Physics — Magnetism

Chapter: Magnetism

Key Definitions

- **Magnetism**: A physical phenomenon produced by the motion of electric charge, which results in attractive and repulsive forces between objects.
- **Magnetic Field**: A region around a magnetic material or a moving electric charge within which the force of magnetism acts. It is represented by the symbol (B) and is measured in teslas (T).
- **Magnetic Field Lines**: Imaginary lines that represent the magnetic field. The direction of the field lines indicates the direction of the magnetic force.
- **Magnetic Poles**: Every magnet has two poles: North (N) and South (S). Like poles repel each other, while opposite poles attract.
- **Electromagnet**: A type of magnet in which the magnetic field is produced by an electric current. It consists of a coil of wire, often wrapped around a core material.

Important Formulas

- **Magnetic Force on a Current-Carrying Conductor**:

$$F = BIL\sin\theta$$

Where:

- (F) = magnetic force (N)
- (B) = magnetic field strength (T)
- (I) = current (A)
- (L) = length of the conductor in the magnetic field (m)
- (\theta) = angle between the conductor and the magnetic field

- **Magnetic Field due to a Long Straight Conductor**:

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

Where:

- (\mu_0) = permeability of free space ((4\pi \times 10^{-7} \, \text{T m/A}))
- (r) = distance from the wire (m)

- **Magnetic Field due to a Circular Loop**:

$$B = \frac{\mu_0 I}{2R}$$

Where:

- (R) = radius of the loop (m)

Diagrams

- **Magnetic Field Lines of a Bar Magnet**:
- The lines emerge from the North pole and enter the South pole, forming closed loops. The density of lines indicates the strength of the magnetic field.
- **Right-Hand Rule**:
- To determine the direction of the magnetic field around a current-carrying conductor, point your thumb in the direction of the current, and your fingers will curl in the direction of the magnetic field lines.

Summary Table

Concept	Definition/Formula
Magnetic Field	(B) (T)
Force on Conductor	(F = BIL \sin \theta)
Field due to Straight Wire	(B = \frac{\mu_0 I}{2\pi r})
Field due to Circular Loop	(B = \frac{\mu_0 I}{2R})

Key Takeaways

- Magnetism is a fundamental force that affects charged particles and current-carrying conductors.
- The strength and direction of the magnetic field can be calculated using specific formulas.
- Understanding the behavior of magnetic fields is crucial for applications in electromagnetism, such as electric motors and generators.
- The right-hand rule is a useful tool for visualizing the direction of magnetic fields around conductors.