B.Sc. PHYSICAL SCIENCE
with Chemistry
2nd Semester: Electricity & Magnetism

Dr. Vishal Mishra 25/03/2020

Self-Inductance : Self Induction

Whenever the electric current flowing through a circuit changes.

↓

The magnetic flux linked with that circuit also changes

↓

As a result an induced e.m.f is set up in the circuit

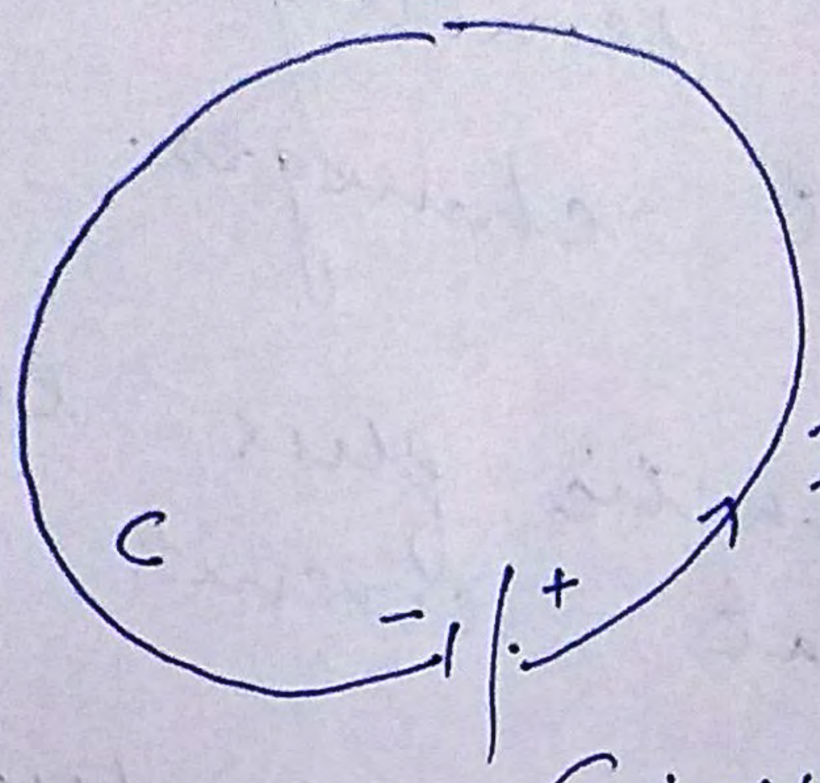
↓

According to Lenz's law the direction of induced e.m.f is such as to oppose the change in the current.

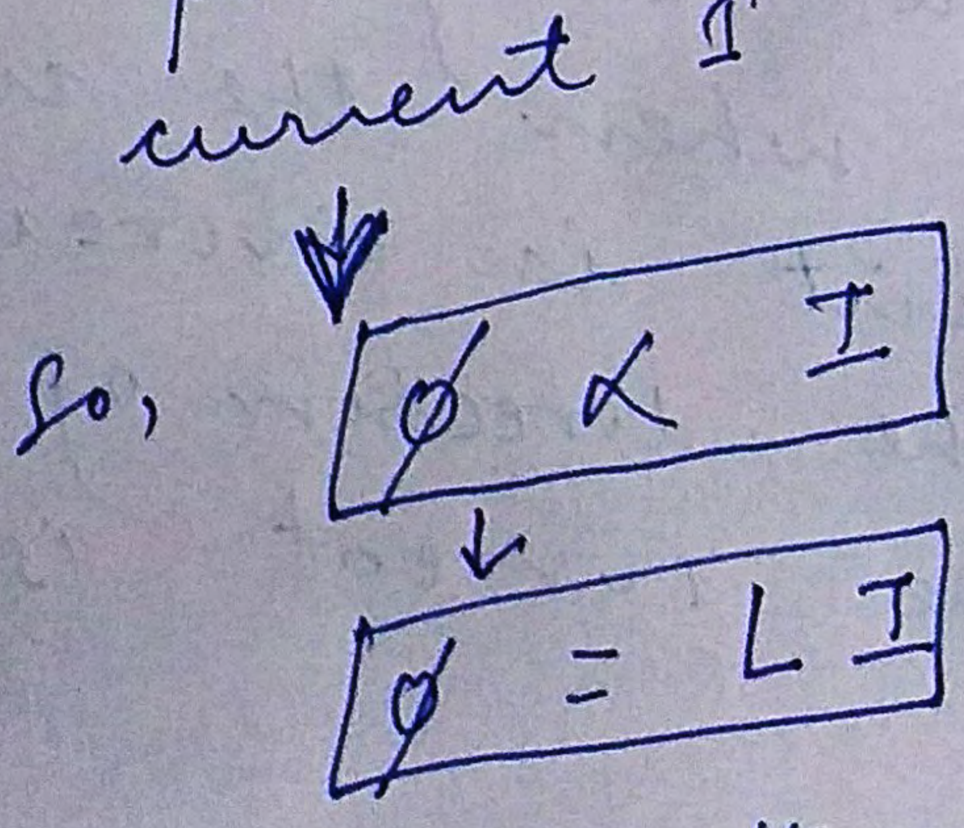
↓

Thus the e.m.f is against the current when the current in the circuit is increasing and along the direction of the current when the current is decreasing

"The phenomenon of the production of an induced e.m.f. in a circuit itself due to change in current through it is called self induction and the induced e.m.f. is called back e.m.f."



Let C = Circuit
I = Current flowing
↓
will set up a mag. field
↓
and hence a magnetic flux ϕ
↓
As the mag. field strength @ any point is proportional to the current I



So, $\phi \propto I$

$\phi = LI$ — (1)

Where, L = const = coeff. of self-induction

When the current I flowing through a circuit is changed, then,

the Rate of change of flux linked with the circuit is given by-

$$\frac{d\phi}{dt} = L \frac{dI}{dt} \quad \text{---(2)}$$

Therefore, from Faraday's law-

$$e = -\frac{d\phi}{dt}$$

i.e. $$e = -L \frac{dI}{dt} \quad \text{---(3)}$$

Again, from eq-(1)-

$$L = \frac{\phi}{I}$$

If $I = 1$ amp, $L = \phi$ Henry

Thus, "The self inductance of a circuit (in Henry) is defined as the magnetic flux (in Web.) linked with the circuit when 1 amp. current flows through it."