CONCEPT MAP

Current Electricity

First Law: The algebraic sum of the currents meeting at a junction is zero *i.e.*, $\Sigma I = 0$

Kirchhoff's Law

Second Law: In a closed loop, the algebraic sum of all the potential differences is zero, *i.e.*, $\Sigma \Delta V = 0$

Electric Current: The rate of flow of electric charge, $I = \frac{q}{t}$

Electric Power: $P = \frac{\text{Electric workdone}}{\text{Time taken}}$

$P = \frac{W}{t} = VI = I^2 R = \frac{V^2}{R}$

Electric Energy: $E = p \times t$

Drift Velocity: $\vec{v}_d = \frac{-e\vec{E}}{m}\tau$

Mobility: It is the drift velocity per unit electric field applied $\mu_e = \frac{v_d}{E}$

Relation between drift velocity and current $I = neAV_d$

Ohm's Law: Current flowing through a conductor is directly proportional to the potential difference across its ends. $V = IR$

Electric Resistance: It is the obstruction posed by the conductor to the flow of electric current through it. $R = \rho\frac{l}{A}$

Internal Resistance of a Cell: Resistance offered by the electrolyte and electrodes of a cell when electric current flows through it.

Wheatstone Bridge : Its principle states that if four resistances P, Q, R, S are arranged to form a bridge and if the galvanometer G shows no deflection then the bridge is said to be balanced. $\frac{P}{Q} = \frac{R}{S}$

Metre Bridge : It is based on the principle of Wheatstone's bridge. The unknown resistance, $R = \frac{Sl}{100-l}$

Resistance in Series: $R_s = R_1 + R_2 + \ldots + R_n$

Resistance in Parallel: $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$

Potential Difference of a Cell: It is the potential difference between the two terminals of a cell in a closed circuit.

Emf of a Cell: It is the potential difference between the two terminals of a cell in an open circuit.

Potentiometer: Its principle is based on the facts that the fall of potential across any portion of the wire is directly proportional to the length of the wire. $V = Kl$

Determination of Internal Resistance of a Cell: $r = \left(\frac{l_1 - l_2}{l_2}\right)R$

Comparison of Emf's of Two Cells: $\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$

Electric Conductivity: It is the reciprocal of resistivity.

Effect of Temperature on Resistance: The resistance of a metal conductor at a temperature t°C is given by $R_t = R_0(1 + \alpha t)$.

Grouping of Cells

Series Grouping: $I = \frac{n\varepsilon}{R + nr}$

- If $R << nr$, then $I = \frac{\varepsilon}{r}$
- If $R >> nr$, then $I = \frac{n\varepsilon}{r}$

Mixed Grouping: $I = \frac{n\varepsilon}{R + \left(\frac{r}{m}\right)}$ current in the circuit is maximum

Parallel Grouping: $I = \frac{\varepsilon}{R + \left(\frac{r}{m}\right)}$

- If $\frac{r}{m} << R$, then $I = \frac{\varepsilon}{R}$
- If $\frac{r}{m} >> R$, then $I = m\frac{\varepsilon}{r}$

Symbols used:

I = electric current
v_d = drift velocity
ρ = resistivity
K = potential gradient
q = electric charge
μ_e = mobility
ε = emf
R_S, R_P = effective resistance
n, m = number of cells in one row and number of rows of cells respectively
t = time taken
E = electric energy
τ = time of relaxation
l = length of the conductor
R, r, S = resistance
P = electric power
E = electric field
n_d = number density of electrons
A = Area of cross section of conductor