Prof. Atpadkar A.V.

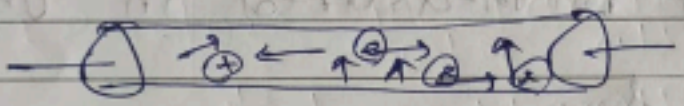
Page No.
Date

Unit No. 01

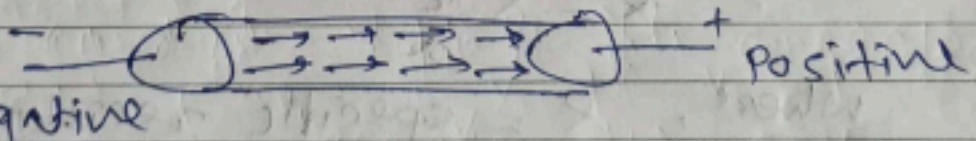
Basic concept of Electricity

(1) current –

All conductors contain electrons which are free to move among its different atoms. If no voltage is applied across the two ends of the conductor, no electric field is set up in the conductor that's why the electrons move around freely between different atoms in a random way as seen in below fig.



When voltage is applied across the conductor, the electrons are attracted towards the positive side of the applied voltage as shown in fig



Defination – The flow of electronic charge in one particular direction is called an electric current.

$$i = \frac{q}{t} = \frac{1 \text{ coulomb}}{1 \text{ second}} = 1 \text{ ampere}$$

(2) Electromotive force (EMF)/voltage —

The force which is responsible to move all random electrons in particular one direction that is called EMF it is measured in voltage (volt)

(3) Resistance - (R) —

opposition to the flow of electronic current that is called resistance

- it is measured in ohm - (Ω)

$$R \propto \frac{l}{a}$$

Resistance is directly proportional to length of the conductor and inversely proportional cross sectional area of the conductor.

$$\therefore R = \rho \frac{l}{a}$$

where, ρ = specific resistance

it is constant terms but it's depend on type of material

$$\therefore \rho = \frac{R \times a}{l} = \frac{\Omega \cdot m^2}{m} = \Omega \cdot m$$

specific resistance measured in $\Omega \cdot m$

4) conductance (G) –

It is reciprocal of resistance it is called conductance

$$G = \frac{1}{R} = \frac{1}{\Omega} = \Omega^{-1}$$

The conductance is measured in siemens

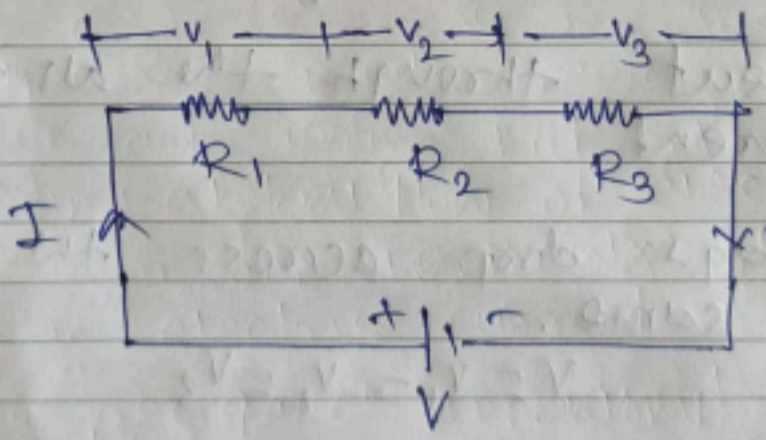
5) conductivity (σ) –

conductivity is defined as reciprocal of resistivity (ρ) and its unit is siemens/metre

$$\sigma = \frac{1}{\rho} = \underline{\underline{\Omega m^{-1}}}$$

* Resistors in series –

When three resistors are connected in series



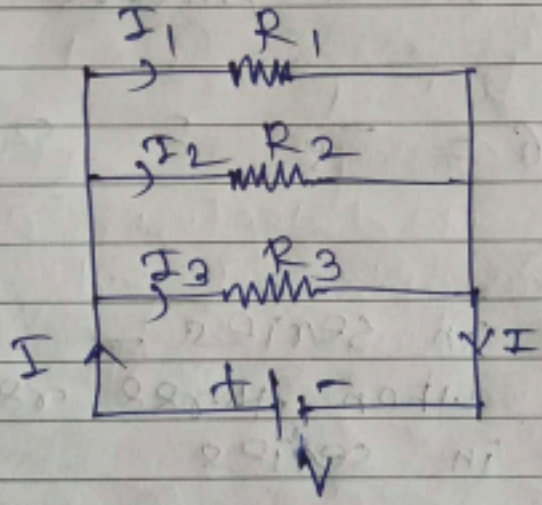
– Current through all connected resistance is same.

- voltage drop across of all resistors are different

$$\therefore V = V_1 + V_2 + V_3$$

$$\therefore \boxed{R_T = R_1 + R_2 + R_3}$$

* Resistors in parallel - when all three resistors are connected in parallel



- current through the all resistors are different.
- voltage drop across the each resistors are same.

$$V = V_1 = V_2 = V_3$$

$$I = I_1 + I_2 + I_3$$

$$R_T = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Unit No. 02

Basic Laws In Electrical

- **Ohm's Law Definition**: Ohm's Law states that the current through a conductor is proportional to the voltage across it and inversely proportional to its resistance.

What is Ohm's Law?

Ohm's law states that the electrical current flowing through any conductor is directly proportional to the potential difference (voltage) between its ends, assuming the physical conditions of the conductor do not change.
In other words, the ratio of potential difference between any two points of a conductor to the current flowing between them is constant, provided the physical conditions (e.g., temperature etc.) do not change.

Mathematically, Ohm's law can be expressed as,

Introducing the constant of proportionality, the resistance R in the above equation, we get,

Where,

- R is the resistance of the conductor in Ohm ( ),
- I is the current through the conductor in Amperes (A),
- V is the voltage or potential difference measured across the conductor in Volts (V).

Ohm's law is applicable to both DC and AC.
The relationship between the potential difference or voltage (V), the current (I) and the resistance (R) in an electrical circuit was first discovered by the German physicist George Simon Ohm.
The unit of resistance is Ohm ( ) was named in honour of George Simon Ohm.

9.2 Coulomb's law (ESBPJ)

Like charges repel each other while unlike charges attract each other. If the charges are at rest then the force between them is known as the **electrostatic force**. The electrostatic force between charges increases when the magnitude of the charges increases or the distance between the charges decreases.

The electrostatic force was first studied in detail by Charles-Augustin de Coulomb around 1784. Through his observations he was able to show that the **magnitude** of the electrostatic force between two point-like charges is inversely proportional to the square of the distance between the charges. He also discovered that the **magnitude** of the force is proportional to the product of the charges. That is:

$$F \propto Q1Q2r2,\ F \propto Q1Q2r2,$$

where

Q1Q1 and Q2Q2 are the magnitudes of the two charges respectively and r is the distance between them. The magnitude of the electrostatic force between two point-like charges is given by *Coulomb's law*.

Faraday's Laws of Electromagnetic Induction –

Faraday's Laws of Electromagnetic Induction consists of two laws. The first law describes the induction of emf in a conductor and the second law quantifies the emf produced in the conductor. In the next few sections, let us learn these laws in detail.

Faraday's First Law of Electromagnetic Induction

The discovery and understanding of electromagnetic induction are based on a long series of experiments carried out by Faraday and Henry. From the experimental observations, Faraday concluded that an emf is induced when the magnetic flux across the coil changes with time. Therefore, Faraday's first law of electromagnetic induction states the following:

Whenever a conductor is placed in a varying magnetic field, an electromotive force is induced. If the conductor circuit is closed, a current is induced, which is called induced current.

Faraday's Second Law of Electromagnetic Induction

Faraday's second law of electromagnetic induction states that

The induced emf in a coil is equal to the rate of change of flux linkage.
The flux linkage is the product of the number of turns in the coil and the flux associated with the coil. The formula of Faraday's law is given below: