Tutorial 03

EN1060 - Signals and Systems

May 23, 2022

1. Find following convolutions:

   (a) $x(t) * \delta(t)$

   (b) $x(t) * \delta(t - t_0)$

   (c) $x(t) * u(t)$

   (d) $x(t) * u(t - t_0)$

2. Let $y(t) = x(t) * h(t)$. Show that $x(t - t_1) * h(t - t_2) = y(t - t_1 - t_2)$

3. Find $y(t)$ of the following system and signal.

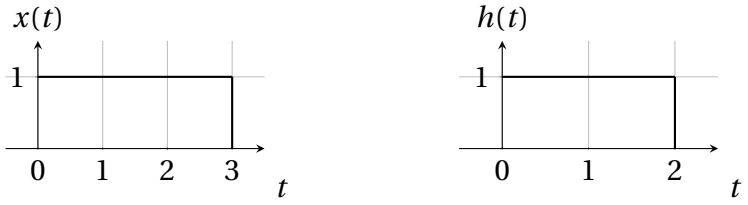

Figure 1:

4. Compute and sketch $y[n] = x[n] * h[n]$ for the following:

   (a) $x[n] = \alpha^n u[n]$ and $h[n] = \beta^n u[n], \alpha < \beta$

   (b) $x[n] = \alpha^n u[n]$ and $h[n] = \alpha^{-n} u[-n]$

5. Consider the continuous time LTI system whose step response is $s(t) = e^{-t} u(t)$. Determine the output of following $x(t)$.

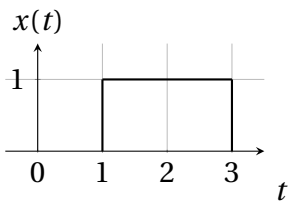

Figure 2:

6. A system is formed by connecting two systems in cascade. The impulse response of those systems are given by $h_1(t)$ and $h_2(t)$ where,

$$h_1(t) = e^{-2t}u(t) \qquad\qquad h_2(t) = 2e^{-t}u(t)$$

   (a) Find the impulse response of the overall system.

   (b) Determine whether the overall system is BIBO stable.

7. Show that if the input $x[n]$ to a discrete time LTI system is periodic with period N, then the output $y[n]$ is also periodic with period N.

8. Consider a discrete time system S_1 with $h[n] = (1/5)^n u[n]$.

   (a) Find the integer A such that $h[n] - Ah[n] = \delta[n]$

   (b) Using the result from part (a) determine the impulse response $g[n]$ of the LTI system S_2, which is the inverse of system S_1.

9. Let $x(t) = 1 + \sin(\omega_0 t) + 2cos(\omega_0 t) + \cos(2\omega_0 t) + \pi/4)$ which has fundamental frequency ω_0 Give this as a linear combination of complex exponentials and identify Fourier series coefficients.

10. Consider the convolution

$$y(t) = \sin(\pi t)\,[u(t+1) - u(t-1)] * [u(t+1) - u(t-1)]$$

   (a) Sketch the two signals.

   (b) Evaluate the convolution.