



## **CODE OF CONDUCT FOR THE LABORATORIES**

- All students must observe the Dress Code while in the laboratory.
- Sandals or open-toed shoes are NOT allowed.
- Foods, drinks and smoking are NOT allowed.
- All bags must be left at the indicated place.
- The lab timetable must be strictly followed.
- Be PUNCTUAL for your laboratory session.
- Program must be executed within the given time.
- Noise must be kept to a minimum.
- Workspace must be kept clean and tidy at all time.
- Handle the systems and interfacing kits with care.
- All students are liable for any damage to the accessories due to their own negligence.
- All interfacing kits connecting cables must be RETURNED if you taken from the lab supervisor.
- Students are strictly PROHIBITED from taking out any items from the laboratory.
- Students are NOT allowed to work alone in the laboratory without the Lab Supervisor
- USB Ports have been disabled if you want to use USB drive consult lab supervisor.
- Report immediately to the Lab Supervisor if any malfunction of the accessories, is there.

### **Before leaving the lab**

- Place the chairs properly.
- Turn off the system properly
- Turn off the monitor.
- Please check the laboratory notice board regularly for updates.



## GENERAL LABORATORY INSTRUCTIONS

You should be punctual for your laboratory session and should not leave the lab without the permission of the teacher.

Each student is expected to have his/her own lab book where they will take notes on the experiments as they are completed. The lab books will be checked at the end of each lab session. Lab notes are a primary source from which you will write your lab reports.

### Organization of the Laboratory

It is important that the programs are done according to the timetable and completed within the scheduled time.

You should complete the pre-lab work in advance and utilize the laboratory time for verification only.

The aim of these exercises is to develop your ability to understand, analyze and test them in the laboratory.

A member of staff and a Lab assistant will be available during scheduled laboratory sessions to provide assistance.

Always attempt program first without seeking help.

When you get into difficulty; ask for assistance.

### Assessment

The laboratory work of a student will be evaluated continuously during the semester for 25 marks. Of the 25 marks, 15 marks will be awarded for day-to-day work. For each program marks are awarded under three heads:

- Pre-lab preparation – 5 marks
- Practical work – 5marks, &
- Record of the Experiment – 5marks

Internal lab test(s) conducted during the semester carries 10 marks.

End semester lab examination, conducted as per the JNTU regulations, carries 50 marks.

At the end of each laboratory session you must obtain the signature of the teacher along with the marks for the session out of 10 on the lab notebook.

### Lab Reports

Note that, although students are encouraged to collaborate during lab, each must individually prepare a report and submit.

They must be organized, neat and legible.

Your report should be complete, thorough, understandable and literate.

You should include a well-drawn and labeled engineering schematic for each circuit investigated

Your reports should follow [the](#) prescribed format, to give your report structure and to make sure that you address all of the important points.

Graphics requiring- drawn straight lines should be done with a straight edge. Well drawn free-hand sketches are permissible for schematics.



Space must be provided in the flow of your discussion for any tables or figures. Do not collect figures and drawings in a single appendix at the end of the report.

Reports should be submitted within one week after completing a scheduled lab session.

### **Presentation**

Experimental facts should always be given in the past tense.

Discussions or remarks about the presentation of data should mainly be in the present tense.

Discussion of results can be in both the present and past tenses, shifting back and forth from experimental facts to the presentation.

Any specific conclusions or deductions should be expressed in the past tense.

### **Report Format:**

Lab write ups should consist of the following sections:

**Aim:**

**Equipments:**

**Circuit Diagram:**

**Theory:**

**Procedure:**

**Expected Waveform:**

**Observation and Calculations:**

**Results:**

**Conclusions:**

.

*Note: Diagrams if any must be drawn neatly on left hand side.*

## **LIST OF EXPERIMENTS**

- 1. Basic Operations on Matrices.**
- 2. Generations of Various Signals and sequences (periodic and Aperiodic), such as unit impulses, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.**
- 3. Operation on Signals and sequences such as addition, Multiplication, Scaling, Shifting, Folding, Computation of energy and average power**
- 4. Finding the even and odd parts of signal/sequence and real and imaginary parts of signal.**
- 5. Convolution between Signals and Sequences**
- 6. Auto correlation and cross correlation between signals and sequences.**
- 7. Verification of linearity and time invariance properties of a given continuous/discrete system.**
- 8. Computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.**
- 9. Gibbs phenomenon**
- 10. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.**
- 11. Wave form synthesis using Laplace Transforms.**
- 12. Locating the zeros and poles and plotting the pole-zero maps in S-plane and Z-plane for the given transfer function.**
- 13. Generation of Gaussian noise (Real and Complex), computation of its mean, M.S. value and its Skew, kurtosis, and PSD, probability distribution function.**
- 14. Sampling theorem verification.**
- 15. Removal of noise by auto correlation/cross correlation.**
- 16. Extraction of periodic signal masked by noise using correlation.**
- 17. Verification of wiener – Khinchine relations.**
- 18. Checking a random process for stationary in wide sense**

## Experiment: 1

### Aim:-

: Basic Operations on Matrices (Addition, Subtraction, Multiplication, Determinant, Trace, Inverse, Rank etc.,)

### Pre lab:-

1. Study all the basic operations on Matrices

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

#### 1. Basic Program for Addition, Subtraction and Multiplication of two matrices.

```
clear all;
close all;
clc;
A = input('Enter the Matrix A ::');
B = input('Enter the Matrix B ::');
%%% Find the size of matrices
disp('The size of Matrix A is .... :: ');disp(size(A));
disp('The size of Matrix B is .... :: ');disp(size(B));

%%% Find the length of vector
P = length(A);
Q = length(B);

%%% Addition of two matrices

disp('Addition of A and B Matrices is .....: ');
disp(A + B);

%%%% Subtration of two matrices
disp('Subtraction of A and B Matrices is .....: ');
disp(A - B);

%%%%% Multiplication (ELEMENT BY ELEMENT) of two matrices
disp('Multiplication of A and B Matrices is .....: ');
disp(A .* B);
```

### **OUTPUT**

```
Enter the Matrix A ::[1 2 3 4 5 6 7]
Enter the Matrix B ::[1 2 3 4 5 6 7]
The size of Matrix A is .... ::
 1  7
```

```
The sise of Matrix B is .... ::
```

1 7

Addition of A and B Matrices is .....::

2 4 6 8 10 12 14

Subtraction of A and B Matrices is .....::

0 0 0 0 0 0 0

Multiplication of A and B Matrices is .....::

1 4 9 16 25 36 49

## 2. Basic Program for Determinant, Trace, Inverse, Rank of a Square Matrix.

```
clear all;
close all;
clc;

A = input('Enter the Square Matrix A ::');

% Finding the Rank of the matrix
disp('Rank of Matrix A is ::');disp(rank(A));

% Find the determinant of the matrix
disp('Determinant of Matrix A is ::'); disp(det(A));

% Find the trace of the matrix
disp('Trace of Matrix A is ::');disp(trace(A));

% Find the Inverse of the matrix
disp('Inverse of Matrix A is ::');disp(inv(A));
```

### OUTPUT

Enter the Square Matrix A ::[1 2 3;3 2 3;1 3 3]

Rank of Matrix A is ::

3

Determinant of Matrix A is ::

6

Trace of Matrix A is ::

6

Inverse of Matrix A is ::

-0.5000 0.5000 0.0000

-1.0000 0 1.0000

1.1667 -0.1667 -0.6667

### Post lab:-



1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Expand MATLAB? And importance of MATLAB
2. What is clear all and close all will do?
3. What is disp() and input()?

## Experiment: 2

### Aim:-

: Generate various signals and sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw Tooth, Triangular, Sinusoidal, Ramp, Sinc.

### Pre lab:-

1. Study all the Basic Signals and Sequences
2. Study all the Functional Representations of Basic Signals and Sequences

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

#### 1. Generate Sinusoidal signal

```
clear all;
close all;
clc;

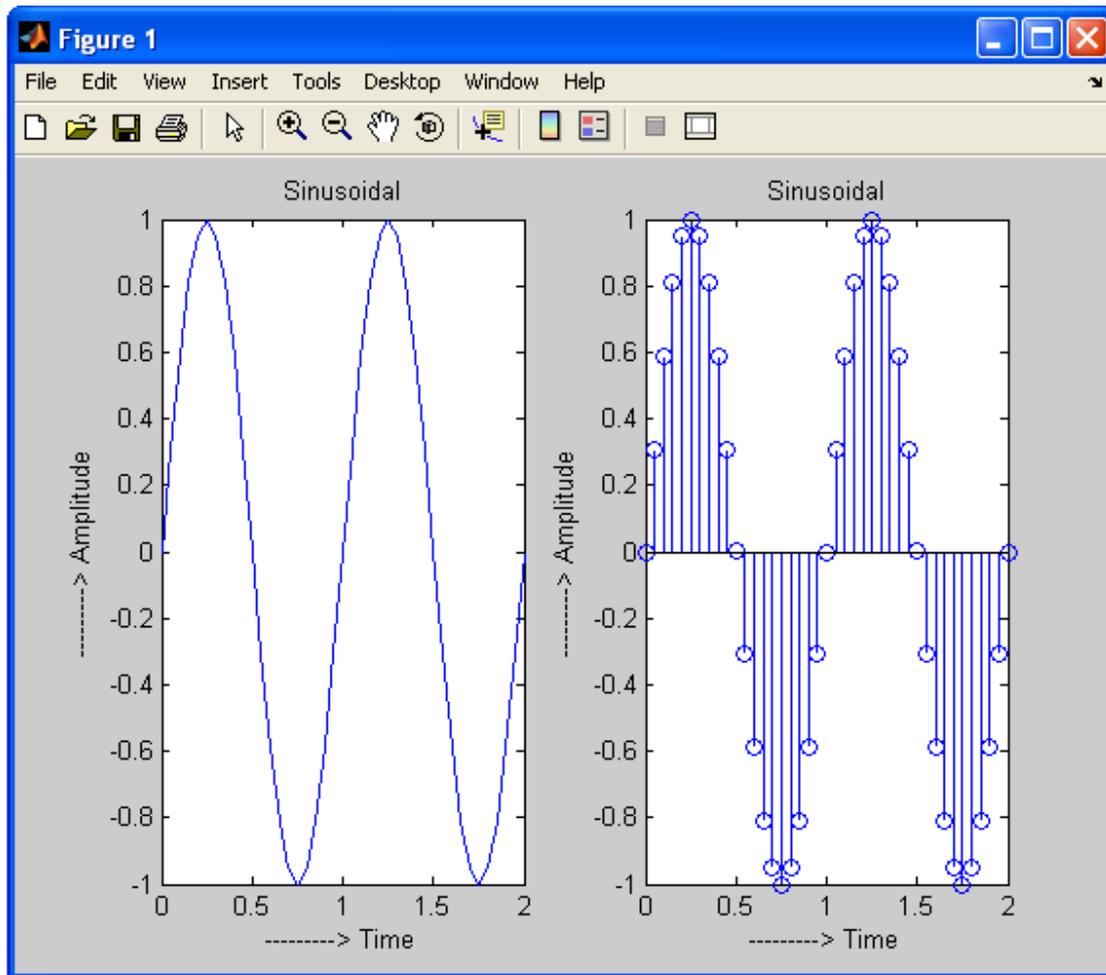
N = input('Enter the number of cycles ...:: ');
t = 0:0.05:N;
x = sin(2*pi*t);

subplot(1,2,1);
plot(t,x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sinusoidal');

subplot(1,2,2);
stem(t,x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sinusoidal');
```

### **OUTPUT**

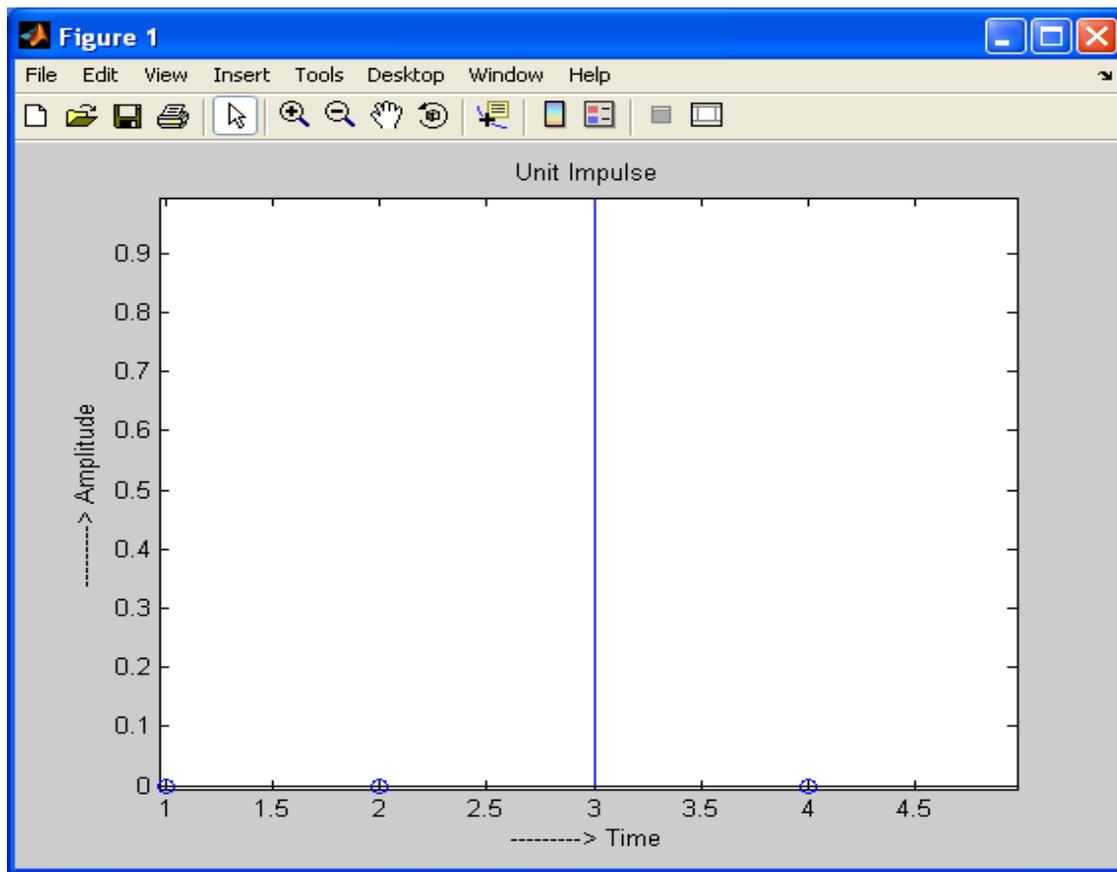
Enter the number of cycles ...:: 2



## 2. Generate Unit Impulse function

```
clear all;
close all;
clc;

x = ones(1,1);
y = zeros(1,2);
z = [y, x, y];
stem(z);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Unit Impulse');
```

**OUTPUT****3. Generate Unit Step function**

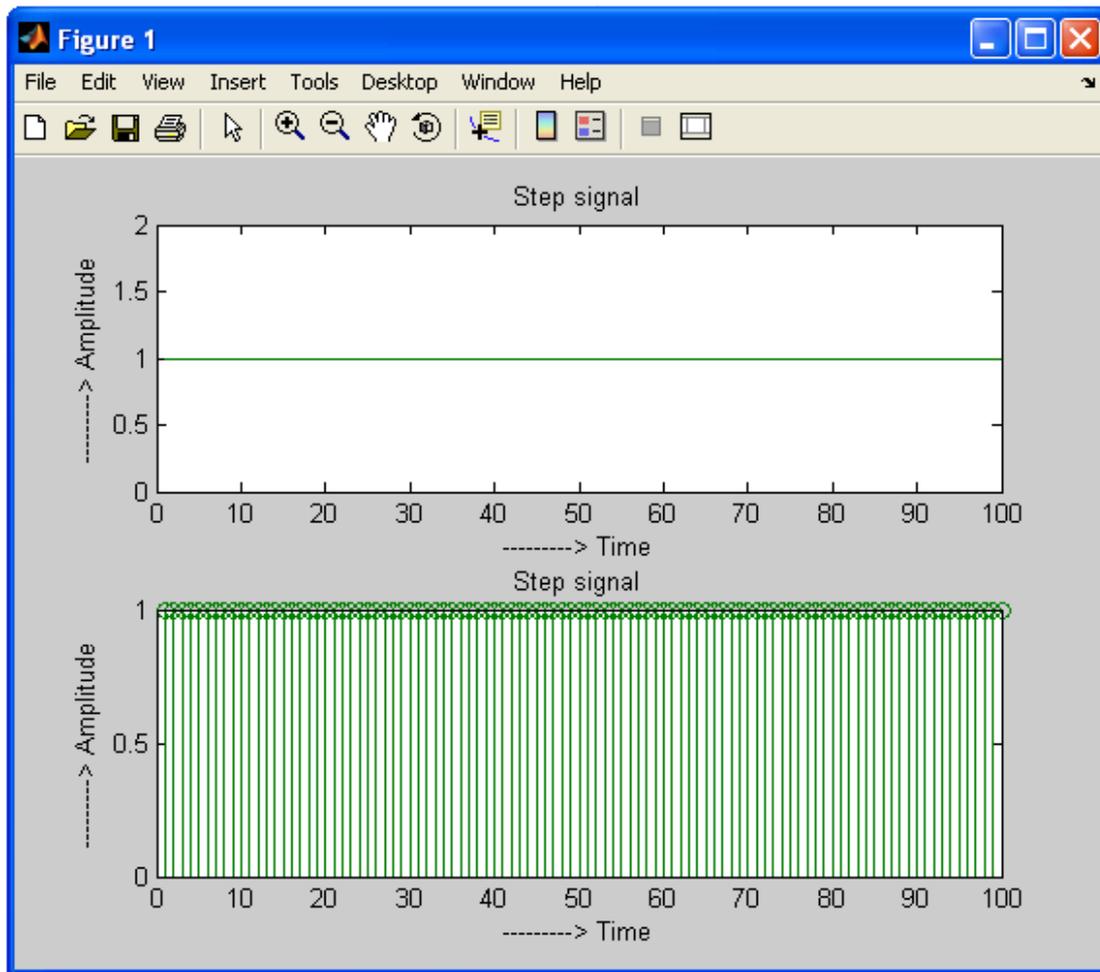
```
clear all;
close all;
clc;

x = ones(100);

subplot(2,1,1);
plot(x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Step signal');

subplot(2,1,2);
stem(x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Step signal');
```

## OUTPUT



### 4. Generate Ramp function

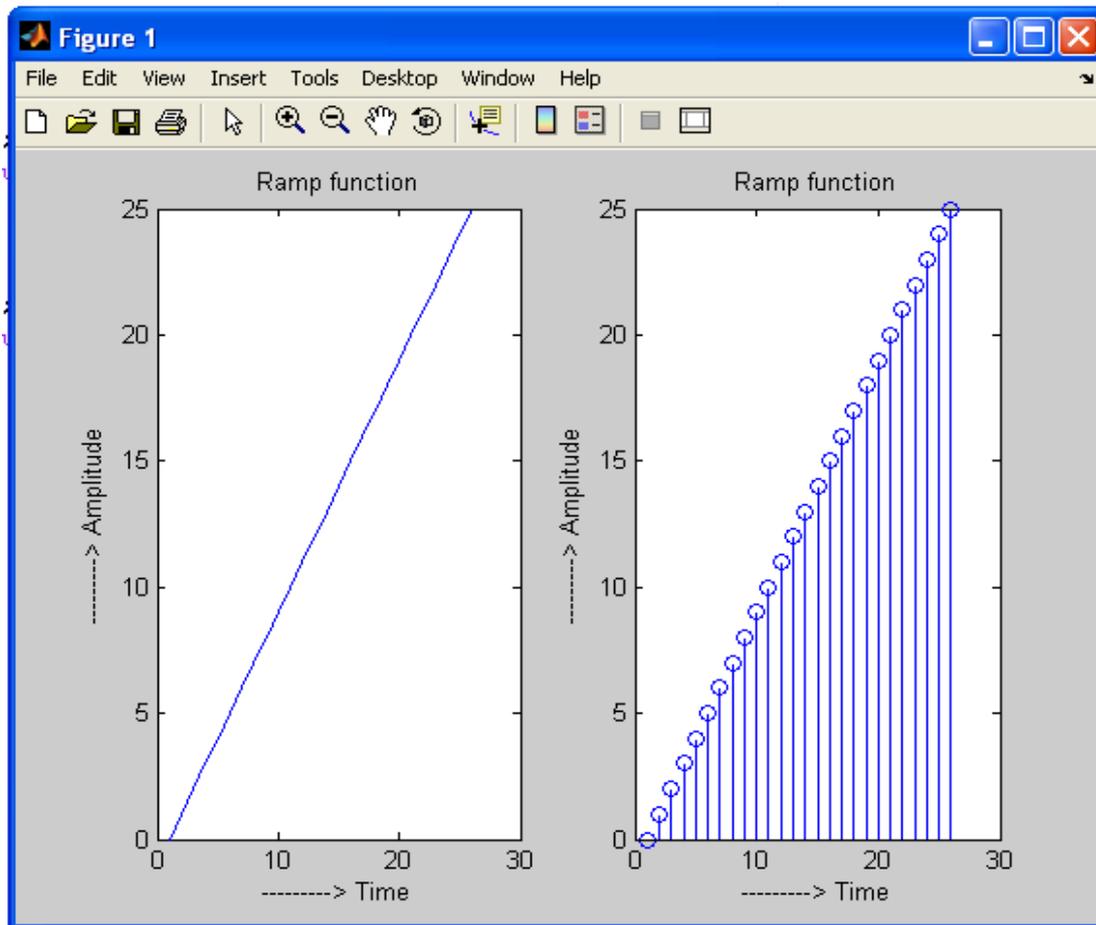
```
clear all;
close all;
clc;

t = 0:25;
y = t;

subplot(1,2,1);
plot(t,y);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Ramp function');

subplot(1,2,2);
stem(t,y);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Ramp function');
```

## OUTPUT



### 5. Generate Sawtooth Waveform

```

clear all;
close all;
clc;

N = input('Enter the number of cycles ...:: ');

t1 = 0:25;
t = [];

for i = 1:N,
    t = [t,t1];
end;

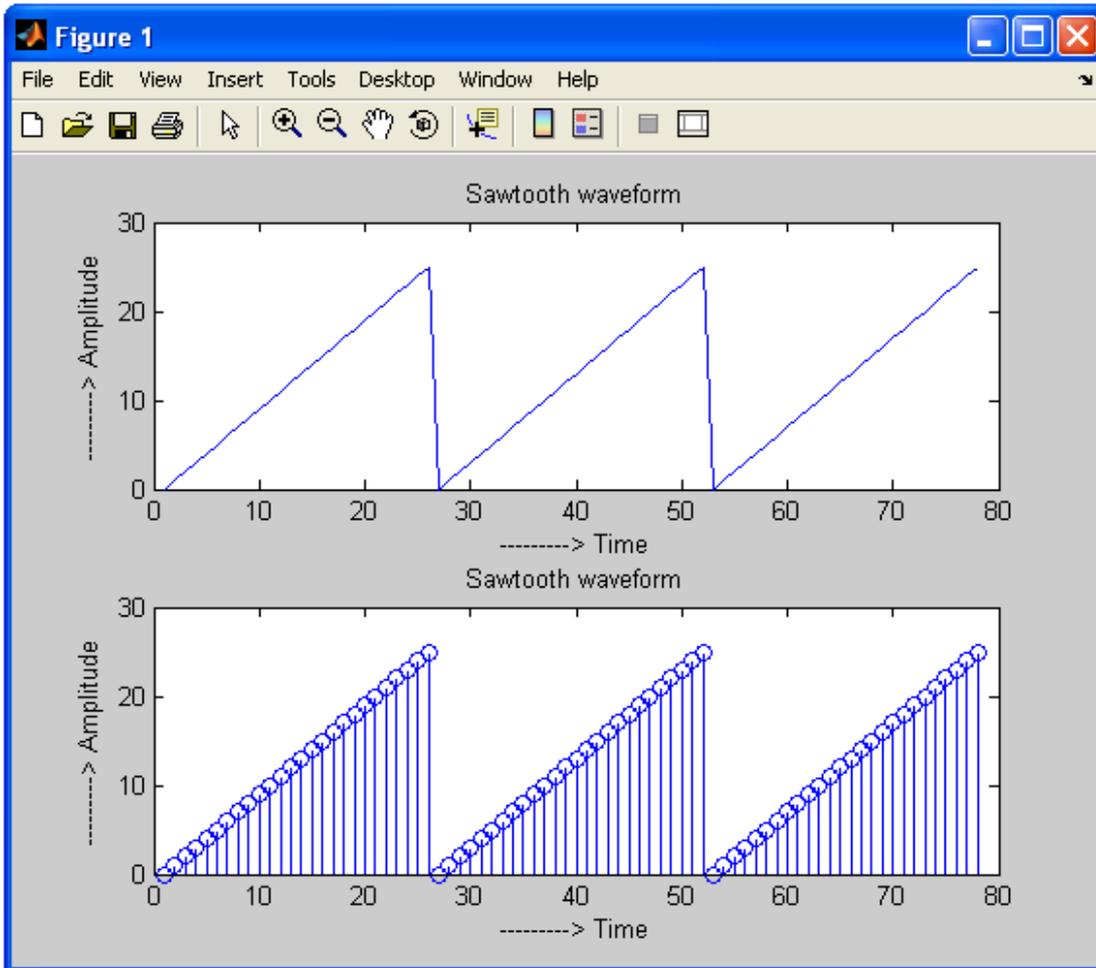
subplot(2,1,1);
plot(t);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sawtooth waveform');

subplot(2,1,2);
stem(t);
    
```

```
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sawtooth waveform');
```

**OUTPUT**

Enter the number of cycles ....: 3



**6. Generate Triangular Waveform**

```
clear all;
close all;
clc;

N = input('Enter the number of cycles .....: ');
M = input('Enter the period .....: ');
t1 = 0:0.1:M/2;
t2 = M/2:-0.1:0;
t = [];
```

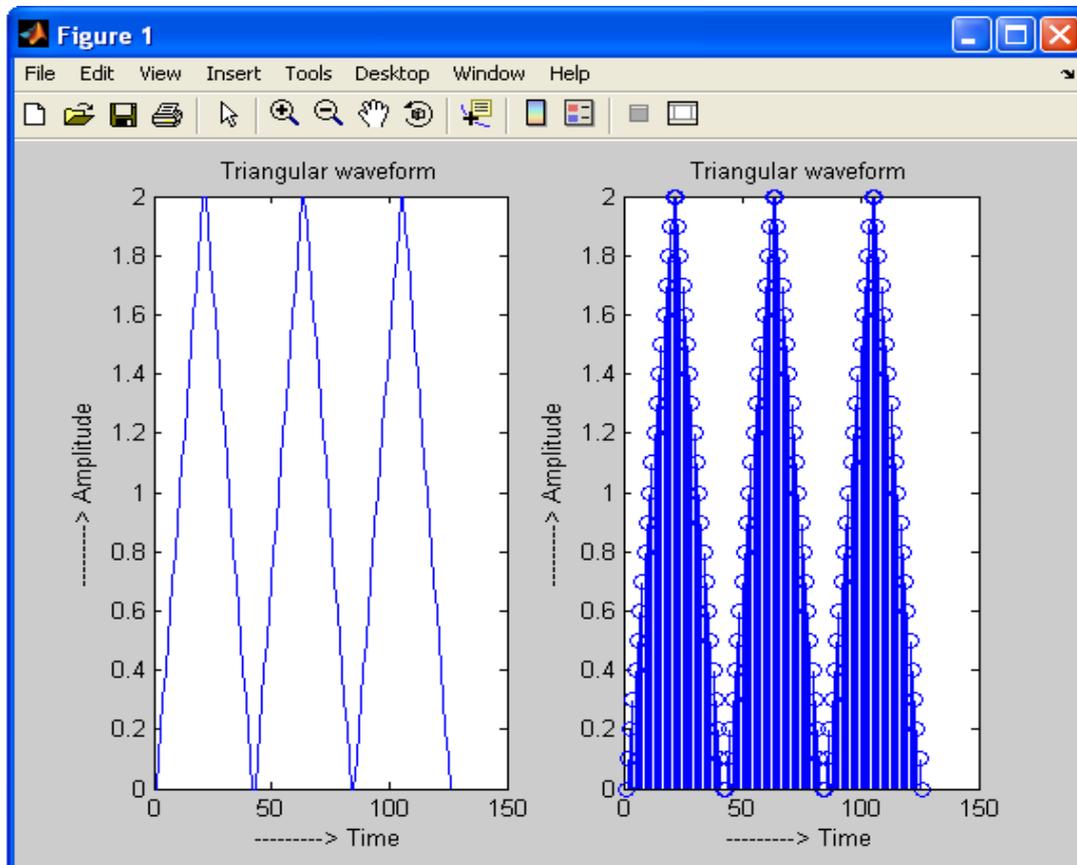
```
for i = 1:N,  
    t = [t,t1,t2];  
end;  
  
subplot(1,2,1);  
plot(t);  
xlabel('-----> Time');  
ylabel('-----> Amplitude');  
title('Triangular waveform');  
  
subplot(1,2,2);  
stem(t);  
xlabel('-----> Time');  
ylabel('-----> Amplitude');  
title('Triangular waveform');
```

## OUTPUT

Enter the number of cycles .....: 3

Enter the period .....: 4

>>



## 7. Generate Square waveform

```
clear all;
close all;
clc;

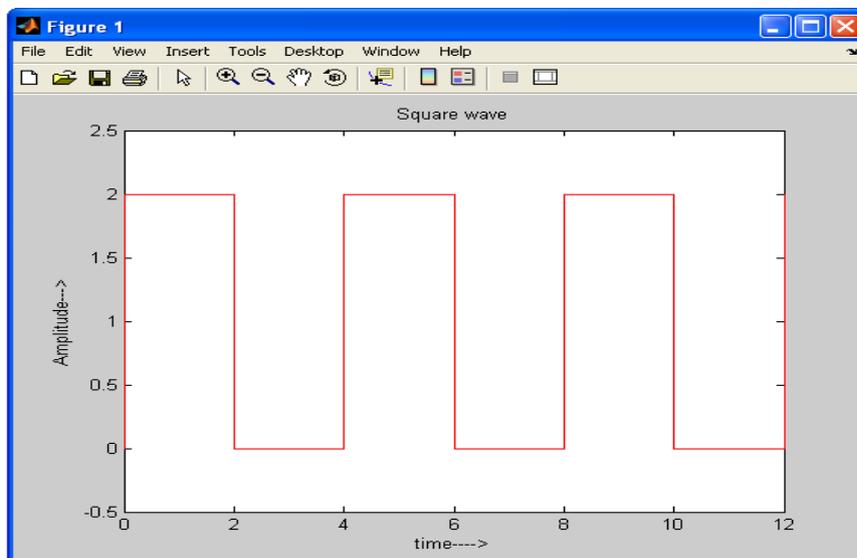
N = input('Enter the number of cycles in a square wave.....: ');
M = input('Enter the period of the square wave .....: ');

y=0:0.001:2;
for j=0:M/2:M*N;
    x=y;
    plot(j,x,'r');
    hold on;
end
for k=0:M:M*N;
    x=k+y;
    m=2;
    plot(x,m,'r')
    hold on
end
for k=2:M:M*N;
    x=k+y;
    m=0;
    plot(x,m,'r');
    hold on;
end
hold off
axis([0 12 -0.5 2.5])
xlabel('time---->');
ylabel('Amplitude--->');
title('Square wave');
```

## OUTPUT

Enter the number of cycles in a square wave.....: 3

Enter the period of the square wave .....: 4



## 8. Generate Sinc function

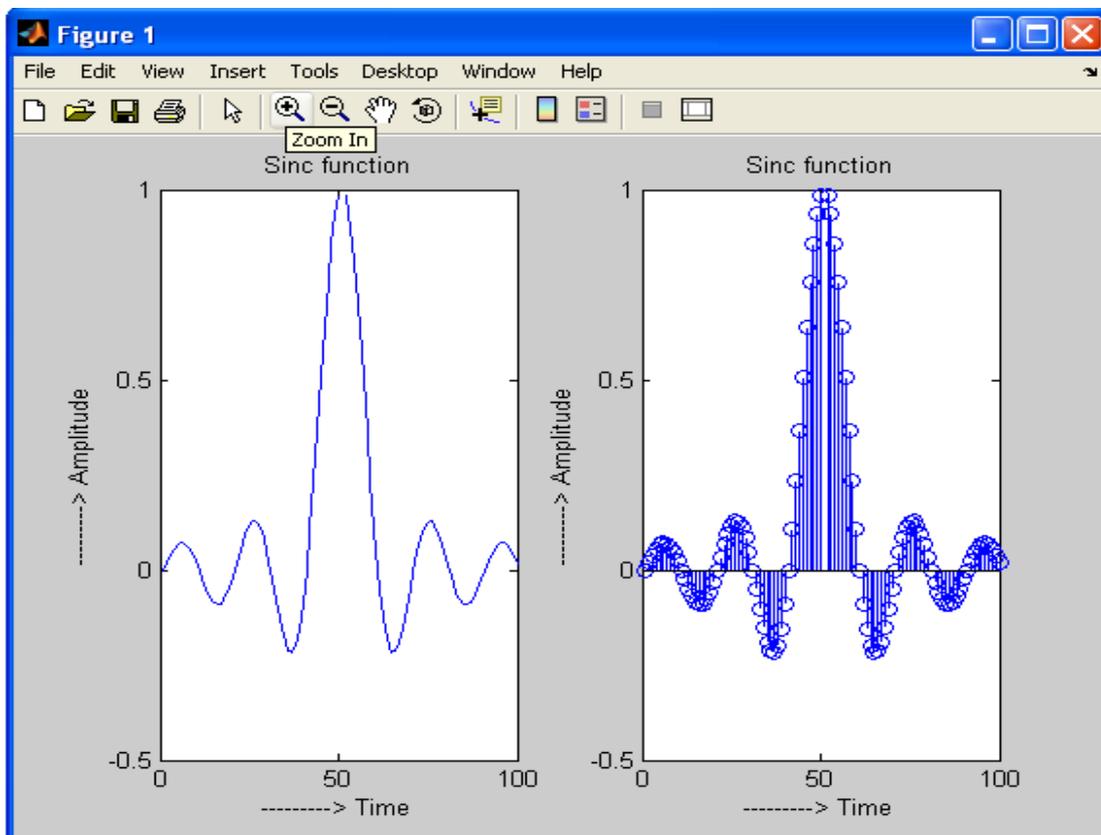
```
clear all;
close all;
clc;

t = -3:0.1:3;
x = sin(pi*t)./(pi*t);

subplot(1,2,1); plot(x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sinc function');
axis([0,100,-0.5,1.0]);

subplot(1,2,2); stem(x);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Sinc function');
axis([0,100,-0.5,1.0]);
```

## OUTPUT

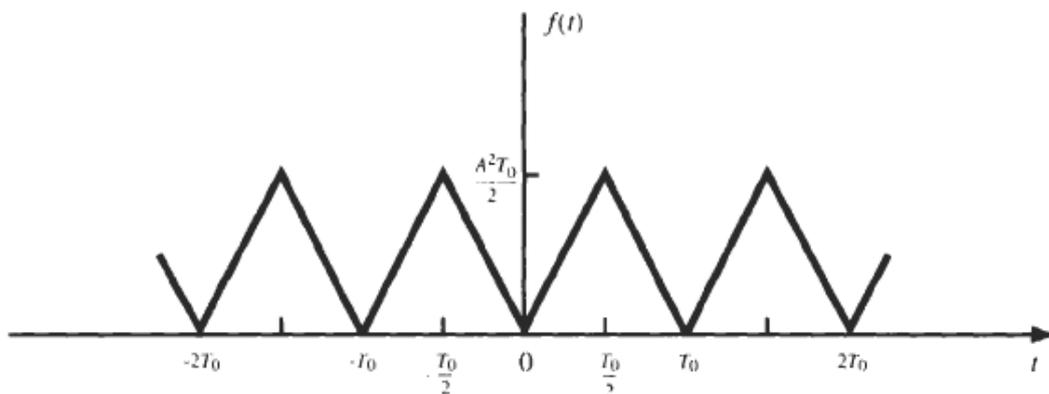
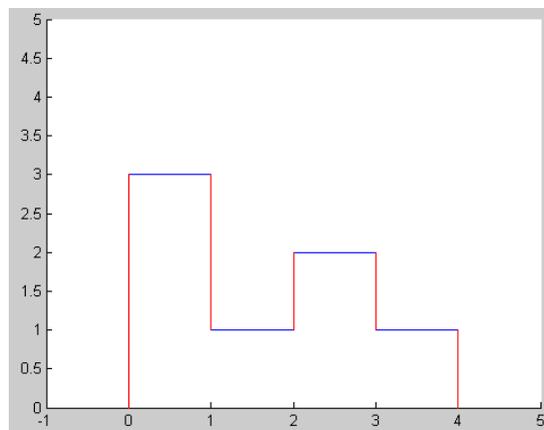


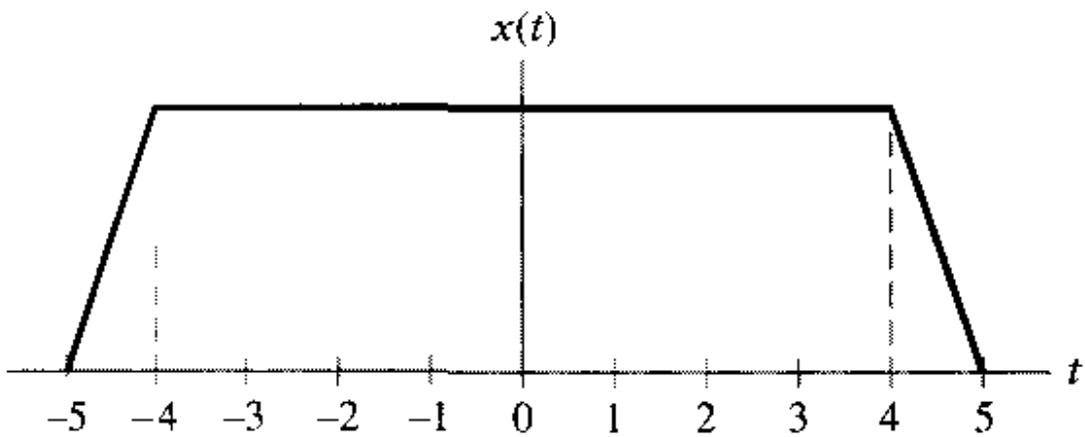
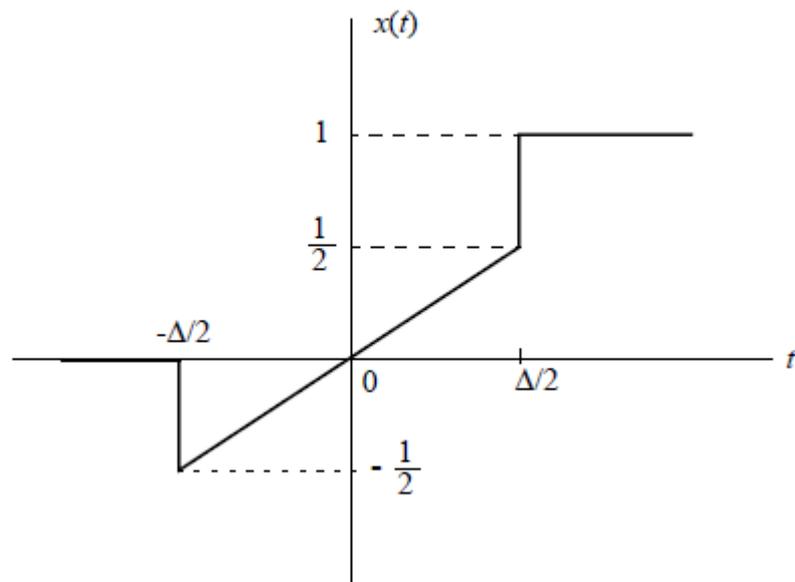
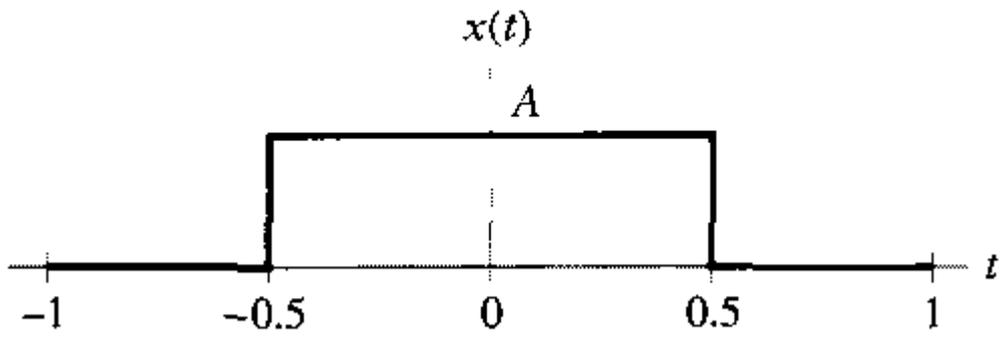
**Post lab:-**

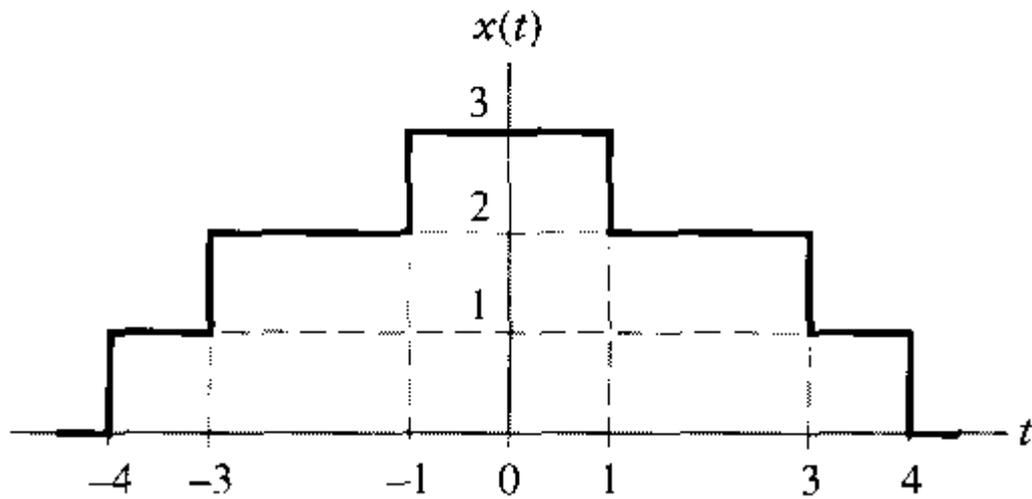
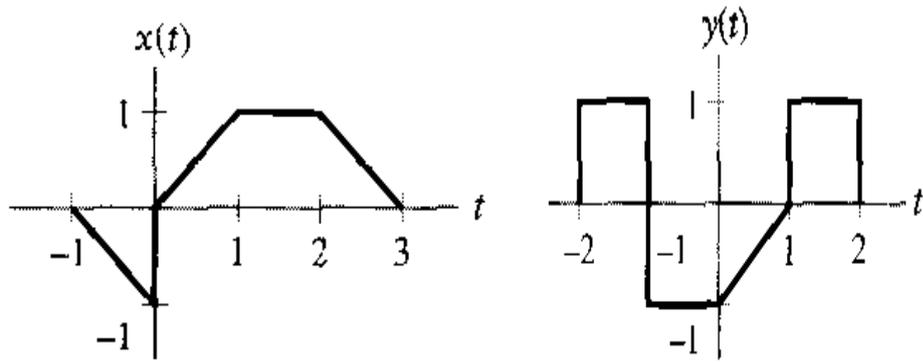
1. Compare the practical results with theoretical results.

**Result:-****Reasoning Questions:-**

1. What is subplot(), stem(), plot()?
2. What is xlabel(), ylabel(), title()?
3. What do you mean by time scale?
4. Generate the following figures







### Experiment:3

#### Aim:-

Operation on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.

#### Pre lab:-

1. Study the concepts of Scaling, Folding and Shifting of Signals or Sequences
2. Study the concepts of energy and Average Power Calculation of Signals or Sequences

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

#### Program:-

##### 1. Addition and Multiplication of two Sequences

```
clear all;
close all;
clc;

x = input(' Enter sequence 1   :: ');
y = input(' Enter sequence 2   :: ');
M = length(x);
N = length(y);

subplot(2,2,1);
stem(x);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Input sequence 1');
subplot(2,2,2);
stem(y);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Input sequence 2');

if M > N
    z = x + [y,zeros(1,M-N)];
else
    z = [x,zeros(1,N-M)] + y;
end;

subplot(2,2,3);
stem(z);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Addition of sequences 1 and 2');

if M > N
    a = x.*[y,zeros(1,M-N)];
else
```

```

a = [x,zeros(1,N-M)].*y;
end;

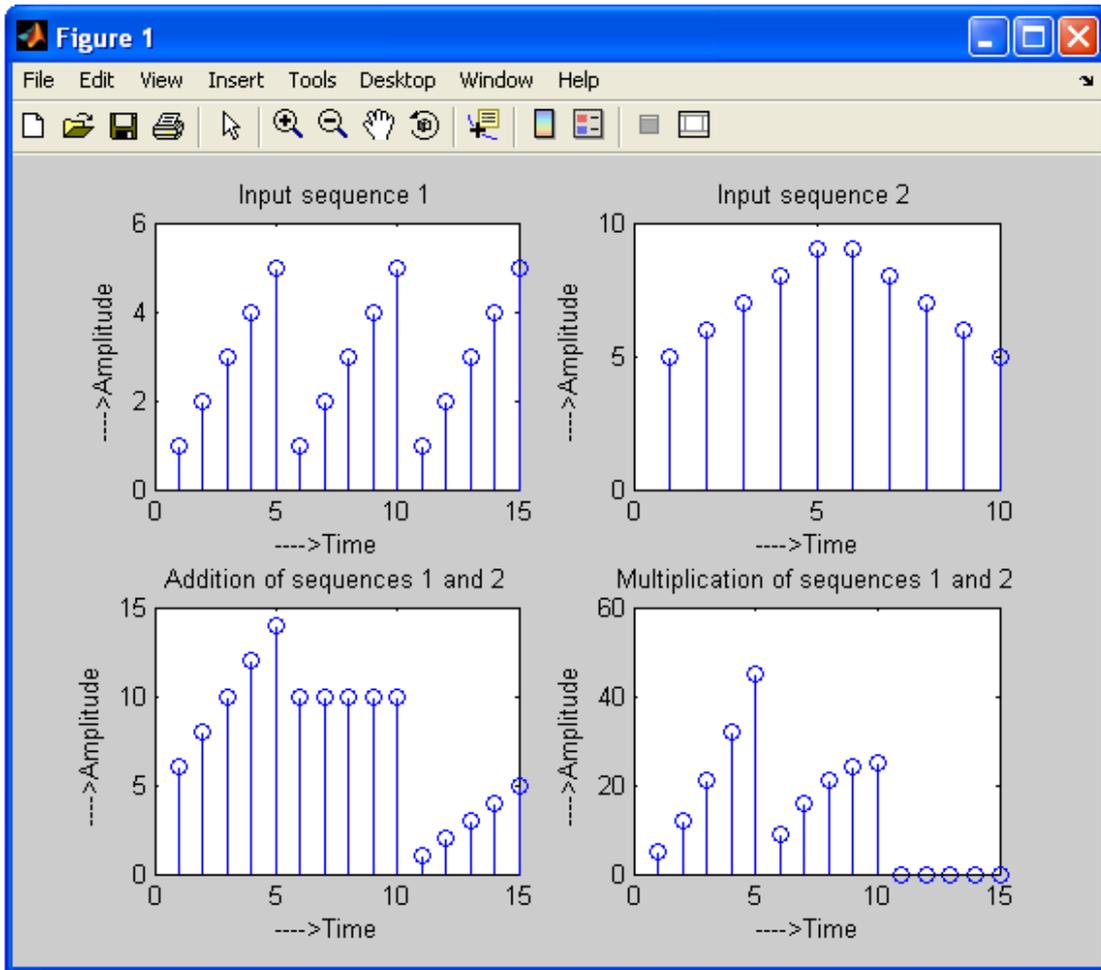
subplot(2,2,4);
stem(a);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Multiplication of sequences 1 and 2');

```

**OUTPUT**

Enter sequence 1 :: [1 2 3 4 5 1 2 3 4 5 1 2 3 4 5]

Enter sequence 2 :: [5 6 7 8 9 9 8 7 6 5]



**2. Scaling Operation on a given Sequence**

```

clear all;
close all;
clc;

s = input('Enter the sequence .....: ');
a = input('Enter the scaling Factor .....: ');
m = length(s);

```

```

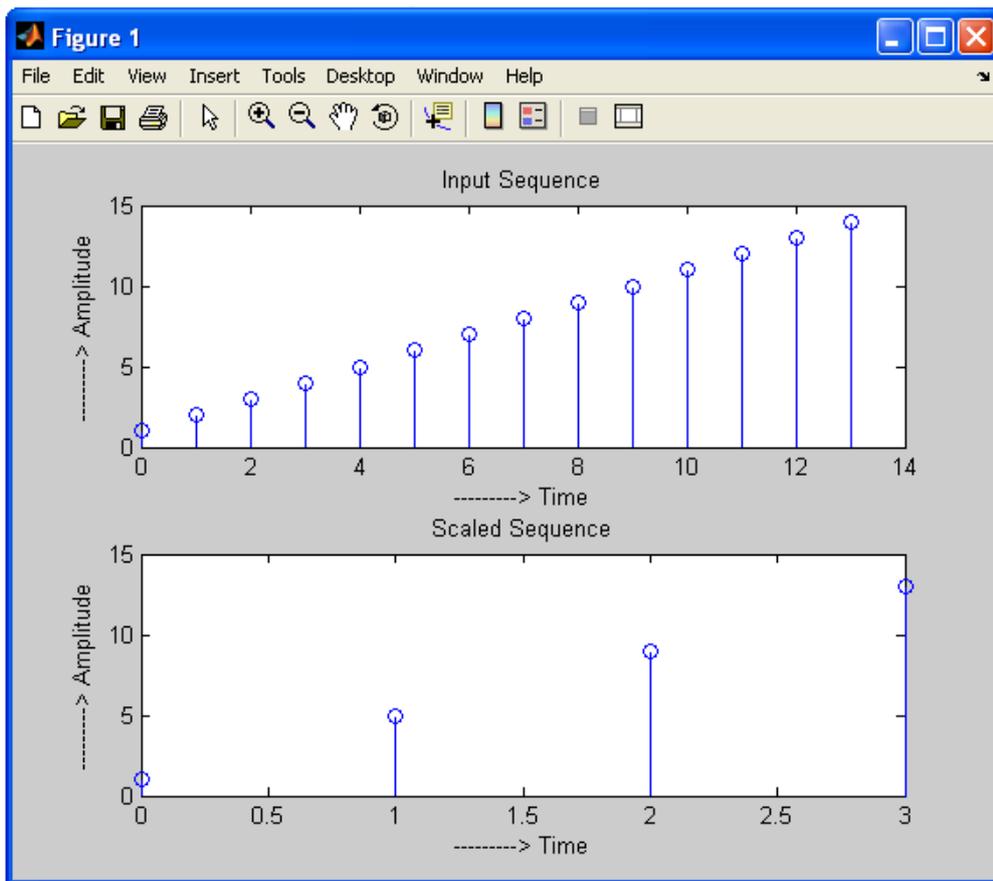
k = ceil(m/a);
s_scal = [];
for i = 1:m,
    if mod(i-1,a) == 0
        s_scal = [s_scal,s(i)];
    end;
end;
subplot(2,1,1)
stem([0:m-1],s);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem([0:k-1],s_scal);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Scaled Sequence');

```

**OUTPUT**

Enter the sequence .....: [1 2 3 4 5 6 7 8 9 10 11 12 13 14]  
 Enter the scaling Factor ....: 4



**3. Shifting Operation on a given Sequence**

```
clear all;
close all;
clc;

s = input('Enter the sequence .....: ');
a = input('Enter the length to be shifted ....: ');
m = length(s);

if a == 0
    subplot(2,1,1)
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Input Sequence');

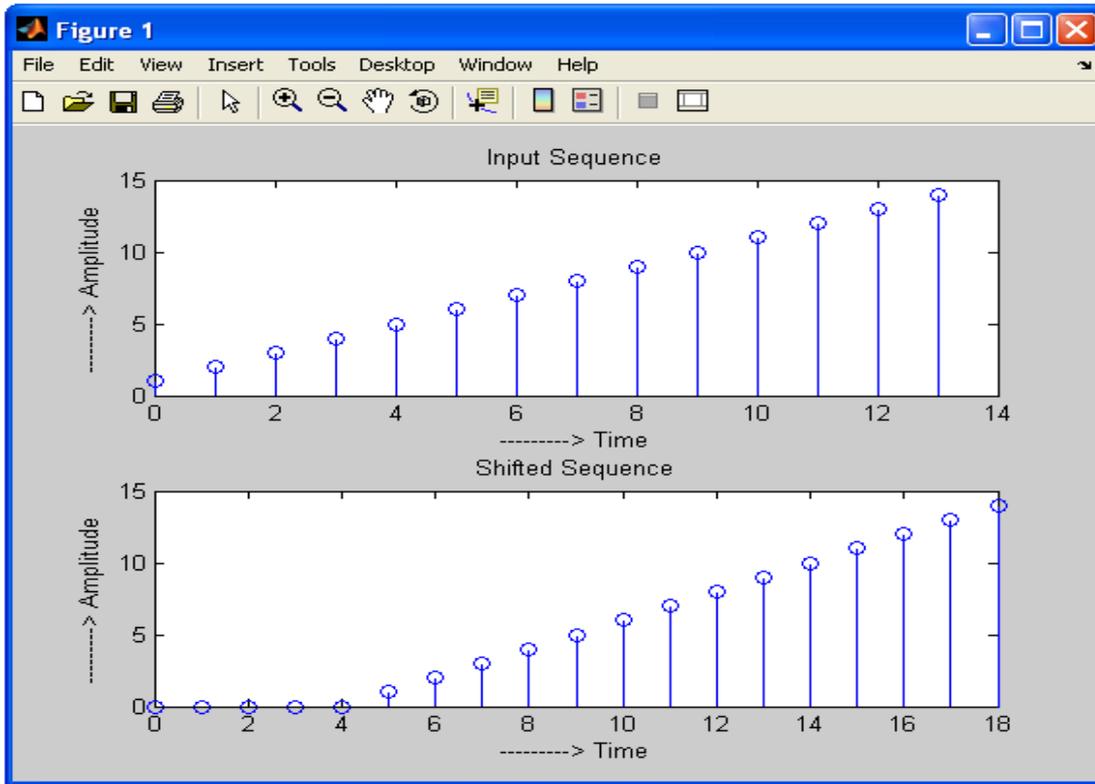
    subplot(2,1,2);
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Shifted Sequence');
elseif a > 0
    subplot(2,1,1)
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Input Sequence');

    subplot(2,1,2);
    stem([0:m+a-1],[zeros(1,a),s]); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Shifted Sequence');
else
    subplot(2,1,1)
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Input Sequence');

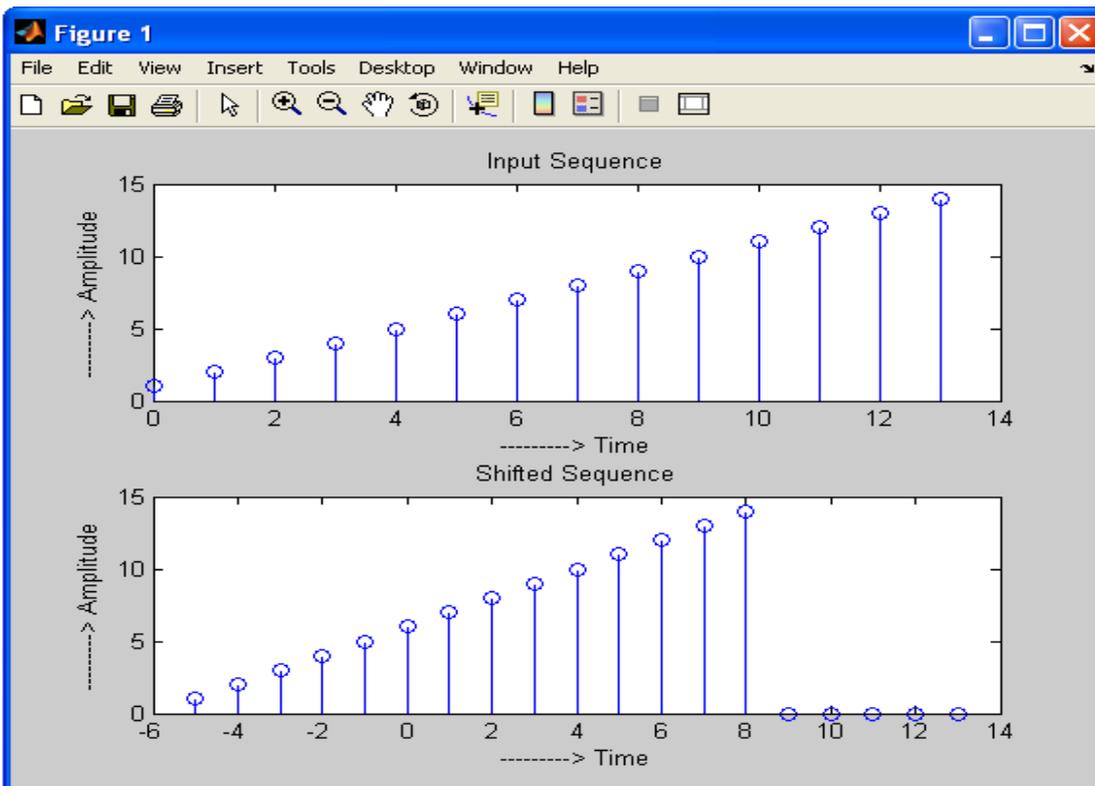
    subplot(2,1,2);
    stem([a:m-1],[s,zeros(1,abs(a))]); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Shifted Sequence');
end;
```

## OUTPUT

```
Enter the sequence .....: [1 2 3 4 5 6 7 8 9 10 11 12 13 14]
Enter the length to be shifted ....: 5
```



Enter the sequence .....: [1 2 3 4 5 6 7 8 9 10 11 12 13 14]  
 Enter the length to be shifted ....: -5



#### 4. Folding Operation on a given Sequence

```
clear all;
close all;
clc;

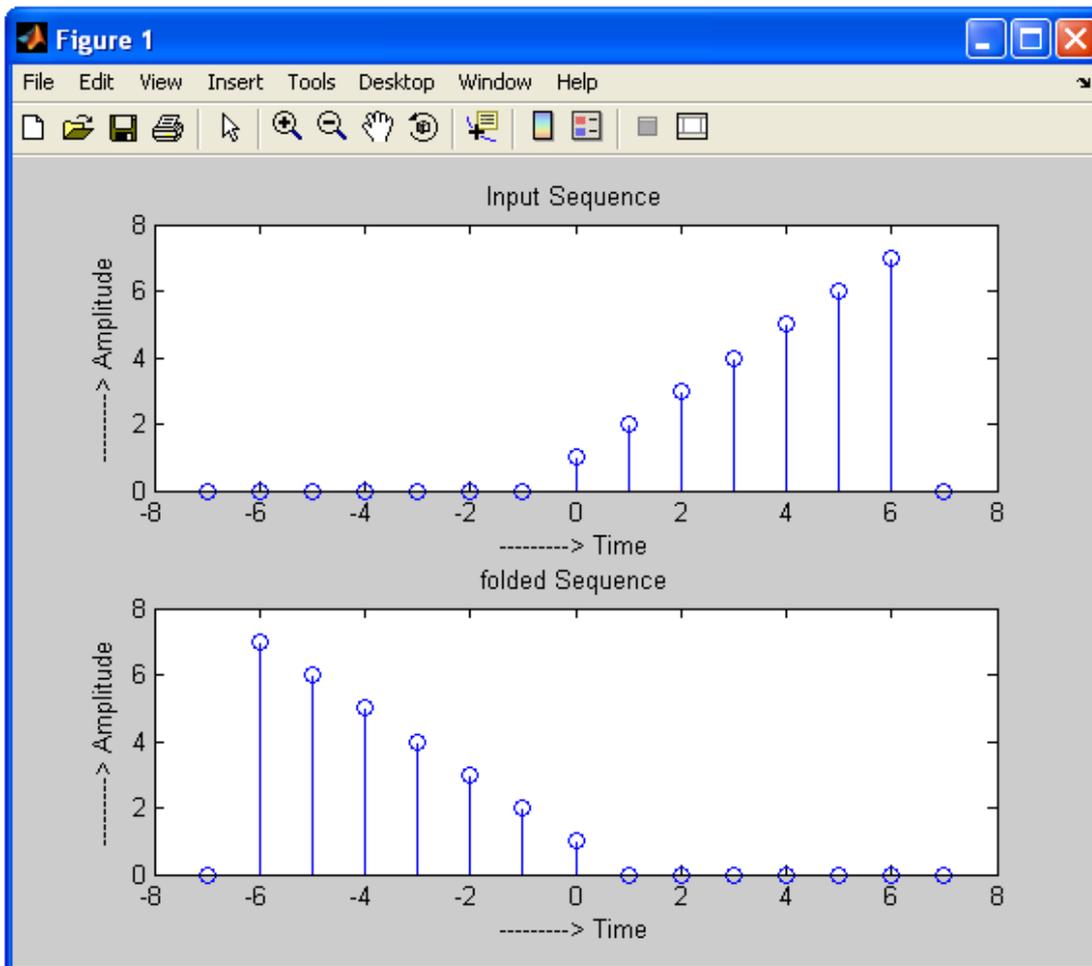
s = input('Enter the sequence .....: ');
m = length(s);

subplot(2,1,1)
stem([-m:m],[zeros(1,m),s,0]);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem([-m:m],[0,fliplr(s),zeros(1,m)]);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('folded Sequence');
```

#### OUTPUT

Enter the sequence .....: [1 2 3 4 5 6 7]



#### 5. Energy and Average Power on a given Sequence

```
clear all;
close all;
clc;

tes = input('Enter the sequence ...:: ');

M = length(tes);
sum = 0;
for i = 1:M,
    sum = sum + tes(i)*tes(i);
end;
disp('Energy of the given sequence is ..... :: ');
Energy = sum
disp('Average Power of the given sequence is ..... :: ');
Average_power = sum/M
OUTPUT
```

```
Enter the sequence ...: [1 2 3 4 5 4 3 2 1]
Energy of the given sequence is ..... ::
```

```
Energy =
```

```
85
```

```
Average Power of the given sequence is ..... ::
```

```
Average_power =
```

```
9.4444
```

## 6. Addition and Multiplication of two Signals

```
clear all;
close all;
clc;

t = 0:0.01:2;
x = sin(2*pi*t);
y = square(2*pi*t);
M = length(x);
N = length(y);

subplot(4,1,1);
stem(x);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Input signal 1');

subplot(4,1,2);
stem(y);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Input signal 2');
```

```

if M > N
    z = x + [y,zeros(1,M-N)];
else
    z = [x,zeros(1,N-M)] + y;
end;

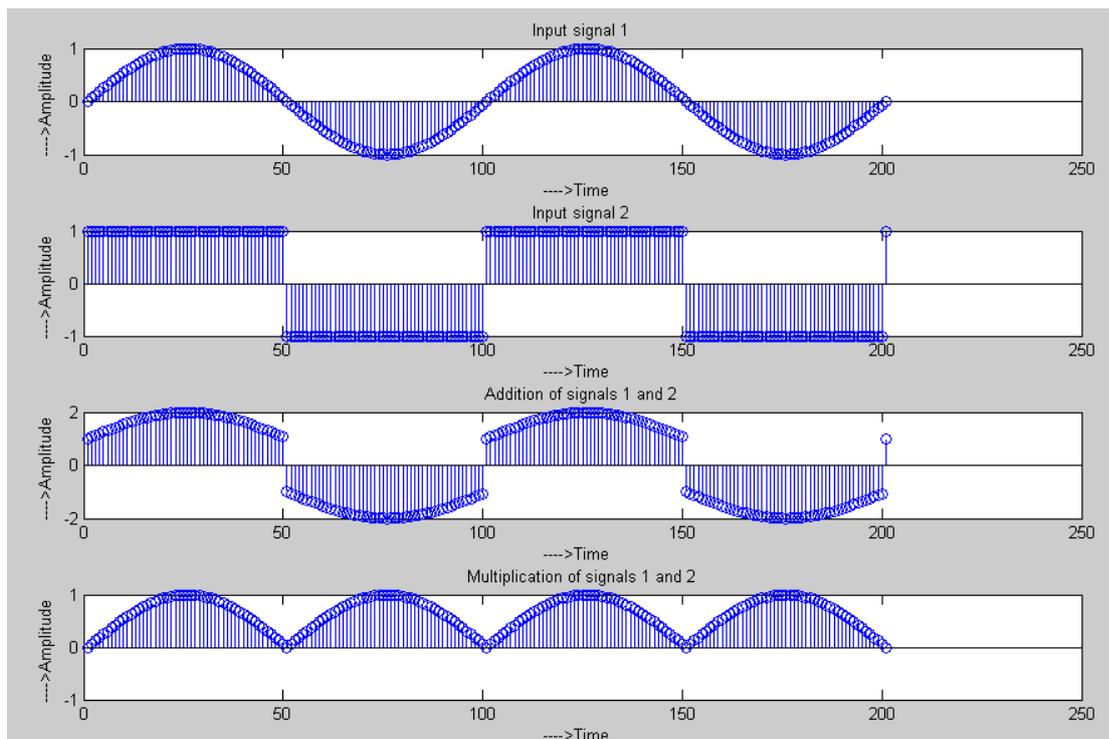
z = x + y;
subplot(4,1,3);
stem(z);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Addition of signals 1 and 2');

if M > N
    a = x.*[y,zeros(1,M-N)];
else
    a = [x,zeros(1,N-M)].*y;
end;

a = x.*y;
subplot(4,1,4);
stem(a);
xlabel('---->Time ');
ylabel('---->Amplitude ');
title('Multiplication of signals 1 and 2');

```

**OUTPUT**



**7. Scaling Operation on a given Signal**

```
clear all;
```

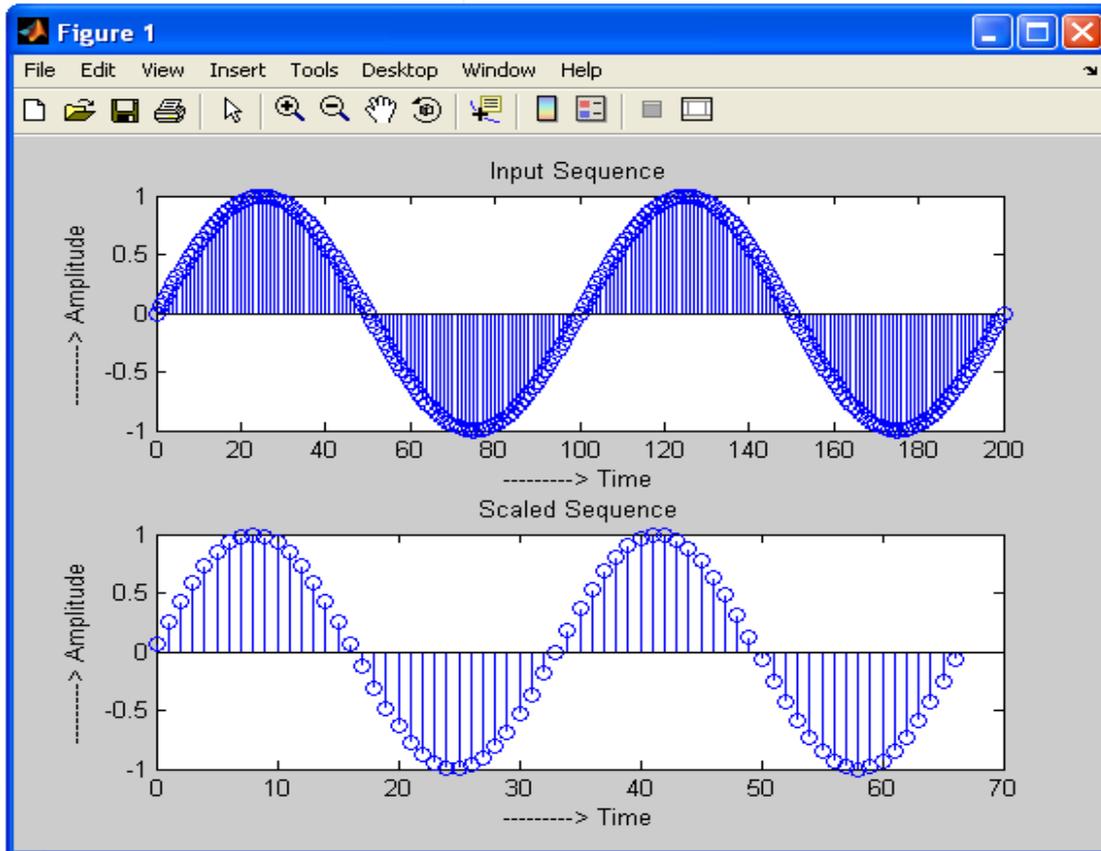
```
close all;
clc;

t = 0:0.01:2;
s = sin(2*pi*t);
a = input('Enter the scaling Factor ...:: ');
m = length(s);
k = ceil(m/a);
s_scal = [];
for i = 1:m,
    if mod(i,a) == 0
        s_scal = [s_scal,s(i-1)];
    end;
end;
subplot(2,1,1)
stem([0:m-1],s);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem([0:k-1],s_scal);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Scaled Sequence');
```

### OUTPUT

Enter the scaling Factor ...:: 3



### 8. Shifting Operation on a given Signal

```

clear all;
close all;
clc;

t = 0:0.01:2;
s = sin(2*pi*t);
a = input('Enter the length to be shifted ...: ');
m = length(s);

if a == 0
    subplot(2,1,1)
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Input Sequence');

    subplot(2,1,2);
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Shifted Sequence');
elseif a > 0
    subplot(2,1,1)
    stem([0:m-1],s); xlabel('-----> Time');
    ylabel('-----> Amplitude');
    title('Input Sequence');

```

```

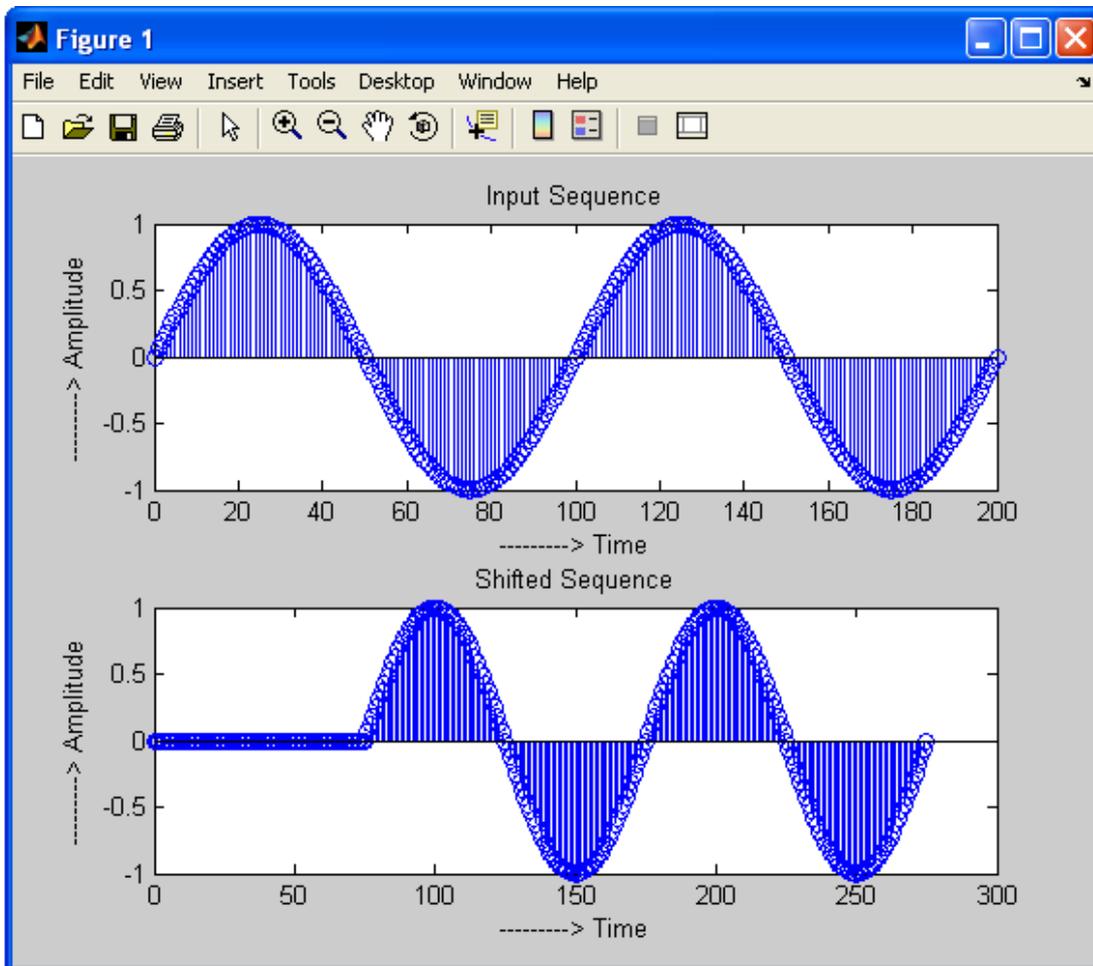
subplot(2,1,2);
stem([0:m+a-1],[zeros(1,a),s]); xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Shifted Sequence');
else
subplot(2,1,1)
stem([0:m-1],s); xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem([a:m-1],[s,zeros(1,abs(a))]); xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Shifted Sequence');
end;

```

**OUTPUT**

Enter the length to be shifted ....: 75



**9. Folding Operation on a given Signal**

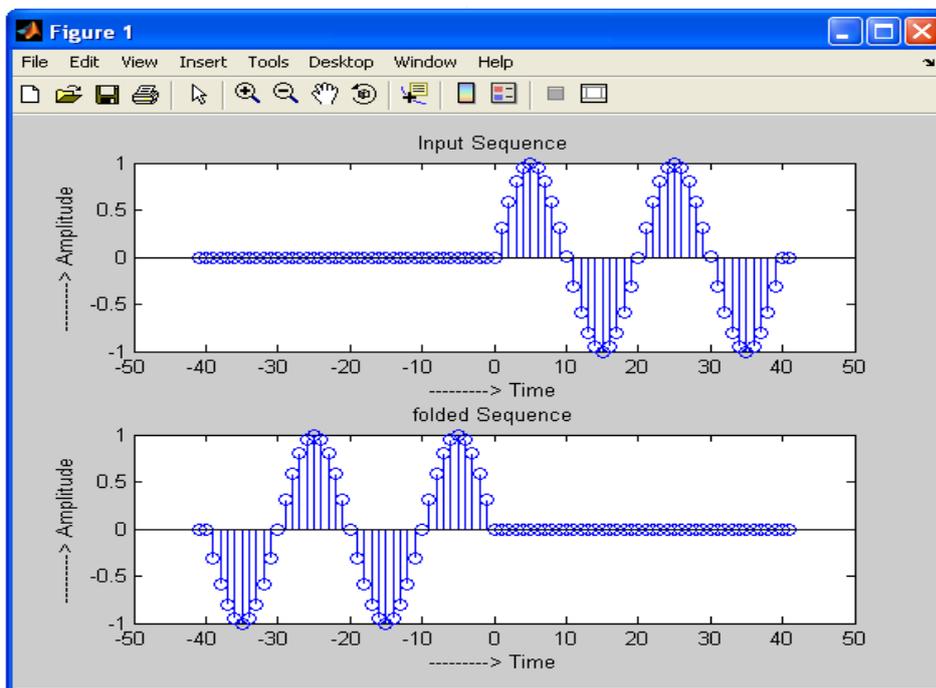
```
clear all;
close all;
clc;

t = 0:0.01:2;
s = sin(2*pi*t);
m = length(s);

subplot(2,1,1)
stem([-m:m],[zeros(1,m),s,0]);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem([-m:m],[0,fliplr(s),zeros(1,m)]);
xlabel('-----> Time');
ylabel('-----> Amplitude');
title('folded Sequence');
```

**OUTPUT**



**10. Energy and Average Power on a given Signal**

```
clear all;
close all;
clc;
t = 0:0.01:4;
tes = cos(2*pi*t);

M = length(tes);
sum = 0;
for i = 1:M,
```

```
sum = sum + tes(i)*tes(i);
end;
disp('Energy of the given sequence is ..... :: ');
Energy = sum
disp('Average Power of the given sequence is ..... :: ');
Average_power = sum/M
```

**OUTPUT**

Energy of the given sequence is ..... ::

Energy =

201

Average Power of the given sequence is ..... ::

Average\_power =

0.5012

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-****Reasoning Questions:-**

1. What Operations can be performed on Signals and Sequences?
2. Define Causality and Stability?
3. Define Scaling property and give its importance.
4. Define Shifting property and give its importance.
5. Define Folding property and give its importance.
6. Give the expressions for finding the Energy of a Signal/Sequence?
7. Give the expressions for finding the Average Power of a Signal/Sequence?
8. Perform all the operations on the following Sequences
  - a.  $x(n) = \{1\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 0\}$
  - b.  $x(n) = \{2\ 3\ 4\ 5\ 6\ 6\ 5\ 4\ 3\ 2\ 1\}$
9. Find the Energy and Average Power of a Signal defined
  - a.  $x(t) = 10*U(t) - 20*U(t - 2)$
  - b.  $x(t) = 1.5*t^2U(t)$

### Experiment: 4

#### Aim:-

: Finding the even and odd parts of signal/sequence and real and imaginary parts of signal.

#### Pre lab:-

1. Study all the Basic Signals and Sequences
2. Study all the Functional Representations of Basic Signals and Sequences

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

#### Program:-

##### 1. Even and Odd part of Signal

```
clear all;
close all;
clc;

t = 0:10;
x = 2*sin(t);
y = -(4 * x);

subplot(2,2,1);
stem(x);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Original signal f(t)');

subplot(2,2,2);
stem(y);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Original signal f(-t)');

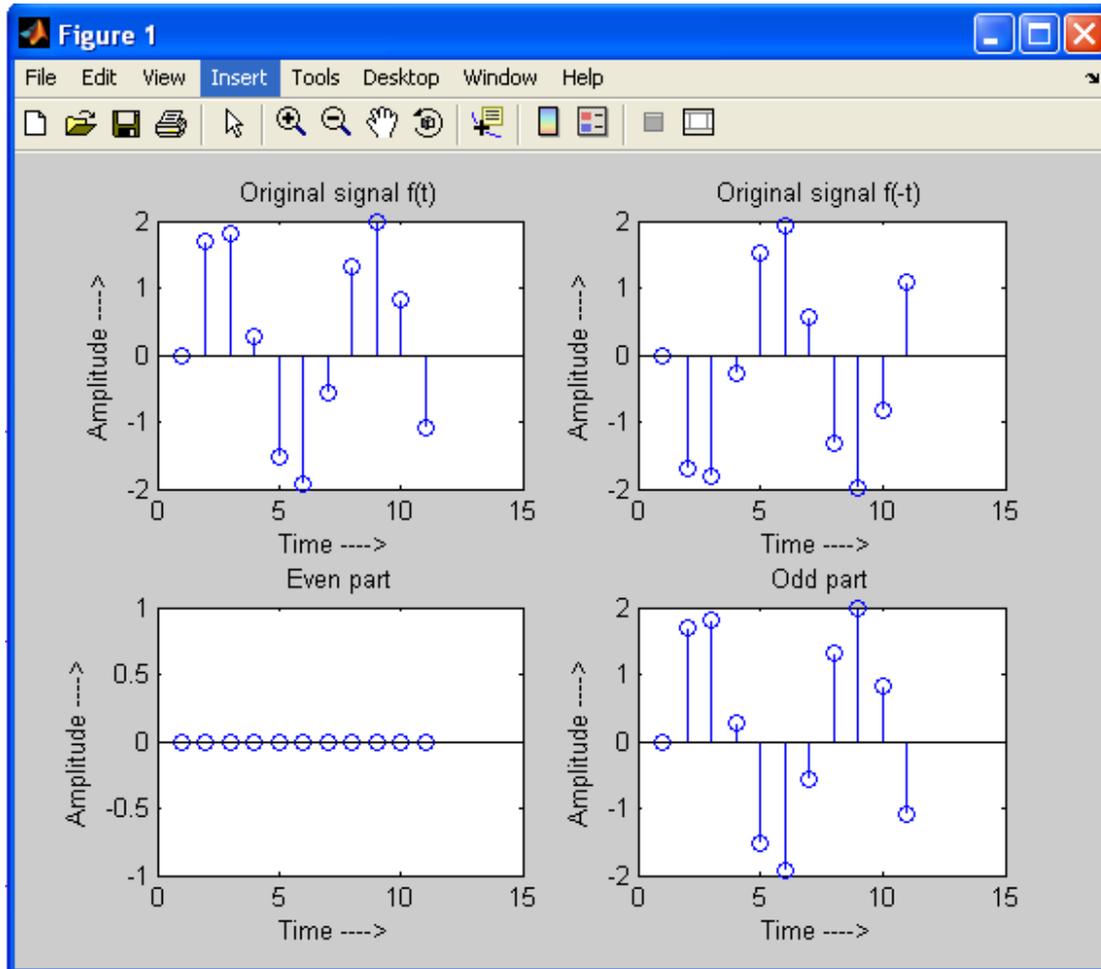
even =0.5*(x + y);

subplot(2,2,3);
stem(even);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Even part');

odd = 0.5*(x - y);

subplot(2,2,4);
stem(odd);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Odd part');
```

#### **OUTPUT**



## 2. Even and Odd part of Sequence

```

clear all;
close all;
clc;

x = input('Enter the sequence  :: ');
y = -x;

subplot(2,2,1);
stem(x);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Original signal f(t)');

subplot(2,2,2);
stem(y);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Original signal f(-t)');

even = 0.5*(x + y);
    
```



```
subplot(2,2,3);
stem(even);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Even part');

odd = 0.5*(x - y);

subplot(2,2,4);
stem(odd);
xlabel('Time ----> ');
ylabel('Amplitude ---->');
title('Odd part');
```

### OUTPUT

Enter the sequence :: [1 2 3 4 3 2 1]

>> x

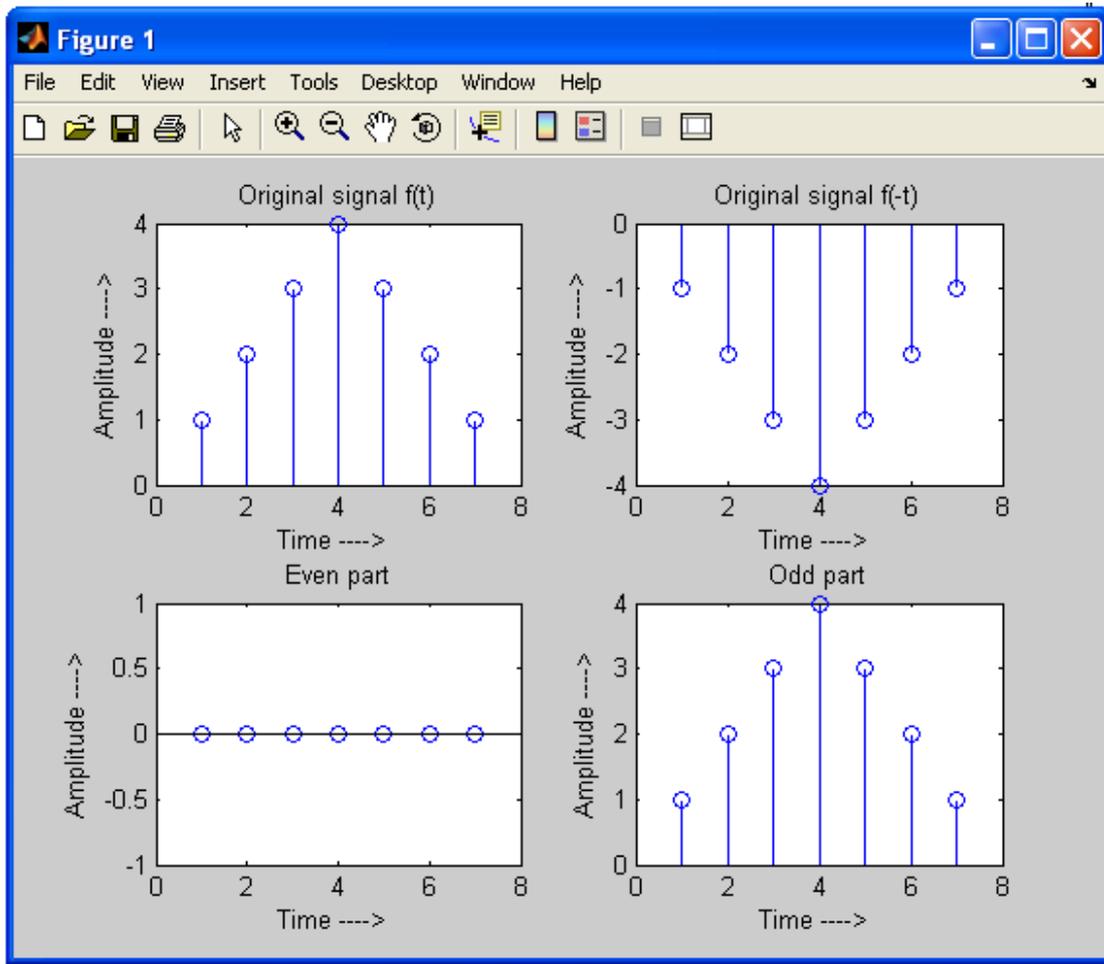
x =

1 2 3 4 3 2 1

>> y

y =

-1 -2 -3 -4 -3 -2 -1



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. What is an even function?
2. What is an odd function?
3. What do you mean by real part and an imaginary part ?

### Experiment: 5

#### Aim:-

: Verifying the Convolution between Signals and Sequences

#### Pre lab:-

1. Study the details of linear convolution
2. Study the details of circular convolution

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

#### Program:-

##### 1. Linear Convolution of two Sequences

```
clear all;
close all;
clc;

x=input('enter the seq1   :: ');
h=input('enter the seq2   :: ');

subplot(3,1,1);
stem(x);

subplot(3,1,2);
stem(h);
o=zeros(1,length(x)+length(h)-1);

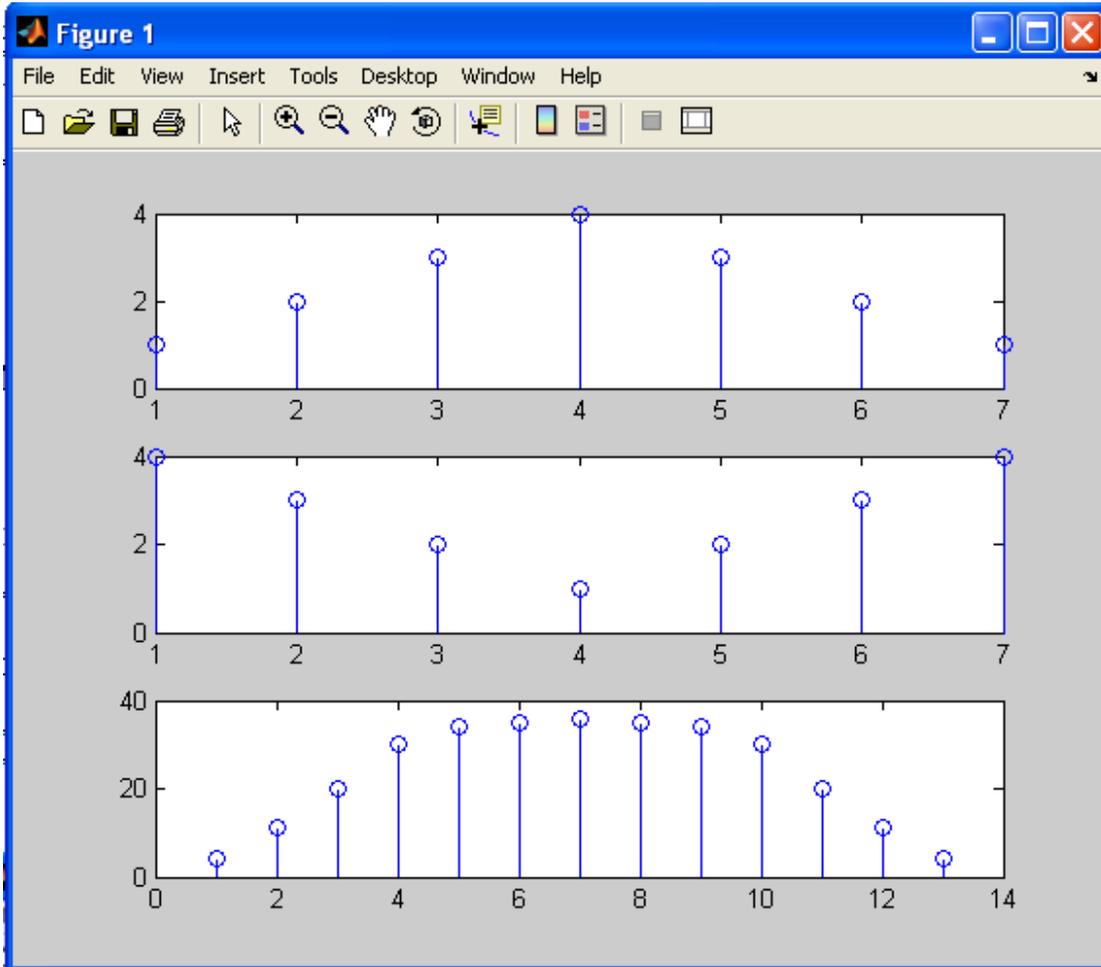
for m=1:length(x),
    for n=1:length(h),
        y(m,n)=x(m)*h(n);
    end;
end;
for n=1:length(x)+length(h)-1,
    for i=1:length(x),
        for j=1:length(h),
            if(i+j==n+1)
                o(n)=o(n) + y(i,j);
            end;
        end;
    end;
end;

subplot(3,1,3);
stem(o);
```

**OUTPUT**

enter the seq1 :: [1 2 3 4 3 2 1]

enter the seq2 :: [4 3 2 1 2 3 4]



**2. Linear Convolution of two Sequences using conv() function**

```
clear all;
close all;
clc;

x=input('enter the seq1   :: ');
h=input('enter the seq2   :: ');

subplot(3,1,1);
stem(x);

subplot(3,1,2);
stem(h);

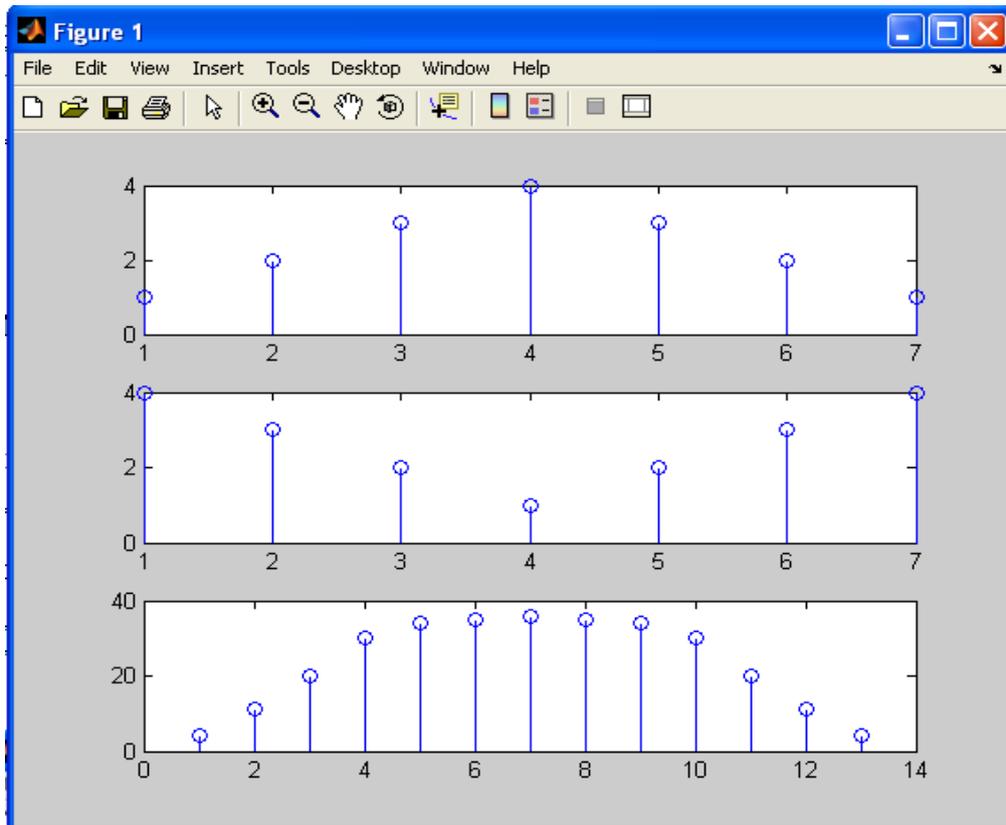
o = conv(x,h);

subplot(3,1,3);
stem(o);
```

**OUTPUT**

```

enter the seq1 :: [1 2 3 4 3 2 1]
enter the seq2 :: [4 3 2 1 2 3 4]
>>
    
```



### 3. Linear Convolution of two Signals

```

clear all;
close all;
clc;

t = 1:10;
x = sin(t);
h = square(t);

subplot(3,1,1);
stem(x);

subplot(3,1,2);
stem(h);

o=zeros(1,length(x)+length(h)-1);

for m=1:length(x),
    for n=1:length(h),
        y(m,n)=x(m)*h(n);
    end;
end;
for n=1:length(x)+length(h)-1,
    for i=1:length(x),
    
```

```

        for j=1:length(h),
            if(i+j==n+1)
                o(n)=o(n) + y(i,j);
            end;
        end;
    end;
end;

subplot(3,1,3);
stem(o);

```

**OUTPUT**

>> x

x =

Columns 1 through 7

0.8415 0.9093 0.1411 -0.7568 -0.9589 -0.2794 0.6570

Columns 8 through 10

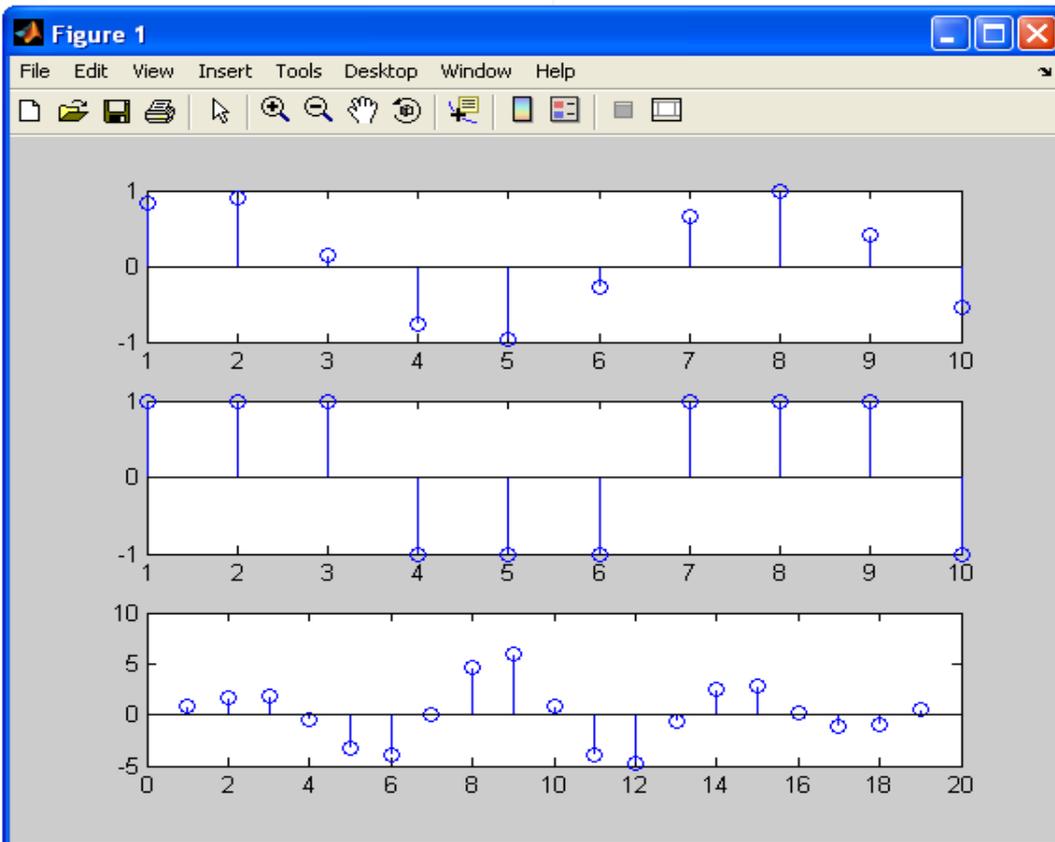
0.9894 0.4121 -0.5440

>> h

h =

1 1 1 -1 -1 -1 1 1 1 -1

>>



#### 4. Linear Convolution of two Signals using conv() function

```
clear all;
close all;
clc;

t = 1:10;
x = sin(t);
h = square(t);

subplot(3,1,1);
stem(x);

subplot(3,1,2);
stem(h);

o = conv(x,h);

subplot(3,1,3);
stem(o);
```

#### OUTPUT

```
>> x
```

```
x =
```

```
Columns 1 through 7
```

```
0.8415 0.9093 0.1411 -0.7568 -0.9589 -0.2794 0.6570
```

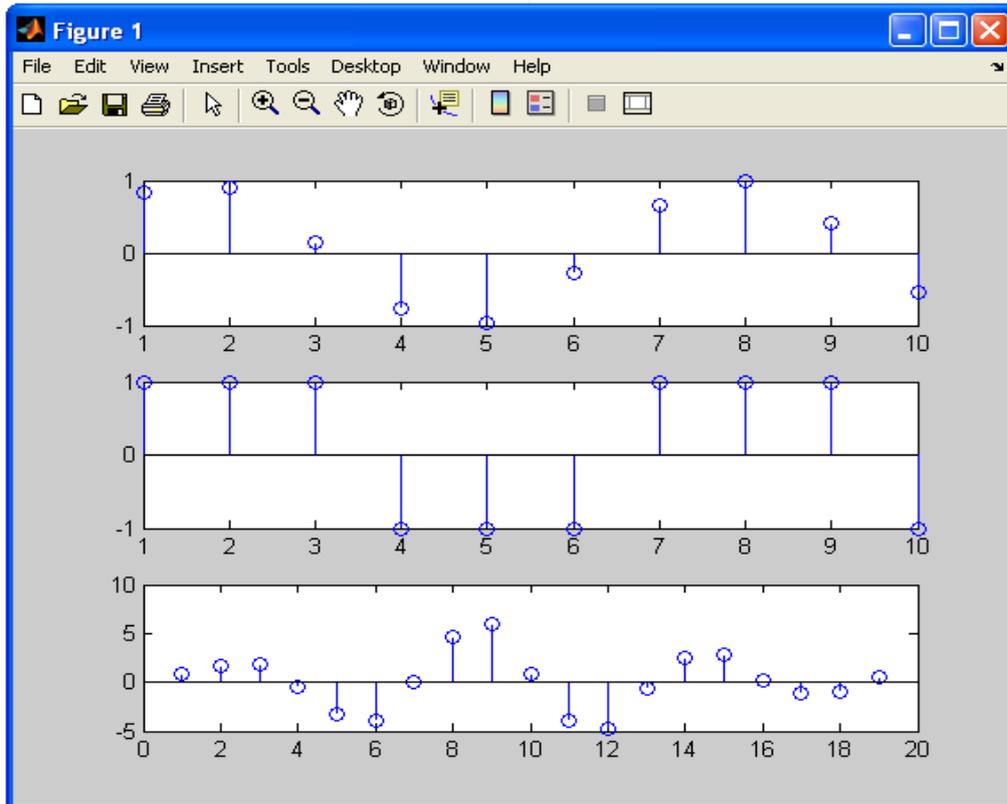
```
Columns 8 through 10
```

```
0.9894 0.4121 -0.5440
```

```
>> h
```

```
h =
```

```
1 1 1 -1 -1 -1 1 1 1 -1
```

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-****Reasoning Questions:-**

1. What is Convolution?
2. What is the importance of convolution?
3. What is the difference between Linear and Circular Convolution?

## Experiment: 6

### Aim:-

: Auto Correlation and Cross Correlation between Signals and Sequences

### Pre lab:-

1. Study in detail about Correlation and how to calculate Correlation of two signals or sequences

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

#### 1. Auto Correlation of a Sequence

```
clear all;
close all;
clc;

a = input('Enter the sequence .....: ');

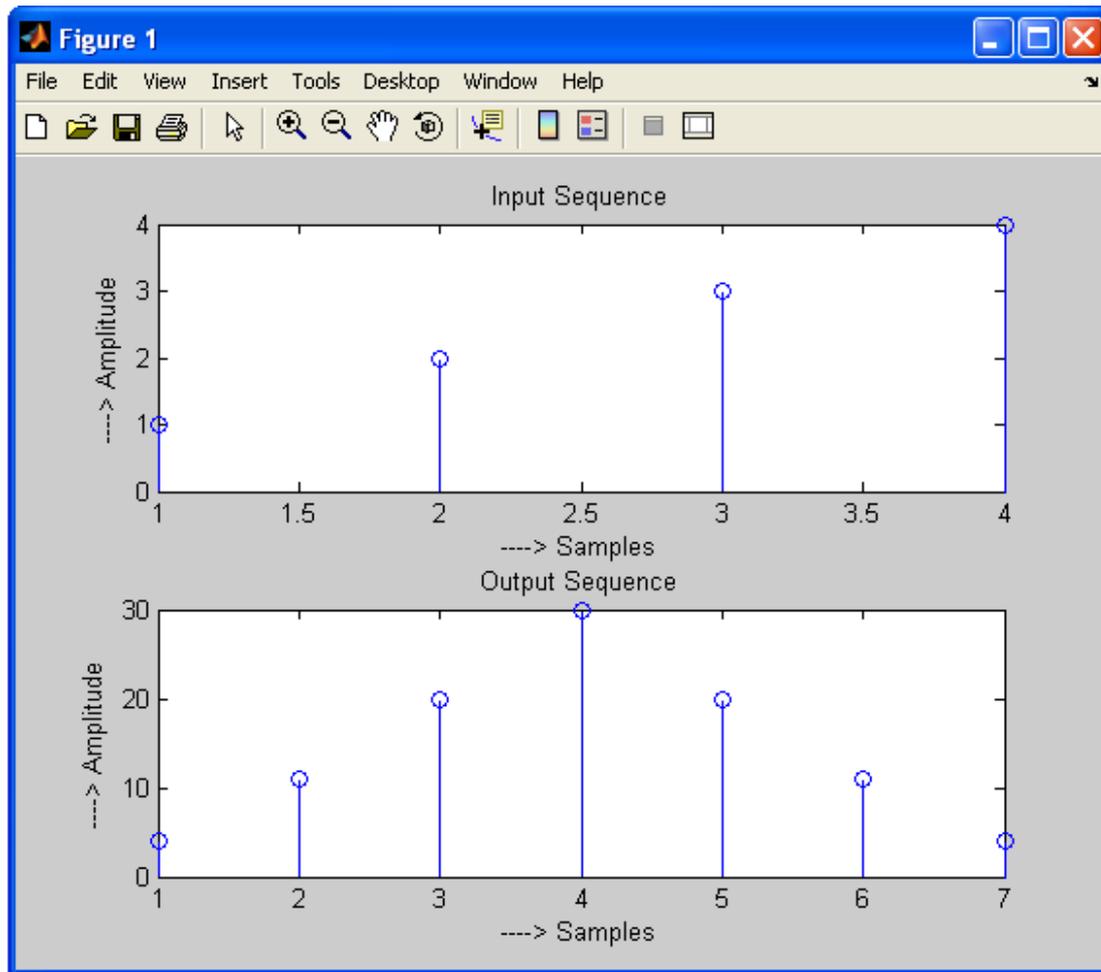
res = xcorr(a);

subplot(2,1,1);
stem(a);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
stem(res);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Output Sequence');
```

### OUTPUT

Enter the sequence .....: [1 2 3 4]



## 2. Auto Correlation of a Signal

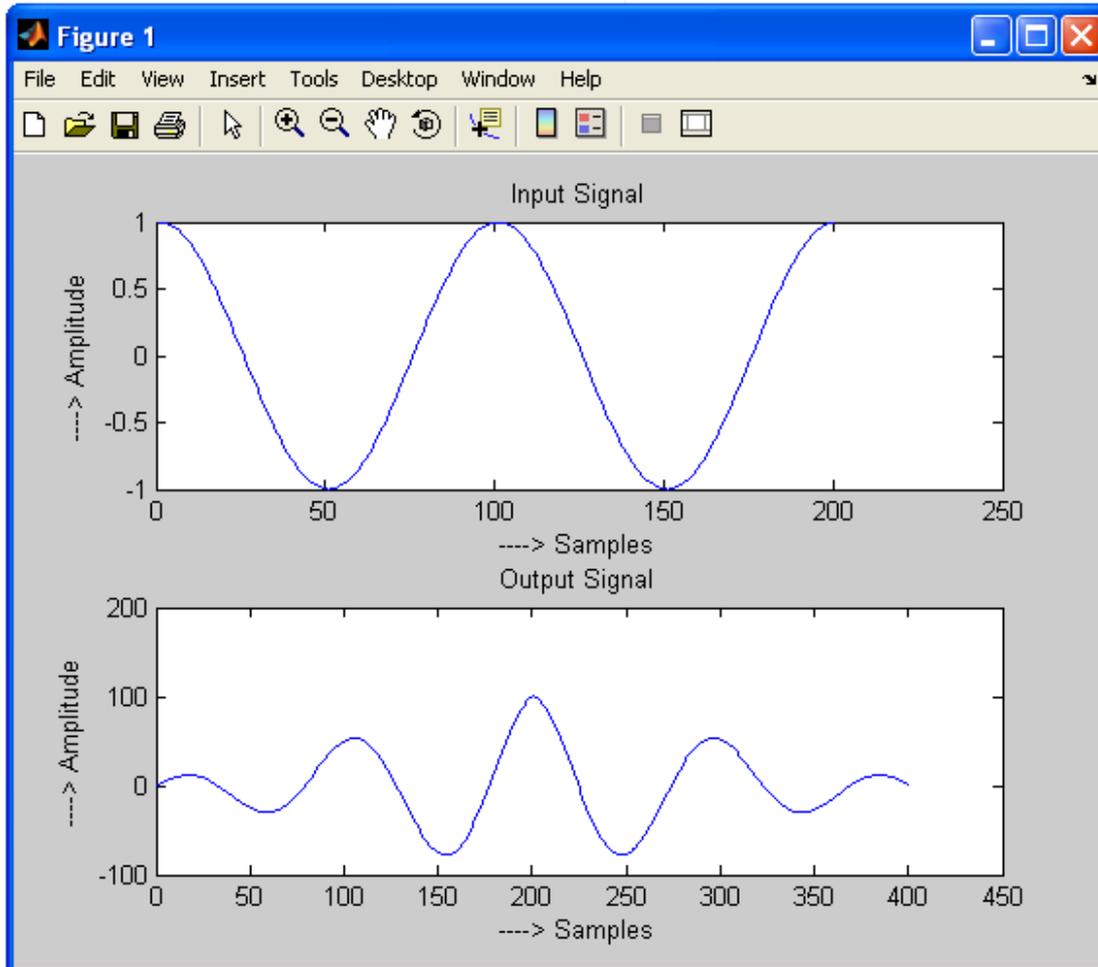
```
clear all;
close all;
clc;
t = 0:0.01:2;
a = cos(2 * pi * t);

res = xcorr(a);

subplot(2,1,1);
plot(a);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Input Sequence');

subplot(2,1,2);
plot(res);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Output Sequence');
```

### OUTPUT



### 3. Cross Correlation of two Sequences

```

clear all;
close all;
clc;

a = input('Enter the first sequence .....: ');
b = input('Enter the second sequence .....: ');
res = xcorr(a,b);

subplot(2,2,1);
stem(a);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Input Sequence(1)');

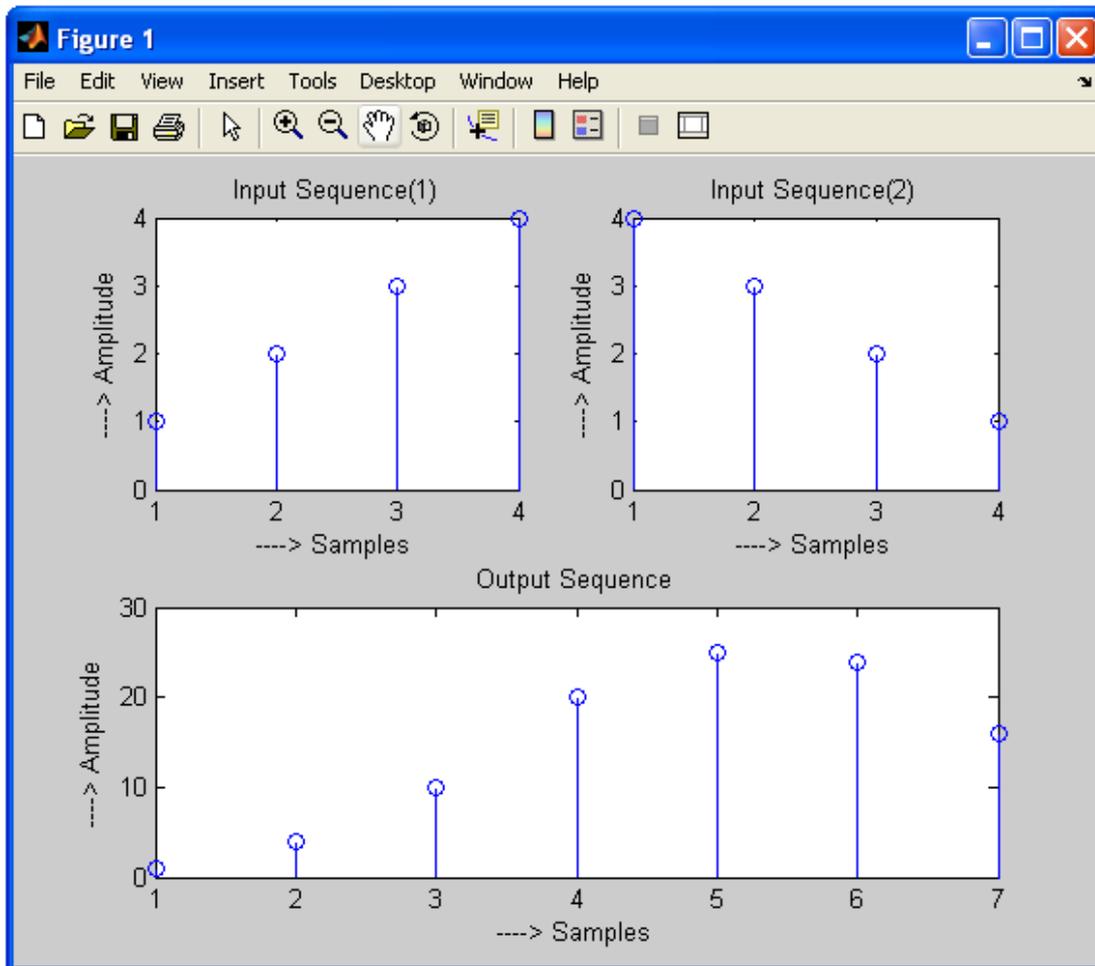
subplot(2,2,2);
stem(b);
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Input Sequence(2)');
subplot(2,2,[3,4]);
stem(res);
    
```

```
xlabel('----> Samples');
ylabel('----> Amplitude');
title('Output Sequence');
```

## OUTPUT

Enter the first sequence .....: [1 2 3 4]

Enter the second sequence .....: [4 3 2 1]



## 4. Cross Correlation of a two Signals

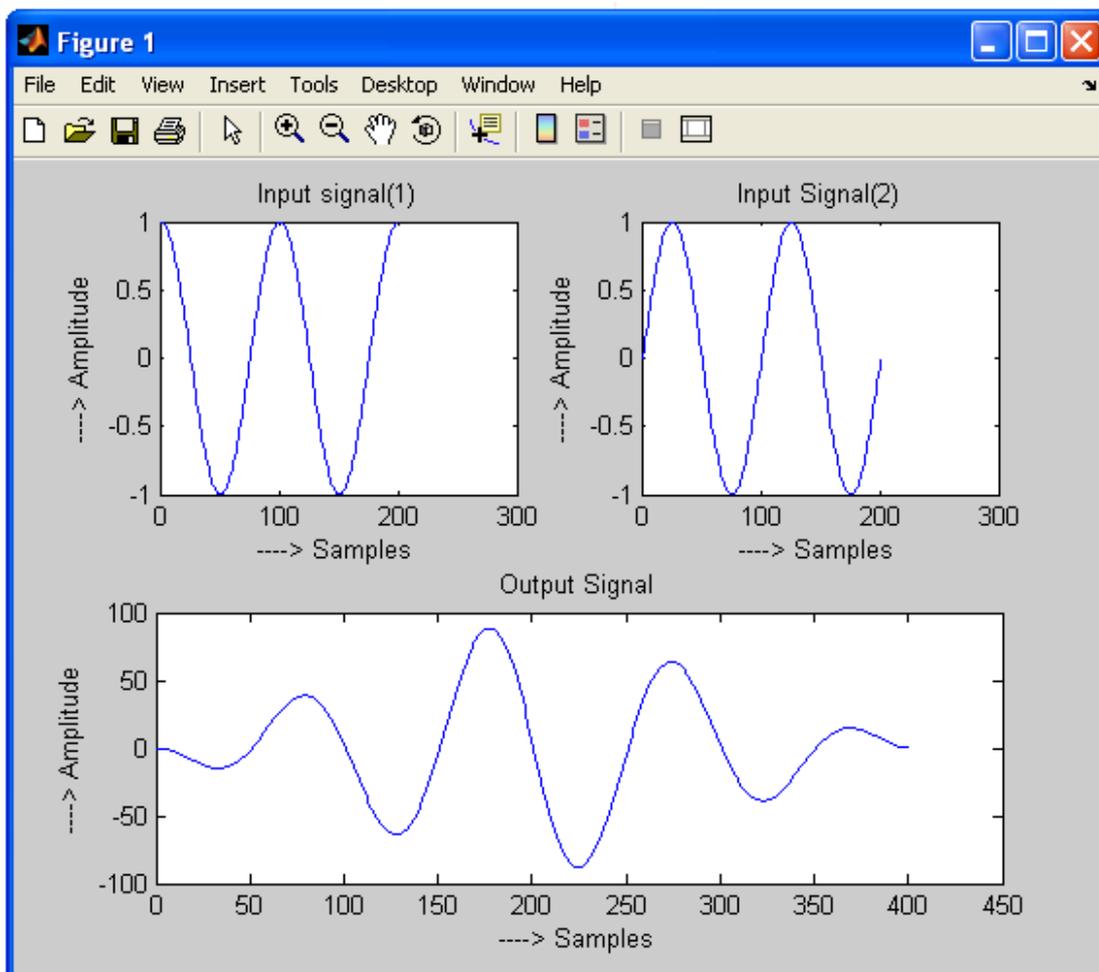
```
clear all;
close all;
clc;
t = 0:0.01:2;
a = cos(2 * pi * t);
b = sin(2 * pi * t);

res = xcorr(a,b);

subplot(2,2,1);
plot(a);
xlabel('----> Samples');
ylabel('----> Amplitude');
```

```
title('Input signal(1)');  
  
subplot(2,2,2);  
plot(b);  
xlabel('----> Samples');  
ylabel('----> Amplitude');  
title('Input Signal(2)');  
  
subplot(2,2,[3,4]);  
plot(res);  
xlabel('----> Samples');  
ylabel('----> Amplitude');  
title('Output Signal');
```

### OUTPUT



### Post lab:-

1. Compare the practical results with theoretical results.

### Result:-



**Reasoning Questions:-**

1. What is Correlation?
2. What is the importance of Correlation?
3. What is the difference between Correlation and Convolution?

### Experiment: 7

#### Aim:-

: Verification of Linearity and Time Invariance properties of a given Continuous / Discrete system.

#### Pre lab:-

1. Study the Concept of Linearity and Time Invariance of a given continuous / discrete system

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

#### Program:-

##### 1. Linearity of a system

```
clear all;
close all;
clc;

n=0:0.01:2;
a= -3; b= 5;

x1=cos(2*pi*n);
x2=cos(3*pi*n);
x=a*x1+b*x2;

ic=[0 0];
num=[2.2403 2.4908 2.2403];
den=[1 -0.4 0.75];

y1=filter(num,den,x1,ic);
y2=filter(num,den,x2,ic);
y=filter(num,den,x,ic);

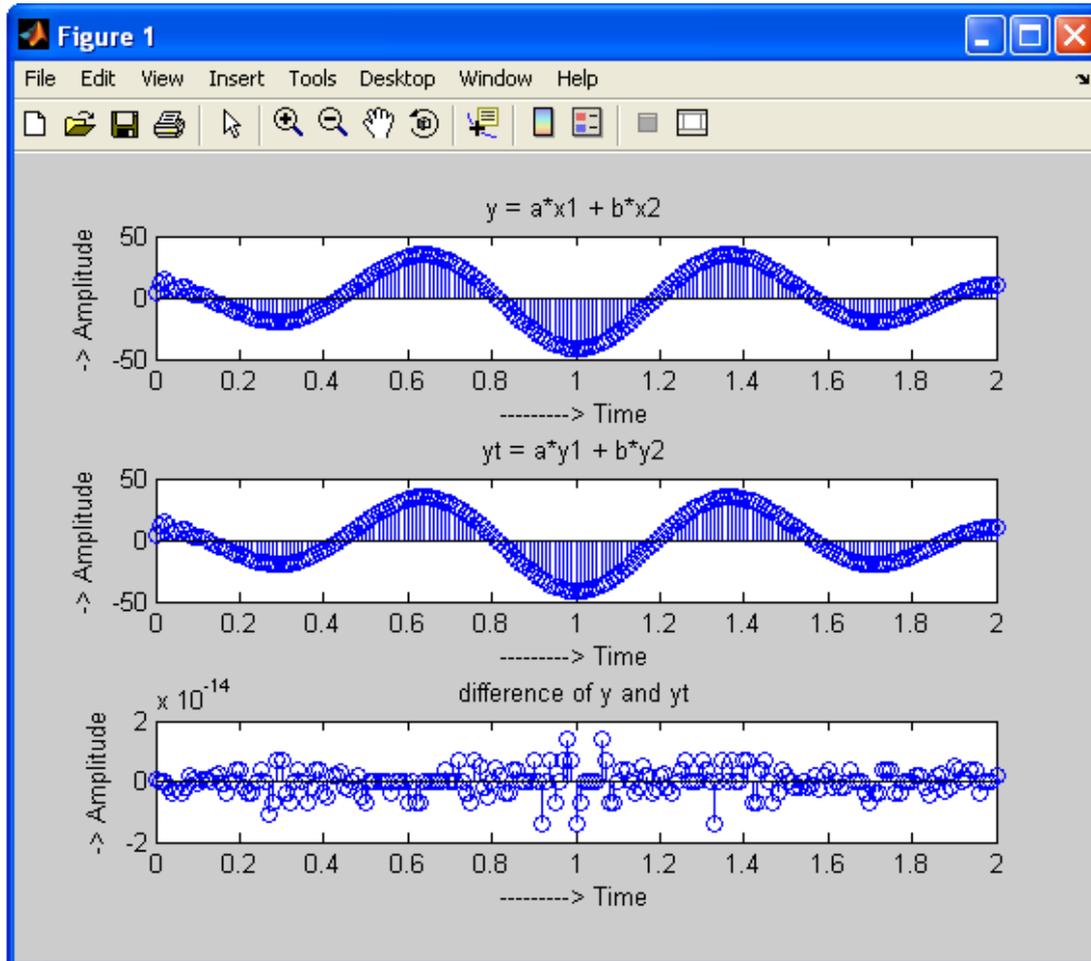
yt=a*y1+b*y2;
d=y-yt;

subplot(3,1,1), stem(n,y);
xlabel('-----> Time');
ylabel('-> Amplitude');
title('y = a*x1 + b*x2');

subplot(3,1,2), stem(n,yt);
xlabel('-----> Time');
ylabel('-> Amplitude');
title('yt = a*y1 + b*y2');

subplot(3,1,3), stem(n,d);
xlabel('-----> Time');
ylabel('-> Amplitude');
title('difference of y and yt');
```

## OUTPUT



### 2. Time Invariance of a system

```

clear all;
close all;
clc;

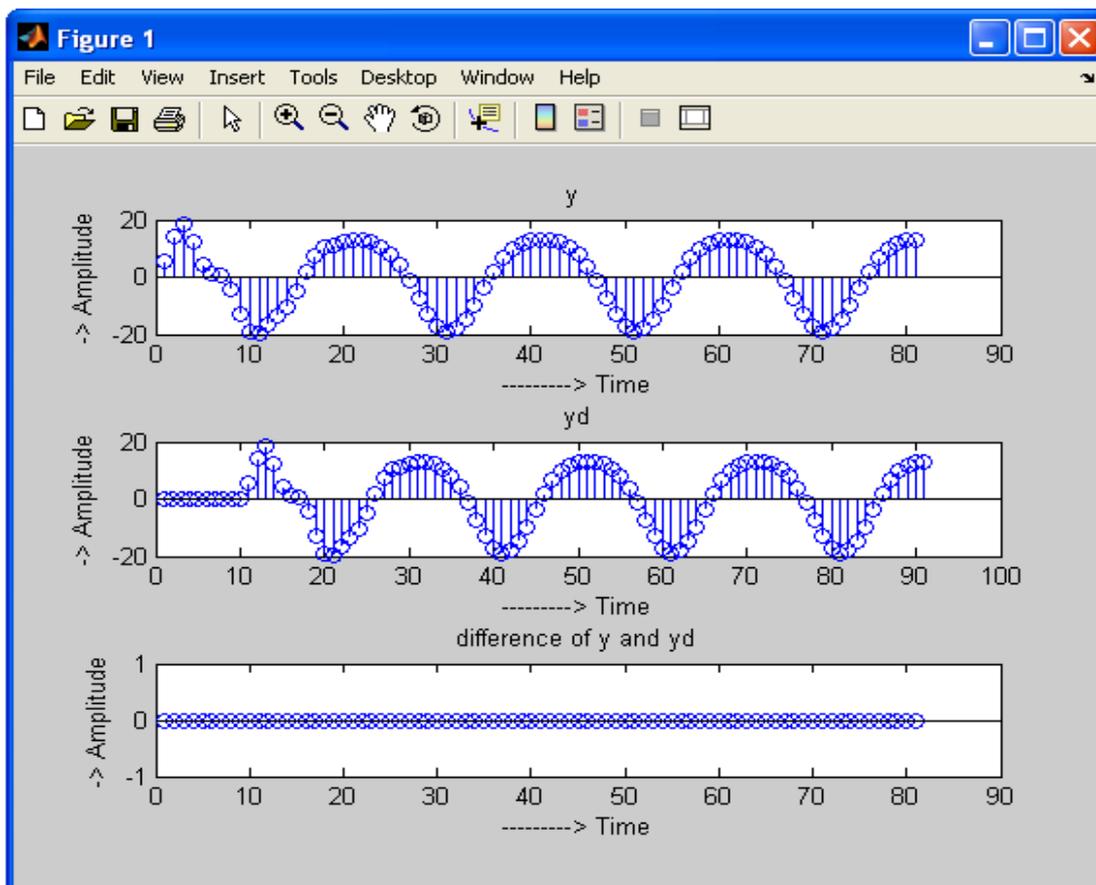
n=0:0.05:4;
D=10;
x=3*cos(2*pi*n)-0.5*cos(4*pi*n);
xd=[zeros(1,D) x];
num=[2.2403 2.4908 2.2403];
den=[1 -0.4 0.75];
ic=[0 0];

y=filter(num,den,x,ic)
yd=filter(num,den,xd,ic)
d=y-yd(1+D:41+D);

subplot(3,1,1), stem(y);
xlabel('-----> Time');
    
```

```
ylabel('-> Amplitude'); title('y ');  
  
subplot(3,1,2), stem(yd);  
xlabel('-----> Time');  
ylabel('-> Amplitude'); title('yd');  
  
subplot(3,1,3), stem(d);  
xlabel('-----> Time');  
ylabel('-> Amplitude');  
title('difference of y and yd');
```

## OUTPUT



### Post lab:-

1. Compare the practical results with theoretical results.

### Result:-

### Reasoning Questions:-



1. What is Linearity and give the condition for a system?
2. What is Time Invariance and give the condition for a system?
3. Check the linearity of the following systems
  - a.  $y(n) = [x(n)]^2$
  - b.  $y(n) = \exp(x(n))$
  - c.  $y(t) = 7x(t) + 5$
4. Check the Time Invariance of the following systems
  - a.  $y(n) = a [x(n)]^2 + b x(n)$
  - b.  $y(t) = x(t + 7)$

## Experiment: 8

### Aim:-

: Computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.

### Pre lab:-

1. Study the details of LTI systems
2. Study stability and physical realizability properties

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

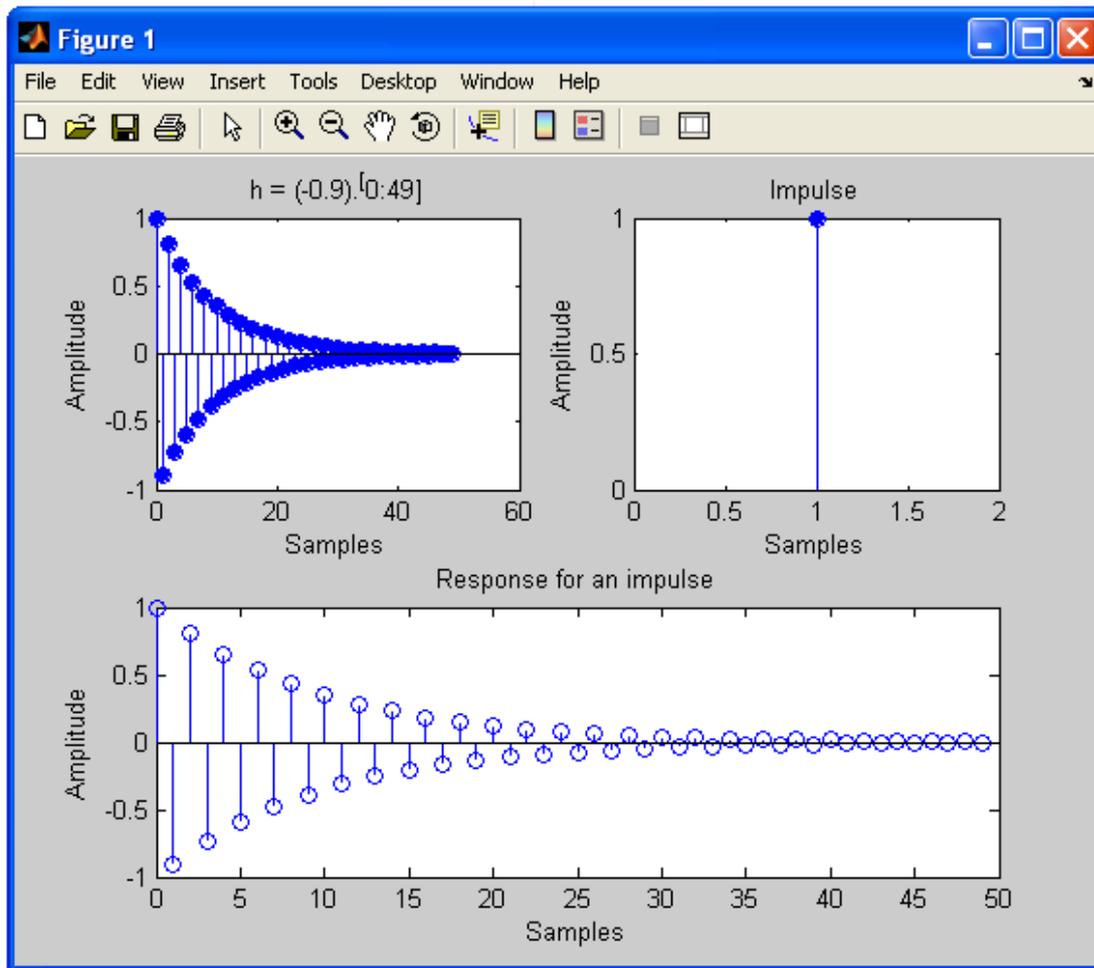
#### 1. Impulse Response of an LTI system

```
clear all;
close all;
clc;

h = (-0.9).^[0:49];
subplot(2,2,1);
stem([0:49],h,'filled');
xlabel('Samples');
ylabel('Amplitude');
title('h = (-0.9).^[0:49]');

u = ones(1);
subplot(2,2,2);
stem(u,'filled');
xlabel('Samples');
ylabel('Amplitude');
title('Impulse');

s = conv(u,h);
subplot(2,2,[3,4]);
stem([0:49],s(1:50));
xlabel('Samples');
ylabel('Amplitude');
title('Response for an impulse');
```

**OUTPUT**

**2. Step Response of an LTI system**

```

clear all;
close all;
clc;

h = (-0.9).^[0:49];
subplot(2,2,1);
stem([0:49],h,'filled');
xlabel('Samples');
ylabel('Amplitude');
title('h = (-0.9).^[0:49]');

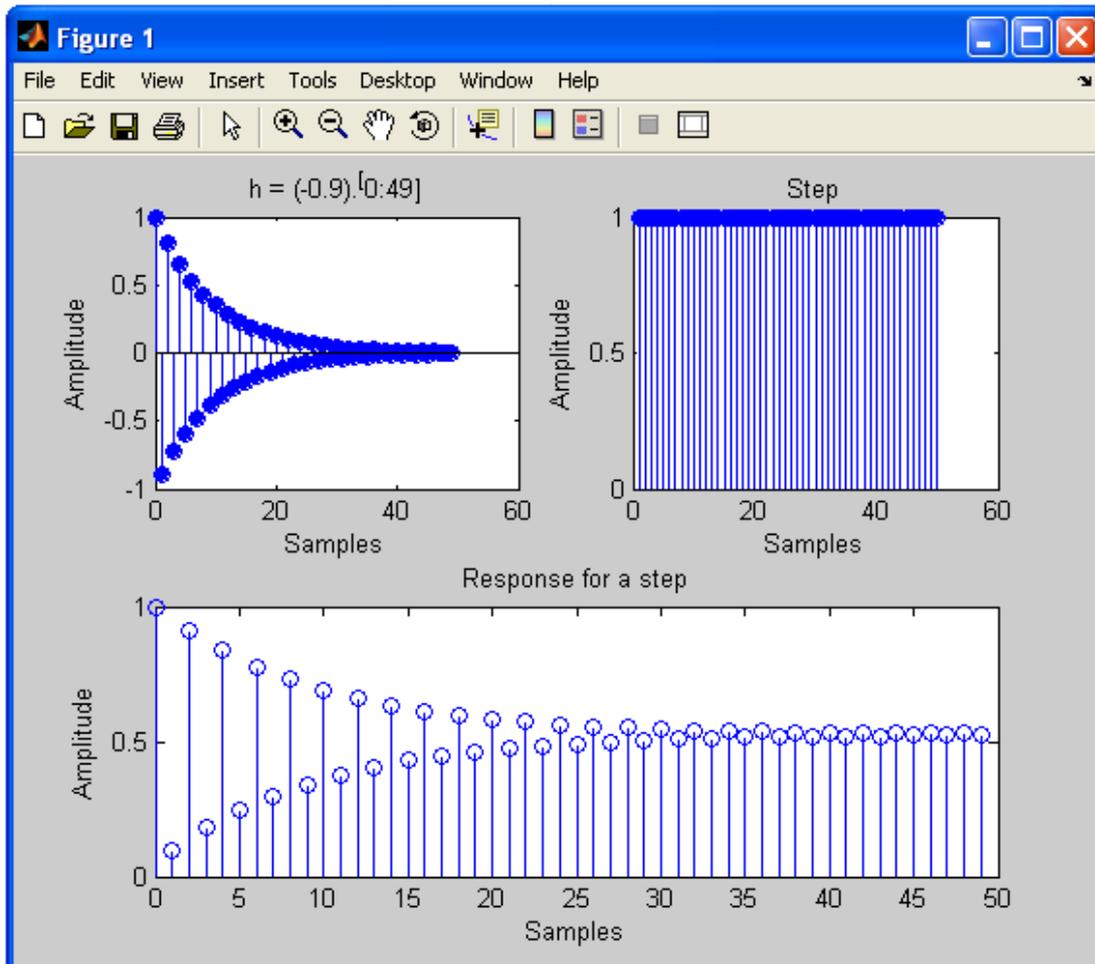
u = ones(1,50);
subplot(2,2,2);
stem([1:50],u,'filled');
xlabel('Samples');
ylabel('Amplitude');
title('Step');

s = conv(u,h);
subplot(2,2,[3,4]);

```

```
stem([0:49],s(1:50));
xlabel('Samples');
ylabel('Amplitude');
title('Response for a step');
```

### OUTPUT



### 3. Sinusoidal Response of an LTI System

```
clear all;
close all;
clc;
t = 1:0.04:2;
h = (-0.9).^t;
subplot(2,2,1);
stem(t,h,'filled');
xlabel('Samples');
ylabel('Amplitude');
title('h = (-0.9).^t');

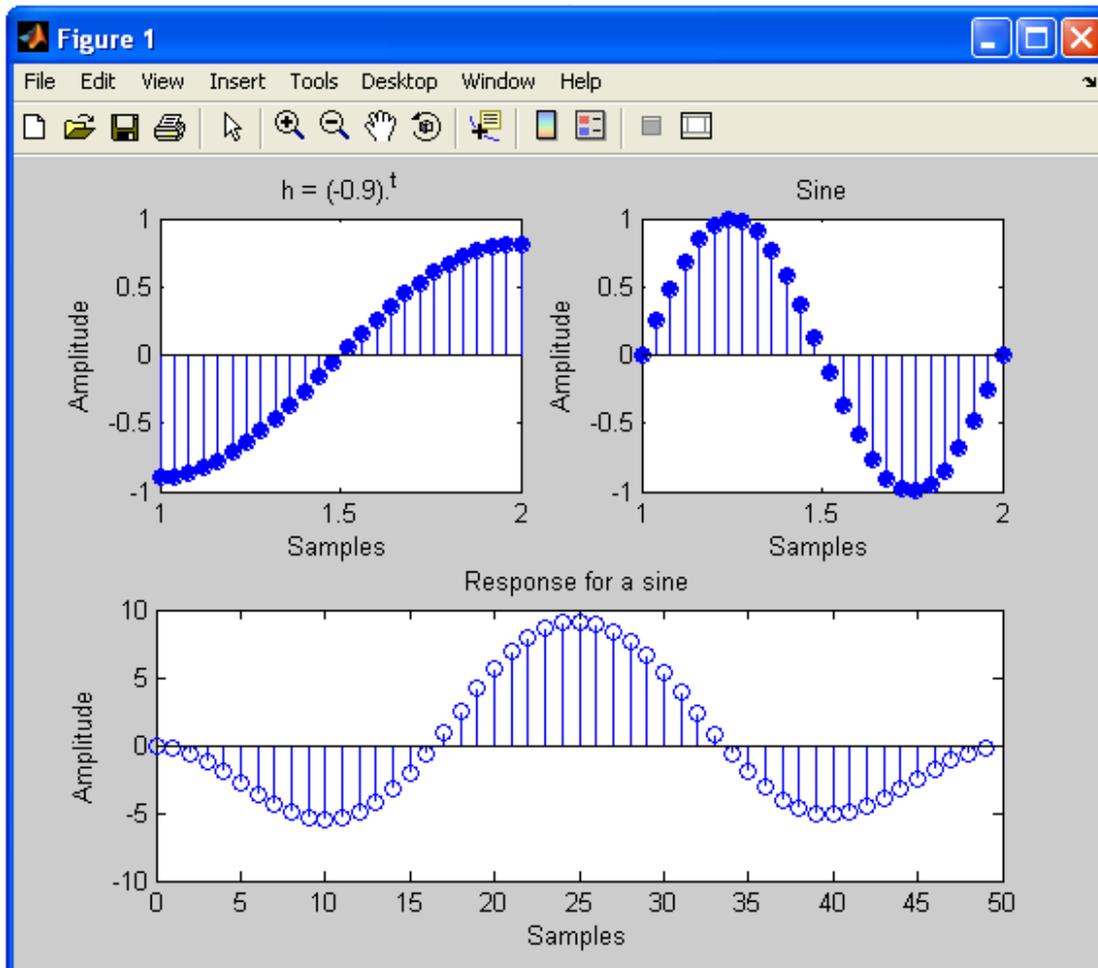
u = sin(2*pi*t);
subplot(2,2,2);
stem(t,u,'filled');
xlabel('Samples');
```

```

ylabel('Amplitude');
title('Sine');

s = conv(u,h);
subplot(2,2,[3,4]);
stem([0:49],s(1:50));
xlabel('Samples');
ylabel('Amplitude');
title('Response for a sine');
    
```

### OUTPUT



### 4. Stability of a given LTI System

```

clear all;
close all;
clc;

n=0:0.1:20;
h= (0.5)*exp(-n);
sum=0;
for k=1:201
if abs(h(k))<10^(-6);
    
```

```
break
end
sum=sum+h(k);
end
stem(n,h);
disp('The summation value is .....: ');sum
if sum > 5.0983e+008
disp('The System is unstable');
else
disp('The System is stable');
end;
```

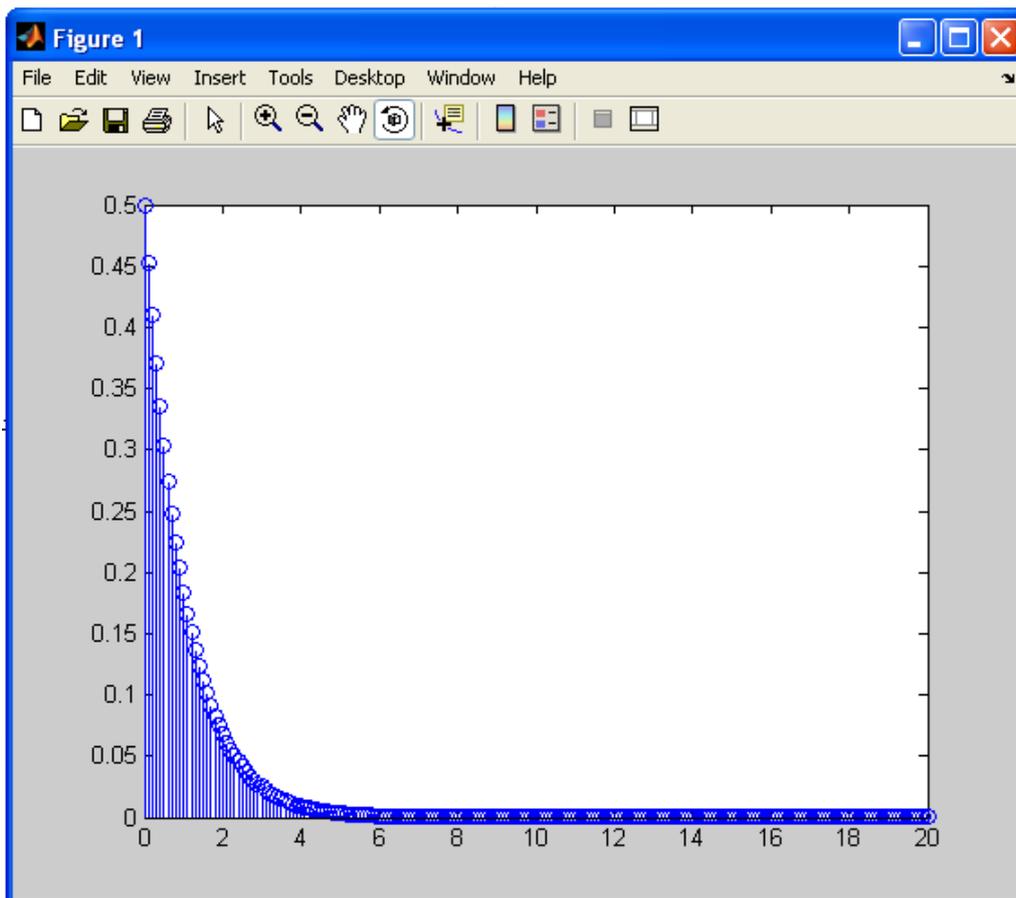
### OUTPUT

The summation value is .....:

sum =

5.2542

The System is stable



### Post lab:-

1. Compare the practical results with theoretical results.



**Result:-**

**Reasoning Questions:-**

1. What is an LTI System?
2. Define Stability?
3. Specify whether the system is stable or not
  - a.  $x(t) = 2.5 * \exp(t) U(t)$
  - b.  $x(n) = 0.5 * (-0.5)^n U(n)$

### Experiment: 9

#### Aim:-

: Verification of Gibbs phenomenon on signals

#### Pre lab:-

1. Study the details of Gibbs phenomenon

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

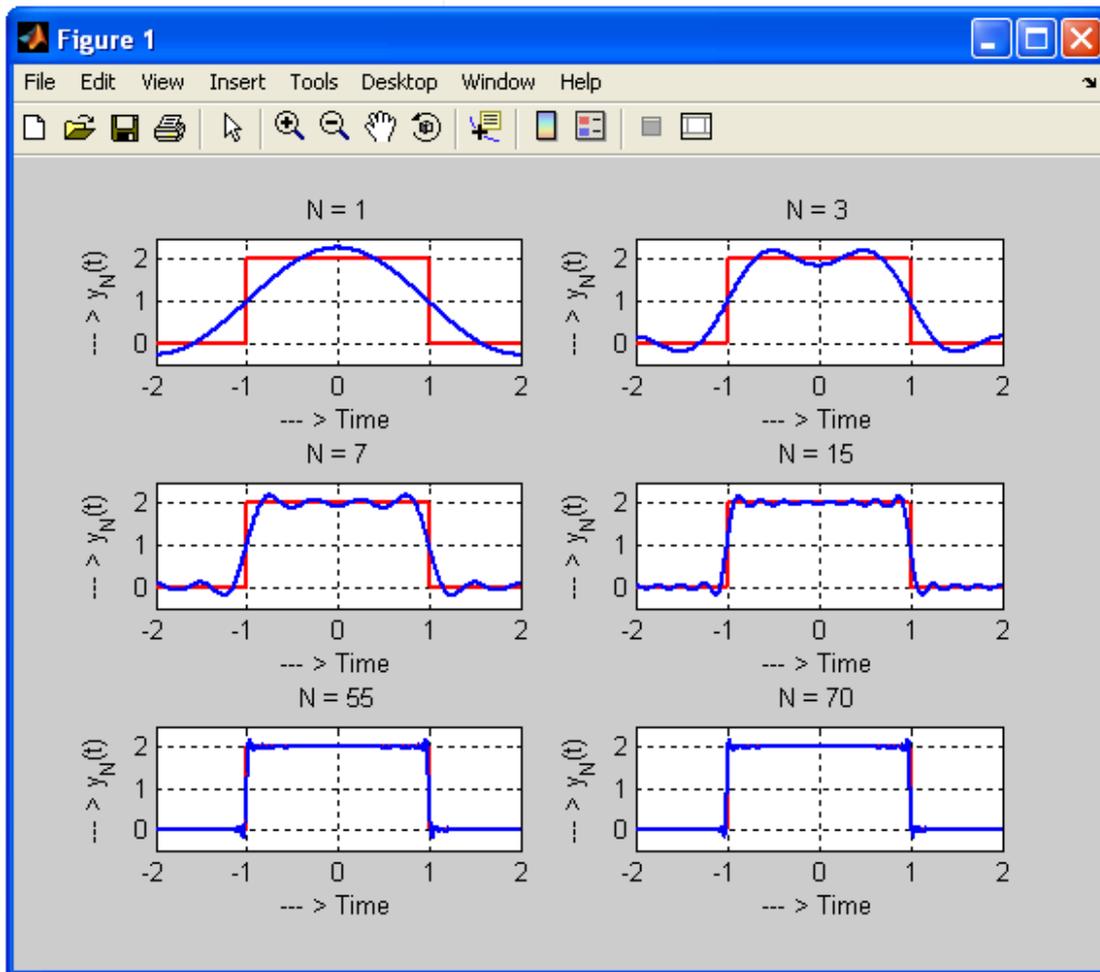
#### Program:-

```
clear all;
close all;
clc;

t=linspace(-2,2,2000);
u=linspace(-2,2,2000);
sq=[zeros(1,500),2*ones(1,1000),zeros(1,500)];

k = 2;
N=[1,3,7,15,55,70];
for n=1:6;
an=[];
for m=1:N(n)
    an=[an,2*k*sin(m*pi/2)/(m*pi)];
end;
fN= 1 ;
for m=1:N(n)
    fN=fN+an(m)*cos(m*pi*t/2);
end;
nq=int2str(N(n));
subplot(3,2,n);
plot(u,sq,'r','LineWidth',2);
hold on;
plot(t,fN,'LineWidth',2);
hold off;
axis([-2 2 -0.5 2.5]);
grid;
xlabel('--- > Time'),
ylabel('--- > y_N(t)');
title(['N = ',nq]);
end;
```

**OUTPUT**



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Define Gibb's Phenomenon?
2. What is the importance of Gibb's Phenomenon?

## Experiment:10

### Aim:-

: Finding the Fourier Transform of a given signal and plotting its Magnitude and Phase spectrum.

### Pre lab:-

1. Study the Fourier Transform Concepts.
2. Study to find the Magnitude and Phase Spectrum of a given Signal.

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

#### 1. Find the Fourier Transform and its Inverse Fourier Transform of a Signal

```
clear all;
close all;
clc;

syms x a b
X = input('Fourier Transform of a function .....: ');
disp('is .....: ');
Xf = fourier(X)
disp('Inverse Fourier Transform of a function .....: ');Xf
disp('is .....: ');
Xt = ifourier(Xf)
```

#### OUTPUT

Fourier Transform of a function .....:  $\exp(-5*x)*\text{heaviside}(x)$   
is .....:

Xf =  $1/(5+i*w)$

Inverse Fourier Transform of a function .....:

Xf =  $1/(5+i*w)$

is .....:

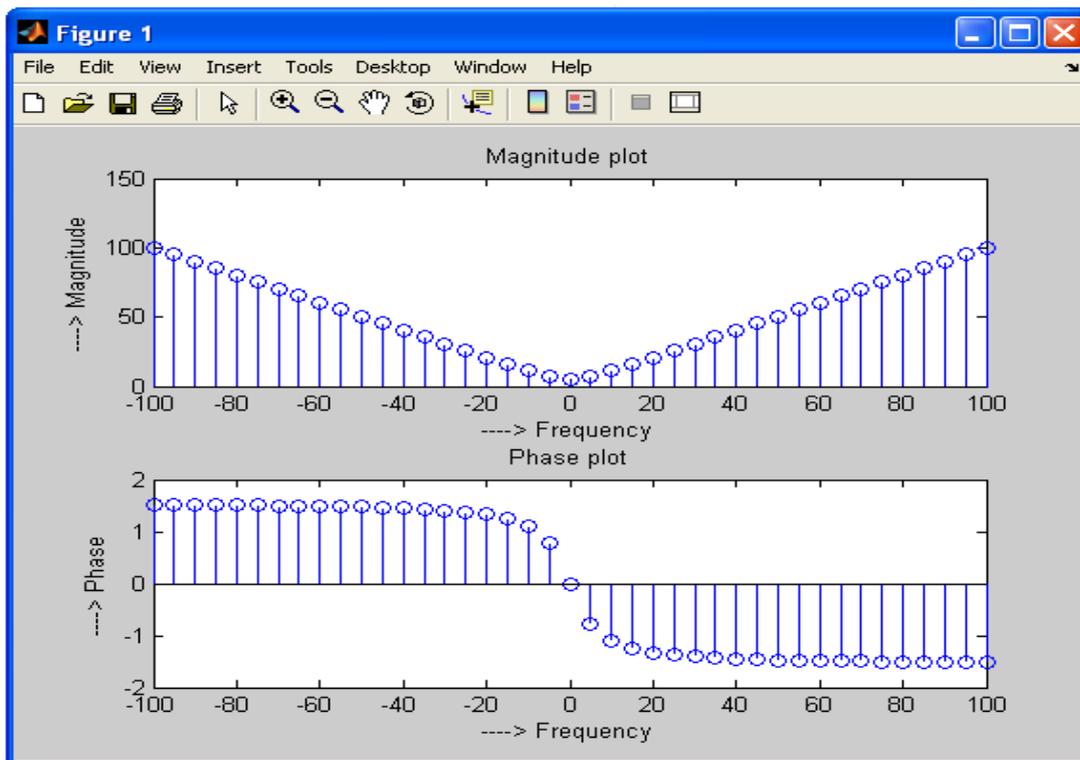
Xt =  $\exp(-5*x)*\text{heaviside}(x)$

#### 2. Find the Magnitude and Phase Spectrum of the above Signal

```
clear all;
close all;
clc;
w = -100:5:100;
```

```
z = sqrt(25+w.*w);  
subplot(2,1,1);  
stem(w,z);  
xlabel('----> Frequency');  
ylabel('----> Magnitude');  
title('Magnitude plot');  
  
y = atan(-w/5);  
subplot(2,1,2);  
stem(w,y);  
xlabel('----> Frequency');  
ylabel('----> Phase');  
title('Phase plot');
```

### OUTPUT



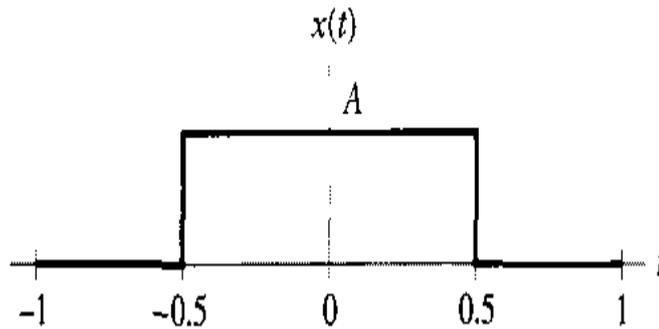
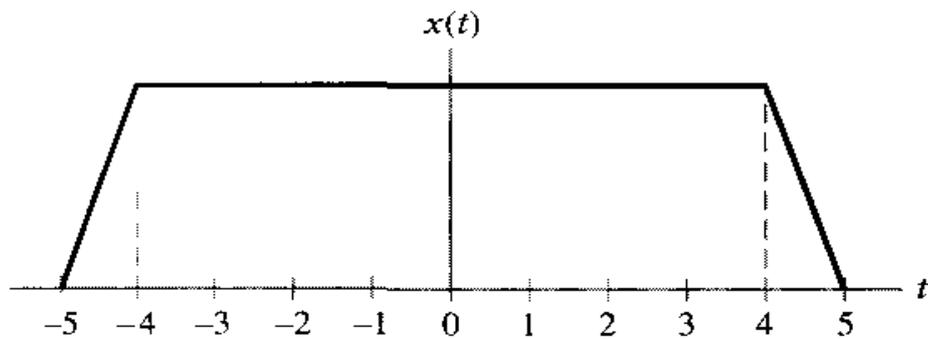
### Post lab:-

1. Compare the practical results with theoretical results.

### Result:-

### Reasoning Questions:-

1. Give the expression for Fourier Transform?
2. Give the expression for Inverse Fourier Transform?
3. Find the Magnitude and Phase of  $x + i*y$ ?
4. Find the Fourier Transform and find its Magnitude and Phase Spectrum
  - a)  $x(t) = U(t)$
  - b)  $x(t) = r(t)$
  - c)  $x(t) = 2\sin(10t)U(t)$
  - d)  $x(t) = \exp(-|t|)U(t)$
5. Find the Fourier Transform and find its Magnitude and Phase Spectrum



## Experiment: 11

**Aim:-**

: Wave form synthesis using Laplace Transforms.

**Pre lab:-**

1. Study in detail about Laplace & Inverse Laplace Transforms.

**Equipment Required:-**

1. MATLAB 7.1
2. Windows XP SP2

**Program:-**

```
clear all;
close all;
clc;

syms t a b
X = input('Laplace Transform of a function .....: ');
disp('is .....: ');
Xf = laplace(X)
disp('Inverse Laplace Transform of a function .....: ');Xf
disp('is .....: ');
Xt = ilaplace(Xf)
```

**OUTPUT**

Laplace Transform of a function .....:  $\sin(t)$  is .....:

$$Xf = 1/(s^2+1)$$

Inverse Laplace Transform of a function .....:

$$Xf = 1/(s^2+1) \text{ is .....:}$$

$$Xt = \sin(t)$$

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. What is Waveform Synthesis?
2. What is the difference between Analysis and Synthesis?
3. Find the Inverse Laplace Transform of
  - a)  $1/(s+2)$
  - b)  $1/s^3$
  - c)  $(s^2 + 2s + 9)/(s(s^2 + 9))$
  - d)  $18/(s^2(s^2 + 9))$
4. Find the Laplace Transform of
  - a)  $x(t) = (1 - e^{-2t}) * U(t)$
  - b)  $x(t) = U(t) - U(t - 2)$
  - c)  $x(t) = 10\cos(t) - 20\sin(20t)$
  - d)  $x(t) = a^{2t}U(t)$

## Experiment: 12

### Aim:-

: Locating the zeros and poles and plotting the pole-zero maps in S-plane and Z-plane for the given transfer function.

### Pre lab:-

1. Study the details of Laplace Transform and Z Transform in detail.
2. Learn to plot the poles and zeros in the S and Z planes

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

#### 1. Location of poles and zeros in the S plane

```
clear all;
close all;
clc;

num = input('Enter the numerator coefficients.....: ');
den = input('Enter the denominator coefficients.....: ');

H = tf(num, den)
poles = roots(den)
zeros = roots(num)
sgrid
pzmap(H)
grid on
title('Pole/Zero Plot for Complex Poles and Zeros in S plane');
```

### OUTPUT

```
Enter the numerator coefficients.....: [1 2.5]
Enter the denominator coefficients.....: [1 6 11 6]
```

Transfer function:

$$s + 2.5$$

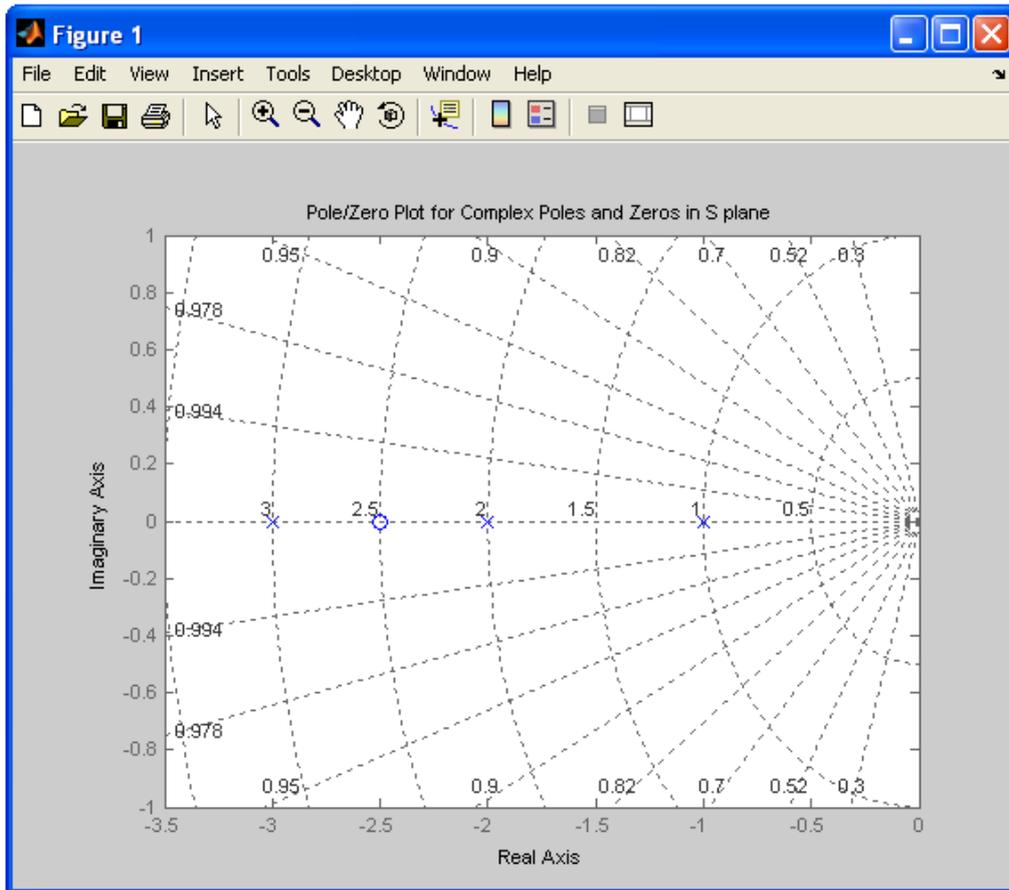
-----  
 $s^3 + 6s^2 + 11s + 6$

poles =

```
-3.0000
-2.0000
-1.0000
```

zeros =

```
-2.5000
```



**2. Location of poles and zeros in the Z plane**

```

clc;
clear all;
close all;

num = input('Enter the numerator coefficients.....: ');
den = input('Enter the denominator coefficients.....: ');

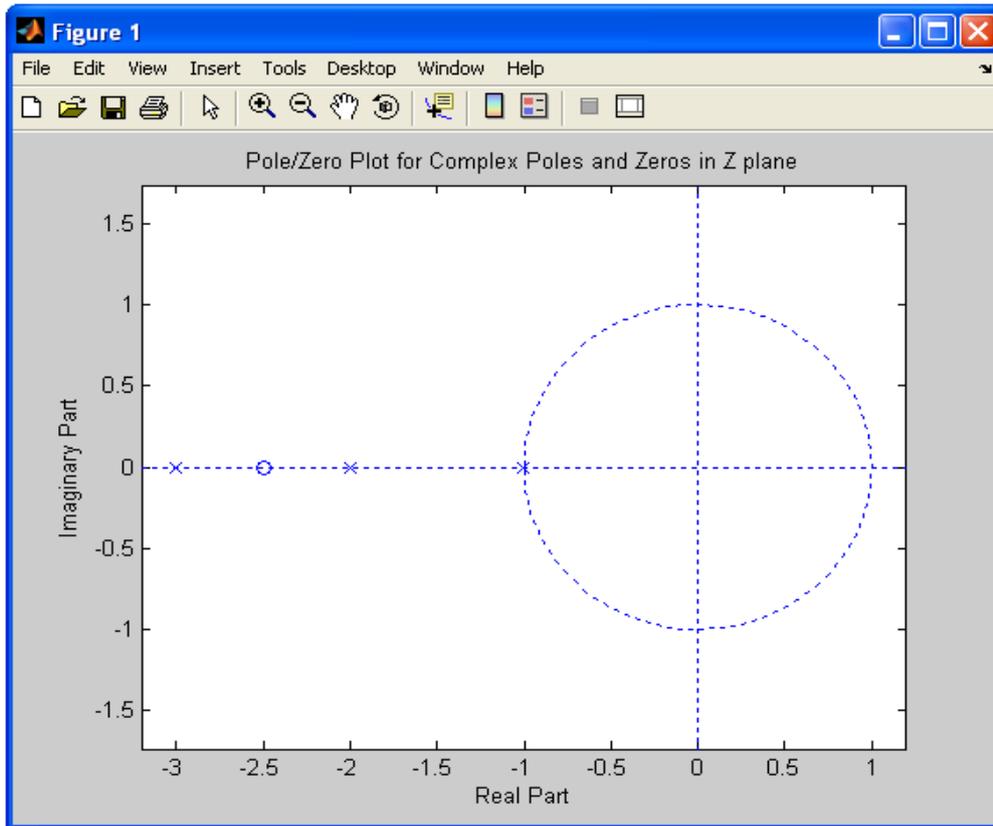
p = roots(den)
z = roots(num)
zplane(z,p);

title('Pole/Zero Plot for Complex Poles and Zeros in Z plane');
    
```

**OUTPUT**

```

Enter the numerator coefficients.....: [1 2.5]
Enter the denominator coefficients.....: [1 6 11 6]
p =
    -3.0000
    -2.0000
    -1.0000
z =
    -2.5000
    
```



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Study the details of sym() function?
2. Study the details of laplace() and ilaplace() functions?
3. Study the details of pretty() and factor() functions?
4. Study the details of Heaviside() function?
5. Study the details of Residue() and roots() functions?
6. Study the details of ztrans() and iztrans() functions?
7. Study the details of dimpulse() function?
8. What are Poles and Zeros?
9. How you Specify the Stability based on poles and zeros?
10. Define S plane and Z plane?
11. What is the difference between S plane and Z plane?

### Experiment: 13

#### Aim:-

: Generation of Gaussian noise (Real and Complex), computation of its mean, M.S. value and its Skew, kurtosis, and PSD, probability distribution function.

#### Pre lab:-

1. Learn about Gaussian noise and its importance
2. Study the details about mean, M.S. value and its Skew, kurtosis, and PSD, probability distribution function

#### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

#### Program:-

```
clc;
clear all;
close all;
N= input(' Enter the number of samples .....: ');
R1=randn(1,N);
M=mean(R1)
K=kurtosis(R1)
P=periodogram(R1);
V=var(R1)
x = psd(R1);
subplot(2,2,1);
plot(R1);
title('Normal [Gaussian] Distributed Random Signal');
xlabel('Sample Number');
ylabel('Amplitude');

subplot(2,2,2);
hist(R1);
title('Histogram [Pdf] of a normal Random Signal');
xlabel('Sample Number');
ylabel('Total');

subplot(2,2,[3,4]);
plot(x);
title('PSD of a normal Random Signal');
xlabel('Sample Number');
ylabel('Amplitude');
```

#### **OUTPUT**

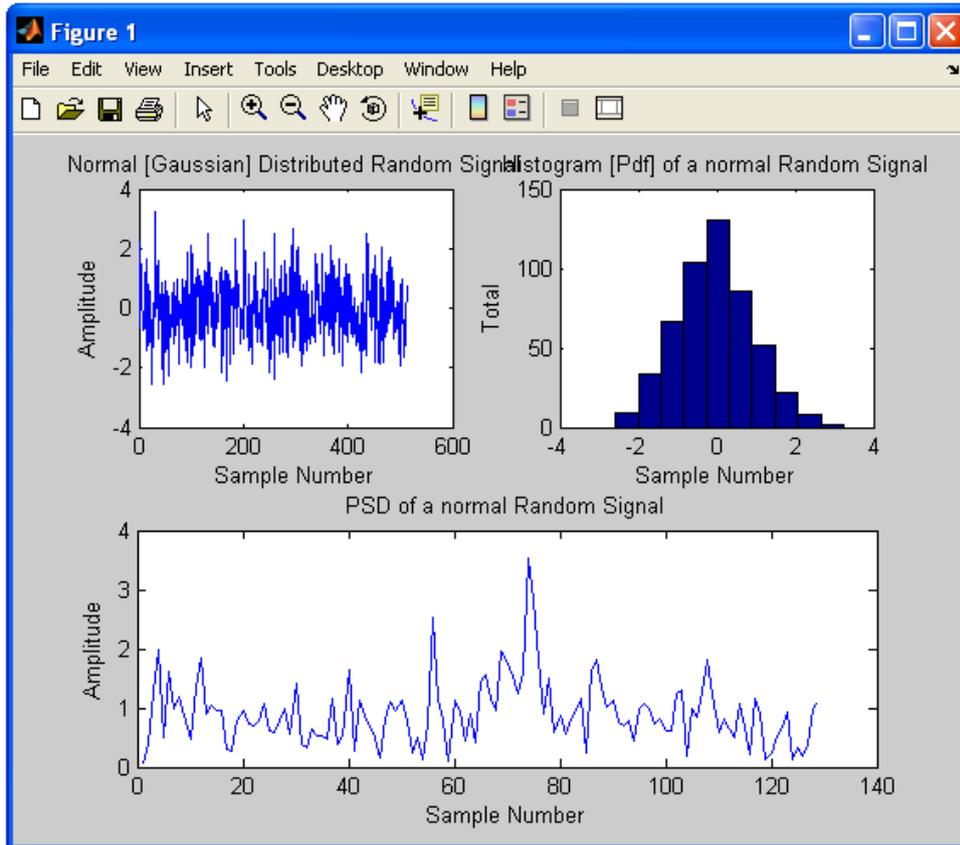
Enter the number of samples .....: 512

M =

-0.0398

K =  
3.0770

V =  
0.9535



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Define Gaussian Noise?
2. Define Mean and Skew?
3. Define kurtosis and PSD?
4. Define CDF and PDF ?
5. What is the difference between CDF and PDF?

## Experiment: 14

### Aim:-

: Verification of Sampling Theorem

### Pre lab:-

1. Study the details of Sampling Theorem

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

```
clear all;
close all;
clc;

Fs = input('Enter Sampling Frequency in Hz .....: ');
Fm = input('Enter Message Frequency in Hz .....: ');

t = 0:0.01:2;
msg = sin(2*pi*t);

k = 2*Fs/Fm;
step = ceil(201/k);
samp_msg = [];
for i = 1:201,
    if (mod(i,step) == 0)
        samp_msg = [samp_msg,msg(i)];
    else
        samp_msg = [samp_msg,zeros(1)];
    end;
end;

subplot(2,1,1);
plot(msg);
xlabel('---> Time');
ylabel('---> Amplitude');
title('Msg signal');

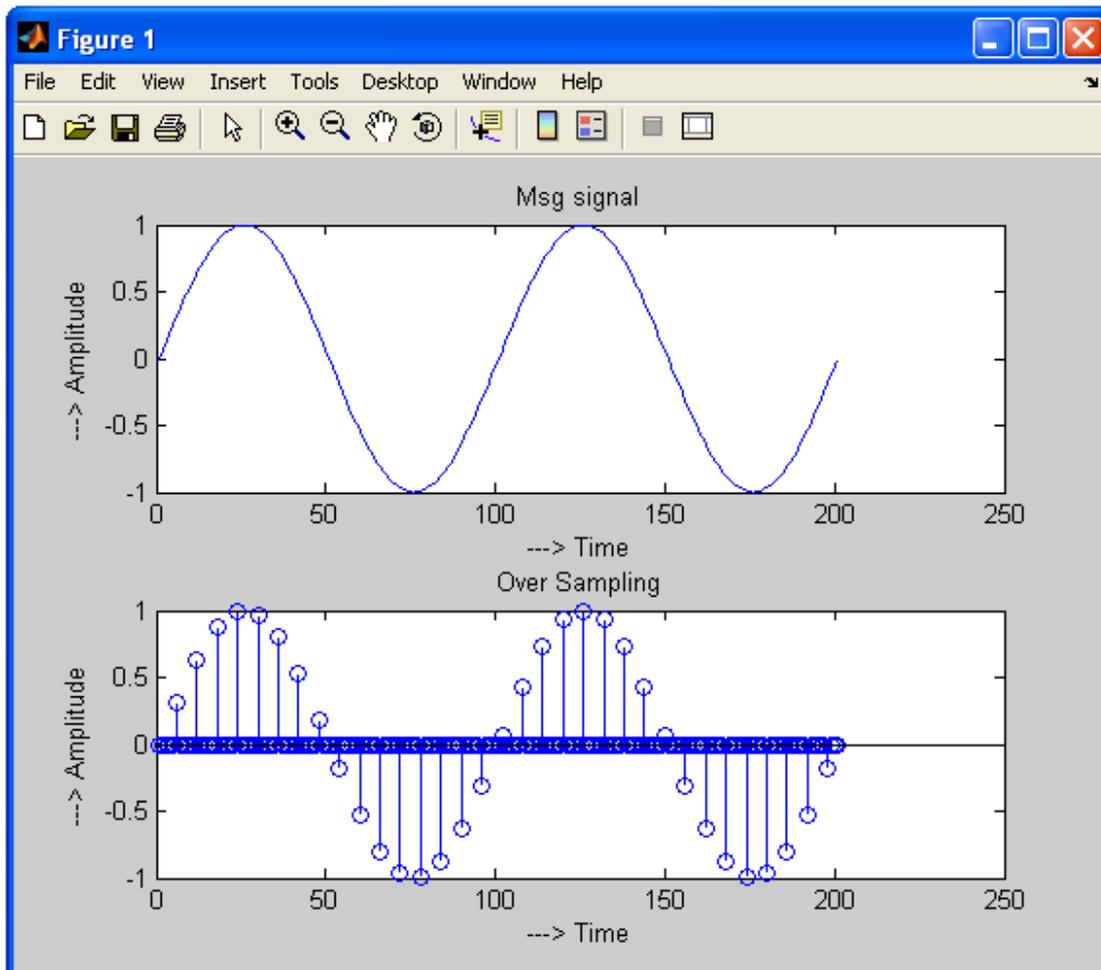
subplot(2,1,2);
stem(samp_msg);
xlabel('---> Time');
ylabel('---> Amplitude');
if Fs < 2*Fm
    title('Under Sampling');
else if Fs == 2*Fm
    title('Critical Sampling');
else
    title('Over Sampling');
end;
end;
```

```
end;
```

## OUTPUT

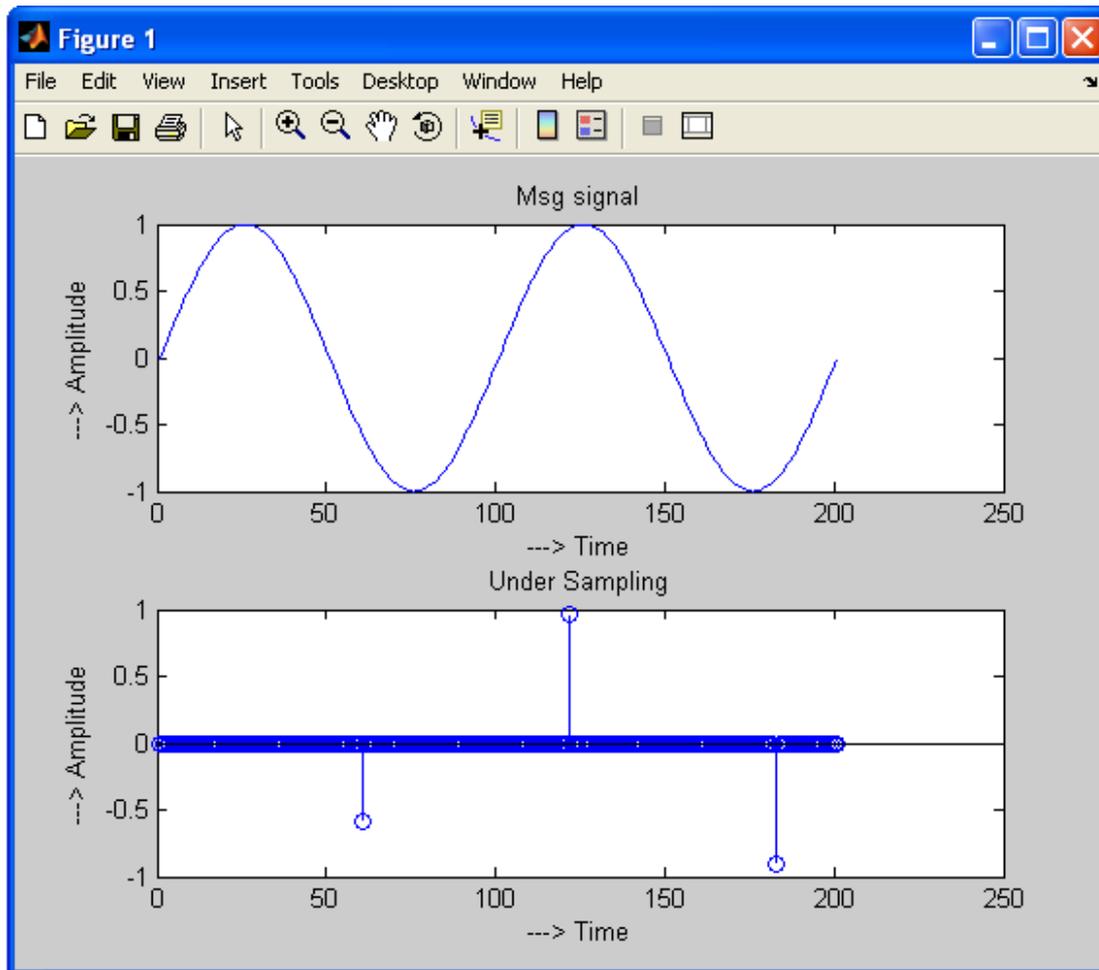
Enter Sampling Frequency in Hz .....: 1200

Enter Message Frequency in Hz .....: 60



Enter Sampling Frequency in Hz .....: 100

Enter Message Frequency in Hz .....: 60

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-****Reasoning Questions:-**

1. Define Sampling Theorem?
2. Define Replication property?
3. What is Impulse train?

### **Experiment:15**

#### **Aim:-**

: Removal of Noise by Auto Correlation/Cross Correlation.

#### **Pre lab:-**

1. Study in detail about Noise factors and types of noise in Communication
2. Study the details of Correlation(Auto and Cross)

#### **Equipment Required:-**

1. MATLAB 7.1
2. Windows XP SP2

#### **Program:-**

```
clear all;
close all;
clc;

N= input('Enter the number of samples .....: ');
h=1/N;
x=0:h:1;
y=sin(3*pi*x);

subplot(4,1,1);
plot(x,y);
xlabel('---> time'); ylabel('-> Amplitude');
title('Original signal');
w=rand(1,N+1);

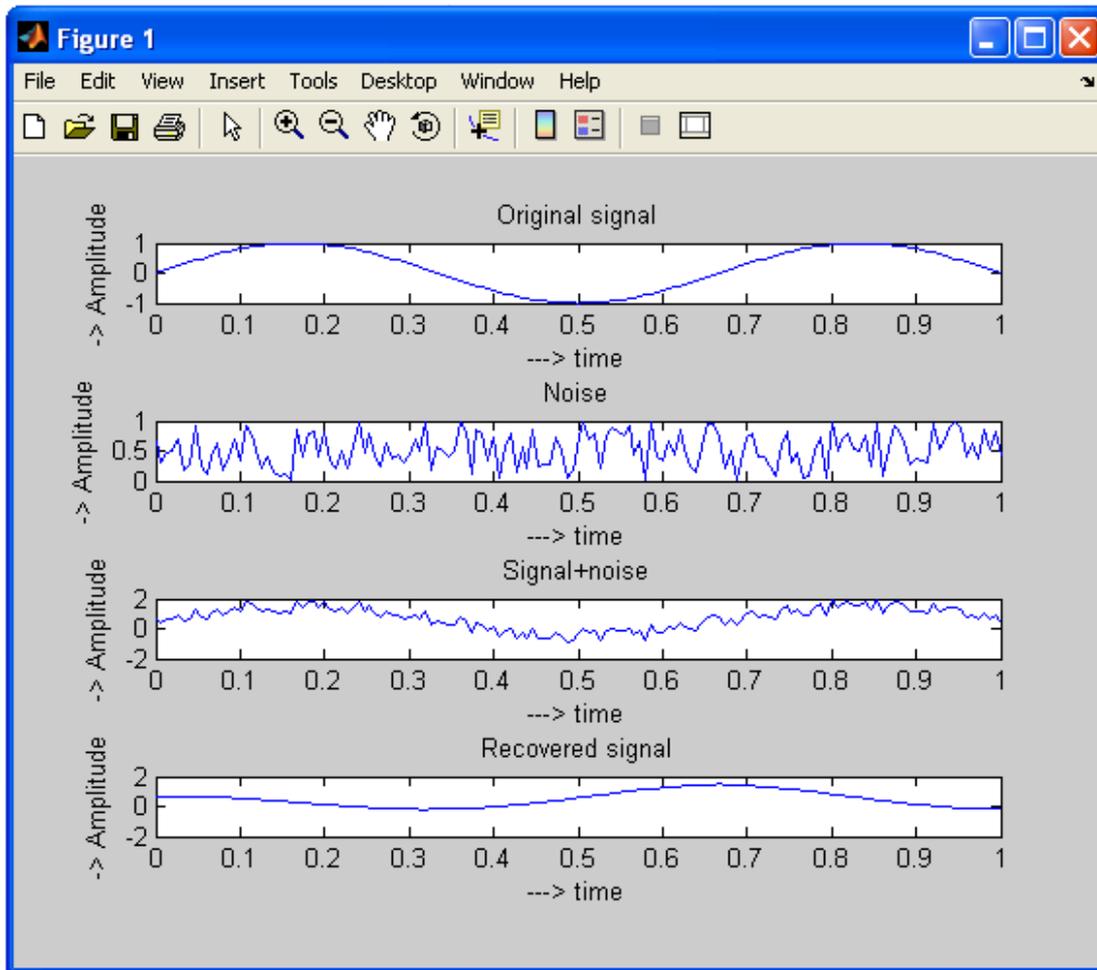
subplot(4,1,2);
plot(x,w);
xlabel('---> time'); ylabel('-> Amplitude');
title('Noise');
k=y+w;

subplot(4,1,3);
plot(x,k);
xlabel('---> time'); ylabel('-> Amplitude');
title('Signal+noise');
m=xcorr(k,100);

subplot(4,1,4)
plot(x,0.01*m(1:N+1));
xlabel('---> time'); ylabel('-> Amplitude');
title('Recovered signal');
```

#### **OUTPUT**

Enter the number of samples .....: 150



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. What is a Noise and how many types of noises are there.
2. What is Gaussian noise?
3. What is Correlation? How many types of Correlations are there?
4. What is the difference between Auto and Cross Correlation
5. What is the importance of Correlation?

## Experiment: 16

### Aim:-

: Extraction of periodic signal masked by noise using correlation.

### Pre lab:-

1. Study in detail about Noise factors and types of noise in Communication
2. Study the details of Correlation(Auto and Cross)

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

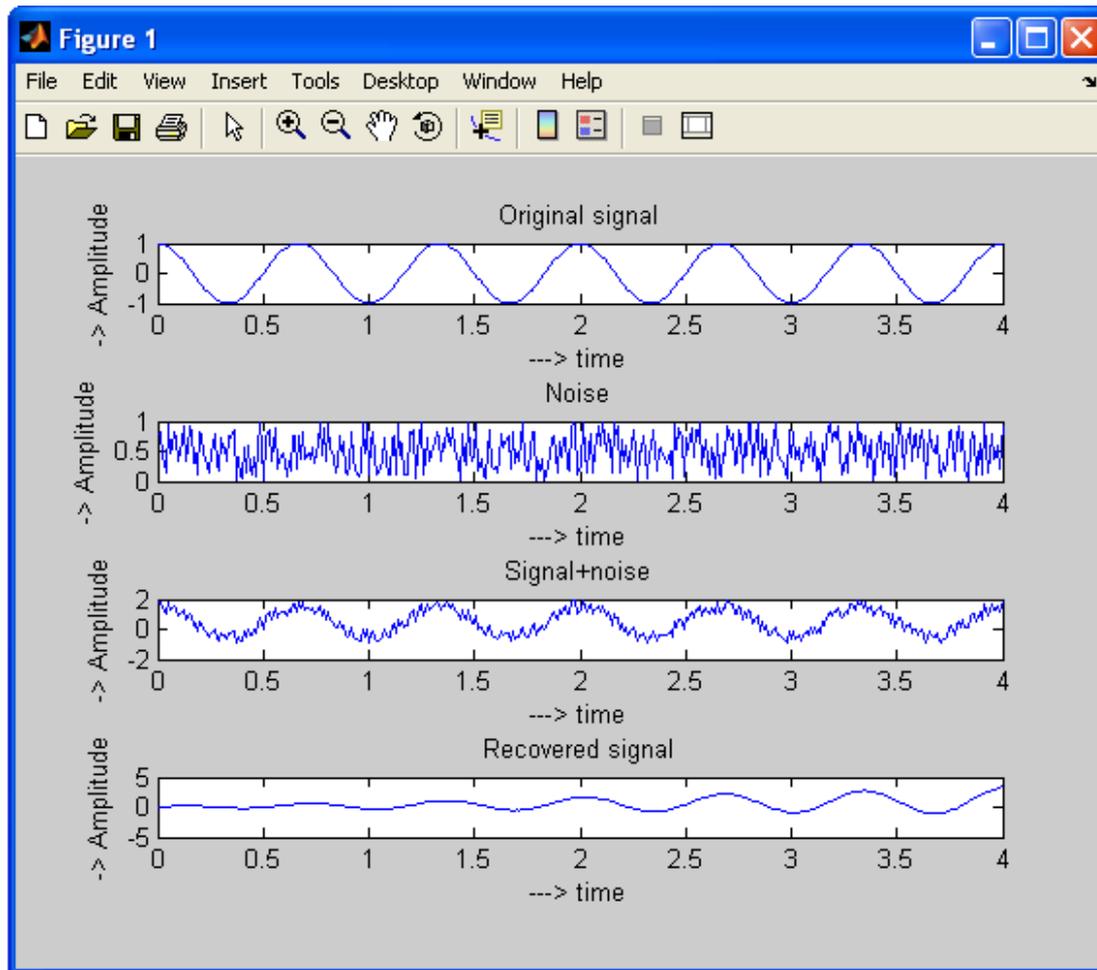
```
clear all;
close all;
clc;

N= input('Enter the number of samples .....: ');
M= input('Enter the number of cycles .....: ');

h=1/N;
x=0:h:M;
y=cos(3*pi*x);
subplot(4,1,1);
plot(x,y);
xlabel('---> time'); ylabel('-> Amplitude');
title('Original signal');
w=rand(1,M*N+1);
subplot(4,1,2);
plot(x,w);
xlabel('---> time'); ylabel('-> Amplitude');
title('Noise');
k=y+w;
subplot(4,1,3);
plot(x,k);
xlabel('---> time'); ylabel('-> Amplitude');
title('Signal+noise');
m=xcorr(k);
subplot(4,1,4);
plot(x,0.01*m(1:M*N+1));
xlabel('---> time'); ylabel('-> Amplitude');
title('Recovered signal');
```

### **OUTPUT**

```
Enter the number of samples .....: 100
Enter the number of cycles .....: 4
```

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-****Reasoning Questions:-**

1. What is a Noise and how many types of noises are there.
2. What is Correlation? How many types of Correlations are there?
3. What is the difference between Auto and Cross Correlation
4. What is the importance of Correlation.

## Experiment: 17

### Aim:-

: Verification of wiener – Khinchine relations.

### Pre lab:-

1. Study in detail about Fourier Transform and its inverse.
2. Learn how to find the Fourier transform of the given function
3. Learn how to find the Power Spectrum of a given function
4. Learn how to find the Auto Correlation of a given function
5. Study the details of wiener – Khinchine relations

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

```
clear all;
close all;
clc;

u=linspace(-2,2,5);
sq=[ones(1,5)];
stem(u,sq,'linewidth',2);

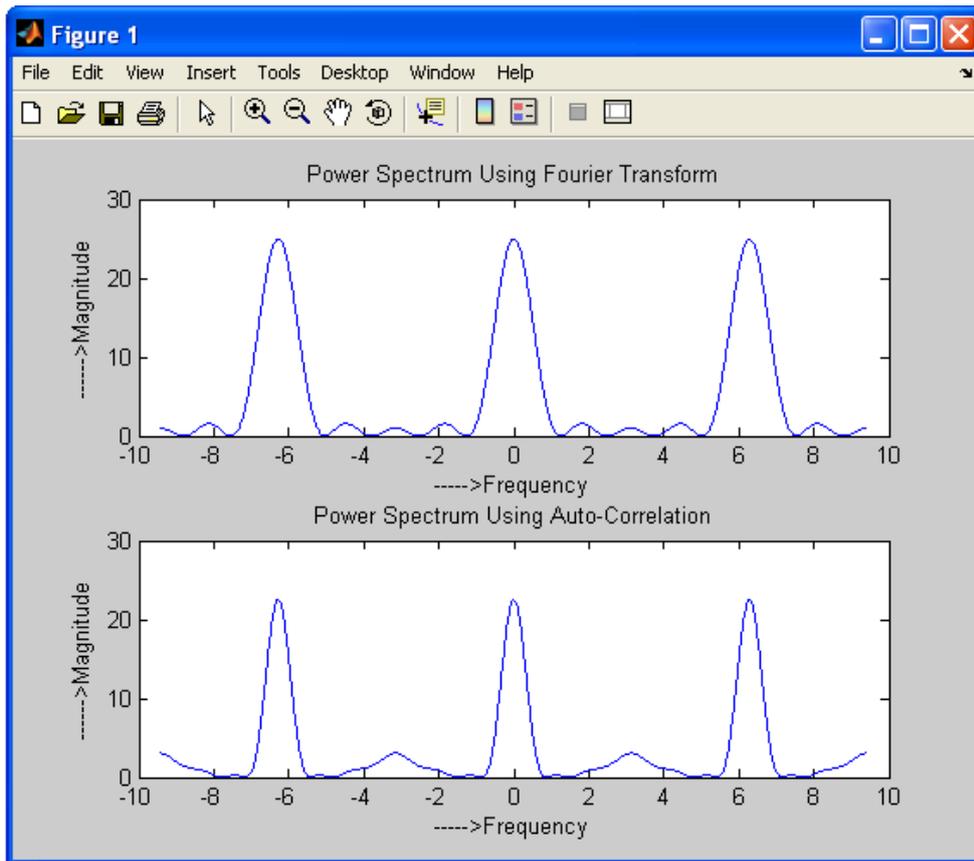
W = -3*pi:0.01:3*pi;
k=sin(2.5*W)./sin(0.5*W);

subplot(2,1,1),plot(W,(k.*k));
xlabel('----->Frequency');
ylabel('----->Magnitude');
title('Power Spectrum Using Fourier Transform');

c=xcorr(sq,sq);
k=5+(2*cos(W))+(6*cos(2*W))+(4*cos(3*W))+(2*cos(4*W));
z=k/4;

subplot(2,1,2),plot(W,(z.*z));
xlabel('----->Frequency');
ylabel('----->Magnitude');
title('Power Spectrum Using Auto-Correlation');
```

**OUTPUT**



**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Define Fourier Transform and its inverse?
2. What is the importance of Correlation?
3. What is the difference between Convolution and Correlation?
4. What is the importance of power spectrum?
5. Find the Fourier Transform of the following signals
  - a.  $x(t) = \exp(-2*t)u(t)$
  - b.  $x(t) = \text{rect}(0.5*t)$
  - c. Trapezoidal function
6. Find the Auto Correlation of the above signals

## Experiment:18

### Aim:-

: Checking a Random Process for Stationary in Wide Sense

### Pre lab:-

1. Study the details of Random Variables and Processes and types of Random Process

### Equipment Required:-

1. MATLAB 7.1
2. Windows XP SP2

### Program:-

```
clear all;
close all;
clc;

syms x
z = input('Enter the function ..... :: ');
Max = input('Max limit .....: ');
Min = input('Min limit .....: ');

mean_value = int(z,Min,Max)
y = subs(z,x,x+5);
Auto_correlation = int(z*y,Min,Max)

disp('If the mean value is constant .....');
disp('and');
disp('Auto Correlation is not a function of x variable ....');
disp('then ');
disp('The Random Process is Wide Sense tationary.');
```

### **OUTPUT**

```
Enter the function ..... :: 10*cos(10*x + 100)
Max limit .....: 2*pi
Min limit .....: 0

mean_value =

0

Auto_correlation =

100*cos(50)*pi

If the mean value is constant .....
and
Auto Correlation is not a function of x variable ....
then
```



The Random Process is Wide Sense stationary.

**Post lab:-**

1. Compare the practical results with theoretical results.

**Result:-**

**Reasoning Questions:-**

1. Define Random Variable and Random Process?
2. Define Mean, Median and Mode?
3. Define Auto Correlation?
4. What are the types of Random Process?
5. What is a Stationary Process?
6. What are the conditions for the Random Process to be WSS?
7. What are the conditions for the Random Process to be SSS?