D C Circuits UNIT-3

Electric current

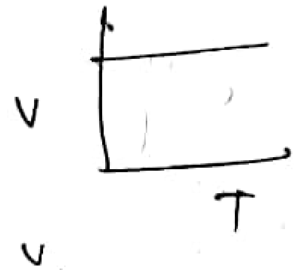
$$i = q/t$$

$\frac{\text{Coulomb}}{\text{sec}}$ = Ampere

1 amp = 6.25×10^{18} electron

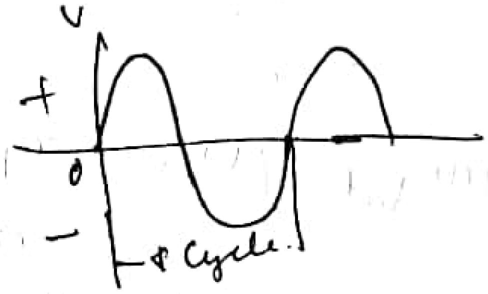
t = 1 sec q - आवेश Amperes

D C



Straight line.
NO Fluctuation

A C



50 Hz

Electric Resistance

$R = \frac{V}{i}$ विद्युत प्रतिरोध = $\frac{\text{विभवान्तर}}{\text{धारा}}$

mks Ω ओम

Law of Resistance

$R \propto l$

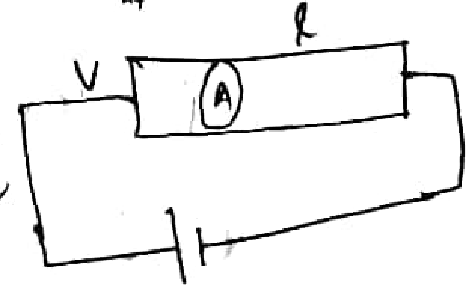
$R \propto \frac{1}{A}$ Cross sectional Area of wire

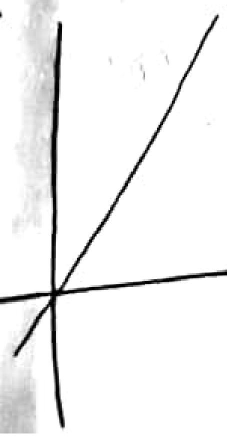
$$R \propto \frac{l}{A}$$

Ohm's Law

At Const Temp

$\frac{V}{i}$ = Const $\frac{V}{I} = R$





$I \propto V$

$V \propto I$

$V = RI$

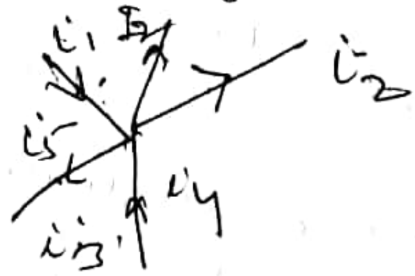
voltage

Resistance (Resistance)

Ohm Ω

Kirchhoff's Laws < KCL, KVL

In any network of conductors, the algebraic sum of currents meeting at a point is zero

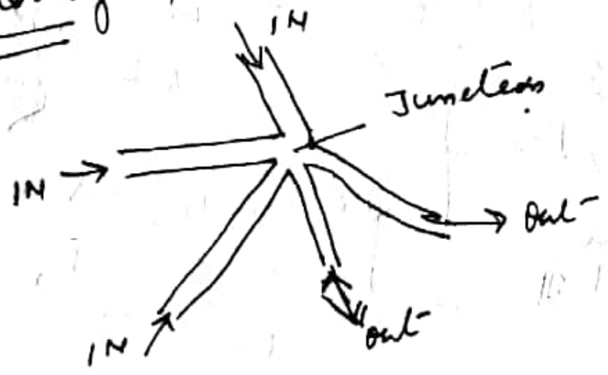


i_1 & i_4 are +ive current
i_2, i_3, i

$$i_1 + i_4 = i_3 + i_5 + I_2$$

$$i_1 - i_2 + i_4 - i_3 - i_5 = 0$$

In simple way, we can say total current leaving a junction is equal to the total current entering that junction.



In = Out
or
In - Out = 0

Kirchhoff's Voltage Law

The algebraic sum of all IR drops and EMFs in any closed loop of a network is zero.

$$\Sigma IR = \Sigma EMF = 0$$

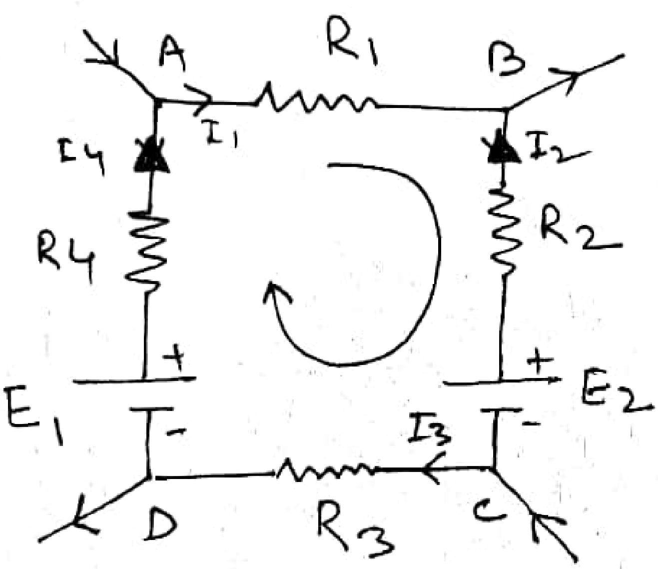
→ Increase in voltage (IR) would be considered +ive.
→ fall in voltage (IR) would be taken as -ive.

Second point is → if we go from -ive terminal to +ive terminal of BTY there is rise in potential, hence Emf will be +ive & vice versa.

Contd to KVL

If we go in the direction of current, then there is fall of voltage since current always flows from higher to a lower potential. so −ive (IR)

If we go against current direction, it means we are coming from low potential to high potential so IR will be +ive.



ABCD is a closed loop

If we go in clockwise direction.

$I_1R_1 \rightarrow$ −ive (fall of potential)

$I_2R_2 \rightarrow$ +ive (Rise -- " -)

$E_2 \rightarrow$ −ive. (fall -- " -)

$I_3R_3 \rightarrow$ −ive (− " −)

$E_1 \rightarrow$ +ive (Rise − ")

$I_4R_4 \rightarrow$ −ive. (fall − ")

Hence according to KVL

$$-I_1R_1 + I_2R_2 - E_2 - I_3R_3 + E_1 - I_4R_4 = 0$$

$$-I_1R_1 + I_2R_2 - I_3R_3 - I_4R_4 = E_2 - E_1$$

~~E_1R_4~~ In Anticlockwise

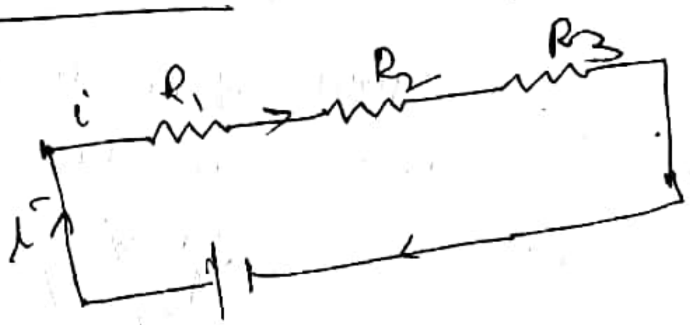
DCBA

$$I_4R_4 - E_1 + I_3R_3 + E_2 - I_2R_2 + I_1R_1 = 0$$

$$I_4R_4 + I_3R_3 - I_2R_2 + I_1R_1 = E_1 - E_2$$

Combinations of Resistance

In Series



Current passes through R_1, R_2, R_3 is same.

But voltage is different

$$\boxed{V = iR}$$

$V_1 = iR_1$ $\quad V_3 = iR_3$

$V_2 = iR_2$

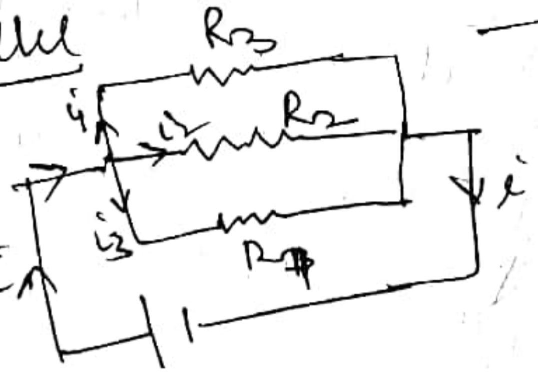
$V = V_1 + V_2 + V_3$

$V = iR_1 + iR_2 + iR_3$

$iR = i(R_1 + R_2 + R_3)$

$$\boxed{R = R_1 + R_2 + R_3}$$

Parallel



$i = \dfrac{V}{R}$

$i_1 = \dfrac{V}{R_1}$

$i_2 = \dfrac{V}{R_2}$ $\quad i_3 = \dfrac{V}{R_3}$

$i = i_1 + i_2 + i_3$

$\dfrac{V}{R} = V\left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}\right)$

$$\boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$