Experiment No: 6 Date: 23/09/2024

DFT AND IDFT

Aim

1. To find the DFT
2. To find the IDFT.

Theory

The Discrete Fourier Transform (DFT) is a mathematical technique used to analyze the frequency content of discrete signals. It transforms a sequence of complex or real numbers, typically sampled data, from the time domain into the frequency domain. This transformation reveals how much of each frequency is present in the signal, providing insights into its spectral characteristics. The DFT works by decomposing a signal into a sum of sinusoidal components, each represented by a complex number. This enables the identification of dominant frequencies and their amplitudes, making it a powerful tool in signal processing, telecommunications, and audio analysis. While the DFT provides valuable information, it can be computationally intensive for large datasets. The Fast Fourier Transform (FFT) is an efficient algorithm that speeds up this process significantly, allowing for real-time analysis and processing. Overall, the DFT is fundamental in applications such as filtering, compression, and feature extraction in various fields, including engineering and science.

The Inverse Discrete Fourier Transform (IDFT) is a mathematical process that transforms frequency domain data back into the time domain. After a signal has been analyzed using the Discrete Fourier Transform (DFT), the IDFT allows us to reconstruct the original discrete signal from its frequency components. In essence, the IDFT takes the complex numbers obtained from the DFT, which represent the amplitudes and phases of sinusoidal waves, and combines them to recreate the original signal. This is crucial for applications where frequency analysis is needed but the final output must be in the time domain, such as in audio processing or digital communications. Like the DFT, the IDFT can also be computationally demanding for large datasets, but it can be efficiently implemented using the Fast Fourier Transform (FFT) algorithms in reverse. The IDFT is fundamental in many applications, including signal reconstruction, filtering, and system analysis, enabling engineers and scientists to work seamlessly between time and frequency domains.

OBSERVATION

1. **INPUT=**

   x = [1 1 1 1]

OUTPUT=

4.0000 + 0.0000i -0.0000 - 0.0000i 0.0000 - 0.0000i 0.0000 - 0.0000i

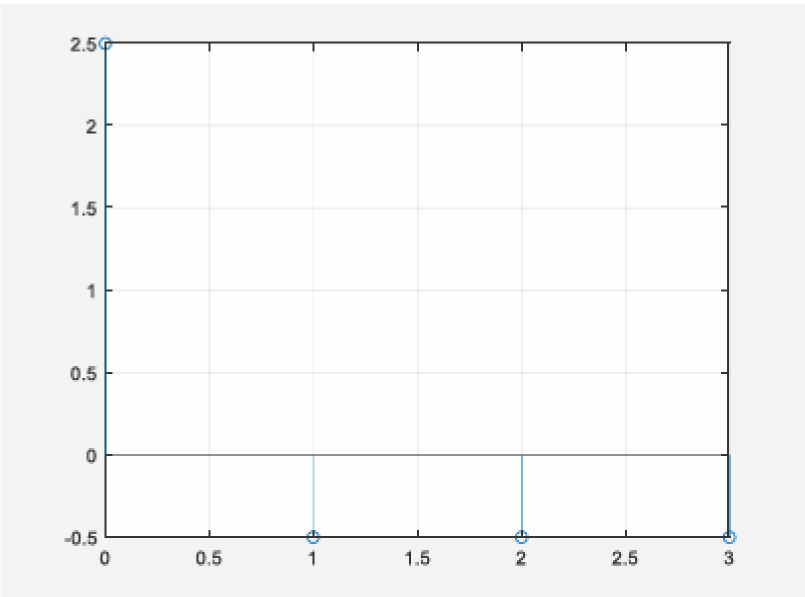
4.0000 - 0.0000i 4.0000 + 0.0000i 4.0000 + 0.0000i 4.0000 - 0.0000i

>>

2. **INPUT=**

   X = [1 2 3 4]

OUTPUT=



Program

1. To find DFT

```
clc;
clf;
close all;
clear all;
x=input ('enter x values=');
L=length(x);
X=zeros(1,L);
for i=1:L
    for k=1:L
        X(i)=X(i)+x(k)*exp((-j*2*pi*(k-1)*(i-1))/L);
    end
end
disp(X);
X1=fft(X);
disp(X1);
```

2. To find IDFT

```
clc;
clf;
close all;
clear all;
X=input ('enter x values=');
L=length(X);
x=zeros(1,L);
for i=1:L
    for k=1:L
        x(i)=x(i)+1/L*((X(k)*exp(j*2*pi*(k-1)*(i-1))/L));
    end
end
disp(X);
x1=ifft(X);
disp(x1);
stem(0:L-1,x1);
grid on;
```

Result

Performed DFT and IDFT and generated the plot.