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chapter 4

Magnetic effect of Electric current

Magnetism in our nature

* Moving charge (Electric current) can be observed in solenoids, motors etc.
charge at rest only ⊕ ⊖ show electric ~~field~~ effects
charge in motion show both electric effects and Mg Magnetic effect

* Permanent Natural synthitic Materials like Irons, Nickel and cobalt and some alloys can be magnetised.
ex Magnetite / Hematite ores of Iron

Fe_3O_4 (Mixture)
Fe_2O_3 ⇓ FeO

$2Fe + O_2 \rightarrow Fe_2O_3$ & $Fe + H_2O \rightarrow \underset{\text{Magnetic iron oxide}}{Fe_3O_4} + H_2$

* Motion of Ions and charge at the core of the Earth creates Earth Magnetism.

Oersted's Experiment

Hans christan Oersted, one of the leading Scientist of the 19th century, played a crucial role in understanding electromagnetism.

In 1820, he accidentally discovered that a compass needle got deflected when an electric current passed through a metallic wire placed nearby.

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Observing Magnetic field and MFL

As Oersted concluded, that there is a relation b/w electricity and magnetism numerous other experiments were carried out in different parts of the world like :-

Hear we can observe that a current carrying wire also creats magnetic field around it due to which, Iron fillings are arranged in and orderly manner

Magnetic field & its lines (Bar Magnet)

Magnetic field :- The magnetic field is the area around a magnet in which the magnetic force can be experienced by others ferromagnetic Materials, Magnets, Moving charge etc.

Magnetic field lines :- Magnetic field lines (MFL or MLF (Magnetic lines of force)) are imaginary lines used to represent magnetic fields around a magnetic sustance

They help describing the direction of the magnetic force acting on Magnetic substance.

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Properties of Magnetic field lines (MFLs)

1) (By convention) that the field lines emerge from north pole and merge at the south pole. Inside the magnet, the direction of field lines is from its south pole to its north pole.

2) Field lines are closed curves

3) Fields lines are (crowded near poles) which shows strength of the magnetic pole.

4) Two field lines cannot cross each other at any time

Why don't Two Magnetic fields lines do not intersect?

* Method of contradiction

Lets suppose, two MFL intersect each other. if we put a magnetic compass at the point of intersection needle cannot show two directions simultaneously so MFL do not intersect.

Bar Magnet

A bar magnet is a long rectangular bar of uniform cross section which attracts pieces of iron, steel, nickel and cobalt.

Properties of Bar Magnet:

→ It has two poles - North pole and south pole
→ It attracts iron and steel particles
→ like poles repels each other unlike poles attract

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each other

←N N→ ←S S→ ~~N S~~ N→ ←S

↳ When freely suspended north pole ~~attract~~ ~~each other~~ of magnet points towards north pole of the earth

→ They are permanent magnets - they do not lose their magnetism until hammered

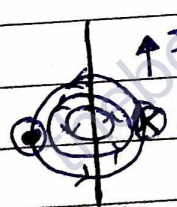
* Maxwell Right hand Thumb Rule

Maxwell's right-hand thumb rule indicates the direction of magnetic field if the direction of current is known.

→ According to this rule, if we grasp the current carrying wire in our right hand so that our thumb points in the direction of current, the direction in which our fingers encircle the wire will give the direction of magnetic field lines around the wire.

When thumb points upwards, the curled fingeres are anticlockwise so, the direction of magnetic field is anticlockwise

Magnetic field lines: Straight conductor / Moving charge



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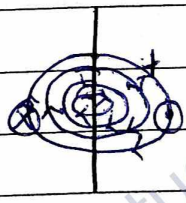

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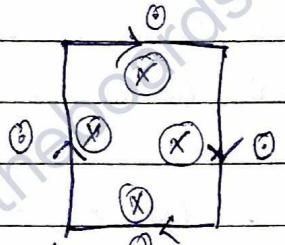
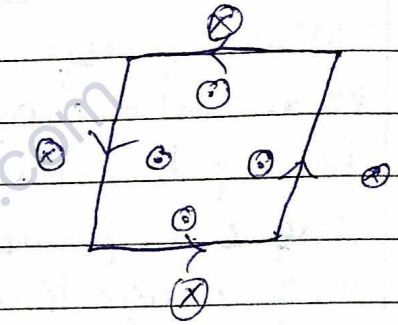
closed circular loop



current → clock wise ↻

Inside → ⊗ ⇒ South pole



current anticlock wise ↺

Inside → ⊙ ⇒ North pole

Magnetic field lines: current carrying solenoid

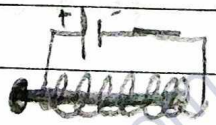
Solenoid is a current carrying coil having multiple circular loops, produced M.F similar to that Bar Magnet.

* M.F of solenoid resembles to that of bar magnet

Application of current carrying solenoid.

In Air core of solenoid keep soft iron and connect to battery formed Electromagnet or temporary magnet.

Solenoid with core



Solenoid as electromagnet

In Air core of solenoid keep hard iron as a core and connect to battery formed permanet Magnet

Eg - Bar magnet • Hard Iron = Fe/Ni/Co

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M.F Denotid by B & SI unit is Tesla.

In side of solenoid m.f is same & at corner M.F become half $\left(\frac{M.F}{2}\right)$ and Just above and below its zero.

Flemings Left Hand Rule

§ It indicates ~~left hand rule~~ the direction of ~~M.F~~ Magnetic force if the direction of current and the direction of magnetic field is known.

When a current carrying conductor is placed in an external magnetic field, the conductor experience a force which is mutually perpendicular to both the magnetic field and to the direction of the current flow.

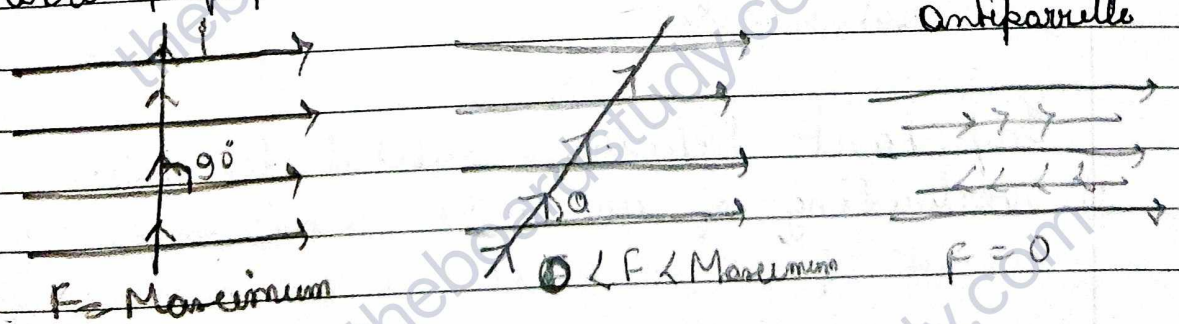
Jis direction me ⊕ entity jenki hai usi direction me current maan kar rule lagado.

Jis direction me ⊖ entity jenki hai uske opposite direction me current maan kar, rule lago do.

Nuetral No force acts on neutral particle

Changing Orientation of straight conductor

1) Wire kept perpendicular 2) Wire kept at an angle 3) Wire kept parrell or Antiparrelle



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Domestic Electric Circuit (DEC

We receive power in our house through a main supply commonly called mains.

- It is supplied through overhead cables or underground cables.
- The potential difference (or voltage) supplied in our country is 220 V @ 50Hz.
- There are 3 types of wires in domestic circuits - Earth wire, live wire, neutral wire.

Earth wire :- It is generally green in colour. It is usually connected to a metal (copper or Aluminium) plate place in the earth near the house as a safety measure to ground gadgets that ~~above~~ have metallic body (refrigerator, toaster). In case of charge leaking on to the metalic body the charges gets grounded and thus prevent shocks.

Live wire :- positive wire generally red in colour.
Neutral wire :- Negative wire generally black in colour.

Generally there are 2 types of electric circuits are used as homes:
15 A :- Appliances which have higher power ratings. Power socket.
5 A :- Appliances which have lower power ratings Normal shocket.

Important Definition related to D.E.C

1) Overloading of an electric circuit means when current flows in a circuit it becomes more

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the capacity of components in the circuit to resist the current. when too much current passes an electric overload occurs through electric wires, which may cause fire to Break.

2. Short circuiting : A short circuit is an electrical circuit that allows a current to travel along an unintended ~~that~~ path with very low electrical resistance This result in an ~~with very low Electrica~~ excessive current flowing through the circuit, which may cause ~~to~~ fire to breaks

AC & DC

~~Alternating Ct Distance~~ Alternating current	DC Direct constant
AC is safe to transfer longer distance even and maintain the the electric power	DC cannot for a away longe distance. It loses electric power. The ~~following~~ rotating magnet caused the change the DC in direction of electric flow, the steady magnetism make DC flow in a single direction
The frequency of AC is depended upon the contry But generally, the frequency is 50 HZ or 60 HZ	DC has no frequency of zero frequency

- In AC the flow of current changes its direction backward periodically — flow in a single direction steadly
- Electrons in AC keep changing its direction backward and forward — Electrons only move in one direction – what is forward.
- AC is less expensive and easy to generate than DC