In the Name of Allah

Assignment 2

Deadline : 1401 / 01 / 10

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1. Discuss the causality and stability of the following discreate-time signals.

$a)\ h[n] = 2^{-n}u[-n+1]$,

$b)\ h[n] = (-1)^n e^{-n+1}u[-n+1]$

c) $h[n] = \sum_{k=-\infty}^{\infty} \delta(n - kN)$

2. Compute $y[n]$ using the convolution sum $y[n] = x[n]^* h[n]$.

a) $\begin{cases} x[n] = \left(\frac{1}{3}\right)^{-n} u[-n-1] \\ h[n] = u[n-1] \end{cases}$

b) $\begin{cases} x[n] = \cos\left(\frac{\pi \cdot n}{6}\right) \\ h[n] = \left(\frac{1}{2}\right)^n u[n] \end{cases}$

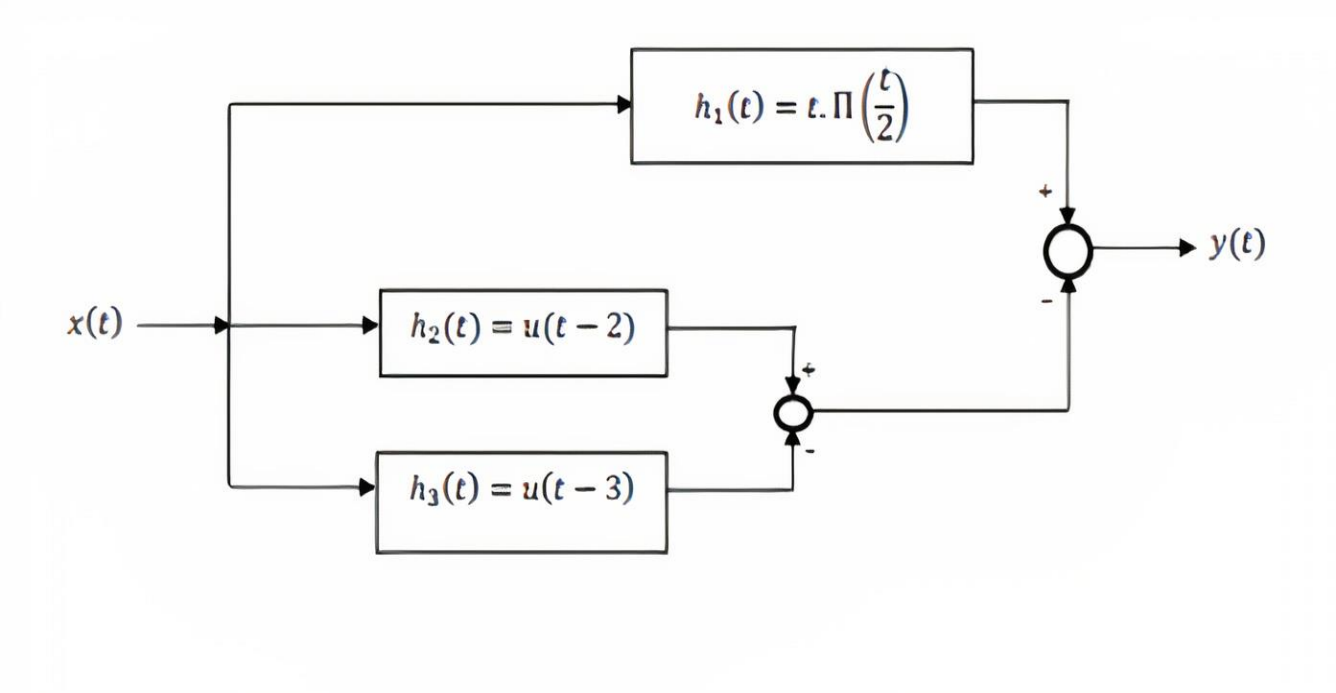
c) $\begin{cases} X(t) = e^{-t}u(t) \\ h(t) = \mathrm{Cos}(t)\,.\,(u(t) - u(t-T)) \end{cases}$

d) $\begin{cases} x[n] = \sum_{k=-\infty}^{+\infty} \delta[n - kN] \\ h[n] = \left(\frac{1}{2}\right)^n u[n] \end{cases}$

3. Prove that the following systems are inverse of each other.

$$h_1(t) = e^{-t}u(t), \quad h_2(t) = \delta(t) + \delta'(t)$$

4. Consider the following system. If the input signal of this system is $x(t) = \Pi\left(\frac{t}{2}\right)$. Find the output? ($h_i(t)$ is an LTI system.)



$$\Pi(t) = \begin{cases} 0, & \text{if } |t| > \frac{1}{2} \\ \frac{1}{2}, & \text{if } |t| = \frac{1}{2} \\ 1, & \text{if } |t| < \frac{1}{2}. \end{cases}$$

5. Consider an LTI system with input and output related through the equation

$$y(t) = \int_{-\infty}^{t} e^{-(t-\tau)} x(\tau - 2) d\tau$$

a. What is the impulse response $h(t)$ for this problem?
b. Determine the response of the system when the input $x(t)$ is as shown in Fig 1.

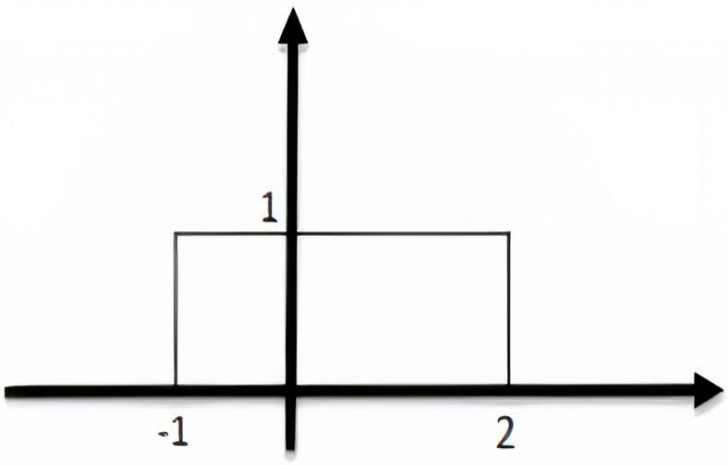


Figure 1

6. Consider an LTI system defined by the following difference equation

$$y[n] + \frac{1}{2} y[n-1] = x[n]$$

a) Find the impulse response of the system.
b) Given the output of the system, $y[n] = \delta[n-1] + 2\delta[n-2] - \delta[n-3]$, determine the input.

7. a) The input and output of a LTI system are given as :

$$x(t) = \sin(t)u(t)$$
$$y(t) = (e^{-t} - \cos t)u(t)$$

Find the impulse response of the system (You should just use the convolution properties)

b) Consider a LTI system with impulse response of $h(t) = e^{-5}u(t)$.

Find an input for this system in a way to obtain $y(t) = \sin(t) + \cos(2t)$.

as output (You should just use the convolution properties).

8. For each of the following LTI systems determine whether the corresponding system is (i) Stable (ii) Causal.

(a) $h_1(t) = \delta(t) + e^{-5t}u(t)$
(b) $h_2(t) = e^{-5t}\sin(2\pi t)u(t)$
(c) $h_3(t) = e^{-2|t|} + u(t+1) - u(t-1)$
(d) $h_4(t) = t[u(t+4) - u(t-4)]$
(e) $h_5(t) = \sin(10t)$
(f) $h_6(t) = \cos(5t)u(t)$
(g) $h_7(t) = 0.95^{|t|}$
(h) $h_8(t) = \begin{cases} 1, -1 \le t < 0 \\ -1, \ 0 \le t \le 1 \\ 0, \ \text{otherwise} \end{cases}$

Good Luck