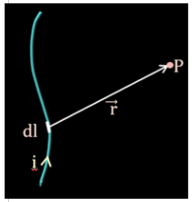
MIND MAP

Magnetic Effect of Currents

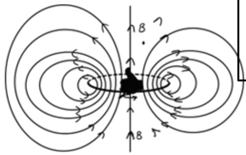
Biot Savart Law



$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{i\,d\vec{\ell} \times \vec{r}}{r^3}$$

SI unit of magnetic field ($\vec{B}$) is Tesla (T)

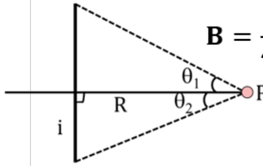
MF Lines due to current carrying loop



Torroid

$B = \mu_0 ni$

Magnetic field intensity due to straight current carrying wire



$$B = \frac{\mu_0 i}{4\pi R}(\sin\theta_1 + \sin\theta_2)$$

MFI due to semi infinite wire

$$B = \frac{\mu_0 i}{4\pi R}$$

MFI due to infinite wire

$$B = \frac{\mu_0 i}{2\pi R}$$

Solenoid

$$B = \frac{\mu_0 n i}{2}(\sin\theta_1 + \sin\theta_2)$$

	Magnetic field
Center of the current carryng loop	$\frac{\mu_0 i}{2R}$
Center of the current carrying circular loop	$\frac{\mu_0 i}{2R}\frac{\alpha}{2\pi}$
Axis of current carrying loop	$B = \frac{\mu_0 i}{2R}(\sin^3\theta)$

Magnetic Moment

$$\vec{\mu} = N\,i\,\vec{A}$$

Torque on a Current Carrying Loop

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

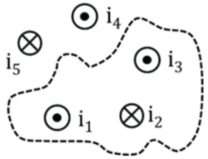
Magnetic Moment due to Rotation of Charge

$$\frac{\mu}{L} = \frac{Q}{2m}$$

MFI due to

Wire		$B = \frac{\mu_0 i}{2\pi R}$
Current Carrying ∞ Long Hollow Cylinder	r<R	$B = 0$
	r>R	$B = \frac{\mu_0 i}{2\pi r}$
Current Carrying ∞ Long Solid Cylinder	r<R	$B = \frac{\mu_0 i}{2}r$
	r>R	$B = \frac{\mu_0 i}{2\pi r}$

Ampere's Circuital Law

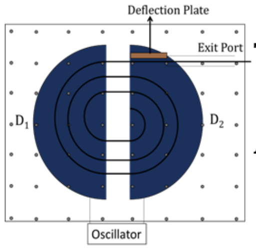


$$\oint \vec{B}\cdot d\vec{\ell} = \mu_0 \sum i$$

Magnetic field lines

- In case of straight current carrying wire magnetic field lines are circular with their centres on the wire.
- Tangent to the magnetic field line at a given point represents the direction of net magnetic field at that point.
- Magnetic field lines form continuous closed loops.

Cyclotron



$$T = \frac{2\pi m}{qB}$$

$$f_c = \frac{qB}{2\pi m} = f_{osc}$$

Resonance condition

Magnetic Force on a Moving Charge Particle

$$\vec{F}_m = q(\vec{v} \times \vec{B})$$

Motion of particle in plane ⊥ to $\vec{B}$

$$F = q\,v\,B = \frac{mv^2}{R}$$

Radius of circular path

If $\vec{v}$ is not ⊥ to $\vec{B}$

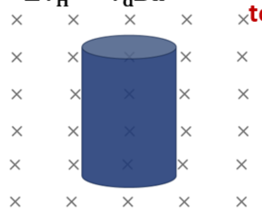
Helical path

$$R = \frac{mv_\perp}{qB} = \frac{mv\sin\theta}{qB}$$

Pitch of helix $T = \frac{2\pi m}{qB}$

Hall Effect

$$\Delta V_H = v_d B d$$



Hold the wire with right hand with thumb pointing along current then direction of curling of fingers will give direction of MFI.

Motion of Charged Particle in Presence of Both $\vec{E}$ and $\vec{B}$

Lorentz force $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$

Magnetic Force on a Current Carrying Wire Kept in Magnetic Field

$$\vec{dF} = i(d\vec{\ell} \times \vec{B})$$

Magnetic Force Between Two Current Carrying Wires

$$\frac{F}{\ell} = \frac{\mu_0\, i_1 i_2}{2\pi d}$$

Same direction currents attract each other and opposite direction currents repel each other.

When wires are perpendicular to each other.

$$F = \frac{\mu_0 i_1 i_2}{2\pi}\ell n\left(\frac{r_2}{r_1}\right)$$

Moving Coil Galvanometer

$\boxed{\tau = NIAB}$ $\boxed{\theta = \frac{NIAB}{k}}$