

# Fourier Analysis

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## Prerequisites

1. Periodic Function:  $\sin x$  and  $\cos x$  having period  $2\pi$ ,  $\tan x$  having period only  $\pi$
2. Trigonometry
3. Basic Integration

## Basic

We can write any function as a series and can modify it with **Integration**. Joseph Fourier(1768 ← 1830) derived a special trigonometric series. Trigonometric series is a series of the form:

$$\frac{A_0}{2} + \sum_{n=1}^{\infty} (A_n \cos nx + B_n \sin nx)$$

It will called **Fourier Series** if the terms  $A_0, A_n, B_n$  is:

$$A_0 = \frac{1}{2\pi} \int_{-\pi}^{\pi} f(x) \cdot dx$$

$$A_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cdot \cos nx \cdot dx$$

$$B_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cdot \sin nx \cdot dx$$

Where  $f(x)$  is any single-valued function defined in interval  $(-\pi, \pi)$ .

## Some helpful equations

1.  $\sin 0^\circ = \sin \pi = 0$
2.  $\cos 0^\circ = \cos 2n\pi = (-1)^{2n} = 1$
3.  $\cos n\pi = (-1)^n$
4.  $\frac{d}{dx} \sin \theta = \cos \theta$
5.  $\frac{d}{dx} \cos \theta = -\sin \theta$
6.  $\int \sin \theta = -\cos \theta$
7.  $\int \cos \theta = \sin \theta$