Rafay Aamir Gull.

Bsee 19047

SnS. Assignment no:- 3

Q:-1

① Difference b/w fourier series and fourier transform.

Fourier series is the expension of a periodic signal as a linear combination of sin and cosines whereas Fourier Transform is the process of of converting or transforming a time-Domain signal into its frequency-Domain equivalent signal

$$x(t) = \sum_{K=-\infty}^{+\infty} (a_K e^{jK\omega_0 t}) \Rightarrow \text{Fourier\_Series [Continuous time]}$$

$$x[N] = \sum_{K=n} (a_K e^{jK\omega_0 N}) \Rightarrow \text{Fourier - Series [Discrete time]}$$

$$x(j\omega) = \int_{-\infty}^{\infty} (x(t)\, e^{-j\omega t})\, dt \Rightarrow \text{Fourier -Transform}$$

$$x(j\omega) = \int_K (x(t)\, e^{-j\omega t})\, dt \Rightarrow (\text{for Discrete or dis/non contin})$$

②

- Noise Cancellation
- Signal Processing
- Control Theory
- Telecommunication
- Radio

Q:- 2

$$N = 5,\ a_0 = 2,\ a_2 = a_{-2}^{*} = 2e^{j\pi/6}$$

$$a_4 = a_{-4}^{*} = e^{j\pi/3}$$

express $x[n] = A_0 + \sum_{K=1}^{\infty} A_K \sin(\omega_K n + \phi_K)$

Solve

$$x[n] = A_0 + \sum_{K=\pm 1}^{N} A_K e^{j\omega K t} = A_0 + \sum_{K=\pm 1}^{\pm 5} A_K e^{jK\omega n}$$

plug-in the given values,

$$x[n] = 2 + \left(2e^{j\pi/6}\right)\left(e^{2j\left(\frac{2\pi}{5}\right)n}\right) + \left(2e^{-j\pi/6}\right)\left(e^{-2j\left(\frac{2\pi}{5}\right)n}\right) + \left(e^{j\pi/3}\right)\left(e^{4j\left(\frac{2\pi}{5}\right)n}\right) + \left(e^{-j\pi/3}\right)\left(e^{-4j\left(\frac{2\pi}{5}\right)n}\right)$$

$$= 2 + 4\cos\left(\frac{4\pi}{5}n + \frac{\pi}{6}\right) + 2\cos\left(\frac{8\pi}{5}n + \frac{\pi}{3}\right)$$

~~∴ cos(φ + 90°) = sin(φ)~~

$$\therefore \cos(\phi + 90^\circ) = \sin(\phi)$$

$$x[n] = 2 + 4\cos\left(\frac{4\pi n}{5} + \frac{\pi}{6} + \frac{\pi}{2}\right) + 2\cos\left(\frac{8\pi n}{5} + \frac{\pi}{3} + \frac{\pi}{2}\right)$$

$$x[n] = 2 + 4\cos\left[\frac{4\pi}{5}n + \frac{2\pi}{3}\right] + 2\cos\left[\frac{8\pi}{5}n + \frac{5\pi}{6}\right] \text{ Ans}$$

Q:- 3 $N = 8$

$$a_k = \cos\left[\frac{k\pi}{4}\right] + \sin\left[\frac{3k\pi}{4}\right] \quad \therefore \omega = \frac{\pi}{4}$$

Solve

$$a_k' = \frac{1}{N}\sum_{0}^{7} x[n]\, e^{-jk\omega n} \Rightarrow \frac{1}{8}\sum_{0}^{7} x[n]\, e^{-jkn\frac{\pi}{4}}$$

$$a_k' = \frac{1}{8}x[0]e^{0} + \frac{x[1]}{8}e^{-jk\pi/4} + \frac{x[2]}{8}e^{-2jk\frac{\pi}{4}} + \frac{x[3]}{8}e^{-3jk\pi/4}$$
$$+ \frac{x[4]}{8}e^{-4jk\frac{\pi}{4}} + \frac{x[5]}{8}e^{-5jk\frac{\pi}{4}} + \frac{x[6]}{8}e^{-jk\frac{\pi}{4}\times 6} + \frac{x[7]}{8}e^{-7jk\frac{\pi}{4}}$$

$$a_k' = \frac{x[0]}{8} + \frac{x[1]e^{-jk\frac{\pi}{4}}}{8} + \frac{x[2]e^{-2jk\frac{\pi}{4}}}{8} + \frac{x[3]e^{-3jk\frac{\pi}{4}}}{8} + \frac{x[4]e^{-4jk\frac{\pi}{4}}}{8}$$
$$+ \frac{x[5]e^{-5jk\frac{\pi}{4}}}{8} + \frac{x[6]e^{-6jk\frac{\pi}{4}}}{8} + \frac{x[7]e^{-7jk\frac{\pi}{4}}}{8} \quad \text{——— (1)}$$

$$a_k = \cos\frac{k\pi}{4} + \sin\frac{3k\pi}{4} \Rightarrow \frac{e^{jk\pi/4}}{2} + \frac{e^{-jk\pi/4}}{2} + \frac{e^{3jk\pi/4}}{2} - \frac{e^{-3jk\pi/4}}{2}$$

$$a_k = \frac{e^{jk\pi/4}}{2} + \frac{e^{-jk\pi/4}}{2} + \frac{e^{3jk\pi/4}}{2j} - \frac{e^{-3jk\pi/4}}{2j} \quad \text{——— (2)}$$

comparing eq (1) and (2)

$x[0] = 0$, $x[1] = 4$, $x[3] = -4j$, $x[5] = 4j$, $x[7] = 4$

as a_k is an odd function hence only odd values of n will be significant and for discrete

$$x[n] = 0 + 4[\delta[n-1]] + 4\delta[n-7] - 4j\delta[n-3] + 4j\delta[n-5]$$

$$x[n] = 4\delta[n-1] - 4j\delta[n-3] + 4j\delta[n-5] + 4\delta[n-7] \quad \text{Answer}$$