Class works:

Task 1: To perform discrete time exponential harmonics using MATLAB.

Code:

```
clc;
clear all;
close all;

N=3;
w=2*pi/N;

fs=500; %real time sample rate(Hz)
t=-3:1/fs:3; %time index(s)
n=-3:1:3; %sample index

for cnt=1:4,
    subplot(4,2,cnt*2-1);
    h=plot(t,real(exp(j*cnt*w*t)),'r');
    set(h,'Linewidth',0.1);
    hold on;
    h=stem(n,real(exp(j*cnt*w*n)),'.');
    hold off;
    box off;
    grid on;

    xlim([min(t) max(t)]);
    ylim([-1.1 1.1]);
    ylabel(sprintf('\\phi_%d',cnt));

     subplot(4,2,cnt*2);
    h=plot(t,imag(exp(j*cnt*w*t)),'r');
    set(h,'Linewidth',0.1);
    hold on;
    h=stem(n,imag(exp(j*cnt*w*n)),'.');
    hold off;
    box off;
    grid on;

    xlim([min(t) max(t)]);
    ylim([-1.1 1.1]);
    ylabel(sprintf('\\phi_%d',cnt));

end
```

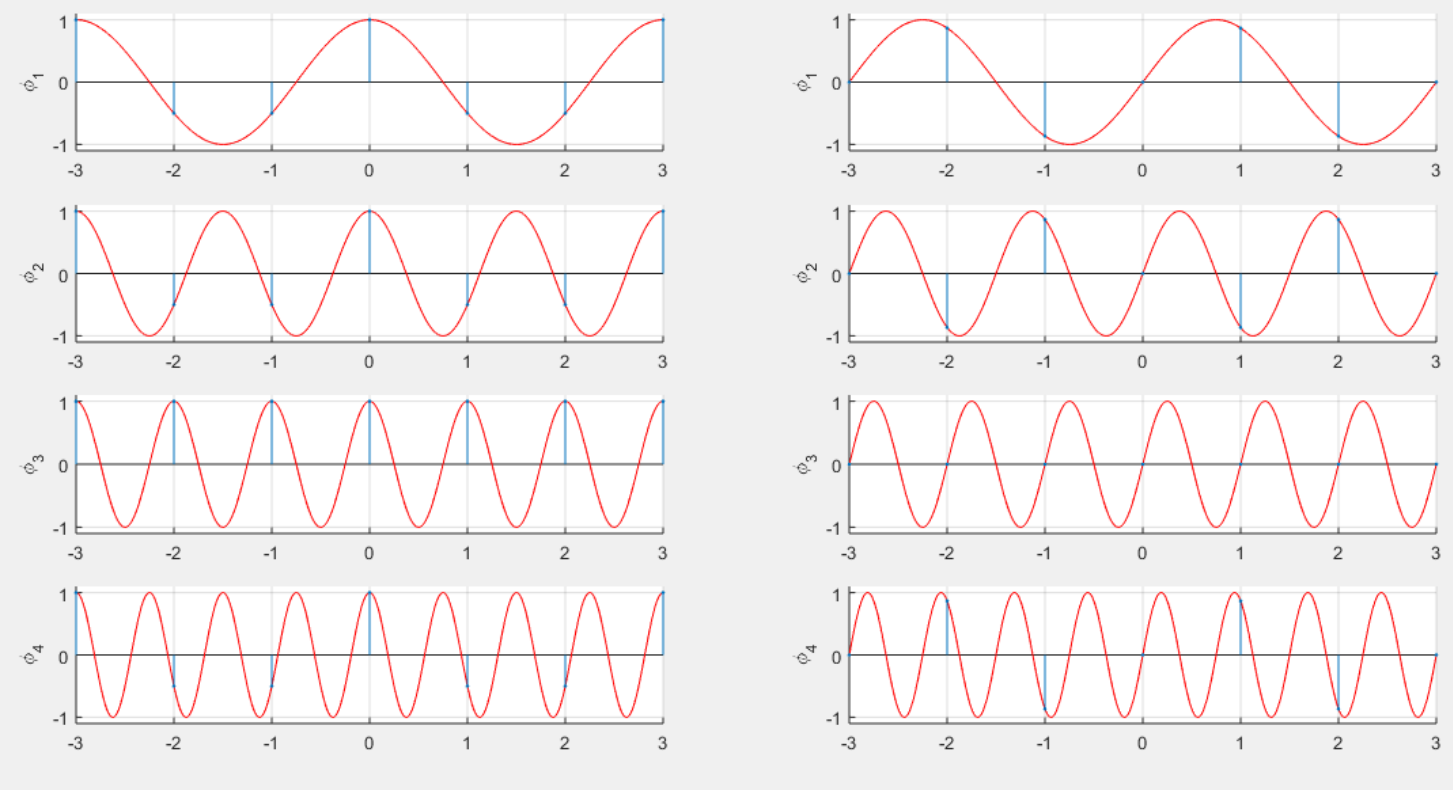

Figure 3.1 : Discrete time exponential harmonics

Task 2: To perform cross correlation for the given sequences .

Code :

```
clc;
clear all;
close all;
x=input('Enter the sequence 1:');
h=input('Enter the sequence 2:');
y=xcorr(x,h); 3
figure;
subplot(2,2,1)
stem(x);
xlabel('n-->');
ylabel('Amp-->');
title('input sequence 1');
subplot(2,2,2)
stem(h);
xlabel('n-->');
ylabel('Amp-->');
title('input sequence 2');
subplot(2,2,3)
```

```
stem(y)
xlabel('n-->');
ylabel('Amp-->');
title('output sequence ');
subplot(2,2,4)
stem(fliplr(y));
xlabel('n-->');
ylabel('Amp-->');
title('flipped output sequence');
disp('the resultant is ');
fliplr(y);
```

Output:

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

ans = 3

the resultant is
```

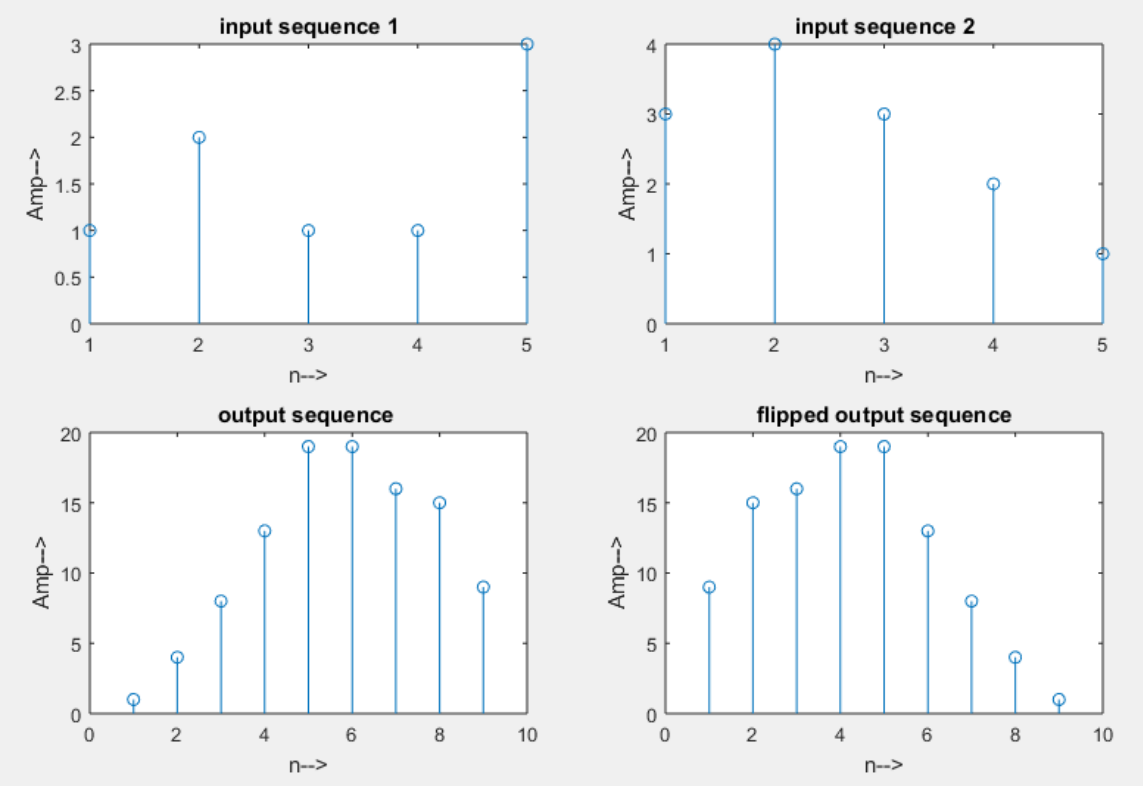

Figure 3.2 : Cross correlation for the given sequences

Home work:

Problem: $x_1(n)= \sin(pi*n/2)$, $x_2(n)= \cos(pi*n/3)$,
Find cross correlation between $x_1(n)$ & $x_2(n)$.

Code :

```
clc;
clear all;
close all;
fs=50;
n=-3:1/fs:3;

x1=sin(n*pi/2);
x2=cos(n*pi/3);
y=xcorr(x1,x2);
figure;

subplot(2,2,1)
stem(x1);
xlabel('n-->');
ylabel('Amp-->');
title('input sequence 1');

subplot(2,2,2)
stem(x2);
xlabel('n-->');
ylabel('Amp-->');
title('input sequence 2');

subplot(2,2,3)
stem(y);
xlabel('n-->');
ylabel('Amp-->');
title('output sequence ');

subplot(2,2,4)
stem(fliplr(y));
xlabel('n-->');
ylabel('Amp-->');
title('flipped output sequence');
disp('the resultant is ');
fliplr(y);
```

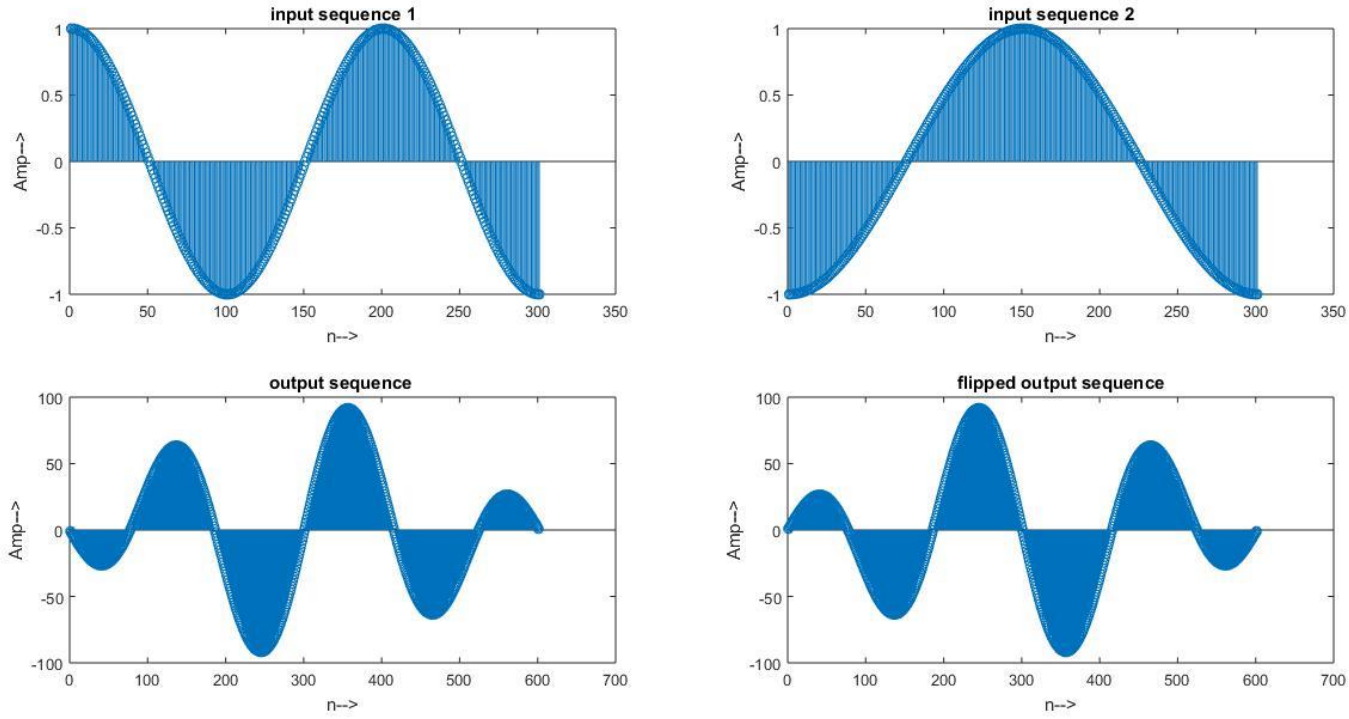

Figure 3.6 : Cross correlation for the given sequences

Problem:

Find DFT,IDFT,FFT,IFFT of $x_2(n)= \cos(pi*n/3)$.

Code:

```
clc;
clear all;
close all;
fs=50;
n=1:1/fs:10;
xn=cos(n*pi/3);
N=length(xn);
Xk=zeros(1,N);
iXk=zeros(1,N);
for k=0:N-1
    for n=0:N-1
        Xk(k+1)=Xk(k+1)+(xn(n+1)*exp((-i)*2*pi*k*n/N));
    end
end
t=0:N-1;
subplot('421');
stem(t,xn);
ylabel('Amplitude');
xlabel('Time Index');
```

```
title('Input sequence');

disp('The discrete fourier transform of x(n)');
disp(Xk);
t=0:N-1;
subplot('422');
stem(t,Xk);
ylabel('Amplitude');
xlabel('Time Index');
title('X(k)');

magnitude=abs(Xk);

disp('the magnitude response of X(k)');
disp(magnitude);

t=0:N-1;
subplot('423');
stem(t,magnitude);
ylabel('Amplitude');
xlabel('k');
title('magnitude response');

%to find the phase of individual DFT points
phase=angle(Xk);

%code block to plot the phase response
disp('the phase response of X(k)');
disp(phase);
t=0:N-1;
subplot('424');
stem(t,phase);
ylabel('phase');
xlabel('K');
title('phase response');
%IDFT
%%code block to find IDFT of the sequence
for n=0:N-1
    for k=0:N-1
        iXk(n+1)=iXk(n+1)+(Xk(k+1)*exp((i)*2*pi*k*n/N));
    end
end
iXk=iXk./N;

t=0:N-1;
subplot('425');
stem(t,xn);
ylabel('amplitude');
xlabel('Time index');
title('IDFT sequence');
```

```
%code block to plot the FFT of i/p sequence using inbuilt function
x2=fft(xn);
subplot('426');
stem(t,x2);
ylabel('amplitude');
xlabel('Time index');
title('FFT of input sequence');
x3=ifft(x2);
subplot('427');
stem(t,x3);
ylabel('amplitude');
xlabel('Time index');
title('IFFT sequence');
```

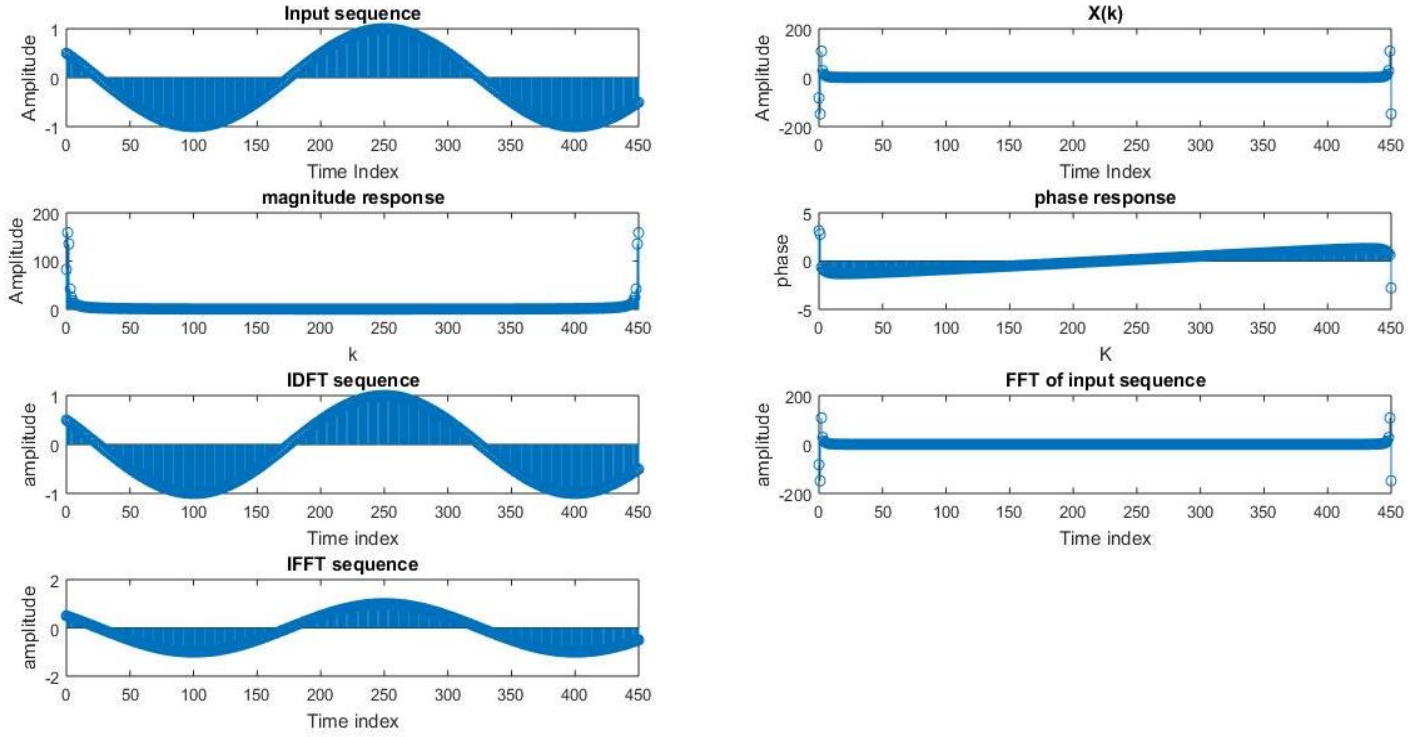

Figure 3.7: Performing DFT,IDFT,FFT,IFFT

Problem :

x(n)= exp(j*n*k/3) + exp(j*2*n*k/5), show 5 harmonics of 20th component.

Code :

```
clc;
clear all;
close all;
N=3;
w=2*pi*20/N;
```

```
fs=200; %real time sample rate(Hz)
n=-3:1/fs:3; %sample index
for cnt=1:5
    y=exp(j*w*n*cnt/3)+exp(j*w*2*n*cnt/5);
    subplot(5,2,(cnt)*2-1);
    h=stem(n,real(y),'.');
    hold off;
    box off;
    grid on;
    xlim([min(n) max(n)]);
    ylim([-2.5 2.5]);
    ylabel(sprintf('\\phi_%d',cnt));
     subplot(5,2,(cnt)*2);
    h=stem(n,imag(y),'.');
    hold off;
    box off;
    grid on;
    xlim([min(n) max(n)]);
    ylim([-2.5 2.5]);
    ylabel(sprintf('\\phi_%d',cnt));
end
```

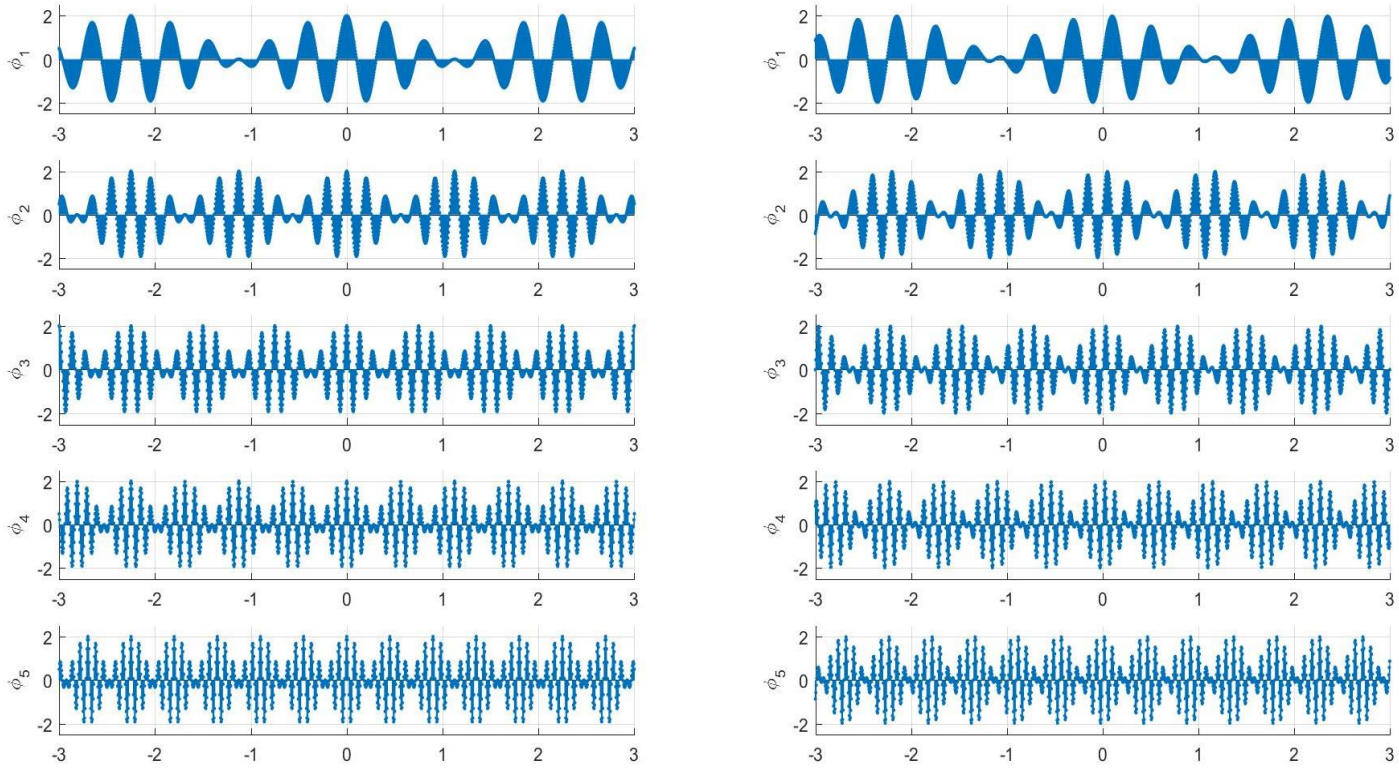

Figure 3.8: 5 harmonics of the 20th component of given signal.

Task : To perform discrete fourier transform

Code :

```
clc;
clear all;
close all;

disp('The sequence from the user');
xn=input('Enter the input sequence : ');
N=length(xn);

Xk=zeros(1,N);
iXk=zeros(1,N);

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

t=0:N-1;
subplot('421');
stem(t,xn);
ylabel('Amplitude');
xlabel('Time Index');
title('Input sequence');

disp('The discrete fourier transform of x(n)');
disp(Xk);
t=0:N-1;
subplot('422');
stem(t,Xk);
ylabel('Amplitude');
xlabel('Time Index');
title('X(k)');
magnitude=abs(Xk);

disp('the magnitude response of X(k)');
disp(magnitude);

t=0:N-1;
subplot('423');
stem(t,magnitude);
ylabel('Amplitude');xlabel('k');
title('magnitude response');
```

```
%to find the phase of individual DFT points
phase=angle(Xk);

%code block to plot the phase response
disp('the phase response of X(k)');
disp(phase);

t=0:N-1;
subplot('424');
stem(t,phase);
ylabel('phase');
xlabel('K');
title('phase response');

%IDFT
%%code block to find IDFT of the sequence
for n=0:N-1
    for k=0:N-1
        iXk(n+1)=iXk(n+1)+(Xk(k+1)*exp((i)*2*pi*k*n/N));
    end
end
iXk=iXk./N;

t=0:N-1;
subplot('425');
stem(t,xn);
ylabel('amplitude');
xlabel('Time index');
title('IDFT sequence');

%code block to plot the FFT of i/p sequence using inbuilt
function
x2=fft(xn);
subplot('426');
stem(t,x2);
ylabel('amplitude');
xlabel('Time index');
title('FFT of input sequence');
x3=ifft(x2);
subplot('427');
stem(t,x3);
ylabel('amplitude');
xlabel('Time index');
title('IFFT sequence');
```

Output:

```
 The sequence from the user
Enter the input sequence : [2 3 5 7 8]
```

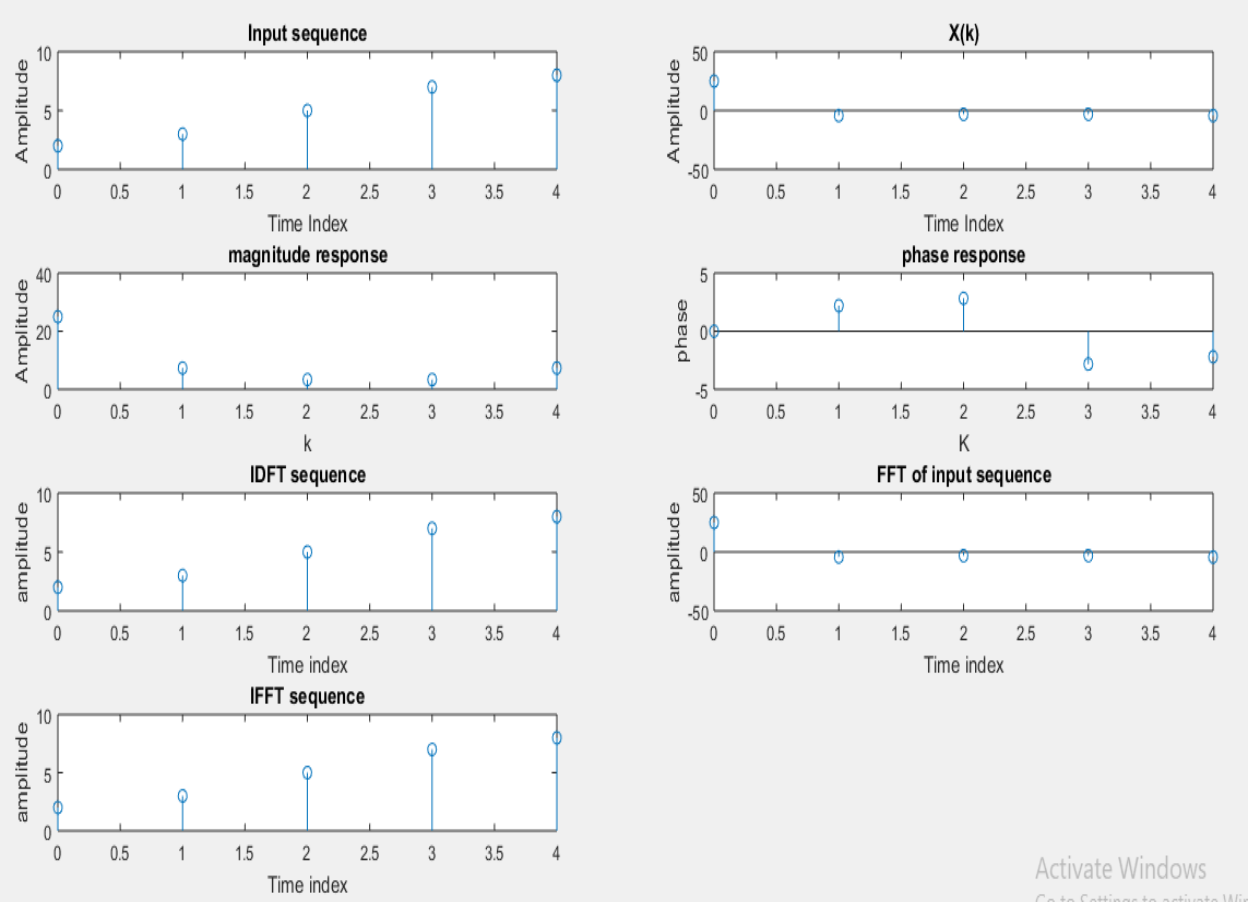

Figure 3.5: Performing DFT,IDFT,FFT,IFFT

Task 3 :Correlation / Cross correlation for the given sequences.

Code :

```
clc;
close all;
clear all;
x=rand(100,1);
y=x+rand(100,1);
subplot(2,2,1);
plot(x,y,'o','MarkerSize',10) %2-D scatter plot
r=corrcoef(x,y);
z=randn(100,1);
subplot(2,2,2);
plot3(x,y,z,'.');
```

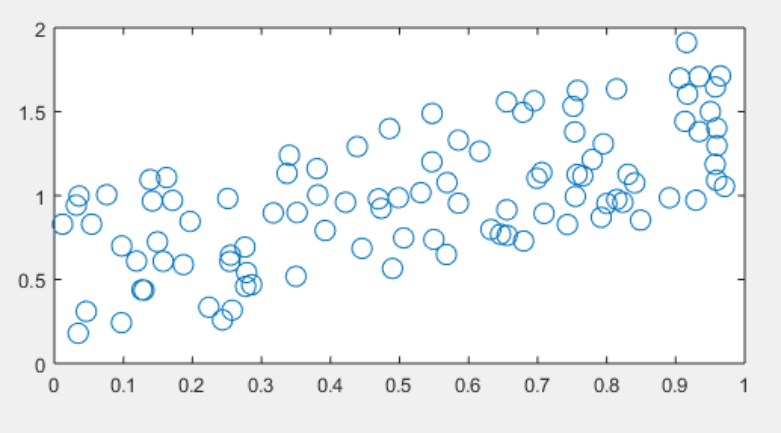

Figure 3.3 : Cross correlation for the given sequences (2D scatter plot)

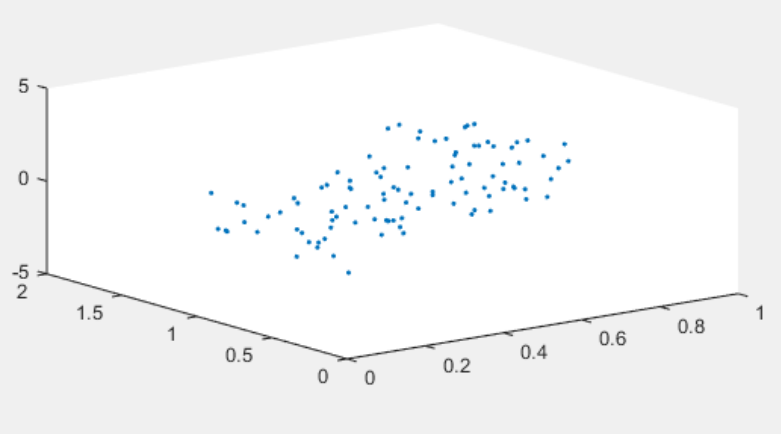

Figure 3.4 : Cross correlation for the given sequences (3D plot)