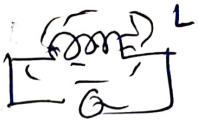
* Magnetic Energy:

→ Energy stored in magnetic field is represented as

$W = \frac{1}{2} L I^2$: Joules (Inductance)

(or)

$W = \frac{1}{2} \int B.H.dv = \frac{1}{2} \int \mu H^2 dv$

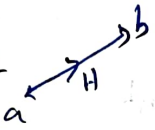


$B = \mu H$

* Magnetic Potential:

(i) Scalar magnetic Potential.

$V_m = -\int_b^a \bar{H}.d\bar{L}$



(ii) Vector magnetic potential

$\bar{B} = \nabla \times \bar{A}$

→ Curl of vector magnetic potential is the flux density $\bar{A}$ = wb/m.

* Magnetic Moment: (m)

→ It is the maximum torque per magnetic flux density.

$m = \frac{T}{B}$ (or) IA.

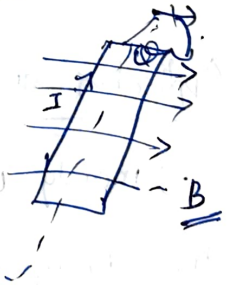
* Magnetic Torque (T):-

→ When a current loop is placed parallel to a magnetic field. forces act on the loop to rotate it.

→ The tangential force multiplied by the radial distance at which it acts → mechanical moments.

$T = B(IA) \sin\theta$

$T = m \times B$

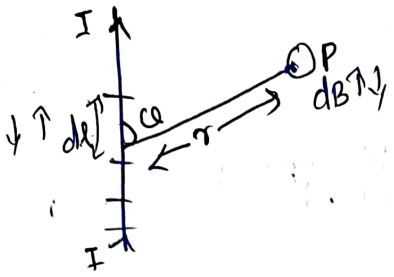


* Biot- Savart law:-

The magnetic flux density produced by a current element at any point in a magnetic field is,

→ proportional to the current element (Idl)

→ inversely proportional to the square of distance between them (r)



$dB \propto I\,dl$

$dB \propto \frac{1}{r^2}$

$dB \propto \sin\theta$

It can be written as.

$dB \propto \frac{I\,dl\,\sin\theta}{r^2}$

$$dB = \frac{\mu}{4\pi} \times \frac{I\,dl\,\sin\theta}{r^2}$$

where;

Idl → current element

r → the distance b/w Idl & the point 'p'

$\mu \Rightarrow \mu_0 \times \mu_r$ → permeability.

* Biot-Savart law in vector form:

$$\vec{dB} = \frac{\mu}{4\pi} \cdot \frac{Id\vec{l}\,\sin\theta}{\vec{r}^2} \times \frac{\vec{r}}{\vec{r}}$$

$$= \frac{\mu}{4\pi} \cdot \frac{Id\vec{l}\,\vec{r}\,\sin\theta}{(\vec{r})^3}$$

$$\vec{dB} = \frac{\mu}{4\pi} \cdot \frac{I(d\vec{l} \times \vec{r})}{\vec{r}^3}$$

$\vec{A} \times \vec{B} = AB\sin\theta$.

$d\vec{l} \times \vec{r} = dl\,\vec{r}\,\sin\theta$.

* Applications of Biot-Savart law:

→ mainly used to measure the magnetic field intensity & flux density at various points. (B & H) measured

Ex:- * To calculate magnetic field due to finite and infinite conductor.

* Magnetic field intensity on the axis of circular coil.

* 'H' on the axis of solenoid.

* 'H' on the axis of rectangular coil.