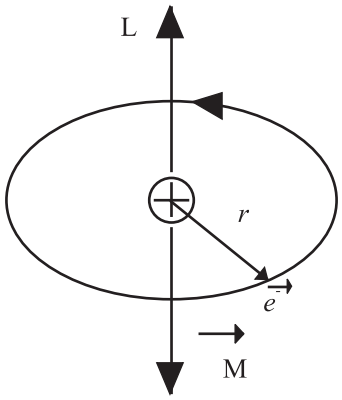
*(ii)* **Paramagnetic materials** are weakly attracted by a magnet, their permeability is more than 1 and susceptibility has a small positive value.

**(iii) Diamagnetic materials** are weakly repelled by a magnet, their permeability is less than 1 and susceptibility has a small negative value.

- **Hysteresis loop** is the result of cycle of magnetisation and demanetisation of magnetic material.
- **Retentivity** or residual magnetism is the property of a magnetic material by which magnetism is left in the specimen core even when magnetising field is reduced to zero.
- **Coercivity** is the property of a magnetic material which depends upon reverse value of magnetising field required to reduce residual magnetism to zero.
- **Curie law** can be stated as susceptibility ($\chi_m$) of a material varies inversely with temperature T (in kelvin) *i.e.*, $\chi_m = \frac{C}{T}$, where C is called curie constant.

C. **Magnetic dipole moment of a revolving electron.**

- **Expression for magnetic moment :** The electron of mass *m* and charge *e* is revolving in the orbit of radius *r* in anticlockwise direction. So the equivalent current is clockwise.




It is given $I = \frac{e}{T}$ where T = time period.

$\therefore I = \frac{e}{2\pi/\omega} = \frac{e\omega}{2p}$ [ ω = angular velocity of the electron ]

$\therefore$ Magnetic moment of the electron orbit, $M = I A = I \pi r^2$

$\therefore M = \frac{e\omega}{2p} \cdot \pi r^2 = \frac{1}{2} e\omega r^2 = \frac{e}{2m}(mr^2\omega)$

Now, angular momentum of the electron, $L = mvr = mr^2\omega$

$\therefore M = \frac{e}{2m} . L$

In vector form, $\vec{M} = -\frac{e}{2m}\vec{L}$

The negative sign implies that magnetic moment of the orbit is opposite to the angular momentum of the electron.

$\therefore M = \frac{e}{2} \cdot \frac{nh}{2\pi m} = n\left(\frac{eh}{4\pi m}\right)$

Minimum value of magnetic moment, $M = \frac{eh}{4\pi m}$ ($\because n = I$)

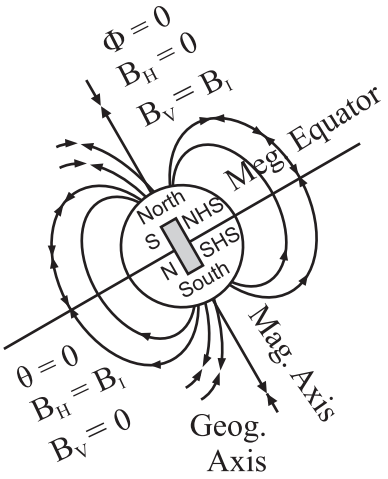
The equation gives the magnetic moment of the electron due to its **orbital motion.** The minimum value of the orbital magnetic moment is called Bohr magneton.

Bohr magneton : it is defined as the magnetic dipole moment associated with an atom due to orbital motion of an electron in the first Bohr orbit of hydrogen atom.

$$1 \text{ Bohr magneton} = \frac{1.6 \times 10^{-19} \times 6.62 \times 10^{-34}}{4\pi \times 9.1 \times 10^{-31}} = 9.27 \times 10^{-24} \text{ A-m}^2$$

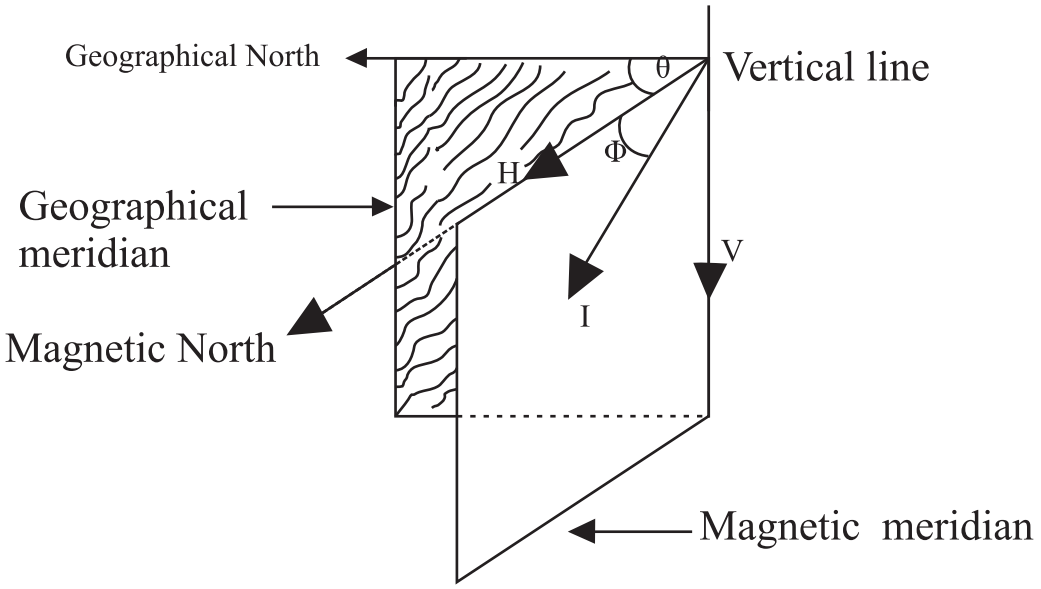
## D. TERRESTTRIAL MAGNETISM (EARTH'S MAGNETISM)

D -1



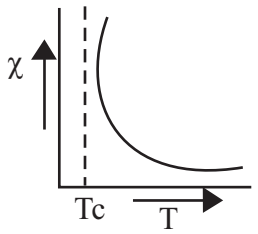
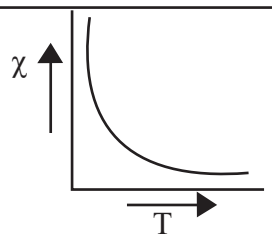
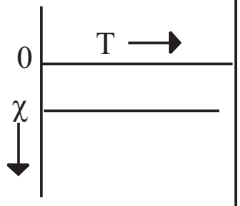

1. Φ = angle of dip
2. δ = declination
3. NHS = northern hemisphere
4. SHS = southern hemisphere

D -2 **EARTH'S MAGNETIC ELEMENTS :**




E

## VARIOUS CURVES FOR MAGNETIC MATERIALS

| Curve | Ferromagnetic material | Paramagnetic material | Diamagnetic material |
|---|---|---|---|
| (a) Magnetic susceptibility ($\chi$) temperature (T) |   |   |   |