EEE 5502 HW #02 Hudanyun Sheng

Question #1:

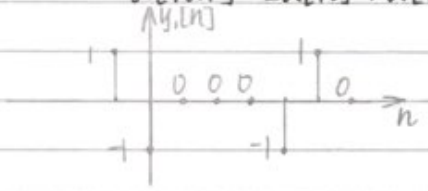
I spent 2 hours.

Question #2:

(a) $y_1[n] = x_1[n+1] - 2x_1[n] + x_1[n-1]$

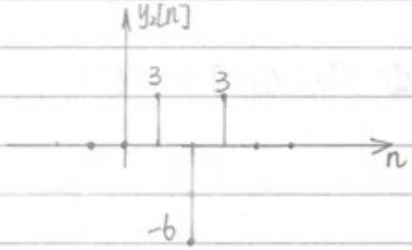
$= u[n+1] - u[n-4] - 2u[n] + 2u[n-5] + u[n-1] - u[n-6]$

$= u[n+1] - 2u[n] + u[n-1] - u[n-4] + 2u[n-5] - u[n-6]$



(b) $y_2[n] = x_2[n+1] - 2x[n] + x[n-1]$

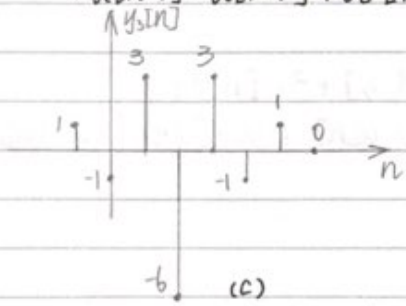
$= 3\delta[n-1] - 6\delta[n-2] + 3\delta[n-3]$



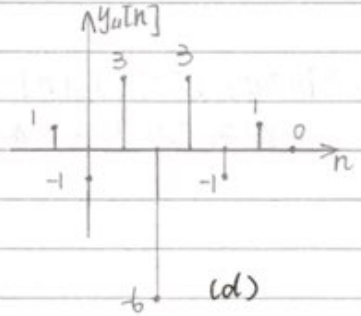
(c) Input: $x_1[n] + x_2[n] = u[n] - u[n-5] + 3\delta[n-2] = x_3[n]$

$y_3[n] = u[n+1] - u[n-4] + 3\delta[n-1] - 2u[n] + 2u[n-5] - 6\delta[n-2]$

$+ u[n-1] - u[n-6] + 3\delta[n-3]$



(c)



(d)

(d) $y_4[n] = H\{x_1[n]\} + H\{x_2[n]\} = y_1[n] + y_2[n]$

The plot is shown above on the right)

(e) Based on the discussion above, the system is linear. The proof is also straightforward and is shown below:

$y_1[n] = H\{a x_1[n]\}$, $y_2[n] = H\{b x_2[n]\}$

$H\{ax_1[n]+bx_2[n]\} = \cancel{ax_1[n+1]-2ax_1[n]+ax_1[n-1]+bx_2[n+1]}$

$ax_1[n+1]+bx_2[n+1]-2ax_1[n]-2bx_2[n]+ax_1[n-1]+bx_2[n-1]$

$= a[x_1[n+1]-2x_1[n]+x_1[n-1]]+b[x_2[n+1]-2x_2[n]+x_2[n-1]]$

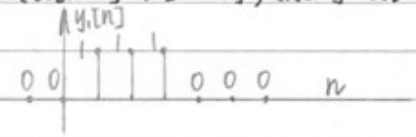
$= ay_1[n]+by_2[n]$

∴ This system is linear.

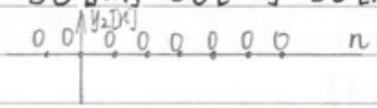
(f) It calculates the difference between "the summation of the past and future signal" and two times the current input signal.

Question #3:

(a) $y_1[n] = (u[n+1]-u[n-4])(u[n]-u[n-5])(u[n-1]-u[n-6])$

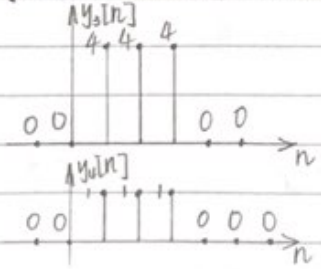


(b) $y_2[n] = 3\delta[n+1]\cdot 3\delta[n-2]\cdot 3\delta[n-3] = 27\,\delta[n+1]\cdot\delta[n-2]\cdot\delta[n-3]$



(c) Input: $x_1[n]+x_2[n] = u[n]-u[n-5]+3\delta[n-2]$

$y_3[n] = (u[n+1]-u[n-4]+3\delta[n-1])(u[n]-u[n-5]+3\delta[n-2])(u[n-1]-u[n-6]+3\delta[n-3])$



(d)

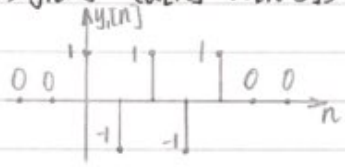
(e) Based on part (c) and (d), the system is not a linear system.

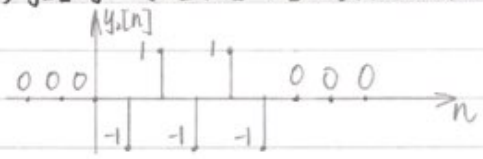
(f) It calculates the production of the past, current and future input

signal.

Question #4:

(a) $y_1[n] = (u[n] - u[n-5])\cos(\pi n)$ (b) $y_2[n] = (u[n-1] - u[n-6])\cos(\pi n)$





(c) This system is not time-invariant. because when the input is $x[n-1]$, the output of the system is not $y[n-1]$ ~~only on the current input signal.~~

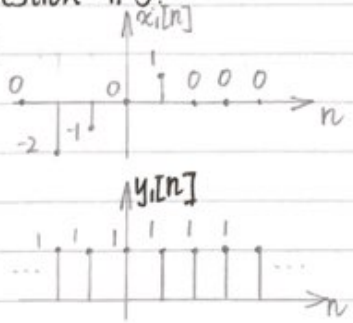
~~$H\{x[n+N]\} = x[n+N]\cos(\pi(n+N))$~~

(d) This system is memoryless, because the output of the system depends only on $x[n]$ at current time.

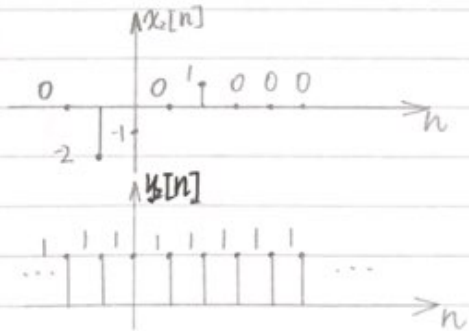
(e) ~~The system gives only 1 or -1 outputs~~. The $\cos(\pi n)$ gives only -1 and 1. So the system either ~~at~~ outputs the input signal, or outputs the negative values of the input signals.

Question #5:

(a)



(b)



(c) The system is time-invariant based on the discussions above. When the input is $x[n-1]$, the output of the system becomes $y[n-1]$.

(e) This system can be used to filter out any input signal with values smaller than 1. outputs values are all not less than 1.