## Chapter-5: Magnetism and Matter-Formulae

1. Magnetic Dipole Moment

$$M = 2lm$$

2. Magnetic field at an axial point due to a short magnet

$$B = \frac{\mu_0}{4\pi}\left(\frac{2M}{r^3}\right)$$

3. Magnetic field at equatorial position due to a short magnet

$$B = \frac{\mu_0}{4\pi}\left(\frac{M}{r^2}\right)$$

4. A current loop placed in a magnetic field $\vec{B}$ experiences a torque

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

5. A magnetic pole strength m placed in a magnetic field $\vec{B}$ experiences a force

$$\vec{F} = m\vec{B}$$

6. Intensity of Magnetisation$(\vec{I})$

$$I = \frac{M}{V}$$

7. Magnetic Intensity or magnetic field strength$(\vec{H})$:

$$\vec{B} = \vec{B}_0 + \vec{B}_M \Rightarrow \vec{B} = \mu_0\vec{H} + \mu_0\vec{I}$$

8. Magnetic permeability

$$\mu = \frac{B}{H}$$

9. Relative magnetic permeability$(\mu_r)$

$$\mu_r = \frac{\mu}{\mu_0}$$

$$\mu_r = \frac{B}{B_0}$$

10. Magnetic susceptibility ($\chi_m$)

$$\chi_m = \frac{I}{H}$$

11. Relation between relative permeability and magnetic susceptibility:

$$\mu_r = 1 + \chi_m$$

12. Curie's Law

$$\chi_m \propto \frac{1}{T} \; or \; \chi_m = \frac{C}{T}$$

13. Curie-Weiss law

$$\chi_m = \frac{C}{T - T_C}$$

14. For Paramagnetic Material

$$\mu_r > 1$$

$$\mu > \mu_0$$

$$\mathrm{X}_m \; slightly \; positive$$

$$\mathrm{X}_m \propto \frac{1}{T}$$

15. For Diamagnetic Material

$$\mu_r < 1$$

$$\mu < \mu_0$$

$$\mathrm{X}_m \; slightly \; negative$$

$$\mathrm{X}_m \; independent \; of \; temperature$$

(parallel to temperature axis and negative)

16. For Ferromagnetic Material

$$\mu_r \gg 1$$

$$\mu \gg \mu_0$$

$$\mathrm{X}_m \propto \frac{1}{T - T_C}$$

17. Work done to rotate a magnet from $\theta_1$ to $\theta_2$ in the uniform magnetic field

$$W = MB(\cos\theta_1 - \cos\theta_2)$$