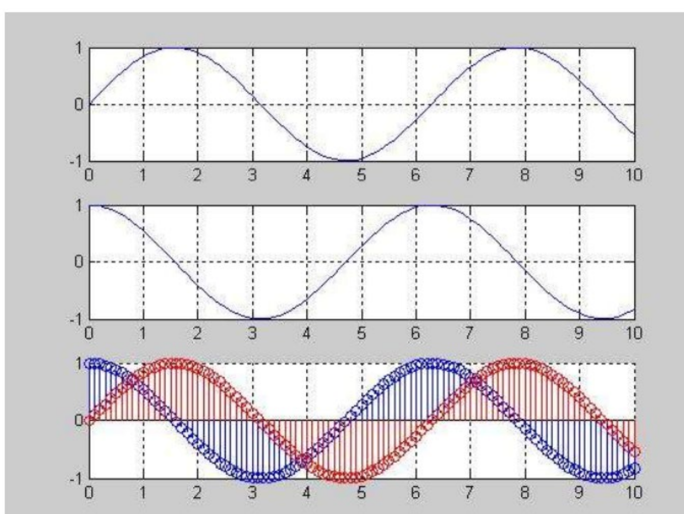
DSP LAB

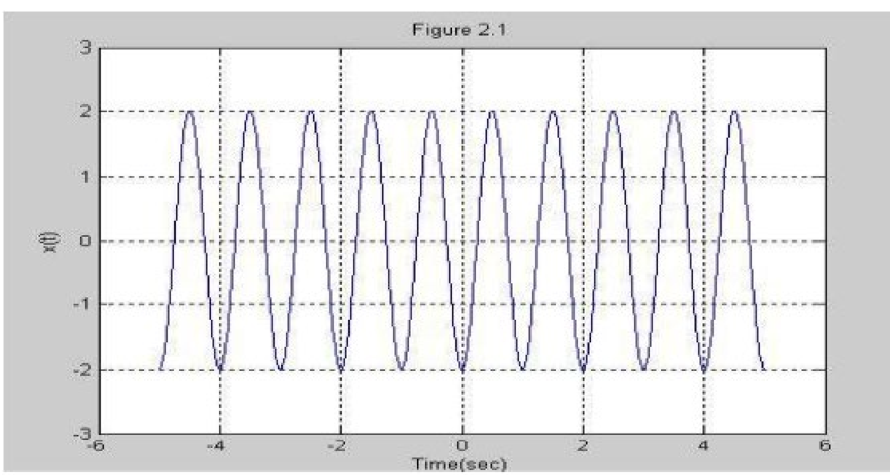
Experiment 1 (PLOTTING)

```
x = [0:0.1:10];
y = sin (x);
z = cos (x);
subplot (3,1,1);
plot (x,y);
grid on;
subplot (3,1,2);
plot (x,z);
grid on;
hold on;
subplot (3,1,3);
stem (x,z);
grid on;
hold on;
subplot (3,1,3);
stem (x,y, ,'r');
```



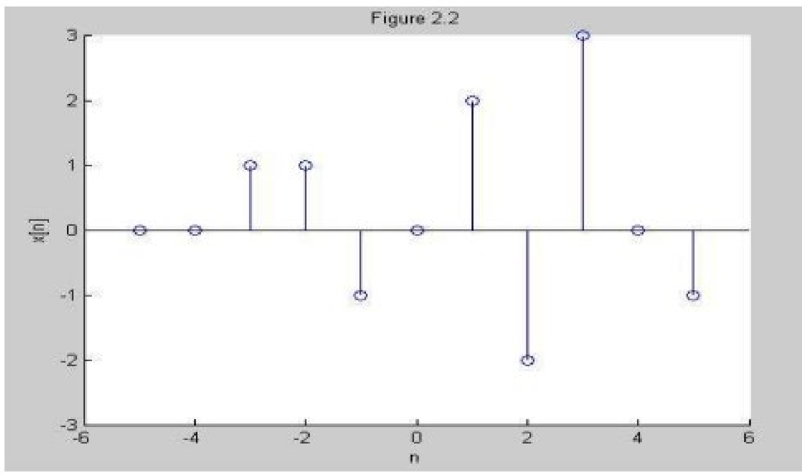
Experiment 2 (Generating a Signal)

```
% Generation of discrete time signals
% 2sin(2πτ-π/2)
t = [-5:0.01:5];
x=2*sin((2*pi*t) - (pi/2));
plot(t,x)
grid on;
axis ([-6 6 -3 3])
ylabel ('x(t)')
xlabel ('Time(sec)')
title ('Figure 2.1')
```



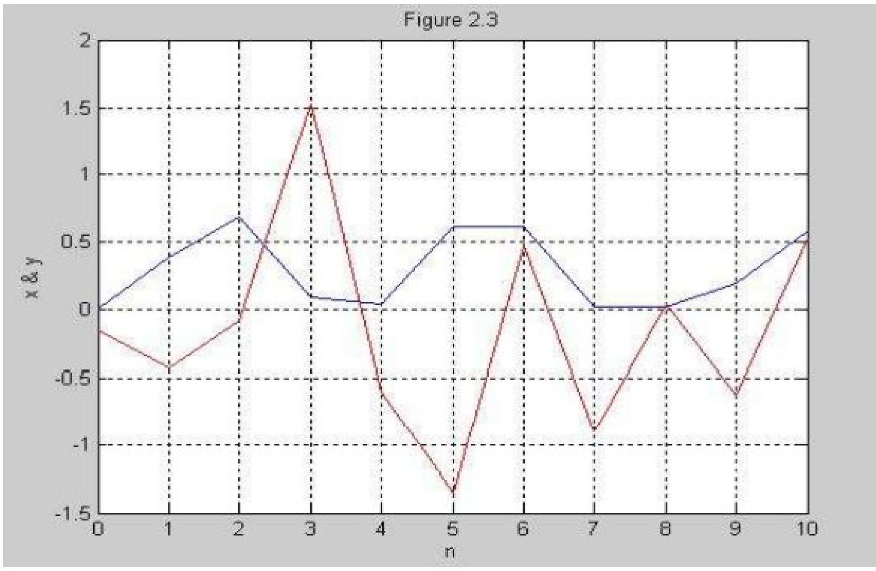
Experiment 3 (Generating a Signal)

```
% Generation of discrete time signals
n = [-5:5];
x = [0 0 1 1 -1 0 2 -2 3 0 -1];
stem (n,x);
axis ([-6 6 -3 3]);
xlabel ('n'); ylabel
('x[n]'); title
('Figure 2.2');
```



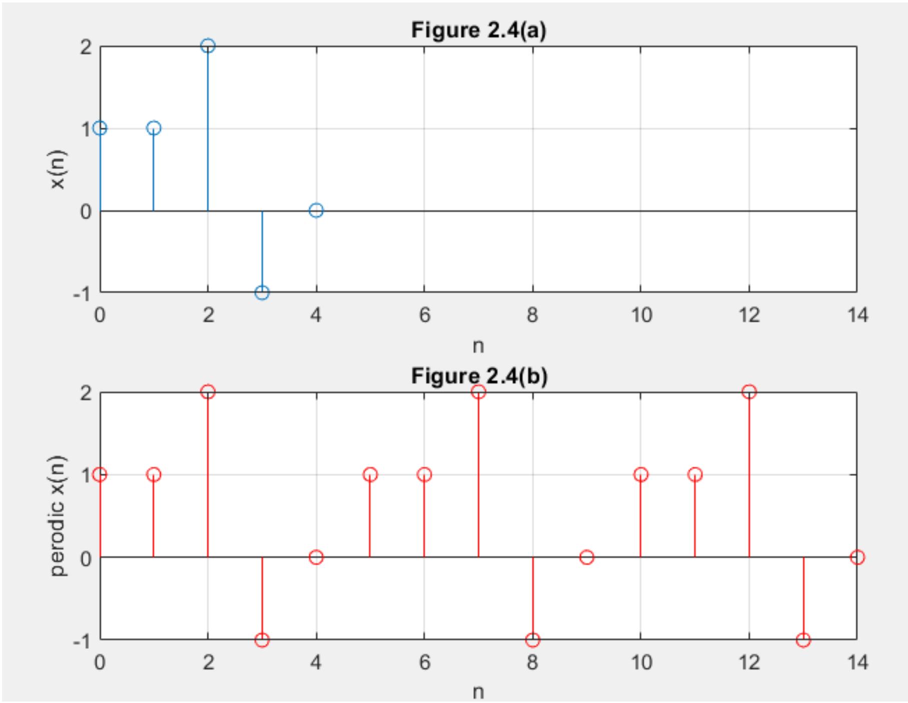
Experiment 4 (Generating a Signal)

```
%Generation of random sequence
n = [0:10];
x = rand (1, length (n));
y = randn (1, length (n));
plot (n,x) ;
grid on;
hold on;
plot(n,y,'r');
ylabel ('x & y')
xlabel ('n')
title ('Figure 2.3');
```



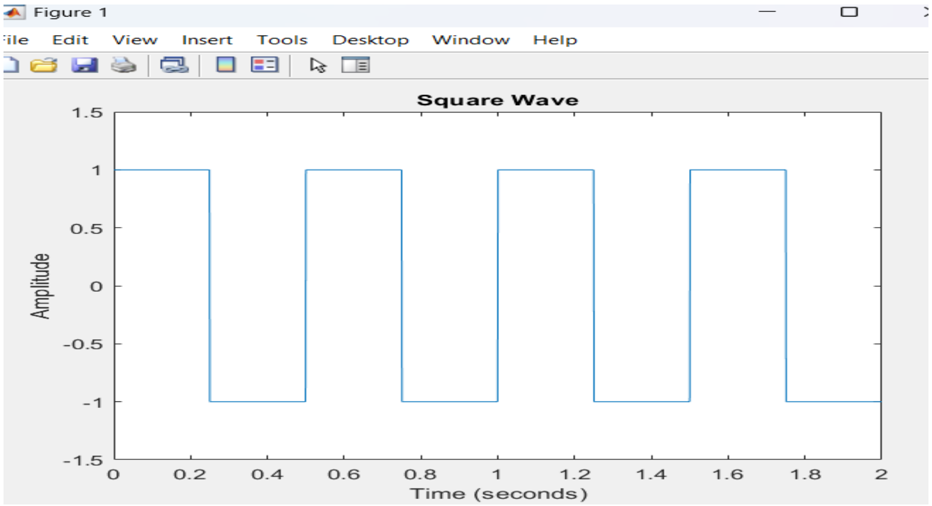
Experiment 5 (Generating a discrete periodic signal Signal)

```
n = [0:4];
x = [1 1 2 -1 0];
subplot (2,1,1);
stem (n,x);
grid on;
axis ([0 14 -1 2]);
xlabel ('n');
ylabel ('x(n)');
title ('Figure 2.4(a)');
xtilde = [x,x,x];
length_xtilde = length (xtilde);
n_new = [0:length_xtilde-1];
subplot (2,1,2);
stem (n_new, xtilde,'r');
grid on;
xlabel ('n');
ylabel ('perodic x(n)');
title ('Figure 2.4(b)');
```



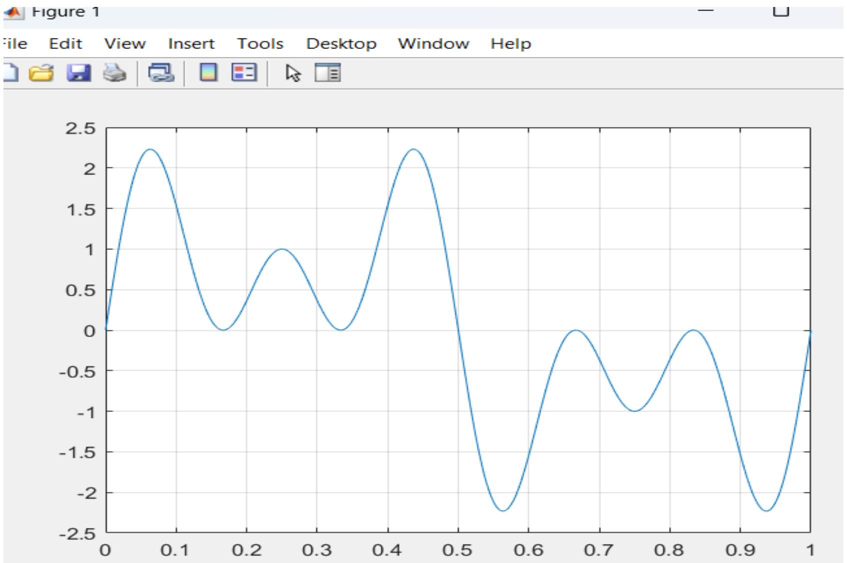
Experiment 6.1 (Generating Square wave) using loop

```
% Parameters
frequency = 2;  % Frequency of the square wave (Hz)
duration = 2;   % Duration of the signal (seconds)
sampling_rate = 1000;  % Sampling rate (samples per second)

% Time vector
t = linspace(0, duration, duration * sampling_rate);
% Generate square wave using a loop
square_wave = zeros(size(t));
for i = 1:length(t)
    if sin(2 * pi * frequency * t(i)) >= 0
        square_wave(i) = 1;
    else
        square_wave(i) = -1;
    end
end

% Plot the square wave
plot(t, square_wave);
xlabel('Time (seconds)');
ylabel('Amplitude');
title('Square Wave');
ylim([-1.5, 1.5]);    % Adjust the y-axis limits for better
visualization
```



<u>Experiment 6.2 (Generating odd wave) using loop</u>

```
clear;
clc;
n = input ('Insert the value of odd n:');
t = 0:.001:1;
sum=0;
for f=1:2:n
w=sin(2*pi*f*t);
sum=sum+w;
end
subplot(1,1,1)
plot(t,sum)
grid on;
```



Experiment 7 (Generating Unit Step Discrete Time Signal)

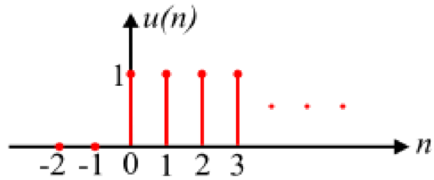
Experiment Name: Generating and Plotting Unit Step Discrete Time Signal.

Discrete Time Unit Step Signal:

It is denoted by u[n]. Mathematically, the discrete-time unit step signal or sequence u[n] is defined as follows –

$$u[n] = \{1 \quad for\ n \geq 0\ 0 \quad for\ n < 0$$

The graphical representation of the discrete-time unit step signal u[n] is shown in the following figure:

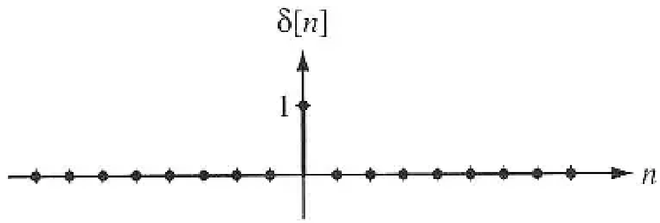



```
%Generating and Plotting Unit Step Discrete Time Signal.
clc; %clears the command window
clear all; %clears the current variables which are being used
close all; %close programs that are running behind in MATLAB

N=input('Enter the range: ');
n=-N:1:N;
y= [zeros(1,N),1,ones(1,N)];
stem(n,y);
axis([-(N+1) N+1 -0.5 1.5]); % [-x x -y y]
xlabel('Time');
ylabel('Amplitude of Y');
title('Generating Unit Step Function');
```

```
clc;
clear all;
n = input("Enter the value of n :");
x = -n:n;
y = [zeros(1,n),1,ones(1,n)];
stem(x,y);
axis([-n-2,n,0,2]);
xlabel("Time");
ylabel("Amplitude");
title('Generating unit step function');
```

<u>Experiment 8 :</u> Unit impulse signal is mathematically defined as,

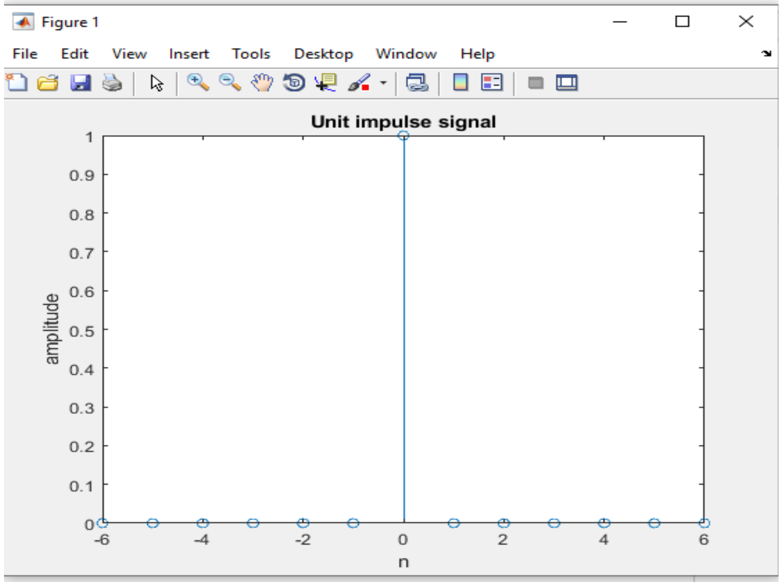
$$\boxed{\delta[n] = \begin{cases} 1\ , n = 0 \\ 0\ , n \neq 0 \end{cases}}$$



Code of implementation of impulse signal in Matlab:

```
%Code of implementation of impulse signal in Matlab:
clc;
clear all;
m1=input('enter the value of x-axis in negative side:');
m2=input('enter the value of x-axis in positive side:');
n=m1:m2;
x=(n==0);%it works as if statement like n=-5:5( 0 0 0 0 0 1 0 0 0 0 0 0)
stem(n,x);
xlabel('n');
ylabel('amplitude');
title('Unit impulse signal');
```

Output:



The unit impulse can be implemented in different way:

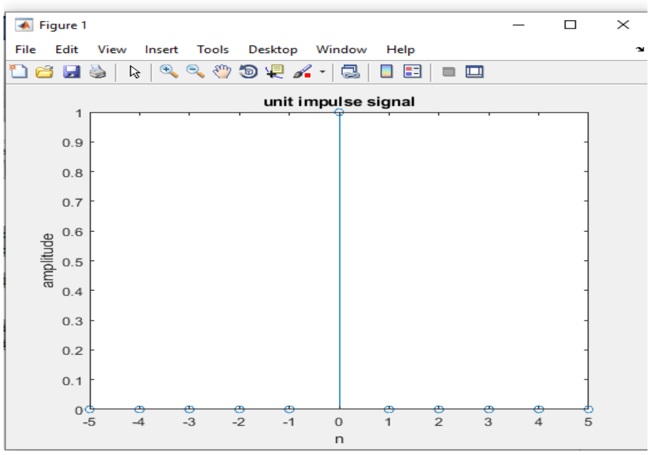
```
clc;
clear all;
close all;
m1=input('enter the value of x-axis in negative side:');
m2=input('enter the value of x-axis in positive side:');
n=-m1:m2;
d=[zeros(1,m1) 1 zeros(1,m2)];
stem(n,d);
xlabel('n');
ylabel('amplitude');
title('unit impulse signal');
```

My code:

```
clc;
clear;
l1 = input("Enter the value of x-axis in negative side: ");
l2 = input("Enter the value of x-axis in positive side: ");
y = [zeros(1,-l1),1,zeros(1,l2)];
x = l1:l2;
stem(x,y);
axis([l1,l2,-2,2]);
```

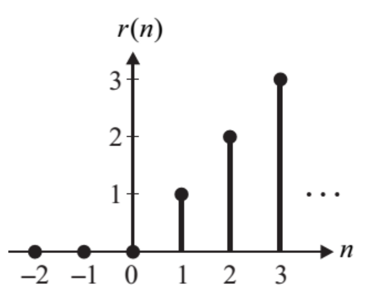
```
xlabel('n');
ylabel('amplitude');
title('unit impulse signal');
```

Output:



Experiment 9 Generating and plotting ramp discrete time signal.
The discrete time unit ramp signal is that function which starts from n = 0 and increases linearly. It is denoted by r(n). It is signal whose amplitude varies linearly with time n. mathematically; the discrete time unit ramp sequence is defined as –

$$r(n) = \begin{cases} n & \text{for} \quad n \geq 0 \\ 0 & \text{for} \quad n < 0 \end{cases}$$



Code:

```
close all;
```

```
clear all;
clc;

n1= input ('Enter lower limit');
n2= input ('Enter upper limit');
n= n1: 1: n2;
x=n.*[n>=0];
stem (n, x, 'b');
axis([(n1-1) (n2+1) -1 (n2+1)]);   % -x,x,-y,y
title (' Ramp Function ');
xlabel ('time');
ylabel ('Amplitude of Y');
```

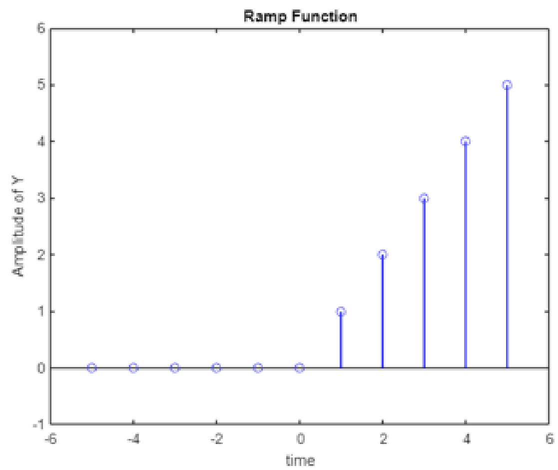
my code:

```
clc;
clear all;
l1 = input('Enter the lower limit :');
l2 = input('Enter the upper limit :');
x = l1:l2;
y =[];
a=0;
for i=1:l2-l1+1
   if i<=-l1
       y(i)=0;
   else
       y(i)=a;
       a=a+1;
   end
end
stem(x,y);
axis([l1,l2+1,-1,l2+2]);
title (' Ramp Function ');
xlabel ('time');
ylabel ('Amplitude of Y');
```

Input:

Enter lower limit
-5
Enter upper limit
5

Output:



Experiment 10 (Time reversal using a discrete sinusoidal function [use of fliplr( ) and values of x-axis(angle) in radian)

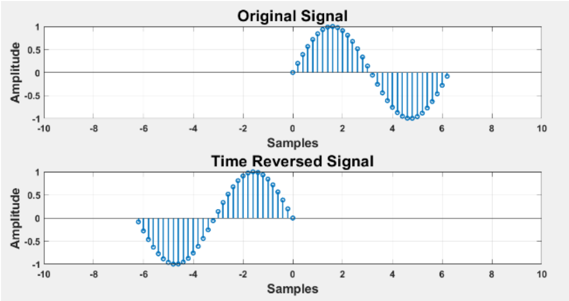
```
%Time reversal using a function (sinusoidal function
angle in radian)

close all
clc

t1=0:0.2:2*pi; %values of x-axis in radian
x1=sin(t1);    %values of y-axis
x2=fliplr(x1); %fliplr() -> this function gives the
flipped result;
               %lr means left right ...flipud() ud
means up down
t2= -fliplr(t1); % time values must be flipped and
negated
```

```
subplot(2,1,1)
stem(t1,x1,'LineWidth',2)
xlim([-10 10])
title('\bf\fontsize{25}Original Signal')
xlabel('\bf\fontsize{20}Samples')
ylabel('\bf\fontsize{20}Amplitude')
grid on;
ax = gca;
ax.XAxis.FontSize = 15;
ax.XAxis.FontWeight = 'bold';
ax.YAxis.FontSize = 15;
ax.YAxis.FontWeight = 'bold';

subplot(212)
stem(t2,x2,'LineWidth',2)
xlim([-10 10])
title('\bf\fontsize{25}Time Reversed Signal')
xlabel('\bf\fontsize{20}Samples')
ylabel('\bf\fontsize{20}Amplitude')
grid on;
ax = gca;
ax.XAxis.FontSize = 15;
ax.XAxis.FontWeight = 'bold';
ax.YAxis.FontSize = 15;
ax.YAxis.FontWeight = 'bold';
```

my code:

```
close all
clc
t1=0:0.2:2*pi;
x1=sin(t1);
x2=fliplr(x1);
t2= -fliplr(t1);
subplot(2,1,1)
stem(t1,x1,'LineWidth',1)
axis([-10 10 -2 2])
title('Original Signal')
xlabel('Samples')
ylabel('Amplitude')
grid on;
```

```
subplot(2,1,2)
stem(t2,x2,'LineWidth',1)
axis([-10 10 -2 2])
title('Time Reversed Signal')
xlabel('Samples')
ylabel('Amplitude')
grid on;
```



Experiment 11 Time reversal using a discrete sinusoidal function <u>[use of fliplr()and values of x-axis(angle) in degree]</u>

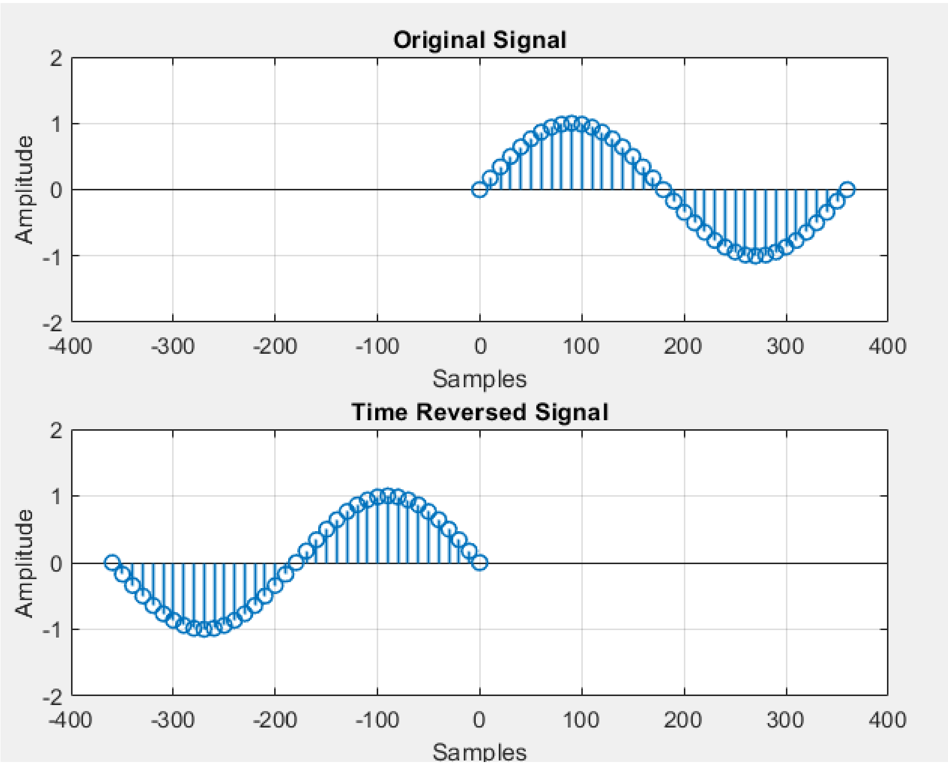
```
%Time reversal using a function (sinusoidal function
angle in degree)

close all
clc

t1=0:10:360; %values of x-axis in degree
x1=sind(t1); % values of y axis
x2=fliplr(x1); %fliplr() -> this function gives the
flippefd result;
                %lr means left right ...flipud() ud
means up down
t2= -fliplr(t1); % time values must be flipped and
negated

subplot(211)
```

```
stem(t1,x1,'LineWidth',2)
xlim([-400 400])
ylim([-1.5 1.5])
title('\bf\fontsize{25}Original Signal')
xlabel('\bf\fontsize{20}Samples')
ylabel('\bf\fontsize{20}Amplitude')
grid on;
ax = gca;
ax.XAxis.FontSize = 15;
ax.XAxis.FontWeight = 'bold';
ax.YAxis.FontSize = 15;
ax.YAxis.FontWeight = 'bold';

subplot(212)
stem(t2,x2,'LineWidth',2)
xlim([-400 400])
ylim([-1.5 1.5])
title('\bf\fontsize{25}Time Reversed Signal')
xlabel('\bf\fontsize{20}Samples')
ylabel('\bf\fontsize{20}Amplitude')
grid on;
ax = gca;
ax.XAxis.FontSize = 15;
ax.XAxis.FontWeight = 'bold';
ax.YAxis.FontSize = 15;
ax.YAxis.FontWeight = 'bold';
```

My code:

```
close all
clc
t1=0:10:360;
x1=sind(t1);
x2=fliplr(x1);
t2= -fliplr(t1);
subplot(2,1,1)
stem(t1,x1,'LineWidth',1)
axis([-400 400 -2 2])
title('Original Signal')
xlabel('Samples')
ylabel('Amplitude')
grid on;
```

```
subplot(2,1,2)
stem(t2,x2,'LineWidth',1)
axis([-400 400 -2 2])
title('Time Reversed Signal')
xlabel('Samples')
ylabel('Amplitude')
grid on;
```



Experiment 12 (Signal Addition)

addition.m ->

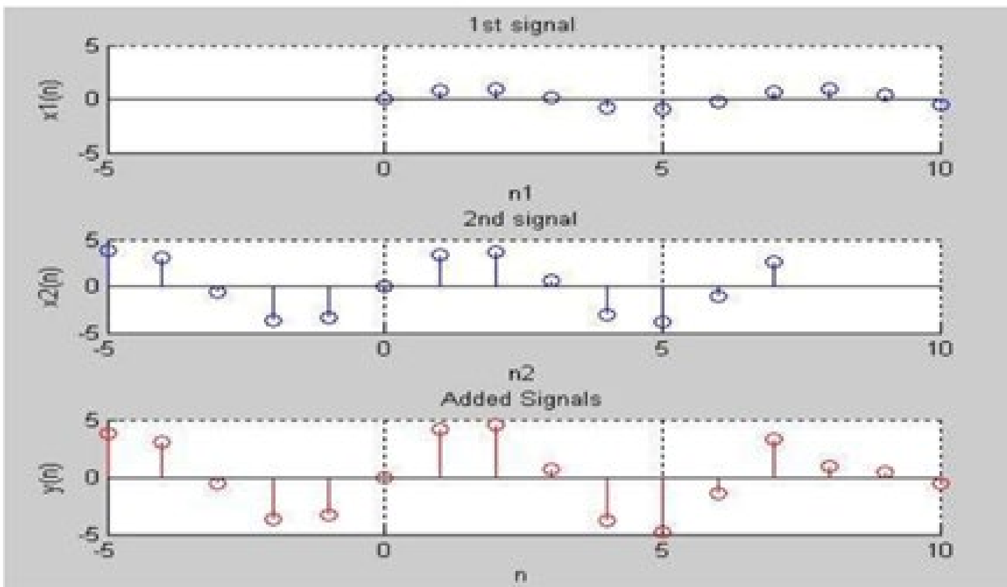
```
clear all;
clc;
x1=[-5 -4 -3 -2 -1 0];
y1=[2 5 4 6 3 5];
x2=[-2 -1 0 1 2];
y2=[8 9 2 5 6];

% Draw the second signal.
```

```
subplot(3,1,1);
stem(x1,y1);
grid on;
grid minor;
axis([-10 10 -8 8]);

% Draw the second signal.
subplot(3,1,2);
stem(x2,y2);
grid on;
grid minor;
axis([-10 10 -8 8]);
n=min(min(x1),min(x2)):1:max(max(x1),max(x2));

% This function is for the addition the two signal .
[y] = add_function(n,x1,x2,y1,y2);

% This is for the plot the added signal.
subplot(3,1,3);
stem(n,y);
grid on;
grid minor;
axis([-10 10 -8 8]);
```

add_function.m ->

```
function[y] = add_function(n,x1,x2,y1,y2)

m1=zeros(1,length(n));
m2=zeros(1,length(n));
temp=1;
for i=1:length(n)
   if(n(i)>=min(x1) & n(i)<=max(x1))
      m1(i)=y1(temp);
      temp=temp+1;
   else
      m1(i)=0;
   end
end
temp=1;
for i=1:length(n)
   if(n(i)>=min(x2) & n(i)<=max(x2))
      m2(i)=y2(temp);
```

```
        temp=temp+1;
    else
        m2(i)=0;
    end
end

y=m1+m2;
```



Experiment 13 (Signal Multiplication)

<u>Multiplicaton.m -></u>

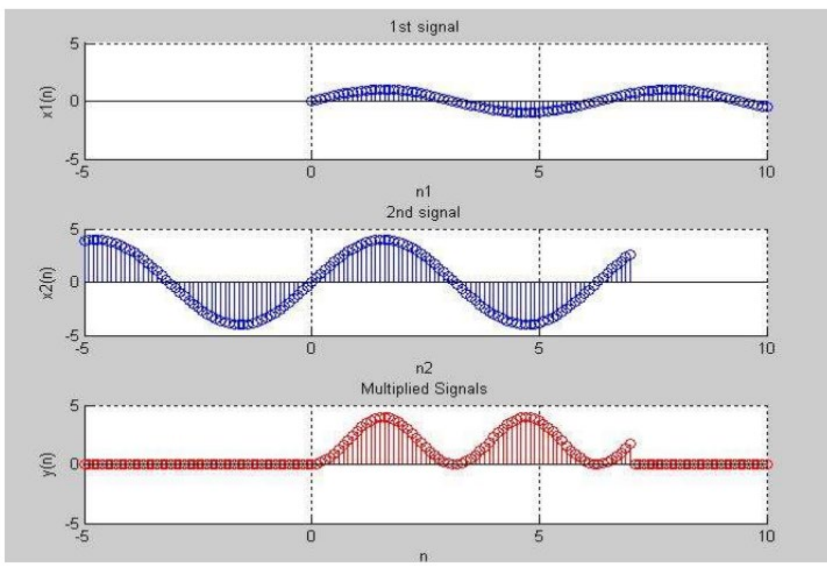
```
clc;
clear all;
close all;

x1=[0:0.1:10];
y1=sin(x1);
x2=[-5:0.1:7];
y2=4*sin(x2);

% This plot is for the plotting the graph of (x1,y1).
```

```
subplot(3,1,1);
stem(x1,y1);
grid on;
grid minor;
axis([-5 10 -5 5]);

% This plot is for the plotting the graph of (x2,y2);
subplot(3,1,2);
stem(x2,y2);
grid on;
grid minor;
axis([-5 10 -5 5]);

% This line is use for find out the new range of the signal.
n=min(min(x1),min(x2)):0.1:max(max(x1),max(x2));

[m]=mul_function(n,x1,y1,x2,y2);

%This plot is for the plotting the graph of (n,y) multiplicated signal.
subplot(3,1,3);
stem(n,m,'r');
grid on;
grid minor;
axis([-5 10 -5 5]);
```

mul_function.m ->

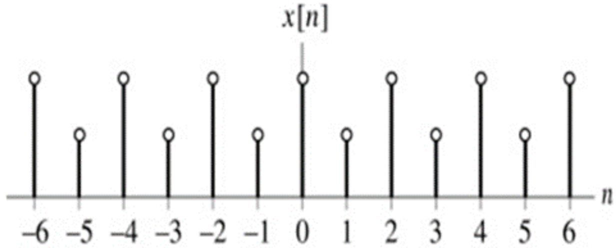
```
function[m]=mul_function(n,x1,y1,x2,y2)

m1=zeros(1,length(n));
m2=m1;

% This loop is use for the fill the loop m1.
temp=1;
for i=1:length(n)
   if(n(i)>=min(x1) & n(i)<=max(x1))
      m1(i)=y1(temp);
      temp=temp+1;
   else
```

```
    m1(i)=0;
  end
end

% This loop is use for the fill the loop m2.
temp=1;
for i=1:length(n)
  if(n(i)>=min(x2) && n(i)<=max(x2))
    m2(i)=y2(temp);
    temp=temp+1;
  else
    m2(i)=0;
  end
end
m=m1.*m2;
```



Experiment 14 (Time Scaling)

A discrete time signal x(n) is shown in figure.



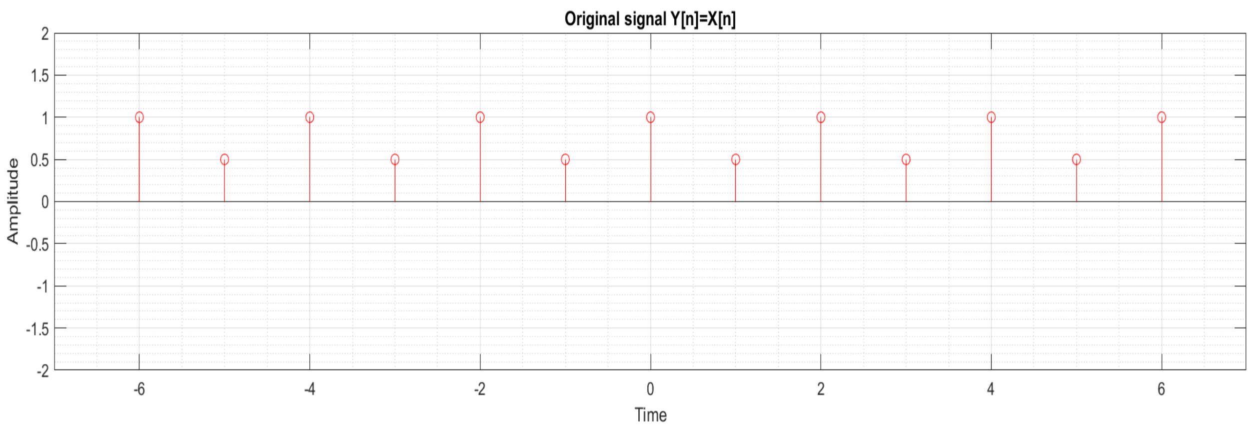
Sketch the signal x[n], the sketch y[n]=x[n/2].

Solution:-

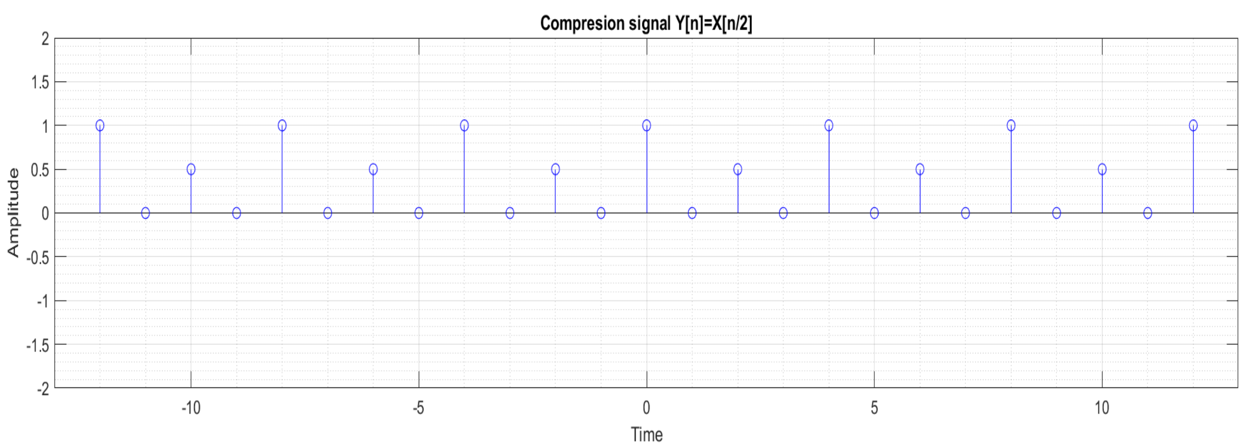
```
close all;
clear all;
clc;

start_value = input('Enter the start value: ');%-6
end_value = input('Enter the end value: ');%6

n1 = start_value:end_value;

y=input("Enter the values of signal = "); %[1 0.5 1 0.5 1 0.5 1 0.5 1 0.5 1 0.5 1]

index=1;

n2=(2*start_value):(2*end_value);

for i=1:length(n2)
   x1(i)=n2(i);
   if(rem(n2(i),2)==0)
      y1(i)=y(index);
      index=index+1;
   else
      y1(i)=0;
   end
end

subplot(2,1,1);
stem(n1,y,'r');
xlabel("Time");
```

```
ylabel("Amplitude");
grid on;
grid minor;
axis([(start_value-1) (end_value+1) -2 2]);
title("Original signal Y[n]=X[n]");

subplot(2,1,2);
stem(x1,y1,'b');
xlabel("Time");
ylabel("Amplitude");
grid on;
grid minor;
axis([(2*start_value-1) (2*end_value+1) -2 2]);
title("Compresion signal Y[n]=X[n/2]");
```

Original signal Y[n]=X[n]: -



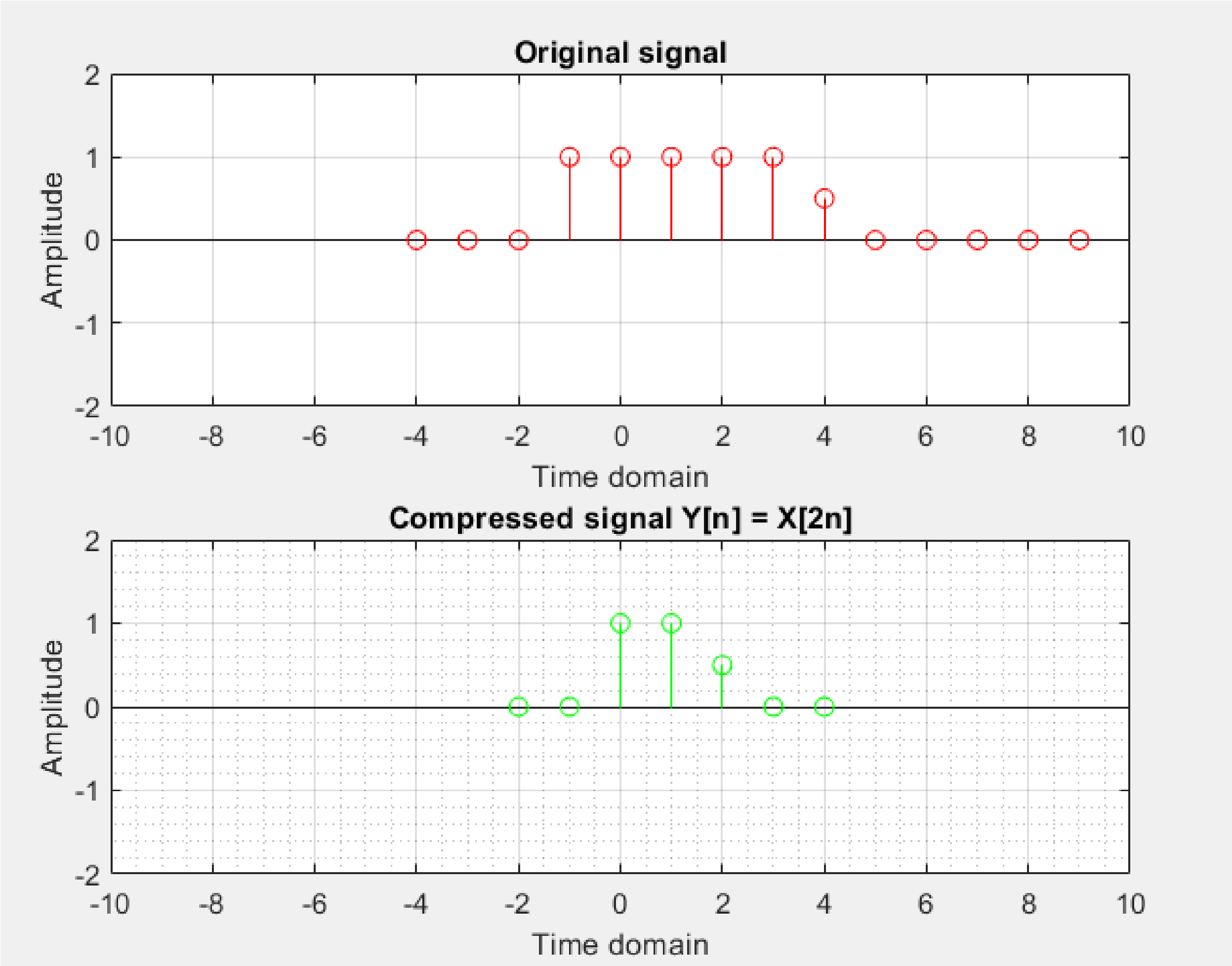
Compressed signal Y[n]=X[n/2]:-



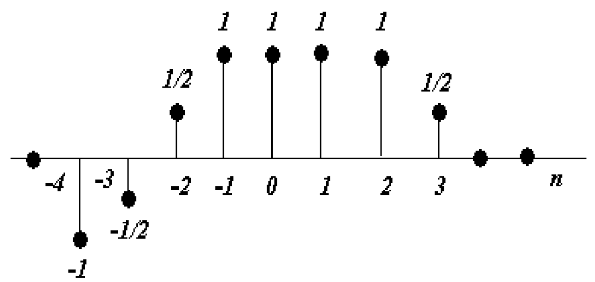
Sketch the signal x[n], the sketch y[n]=x[2n].

```
% Clear all existing figures and the command window
close all;
clear all;
clc;
% Define the time domain range for the original signal
n1 = -4;
n2 = 9;
% Define the original signal
y = [0 0 0 1 1 1 1 1 0.5 0 0 0 0 0];
% Generate the time vector for the original signal
n = n1:n2;
% Specify the compression factor
value = 2;
% Initialize temporary variables
temp = 1;
% Create compressed signal vectors
for i = 1:length(n)
   if (rem(n(i), value) == 0)
       x1(temp) = n(i) / value;
       y1(temp) = y(i);
       temp = temp + 1;
   end
end
% Plot the original signal in the first subplot
subplot(2, 1, 1);
stem(n, y, 'r');
xlabel("Time domain");
ylabel("Amplitude");
grid on;
axis([-10 10 -2 2]);
title("Original signal");
% Plot the compressed signal in the second subplot
subplot(2, 1, 2);
stem(x1, y1, 'g');
xlabel("Time domain");
ylabel("Amplitude");
grid on;
grid minor;
```

```
axis([-10 10 -2 2]);
title("Compressed signal Y[n] = X[2n]");
```



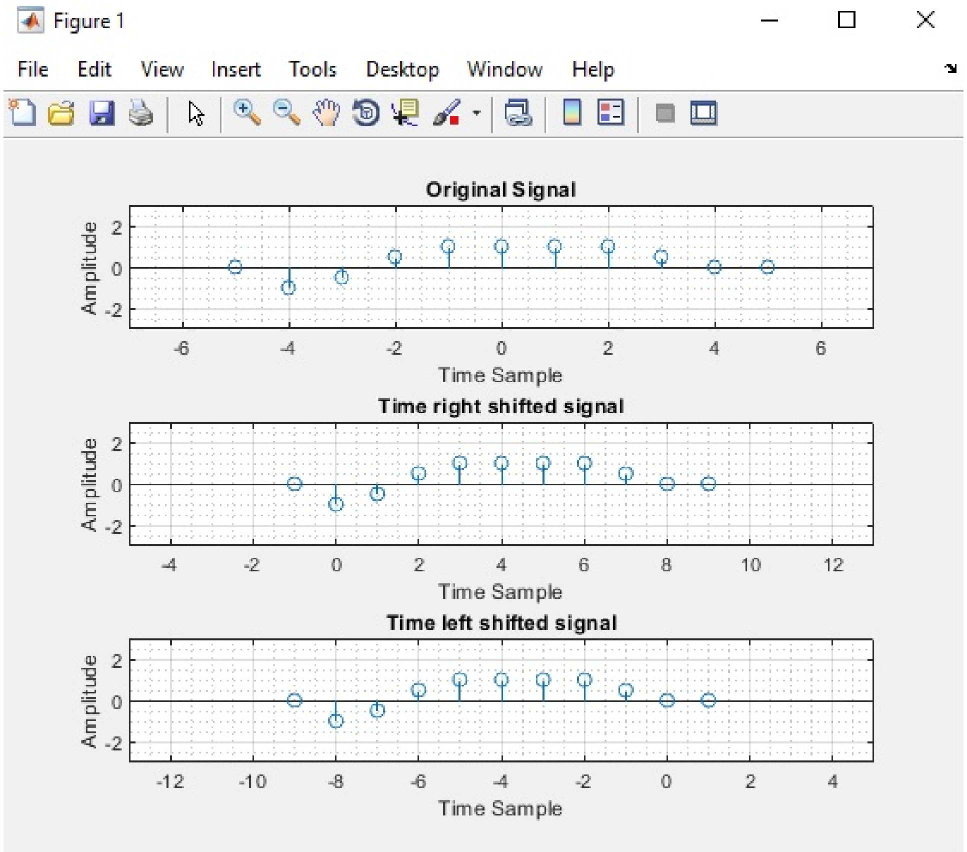
Experiment 15: A discrete time signal x(n) is shown in figure. Sketch the signal x[n], y[n]=x[n-4] and x[n+4], derived from x[n].



Solution:

```
clc;
clear;

n = -5:5;
x= [0 -1 -.5 .5 1 1 1 1 .5 0 0]
subplot(3,1,1);
stem (n,x);
xlabel('Time Sample');
ylabel('Amplitude');
title('Original Signal');
axis([-7 7 min(x)-2 max(x)+2]);
grid on;
grid minor;

m = n+4;
subplot(3,1,2);
```

```
stem (m,x);
xlabel('Time Sample');
ylabel('Amplitude');
title('Time right shifted signal');
axis([-7-2+4 7+2+4 min(x)-2 max(x)+2]);
grid on;
grid minor;

l = n-4;
subplot(3,1,3);
stem (l,x);
xlabel('Time Sample');

ylabel('Amplitude');
title('Time left shifted signal');
axis([-7-2-4 7+2-4 min(x)-2 max(x)+2]);
grid on;
grid minor;
```

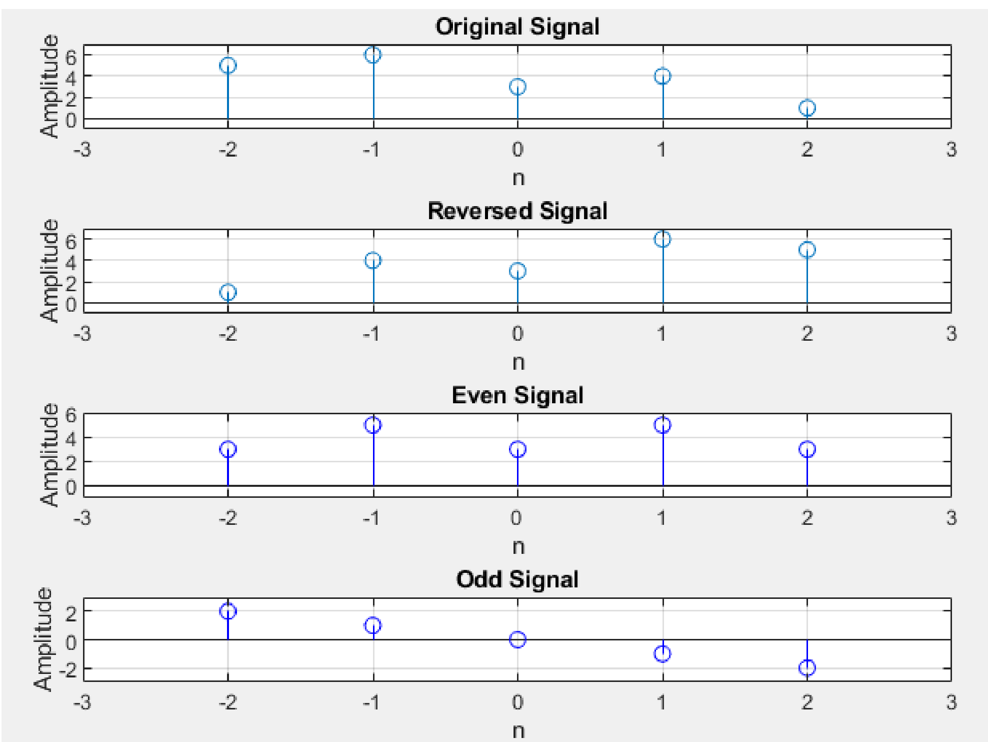


Experiment 16: Find the even and odd components of the discrete-time signal x(n), where,

$$x[n] = \{5, 6, \underset{\uparrow}{3}, 4, 1\}$$

```
n = -2:2;
x = [5,6,3,4,1];

% Creating mirrored versions for negative indices
x_mirror = fliplr(x); %x_mirror = [1,4,3,5,5]

% even and odd components
xe = (x + x_mirror) / 2; %xe= ( x(n)+x(-n) )/2;
xo - (x - x_mirror) / 2; %xo= ( x(n)-x(-n) )/2;

% Plotting
subplot(4,1,1);
stem(n, x);
grid on;
axis([-3 3 -1 7]);
```

```
xlabel('n');
ylabel('Amplitude');
title('Original Signal');

subplot(4,1,2);
stem(n, x_mirror);
grid on;
axis([-3 3 -1 7]);
xlabel('n');
ylabel('Amplitude');
title('Reversed Signal');

subplot(4,1,3);
stem(n, xe, 'b');
grid on;
axis([-3 3 -1 6]);
xlabel('n');
ylabel('Amplitude');
title('Even Signal');

subplot(4,1,4);
stem(n, xo, 'b');
grid on;
axis([-3 3 -3 3]);
xlabel('n');
ylabel('Amplitude');
title('Odd Signal');
```

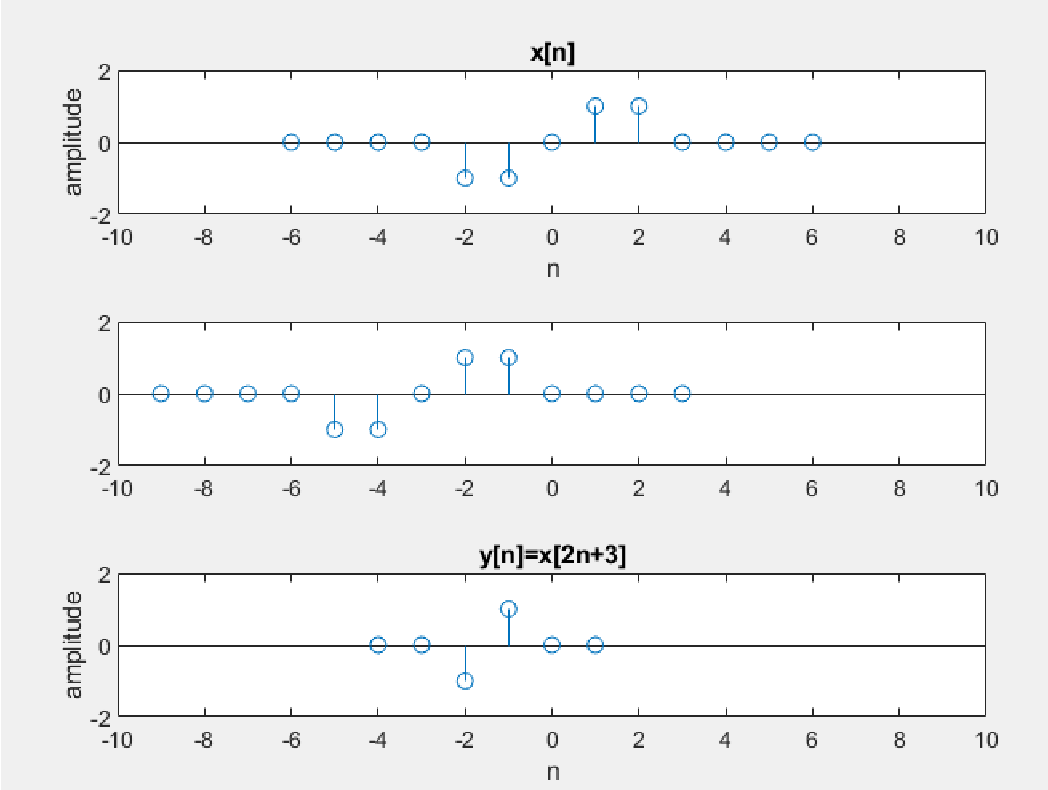


Experiment 17: A discrete time signal x(n) is given by

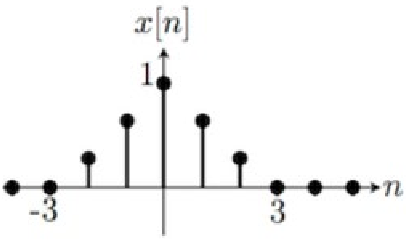
$$x[n] = \begin{cases} 1, & n = 1,2 \\ -1, & n = -1,2 \\ 0. & n = 0, \qquad |n| > 2 \quad and\ |n| \le 6 \end{cases}$$

Sketch, y[n]=x[2n+3].

```
clc;
close all;

%orginal signal
n=-6:6;
y=[0 0 0 0 -1 -1 0 1 1 0 0 0 0];
subplot(3,1,1);
stem(n,y);
axis([-10 10 -2 2]);
xlabel('n');
ylabel('amplitude');
title('x[n]');

%shifting the given signal
n1=n-3;
subplot(3,1,2);
stem(n1,y);
axis([-10 10 -2 2]);


value=2;

temp=1;
for i=1:length(n1)
    if(rem(n1(i),value)== 0)
        x1(temp)=n1(i)./ value;
        y1(temp)=y(i);
        temp=temp+1;
    end

end

%final signal
subplot(3,1,3);
stem(x1,y1);
axis([-10 10 -2 2]);
xlabel('n');
ylabel('amplitude');
title('y[n]=x[2n+3]');
```



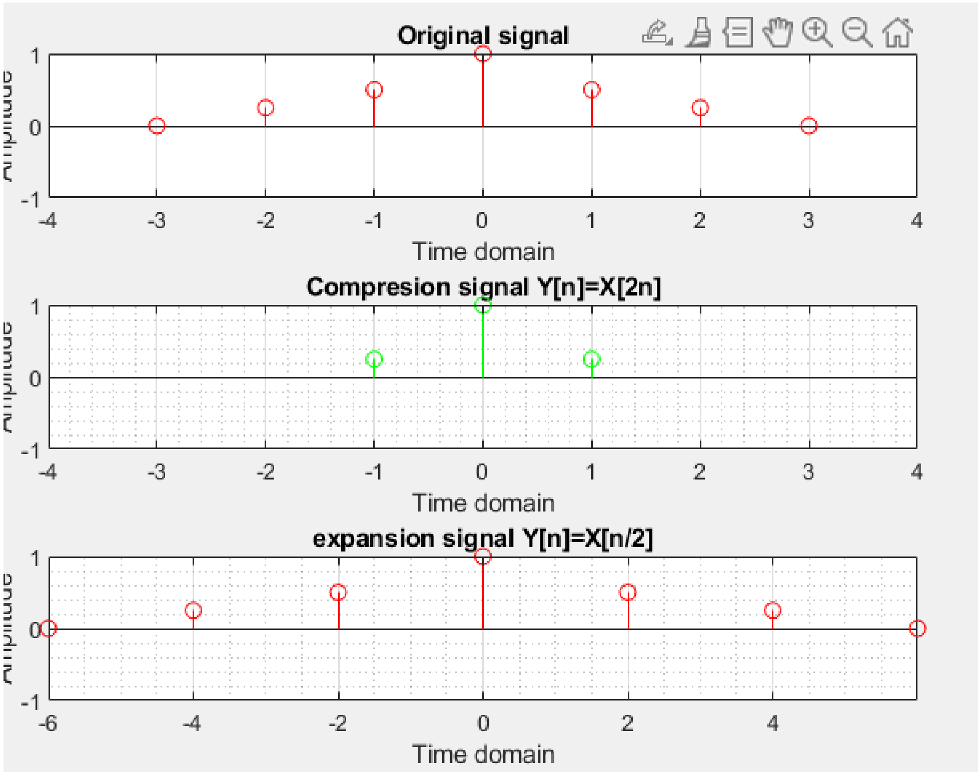
Experiment 17: Given the signal



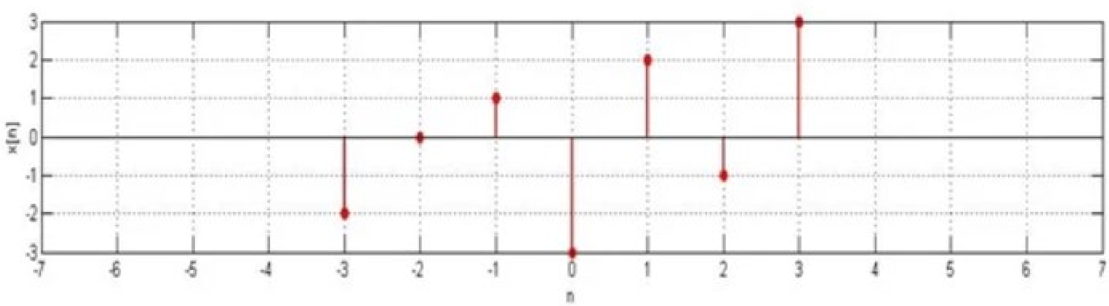
Find y[n]=x[2n] and y[n]=x[n/2]

```
close all;
clear all;
clc;
n=-3:3;
y=[0 0.25 0.5 1 0.5 0.25 0];

value=2;
temp=1;
for i=1:length(n)
    if(rem(n(i),value)==0)
        x1(temp)=n(i)./value;
        y1(temp)=y(i);
        temp=temp+1;
    end;
```

```
end
value=0.5;
temp1=1;
for i=1:length(n)
    if(rem(n(i),value)==0)
        x2(temp1)=n(i)./value;
        y2(temp1)=y(i);
        temp1=temp1+1;
    end;
end
subplot(3,1,1);
stem(n,y,'r');
xlabel("Time domain");
ylabel("Amplitude");
grid on;

axis([-4 4 -1 1]);
title("Original signal");

subplot(3,1,2);
stem(x1,y1,'g');
xlabel("Time domain");
ylabel("Amplitude");
grid on;
grid minor;
axis([-4 4 -1 1]);
title("Compresion signal Y[n]=X[2n]");
subplot(3,1,3);
stem(x2,y2,'r');
xlabel("Time domain");
ylabel("Amplitude");
grid on;
grid minor;
axis([-4 4 -1 1]);
title("expansion signal Y[n]=X[n/2]");
```



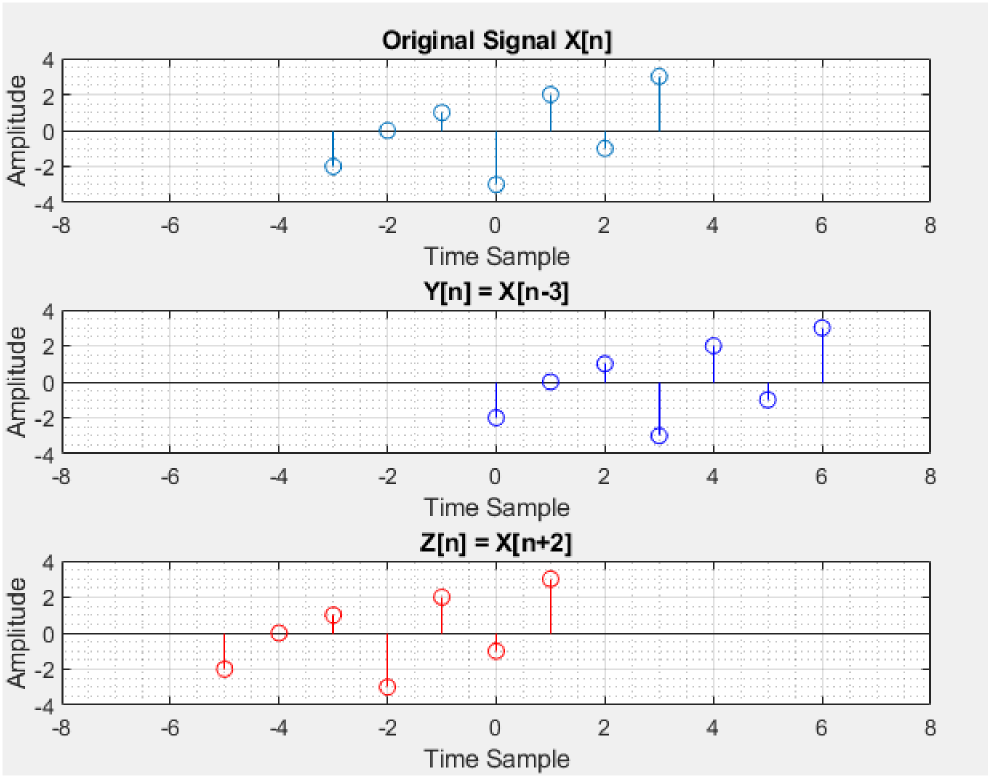
Experiment 18: Given the signal



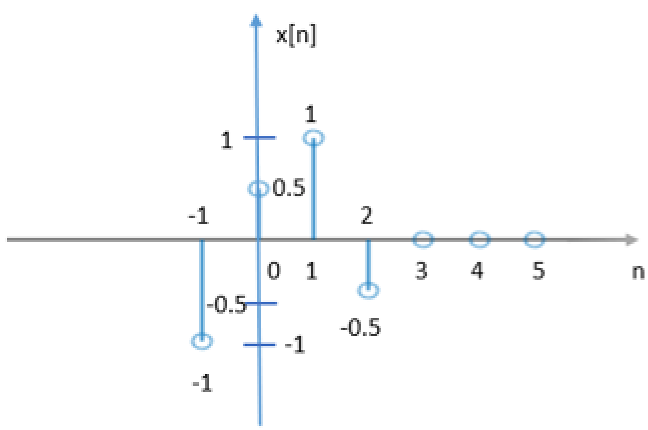
Find y[n]=x[n-3] and z[n]=x[n+2]

```
% Clear the command window and workspace
clc;
clear;

% Define the discrete time index
n = -3:3;

% Define the original signal X[n]
x = [-2 0 1 -3 2 -1 3];

% Plot the original signal X[n]
subplot(3,1,1);
```

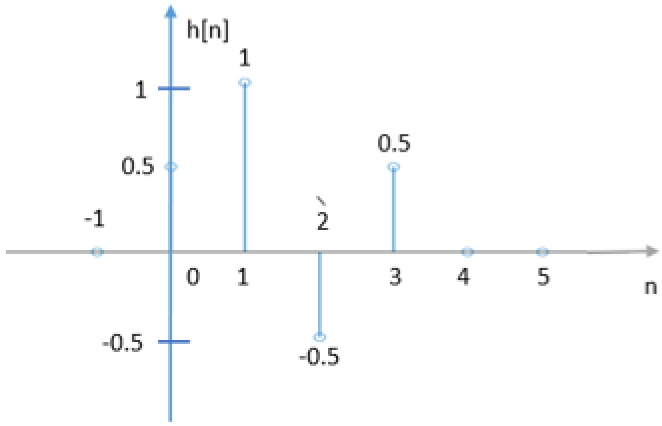
```
stem(n, x);
xlabel('Time Sample');
ylabel('Amplitude');
title('Original Signal X[n]');
axis([-8 8 -4 4]);
grid on;
grid minor;

% Right-shift the signal by 3 units (Y[n] = X[n-3])
m = n + 3;
subplot(3,1,2);
stem(m, x, 'b');
xlabel('Time Sample');
ylabel('Amplitude');
title('Y[n] = X[n-3]');
axis([-8 8 -4 4]);
grid on;
grid minor;

% Left-shift the signal by 2 units (Z[n] = X[n+2])
l = n - 2;
subplot(3,1,3);
stem(l, x, 'r');
xlabel('Time Sample');
ylabel('Amplitude');
title('Z[n] = X[n+2]');
axis([-8 8 -4 4]);
grid on;
grid minor;
```



Experiment 19: The input x[n] of a LTI system,



The impulse response of the system:



Find out y[n].

Code:

Convolution.m

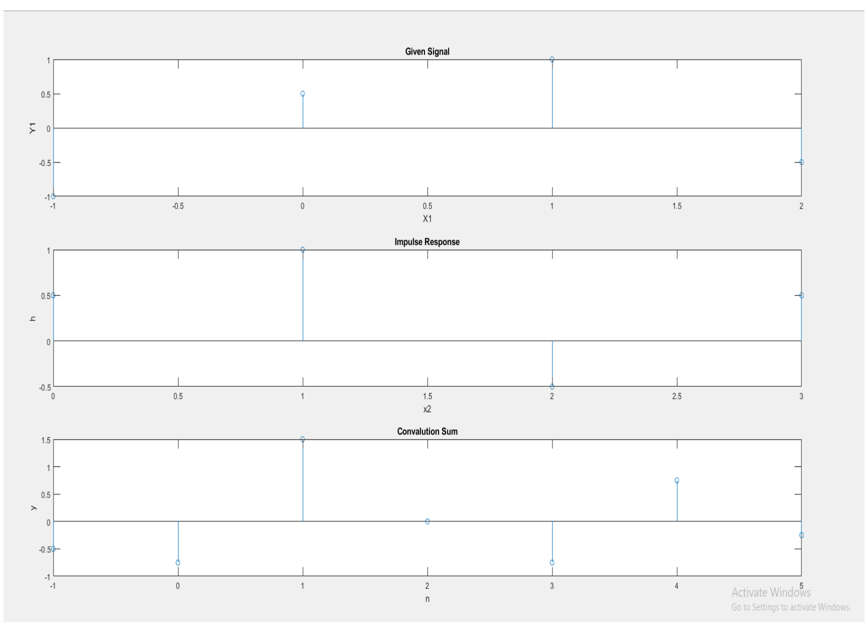
```
clc;
clear all;
close all;

x1=[-1 0 1 2];
y1=[-1 0.5 1 -0.5];
x2=[0 1 2 3 ];
h=[0.5 1 -0.5 0.5];

[n y]=func_convalution(x1,y1,x2,h);

subplot(3,1,1);
stem(x1,y1);
xlabel('X1');
ylabel('Y1');
title("Given Signal");

subplot(3,1,2);
stem(x2,h);
xlabel('x2');
ylabel('h');
```

```
title("Impulse Response");

subplot(3,1,3);
stem(n,y);
xlabel('n');
ylabel('y');
title("Convalution Sum");
```

func_convaluation.m:

```
function[n y]=func_convalution(x1,y1,x2,h)
m1=min(x1)+min(x2);
m2=max(x1)+max(x2);

n=m1:m2;
y=conv(y1,h); % build in function
```

Output:



```
clc;
clear all;
close all;
t=-20:0.0001:20;
x=sin(t)./t;
plot(t,x);
title("Sinc function");
xlabel("Time");
ylabel("Amplitude");
```