NeSS
Tutorial – 4

2.8. Determine and sketch the convolution of the following two signals:

$$x(t) = \begin{cases} t+1, & 0 \le t \le 1 \\ 2-t, & 1 < t \le 2 \\ 0, & \text{elsewhere} \end{cases},$$

$$h(t) = \delta(t+2) + 2\delta(t+1).$$

2.11. Let

$$x(t) = u(t-3) - u(t-5) \quad \text{and} \quad h(t) = e^{-3t}u(t).$$

(a) Compute $y(t) = x(t) * h(t)$.
(b) Compute $g(t) = (dx(t)/dt) * h(t)$.
(c) How is $g(t)$ related to $y(t)$?

2.12. Let

$$y(t) = e^{-t}u(t) * \sum_{k=-\infty}^{\infty} \delta(t-3k).$$

Show that $y(t) = Ae^{-t}$ for $0 \le t < 3$, and determine the value of A.

2.22. For each of the following pairs of waveforms, use the convolution integral to find the response $y(t)$ of the LTI system with impulse response $h(t)$ to the input $x(t)$. Sketch your results.

(c) $x(t)$ and $h(t)$ are as in Figure P2.22(a).
(d) $x(t)$ and $h(t)$ are as in Figure P2.22(b).
(e) $x(t)$ and $h(t)$ are as in Figure P2.22(c).

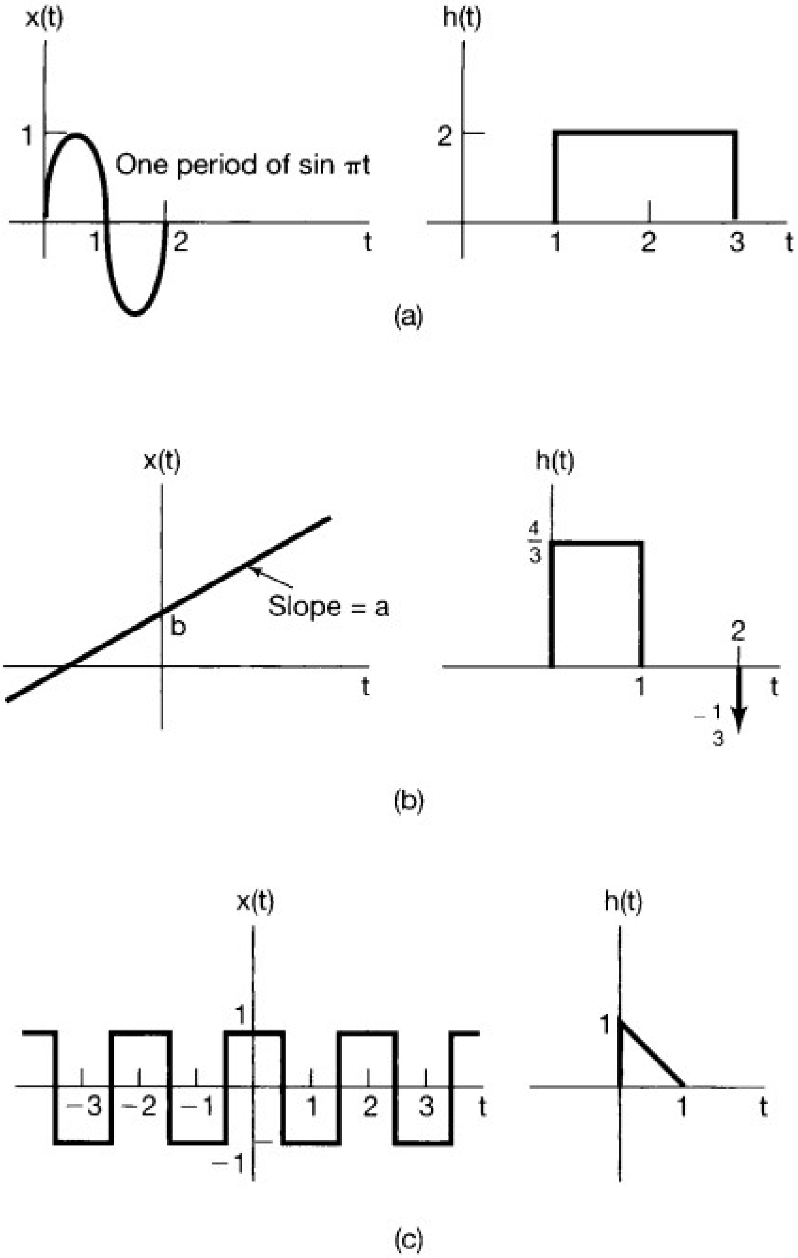

Figure P2.22

2.14. Which of the following impulse responses correspond(s) to stable LTI systems?
(a) $h_1(t) = e^{-(1-2j)t}u(t)$ **(b)** $h_2(t) = e^{-t}\cos(2t)u(t)$

2.23. Let $h(t)$ be the triangular pulse shown in Figure P2.23(a), and let $x(t)$ be the impulse train depicted in Figure P2.23(b). That is,

$$x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - kT).$$

Determine and sketch $y(t) = x(t) * h(t)$ for the following values of T:
(a) $T = 4$ **(b)** $T = 2$ **(c)** $T = 3/2$ **(d)** $T = 1$

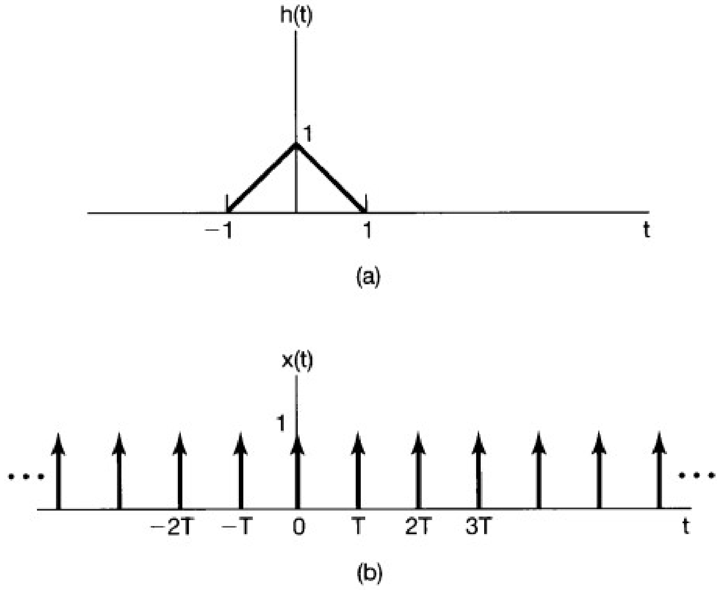

Figure P2.23

Parts – a,e&f

2.48. Determine whether each of the following statements concerning LTI systems is true or false. Justify your answers.

(a) If $h(t)$ is the impulse response of an LTI system and $h(t)$ is periodic and nonzero, the system is unstable.

(b) The inverse of a causal LTI system is always causal.

(c) If $|h[n]| \leq K$ for each n, where K is a given number, then the LTI system with $h[n]$ as its impulse response is stable.

(d) If a discrete-time LTI system has an impulse response $h[n]$ of finite duration, the system is stable.

(e) If an LTI system is causal, it is stable.

(f) The cascade of a noncausal LTI system with a causal one is necessarily non-causal.

(g) A continuous-time LTI system is stable if and only if its step response $s(t)$ is absolutely integrable—that is, if and only if

$$\int_{-\infty}^{+\infty} |s(t)|\, dt < \infty.$$

(h) A discrete-time LTI system is causal if and only if its step response $s[n]$ is zero for $n < 0$.

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?

9.1. For each of the following integrals, specify the values of the real parameter σ which ensure that the integral converges:

(a) $\int_0^{\infty} e^{-5t} e^{-(\sigma + j\omega)t}\, dt$ **(b)** $\int_{-\infty}^{0} e^{-5t} e^{-(\sigma + j\omega)t}\, dt$

(c) $\int_{-5}^{5} e^{-5t} e^{-(\sigma + j\omega)t}\, dt$ **(d)** $\int_{-\infty}^{\infty} e^{-5t} e^{-(\sigma + j\omega)t}\, dt$

(e) $\int_{-\infty}^{\infty} e^{-5|t|} e^{-(\sigma + j\omega)t}\, dt$ **(f)** $\int_{-\infty}^{0} e^{-5|t|} e^{-(\sigma + j\omega)t}\, dt$