MAGNETIC EFFECT OF ELECTRIC CURRENT
Self and Mutual Induction

Self and Mutual Induction:

We are aware that whenever an electric current flows through a conductor, a magnetic field surrounding it is produced. A varying current result in a varying magnetic field. Due to this, the magnetic flux varies and an electromotive force is induced in the circuit. Let us learn about it in more detail in this article.

Inductance is the tendency of an electrical conductor to oppose a change in the electric current flowing through it. L is used to represent the inductance, and Henry is the SI unit of inductance. 1 Henry is defined as the amount of inductance required to produce an emf of 1 volt in a conductor when the current change in the conductor is at the rate of 1 Ampere per second.

An electric current flowing through a conductor creates a magnetic field around it. The strength of the field depends upon the magnitude of the current. The generated magnetic field follows any changes in the current, and from Faraday's law of induction, we know that changing the magnetic field induces an electromotive force in the conductor. Considering this principle, inductance is defined as the ratio of the induced voltage to the rate of change of current causing it. The electronic component designed to add inductance to a circuit is an inductor.

Self-Inductance

When there is a change in the current or magnetic flux of the coil, an electromotive force is induced. This phenomenon is termed Self Inductance. When the current starts flowing through the coil at any instant, it is found that, that the magnetic flux becomes directly proportional to the current passing through the circuit. The relation is given as:

$$\Phi = L \times I$$

Where L is termed as the self-inductance of the coil or the coefficient of self-inductance, the self-inductance depends on the cross-sectional area, the permeability of the material, and the number of turns in the coil.

The rate of change of magnetic flux in the coil is given as,

$$e = -\frac{d\phi}{dt} = -\frac{d(LI)}{dt}$$

$$e = -L\frac{dI}{dt}$$

Mutual Inductance

Consider two coils: P – coil (Primary coil) and S – coil (Secondary coil). A battery and a key are connected to the P-coil, whereas a galvanometer is connected across the S-coil. When there is a change in the current or magnetic flux linked with the two coils, an opposing electromotive force is produced across each coil, and this phenomenon is termed Mutual Inductance.

This phenomenon is given by the relation:

$$\emptyset = MI$$

Where M is termed as the mutual inductance of the two coils or the coefficient of the mutual inductance of the two coils.

$$e = -\frac{d\phi}{dt} = -\frac{d(MI)}{dt}$$

$$e = -M\frac{dI}{dt}$$

The rate of change of magnetic flux in the coil is given as,

Difference between Self and Mutual Inductance

Self-inductance	Mutual inductance
In self-inductance, the change in the strength of current in the coil is opposed by the coil itself by inducing an e.m.f.	In mutual inductance out of the two coils one coil opposes change in the strength of the current flowing in the other coil.
The induced current opposes the growth of current in the coil when the main current in the coil increases.	The induced current developed in the neighboring coil opposes the growth of current in the coil when the main current in the coil increases.
The induced current opposes the decay of current in the coil when the main current in the coil decreases.	The induced current developed in the neighboring coil opposes the decay of the current in the coil when the main current in the coil decreases.