Name Answers

EE-3221 – Dr. Durant – Quiz 5
Winter 2020-'21, Week 5

This is an ***open***-book quiz. As always, you may also refer to your homework that is due today.

1. (2 points) Let y[n] = 3 x[n] – 2 x[n-1] + x[n-3]. Find the system impulse response, h[n].
2. (2 points) Let y[n] = 0.5 y[n-1] + x[n]. Find the system impulse response, h[n].

(1) Sub in $x[n]=\delta[n]$. Then $y[n]$ becomes $h[n]$

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

$=\{3,-2,0,1\}$

(-1/2) step response

(2) $h[n]=\frac{1}{2}h[n-1]+\delta[n]$

"Assume" $h[-1]=0$. It must, since the equation is causal & in a known LTI form.

n	h[n-1]	δ[n]	$h[n]=\frac{1}{2}h[n-1]+\delta[n]$
0	0	1	$\frac{1}{2}\cdot 0+1=1$
1	1	0	$\frac{1}{2}\cdot 1+0=\frac{1}{2}$
2	1/2	0	$\frac{1}{2}\cdot\frac{1}{2}+0=1/4$
3	1/4	0	$\frac{1}{2}\cdot\frac{1}{4}+0=1/8$
4	1/8	0	$\frac{1}{2}\cdot\frac{1}{8}+0=1/16$

$h[n]=\{1,\frac{1}{2},\frac{1}{4},\frac{1}{8},\dots\}$

$=(\frac{1}{2})^n u[n]$

(-1/4) δ.v. u in final answer
(-1/2) only 2 terms
(-1/4) a_1 sign reversal
(-1/2) step response

(question #3 on back)

3. (6 points) Find the result of convolving x[n] = {3, 2, 1} with h[n] = {7, -1, 5}.

$$y[n] = \sum_k x[k]\,h[n-k]$$

- $x[k]$: scale by sample @ time k
- $h[n-k]$: shift impulse response right by k samples

k	x[k]	n=0	n=1	n=2	n=3	n=4
0	3	21	-3	15		
1	2		14	-2	10	
2	1			7	-1	5
		21	11	20	9	5

$y[n] = \{21, 11, 20, 9, 5\}$

Check: Area Property: $A_x = \sum_n x[n] = 3+2+1 = 6$

$A_h = 7-1+5 = 11$

$A_y = 21+11+20+9+5 = 66$ ✓

$A_y \stackrel{?}{=} A_x \cdot A_h = 6 \cdot 11 = 66$

Width Property

$W_x = n_{xend} - n_{xstart} + 1 = 2-0+1 = 3$ samples

$W_h = 2-0+1 = 5$

$W_y = 4-0+1 = 5$

$W_y \stackrel{?}{=} W_x + W_h - 1 = 3+3-1 = 5$ ✓