Experiment No: 15

Experiment Name: Cross-Correlation of Two Given Signals

Description of the Problem:

The purpose of this experiment is to compute the **cross-correlation** between two given discrete-time signals.
Cross-correlation measures **similarity** between two signals for different time shifts.
It is used for pattern matching, delay detection, feature detection, and comparing two signals.

Formula:

$$r_{xy}[k] = \sum x[n] \cdot y[n+k]$$

Here,

- $x[n]$= first signal
- $y[n]$= second signal
- $r_{xy}[k]$= correlation output

This experiment uses MATLAB's built-in **xcorr()** function.

Source Code Sample:

```
clc;
clear all;
close all;

% Take input signals from the user
x = input('Enter the first signal x[n]  ');
y = input('Enter the second signal y[n]  ');

% Compute cross-correlation using built-in xcorr function
r = xcorr(x, y);

% Display result
disp('Cross-correlation r[n] = ');
disp(r);

% Plot the signals and cross-correlation
subplot(3,1,1);
stem(x, 'filled');
```

```
title('Signal x[n]');
xlabel('n'); ylabel('x[n]');
grid on;

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

subplot(3,1,3);
stem(r, 'filled');
title('Cross-correlation r[n] = x[n] * y[n]');
xlabel('CrossCorrelation'); ylabel('r[n]');
grid on;
```

Sample Input:

```
Enter the first signal x[n] : [1 2 3]
Enter the second signal y[n] : [1 1 1]
```

Sample Output:

```
Cross-correlation r[n] =
     1     3     6     5     3
```

Screenshot:

Figure 15.1: Cross-Correlation of x[n] and y[n]