Fourier Series Expansion

Fourier series expansion is used for ① periodic signals to expand them in terms of their harmonics which are ② Sinusoidal and ③ orthogonal to another.

14 Periodic Signal → CT → CTFS
→ DT → DTFS

Non Periodic → CTFT
→ DTFT

- Use of Laplace Transform → Design Purpose (Cont Time)
  Fourier Transform → Analysis "
  Z transform → Discrete Time.

- Periodic signal

$$x(t \pm T) = x(t)$$

T ← Time Period

Fourier series Expansion condition check.
→ Dirichlet condn.

Harmonic $f = \frac{\text{cycles}}{\text{sec}}$

$$x(t) = 2\sin wt + 1\cdot \sin 2wt + 7\cdot \sin 3wt + \cdots$$

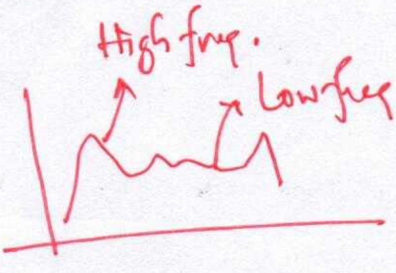
$2\sin wt$ ← First Harmonic

$\sin 2wt$ ← Even Harmonic

$\sin 3wt$ ← Odd Harmonic

Effects of Third Harmonics more dominant.

w ← Fundamental freq.



Freq → Rate of change

Fourier Series = DC + sin + Cosine

- DC + Sin
- DC + Cosine
- DC + Sin + Cosine.

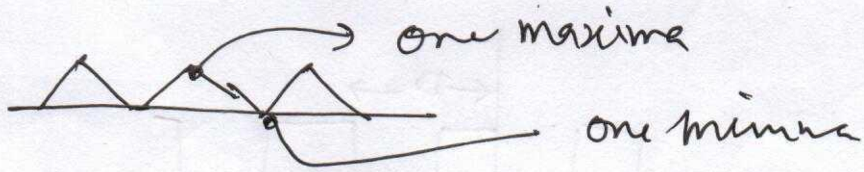
$W = 2\pi f$.
↑
Fundamental Angular Freq.

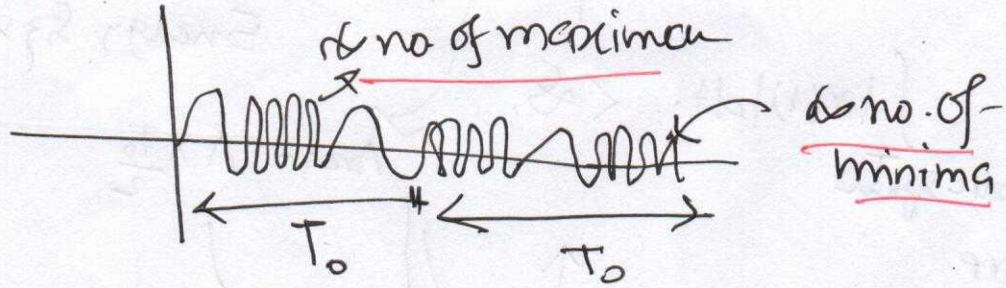
- Trigonometric Fourier series Expansion
- complex exp. Fourier "
- Polar / Harmonic " " "

Condition for existance of Fourier Series

Condition 1 → Signal should have finite number of maxima and minima over the range of time period.

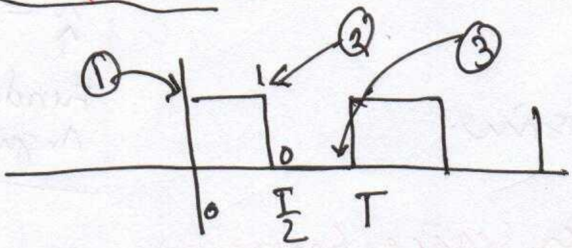
→ means one Maxima and one minima over time period.



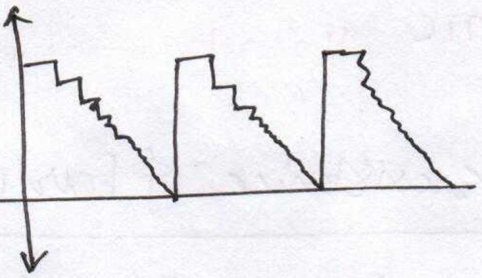


$T_0 = 2T_1 = 4T_2 \cdots$

Condition 2: Periodic signal should have finite number of discontinuities over the range of time period.



No. of discontinuities is 3



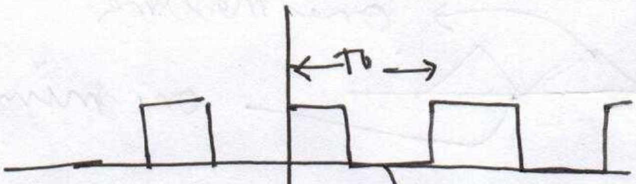
n, n → $\frac{n}{2}$, $\frac{n}{2}$

∴ So ∞ infinite discontinuities

∴ FS not possible

Condition-3

Signal should be absolutely integrable over the range of time period.

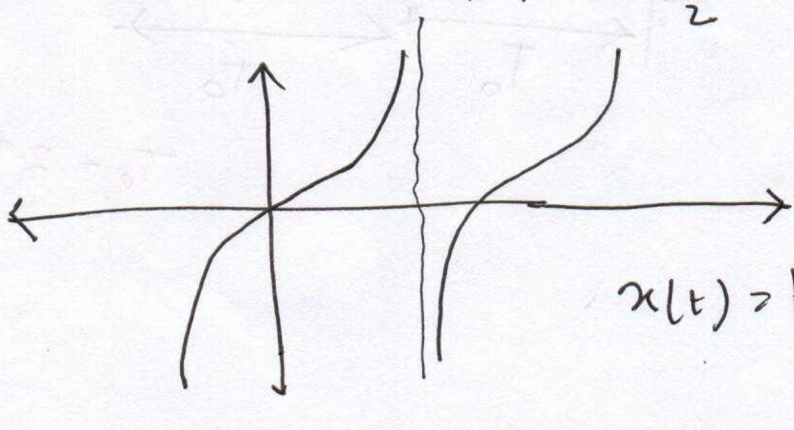


Energy Signal

$$\int_T |x(t)|\,dt < \infty$$

Area = $A \times \frac{T_0}{2}$

PS → Periodic Signal
→ NENP



$x(t) = \tan t$