Experiment No 1

LIT System: To find the impulse response of a given system, Solution of difference equation, Verification of Sampling Theorem.

i)LIT System

%Without initializing values
%y(n)+0.8y(n-2)+0.6y(n-3)=x(n)+0.7x(n-1)+0.5x(n-2)

```
clear all;
close all;
b=input('Enter the coefficients of x ');
a=input('Enter the coefficients of y ');
N=input('Enter the length of the input sequence ');
n=0:1: N;
step=1.^n;
imp=[1,zeros(1,N)];

RES1=filter(b,a,step)
RES2=filter(b,a,imp)

subplot(2,2,1)
stem(n,step)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Input ')

subplot(2,2,2)
stem(n,imp)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Impulse Input')

subplot(2,2,3)
stem(n,RES1)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Response')

subplot(2,2,4)
stem(n,RES2)
grid on
xlabel('Input');
ylabel('Output Response');
title('Impulse Response')
```

Result

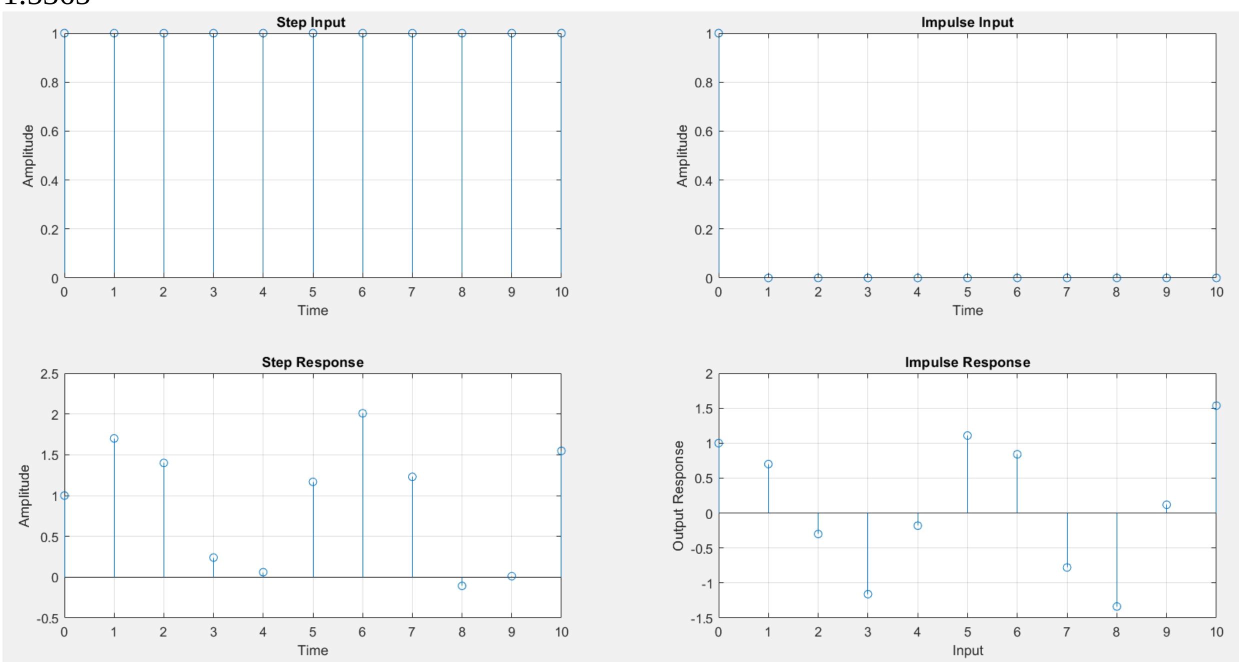
Enter the coefficients of x [1 0.7 0.5]
Enter the coefficients of y [1 0 0.8 0.6]
Enter the length of the input sequence 10

RES1 =

    1.0000   1.7000   1.4000   0.2400   0.0600   1.1680   2.0080   1.2296   -0.1072   0.0115
1.5480

RES2 =

    1.0000   0.7000   -0.3000   -1.1600   -0.1800   1.1080   0.8400   -0.7784   -1.3368   0.1187
1.5365



Program 2
%Initializing Y values
%y(n)=1//3x(n)+1/3x(n-1)+1/3x(n-2)+0.95y(n-1)-0.9025y(n-2)
%y(-1)=-2, y(-2)=-3

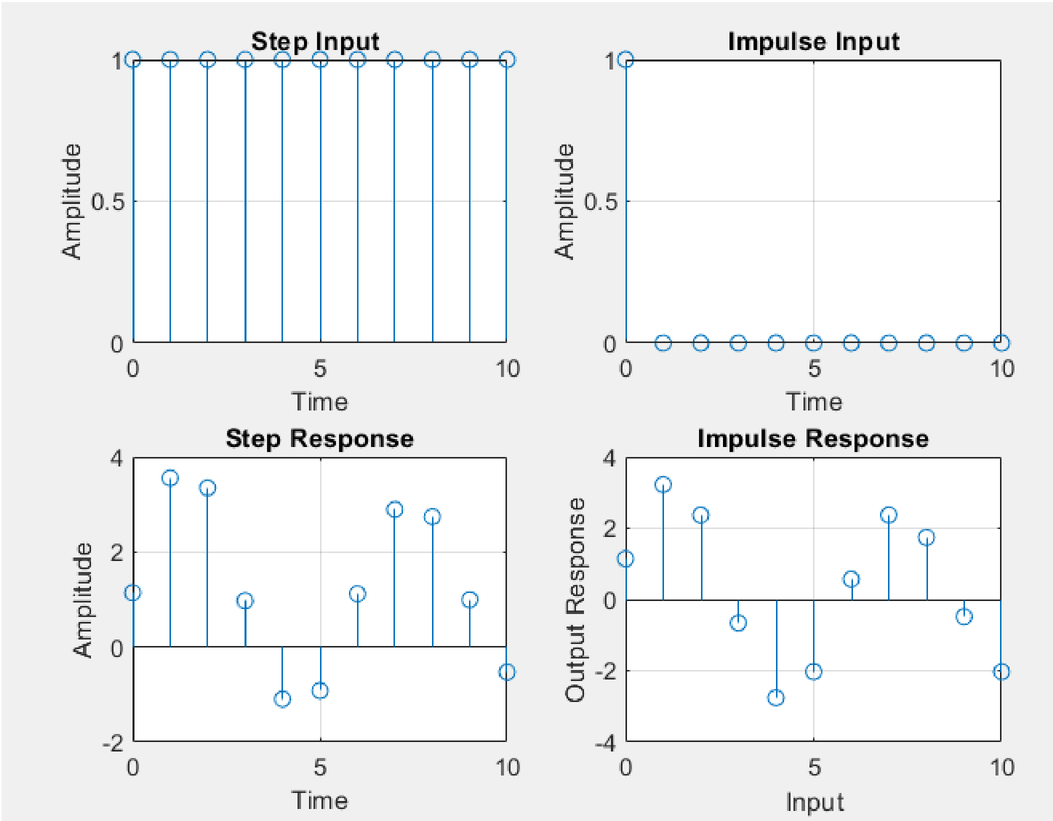
```
clear all;
close all;
b=input('Enter the coefficients of x ');
a=input('Enter the coefficients of y ');
N=input('Enter the length of the input sequence ');
n=0:1:N;
step=1.^n;
```

```
imp=[1,zeros(1,N)];

Y=[-2 -3];
XIC=filtic(b,a,Y);
RES1=filter(b,a,step,XIC)
RES2=filter(b,a,imp,XIC)

subplot(2,2,1)
stem(n,step)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Input ');

subplot(2,2,2)
stem(n,imp)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Impulse Input');

subplot(2,2,3)
stem(n,RES1)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Response');

subplot(2,2,4)
stem(n,RES2)
grid on
xlabel('Input');
ylabel('Output Response');
title('Impulse Response');
```

Result

```
Enter the coefficients of x [1/3 1/3 1/3]
Enter the coefficients of y  [1 -0.95 0.9025]
Enter the length of the input sequence 10

RES1 =

   1.1408    3.5555    3.3481    0.9719   -1.0984   -0.9206    1.1167    2.8917    2.7393    0.9925
  -0.5293


RES2 =
```

1.1408 3.2221 2.3647 -0.6615 -2.7626 -2.0275 0.5671 2.3686 1.7383 -0.4862 -2.0307



%For the given interval
%y(n)-y(n-1)+0.9y(n-2)=x(n) for all n
%n=-5:5

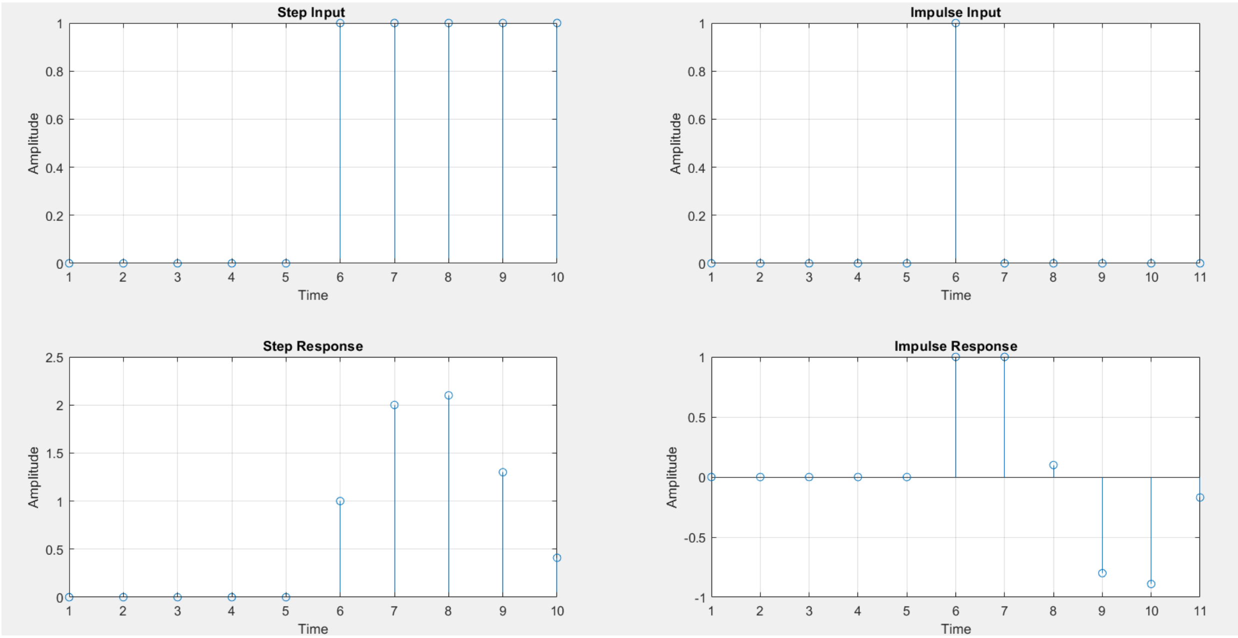
```
%For the given interval
%y(n)-y(n-1)+0.9y(n-2)=x(n) for all n
%n=-5:5

clear all;
close all;
b=input('Enter the coefficients of x ');
a=input('Enter the coefficients of y ');
n=-5:5;
step=[zeros(1,5) ones(1,5)];
imp=[zeros(1,5) 1 zeros(1,5)];

RES1=filter(b,a,step)
RES2=filter(b,a,imp)

subplot(2,2,1)
```

```
stem(step)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Input ');

subplot(2,2,2)
stem(imp)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Impulse Input');

subplot(2,2,3)
stem(RES1)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Step Response');

subplot(2,2,4)
stem(RES2)
grid on
xlabel('Time');
ylabel('Amplitude');
title('Impulse Response');
```

Result

Enter the coefficients of x 1
Enter the coefficients of y [1 -1 0.9]

```
RES1 =

     0     0     0     0     0  1.0000  2.0000  2.1000  1.3000  0.4100


RES2 =

     0     0     0     0     0  1.0000  1.0000  0.1000  -0.8000  -0.8900  -0.1700
```



ii) Sampling Theorem

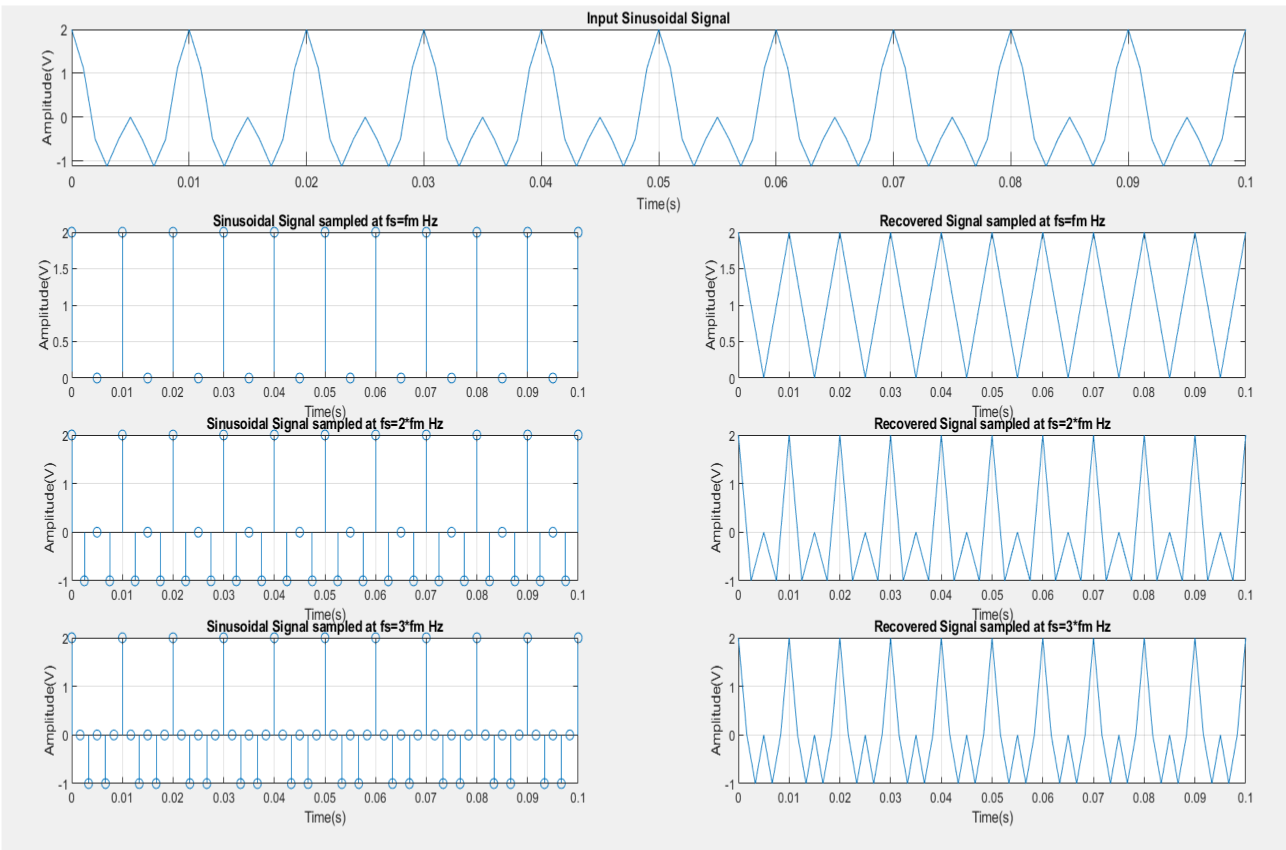
```
close all;
clear all;
t=0:0.001:0.1;
f1=input('Enter the Input Frequency1 = ');
f2=input('Enter the Input Frequency2 = ');

%Input Signal
y=cos(2*pi*f1*t) + cos(2*pi*f2*t);
fm=max(f1,f2);

subplot(4,1,1)
plot(t,y);
grid on;
title('Input Sinusoidal Signal');
xlabel('Time(s)');
ylabel('Amplitude(V)');

%Under Sampling
fs1=fm;
ts1=1/fs1;
tx1=0:ts1:0.1;
y1=cos(2*pi*f1*tx1) + cos(2*pi*f2*tx1)

subplot(4,2,3)
stem(tx1,y1);
grid on;
```

```
title('Sinusoidal Signal sampled at fs=fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');

subplot(4,2,4)
plot(tx1,y1);
grid on;
title('Recovered Signal sampled at fs=fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');

%Right Sampling
fs2=2*fm;
ts2=1/fs2;
tx2=0:ts2:0.1
y2=cos(2*pi*f1*tx2) + cos(2*pi*f2*tx2)

subplot(4,2,5)
stem(tx2,y2);
grid on;
title('Sinusoidal Signal sampled at fs=2*fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');

subplot(4,2,6)
plot(tx2,y2);
grid on;
title('Recovered Signal sampled at fs=2*fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');

%Over Sampling
fs3=3*fm;
ts3=1/fs3;
tx3=0:ts3:0.1;
y3=cos(2*pi*f1*tx3) + cos(2*pi*f2*tx3)

subplot(4,2,7)
stem(tx3,y3);
grid on;
title('Sinusoidal Signal sampled at fs=3*fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');

subplot(4,2,8)
plot(tx3,y3);
```

```
grid on;
title('Recovered Signal sampled at fs=3*fm Hz');
xlabel('Time(s)');
ylabel('Amplitude(V)');
```

Result

Enter the Input Frequency1 = 100
Enter the Input Frequency2 = 200



Experiment No 2

ii) Linear Convolution

```
clear all;
close all;
x=input('Enter the first input sequence x[n] ');
h=input('Enter the first input sequence h[n] ');
Lx=length(x);
Lh=length(h);
len=Lx+Lh -1;

for n=1:len
    y(n)=0;
    for k=1:Lx
        if((n-k)>=0&(n-k)<Lh)
            y(n)=y(n)+x(k).*h(n-k+1);
        end
    end
end
disp('Linear Convolution of x[n] & h[n] is ')
disp(y)
```

Result

Enter the first input sequence x[n] [1 2 3 4]
Enter the first input sequence h[n] [1 0 1]
Linear Convolution of x[n] & h[n] is

```
   1   2   4   6   3   4
```

ii) Circular Convolution

```
clear all;
close all;
x1=input('Enter the first input sequence x1[n] ');
x2=input('Enter the first input sequence x2[n] ');
Lx1=length(x1);
Lx2=length(x2);
len=max(Lx1,Lx2);
if Lx1<len
    x1=[x1,zeros(len-Lx1)];
else
    x2=[x2,zeros(len-Lx2)];
end

for n=1:len
    y(n)=0;
    for k=1:len
        i=n-k+1;
```

```
        if(i<=0)
            i=i+len;
        end
        y(n)=y(n)+x2(k)*x1(i);
    end
end
disp('Circular Convolution of x1[n] & x2[n] is ')
disp(y)
```

Result

Enter the first input sequence x1[n] [1 2 3 4]
Enter the first input sequence x2[n] [1 0 1]
Circular Convolution of x1[n] & x2[n] is
 4 6 4 6

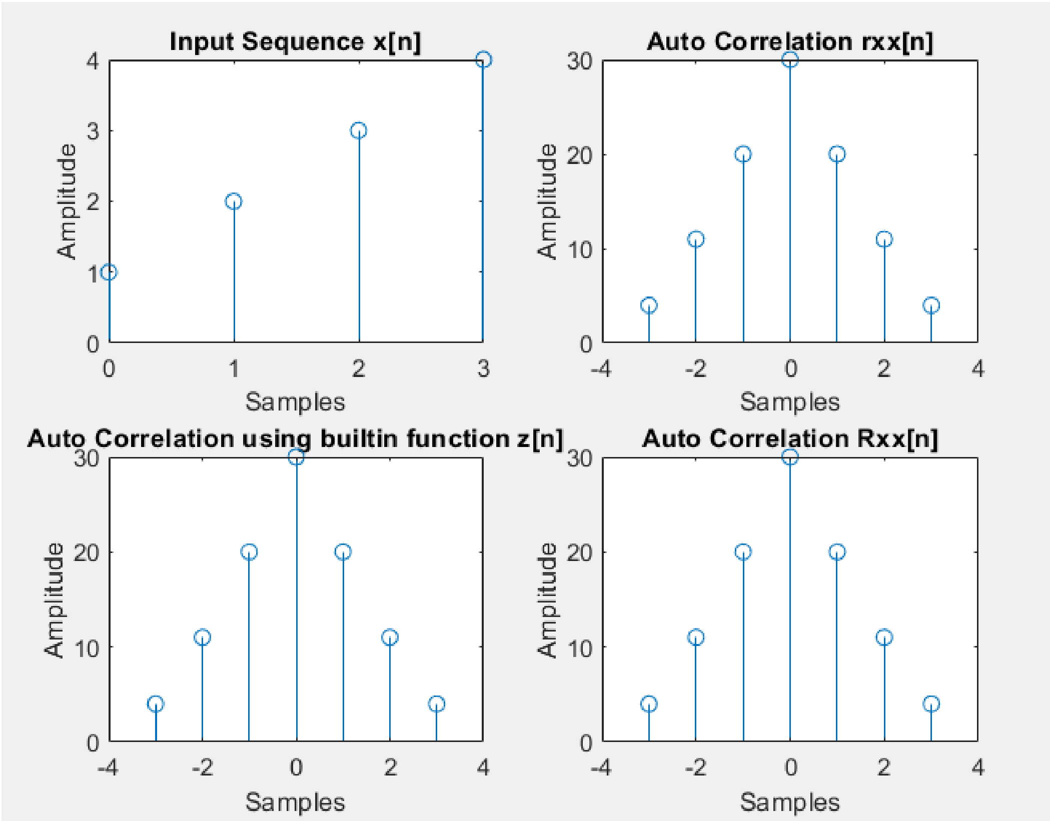
iii) Autocorrelation

```
clear all;
close all;
x=input('Enter the input sequence x[n]');
Lx=length(x)-1;
h=fliplr(x);
rxx=conv(x,h);
disp('Auto Corelation of x[n] is rxx[n]')
disp(rxx)

%Verification using builtin function xcorr()
z=xcorr(x,x);
disp('Auto Corelation of x[n] using builtin function is
z[n]')
disp(z)

%Auto correlation using for loop
len=2*Lx+1;
for n=1:len
    Rxx(n)=0;
    for k=1:Lx+1
        if((n-k)>=0 & (n-k)<=Lx)
            Rxx(n)=Rxx(n)+x(k).*h(n-k+1);
        end
    end
end
disp('Auto Corelation of x[n] is Rxx[n]')
disp(Rxx)

%Ploting the graph
```

```
a=0:Lx;
subplot(2,2,1)
stem(a,x)
title('Input Sequence x[n]')
xlabel('Samples')
ylabel('Amplitude')

b=(-Lx):Lx;
subplot(2,2,2)
stem(b,Rxx)
title('Auto Correlation rxx[n]')
xlabel('Samples')
ylabel('Amplitude')

subplot(2,2,3)
stem(b,z)
title('Auto Correlation using builtin function z[n]')
xlabel('Samples')
ylabel('Amplitude')

subplot(2,2,4)
stem(b,z)
title('Auto Correlation Rxx[n]')
xlabel('Samples')
ylabel('Amplitude')
```

Result

```
Enter the input sequence x[n][1 2 3 4]
Auto Corelation of x[n] is rxx[n]
    4    11    20    30    20    11     4

Auto Corelation of x[n] using builtin function is z[n]
   4.0000   11.0000   20.0000   30.0000   20.0000   11.0000    4.0000

Auto Corelation of x[n] is Rxx[n]
    4    11    20    30    20    11     4
```



iv) Cross Correlation

```
clear all;
close all;
x=input('Enter the input sequence x[n]');
Lx=length(x)-1;
h=input('Enter the second sequence h[n]');
Lh=length(h)-1;
y=fliplr(h);
Rxy=conv(x,y);
disp('Cross Correlation is Rxy[n]')
disp(Rxy)

%Verification using builtin function xcorr()
z=xcorr(x,h);
disp('Cross Correlation using builtin function is z[n]')
disp(z)

%Cross correlation using for loop
len=Lx+Lh+1;
for n=1:len
    rxx(n)=0;
    for k=1:Lx+1
```

```
        if((n-k)>=0 & (n-k)<=Lh)
            rxx(n)=rxx(n)+x(k).*y(n-k+1);
        end
    end
end
disp('Cross Correlation of x[n] is Z[n]')
disp(rxx)

a=0:Lx;
subplot(3,2,1)
stem(a,x)
title('First Input Sequence x[n]')
xlabel('Samples')
ylabel('Amplitude')

b=0:Lh;
subplot(3,2,2)
stem(a,h)
title('Second Input Sequence y[n]')
xlabel('Samples')
ylabel('Amplitude')

c=(-Lx):Lx;
subplot(3,2,3)
stem(c,Rxy)
title('Cross Correlation Rxy[n] using builtin function
xcorr()')
xlabel('Samples')
ylabel('Amplitude')

subplot(3,2,4)
stem(c,z)
title('Cross Correlation using builtin function xcorr()
z[n]')
xlabel('Samples')
ylabel('Amplitude')

subplot(3,2,5:6)
stem(c,rxx)
title('Cross Correlation rxx[n]')
xlabel('Samples')
ylabel('Amplitude')
```

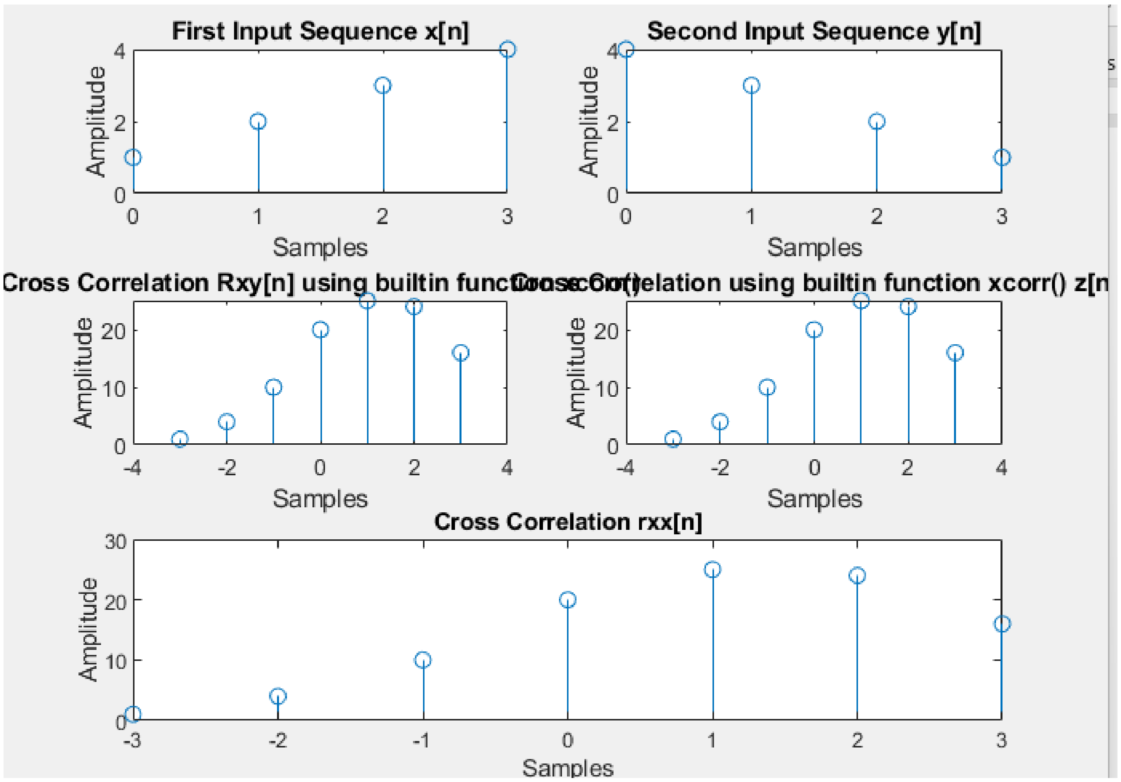
Result

Enter the input sequence x[n][1 2 3 4]

Enter the second sequence h[n][4 3 2 1]
Cross Correlation is Rxy[n]
1 4 10 20 25 24 16

Cross Correlation using builtin function is z[n]
1.0000 4.0000 10.0000 20.0000 25.0000 24.0000 16.0000

Cross Correlation of x[n] is Z[n]
1 4 10 20 25 24 16



Experiment No 3

To find DFT and IDFT of a sequence

```
close all;
clear all;
x=input('Enter the input sequence x[n]=')
L=length(x)
N=input('Enter the length of the DFT sequence N =');
if(N<L)
    disp('N should be greater than L')
else
    %Wn=-j*2*pi/N;
    for k=0:N-1
        X(k+1)=0;
        for n=0:L-1
            X(k+1)=X(k+1)+x(n+1)*exp(-j*2*pi*n*k/N);
        end
    end
    disp('DFT of x[n] is X(K)=')
    disp(X)
end

%Verification
disp('DFT using built in function')
Y=fft(x,N)
disp(Y)

%Inverse DFT
for n=0:N-1
    y(n+1)=0;
    for k=0:L-1
        y(n+1)=y(n+1)+X(k+1)*exp(j*2*pi*n*k/N);
    end
    y(n+1)=y(n+1)/N;
end
disp('IDFT of X(K)is y(n)=')
disp(y)

%Verification
disp('IDFT using built in function ')
Z=ifft(X)
disp(Z)

a=0:L-1;
subplot(3,2,1)
```

```
stem(a,x)
grid on
title('Input Sequence x[n]')
xlabel('Samples')
ylabel('Values')

b=0:N-1;
subplot(3,2,2)
stem(b,X)
grid on
title('DFT Sequence X(K)')
xlabel('Samples')
ylabel('Values')

subplot(3,2,3)
stem(b,abs(X))
grid on
title('DFT magnitude')
xlabel('Samples')
ylabel('Values')

subplot(3,2,4)
stem(b,angle(X))
grid on
title('DFT phase angle')
xlabel('Samples')
ylabel('Values')

subplot(3,2,5)
stem(y)
grid on
title('IDFT sequence y[n]')
xlabel('Samples')
ylabel('Values')
```

Result:

Enter the input sequence x[n]=[1 2 3 4]

x =

    1   2   3   4

L =

4

Enter the length of the DFT sequence N =4
DFT of x[n] is X(K)=
10.0000 + 0.0000i -2.0000 + 2.0000i -2.0000 - 0.0000i -2.0000 - 2.0000i

DFT using built in function

Y =

10.0000 + 0.0000i -2.0000 + 2.0000i -2.0000 + 0.0000i -2.0000 - 2.0000i

10.0000 + 0.0000i -2.0000 + 2.0000i -2.0000 + 0.0000i -2.0000 - 2.0000i

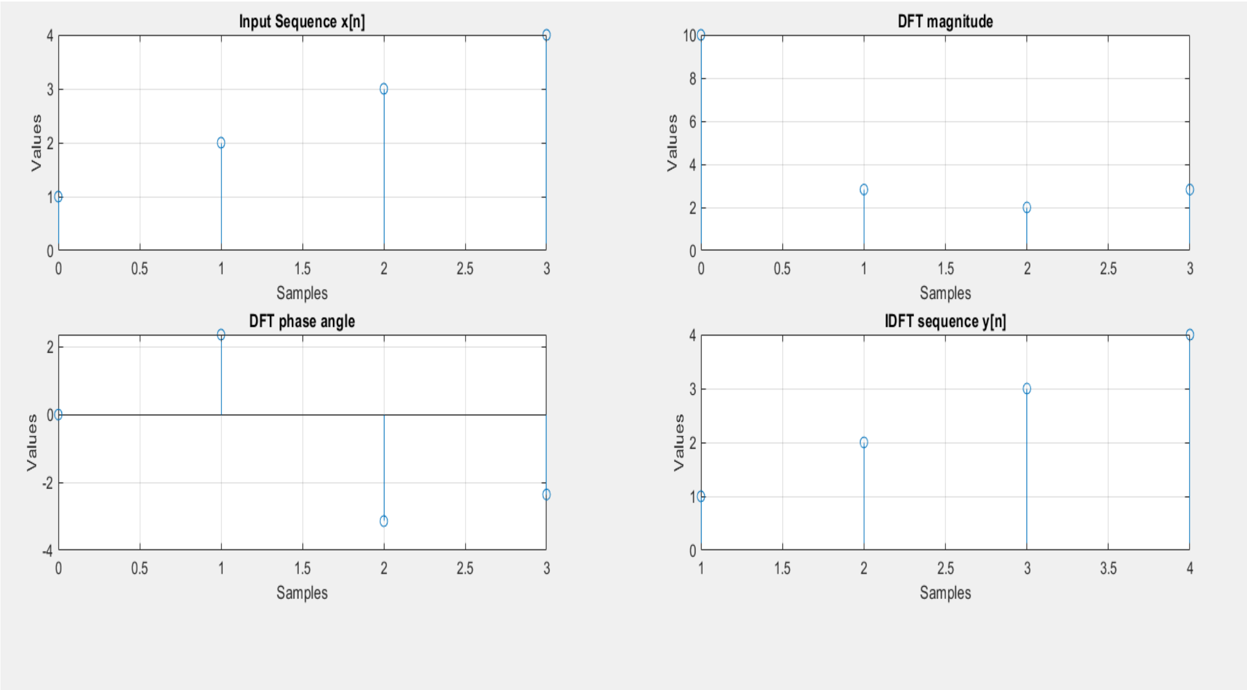
IDFT of X(K)is y(n)=
1.0000 - 0.0000i   2.0000 - 0.0000i   3.0000 - 0.0000i   4.0000 + 0.0000i

IDFT using built in function

Z =

1.0000 - 0.0000i   2.0000 - 0.0000i   3.0000 + 0.0000i   4.0000 + 0.0000i

1.0000 - 0.0000i   2.0000 - 0.0000i   3.0000 + 0.0000i   4.0000 + 0.0000i



ii) To find FFT and IFFT of a sequence

```
close all;
clear all;
x=input('Enter the input Sequnce x[n]');
L=length(x);
N=input('Enter the length of the FFT sequence N =');
if(N<L)
    disp('N should be greater than L')
else
    x=[x zeros(1,N-L)];
end

%Plotting the Input Sequence
d=0:N-1;
subplot(3,2,1)
stem(d,x)
title('Input Sequence x[n]');

%To alter the input sequence ie x[0] x[2] x[1] x[3]
x=bitrevorder(x);

M=log2(N);
h=1;

for stage=1:M
    for index=0:(2^stage):N-1
        for n=0:(h-1)
            pos=n+index+1;
            pow=(2^(M-stage)*n);
            w=exp((-i)*(2*pi)*pow/N);
            a=x(pos)+x(pos+h).*w;
            b=x(pos)-x(pos+h).*w;
            x(pos)=a;
            x(pos+h)=b;
        end
    end
    h=2*h;
end
y=x
disp(y);
%Plotting the FFT Sequence

subplot(3,2,2)
stem(d,abs(y))
grid on
```

```
title('FFT magnitude')
xlabel('Samples')
ylabel('Values')

subplot(3,2,3)
stem(d,angle(y))
grid on
title('FFT phase angle')
xlabel('Samples')
ylabel('Values')

y=bitrevorder(y);
h=1;

for stage=1:M
    for index=0:(2^stage):N-1
        for n=0:(h-1)
            pos=n+index+1;
            pow=(2^(M-stage)*n);
            w=exp((i)*(2*pi)*pow/N);
            a=y(pos)+y(pos+h).*w;
            b=y(pos)-y(pos+h).*w;
            y(pos)=a;
            y(pos+h)=b;
        end
      end
    h=2*h;
end

z=y/N
disp(z)

%Plotting the IFFT Sequence
subplot(3,2,4)
stem(d,z)
title('IFFT Sequence z[n]');
```

Result:

Enter the input Sequnce x[n][1 2 3 4]
Enter the length of the FFT sequence N =4

y =

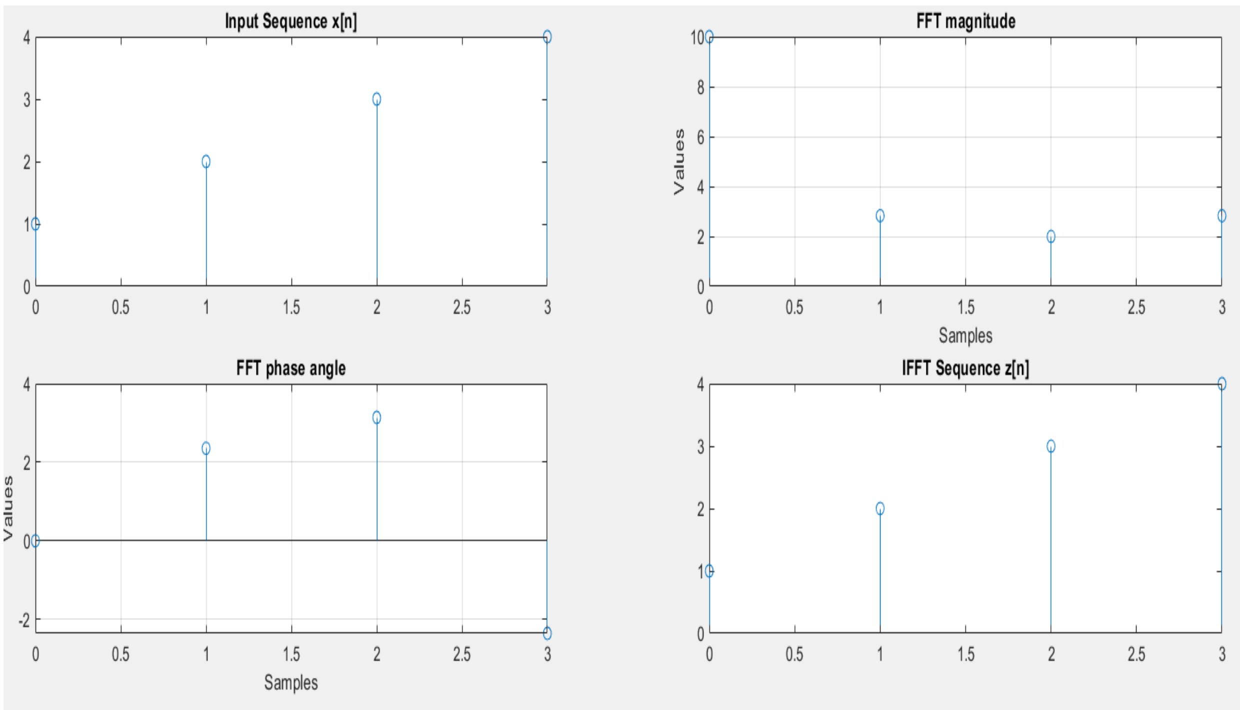
10.0000 + 0.0000i -2.0000 + 2.0000i -2.0000 + 0.0000i -2.0000 - 2.0000i

10.0000 + 0.0000i -2.0000 + 2.0000i -2.0000 + 0.0000i -2.0000 - 2.0000i

z =

1.0000 + 0.0000i   2.0000 + 0.0000i   3.0000 + 0.0000i   4.0000 - 0.0000i

1.0000 + 0.0000i   2.0000 + 0.0000i   3.0000 + 0.0000i   4.0000 - 0.0000i



iii)To find Linear and Circular Convolution using FFT algorithm
Linear Convolution

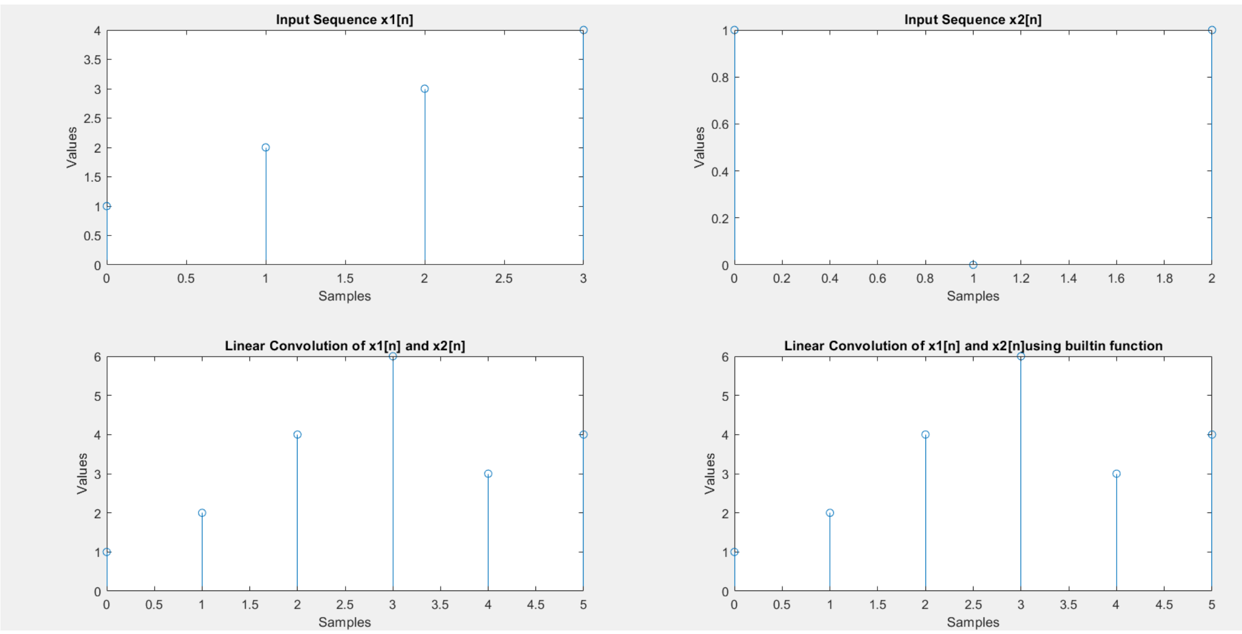
```
clear all;
close all;
x1=input('Enter the first input sequence x1[n] ');
x2=input('Enter the second input sequence x2[n] ');
Lx1=length(x1);
Lx2=length(x2);
N=Lx1+Lx2-1;
X1=fft(x1,N);
X2=fft(x2,N);
Y=X1.*X2;
y=ifft(Y,N);
disp('Linear Convolution of x1[n] and x2[n] is y[n]= ')
disp(y)

%Verification
z=conv(x1,x2);
disp('Linear Convolution of x1[n] and x2[n] using builtin
function is z[n]= ')
disp(z)

a=0:Lx1-1;
subplot(2,2,1)
stem(a,x1)
title('Input Sequence x1[n]')
xlabel('Samples')
ylabel('Values')

b=0:Lx2-1;
subplot(2,2,2)
stem(b,x2)
title('Input Sequence x2[n]')
xlabel('Samples')
ylabel('Values')

c=0:N-1;
subplot(2,2,3)
stem(c,y)
title('Linear Convolution of x1[n] and x2[n]')
xlabel('Samples')
ylabel('Values')

d=0:N-1;
```

```
subplot(2,2,4)
stem(c,z)
title('Linear Convolution of x1[n] and x2[n]using builtin
function')
xlabel('Samples')
ylabel('Values')
```

Result:

Enter the first input sequence x1[n] [1 2 3 4]
Enter the second input sequence x2[n] [1 0 1]
Linear Convolution of x1[n] and x2[n] is y[n]=
    1   2   4   6   3   4

Linear Convolution of x1[n] and x2[n] using builtin function is z[n]=
    1   2   4   6   3   4



Circular Convolution

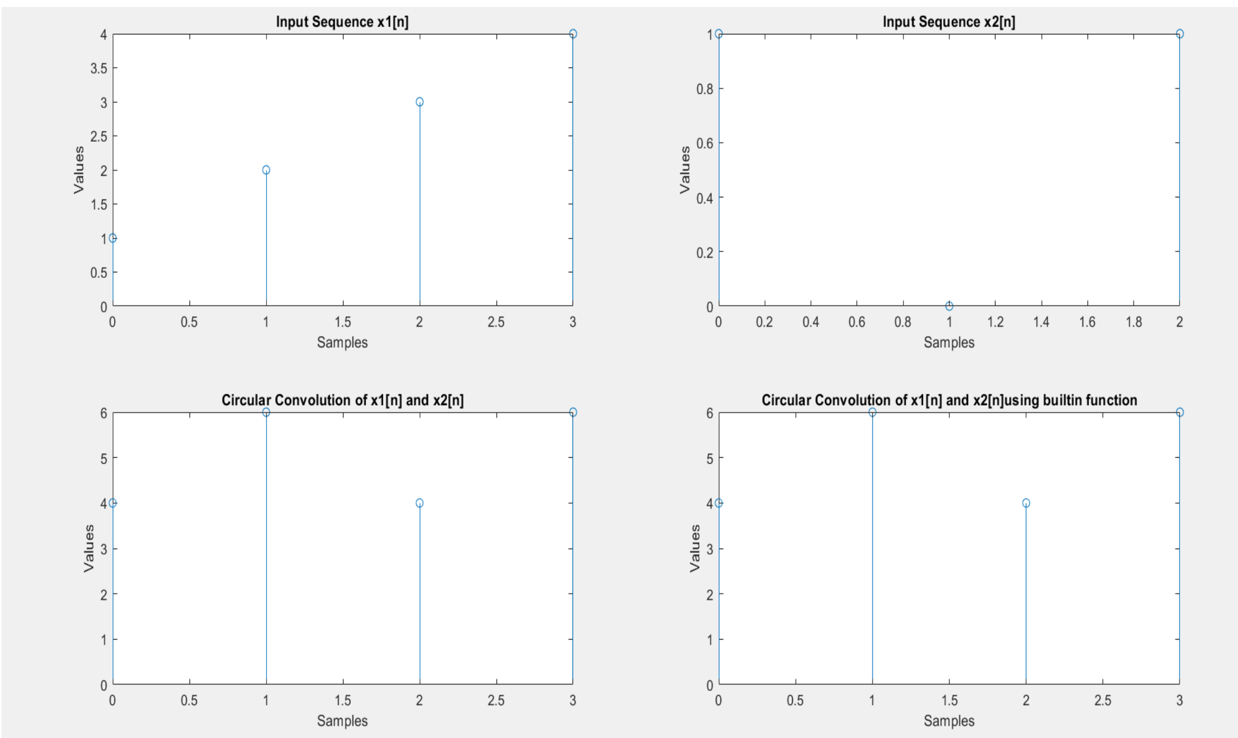
```
clear all;
close all;
x1=input('Enter the first input sequence x1[n] ');
x2=input('Enter the second input sequence x2[n] ');
Lx1=length(x1);
Lx2=length(x2);
N=max(Lx1,Lx2);
X1=fft(x1,N);
X2=fft(x2,N);
Y=X1.*X2;
y=ifft(Y,N);
disp('Circular Convolution of x1[n] and x2[n] is y[n]= ')
disp(y)

%Verification
z=cconv(x1,x2,N);
disp('Circular Convolution of x1[n] and x2[n] using builtin
function is z[n]= ')
disp(z)

a=0:Lx1-1;
subplot(2,2,1)
stem(a,x1)
title('Input Sequence x1[n]')
xlabel('Samples')
ylabel('Values')

b=0:Lx2-1;
subplot(2,2,2)
stem(b,x2)
title('Input Sequence x2[n]')
xlabel('Samples')
ylabel('Values')

c=0:N-1;
subplot(2,2,3)
stem(c,y)
title('Circular Convolution of x1[n] and x2[n]')
xlabel('Samples')
ylabel('Values')

d=0:N-1;
subplot(2,2,4)
stem(c,z)
```

```
title('Circular Convolution of x1[n] and x2[n]using builtin
function')
xlabel('Samples')
ylabel('Values')
```

Result:

Enter the first input sequence x1[n] [1 2 3 4]
Enter the second input sequence x2[n] [1 0 1]
Circular Convolution of x1[n] and x2[n] is y[n]=
    4   6   4   6

Circular Convolution of x1[n] and x2[n] using builtin function is z[n]=
    4   6   4   6



iv)To find Linear and Circular Convolution using FFT algorithm

Linear Convolution

```
clear all;
close all;
x1=input('Enter the first input sequence x1[n] ');
x2=input('Enter the second input sequence x2[n] ');
Lx1=length(x1);
Lx2=length(x2);
N=Lx1+Lx2-1;
X1=FFT_L(x1,N);
X2=FFT_L(x2,N);
Y=X1.*X2;
y=IFFT_L(Y,N);
disp('Linear Convolution of x1[n] & x2[n] is ')
disp(y)
```

Result

Enter the first input sequence x1[n] [1 2 3 4]
Enter the second input sequence x2[n] [1 1 1 1]
Linear Convolution of x1[n] & x2[n] is
 1.0000 - 0.0000i 3.0000 - 0.0000i 6.0000 - 0.0000i 10.0000 + 0.0000i 9.0000 + 0.0000i 7.0000 + 0.0000i 4.0000 + 0.0000i 0.0000 - 0.0000i

Circular convolution

```
clear all;
close all;
x1=input('Enter the first input sequence x1[n]');
x2=input('Enter the first input sequence x2[n]');
Lx1=length(x1);
Lx2=length(x2);
N=max(Lx1,Lx2);
if Lx1<N
 x1=[x1,zeros(N-Lx1)];
else
 x2=[x2,zeros(N-Lx2)];
end
X1=FFT_L(x1,N);
X2=FFT_L(x2,N);
Y=X1.*X2;
y=IFFT_L(Y,N);
disp('Circular Convolution of x1[n] & x2[n] is ')
disp(y)
%Verification
z=cconv(x1,x2,N);
```

```
disp('Circular Convolution of x1[n] and x2[n] using builtin
function is z[n]= ')
disp(z)
```

Result
Enter the first input sequence x1[n][1 2 3 4]
Enter the first input sequence x2[n][1 0 1]
Circular Convolution of x1[n] & x2[n] is
4 6 4 6

Circular Convolution of x1[n] and x2[n] using builtin function is z[n]=
4 6 4 6

Functions
FFT
```
function y=FFT_L(x,N)
L=length(x);
M=nextpow2(N);
R=rem(N,2);
if(R~=0)
 x=[x zeros(1,(2^M)-L)];
end
%To alter the input sequence ie x[0] x[2] x[1] x[3]
x=bitrevorder(x);
h=1;
N=2^M;
for stage=1:M
 for index=0:(2^stage):N-1
 for n=0:(h-1)
 pos=n+index+1;
 pow=(2^(M-stage)*n);
 w=exp((-i)*(2*pi)*pow/N);
 a=x(pos)+x(pos+h).*w;
 b=x(pos)-x(pos+h).*w;
 x(pos)=a;
 x(pos+h)=b;
 end
 end
 h=2*h;
end
y=x;
```

IIFT

```
function z=IFFT_L(y,N)
L=length(y);
M=nextpow2(N);
R=rem(N,2);
if(R~=0)
 y=[y zeros(1,(2^M)-L)];
end
y=bitrevorder(y);
h=1;
N=2^M;
for stage=1:M
 for index=0:(2^stage):N-1
 for n=0:(h-1)
 pos=n+index+1;
 pow=(2^(M-stage)*n);
 w=exp((i)*(2*pi)*pow/N);
 a=y(pos)+y(pos+h).*w;
 b=y(pos)-y(pos+h).*w;
 y(pos)=a;
 y(pos+h)=b;
 end
 end
 h=2*h;
end
z=y/N;
```

Experiment No 4

i) To find the 2N point DFT using N point DFT

```
close all;
clear all;
v=input('Enter the Input sequence v[n]');
N=length(v)/2

for n=0:N-1
    g(n+1)=v((2*n)+1);
    h(n+1)=v((2*n)+2);
end

[G,H]=myN_Point(g,h);


for k=0:(2*N)-1
    w(k+1)=exp((-i*pi*k)/N);
end

m=0;
for k=1:2
    for n=0:N-1
        V(m+n+1)=G(n+1)+(w(m+n+1)*H(n+1));
    end
    m=4;
end

disp('2N -Point DFT using N point DFT is V(K)')
disp(V)
****************************************

function[G,H]=myN_Point(g,h)
N=length(g);

%x[n]= g[n]+jh[n]
for i=0:N-1
    x(i+1)=g(i+1)+h(i+1)*j;
end

%Finding DFT of x[n] i.e X[K]
X =mydftusingfft(x,N);

%Finding Conjugate of X(K) i.e X*(K)
Z=conj(X);
```

```
%X*[(N-K)N]
%n=0:N-1
%Z(mod(-n,N)+1)
for k=0:N-1
    n=N-k;
    if(n==N)
        y(k+1)=Z(k+1);
    else
        y(k+1)=Z(n+1);
    end
end

G=zeros(1,N);
H=zeros(1,N);

for k=1:N
    G(k)=(1/2)*(X(k)+y(k));
    H(k)=(X(k)-y(k))/(2*j)
end
end

************************************************************
function y=mydftusingfft(x,N)

%to alter the input sequence is X[0] x[1] x[3]

x=bitrevorder(x);


% To find n from 2^n i.e No of stages
%p=nextpow2(N);
M=log2(N);
h=1;


for stage = 1:M
    for index = 0:(2^stage):N-1
        for n=0:(h-1)
            pos =n+index+1;
            pow= (2^(M-stage)*n);
            w=exp((-i)*(2*pi)*pow/N);
            a=x(pos)+x(pos+h).*w;
            b=x(pos)-x(pos+h).*w;
            x(pos)=a;
            x(pos+h)=b;
```

```
        end
    end
    h=2*h;
end
y=x;
end
```

Result

Enter the Input sequence v[n] [1 2 2 2 0 1 1 1]

N =

4

H =

6 0 0 0

H =

6.0000 + 0.0000i 1.0000 - 1.0000i 0.0000 + 0.0000i 0.0000 + 0.0000i

H =

6.0000 + 0.0000i 1.0000 - 1.0000i 0.0000 + 0.0000i 0.0000 + 0.0000i

H =

6.0000 + 0.0000i 1.0000 - 1.0000i 0.0000 + 0.0000i 1.0000 + 1.0000i

2N -Point DFT using N point DFT is V(K)
10.0000 + 0.0000i 1.0000 - 2.4142i -2.0000 + 0.0000i 1.0000 - 0.4142i -2.0000 - 0.0000i
1.0000 + 0.4142i -2.0000 + 0.0000i 1.0000 + 2.4142i

ii)To find the N point DFT of two sequences using single N point DFT(Using FFT algorithm to find DFT)

```
close all;
clear all;
g=input('Enter the first  sequence g[n]');
h= input('Enter the second sequence h[n]');
N=length(g)

for i=0:N-1
    x(i+1)=g(i+1)+h(i+1)*j;
end
disp(x)


%Finding DFT of x[n] i.e X[K]
X =mydftusingfft(x,N)

%Finding Conjugate of X(K) i.e X*(K)
Z=conj(X)

%X*[(N-K)N]
%n=0:N-1
%Z(mod(-n,N)+1)
for k=0:N-1
    n=N-k;
    if(n==N)
        y(k+1)=Z(k+1);
    else
        y(k+1)=Z(n+1);
    end
end
disp(y)

G=zeros(1,N);
H=zeros(1,N);

for k=1:N
    G(k)=(1/2)*(X(k)+y(k));
    H(k)=(X(k)-y(k))/(2*j);
end

disp('N Point DFT of two sequences using N point DFT')
disp(G)
disp(H)
```

```
function y=mydftusingfft(x,N)

%to alter the input sequence is X[0] x[1] x[3]

x=bitrevorder(x);


% To find n from 2^n i.e No of stages
%p=nextpow2(N);
M=log2(N);
h=1;


for stage = 1:M
    for index = 0:(2^stage):N-1
        for n=0:(h-1)
            pos =n+index+1;
            pow= (2^(M-stage)*n);
            w=exp((-i)*(2*pi)*pow/N);
            a=x(pos)+x(pos+h).*w;
            b=x(pos)-x(pos+h).*w;
            x(pos)=a;
            x(pos+h)=b;
        end
    end
    h=2*h;
end
y=x;
end
```

Result:

Enter the first sequence g[n] [1 2 0 1]
Enter the second sequence h[n] [2 2 1 1]

N =

    4

   1.0000 + 2.0000i   2.0000 + 2.0000i   0.0000 + 1.0000i   1.0000 + 1.0000i

X =

4.0000 + 6.0000i   2.0000 + 0.0000i -2.0000 + 0.0000i   0.0000 + 2.0000i

Z =

4.0000 - 6.0000i   2.0000 - 0.0000i -2.0000 + 0.0000i   0.0000 - 2.0000i

4.0000 - 6.0000i   0.0000 - 2.0000i -2.0000 + 0.0000i   2.0000 - 0.0000i

N Point DFT of two sequences using N point DFT

4.0000 + 0.0000i   1.0000 - 1.0000i -2.0000 + 0.0000i   1.0000 + 1.0000i

6.0000 + 0.0000i   1.0000 - 1.0000i   0.0000 + 0.0000i   1.0000 + 1.0000i

Experiment 5

Sectioned Convolution: Overlap Save and Overlap Add Method for long Duration Sequences

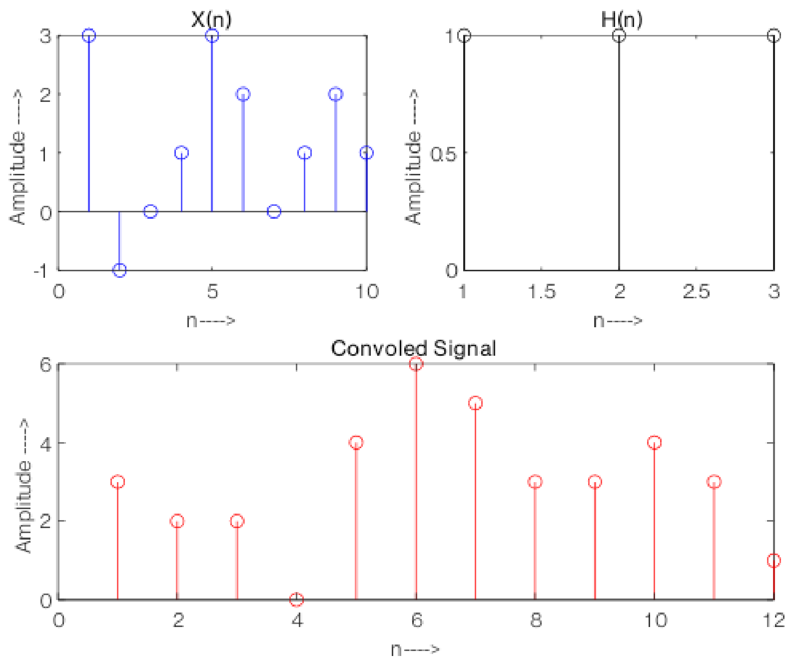
Overlap save

```
clc;
clear all;
close all;
x=input('Enter 1st Sequence X(n)= ');
h=input('Enter 2nd Sequence H(n)= ');
N=input('Enter length of each block N = ');

% Code to plot X(n)
subplot(2,2,1);
stem(x,'blue');
xlabel ('n---->');
ylabel ('Amplitude ---->');
title('X(n)');

%Code to plot H(n)
subplot(2,2,2);
stem(h,'black');
xlabel ('n---->');
ylabel ('Amplitude ---->');
title(' H(n)');

% Code to perform Convolution using Overlap Save Method
lx=length(x);
lh=length(h);
m=lh-1;
x=[zeros(1,m) x zeros(1,N)];
h=[h zeros(1,N-lh)];
L=N-lh+1;
k=floor(lx/L);
for i=0:k
y=x(1,i*L+1:i*L+N);
q=cconv(y,h,N)
%q=C_Conv(y,h);  %Call the C_Conv function.
p(i+1,:)=q;
end
p1=p(:,lh:N)';
p=p1(:)'

% Representation of the Convoled Signal
```

```
subplot(2,2,3:4);
stem(p,'red');
xlabel ('n---->');
ylabel ('Amplitude ---->');
title('Convoled Signal');
```

Output
Enter 1st Sequence X(n)= [3,-1,0,1,3,2,0,1,2,1]
Enter 2nd Sequence H(n)= [1, 1,1]
Enter length of each block L = 8
p =

3 2 2 0 4 6 5 3 3 4 3 1



Overlap add

```
close all;
clear all;
x=input('Enter First Sequence x[n]= ');
h=input('Enter Second Sequence h[n]= ');
N=input('Enter length of each block N = ');
Lx=length(x);
M=length(h);
L=N-M+1;
K=ceil(Lx/L)
R=rem(Lx,L);
%Padding zeros to input sequences to make length equal to N
if R>0
 x=[x zeros(1,L-R)]
end
h=[h zeros(1,N-M)]
%Initialising the Output
y=zeros(N,K);
%Padding zeros to Input sequence at the end of the sequence
z=zeros(1,M-1);
%To perform Circular Convolution of two input sequences
for i=0:K-1
 Xn=x(L*i+1:L*i+L);
 Xi=[Xn z];
 u(i+1,:)=cconv(Xi,h,N) %u(i+1,:)=C_Conv(Xi(i,:),h);
end
Y=u';
M1=M-1;
p=L+M1;
for i=1:K-1
 u(i+1,1:M-1)=u(i,p-M1+1:p)+u(i+1,1:M-1);
end
z1=u(:,1:L)'
y1=(z1(:))'
y=[y1 u(K,(M:N))]
%Ploting the Input Sequences
subplot (2,2,1);
stem(x);
title('First Sequence x[n]');
xlabel ('Samples');
ylabel ('Amplitude');
subplot (2,2,2);
stem(h);
title('Second Sequence h[n]');
xlabel ('Samples');
```

```
ylabel ('Amplitude');
%Plotting of the Convoled Signal
subplot (2,2,3:4);
stem(y);
title ('Convolved Signal');
xlabel ('Samples');
ylabel ('Amplitude');
```

Result
Enter First Sequence x[n]= [1 2 -1 2 3 -2 -3 -1 1 1 2 -1]
Enter Second Sequence h[n]= [1 2]
Enter length of each block N = 4

```
K =

     4


h =

     1     2     0     0


u =

     1     4     3    -2


u =

     1     4     3    -2
     2     7     4    -4


u =

     1     4     3    -2
     2     7     4    -4
    -3    -7    -1     2
```

u =

1	**4**	**3**	**-2**
2	**7**	**4**	**-4**
-3	**-7**	**-1**	**2**
1	**4**	**3**	**-2**

z1 =

1	**0**	**-7**	**3**
4	**7**	**-7**	**4**
3	**4**	**-1**	**3**

y1 =

1 4 3 0 7 4 -7 -7 -1 3 4 3

y =

1 4 3 0 7 4 -7 -7 -1 3 4 3 4 3 -2