3. SPECTRAL ANALYSIS USING DFT

AIM:

To perform spectral analysis on a signal using Discrete Fourier Transform and plot the power distribution of the signal versus frequency graph

APPARATUS:

PC with MATLAB

THEORY:

The discrete Fourier transform (DFT) maps a finite number of discrete time-domain samples to the same number of discrete Fourier-domain samples. Being practical to compute, it is the primary transform applied to real-world sampled data in digital signal processing. The DFT has special relationships with the discrete-time Fourier transform and the continuous-time Fourier transform that let it be used as a practical approximation of them through truncation and windowing of an infinite-length signal. Different window functions make various tradeoffs in the spectral distortions and artifacts introduced by DFT-based spectrum analysis.

The DFT transforms *N* samples of a discrete-time signal to the same number of discrete frequency samples, and is defined as

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-\frac{i2\pi nk}{N}}$$

The DFT is invertible by the inverse discrete Fourier transform (IDFT):

$$x(n) = \frac{1}{N} \sum_{k=0}^{N-1} X(k) e^{i\frac{2\pi nk}{N}}$$

The DFT and IDFT are a self-contained, one-to-one transform pair for a length-*N*discrete-time signal. The DFT is notmerely **a**n approximation to the DTFT. However, the DFT is very often used as a practical approximation to the DTFT.

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:

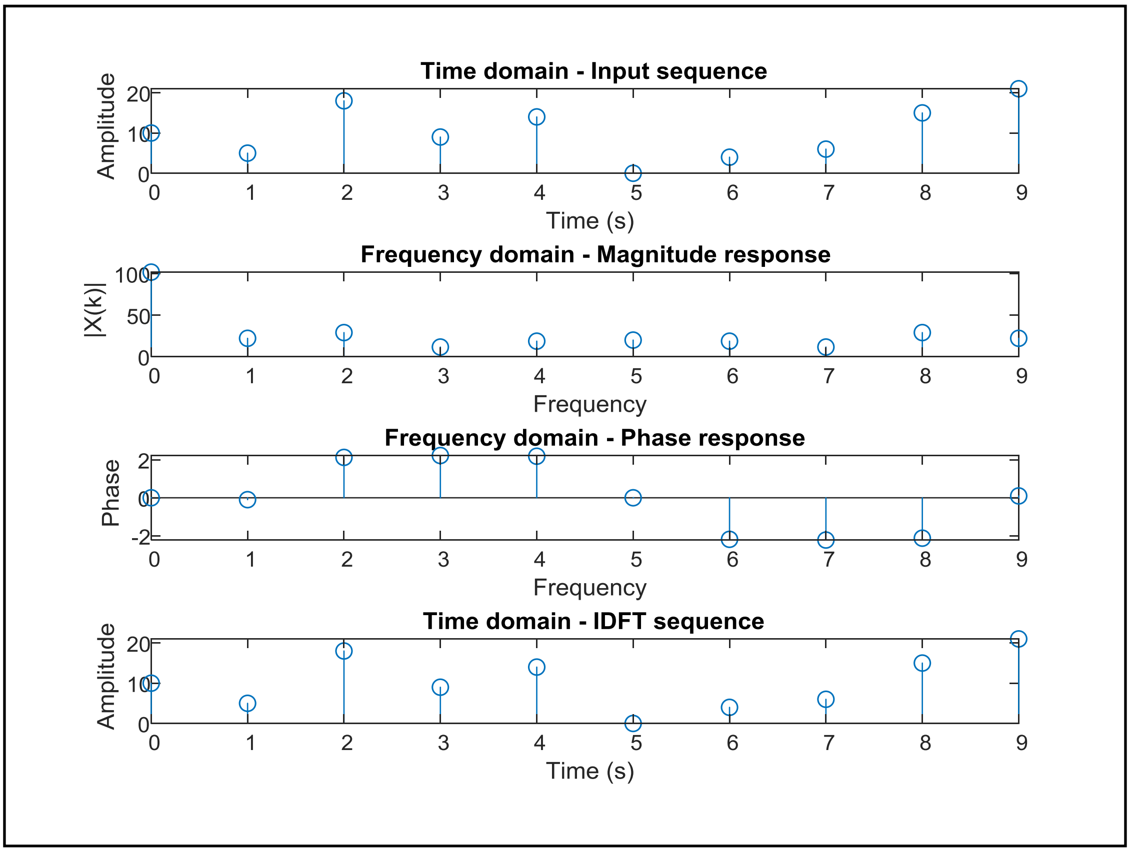
```
% To compute DFT of sequence and its Spectrum Analysis.
clc; clear all; close all;
x=input('enter input sequence') % x = [2 3 -1 4];
N = length(x);
X = zeros(N,1)
```

```
% code for DFT
for k = 0:N-1
    for n = 0:N-1
        X(k+1) = X(k+1) + x(n+1)*exp(-j*pi*2*n*k/N)
    end
end
% code for IDFT
xk = zeros(N,1)
for k = 0:N-1
    for n = 0:N-1
        xk(k+1) = xk(k+1) + X(n+1)*exp(j*pi*2*n*k/N)
    end
end
xk = xk./N;

t = 0:N-1
subplot(411)
stem(t,x);
xlabel('Time (s)');
ylabel('Amplitude');
title('Time domain - Input sequence')

subplot(412)
stem(t,abs(X))
xlabel('Frequency');
ylabel('|X(k)|');
title('Frequency domain - Magnitude response')

subplot(413)
stem(t,angle(X))
xlabel('Frequency');
ylabel('Phase');
title('Frequency domain - Phase response')

subplot(414)
stem(t,xk)
xlabel('Time (s)');
ylabel('Amplitude');
title('Time domain - IDFT sequence')
```

INPUT:

Enter x: [10 5 18 9 14 0 4 6 15 21]

OUTPUT:



RESULT:

DFT Spectral analysis on a continuous time signal was performed and the Power density spectral graph with respect to frequency was plotted