Experiment No: 02

Experiment Name: Write a code for linear convolution and plot the signal using MATLAB.

Theory: Linear convolution is a mathematical operation done to calculate the output of any Linear-Time Invariant (LTI) system given its input and impulse response. It is applicable for both continuous and discrete-time signals. We can represent Linear Convolution as **y(n)=x(n)*h(n)** Here, y(n) is the output (also known as convolution sum). x(n) is the input signal, and h(n) is the impulse response of the LTI system. In linear convolution, both the sequences (input and impulse response) may or may not be of equal sizes. That is, they may or may not have the same number of samples. Thus the output, too, may or may not have the same number of samples as any of the inputs.

Here we can calculate the number of samples in the output of linear convolution. **L = M + N – 1** Where M is the number of samples in x(n). N is the number of samples in h(n).

Graphically, when we perform linear convolution, there is a linear shift taking place. Check out the formula for a convolution.

$$\sum_{-\infty}^{\infty} \mathbf{x(k)h(n-k)}$$

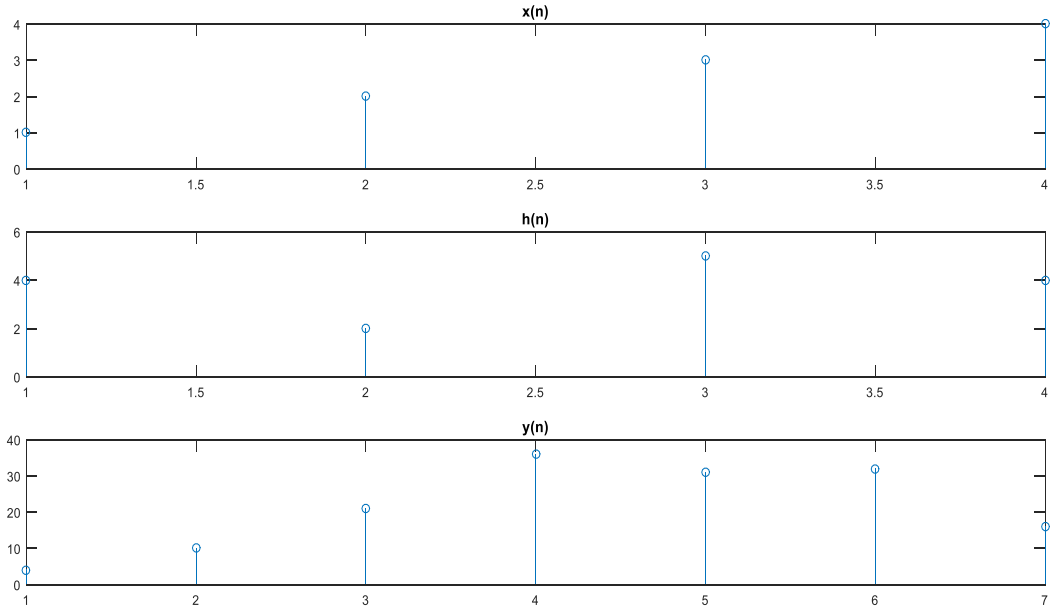
There is a folding of the IR sequence, shifting it by n, multiplying it with another sequence (input), and summing the resulting products.

Code:

```
clc
clear all
xn = [1 2 3 4];
hn = [4 2 5 4];
L = length(xn);
M = length(hn);
X = [xn, zeros(1,L)];
H = [hn, zeros(1,M)];

for n = 1 : L+M-1
    y(n)=0;
    for i = 1 : L
        if(n-i+1>0)
        y(n) = y(n)+X(i)*H(n-i+1)
        end
    end
end
subplot(3,1,1)
stem (xn)
title('x(n)')

subplot(3,1,2)
stem (hn)
title('h(n)')

subplot(3,1,3)
stem (y)
title('y(n)')
```

Output:

```
y =

     4    10    21    36    31    32    16
```



Discussion : Linear convolution code was implemented using MATLAB. For implementing the code, two 1×4 matrix was declared. Then length function was used for the length of the matrix. After that, a nested for loop was used. Here the first for loop was run from 1 to L+M-1. In the second for loop a condition was applied using if condition. Through the if condition a formula was written for the output. After the for loop, I wrote some code for plotting these signal. Here subplot was used. As the signal was discrete, I used stem function to plot the signal.

Conclusion : The code was executed successfully and no errors were found. Form this experiment, we had learned about linear convolution and how to plot the signal using MATALB.