Magnetic Field Lines (By Michal Faraday):

Field lines of magnetic field are imaginary lines; the tangent on these lines represents the direction of magnetic field.

Magnetic field lines are a visual tool used to represent magnetic fields. They describe the direction of the magnetic force on a north monopole at any given position.

Properties of Magnetic field lines:

- Magnetic field lines always emerge or start from the North Pole and terminate at the South Pole outside the magnet and South Pole to North Pole inside the magnet.
- Magnetic field lines never cross each other. [Why?]
- The density of the field lines indicates the strength of the field
- Magnetic field lines are continuous and always make closed-loops
- In any region, if field lines are equidistant and straight, the field is uniform otherwise not

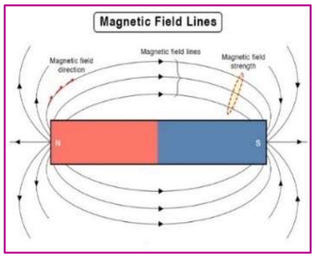


fig (a): Magnetic field around bar magnet

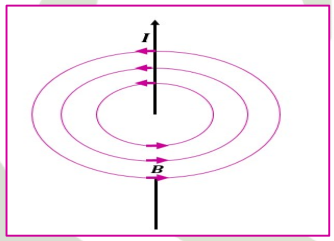


fig (b): Magnetic field around current carrying straight conductor

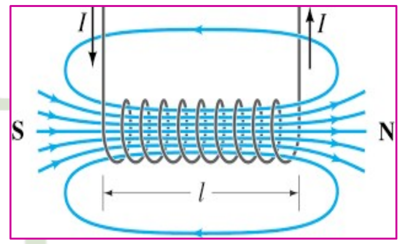
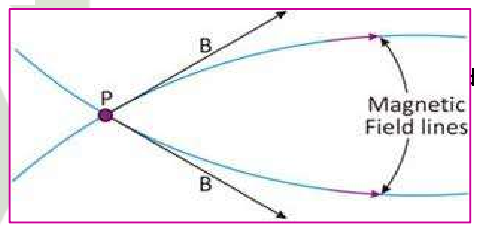


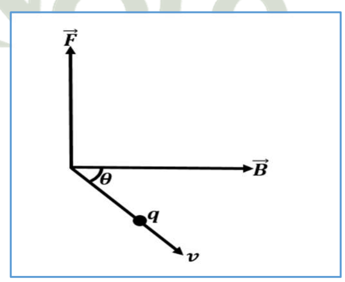
fig (c): Magnetic field around current carrying solenoid

Note:
The two magnetic field lines do not intersect each other because if they do, it means at the point of intersecting, the compass needle is showing two different directions, which are not possible.



Force on a moving charge due to magnetic field:

Let a charged particle of magnitude q enters in uniform magnetic field B with velocity V making an angle θ with the direction of magnetic field. When charged particle enters in a magnetic field, it experiences a force, which is known as Lorentz force.



Experimentally, it is found that the Lorentz force experienced by charged particle is

1. Directly proportional to magnitude of magnetic field.

   i.e. $F \propto B ------(1)$

2. Directly proportional to magnitude of charge.

   i.e. $F \propto q ------(2)$

3. Directly proportional to speed of charged particle,

   i.e. $F \propto v ------(3)$

4. Directly proportional to the sine of angle between the velocity and magnetic field.

   i.e. $F \propto \sin\theta ------(4)$

Combining above equation we get; $F \propto Bqv\sin\theta$