State Institute of Engineering and Technology Nilokheri.

DIGITAL SIGNAL PROCESSING
LAB MANUAL

Department of Electronics and Communication Engineering

List of Experiment

1. Write a Program to plot unit step, unit impulse ,ramp & exponential signal.
2. Write a program to plot real , imaginary, absolute and anglevalues of an exponential function.
3. Write a program to plot sine and cosine wave.
4. Write a program to compute and plot the convolution & multiplication of two signal.
5. Write a program to study Sampling Theorem and Aliasing effect.
6. To verify the linearity property of DFT.
7. To verify circular convolution property of DFT.
8. Write a program in MATLAB to plot window function used to design FIR filter.
9. Write a program to implement FIR filter.
10. Write a program in MATLAB to design a Butter-worth Low pass filter.

EXPERIMENT NO. – 1

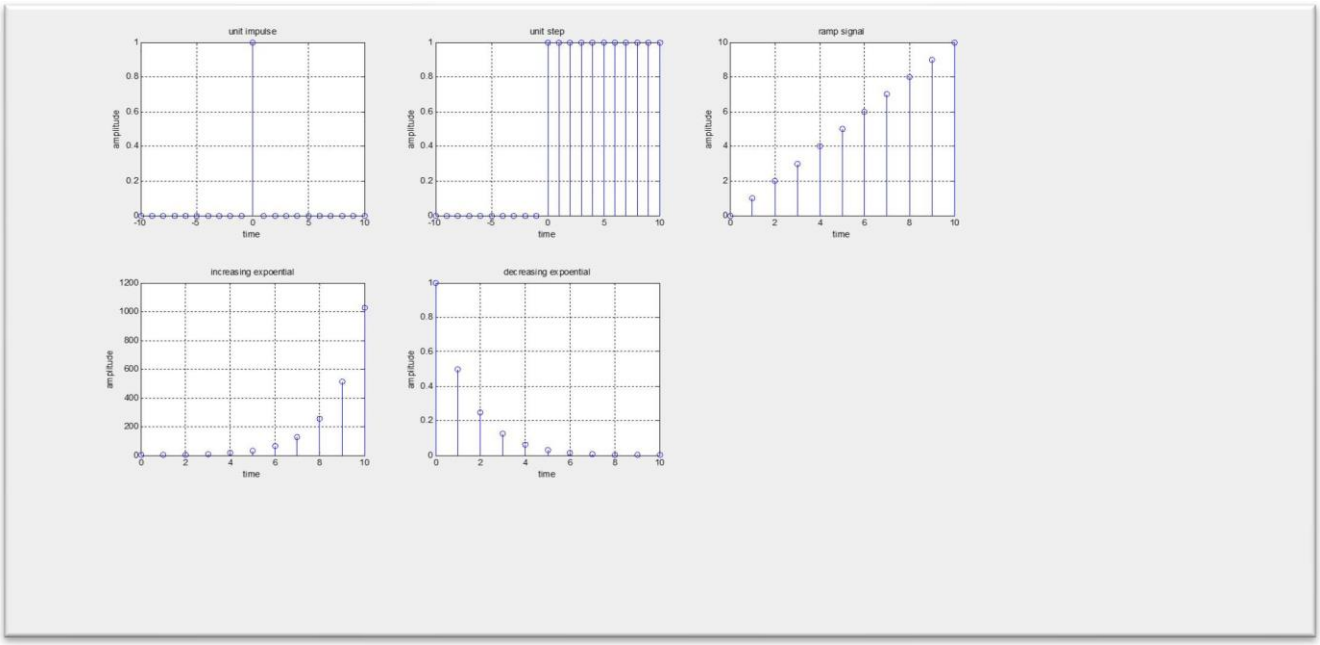
Aim : Write a Program to plot unit step, unit impulse ,ramp & exponential signal.

Software Requirements : MATLAB2013a

CODE/PROGRAM :

```
% ROLL NO. 2821556
n = -10:1:10;
i=[zeros(1,10),1,zeros(1,10)];
subplot(2,3,1);
stem(n,i);
xlabel('time');
ylabel('amplitude');
title('unit impulse');
grid on;

u=[zeros(1,10),ones(1,11)];
subplot(2,3,2);
stem(n,u);
xlabel('time');
ylabel('amplitude');
title('unit step');
grid on;

m = 0:1:10;
r=m;
subplot(2,3,3);
stem(m,r);
xlabel('time');
ylabel('amplitude');
title('ramp signal');
grid on;

r=2.^m;
subplot(2,3,4);
stem(m,r);
xlabel('time');
ylabel('amplitude');
title('increasing exponential');
grid on;


r=2.^(-m);
subplot(2,3,5);
stem(m,r);
xlabel('time');
ylabel('amplitude');
title('decreasing exponential');
grid on;
```

Simulation Result :



EXPERIMENT NO. – 2

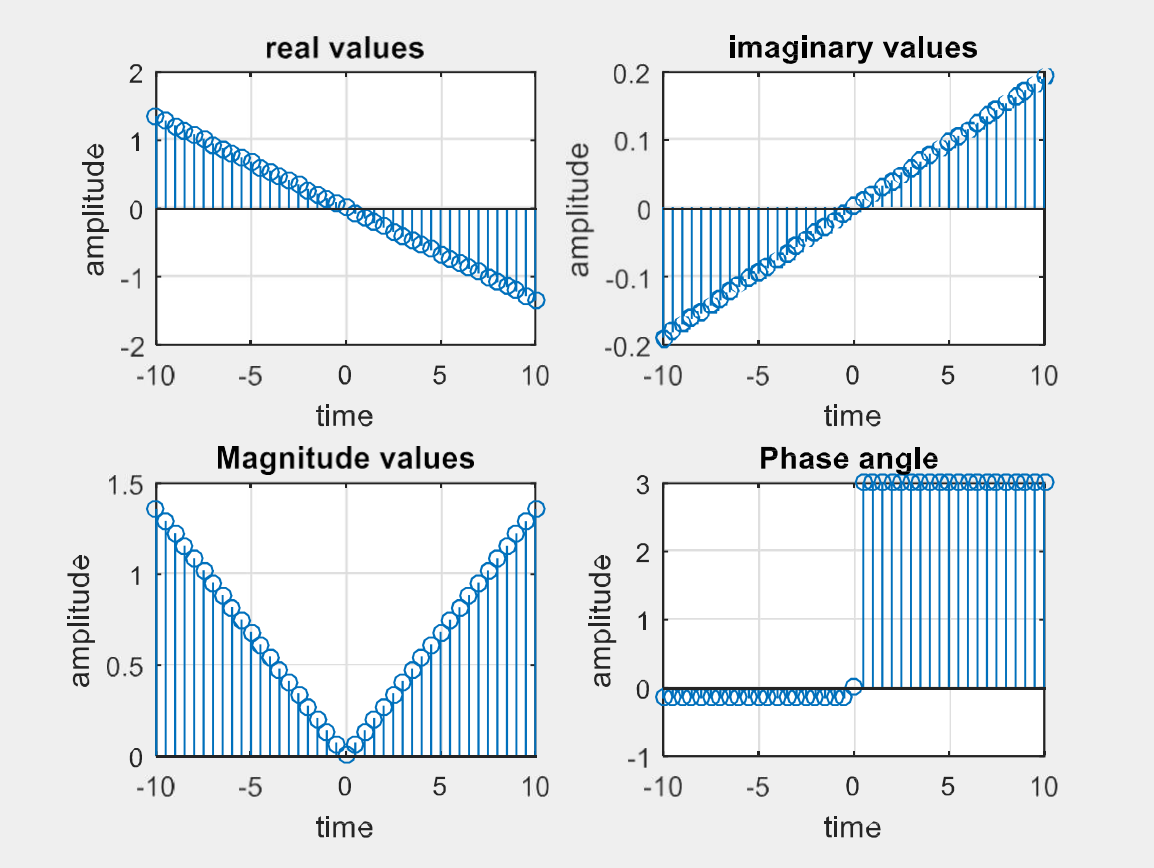
Aim : Write a program to plot real , imaginary, absolute and anglevalues of an exponential function.

Software Requirements : MATLAB2013a

CODE/PROGRAM :

```
% ROLL NO. 2821556
t=-10:0.5:10;
e=exp(-2+j*3)*t;
x=real(e);
y=imag(e);
z=abs(e);
a=angle(e);

%Real Values
subplot(2,2,1);
stem(t,x);
xlabel('time');
ylabel('amplitude');
title('real values');
grid on;

%Imaginary Values
subplot(2,2,2);
stem(t,y);
xlabel('time');
ylabel('amplitude');
title('imaginary values');
grid on;

%Magnitude Values
subplot(2,2,3);
stem(t,z);
xlabel('time');
ylabel('amplitude');
title('Magnitude values');
grid on;

%Phase angle
subplot(2,2,4);
stem(t,a);
xlabel('time');
ylabel('amplitude');
title('Phase angle ');
grid on;
```

Simulation Result :



EXPERIMENT NO. – 3

Aim : Write a program to plot sine and cosine wave.

Software Requirements : MATLAB2013a

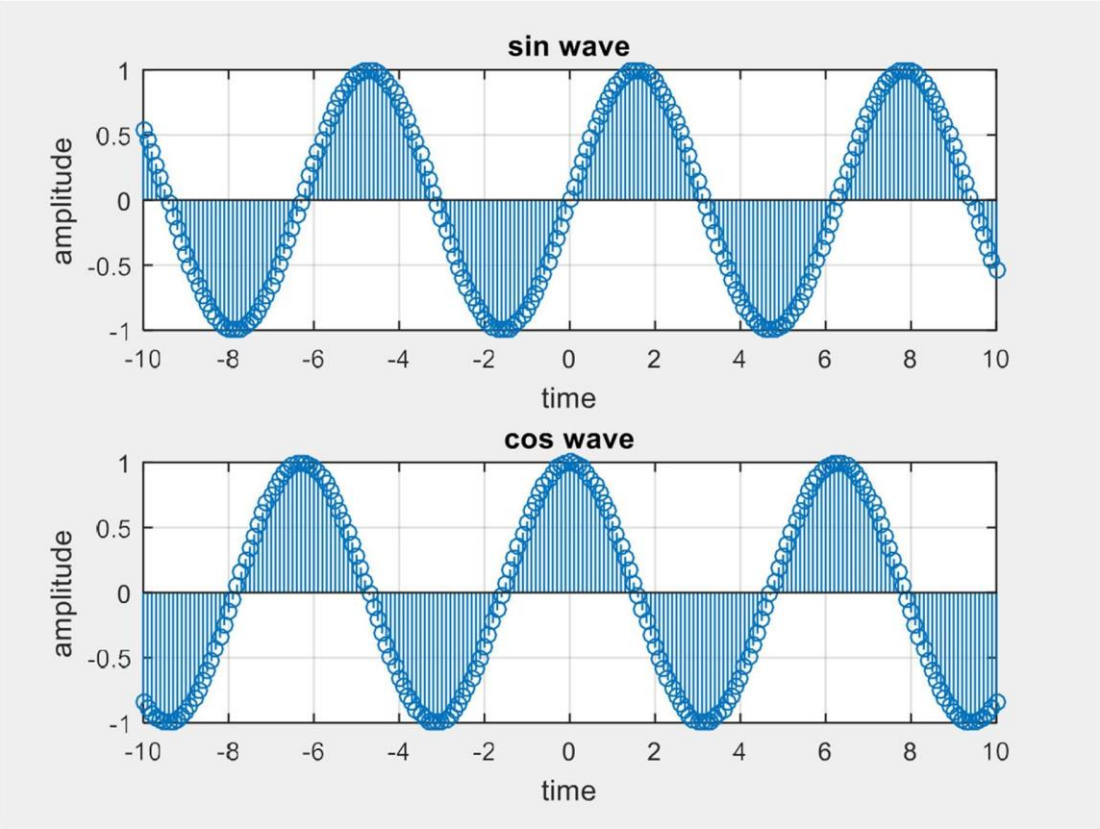
CODE/PROGRAM :

```
% ROLL NO. 2821556
```

1: Using subplot command

```
n=-10:0.1:10;
s=sin(n);
c=cos(n);

%For Sine Wave
subplot(2,1,1);
stem(n,s);
xlabel('time');
ylabel('amplitude');title('sin
wave');
grid on;

%for cos wave
subplot(2,1,2);
stem(n,c);
xlabel('time');
ylabel('amplitude');title('cos
wave');
grid on;
```

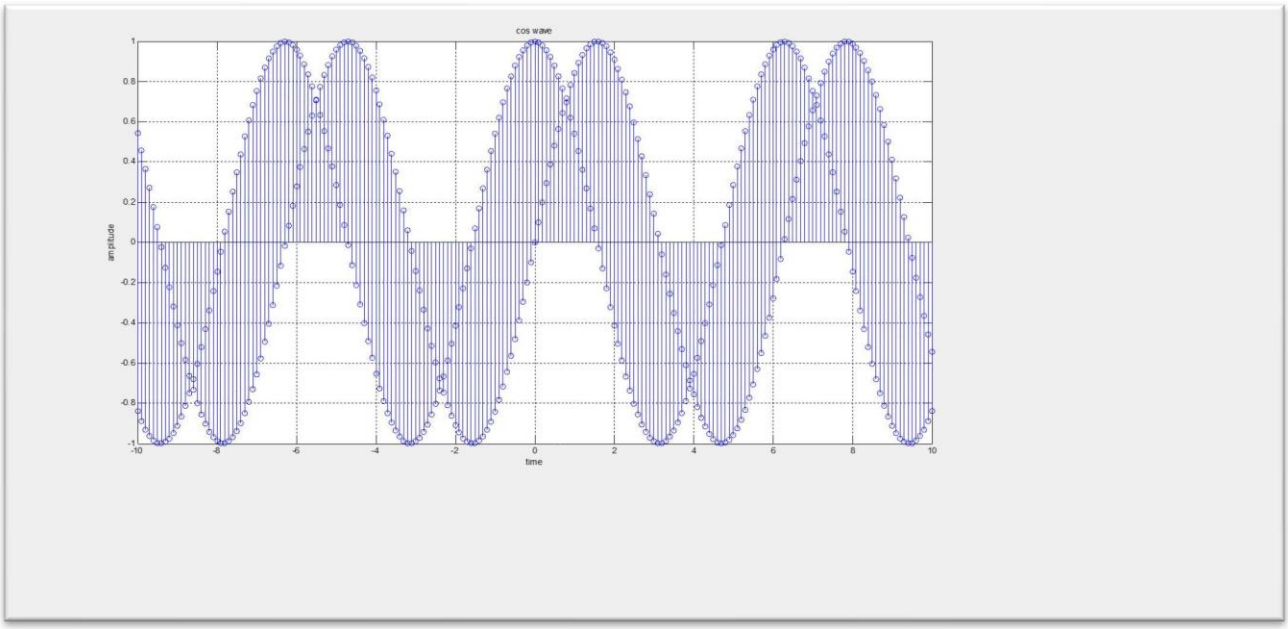
Simulation Result :



2:Using Hold on command

```
n=-10:0.1:10;
s=sin(n);
c=cos(n);
stem(n,s);
xlabel('time');
ylabel('amplitude');
title('sin wave'); grid
on;
hold on;
stem(n,c);
xlabel('time');
ylabel('amplitude');
title('cos wave'); grid
on;
hold on;
```

Simulation Result :



EXPERIMENT NO. – 4

Aim : Write a program to compute and plot the convolution & multiplication of two signal.

Software Requirements : MATLAB2013a

CODE/PROGRAM :

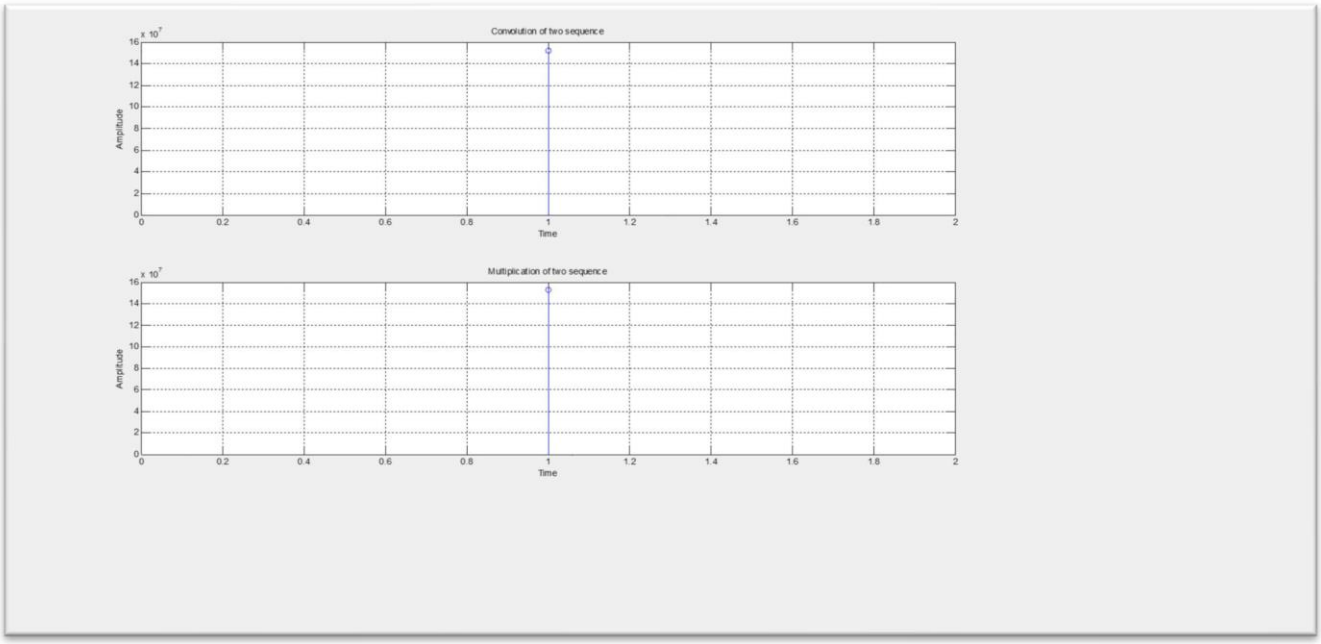
```
% ROLL NO. 2821556
%Convolution of two sequence
%Multiplication of two sequence
x=input('Enter the sequence1 ');
y=input('Enter the sequence2 ');
z=conv(x,y);
m=x.*y; subplot(2,1,1);
stem(z); xlabel('Time');
ylabel('Amplitude');
title('Convolution of two sequence');grid on;
subplot(2,1,2); stem(m);
xlabel('Time');
ylabel('Amplitude');
title('Multiplication of two sequence');
grid on;
```

Input :-

Enter the sequence1 [1 2 3 4 5]

Enter the sequence2 [4 2 1 3 5]

Simulation Result :



EXPERIMENT NO. – 5

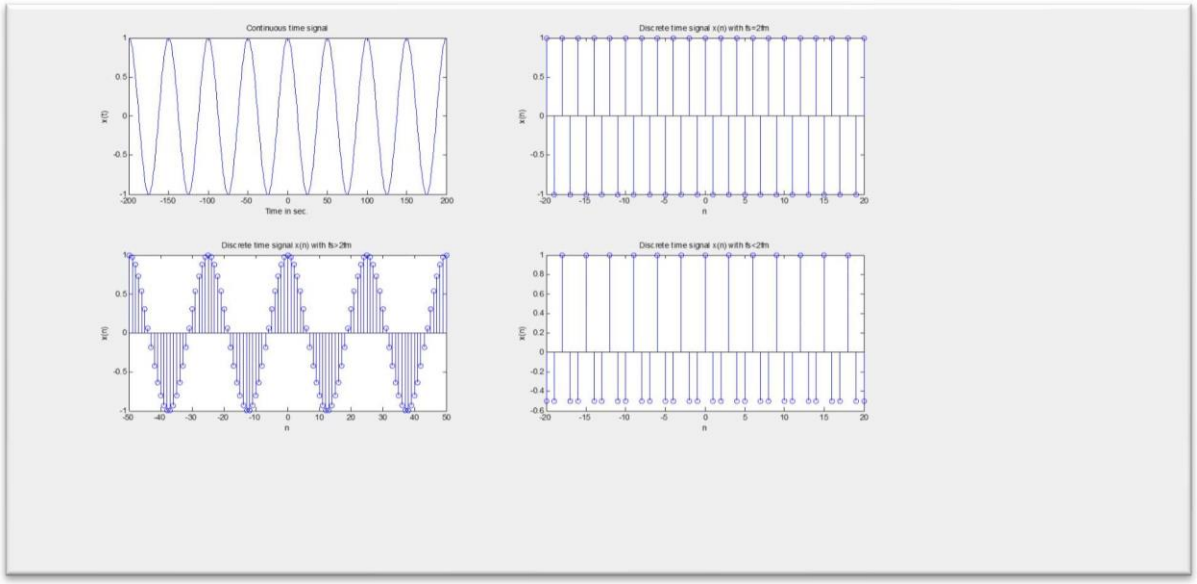
Aim : Write a program to study Sampling Theorem and Aliasing effect.

Software Requirements : MATLAB2013a

CODE/PROGRAM :

```
% ROLL NO. 2821556
 t=-200:01:200; fm=0.02;
 x=cos(2*pi*t*fm);

 %for plotting continuous time signal subplot(2,2,1);
 plot(t,x);  xlabel('Time in sec.');
 ylabel('x(t)');
 title('Continuous time signal');

 %for signal fs=2fm, plotting graph n=-20:20;
 fs1=0.04;
 x1=cos(2*pi*fm*n/fs1); subplot(2,2,2);
 stem(n,x1);
 xlabel('n');
 ylabel('x(n)');
 title('Discrete time signal x(n) with fs=2fm');

 %for signal fs>2fm, plotting graph fs2=0.5;
 n1=-50:50;
 x2=cos(2*pi*fm*n1/fs2); subplot(2,2,3);
 stem(n1,x2);
 xlabel('n');
 ylabel('x(n)');
 title('Discrete time signal x(n) with fs>2fm');

 %for signal fs<2fm, plotting graph
 fs3=0.03;
 n2=-20:20;
 x3=cos(2*pi*fm*n2/fs3); subplot(2,2,4);
 stem(n2,x3);
 xlabel('n');
 ylabel('x(n)');
title('Discrete time signal x(n) with fs<2fm');
```

Simulation Result :



EXPERIMENT NO. – 6

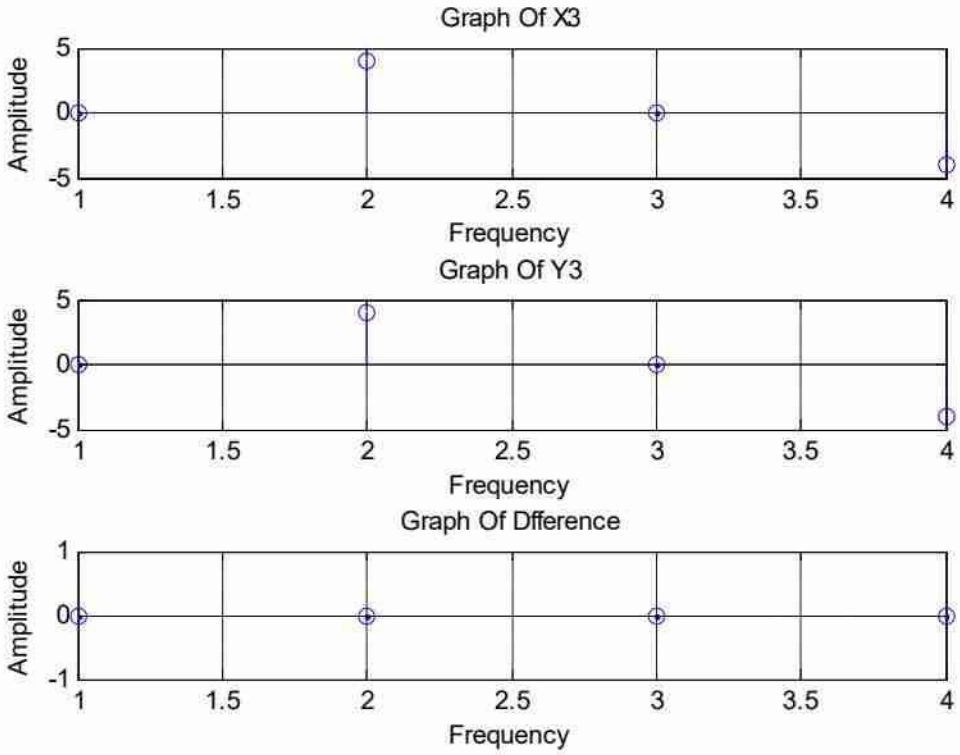
Aim : To verify linearity property of DFT.

Software Requirements :MATLAB2013a

PROGRAM :

```
% ROLL NO. 2822922
x1=[1 2 3 4];
x2=[-2 3 1 3];
n=1:4;
A=2;
B=3;
X1=fft(x1);
X2=fft(x2);
x3=A*x1+B*x2;
X3=fft(x3);
subplot(3,1,1);
stem(X3);
xlabel('Frequency');
ylabel('Amplitude');
title('Graph Of X3');
grid on;

Y3=A*X1+B*X2;
subplot(3,1,2);
stem(Y3);
xlabel('Frequency');
ylabel('Amplitude');
title('Graph Of Y3');
grid on;

d=X3-Y3;
subplot(3,1,3);
stem(d);
xlabel(' Frequency ');
ylabel('Amplitude');
title('Graph Of Dfference');
grid on;

if d==0;
disp('DFT Follows Linear Property');
else
disp('DFT Does Not Follows Linear Property');
end;
```

Result :


Graph Of X3
Amplitude
5
0
-5
1
1.5
2
2.5
3
3.5
4
Frequency
Graph Of Y3
Amplitude
5
0
-5
1
1.5
2
2.5
3
3.5
4
Frequency
Graph Of Dfference
Amplitude
1
0
-1
1
1.5
2
2.5
3
3.5
4
Frequency

EXPERIMENT NO. – 7

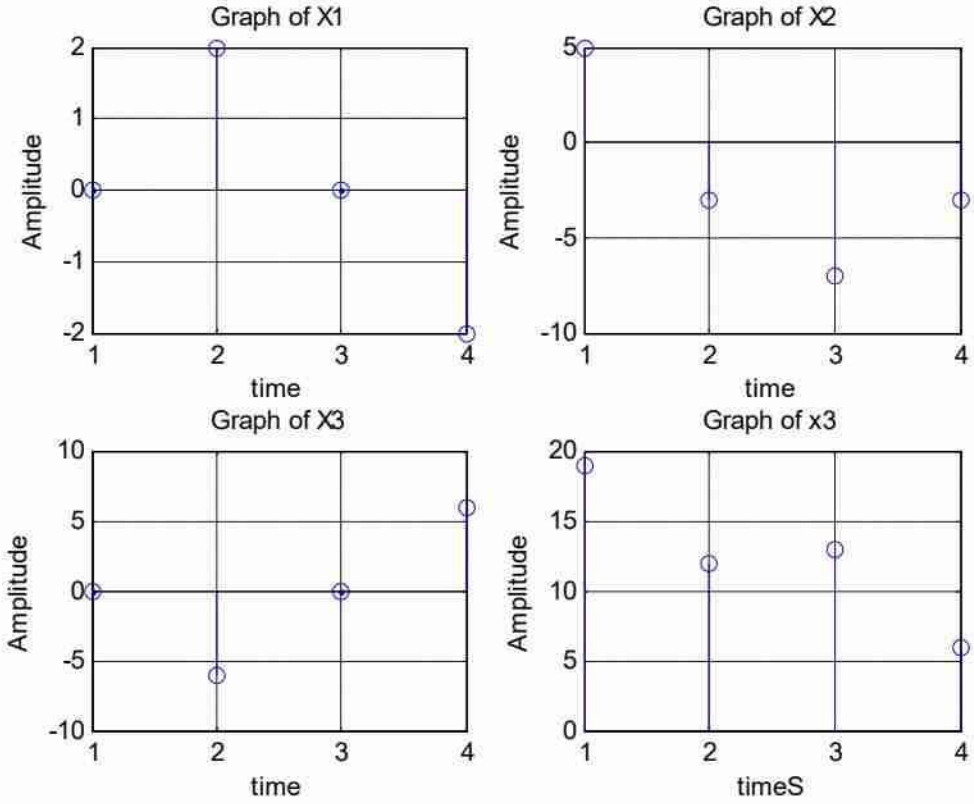
Aim : To verify circular convolution property of DFT.

Software Requirements :MATLAB2013a

PROGRAM :

```
% ROLL NO. 2822922
x1=[1 2 3 4];
x2=[-2 3 1 3];
n=1:4;
X1=fft(x1);
X2=fft(x2);
X3=X1.*X2;
x3=ifft(X3);
subplot(2,2,1);
stem(X1);
xlabel('time');
ylabel('Amplitude');
title('Graph of X1');
grid on;

subplot(2,2,2);
stem(X2);
xlabel('time');
ylabel('Amplitude');
title('Graph of X2');
grid on;

subplot(2,2,3);
stem(X3);
xlabel('time');
ylabel('Amplitude');
title('Graph of X3');
grid on;

subplot(2,2,4);
stem(x3);
xlabel('timeS');
ylabel('Amplitude');
title('Graph of x3');
grid on;
```

Result :


Graph of X1
Amplitude
time
Graph of X2
Amplitude
time
Graph of X3
Amplitude
time
Graph of x3
Amplitude
timeS

EXPERIMENT NO. – 8

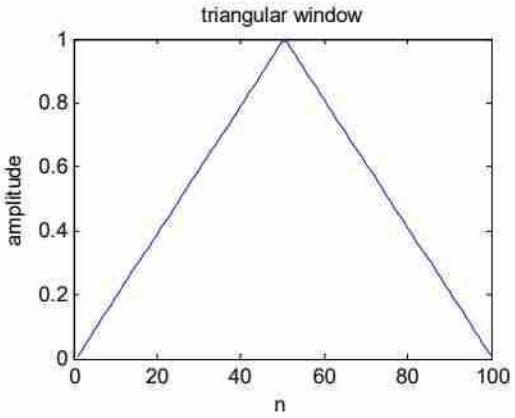
Aim : Write a program in MATLAB to plot window functions used to design FIR filters.

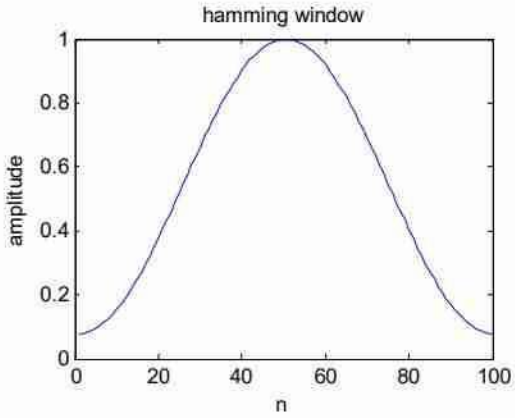
SoftwareRequirements :MATLAB2013a

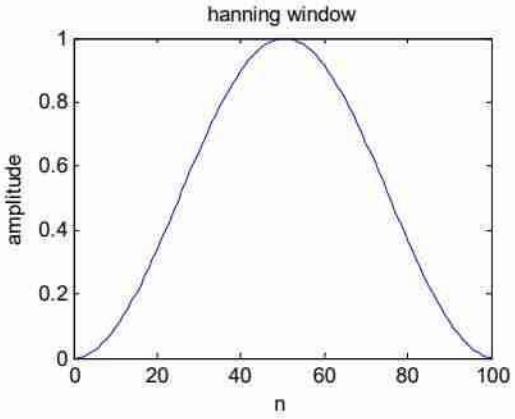
PROGRAM :

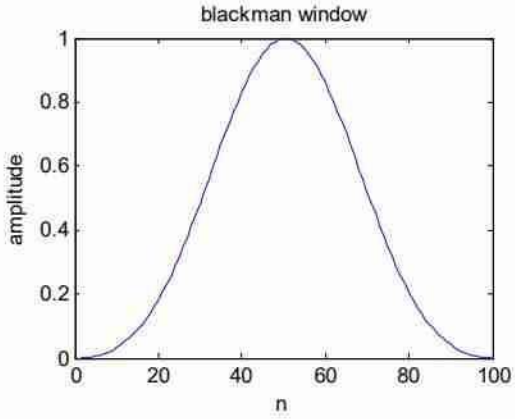
```
% ROLL NO. 2822922
l=100;
y=1:100;
x=triang(l);
subplot(2,2,1);
plot(y,x);
xlabel('n');
ylabel('amplitude');
title('triangular window');

subplot(2,2,2);
y=1:100;
l=100;
x=hamming(l);
plot(y,x);
xlabel('n');
ylabel('amplitude');
title('hamming window');

subplot(2,2,3);
y=1:100;
l=100;
x=hanning(l);
plot(y,x);
xlabel('n');
ylabel('amplitude');
title('hanning window');

subplot(2,2,4);
y=1:100;
l=100;
x=blackman(l);
plot(y,x);
xlabel('n');
ylabel('amplitude');
title('blackman window');
```

Result :


triangular window
amplitude
n
0
0.2
0.4
0.6
0.8
1
0
20
40
60
80
100


hamming window
amplitude
n
0
0.2
0.4
0.6
0.8
1
0
20
40
60
80
100


hanning window
amplitude
n
0
0.2
0.4
0.6
0.8
1
0
20
40
60
80
100


blackman window
amplitude
n
0
0.2
0.4
0.6
0.8
1
0
20
40
60
80
100

EXPERIMENT NO. – 9

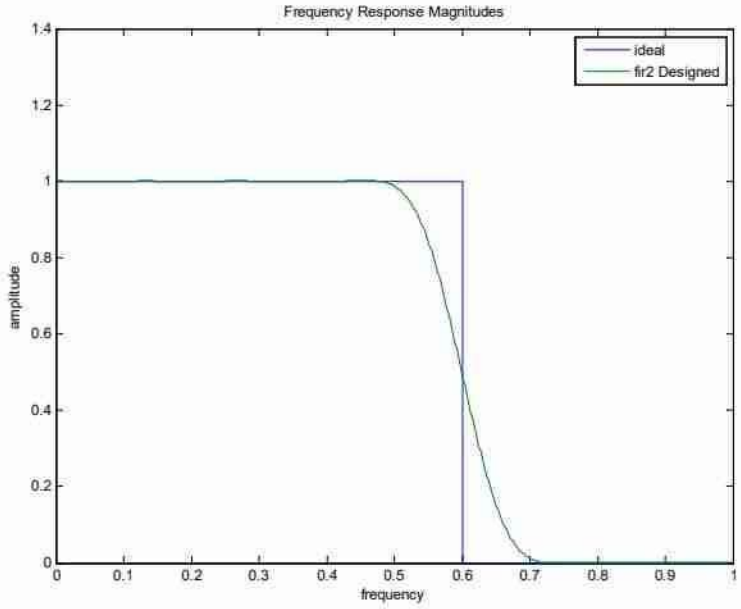
Aim : Write a program to implement FIR filter.

SoftwareRequirements :MATLAB2013a

PROGRAM :

```
% ROLL NO. 2822922
clc;
f=[0 0.6 0.6 1];
m=[1 1 0 0];
b=fir2(30,f,m);
[h,w]=freqz(b);
plot(f,m,w/pi,abs(h));
legend('ideal','fir2 Designed');
xlabel('frequency');
ylabel('amplitude');
title('Frequency Response Magnitudes
```

Result :



EXPERIMENT NO. – 10

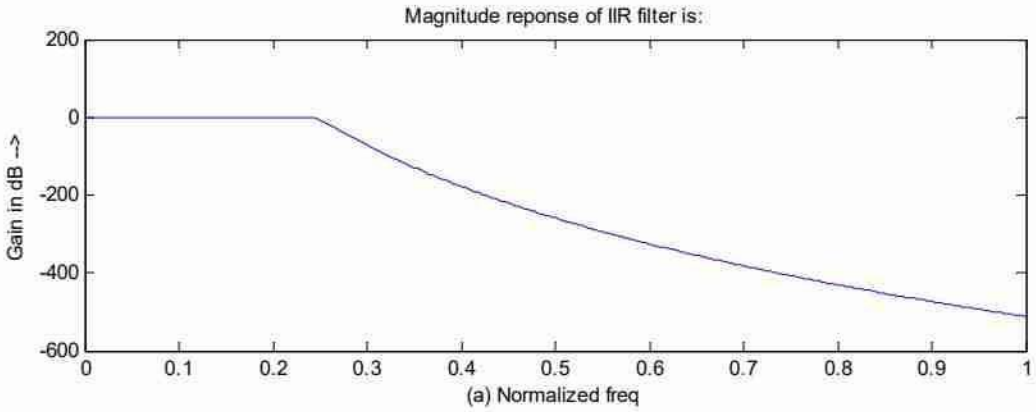
Aim : Write a Program in -MATLAB to design Butter-Worth Low Pass Filter with following specification:- dpI; ds-40; wp-200; ws-600; Fs-300;

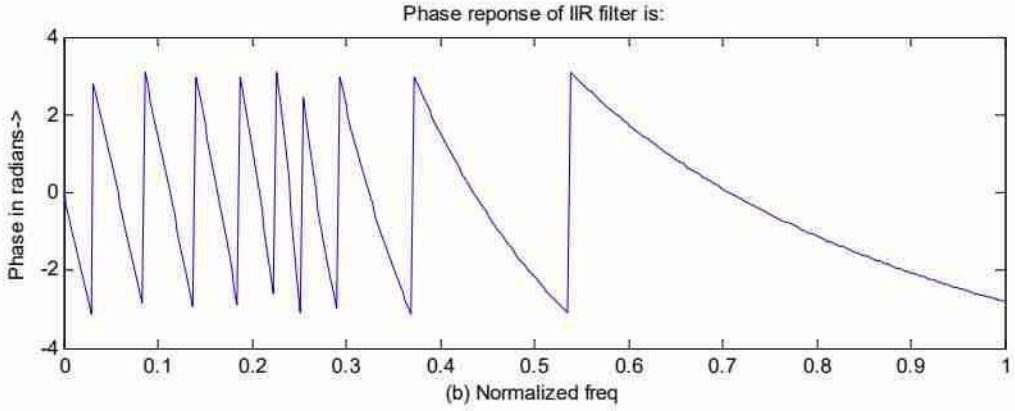
SoftwareRequirements :MATLAB2013a

PROGRAM :

```
% ROLL NO. 2822922
clc;
clear a!;
close all;
rp=1
40;
wp=200;
ws=600;
fs=300;
wl=2*wp/fs;
w2=2*ws/fs;
[n,wn]=buttord(wl,w2,wp,ws, 's');
disp('Frequency Response Of IIR LPF Is');
[b,a]=butter(n,wn,'low','s');
w=0:.01:pi;
[h,om]=freqs(b,a,w);
m=20*log10(abs(h));
an=angle(h);
figure,subplot(2,1,1);
plot(om/pi,m);
title('Magnitude reponse of IIR filter is:');
xlabel('(a) Normalized freq');
ylabel('Gain in dB -->');
subplot(2,1,2);
plot(om/pi,an);
title('Phase reponse of IIR filter is:');
xlabel('(b) Normalized freq');
ylabel('Phase in radians->');
```

Result :


Magnitude reponse of IIR filter is:
Gain in dB -->
200
0
-200
-400
-600
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
(a) Normalized freq


Phase reponse of IIR filter is:
Phase in radians->
4
2
0
-2
-4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
(b) Normalized freq