ISRA UNIVERSITY

Islamabad Campus

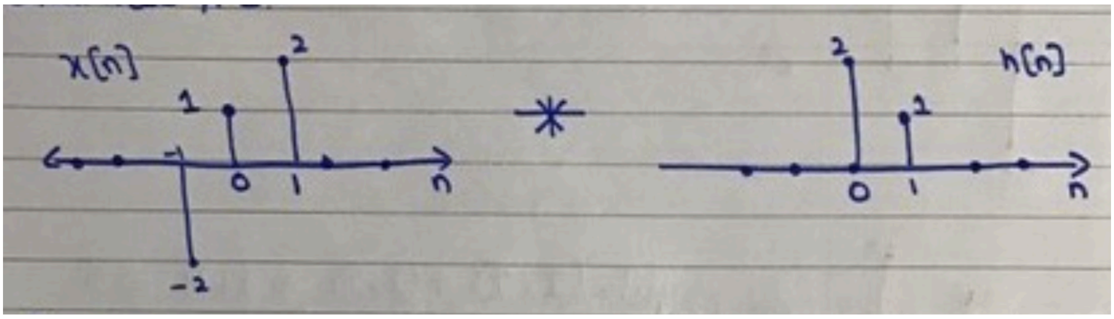
Department of Electrical Engineering
Program: B.E. (Electrical)
Semester - Fall 2016

EL313- Signal & Systems

Quiz – 3 Solution
Marks: 15 **Handout Date: 23/11/2016**

Question # 1:

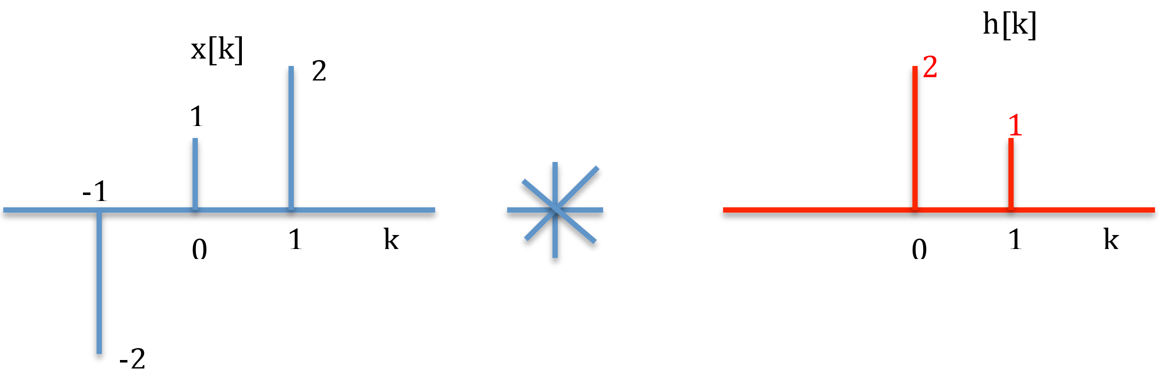
Compute and plot y [n] = x[n] * h[n], where:



Solution:

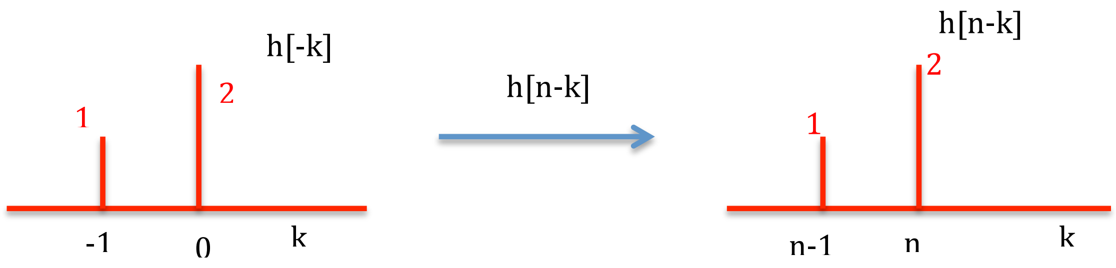
Step#1:

Change the subscript n to k.



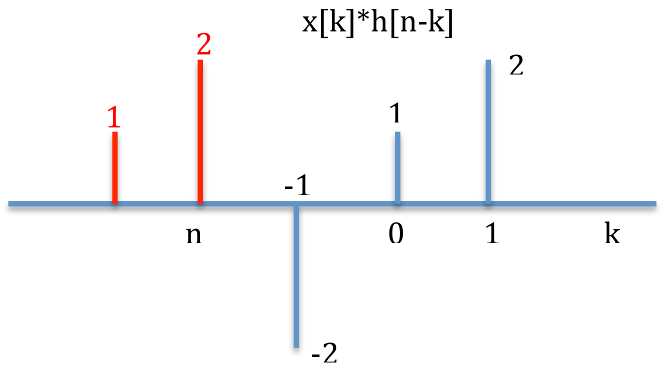
Step#2:

Flip and shift anyone of the signal. Here we are flipping and shifting h[k].



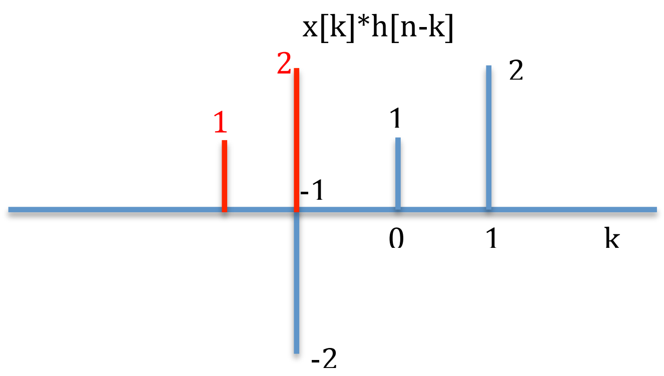
Step#3:

Start sliding h [n-k] over the signal x [k] and convolve.



$$when\ n < -1$$

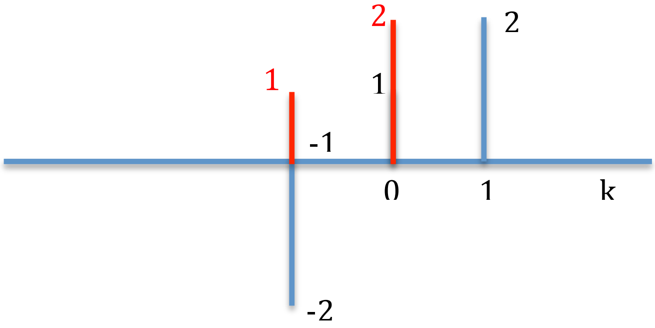
$$\sum_{n=-\infty}^{\infty} x[k]h[n-k] = 0\ As\ there\ is\ no\ overlapping$$



$$when\ n = -1$$

$$y[-1] = \sum_{n=-\infty}^{\infty} x[k]h[n-k] = 2\times(-2) \Rightarrow -4$$

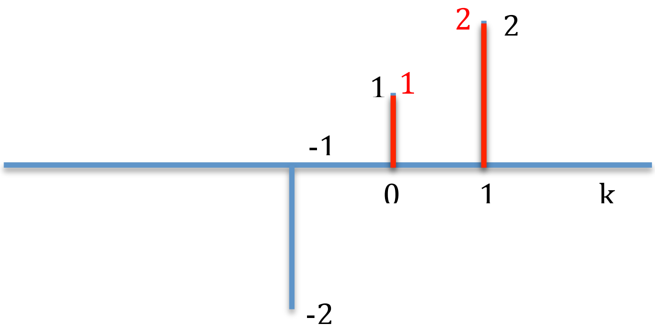
x[k]*h[n-k]



$$when\ n = 0$$

$$y[0] = \sum_{n=-\infty}^{\infty} x[k]h[n-k] = 1\times(-2) + (2\times1) = -2 + 2 \Longrightarrow 0$$

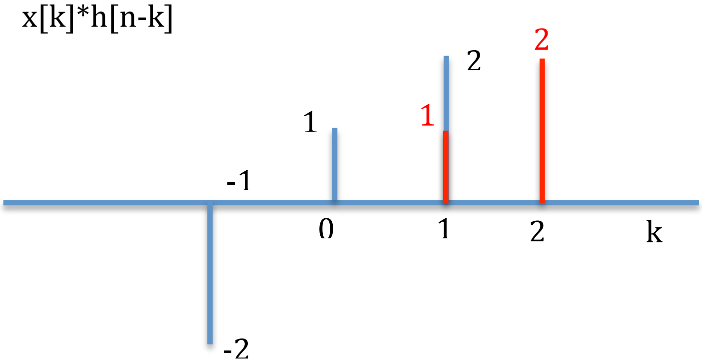
x[k]*h[n-k]



$$when\ n = 1$$

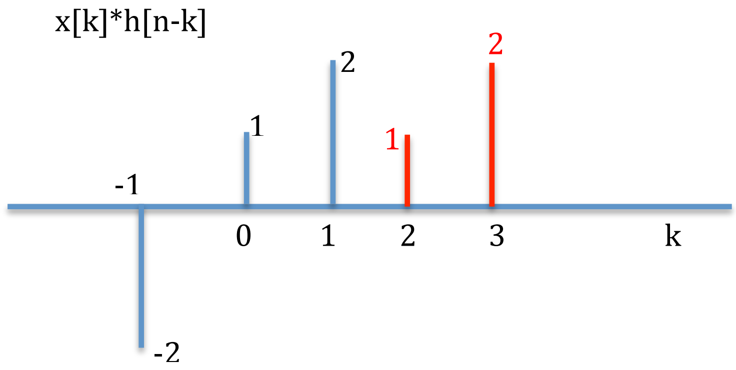
$$y[1] = \sum_{n=-\infty}^{\infty} x[k]h[n-k] = 2\times(2) + (1\times1) = 4 + 1 \Longrightarrow 5$$

x[k]*h[n-k]



$$when\ n = 2$$

$$y[2] = \sum_{n=-\infty}^{\infty} x[k]h[n-k] = 2\times(0) + (1\times2) = 0 + 2 \Longrightarrow 2$$

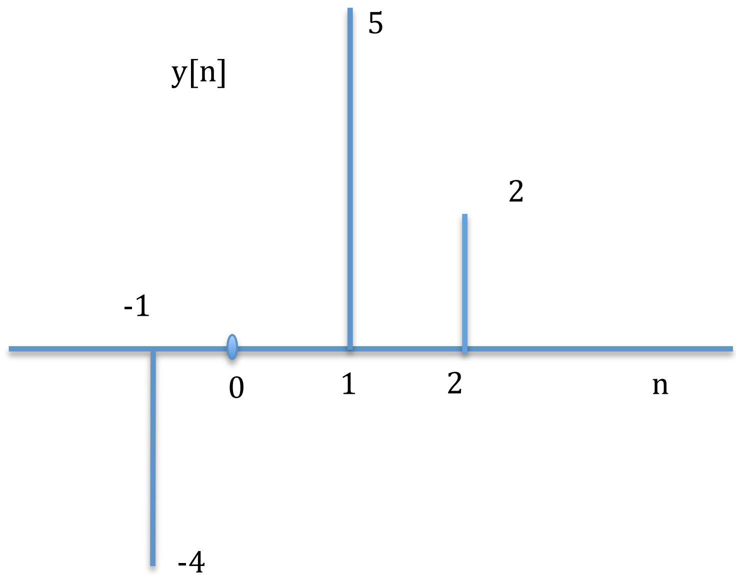


$$when\ n = 3$$

$$y[3] = \sum_{n=-\infty}^{\infty} x[k]h[n-k] = 0\ As\ there\ is\ no\ overlapping$$

Step#4:

Sketch the final signal.



Question # 2:

Find the Fourier series coefficients for each of the following signals:

a) $x(t) = \sin\left(10\pi t + \frac{\pi}{6}\right)$

b) $x(t) = 1 + \cos(2\pi t)$

Solution:

a) $x(t) = \sin\left(10\pi t + \frac{\pi}{6}\right)$

Using Euler's identity:

$$x(t) = \frac{e^{j\pi/6}}{2j} e^{j2\pi t5} - \frac{e^{-j\pi/6}}{2j} e^{-j2\pi t5}$$

The fundamental frequency, $\omega_0 = 2\pi$.

$$x(t) = \sum_k a_k e^{jk\omega_0 t}$$

Where:

$$a_5 = \frac{e^{j\pi/6}}{2j} \;, a_{-5} = \frac{-e^{-j\pi/6}}{2j}$$

Otherwise $a_k = 0$.

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b) $x(t) = 1 + \cos(2\pi t)$

Using Euler's identity:

$$x(t) = 1 + \frac{e^{j2\pi t}}{2} + \frac{e^{-j2\pi t}}{2}$$

The fundamental frequency, $\omega_0 = 2\pi$.

$$x(t) = \sum_k a_k e^{jk\omega_0 t}$$

Where:

$$a_{-1} = a_1 = \frac{1}{2} \;\&\; a_0 = 1$$

Otherwise $a_k = 0$.

Good Luck