Experiment No: 03
Experiment Date: 08-05-2023
Experiment Name: Study of Auto-correlation & Cross-correlation Using MATLAB

Theory:

1.Autocorrelation: Auto-correlation measures the similarity of a signal with itself as it is shifted by various time lags. In other words, it quantifies how much a signal correlates with a delayed version of itself. Auto-correlation is often used to identify periodicity, repeating patterns, and cyclic behavior within a signal.

2.Cross-correlation: Cross-correlation measures the similarity between two different signals as one of the signals is shifted with respect to the other. It is used to identify how much one signal "matches" or "aligns" with another signal at different time lags. Cross-correlation is widely used in applications such as signal synchronization, time delay estimation, and pattern matching.

By studying the auto-correlation and cross-correlation of signals, we can gain insights into the periodicity, similarity, and time relationships between signals, which can be valuable in applications such as signal processing, time series analysis, and pattern recognition

Code:

For problem 01:

```
x=input('Enter your sequence:');
h=fliplr(x);
a=length(x);
b=length(h);
n=a+b-1;
y=zeros(1,n);
l=1:n;
for i=0:n
for j=0:n
if((i-j+1)>0 && (i-j+1)<=b && (j+1)<=a)
y(i+1)=y(i+1)+x(j+1).*h(i-j+1);
end
end
end
b=xcorr(x,x)
disp(y)
```

```
subplot(4,1,1)
stem(x)
xlabel('n');
ylabel('x[n]');
title('Sequence1');
subplot(4,1,2)
stem(h)
xlabel('n');
ylabel('h[n]');
title('Sequence2');
subplot(4,1,3);
stem(l,y)
xlabel('n');
ylabel('y[n]');
title('Result');
subplot(4,1,4);
stem(b)
xlabel('n');
ylabel('y[n]');
title('Result using built-in function');
```

For problem 02:

```
x = input('Enter the 1st signal sequence:');
h = input('Enter the 2nd signal sequence: ');
z=fliplr(h);
a=length(x);
b=length(z);
n=a+b-1;
y=zeros(1,n);
l=1:n;
for i=0:n
for j=0:n
if((i-j+1)>0 && (i-j+1)<=b && (j+1)<=a)
y(i+1)=y(i+1)+x(j+1).*z(i-j+1);
end
end
end
b=xcorr(x,h)
disp(y)
subplot(4, 1, 1);
stem(x);
```

```
xlabel('n');
ylabel('x[n]');
title('1st Sequence');
subplot(4, 1, 2);
stem(h);
xlabel('n');
ylabel('z[n]');
title('2nd Sequence');
subplot(4, 1, 3);
stem(l,y);
xlabel('n');
ylabel('y[n]');
title('Result');
subplot(4, 1, 4);
stem(b);
xlabel('n');
ylabel('b[n]');
title('Result using built-in function');
```

Output:

For problem 01:

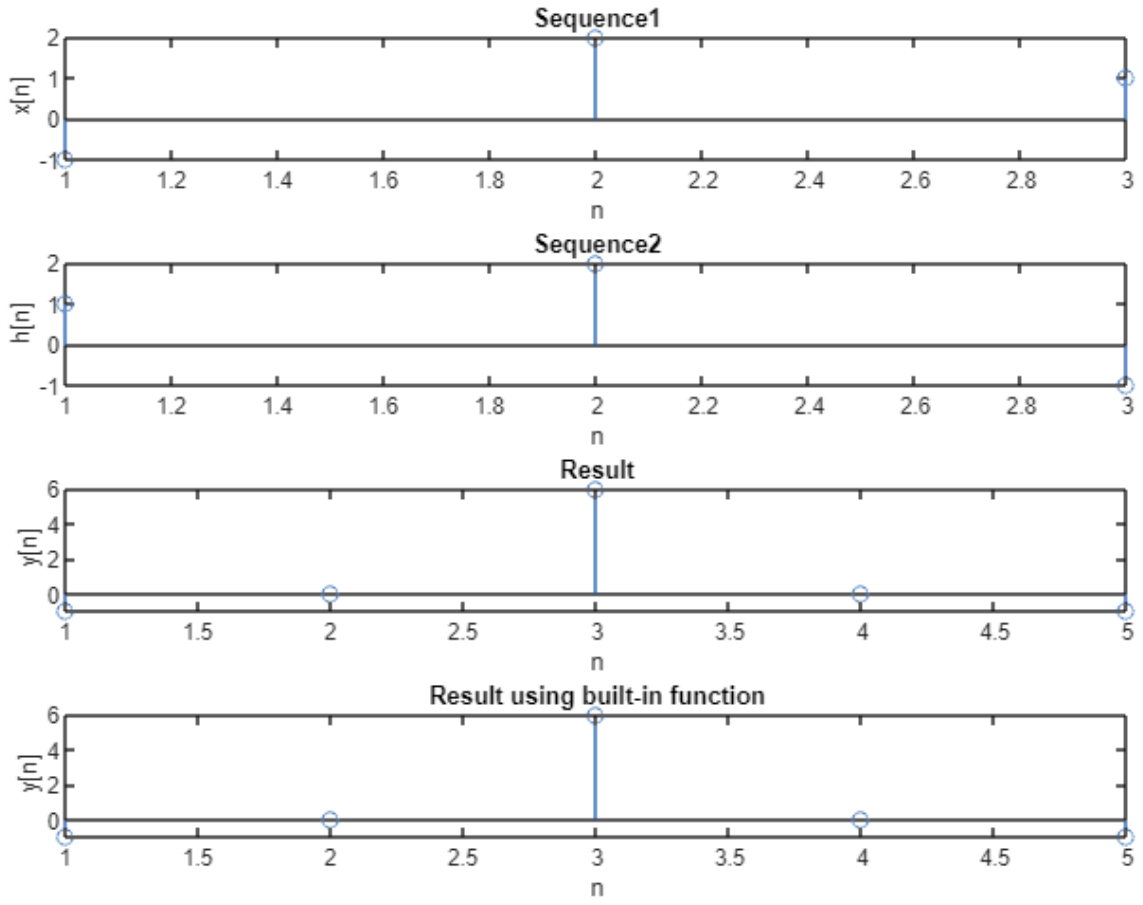

Figure 01: Auto-correlation Output

```
Enter your sequence:
[-1 2 1]

b =

    -1     0     6     0    -1

    -1     0     6     0    -1
```

Figure 02: Auto-correlation Result

For problem 02:

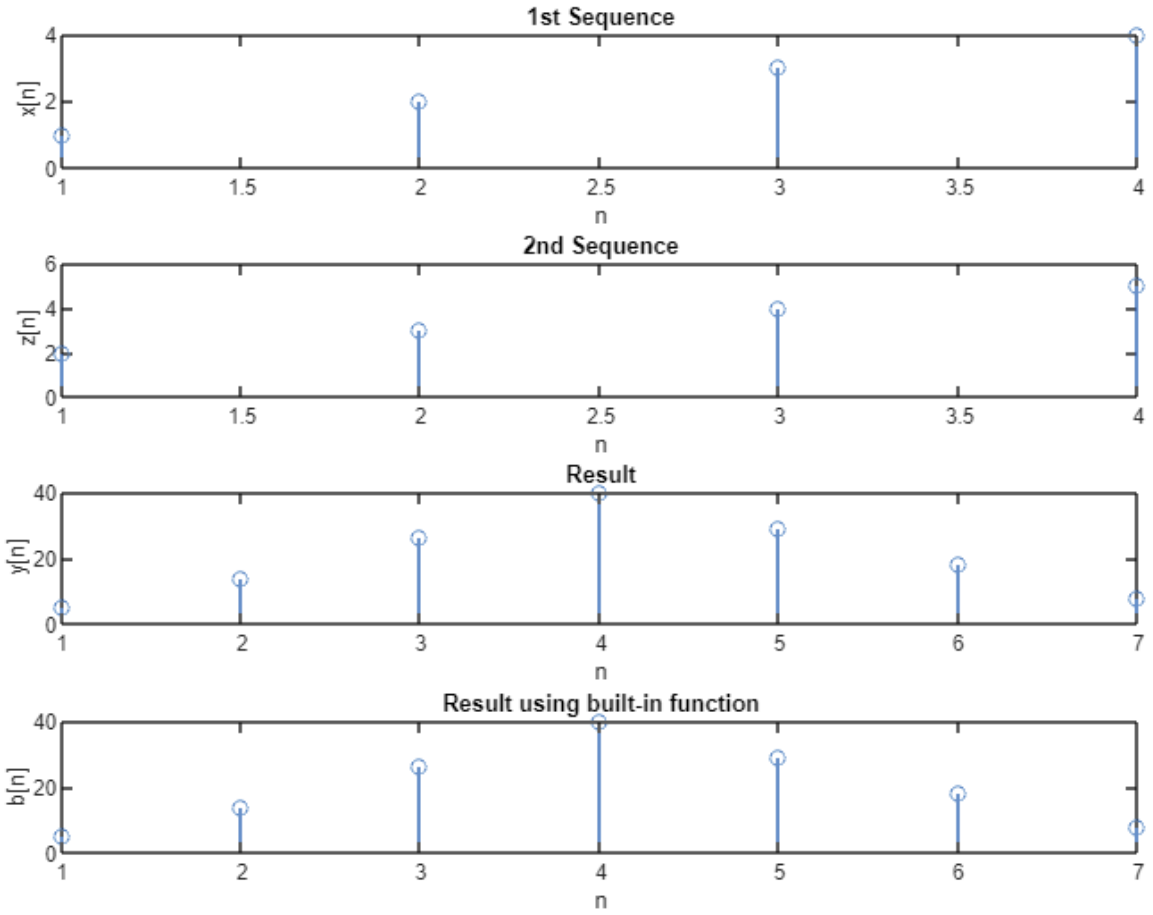

Figure 03: Cross-correlation Output

```
Enter the 1st signal sequence:
[1 2 3 4]
Enter the 2nd signal sequence:
[2 3 4 5]

b =

     5    14    26    40    29    18     8

     5    14    26    40    29    18     8
```

Figure 04: Cross-correlation Result

Discussion and conclusion: Signal autocorrelation and cross-correlation of two signals were performed without the built-in function. The built-in function was also used to check whether the previous output was similar or not. The result obtained was the same in both cases. The signals, their autocorrelation and cross-correlation with and without built-in functions were all plotted in MATLAB. The test was completed successfully.