Magnet and Magnetic Effect of Current

Magnet:

- The materials which can attract the magnetic substances (such as cobalt, iron and nickel) are called a **magnet**.
- A magnet has two poles, **the North Pole (N) and the South Pole (S).** The magnet may be of the following two types:

1. Natural Magnet: The stones or minerals having magnetic Properties are called natural magnets.
Natural magnets have the following properties.

- These magnets have low magnetism.
- These magnets are brittle and cannot be used in laboratories.
- These magnets are of irregular shape.

2. Man-made Magnet: The magnets made artificially are called un-natural magnets. Strong magnets are made after magnetization of some metals or alloys by special methods.
Mostly they are made of steel. They are made in different shapes.

- Bar magnet
- Circular magnet
- Ring magnet
- Horse-shoe magnet
- U-shape magnet

Geometric Length and Magnetic Length:

- The distance between the locations of the assumed poles is called the magnetic length of the magnet.
- The distance between the ends of the magnet is called the geometrical length.
- **Magnetic length = $\frac{5}{6}$ × Geometric length**

Magnetic and Non-magnetic Materials:

- The materials which get strongly attracted towards a magnet are called magnetic material e.g. iron, nickel or cobalt etc.
- The materials which are not attracted towards magnetic magnet are called non-magnetic material e.g. plastic, rubber etc.
- The magnetic strength of a magnet is maximum near its poles.
- A freely suspended bar magnet always points towards North-South direction.

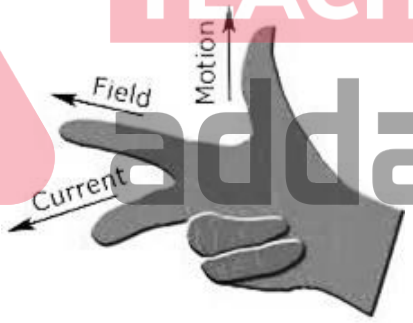
Magnetic Field:

- The space surrounding a magnet in which magnetic force can be experienced is called magnetic field. It has both magnitude as well as direction.
- Magnetic field lines are the lines drawn in a magnetic field along which a north magnetic pole would move.
- Some basic properties of magnetic field are:
  1. Magnetic field lines originate from North Pole and end at South Pole.
  2. Magnetic field lines come closer to one another near the poles of magnet but widely separated at other places.
  3. Magnetic field lines do not intersect each other.

Note: Magnetic field lines never intersect each other because resultant force at North Pole can only be in one direction.

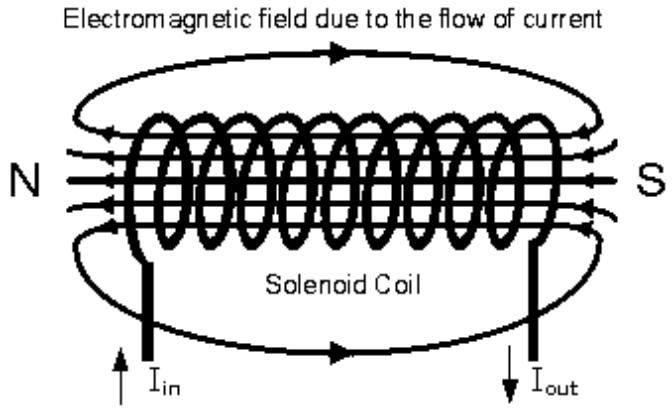
Magnetic Effect of Current: When electric current passes through a wire, it behaves like a magnet. This is the effect of the electric current.
The magnetic effect of current was observed by **Hans Christian Oersted.**

Right hand Thumb Rule: Right hand thumb rule states that **if we hold the current carrying wire in the right hand and if the thumb points towards the current, the direction in which the fingers encircle gives the direction of Magnetic field.**



Magnetic Field due to current in solenoid:

- Solenoid is a long coil containing a large number of close turns of insulated copper wire. The Magnetic field lines of a Bar Magnet are similar to that of solenoid.
- The magnetic field inside the solenoid is more but less outside it. Magnetic field inside solenoid is uniform i.e. same everywhere.



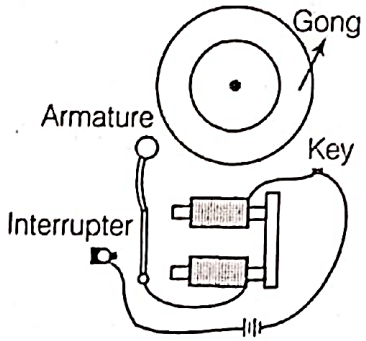
Electromagnet:

- It is a magnet formed by putting a soft iron core inside a current carrying solenoid. It is a temporary magnet as the magnetic effect is lost when there is no current flowing into it.
- The polarity of electromagnet can also be changed on changing the direction of current.

Some Applications of Magnetic Effects of Current:

Some applications of magnetic effects of current are given below:

(i) Electric Bell: An electric bell contains a coil of wire wound on an iron core that acts as an electromagnet. An armature having a hammer at one end is kept close to the electromagnet facing its poles as shown in the figure.



Electric bell

- If current flows through the coil, it becomes an electromagnet and attracts the armature made of iron.
- On account of it the armature gets pulled towards magnet. Hence, hammer at the end of armature strikes the gong of bell, to give sound.
- For making the bell ring continuously, a device (interrupter) is used to keep the hammer moving back and forth. The armature of the bell is constructed as such that current flows to the coil of electromagnet through a contact near its movable end. So, when armature is pulled by electromagnet, a break occurs in the circuit and current through coil ceases to flow. Then, armature is pulled back by spring attached to it, which brings back the contact to its original position to complete the circuit.
- The cycle is repeated when current flows again in the coil.

(ii) Generator or Dynamo: The dynamo or generator works on the principle of electromagnetic induction in which any pole of a permanent magnet is firstly moved inside or outside of a coil of wire, the current is induced in the coil.

- **Dynamo converts the mechanical energy into electric energy.**

(iii) Motor: It is an electrical machine which converts electrical energy into mechanical energy. It is based on the fact that a current carrying coil placed in the magnetic field experiences a torque. This torque rotates the coil.