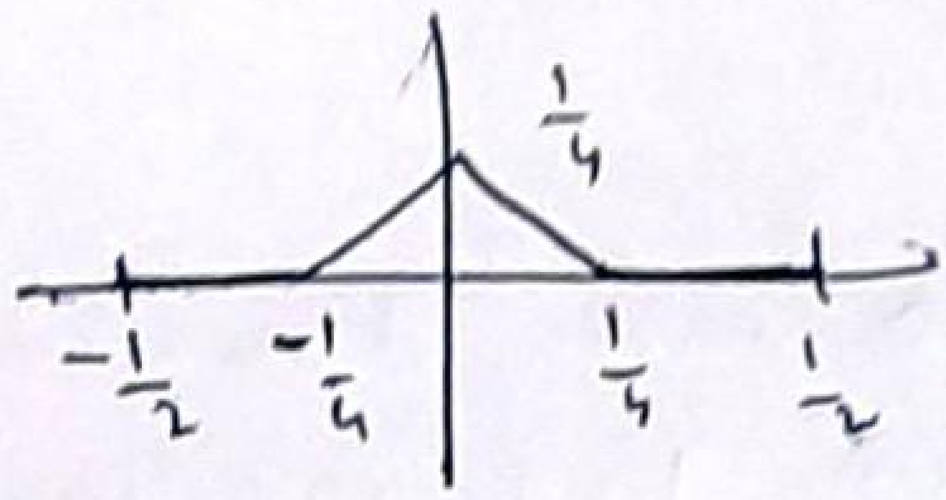
1.1)

b) $x(t) = \begin{cases} \frac{1}{4} - |t| & -T_1 \le t \le T_1 \\ 0 & T_1 < |t| < \frac{T}{2} \end{cases}$

$T = 1$ and $T = 4T_1$

$\Rightarrow x(t) = \begin{cases} \frac{1}{4} - |t| & -\frac{1}{4} \le t \le \frac{1}{4} \\ 0 & -\frac{1}{2} < t < -\frac{1}{4} \text{ \& } \frac{1}{4} < t < \frac{1}{2} \end{cases}$



$$a_0 = \frac{1}{T}\int_{-\frac{1}{2}}^{\frac{1}{2}} x(t)\,dt = \int_{-\frac{1}{4}}^{\frac{1}{4}} x(t)\,dt = \frac{1}{16}$$

$$a_k = \frac{1}{T}\int_{-\frac{1}{4}}^{\frac{1}{4}} \left(\frac{1}{4} - |t|\right) e^{-jk\omega t}\,dt$$

$$= \int_{-\frac{1}{4}}^{\frac{1}{4}} \left(\frac{1}{4} - |t|\right)\left(\cos(k\omega t) - j\sin(k\omega t)\right)dt$$

$$= 2\int_{0}^{\frac{1}{4}} \left(\frac{\cos k\omega t}{4} - t\cos k\omega t\right)dt$$

$$= 2\left(\frac{\sin k\omega t}{4k\omega t}\Big|_0^{\frac{1}{4}} - \left(\frac{t\sin(k\omega t)}{k\omega} + \frac{\cos(k\omega t)}{k^2\omega^2}\right)\right)$$

$$a_k = 2\left(\frac{1 - \cos\left(\frac{k\omega}{4}\right)}{k^2\omega^2}\right)$$

$$\boxed{a_k = \frac{\left(1 - \cos\left(\frac{k\pi}{2}\right)\right)}{2k^2\pi^2}}$$

We verify $\boxed{a_1 = a_{-1} = \frac{1}{2\pi^2} = 0.0507}$

$\boxed{a_2 = a_{-2} = \frac{1}{4\pi^2} = 0.02535}$

1.2) d) The observation is that as N increases ~~error~~ both the maximum absolute error and mean squared error decreases and when N is sufficiently large becomes very close to 0

1.3) b) When we try to use "FourierCoeff" when N = 100*T when T = 1, 100, 1000, the Fourier coefficients decrease in magnitude and become nearly 0 as $T \to \infty$

1.3) c) As N is increased from 10 to 50, 100, 1000, we find that the error decreases and the resulting curve is almost same as the original curve

1.4) c) → The first curve is even function. So we expect the results to contain only real coefficients as symmetry with x-axis means sine terms are not present and so ensures real values

→ The second curve is odd function. So we expect the results to also contain complex coefficients as symmetry about origin means $j\sin(k\omega t)$ are present causing complex values.

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