Experiment No.: 14

Experiment Name: Convolution of Two Discrete-Time Signals

Description of the Problem:

The objective of this experiment is to compute the **linear convolution** of two discrete-time signals using MATLAB. Convolution is one of the most fundamental operations in Digital Signal Processing (DSP) and is used to determine the output of an LTI (Linear Time-Invariant) system when the input and the system impulse response are known.

Basic Theory:

In DSP, convolution is used to find how an input signal interacts with a system.
If

- $x[n]$= input signal
- $h[n]$= impulse response

Then output $y[n]$is given by:

$$y[n] = (x * h)[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

Purpose of the Experiment:

- To understand the convolution operation.
- To observe how two signals combine to produce a third signal.
- To practice using MATLAB's built-in **conv()** function.

MATLAB Function Used:

```
y = conv(x, h);
```
This function performs linear convolution between vectors **x** and **h**.

Source Code Sample:

```
clc;
clear all;
```

```
close all;

% Take input signals from the user
x = input('Enter the first signal x[n] as a vector (e.g., [1 2 3]): ');
h = input('Enter the second signal h[n] as a vector (e.g., [1 1 1]): ');

% Compute convolution using built-in conv() function
y = conv(x, h);

% Display result
disp('Convolution y[n] = ');
disp(y);

% Plot signals
figure;

subplot(3,1,1);
stem(x, 'filled');
title('Signal x[n]');
xlabel('n'); ylabel('x[n]');

subplot(3,1,2);
stem(h, 'filled');
title('Signal h[n]');
xlabel('n'); ylabel('h[n]');

subplot(3,1,3);
stem(y, 'filled');
title('Convolution y[n] = x[n] * h[n]');
xlabel('n'); ylabel('y[n]');
```

Sample Input:

When MATLAB asks:

```
Enter the first signal x[n] as a vector: [1 2 3]
Enter the second signal h[n] as a vector: [1 1 1]
```

Sample Output:

Result shown in MATLAB Command Window:

```
Convolution y[n] =
     1     3     6     5     3
```

Screenshot:

Figure 14.1: Plot of Input Signal x[n]
Figure 14.2: Plot of Impulse Response h[n]
Figure 14.3: Plot of Convolution Output y[n]