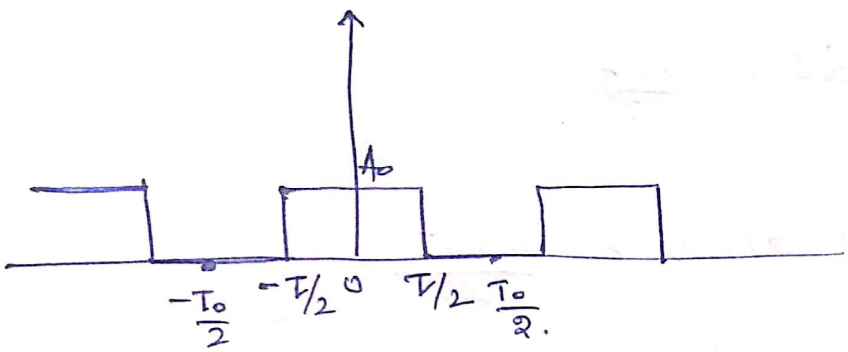
Eg: 3 Complex Exponential fourier series

$$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$$

$C_n \rightarrow$ Complex exponential fourier Coefficient.

$$C_n = \frac{1}{T_0} \int_{T_0} x(t) e^{-jn\omega_0 t} dt.$$




$$C_n = \frac{1}{T_0} \int_{T_0} x(t) e^{-jn\omega_0 t} dt$$

$$\omega_0 = \frac{2\pi}{T}$$

$$C_n = \frac{1}{T_0} \int_{-T_0/2}^{T_0/2} x(t) e^{-jn\omega_0 t} dt.$$

$$= \frac{1}{T_0} \left[ \int_{-T/2}^{T/2} A_0 e^{-jn\omega_0 t} dt \right]$$

$$\left[ \frac{e^{-jn\omega_0 t}}{-jn\omega_0} \right]$$

$$\left[ \frac{e^{-jn\frac{2\pi}{T_0}t}}{-jn\omega_0} \right]$$

$$= \frac{A_0}{T_0} \int_{-T/2}^{T/2} e^{-jn\omega_0 t} dt.$$

$$= \frac{A_0}{T_0} \left[ \frac{e^{-jn\omega_0 t}}{-jn\omega_0} \right]_{-T/2}^{T/2} = \frac{A_0}{T_0} \left[ \frac{e^{-jn\omega_0 T/2} - e^{jn\omega_0 T/2}}{jn\omega_0} \right]$$

Scanned by CamScanner

$$C_n = \frac{A_0}{n\omega_0 T_0}\left[\frac{e^{jn\omega_0 \tau/2} - e^{-jn\omega_0 \tau/2}}{j}\right]$$

$$C_n = \frac{2A_0}{n\omega_0 T_0} \sin(n\omega_0 \tau/2)$$

$$C_n = \frac{A_0}{jn\omega_0 T_0} 2\sin\frac{n\omega_0 \tau}{2}$$

Multiply and divide by $\frac{n\omega_0 \tau}{2}$.

$$C_n = \frac{A_0}{j\cancel{n\omega_0} T_0} \frac{2\sin\frac{n\omega_0\tau}{2}}{\frac{n\omega_0\tau}{2}} \times \frac{\cancel{2}}{\cancel{n\omega_0}\tau} \cdot \frac{\cancel{n}\cancel{\omega_0}\tau}{2}$$

$$C_n = \frac{A_0 \tau}{T_0} \frac{\sin\frac{n\omega_0\tau}{2}}{\frac{n\omega_0\tau}{2}}$$

$$\boxed{C_n = \frac{A_0 \tau}{T_0} \operatorname{sinc}\left(\frac{n\omega_0\tau}{2}\right)}$$

Scanned by CamScanner