Experiment No. 4

Aim: To apply Discrete Fourier Transform on DT signal

Objective:

1. Write a code to perform DFT of N point signal

2. Calculate DFT of a DT signal

3.Calculate FFT of same signal

Input Specifications:

1. Length of Signal N

2. Signal values

Theory:

Discrete Fourier Transform

Discrete Fourier transform (**DFT**) converts a finite list of equally spaced samples of a function into the list of coefficients of a finite combination of complex sinusoids, ordered by their frequencies, that has those same sample values. It can be said to convert the sampled function from its original domain (often time or position along a line) to the frequency domain.

The input samples are complex numbers (in practice, usually real numbers), and the output coefficients are complex as well. The frequencies of the output sinusoids are integer multiples of a fundamental frequency, whose corresponding period is the length of the sampling interval. The combination of sinusoids obtained through the DFT is therefore periodic with that same period. The DFT differs from the discrete-time Fourier transform (DTFT) in that its input and output sequences are both finite; it is therefore said to be the Fourier analysis of finite-domain (or periodic) discrete-time functions.

The sequence of **N** complex numbers $x_0, x_1, \ldots, x_{N-1}$ is transformed into an **N**-periodic sequence of complex numbers as follows

$$X_k \stackrel{\text{def}}{=} \sum_{n=0}^{N-1} x_n \cdot e^{-i 2\pi k n / N}, \quad k \in \mathbb{Z}$$

Problem Definition:

1. Take any four-point & eight-point sequence x[n].

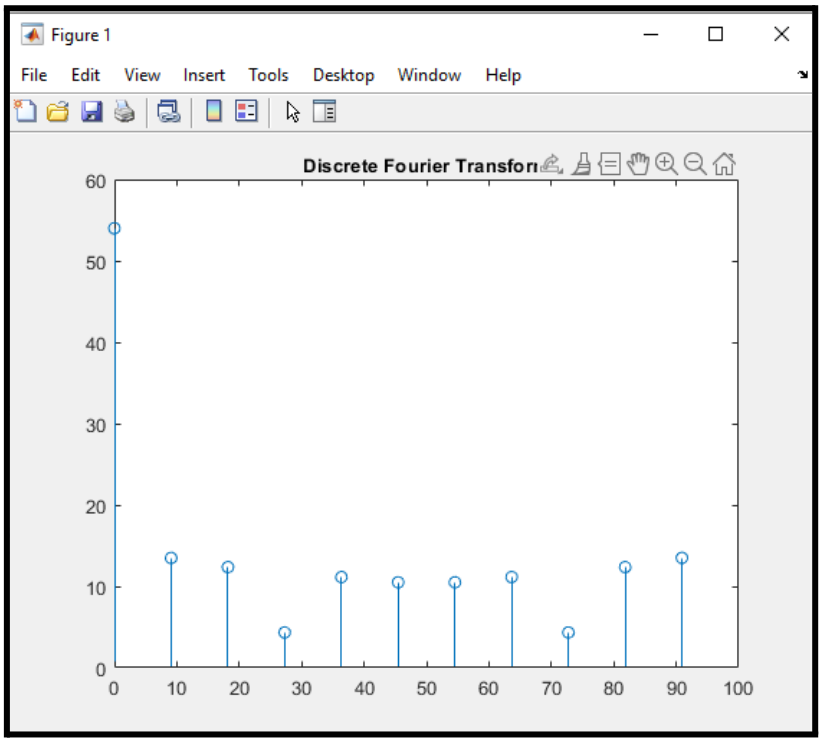
- Find DFT X[k].

Code

```
clc;
signal_input=input("Enter Signal: ");
y=fft(signal_input);
x = (0:length(y)-1)*100/length(y);
m = abs(y);
y(m<1e-6) = 0;
subplot(1,1,1),stem(x, m);
title("Discrete Fourier Transform", 'FontSize', 10);
```

Output

```
Enter Signal: [1 3 4 6 2 6 4 9 12 2 5]
```

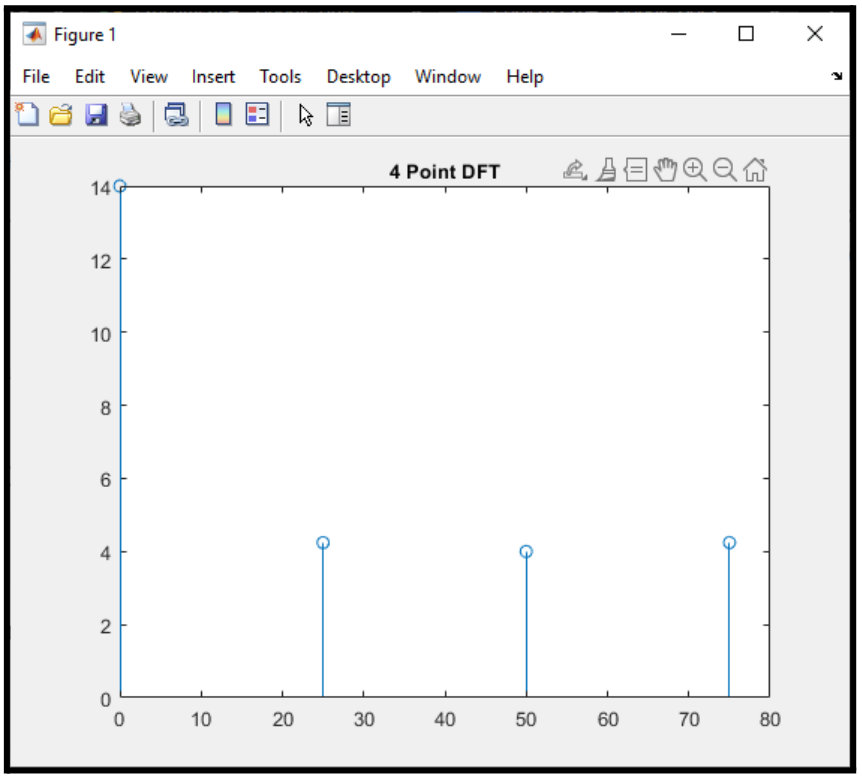


Code (4 Point DFT)

```
clc;
signal_input=input("Enter Signal: ");
y=fft(signal_input, 4);
x = (0:length(y)-1)*100/length(y);
m = abs(y);
y(m<1e-6) = 0;
subplot(1,1,1),stem(x, m);
title("4 Point DFT", 'FontSize', 10);
```

Output

```
Enter Signal: [1 3 4 6 2 6 4 9 12 2 5]
```

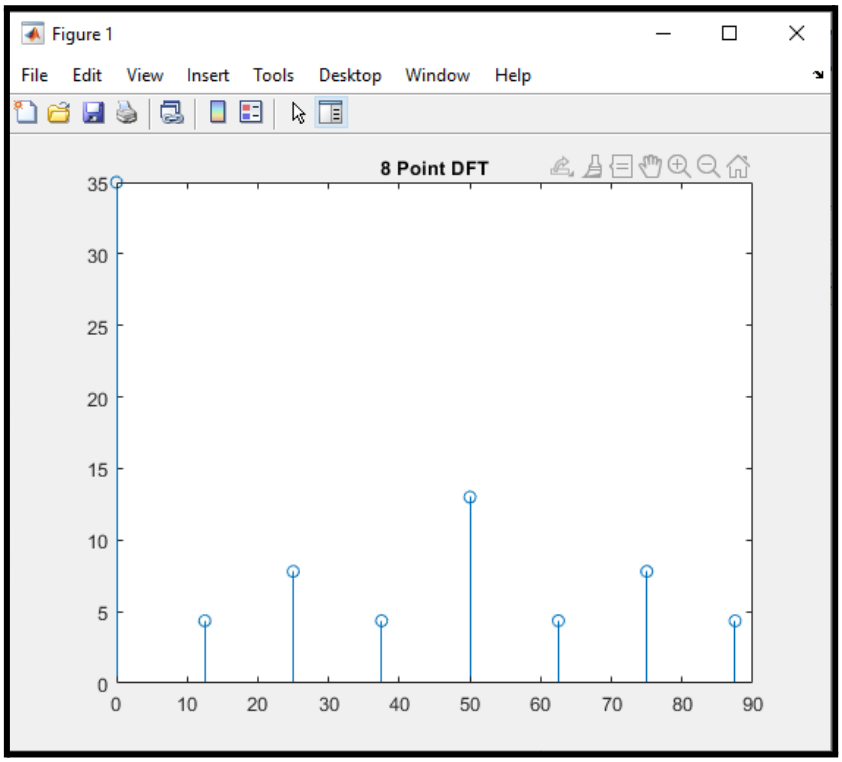


Code (8 Point DFT)

```
clc;
signal_input=input("Enter Signal: ");
y=fft(signal_input, 8);
x = (0:length(y)-1)*100/length(y);
m = abs(y);
y(m<1e-6) = 0;
subplot(1,1,1),stem(x, m);
title("8 Point DFT", 'FontSize', 10);
```

Output:

```
Enter Signal: [1 3 4 6 2 6 4 9 12 2 5]
```



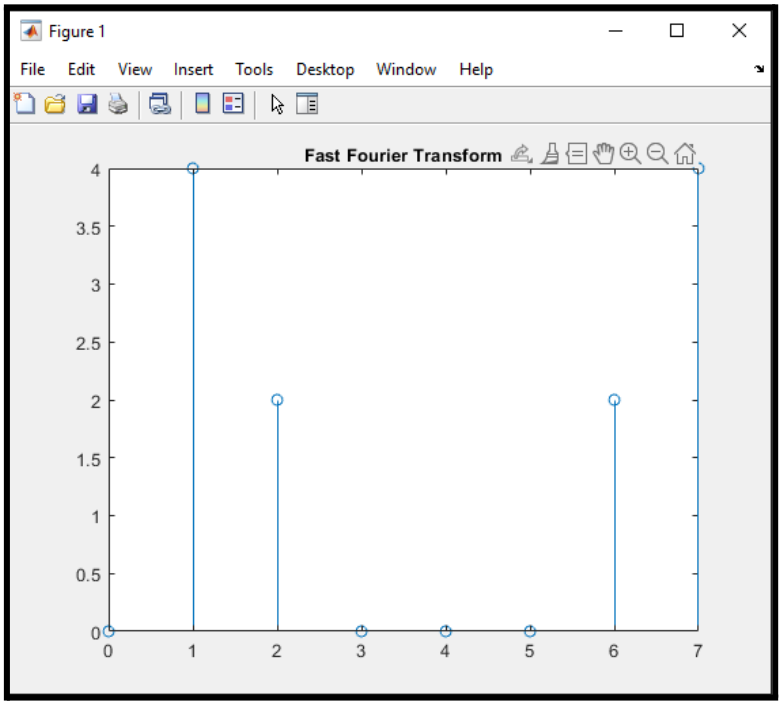
Code (FFT)

```
clc;
input_signal = input('Input N : ');
signal = zeros(1, input_signal);
for k = 0:input_signal-1
signal(1,k+1) = sin((pi/4)*k) + 0.5*sin((pi/2)*k);
end
FFT = fft(signal);
FFT_Value = abs(FFT);
disp(FFT_Value);
range = 0:input_signal-1;
subplot(1,1,1),stem(range, FFT_Value);
title("Fast Fourier Transform", 'FontSize', 10);
```

Output:

```
Input N : 8
    0.0000    4.0000    2.0000    0.0000    0.0000    0.0000
```

```
2.0000    4.0000
```



Conclusion

In this experiment, we learnt about Discrete Fourier Transform and Fast Fourier Transform. We then implemented these using MATLAB.

SAP ID: 60004190057

Name: Junaid Altaf Girkar