UNIT - 07

Magnetostatic

Magnet —

A piece of substance which have the property of attracting small pieces of iron like material toward it, is called magnet.

Properties of magnet: —

→ A magnet has two poles i.e north & south pole.

→ It has property of attracting iron like material.

→ Directional property i.e A freely suspended magnet always point particular direction i.e geographic north & South pole.

→ Magnetic poles are always exist in pair. Magnetic monopole doesn't exist.

→ Two similar pole repole each other then two dissimilar pole attract each other.

Coulomb's law in magnetism —

According to Coulomb's law the magnitude of the force between two magnetic poles varies directly with the product of their poles and inversely proposnal to the square of distance between them.

i.e $|\vec{F}| \propto m_1 m_2$

$|\vec{F}| \propto \frac{1}{r^2}$

$\Rightarrow |\vec{F}| \propto \frac{m_1 m_2}{r^2}$

$\Rightarrow |\vec{F}| = K \cdot \frac{m_1 m_2}{r^2}$

K is proaposnality Constant.

$K = \mu_0 / 4\pi$

$$\boxed{F = \frac{\mu_0}{4\pi} \cdot \frac{m_1 m_2}{r^2}}$$

($|\vec{F}|$ = magnitude of force of two pole. m_1 & m_2 are two pole strength of magnet.

$\mu_0 = 4\pi \times 10^{-7}$ wb $A^{-1} m^{-1}$

μ_0 = absolute magnetic permiability.

Magnetic field :—

Magnetic field of any magnetic pole is the space around it, within which its magnetic influence can be realised.

Magnetic lines of force :—

Lines of force is the path along which a unit north pole would move freely.

Property —

1) lines of force always directed away from north pole and directed towards the south pole.

2) For isolated poles, lines of force starts from north pole and ends at south pole.

3) Tangent at any point to the magnetic line of force gives the direction of magnetic intensity.

4) Two lines of force never intersect each other. If they do so then at a single point we get 2 direction for this which is impossible.

5) A unit magnetic pole produce 4π lines of force

6) The magnetic lines of force per unit area is proposnal to the magnitude of the strength of the magnetic field.

Magnetic field intensity (H) :—

Magnetic field intensity at a point in a magnetic field is defined as the magnetic force experienced by unit North pole placed at that point.

$$H = \frac{\mu_0}{4\pi} \frac{m}{r^2}$$

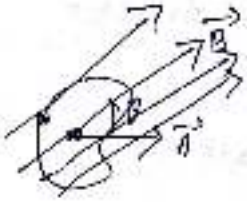
Magnetic flux :—

It is defined as no of magnetic lines of force passing through a given closed surface.

SI unit : Weber CGS Unit : Maxwell.

Mathematically it is product of the average magnetic field times the perpendicular area that it crosses or penetrates.

Magnetic flux = Magnetic field · Area.



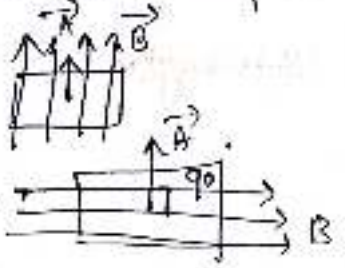
i.e $\phi = B \cdot A$

$= BA\cos\theta$

B = Magnetic field
A = Area ⊥r to the Magnetic field B

θ is the angle between Magnetic field and area vector.

if $\theta = 0$ | $\phi = BA$ (max)
if $\theta = \pi/2$ | $\phi = 0$ (min)
if $\theta = \pi$ | $\phi = -BA$.



1 weber = 1 Tesla × 1 m^2 — D.F =

1 Maxwell = 1 Gauss × 1 cm^2 — $[ML^2T^{-2}A^{-1}]$

$\boxed{1W = 10^8 \text{ maxwell}}$

Magnetic flux density :-

Magnetic flux density is defined as the amount of magnetic flux in an area taken perpendicular to the magnetic flux's direction.