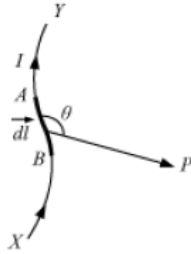


## 4. Moving Charges and Magnetism

- **Biot-Savart's law:**

$$dB = \frac{Idl \sin\theta}{r^2}$$



- The magnetic field at the centre of a circular coil-carrying current is given by

$$B = \frac{\mu_0 n I}{2r}$$

Where,

$n \rightarrow$  No. of turns in the coil

$I \rightarrow$  Current flowing through the circular coil

$r \rightarrow$  Radius of the coil

- The magnetic field at a point on the axis of a circular coil-carrying current is given by

$$B = \frac{\mu_0 n I r^2}{2(r^2 + x^2)^{\frac{3}{2}}}$$

Where,

$n \rightarrow$  No. of turns in the coil

$I \rightarrow$  Current flowing through the circular coil

$r \rightarrow$  Radius of the coil

$x \rightarrow$  Distance of the point from the centre of the coil

- **Ampere's circuital law:**

The line integral of magnetic field induction  $\vec{B}$  around a closed path in vacuum is equal to  $\mu_0$  times the total current  $I$  threading it.

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

- The magnetic field induction at a point well inside a solenoid is given by

$$B = \mu_0 n I$$

Where,  $n$  is the number of turns of the solenoid

- The magnetic field induction due to current in an ideal toroid is given by

$$B = \mu_0 n I$$

- **Lorentz Force:** It is the force experienced by a charged particle moving in a space where both electric and magnetic fields exist.

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

Where,

$q\vec{E} \rightarrow$  Force due to electric field

$q(\vec{v} \times \vec{B}) \rightarrow$  Force due to magnetic field

- Cyclotron  $\rightarrow$  Device to accelerate positively charged particles

➤ Cyclotron frequency:

$$\nu = \frac{Bq}{2\pi m}$$

Where  $m$  is the mass of the ion

➤ Maximum energy of positive ion:

$$\text{Max. K.E} = \frac{B^2 q^2 R^2}{2m}$$

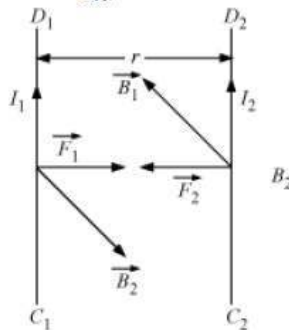
Where,  $R$  is the radius of the deez

- The force on a current-carrying conductor placed in a magnetic field is given by

$$F = IlB \sin\theta$$

- The force between two parallel conductors carrying current is given by

$$F_2 = \frac{\mu_0 I_1 I_2}{2\pi r}$$



Note

➤ Two linear parallel conductors carrying currents in the same direction attract each other.

➤ Two linear parallel conductors carrying currents in opposite directions repel each other.

- In a moving coil galvanometer, the coil is wound over the metallic frame in order to make the galvanometer dead beat, i.e., on passing current, the galvanometer shows a steady deflection without any oscillation.
- A moving coil galvanometer can be converted into an ammeter by introducing a shunt resistance  $r_s$  of a small value, in parallel. It can be converted into a voltmeter by introducing a resistance of a large value, in series.

Examrace