

$-1) - \sin(4t - 1)$
 $e^{j2\pi n/5}$

expressed as

"impulse train"

obtained through
 The input-output

order in which S_1

The input-output

- (a) Is the system memoryless?
- (b) Determine the output of the system when the input is $A\delta[n]$, where A is any real or complex number.
- (c) Is the system invertible?

1.17. Consider a continuous-time system with input $x(t)$ and output $y(t)$ related by

$$y(t) = x(\sin(t)).$$

- (a) Is this system causal?
- (b) Is this system linear?

1.18. Consider a discrete-time system with input $x[n]$ and output $y[n]$ related by

$$y[n] = \sum_{k=n-n_0}^{n+n_0} x[k],$$

where n_0 is a finite positive integer.

- (a) Is this system linear?
- (a) Is this system time-invariant?
- (c) If $x[n]$ is known to be bounded by a finite integer B (i.e., $|x[n]| < B$ for all n), it can be shown that $y[n]$ is bounded by a finite number C . We conclude that the given system is stable. Express C in terms of B and n_0 .

1.19. For each of the following input-output relationships, determine whether the corresponding system is linear, time invariant or both.

- (a) $y(t) = t^2x(t - 1)$
- (b) $y[n] = x^2[n - 2]$
- (c) $y[n] = x[n + 1] - x[n - 1]$
- (d) $y[n] = \mathcal{O}d\{x(t)\}$

1.20. A continuous-time linear system S with input $x(t)$ and output $y(t)$ yields the following input-output pairs:

$$x(t) = e^{j2t} \xrightarrow{S} y(t) = e^{j3t},$$

$$x(t) = e^{-j2t} \xrightarrow{S} y(t) = e^{-j3t}.$$

- (a) If $x_1(t) = \cos(2t)$, determine the corresponding output $y_1(t)$ for system S .
- (b) If $x_2(t) = \cos(2(t - \frac{1}{2}))$, determine the corresponding output $y_2(t)$ for system S .

BASIC PROBLEMS

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

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) $x[(n - 1)^2]$

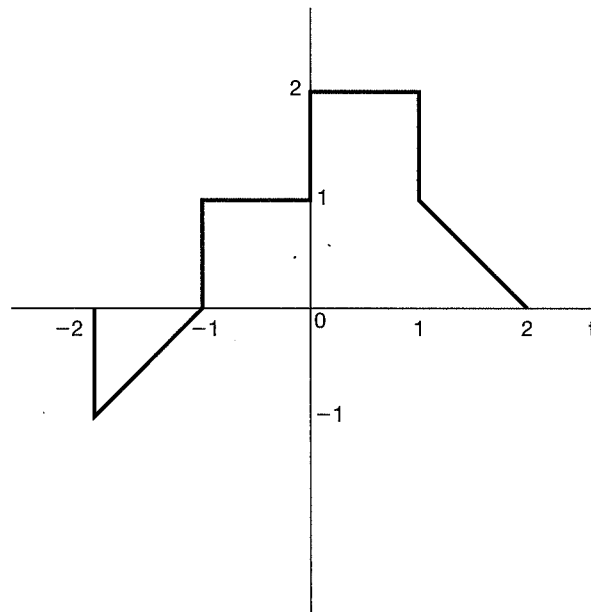


Figure P1.21

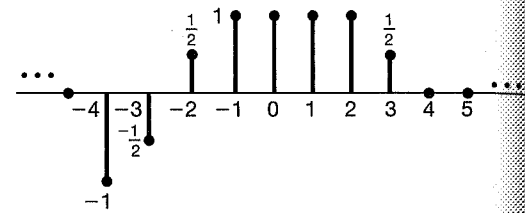


Figure P1.22

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

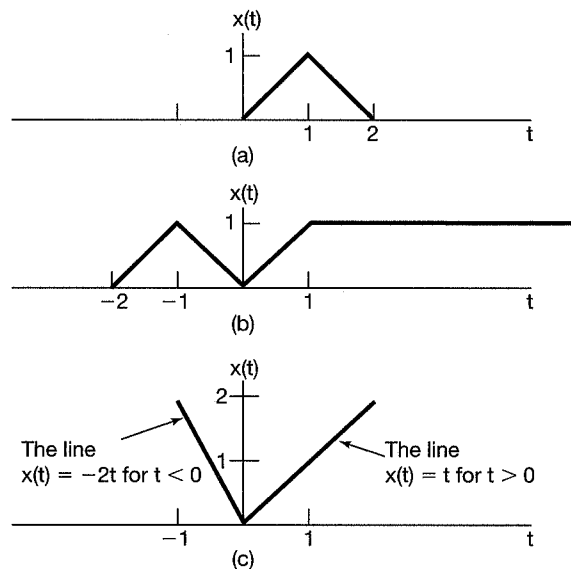


Figure P1.23

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