Outline

- Discrete-Time Linear Time-Invariant Systems
  - The convolution sum
- Continuous-Time Linear Time-Invariant Systems
  - The convolution integral
- Properties of Linear Time-Invariant Systems
- Causal Linear Time-Invariant Systems Described by Differential & Difference Equations
- Singularity Functions

$x[n] \rightarrow$ h[n] $\rightarrow y[n]$ $\qquad$ $x(t) \rightarrow$ h(t) $\rightarrow y(t)$

Problem 2.8 (p.139) – Convolution Integral [SS2:37]

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

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

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

Problem 2.22 (p.141) – Convolution Integral [SS2:37]

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.

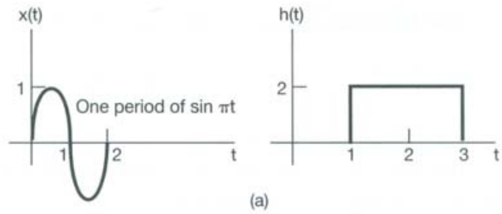
(a) $\left.\begin{aligned} x(t) &= e^{-\alpha t}u(t) \\ h(t) &= e^{-\beta t}u(t) \end{aligned}\right\}$ (Do this both when $\alpha \neq \beta$ and when $\alpha = \beta$.)

(b) $x(t) = u(t) - 2u(t-2) + u(t-5)$
$h(t) = e^{2t}u(1-t)$

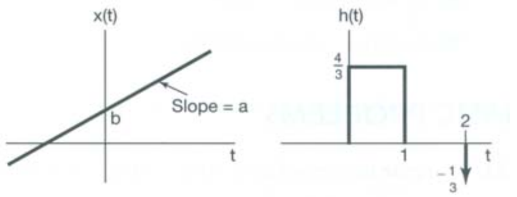
(c) $x(t)$ and $h(t)$ are as in Figure P2.22(a).

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

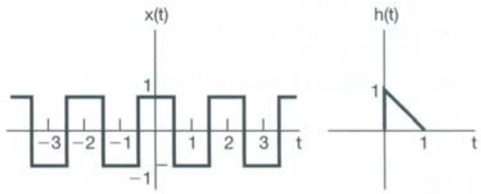
(e) $x(t)$ and $h(t)$ are as in Figure P2.22(c).



(a)



(b)



(c)

Midterm 2012-3, 2013-5

3. [10] Suppose that the impulse response $h(t)$ of an LTI system is given by the following function:

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

If the following function is the input signal into the LTI system:

$$x(t) = \begin{cases} 1, & 0 < t \le 1 \\ 0, & \text{otherwise} \end{cases},$$

Find the output of the system.