## EXPERIMENT NO: 2 FREQUENCY ANALYISIS OF DISCRETE TIME SIGNALS USING DET.

AIM: - To plot magnitude and phase spectrum and perform frequency analysis of Discrete Time signals.

SOFTWARE: Spyder 3: Python 3.8.

THEORY:— The frequency spectrum of an signal is the distribution of the amplitudes and phases of each frequency component against frequency.

A signal can be converted between the time and frequency domains with a pair of mathematical operators alled as transform. An example is the Fourier transform, which decomposes a function into the sum of a (potentially ifinite) number of sine wave frequency components. The 'spectrum' of frequency components is the frequency domain representation of the signal. The inverse Fourier transform sonverts the frequency domain function back to time

Important frequency characteristic of a signal x(t) with Fourier transform X(w) are displayed by plots of the magnitude spectrum, (X(w)) versus 'w, and phase spectrum <X(w) yersus w.

Definition'- The discrete-time Fourier transform (DTFT).

X (eiw) of sequence x[n] is given by.

$$X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x(n)e^{-j\omega n}$$

In general, X (0,00) is a complex function of was follows

$$X(e^{j\omega}) = X_{ie}(e^{j\omega}) + \int X_{in}(e^{j\omega})$$

Xie (ciw) and Xim (eiw) are respectively the real and imaginary parts of x (eiw), and are real function of co

X (ejw) can alternatively be expressed as.

$$X(e^{i\omega}) = |X(e^{i\omega})|e^{i\theta(\omega)}$$

where,

$$\theta(\omega) = \arg \left\{ X(e^{j\omega}) \right\}.$$

Here.

· Ix (esa) I is colled the magnitude function.

· O(w) is called the phase function.

· In many applications, the DIFT is called the Fourier spectro · Likewise, (x(eiw)) and O(w) are called the magnitude and phase spectra.

For a real sequence &(n), [xlesw) | and Xre (esw) are even functions of w, wheareas O(w) and xim (eiw) are odd function of w.

Note:  $X(e^{j\omega}) = |X(e^{j\omega})| e^{j(\theta(\omega) + 2\pi i k)} = |X(e^{j\omega})| e^{j(\theta(\omega) + 2\pi i k)}$ 

The phase function o (w) cannot be uniquely specified for any DIFI.

DFT is not suitable for DSP applications because. In DSP, we are able to compute the spectrum only at specific discrete values of w.

Any signal in any DSP application can be measured only in ofinite number of points.

Therefore, DFT is suitable tool for frequency analysis, using finite number of samples of frequency spectrum



obtained from DTFT.

$$X(k) = \chi(k\Delta\omega), \ \Delta\omega = 2\pi \longrightarrow N$$

$$X(k) = \sum_{n=0}^{N-1} 2c(n) e^{-j2\pi kn/N}$$
 DET

Representing the signal into its "N" number of frequency components is N points DFT or analysis and reconstruction of input sequence from the knowledge of frequency component is called IDFT or synthesis.

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-\frac{i^2 \prod kn}{N}}$$
 analysis.

$$x(n) = \frac{1}{N} \sum_{k=0}^{N-1} x(k) e^{j2\pi i \frac{kn}{N}}$$
 Synthesis.

STEPS OF PROGRAMI:

step 1: Declare an input sequence and calculate its length using len () function.

step 2: Declare a variable for user to input a no. of DFT points Required

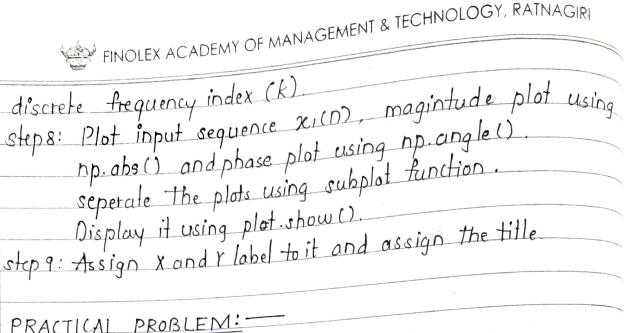
step 3: Calculate number of trailing zeros and them to the sequence using zero padding.

step 4: Compute N-point DFT using fft () function.

step 5: Compute N point IDFT using ifft() function and round up the values to 1 decimal point using np. round ofunction.

step 6: import matplotlib library

otip 7: To plot magnitude and phase response, declare two variables for discrete time range (n) and



## PRACTICAL PROBLEM:

$$\chi(n) = \begin{bmatrix} 4,2,1;3 \end{bmatrix}$$

$$\chi(k) = W_N \cdot \chi_N$$

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$$X(k) = [10, 3+j, 0, 3-j]$$

$$2EN = \frac{1}{N}W_N^* \cdot X(k)$$

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$$9c(b) = [4,2,3,3]$$

CONCLUSION:
(1) Through this experiment, we have learned to plot magnitude
 and phase spectrum of discrete time sequences.
(2) For a discrete time sequence of I point, idelly N=L point
DFT is required to compute.
(3) For number of DFT points N>1, the frequency spectrum
(magnitude and phase) become denser and better represented
in frequency domain.
(4) Resulting IDFI for N>1 is having (N-1) trailing zeros.