Prelab - 7

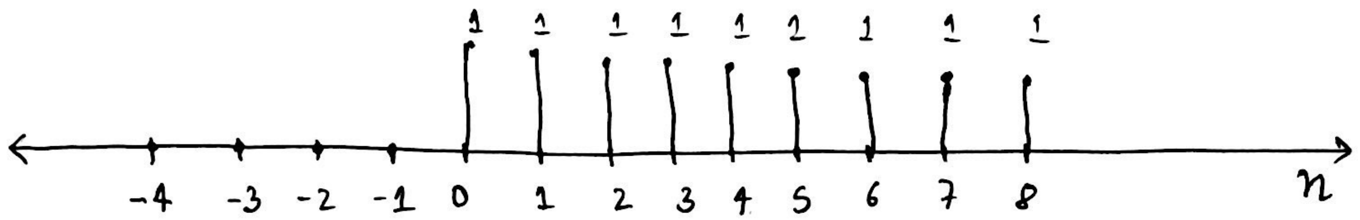
Ravitashaw Bathla
(86369)

1)

$$y[n] = \frac{1}{L} \sum_{k=0}^{L-1} x[n-k]$$

$$x[n] = u[n] = \begin{cases} 0 , & n < 0 \\ 1 , & n \geq 0 \end{cases}$$

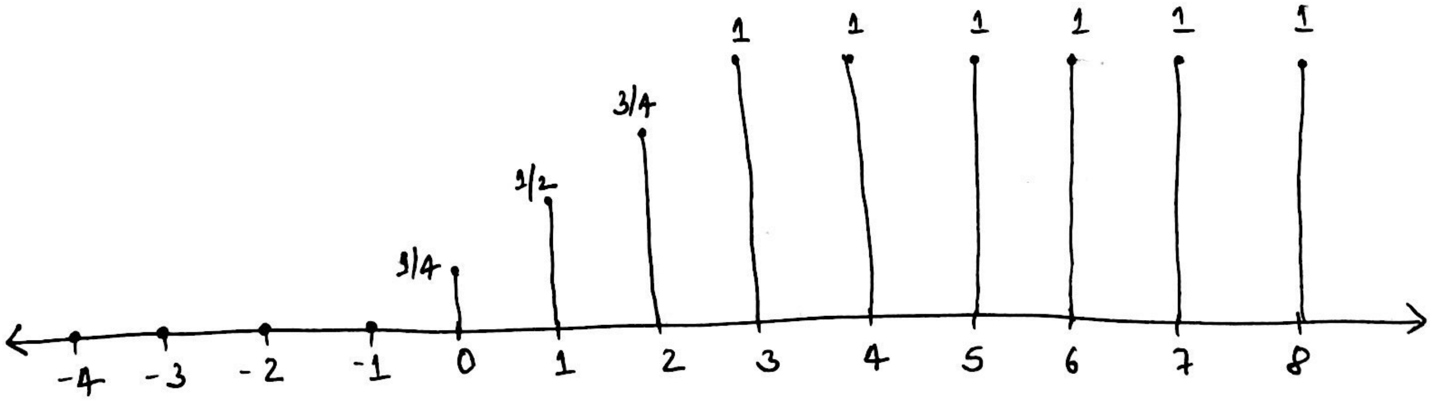
(a)



(b)

	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8
$x[n] = u[n] =$	0	0	0	0	1	1	1	1	1	1	1	1	1
$L = 4$, $y[n] =$	0	0	0	0	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$	1	1	1	1	1	1

(c)



Scanned with CamScanner

(d)

$$y[n] = \begin{cases} 0 & n < 0 \\ \frac{1}{L}(n+1) & 0 \le n < L-1 \\ 1 & n \ge L-1 \end{cases}$$

2)

$$G = \sum_{n=-2}^{6} \left(7\delta[n-3] - 7\delta[n-4]\right) e^{-j0.5\pi n}$$

G_n will have value ~~greater~~ other than 0 for $n = 3$ and $n = 4$, rest all components will be zero.

$$\therefore\ G = 7e^{-j0.5\pi(3)} - 7e^{-j0.5\pi(4)}$$

$$= 7e^{-j1.5\pi} - 7e^{-j2\pi}$$

$$= 7\left[\cos(-1.5\pi) + j\sin(-1.5\pi)\right] - 7\left[\cos(-2\pi) + j\sin(-2\pi)\right]$$

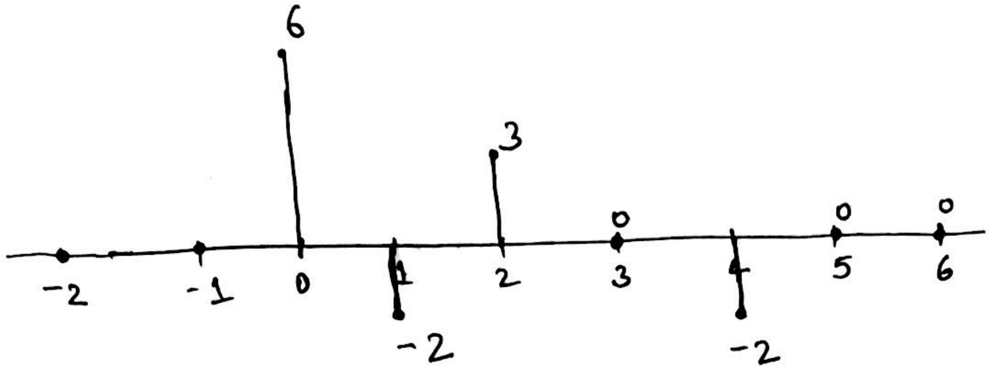
$$= 7[0 + j] - 7[1 + 0]$$

$$= -7 + 7j = 7(-1 + 1j)$$

$$= \underline{\underline{7\sqrt{2}\, e^{j3\pi/4}}} = \underline{\underline{9.898 e^{j2.36}}}$$

3) $x[n] = \delta[n]$

$h[n]$



(a) Filter Coefficients b_k :

k	0	1	2	3	4	5
b_k	6	-2	3	0	-2	

(b) Difference equation,

$$= 6\,\delta[n] - 2\,\delta[n-1] + 3\,\delta[n-2] - 2\,\delta[n-4]$$

(c) Length of filter, $L = 5$

(d) Order of filter $= M = L - 1 = 4$

(e) (next - page - continued)

3)
(e)

$$x[n] = u[n]$$

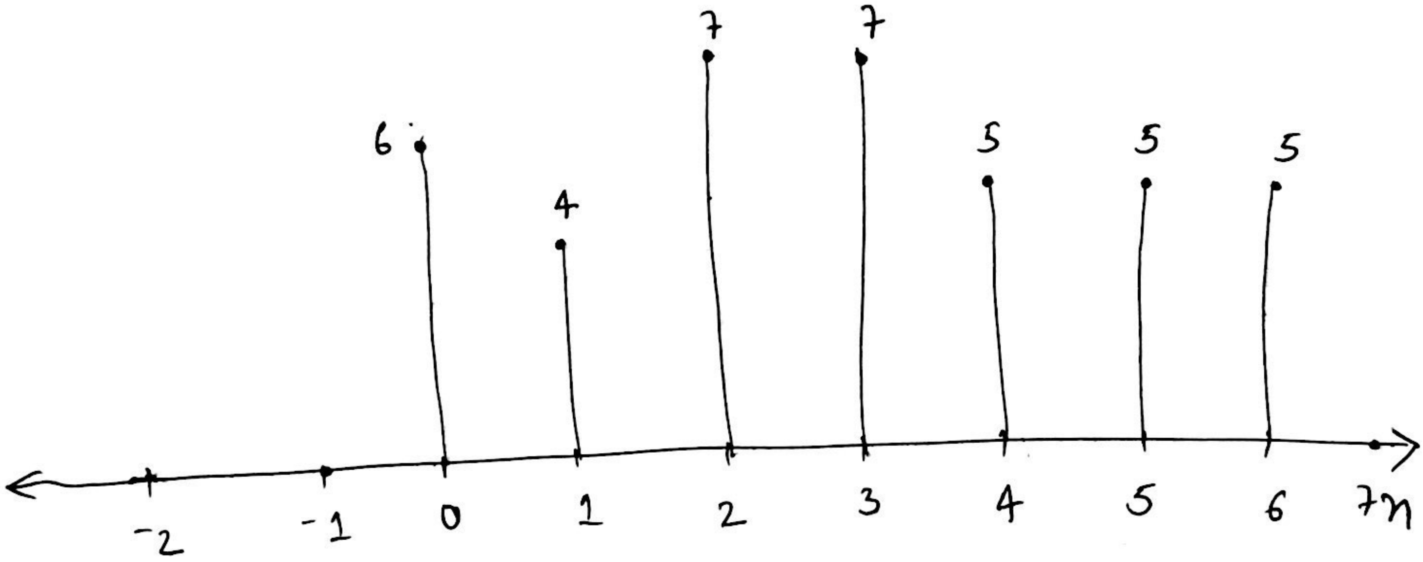
$$u[n] = \begin{cases} 0 & n < 0 \\ 1 & n \geq 0 \end{cases}$$

$$y[n] = \sum_{k=0}^{4} \{b_k\} u[n-k]$$

$$y[n] = 6u[n] - 2u[n-1] + 3u[n-2] - 2u[n-4]$$

if $x[n] = u[n]$

$$y[n] = 6u[n] - 2u[n-1] + 3u[n-2] - 2u[n-4]$$



4) $$y[n] = 2x[n] - 3x[n-1] + 2x[n-2]$$

(a)
$$x[n] = \begin{cases} 0 & n < 0 \\ n+1 & n = 0,1,2 \\ 5-n & n = 3,4 \\ 1 & n \geq 5 \end{cases}$$

$$\begin{aligned} y[0] &= 2x[0] - 3x[-1] + 2x[-2] \\ &= 2(0+1) - 0 + 0 = \underline{\underline{2}} \end{aligned}$$

$$\begin{aligned} y[1] &= 2x[1] - 3x[0] + 2x[-1] \\ &= 2(1+1) - 3(0+1) + 0 = 4 - 3 = \underline{\underline{1}} \end{aligned}$$

$$\begin{aligned} y[2] &= 2x[2] - 3x[1] + 2x[0] \\ &= 2(2+1) - 3(1+1) + 2(0+1) = 6 - 6 + 2 = \underline{\underline{2}} \end{aligned}$$

$$\begin{aligned} y[3] &= 2x[3] - 3x[2] + 2x[1] \\ &= 2\cdot(5-3) - 3(2+1) + 2(1+1) = 4 - 9 + 4 = \underline{\underline{-1}} \end{aligned}$$

$$\begin{aligned} y[4] &= 2x[4] - 3x[3] + 2x[2] \\ &= 2(5-4) - 3(5-3) + 2(2+1) = 2 - 6 + 6 = \underline{\underline{2}} \end{aligned}$$

$$\begin{aligned} y[5] &= 2x[5] - 3x[4] + 2x[3] \\ &= 2\cdot 1 - 3(5-4) + 2\cdot(5-3) = 2 - 3 + 4 = \underline{\underline{3}} \end{aligned}$$

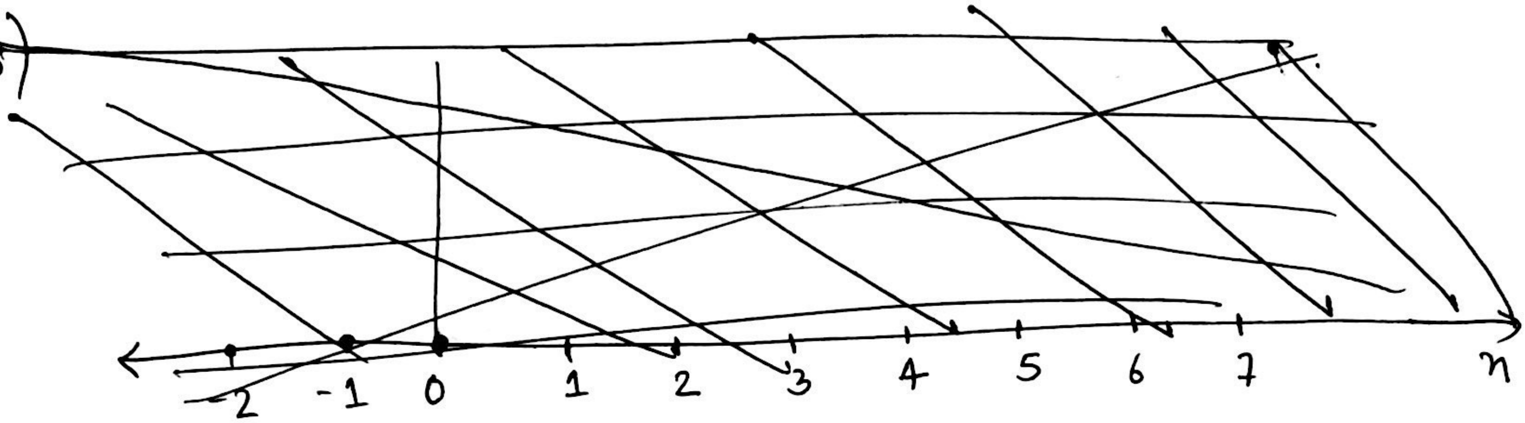
$$y[6] = 2x[6] - 3x[5] + 2x[4]$$

$$= 2\cdot 1 - 3\cdot 1 + 2(5-4) = 2 - 3 + 2 = 1$$

$$y[7] = 2x[7] - 3x[6] + 2x[5]$$

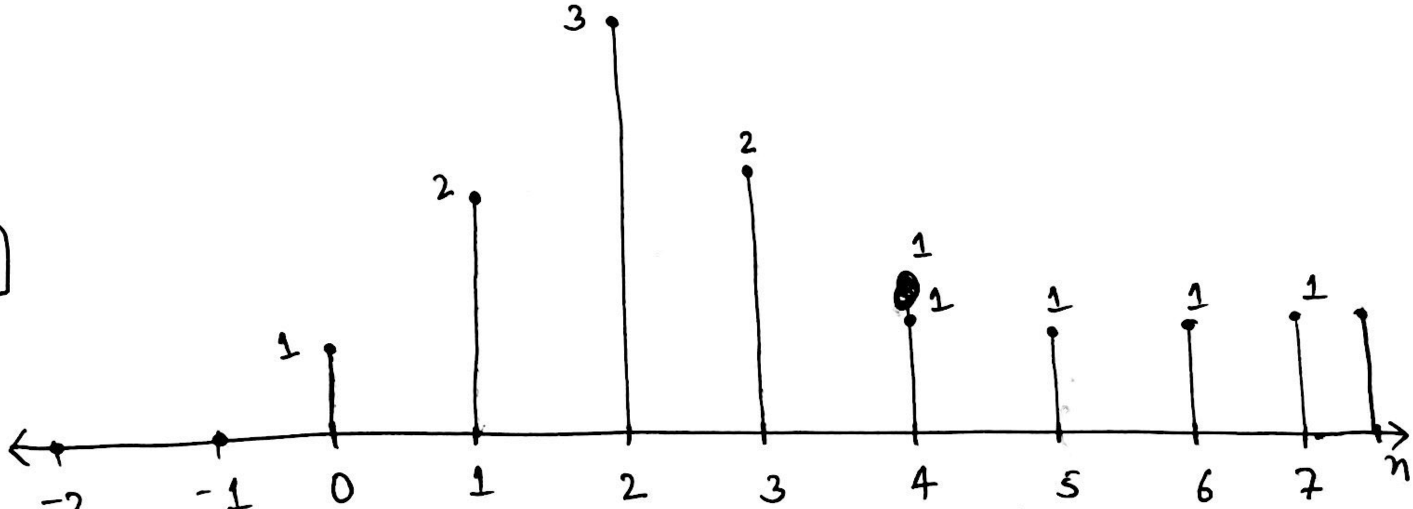
$$= 2\cdot 1 - 3\cdot 1 + 2\cdot 1 = 1$$

(b)

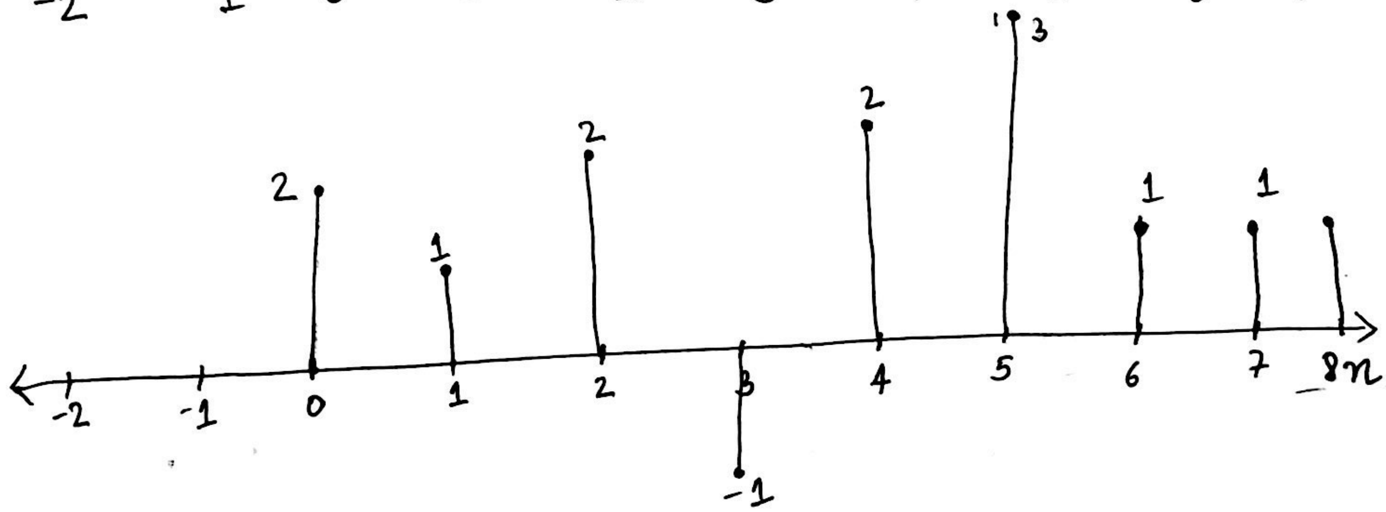


(b)

$x[n]$



$y[n]$



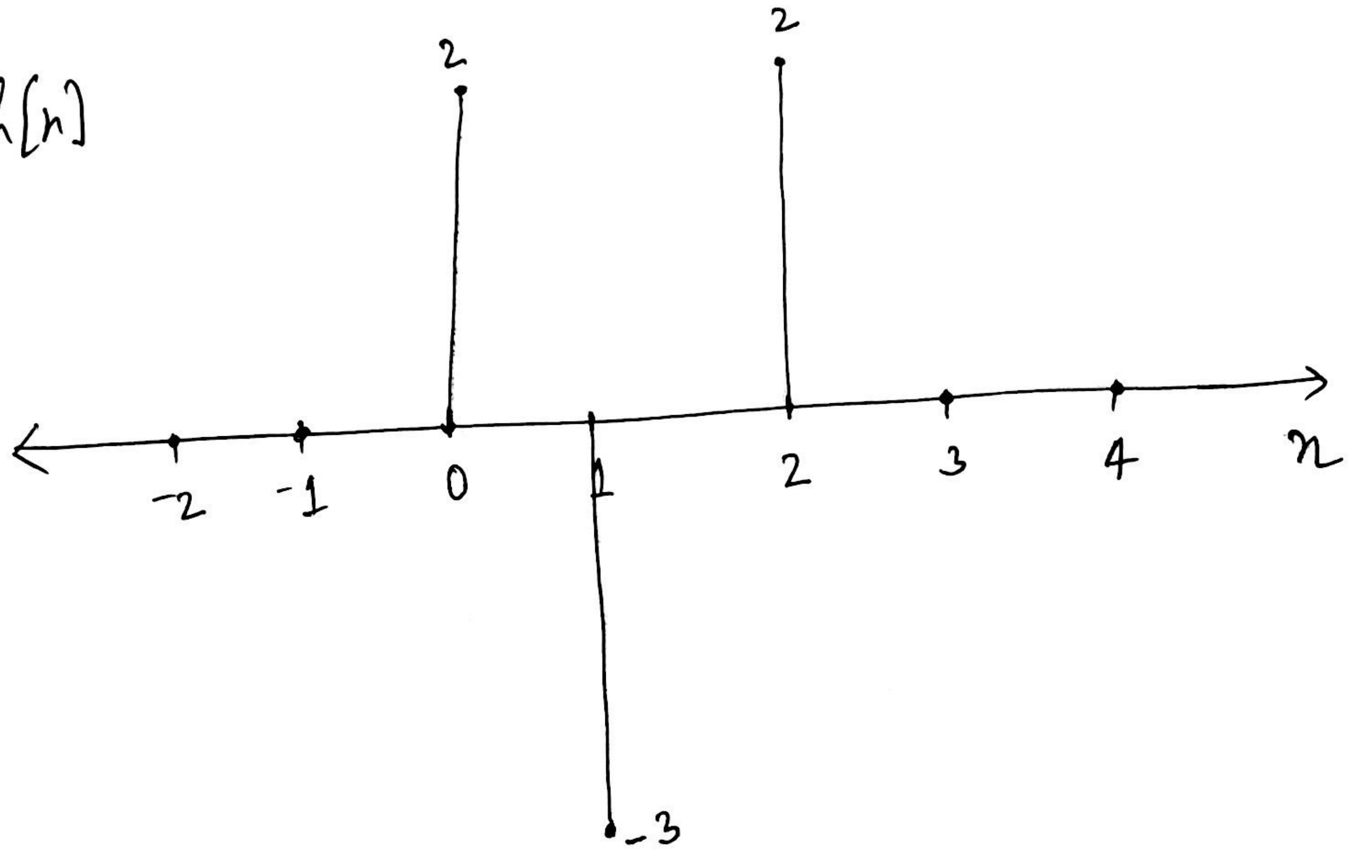
Scanned with CamScanner

(c) $y[n] = h[n]$, when $x[n] = \delta[n]$

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

$$y[n] = h[n] = \begin{cases} 2 & n = 0 \text{ or } 2 \\ -3 & n = 1 \\ 0 & \text{otherwise} \end{cases}$$

$h[n]$



5) (a)

$$y[n] = \sum_{k=0}^{M} b_k x[n-k]$$

$$y[n] = b_0 x[n] + b_1 x[n-1] + b_2 x[n-2] + \cdots$$
$$\cdots\; b_{M-1} x[n-(M-1)] + b_M x[n-M]$$

if $x[n]$ is non-zero for $0 \le n \le N-1$

<u>Lower limit</u> | <u>Upper limit</u>

$\therefore$ $n = 0$ $\qquad$ $n - M = N - 1$

$\therefore$ $n = 0$ $\qquad$ $n = N + M - 1$

$\therefore$ $y[n]$'s support is $0 \le n \le N+M-1$

$\therefore$ $\boxed{P = N + M}$

(b) if $x[n]$ is non-zero for $N_1 \le n \le N_2$

<u>Lower limit</u> | <u>Upper limit</u>

$n = N_1$ $\qquad$ $n - M = N_2$

$n = N_1$ $\qquad$ $n = N_2 + M$

$\boxed{\text{Length of } x[n] = N_2 - N_1 + 1}$. (+1 because of equality)

Scanned with CamScanner

Support of $y[n]$:

$$N_1 \leq n \leq N_2 + M$$

$\therefore$ $\boxed{N_3 = N_1}$

$\boxed{N_4 = N_2 + M}$

$\boxed{\text{Length of } \overset{\text{Support}}{\wedge} y[n] = N_2 + M - N_1 + 1}$