

Current Electricity

Electric Current : Electric current is defined as the rate of flow of charge or charge flowing per unit time interval. Its direction is the direction of flow of positive charge. Its SI unit is ampere (A). It is a scalar quantity.

---> A current of one ampere flowing through a conductor means 6.25×10^{18} electrons are entering at one end or leaving the other end of the conductor in one second.

Resistance : The opposition offered by a conductor to the flow of current through it is called resistance. It arises due to collisions of drifting electrons with the core ions. Its SI unit is ohm.

Ohm's law : If physical conditions like temperature, intensity of light etc. remains unchanged then electric current flowing through a conductor is directly proportional to the potential difference across its ends. If V is the potential difference across the ends of a conductor and I is the current through it, then according to ohm's law $V \propto I$ or, $V = RI$ where R is a constant called resistance of conductor.

Ohmic Resistance : The resistances of such conductors which obey ohm's law are called ohmic resistance. For example resistance of manganin wire.

Non ohmic resistance : The resistances of such materials which do not obey ohm's law are called non ohmic resistance.

Example : Resistance of diode valve, resistance of triode valve.

Conductance : Reciprocal of resistance of a conductor is called its conductance i.e. $\text{conductance} = 1/\text{Resistance}$

It is denoted by G and ($G=1/R$)

Its SI unit is ohm^{-1} (also called mho or siemen.)

The resistance of a conductor is directly proportional to its length and inversely proportional to its cross sectional area. i.e. if l and A are respectively length and cross sectional area of a conductor and R is its resistance then $R \propto l/A$ or, $R = \rho l/A$ where ρ is a constant of material of conductor called specific resistance or resistivity. Its SI unit is ohm meter.

Specific conductance or conductivity : The reciprocal of resistivity of a conductor is called its conductivity (σ). Its SI unit is mho m^{-1} or siemen / meter (sm^{-1})

Combination of Resistance : Various resistances can be combined to form a network mainly in two ways : (i) Series combination (ii) Parallel combination.

In series combination, the equivalent resistance is equal to the sum of the resistances of individual conductors. ($R = R_1 + R_2 + \dots + R_n$)

In parallel combination, the reciprocal of equivalent resistance is equal to the sum of the reciprocal of individual resistances.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$$

Electric Power : The rate at which electrical energy is consumed in a circuit is called electric power. Its SI unit is watt.

Kilo watt hour : It is the unit of energy and is equal to the energy consumed in the circuit at the rate of 1 kilowatt (1000 J/s) for 1 hour.

$$1 \text{ kilowatt hour} = 3.6 \times 10^6 \text{ joule}$$

1 kWh is also called board of trade unit.

Ammeter : Ammeter is a device which is used to measure electric current in a circuit. It is connected in series in the circuit.

---> The resistance of an ideal ammeter is zero.

Voltmeter : Voltmeter is a device used to measure the potential difference between two points in a circuit. It is connected in parallel to the circuit.

---> The resistance of an ideal voltmeter is infinite.

Electric fuse : Electric fuse is a protective device used in series with an electric appliance to save it from being damaged due to high current. In general, it is a small conducting wire of alloy of copper, tin and lead having low melting point.

---> Pure fuse is made up of tin.

Galvanometer : Galvanometer is a device used to detect and measure electric current in a circuit. It can measure current up to 10^{-6} A.

Shunt : Shunt is a wire of very small resistance. In simple words, galvanometer is an instrument for detecting and measuring small electric currents.

---> A galvanometer can be converted into an ammeter by connecting a shunt parallel to it.

---> A galvanometer can be converted into a voltmeter by connecting a very high resistance in its series.

Transformer : Transformer is a device which converts low voltage A.C. into high voltage A.C. and high voltage A.C. into low voltage A.C. It is based on electromagnetic induction and can be used only in case of alternating current.

A.C. Dynamo (or generator) : It is device used to convert mechanical energy into electrical energy. It works on the principle of electro-magnetic induction.

Electric motor : It is a device which converts electrical energy into mechanical energy.

Microphone : It converts sound energy into electrical energy and works on the principle of electromagnetic induction. In other words, microphone is an instrument for changing sound waves into electrical energy which may then be amplified, transmitted or recorded.

---> The current generated in the power stations are alternating current having voltage 22000 volt or more. In grid substations, with the help of transformer, their voltage is increased up to 132000 volt to minimise loss of energy in long distance transmission.