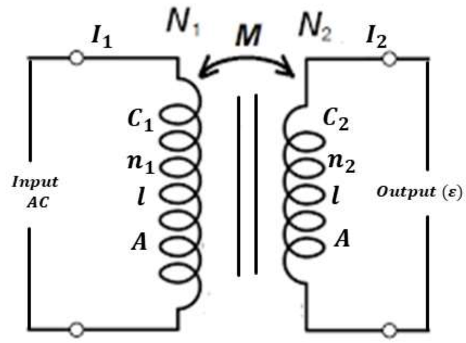
**Mutual-Induction:**

The phenomenon of production of induced emf in a coil by passing changing current through a neighboring coil is known as mutual induction.

Let us consider two coils $C_1$ and $C_2$ are placed very close to each other without metallic contact having a number of turns $N_1$ and $N_2$ respectively. The coil $C_1$ is connected with the AC source (charging current) and output is taken from coil $C_2$. Two coils are placed in such a way that when changing current from the AC source is passed through the first coil $C_1$, the magnetic flux linked with the coil $C_1$ changes which enhances the change in magnetic flux through $C_2$. Due to the change in magnetic flux linked with the coil $C_2$ and emf is induced in it.




Let, $I_1$ be the instantaneous current flowing through the coil $C_1$. Since the magnetic field is linked with the coil $C_2$ is directly proportional to the current through $C_1$,

i.e. $$\phi_2 \propto I_1$$

$$or,\ \phi_2 = MI_1 ------(1)$$

Where M is the proportionality constant known as mutual inductance or coefficient of mutual induction.

From equation (1), $$M = \frac{\phi_2}{I} ---------(2)$$

Hence mutual inductance is defined as the magnetic flux passing through the second coil per unit current across the first coil.

Now, from faradays laws of electromagnetic induction,

$$\varepsilon = -\frac{d\phi_2}{dt} ------(3)$$

From $eq$ (1) and $eq$ (3) $$or, \varepsilon = -\frac{d(MI_1)}{dt}$$

$$or, \boldsymbol{\varepsilon = -M\frac{dI_1}{dt}} ----(4)$$

If $\frac{dI_1}{dt} = 1\ A/s$ then, $$\boldsymbol{M = -\varepsilon}$$

Hence, the coefficient of mutual induction is defined as the emf induced in a coil due to the flow of rate of change of current $1A/s$ through the neighbouring coil.

Its SI unit is $\frac{V}{A/s}$ $or\ Henry\ (H) or\ Weber\ per\ ampere\ (Wb/A)$.

- Find the Mutual-inductance of the ***two concentric plane coils (current loop)*** and ***two co-axial solenoids***.