

EEE391 Homework 4:

① Determine whether the systems described by the following equations are i) linear ii) time invariant iii) causal or not. Justify your answer in each case.

a) $y[n] = \cos|x[n]|$

b) $y[n] = 5x[n-1] + 2$

c) $y[n] = n \times [n+1]$

d) $y[n] = x[\sin(n)]$

e) $y[n] = x[n] \cdot \cos(3n)$

② Consider a system S with input $x[n]$ and output $y[n]$. This system is obtained through a series interconnection of a ^(cascaded) system S_1 followed by a system S_2 . The input-output relationship for S_1 and S_2 are:

$$S_1: y_1[n] = 2x_1[n] + 4x_1[n-1]$$

$$S_2: y_2[n] = x_2[n-2] + \frac{1}{2}x_2[n-3]$$

where $x_1[n]$ and $x_2[n]$ denote input signals, and $y_1[n]$ and $y_2[n]$ denote output signals.

- Determine the input-output relationship for system S .
- Does the input-output relationship of system S change if the order in which S_1 and S_2 are connected is reversed?
- Find the (unit) impulse response of system S .

③ A linear time-invariant (LTI) system produces

$$y_1[n] = \delta[n-1] + 2\delta[n] - \delta[n+1] \text{ when the input}$$

$$x_1[n] = u[n] - u[n-4] \text{ is applied where } u[n] \text{ is the unit-step sequence}$$

Find the output of the system when the following input is applied

a) $x_2[n] = u[n] - 2u[n-4] + u[n-8]$

b) $x_3[n] = 2u[1-n] - 2u[-3-n]$

④ Convolve the two sequences in each part using any method that you like.

a) $x_1[n] = 3\delta[n+3] + 2\delta[n+1] - \delta[n-1]$

$x_2[n] = u[-3-n] - u[n-2]$

b) $x_1[n] = 3\delta[n+2] - 2\delta[n] + 4\delta[n-4]$

$x_2[n] = -\delta[n+1] + \delta[n] + 5\delta[n-3]$

c)

