Assignment 2: LTI Systems

Signals & Systems

Complete the following problems. Please submit your solutions to these problems in a single PDF document to the course site. Use the *lastname_firstname_PS02.pdf* format for your file name.

1. Suppose the input signal $x(t)$ and the impulse response $h(t)$ of a continuous-time LTI system are given by

$$x(t) = e^{t}u(t)$$

$$h(t) = e^{-t}u(t)$$

   Find the output signal $y(t)$ of this LTI system using continuous-time convolution.

2. Consider the LTI system described in Problem 1 above. Determine whether the system is
   (a) Stable. Give a reason for your answer
   (b) Causal. Give a reason for your answer
   (c) Memoryless. Give a reason for your answer

3. Compute the discrete-time convolution between the following two signals (you may use the MATLAB command *conv* to **verify** your answer). Note that the underscore denotes the $n = 0$ point.

$$x[n] = \{-1,\ \underline{0},\ 2\} \text{ and } h[n] = \{\underline{5},\ 4, -3,\ 1, -2\}$$

4. Suppose we have a linear, time-invariant discrete-time system with an *unknown* impulse response $h[n]$. We note that the LTI system yields the following input-output pair

$$x[n] = \{\underline{-1},\ 2, -3\} \quad \Longrightarrow \quad y[n] = \{\underline{-2},\ 5,\ -11,\ 8,\ -7, -3\}$$

Find the system impulse response $h[n]$. Note that the underscore denotes the $n = 0$ point.

5. Consider the following impulse response $h[n]$ for a linear, time-invariant discrete-time system:

$$h[n] = \{2, -3, \underline{7}, 3, -1\}$$

(a) Is the LTI system causal? Why or why not?

(b) Is the LTI system stable? Why or why not?

(c) Is the LTI system FIR or IIR? Give a reason for your answer.

(d) Does the LTI system have memory? Give a reason for your answer.

Note that the underscore denotes the $n = 0$ point.