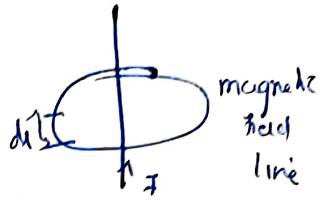
* Ampere's law + Applications:

→ Ampere's law relates the net magnetic field along a closed loop to the electric current passing through the loop.

Statement:

$$\oint \vec{H} \cdot \vec{dl} = I$$



→ The line integral of magnetic field intensity 'H' around any closed path is equal to the total current 'I' enclosed by the path.

* Application of Ampere's law:

→ Ampere's law is widely used to calculate the magnetic fields of current distributions with a high degree of symmetry.

Ex: → To measure the magnetic field intensity of an infinite line current.

→ $\vec{H}$ of an infinitely long axial transmission line.

* Amperian Path:

→ The closed loop to which Ampere's law is applied. → Amperian loop.

x

Ampere's law in point form:

→ According to Ampere's law,

$$\oint H \cdot dl = I \quad \rightarrow (1)$$

→ From the relation between I + J

J → current density
I per Area

$$I = \iint_S J \cdot ds \quad \rightarrow (2)$$

→ Comparing ① & ②

$$\oint_l H \cdot dl = \iint_s J \cdot ds \rightarrow ③$$

→ Applying Stoke theorem.

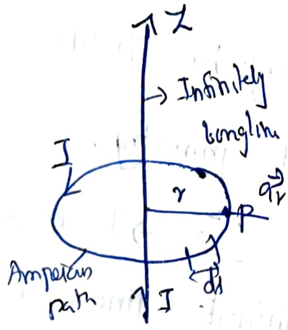
$$\oint_l H \cdot dl = \iint_s (\nabla \times H) \cdot ds \rightarrow ④$$

→ From ③ + ④

$$\iint_s (\nabla \times H) \cdot ds = \iint_s J \cdot ds.$$

$$\boxed{\nabla \times H = J} \quad A/m^2.$$

* $\vec{H}$ of an infinitely long line current carrying conductor:



→ Consider an infinitely long line which is carrying the current 'I'.

→ Let 'P' be any point at which $\vec{H}$ has to be found.

→ Consider a closed path passing through the point 'P' (ie) Amperian path.

$\oint \vec{H} \cdot dl = I$

$H \oint dl = I$

According to Ampere's law:

$$\oint \vec{H} \cdot dl = I$$

$$\vec{H} \oint dl = I$$

$$\vec{H}(2\pi r) = I$$

[$\oint dl = 2\pi r$] → circumference of circle.

$$\boxed{\vec{H} = \frac{I}{2\pi r} \vec{a_r}} \quad A/m$$

* Lorentz Force Equation:

The force on a moving particle due to combined electric and magnetic fields is given by,

$$\boxed{\vec{F} = \vec{F_E} + \vec{F_m}} \rightarrow (1)$$

where,

$F_E \rightarrow$ electric force ; the force acting on a charged Particle.

$$\boxed{\vec{F_E} = Q\vec{E}} \rightarrow (2)$$

The direction of the force is same as the direction of $\vec{E}$

$F_m \rightarrow$ magnetic force : the force experienced by a charged particle moving with ~~velocity~~ velocity (v) in a magnetic field of 'B'

$$\boxed{\vec{F_m} = Q(\vec{v} \times \vec{B})} \rightarrow (3)$$

Substitute (2) + (3) in (1).

$$\vec{F} = Q\vec{E} + Q(\vec{v} + \vec{B})$$

$$\boxed{\vec{F} = Q[\vec{E} + (\vec{v} + \vec{B})]}$$ X: 2m + 8m

This equation is called as Lorentz force equation