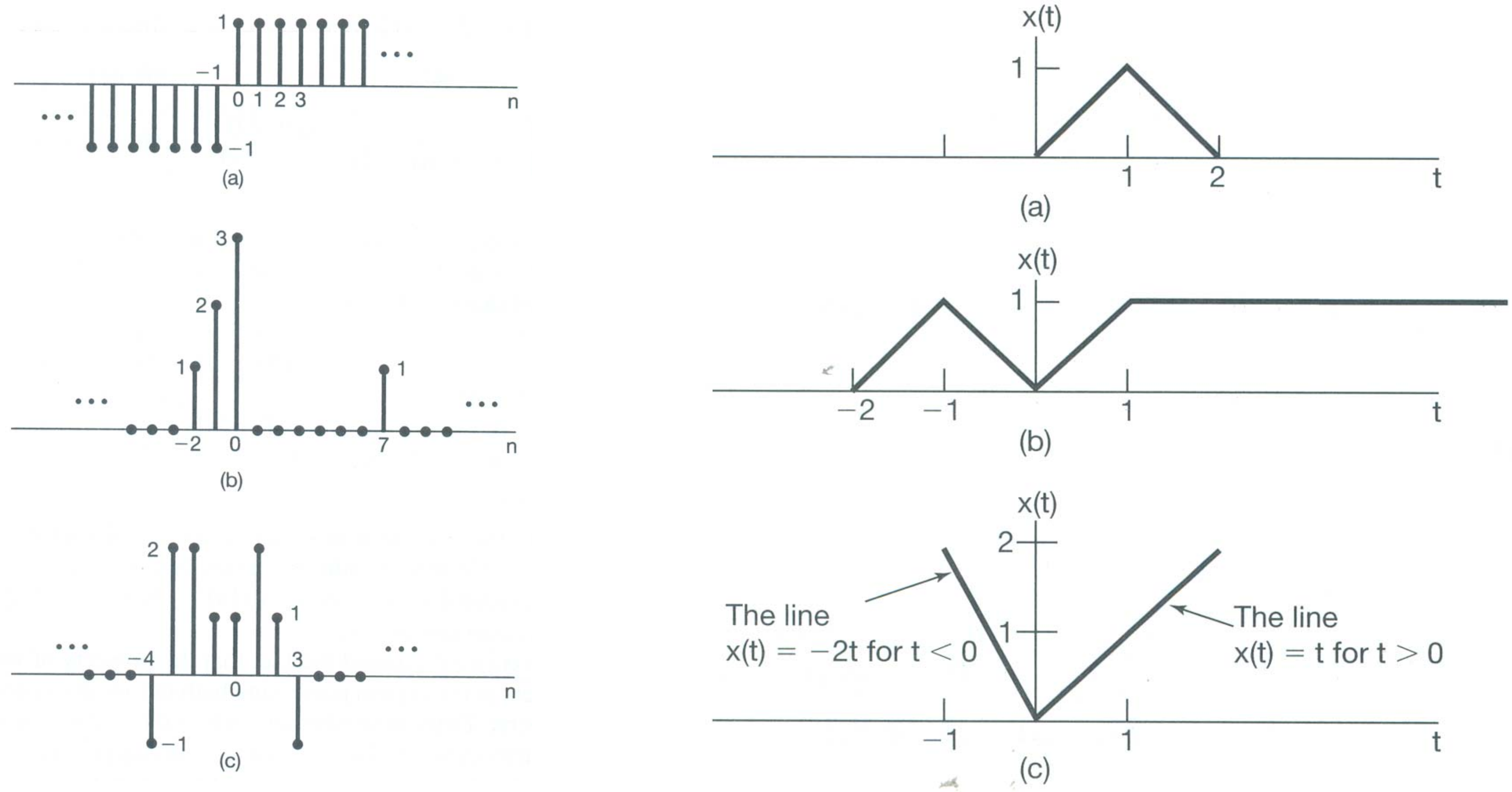
Figure P1.21

1.22. A discrete-time signal is shown in Figure P1.22. Sketch and label carefully each of the following signals:

(a) $x[n-4]$ (b) $x[3-n]$ (c) $x[3n]$
(d) $x[3n+1]$ (e) $x[n]u[3-n]$ (f) $x[n-2]\delta[n-2]$
(g) $\frac{1}{2}x[n]+\frac{1}{2}(-1)^n x[n]$ (h) $x[(n-1)^2]$

Problem: 1.23, 1.24

1.23. Determine and sketch the even and odd parts of the signals depicted in Figure P1.23. Label your sketches carefully.



1.24. Determine and sketch the even and odd parts of the signals depicted in Figure P1.24. Label your sketches carefully.

2. [12] Determine whether or not the each of the following signals are periodic. Please justify your answer.

   (a) $x[n] = \cos(\frac{\pi}{8} n^2)$. [6]

   (b) $x(t) = Ev\{\cos(4\pi t)u(t)\}$ [6]

2. (8 %) Consider a periodic signal $x(t)$ with period 1 and $x(t) = 1/\sqrt{t}$ for $0 \le t < 1$. Show that the signal is absolutely integrable in one period but has infinite average power $P_T = \frac{1}{T}\int_0^T |x(t)|^2 \, dt$ over one period.

1. Find the even and odd components of the following signals.

   (a) **[3]** $x(t) = 1 + t\cos(t) + t^2\sin(t) + t^3\sin(t)\cos(t)$

   (b) **[3]** $x(t) = 5\cos(3t) + \sin(3t - \frac{\pi}{2})$

2. For each of the following signals, determine whether it is periodic, and if it is, find the fundamental period.

   (a) **[2]** $x(t) = \sin^3(2t)$

   (b) **[2]** $x[n] = \cos(2n)$

   (c) **[2]** $x(t) = te^{\sin(t)}$

   (d) **[2]** $x(t) = e^{-j10t} + e^{j15t}$

   (e) **[2]** $x[n] = \cos(\frac{\pi}{8}n^2)$

3. **[5]** Assume that an real-valued continuous-time signal is expressed as

$$x(t) = x_e(t) + x_o(t),$$

where $x_e(t)$ and $x_o(t)$ are, respectively, the even and odd components of $x(t)$.
Show that the energy of the signal $x(t)$ is equal to the sum of the energy of the even component $x_e(t)$, and the energy of the odd component $x_o(t)$. That is, show that

$$\int_{-\infty}^{\infty} x^2(t)dt = \int_{-\infty}^{\infty} x_e^{\,2}(t)dt + \int_{-\infty}^{\infty} x_o^{\,2}(t)dt$$

- For the functions used to describe the signals,
- the time axis is absolute value,
- i.e., the world time,
- (a) True or (b) False
- and
- for the functions used to describe the systems,
- the time axis is relative value,
- i.e., the time difference from the activation time?
- (c) True or (d) False

SS1-SS-7: DT Signals and CT Signals

- The time variables for CT signals is real number,
- i.e., x(t), t is real number (the R set),
- (a) True or (b) False
- and
- the time variables for DT signals is integer number,
- i.e., x[n], n is integer number (the Z set),
- (c) True or (d) False

SS1-SS-11: Signal Energy & Signal Power

- (a)
- If the total energy of one signal
- over an infinite time interval
- is finite, say, 10,
- then, what is the average power of the signal,
- over an infinite time interval?

- (b)
- If the average power of one signal
- over an infinite time interval
- is finite, say, 10,
- then, what is the total energy of the signal,
- over an infinite time interval?

SS1-SS-13: Delayed and Advanced Signals

- (a)
- For a signal x(t),
- the 3.4-unit delayed signal becomes x(t-3.4),
- i.e., to the left of the original signal x(t)?

- (b)
- For a signal x(t) or x[n],
- a 2-unit advanced signal becomes x[n+2],
- i.e., to the right of the original signal x[n]?

SS1-SS-15: Time Scaling

- For x(t),
- the shape of x(3t) becomes wider than that of x(t)?

- (a) True or (b) False

SS1-SS-18: x(A t + B)

- For x(t),
- (a)
- what is the signal after doing the following steps:
- (1) t -> t + 2
- (2) t -> t/3
- e.g., x(A t + B), what are A and B?

- (b)
- what is the singal after doing the following steps:
- (1) t -> t/3
- (2) t -> t + 2
- e.g., x(A t + B), what are A and B?

SS1-SS-20: Periodic Signals

- Is x[n] = cos(n/8 - pi) a periodic signal?

- (a) Yes or (b) No

SS1-SS-25: Even-Odd Signals

- Let
- $x[n] = 1, n < 0$
- $x[n] = 2, n = 0$
- $x[n] = 1, n > 0$
- Find the even part and odd part of $x[n]$.