# Faraday's Laws Of Electromagnetic Induction

**Faradays law of electromagnetic induction**: Faraday from the experimental observations gave the following two laws for electromagnetic induction to find the value of emf induced across the circuit.

**First law**: The induced emf is proportional to the number of turns in the coil.

$e \propto N \rightarrow (1)$ where N = number of turns in the coil.

**Second law**: The emf induced across the coil is proportional to the rate of change of flux through the coil.

Let $\phi_1$ and $\phi_2$ be the flux ( the total no of magnetic lines of force passing perpendicularly) through the coil at an instant of time t & $t + \Delta t$ respectively

$\therefore$ Change in flux through the coil in time $\Delta t$ : $\Delta\phi = \phi_2 - \phi_1$

$\therefore$ The rate of change of flux through the coil $= \dfrac{\Delta\phi}{\Delta t}$

$e \propto \dfrac{\Delta\phi}{\Delta t} \rightarrow (2)$

If the rate of change of flux through the coil is not uniform then

$e \propto \dfrac{d\phi}{dt}$ where $\dfrac{d\phi}{dt}$ is rate of change of flux at an instant t

Combining first and second law : $e \propto N\dfrac{d\phi}{dt}$

$e = KN\dfrac{d\phi}{dt}$

Where K = constant of proportionality, by proper choice of unit i.e. if e is in volt and flux in tesla - $m^2$ then constant K = 1

$e = N\dfrac{d\phi}{dt} \rightarrow (3)$

Equation(3) can be more correctly written as

$e = -N\dfrac{d\phi}{dt} \rightarrow (4)$

The negative sign indicates that the direction of the induced emf is opposite to that of the cause.