Basic Signals

Energy content and power

1. Find the energy content of the exponentially decreasing sinusoidal signal $x(t)=\begin{cases} e^{-2t}\sin t & t\geq 0 \\ 0 & t<0 \end{cases}$

2. Let $x(t) = A\cos\omega t$ where A is a positive real constant. Find

a. the signal energy over one period

b. the average power of the signal

3. Consider a trapezoidal pulse, which is defined by $x(t)=\begin{cases} 7+t & -7\leq t\leq 3 \\ 4 & -3\leq t\leq 3 \\ 7-t & 3\leq t\leq 7 \end{cases}$. Find

a. the energy content

b. the average power

of this signal.

Even and odd functions

4. Determine whether the following functions are even or odd:

a. $x(t) = t\cos t$

b. $x(t) = \cos t \sin^2 t$

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

LTI systems

Linearity

5. Determine whether the following systems are linear :

a. $y(t) = R\, x(t)$, where R is a constant

b. $y(t) = x^3(t)$

Further examples

6. Determine if each of the following systems are memoryless, causal, BIBO stable, and time-invariant :

a. $y(t) = 2e^{-4\cos[x(t)]}$ for $t \geq 0$, $y(t) = 0$ otherwise

b. $y(t) = x(t-6)$

c. $y(t) = x^2(t)$

d. $y(t) = x(t)\cosh t$

e. $y(t) = dx/dt$

f. $y(t)=\int_{\infty}^{t/3} x(s)\,ds$

LTI systems (continued)

Impulse response and system properties

1. Discuss the memory, causality and stability of systems with an impulse response of

c. $h(t) = 4\delta(t)$

d. $h(t) = \cos(\pi t)u(t + 1)$

Convolution

2. Given $h(\tau)$ in figure 1, sketch $h(t-\tau)$ for $t = -2$ and $t = 2$.

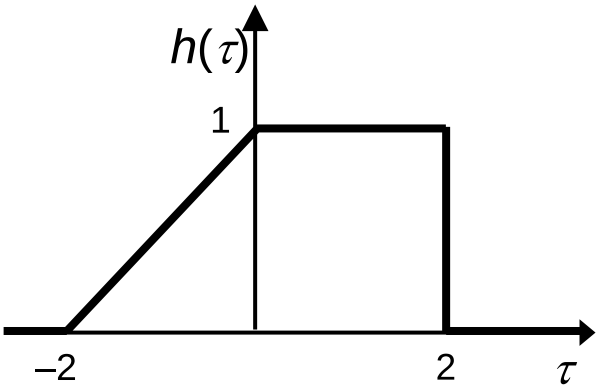

Figure 1 Impulse response of a continuous system

3. Determine and sketch the response $y(t)$ of the LTI system with impulse response $h(t) = e^{-at}u(t),\ \ a > 0$ to the step input signal $x(t) = u(t)$.

4. For a given system, $x(t) = e^{-t}u(t+2)$ and $h(t) = e^{t}u(-t)$. Find the response $y(t)$.