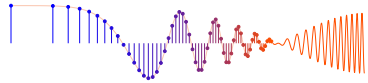


PROBLEM:

This problem is concerned with finding the output of an FIR filter for a given input signal. A linear time-invariant system is described by the difference equation

$$y[n] = \sum_{k=0}^{4} (5-k)x[n-k]$$

(a) Determine the filter coefficients $\{b_k\}$ of this FIR filter.

(b) Find the impulse response, $h[n]$, for this FIR filter. The impulse response is a discrete-time signal, so make a (stem) plot of $h[n]$ versus n.

(c) Use the above difference equation to compute the output $y[n]$ when the input is

$$x[n] = \begin{cases} 0 & n < 0 \\ 10 & 0 \le n \le 5 \\ 1 & 6 \le n \le 10 \\ 0 & n \ge 11. \end{cases}$$

Make a plot of both $x[n]$ and $y[n]$ vs. n. (Hint: you might find it useful to check your results with MATLAB's `conv( )` function.)

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

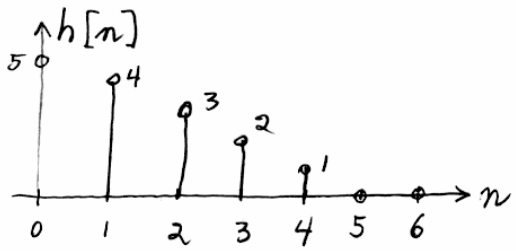
SOLUTION

(a)

k	$5-k$
0	5
1	4
2	3
3	2
4	1

$$[b_k] = [5 \quad 4 \quad 3 \quad 2 \quad 1]$$

(b)



(c)

$n=$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$h[n]$	5	4	3	2	1												
$x[n]$	10	10	10	10	10	10	1	1	1	1	1	0	0	0	.	.	.
	50	40	30	20	10												
		50	40	30	20	10											
			50	40	30	20	10										
				50	40	30	20	10									
					50	40	30	20	10								
						50	40	30	20	10							
							5	4	3	2	1						
								5	4	3	2	1					
									5	4	3	2	1				
										5	4	3	2	1			
											5	4	3	2	1		
	50	90	120	140	150	150	105	69	42	24	15	10	6	3	1		$= y[n]$

(c)

$n=$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$h[n]$	5	4	3	2	1												
$x[n]$	10	10	10	10	10	10	1	1	1	1	1	0	0	0	.	.	.
	50	40	30	20	10												
		50	40	30	20	10											
			50	40	30	20	10										
				50	40	30	20	10									
					50	40	30	20	10								
						50	40	30	20	10							
							5	4	3	2	1						
								5	4	3	2	1					
									5	4	3	2	1				
										5	4	3	2	1			
											5	4	3	2	1		
$y[n]$	50	90	120	140	150	150	105	69	42	24	15	10	6	3	1