→ Magnetism (चुम्बकत्व)

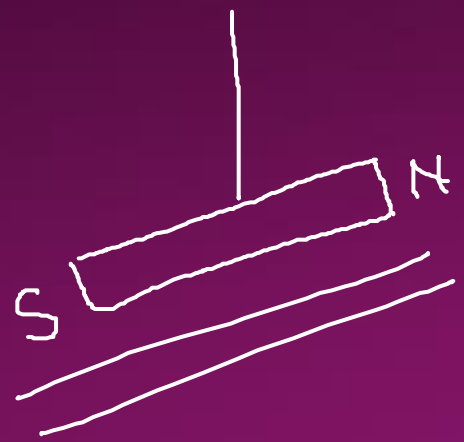
MAGNETISM

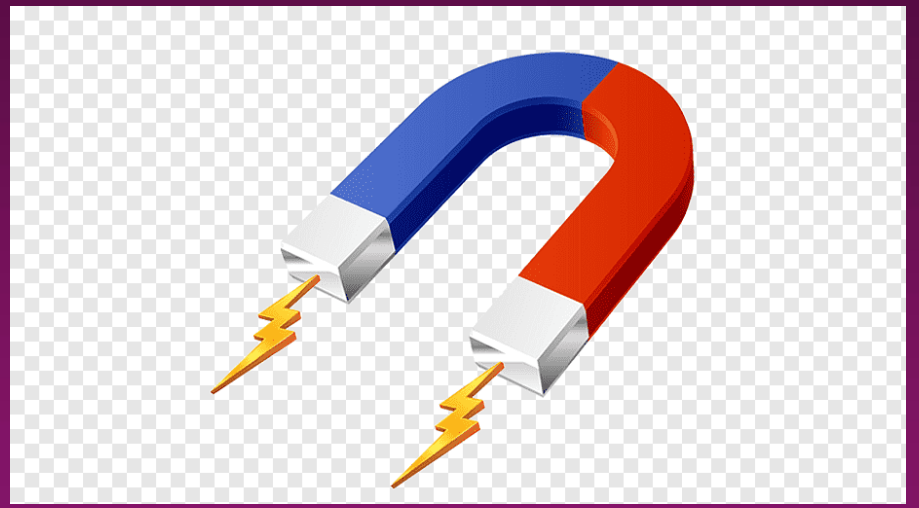
MAGNET
(चुम्बक)

Magnet

- A magnet is a material which can attract iron objects.
- A **natural magnet** is an ore of iron (Fe_3O_4) called magnetite or lodestone.
- A magnet which is prepared artificially is called an **artificial magnet**.

e.g:- दंड चुम्बक, → Steel





TYPES :

There are three types of magnets, and they are as follows:

1. Permanent magnet (स्थायी)
2. Temporary magnet (अस्थायी)
3. Electromagnets (विद्युत चुम्बक)

- मैग्नेट तीन प्रकार के होते हैं, और वे इस प्रकार हैं:

- 1. स्थायी चुंबक

- 2. अस्थायी चुंबक

- 3. इलेक्ट्रोमैग्नेट्स

Permanent Magnet:

Permanent magnets are those magnets that are commonly used. They are known as permanent magnets because they do not lose their magnetic property once they are magnetized.

Following are the ways to demagnetize the permanent magnets:

1. Exposing magnets to extreme temperatures.

2. The magnetic attraction between the magnet's atoms gets loosen when they are hammered.

3. Stroking one magnet with the other in an inappropriate manner will reduce the magnetic strength.

- **<u>स्थायी चुंबक</u>**:
- स्थायी मैग्नेट वे मैग्नेट होते हैं जो आमतौर पर उपयोग किए जाते हैं। उन्हें स्थाई चुम्बक के रूप में जाना जाता है क्योंकि वे चुम्बकित होने के बाद अपनी चुंबकीय संपत्ति नहीं खोते हैं।

- स्थाई चुम्बकों को निष्क्रिय करने के तरीके निम्नलिखित हैं:

- 1. अत्यधिक तापमान पर मैग्नेट का एक्सपोजर।

- 2. चुंबक के परमाणुओं के बीच चुंबकीय आकर्षण ढीला होने पर ढीला हो जाता है।

- 3. एक चुंबक को दूसरे के साथ अनुचित तरीके से मारने से चुंबकीय शक्ति कम हो जाएगी।

There are four types of permanent magnets:

- Ceramic or ferrite
- Alnico
- Samarium Cobalt (SmCo)
- Neodymium Iron Boron (NIB)

- **Temporary Magnet :**

Temporary magnets can be magnetized in the presence of a magnetic field. When the magnetic field is removed, these materials lose their magnetic property. Iron nails and paper-clips are examples of the temporary magnet

चुंबकीय क्षेत्र की उपस्थिति में अस्थायी चुम्बकों को चुम्बकित किया जा सकता है। जैब

चुंबकीय क्षेत्र हटा दिया जाता है, तो ये पदार्थ अपनी चुंबकीय संपत्ति खो देती हैं। लौहे के

कील और पेपर-क्लिप अस्थायी चुंबक के उदाहरण हैं

- **Electromagnets:**

Electromagnets consist of a coil of wire wrapped around the metal core made from iron. When this material is exposed to an electric current, the magnetic field is generated making the material behave like a magnet. The strength of the magnetic field can be controlled by controlling the electric current.

इलेक्ट्रोमैग्नेट्स में लोहे से बने धातु कोर के चारों ओर तार के एक तार होते हैं। जब यह

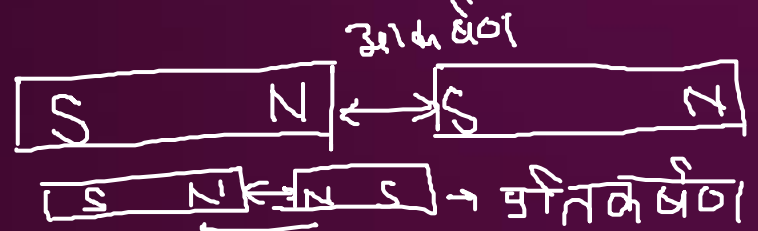
पदार्थ एक विद्युत प्रवाह के संपर्क में होती है, तो चुंबकीय क्षेत्र उत्पन्न होता है जिससे

पदार्थ चुंबक की तरह व्यवहार करती है। विद्युत धारा को नियंत्रित करके चुंबकीय क्षेत्र की

ताकत को नियंत्रित किया जा सकता है

Characteristics of Magnet

Attractive property: This property proves that the magnetic strength at the ends of the poles is strong.



Directive property: This property helps to understand which pole of the magnet is north and south by suspending the magnet in mid-air.

Law of magnetic poles: Like poles repel while unlike poles attract.

Pair property: When a magnet is cut into two pieces, both the pieces will have the North Pole and the South Pole.

Sure test of magnetization: This test is conducted to check if a given rod is magnetized or not by checking either the attraction or the repulsion of the iron rod and magnet.

Uses of Magnets

Magnets are used for constructing magnetic needles and mariner's compass.

Permanent magnets find applications in generators, electric accelerators, and electric motors.

Electromagnets find application in speakers, electric bells, and electric cranes.

Magnets are used for the separation of iron filling from other solid mixture.

- मैग्नेट का उपयोग

- मैग्नेट का उपयोग चुंबकीय सुई और मेरिनर के कम्पास के निर्माण के लिए किया जाता है।

- स्थायी मैग्नेट जेनरेटर, इलेक्ट्रिक एक्सेलेरेटर और इलेक्ट्रिक मोटर्स में अनुप्रयोग पाते हैं।

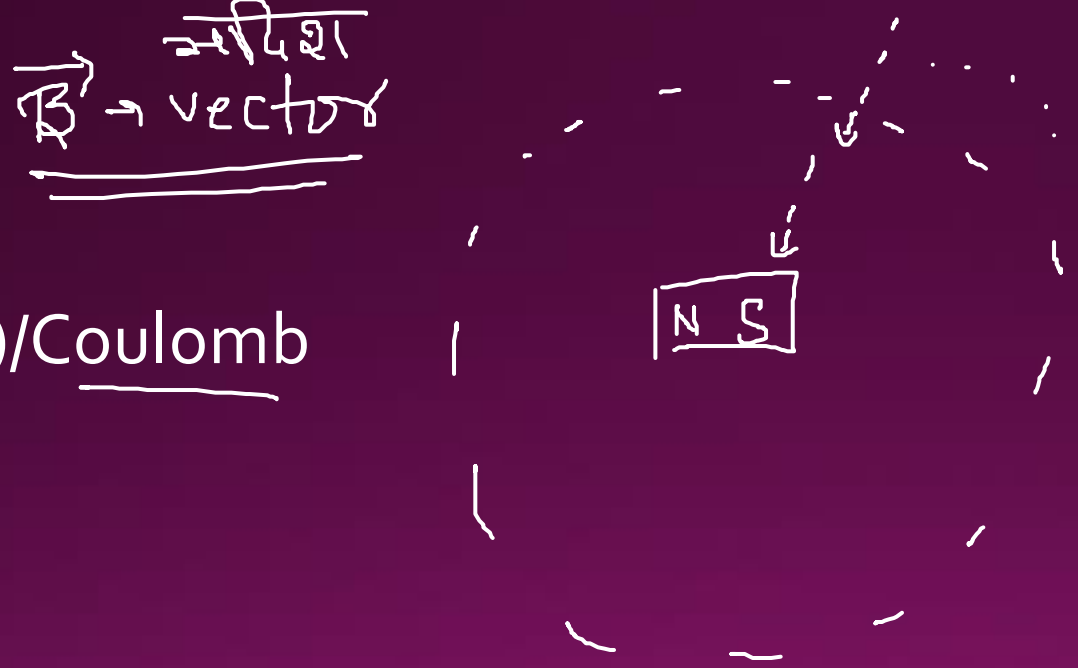
- इलेक्ट्रोमैग्नेट्स स्पीकर, इलेक्ट्रिक बेल्स और इलेक्ट्रिक क्रेन्स में एप्लिकेशन ढूंढते हैं।

- अन्य ठोस मिश्रण से लोहे के भराव को अलग करने के लिए चुंबक का उपयोग किया जाता है।

MAGNETIC FIELD

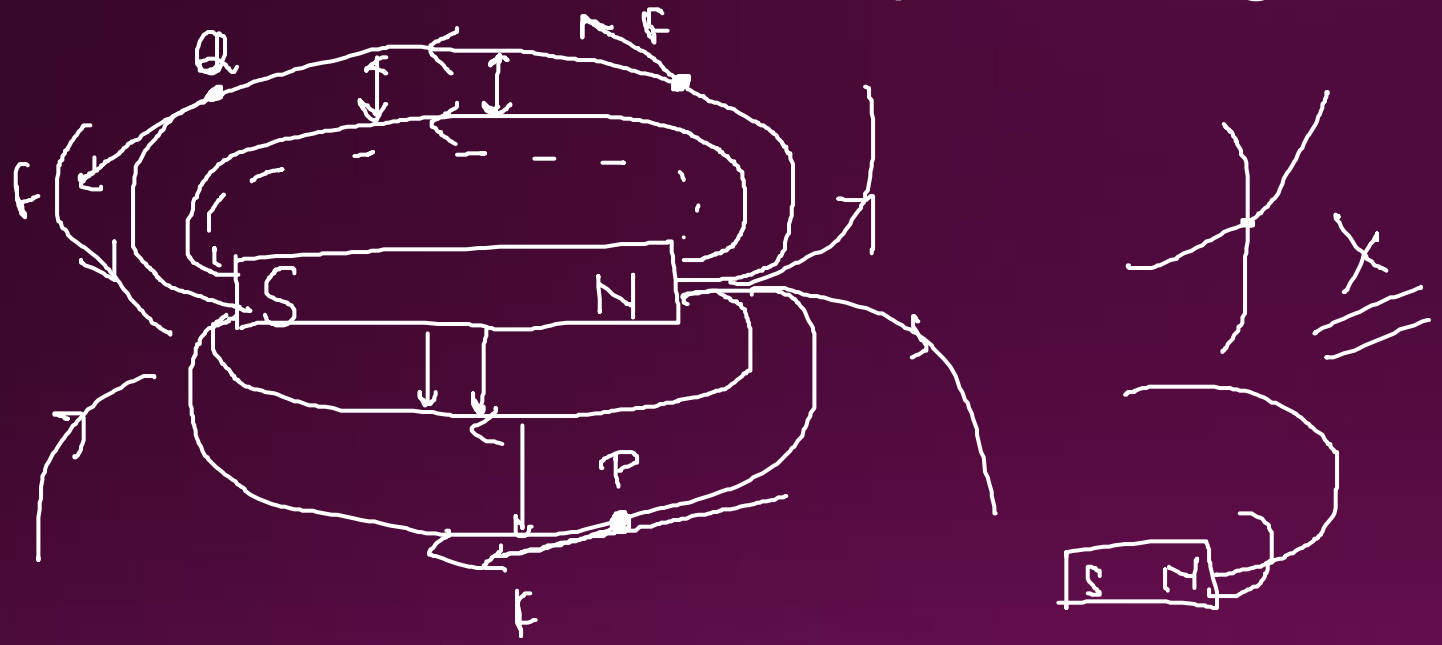
- Magnetic Field is the region around a magnetic material or a moving electric charge within which the force of magnetism acts.

- Symbol B or H
- Unit Tesla
- Base Unit (Newton Second)/Coulomb

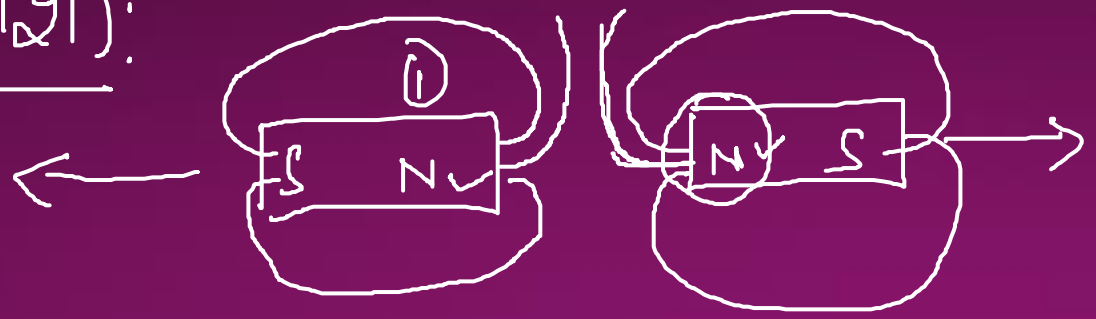


MAGNETIC FIELD LINES

- Magnetic field lines are a visual tool used to represent magnetic fields.



* Closed Loop (बन्द पाश):



Properties of Magnetic Field Lines

Magnetic field lines never cross each other

The density of the field lines indicates the strength of the field

Magnetic field lines always make closed-loops

Magnetic field lines always emerge or start from the north pole and terminate at the south pole.

MAGNETIC FLUX

- **Magnetic flux** is defined as the number of magnetic field lines passing through a given closed surface. It provides the measurement of the total magnetic field that passes through a given surface area.

Symbol

Magnetic flux is commonly denoted using Greek letter Phi or Phi suffix B.

Magnetic flux symbol: Φ or Φ_B.

Φ_B

$\Phi_B = B \cdot A$

$= BA\cos\theta$

Formula

$$\varphi B = B.A = BA\cos\Theta$$

Magnetic Flux Unit

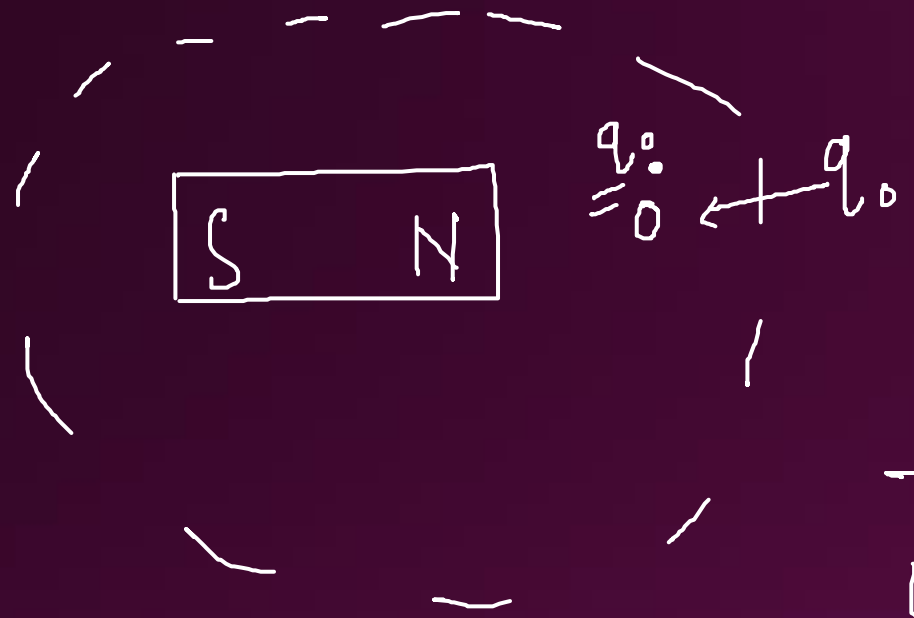
Magnetic flux is usually measured with a **flux meter**.

SI unit of magnetic flux is **Weber (Wb).**

The fundamental unit is **Volt-seconds.**

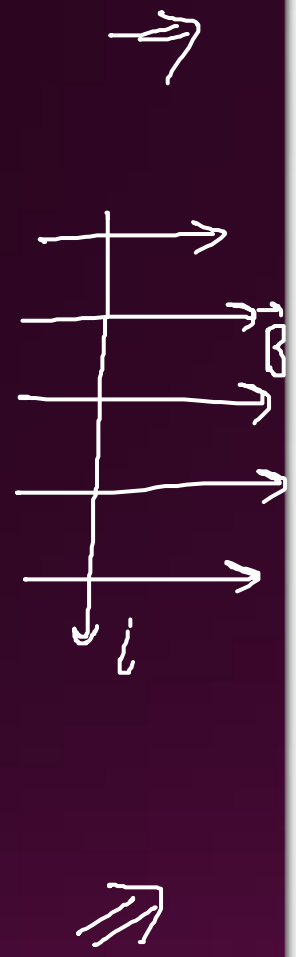
The CGS unit is **Maxwell.**

Magnetic Forces on Charged Particles

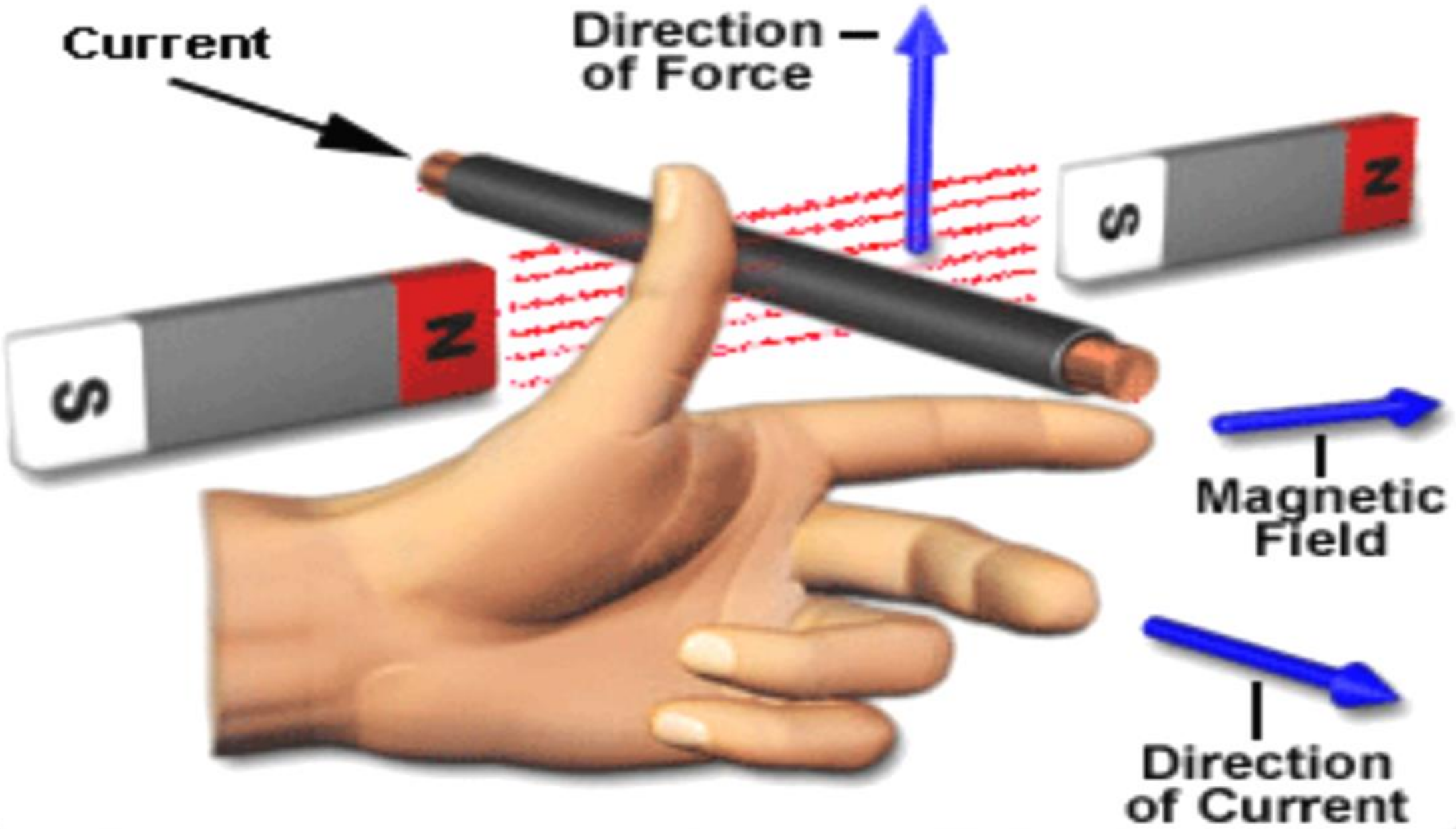


$$\vec{F}_m = q\,\vec{v}\,\vec{B}\sin\theta$$

Unit => Newton



Left Hand Rule



Introduction

- **Magnetic Materials** are those materials in which a state of magnetization can be induced. In other words, The materials which can be magnetized are known as Magnetic Materials.
- **Magnetic Moment** is a measure of the strength of a magnet. It is the product of strength of one of the poles and the distance between the two poles of a magnet.

Classification Of Magnetic Material

- Magnetic materials are classified into different categories based on their magnetic parameters. And also on the basis of effect of temperature and magnetic field on the magnetic properties.
- So, all materials are classified broadly into the following three categories
  - Diamagnetic Materials
  - Paramagnetic Materials
  - Ferromagnetic Materials
  - Antiferromagnetic Materials
  - Ferrimagnetic Materials

These are having very close structure to ferromagnetic materials but posses different magnetic effect.

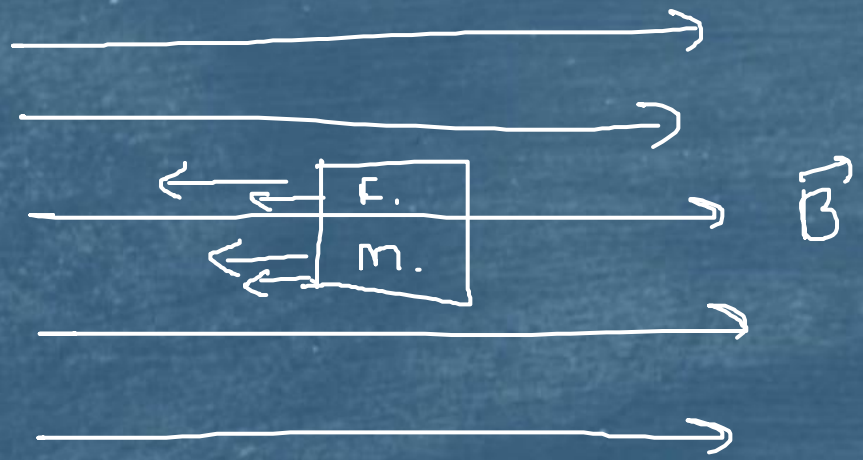
Diamagnetic Materials

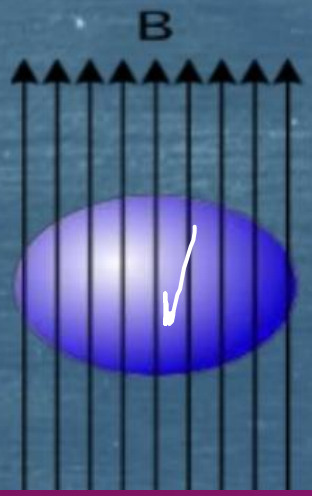
⇒ (प्रतिचुम्बकीय पदार्थ)

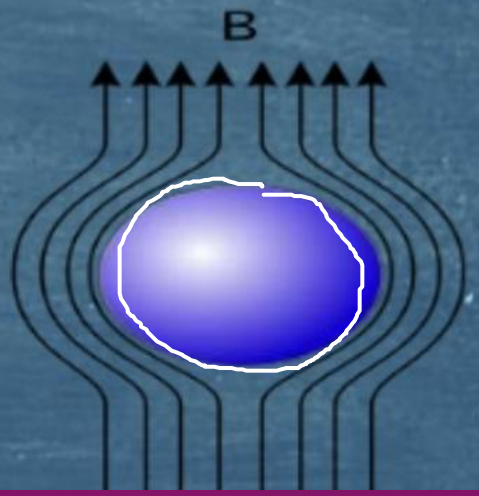
examples:

- Bi
- Zn
- Cu
- Ag
- NaCl
- Hg
- N_2

- **Diamagnetic** materials create an induced magnetic field in a direction opposite to an externally applied magnetic field.
- They are repelled by the applied magnetic field.
- The permanent dipoles are absent in Diamagnetic materials







General Properties of Diamagnetic Materials

- Diamagnetic Materials experiences a repelling force when brought near the pole of a strong magnet.
- The magnetic susceptibility χ of these materials is always negative.
- The relative permeability μr is always less than one.
- In the absence of external magnetic field ,The net magnetic dipole moment over each atom or molecule of a diamagnetic material is zero. This is due to pairing of electrons.
- Examples:-Bismuth,Copper,Lead,Zinc etc.

examples

Cr

Al

Na

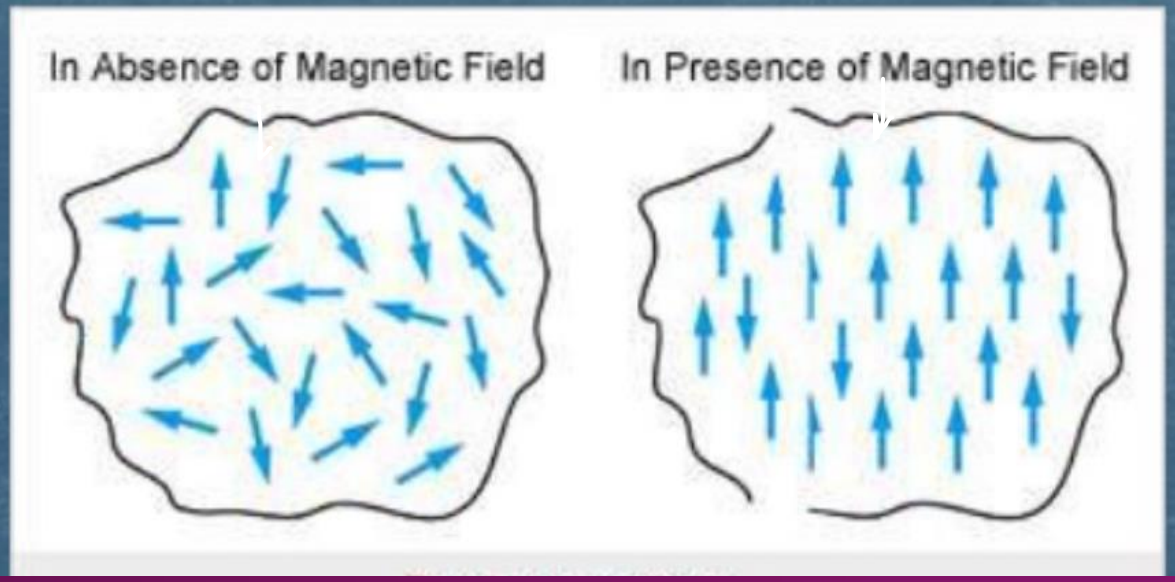
Mn

$CuCl_2$

Liquid O_2

Paramagnetic Material
(अनुचुम्बकीय पदार्थ)

- Paramagnetic materials exhibit magnetism when the external magnetic field is applied. Paramagnetic materials loose magnetization in the absence of an externally applied magnetic field. These materials are weakly attracted towards magnetic field.



General Properties of Paramagnetic materials

- Paramagnetic materials experiences a feeble attractive force when brought near the pole of a magnet
- These materials possess some permanent dipole moment which arise due to some unpaired electrons.
- The magnetic susceptibility χ is small and +ve.
- Examples:-Platinum,Aluminium,Copper sulphate etc.

Ferromagnetic Material

(लौह चुम्बकीय पदार्थ)

examples

Fe

Ni

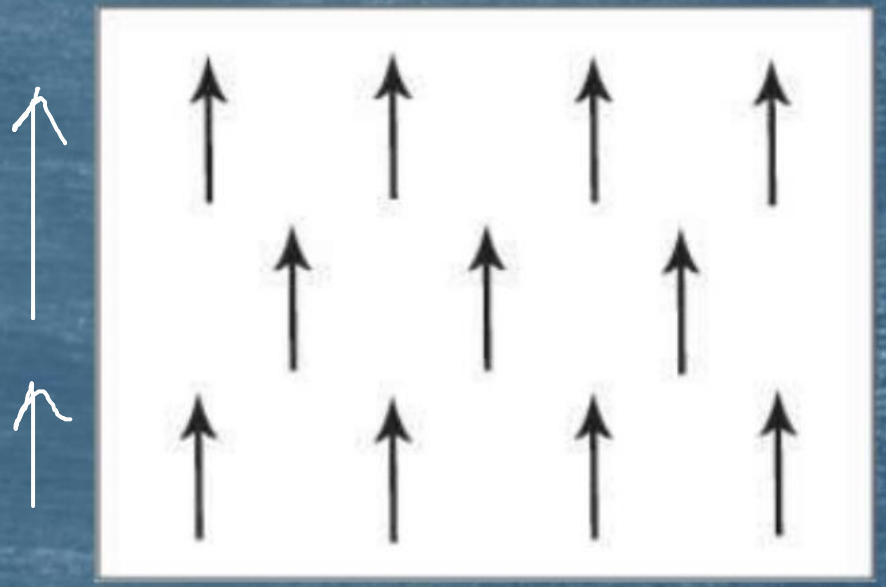
Co

Fe_3O_4

Ferric Chloride

पतला रूप से चुम्बकित

- It is the phenomenon in which a material gets magnetized to a very large extent in the presence of an external field.
- The direction in which the material gets magnetized is the same as that of the external field.



General Properties of ferromagnetic materials

- Ferromagnetic materials experience a very strong attractive force when brought near the pole of a magnet.
- Permeability is very much greater than one.
- Susceptibility is +ve and high.
- Examples:-Fe,Co,Ni,MnAs etc.

CURIE TEMPERATURE

क्यूरी तापमान

लौह-चुम्बक

- The Curie temperature is the one at which ferromagnetic material turns to paramagnetic o heating. This kind of transition is used in optical storage media for erasing and inserting new data.

→ लौह चुम्बकीय पदार्थ ⇒ तापमान ↑ ⇒ Ni, Co, Iron (Fe)

↓

Curie Temp

↓

{ Ni → 350°C
Co → 1121°C
Fe → 770°C }

अनु चुम्बकीय

↓ तापमान ↓

लौह चुम्बकीय

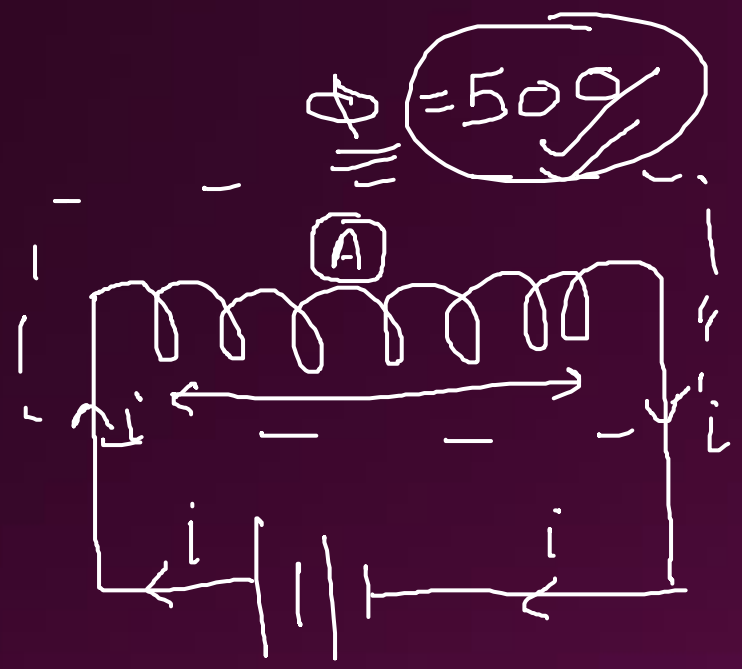
INDUCED EMF (प्रेरित या प्रेरण)

- It can be defined as the generation of a potential difference in a coil due to the changes in the magnetic flux through it.

- In simpler words, electromotive Force or EMF is said to be induced when the flux linking with a conductor or coil changes.

Electromotive forces can be induced in two different ways –

- The first way involves the placement of an electric conductor in a magnetic field that is moving.
- The second way involves the placement of a constantly moving conductor of electricity into a magnetic field that is static in nature.



$i \rightarrow$ constant

Φ_B = constant (flux)

$\left\{ \begin{array}{l} i \rightarrow \text{increase} \\ i \rightarrow \text{decrease} \end{array} \right\}$

$$\frac{d\Phi}{dt} = e \rightarrow \text{induced emf}$$

$$f = BvL$$

Applications

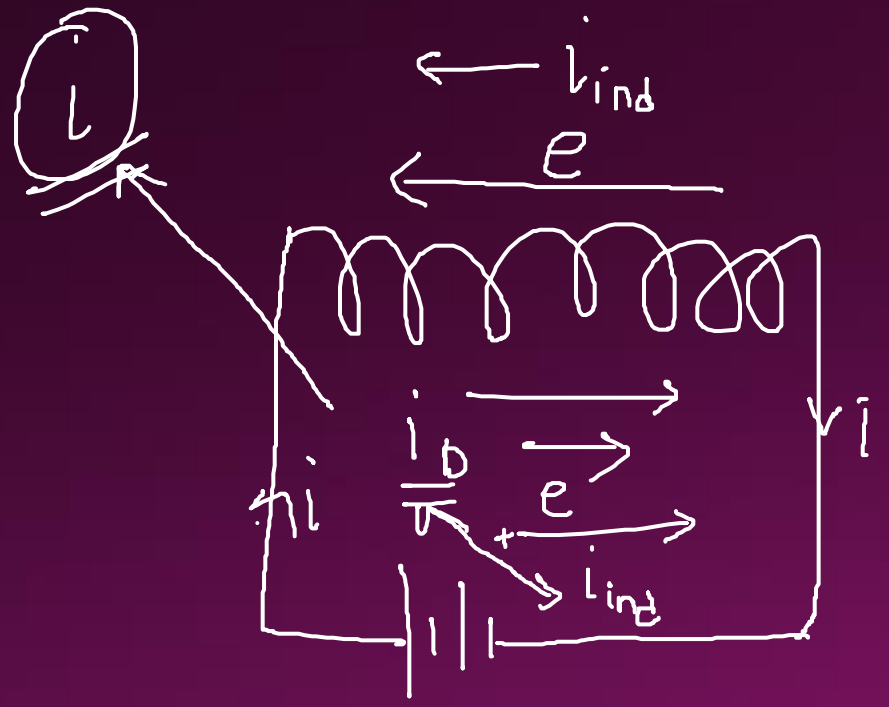
Used in generators

Used in galvanometers

Used in transformers

LENZ'S LAW

- The induced electromotive force with different polarities induces a current whose magnetic field opposes the change in magnetic flux through the loop in order to ensure that original flux is maintained through the loop when current flows in it.



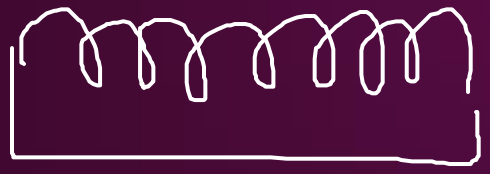
i → increas

e → Direction → i के opst

i → Decrease

e → Direction of i

Lenz's Law Formula



$$Emf = -N(\Delta\varphi/\Delta t)$$

$$\left| e = -N \frac{\Delta \phi}{\Delta t} \right|$$

Where,

Emf is the induced voltage (also known as electromotive force).

N is the number of loops.

$\Delta\varphi$ Change in magnetic flux.

Δt Change in time

Lenz's Law Applications

Eddy current balances (भँवर धारा) ⇒ उच्च प्रतिरोध धारा

Metal detectors

Eddy current dynamometers

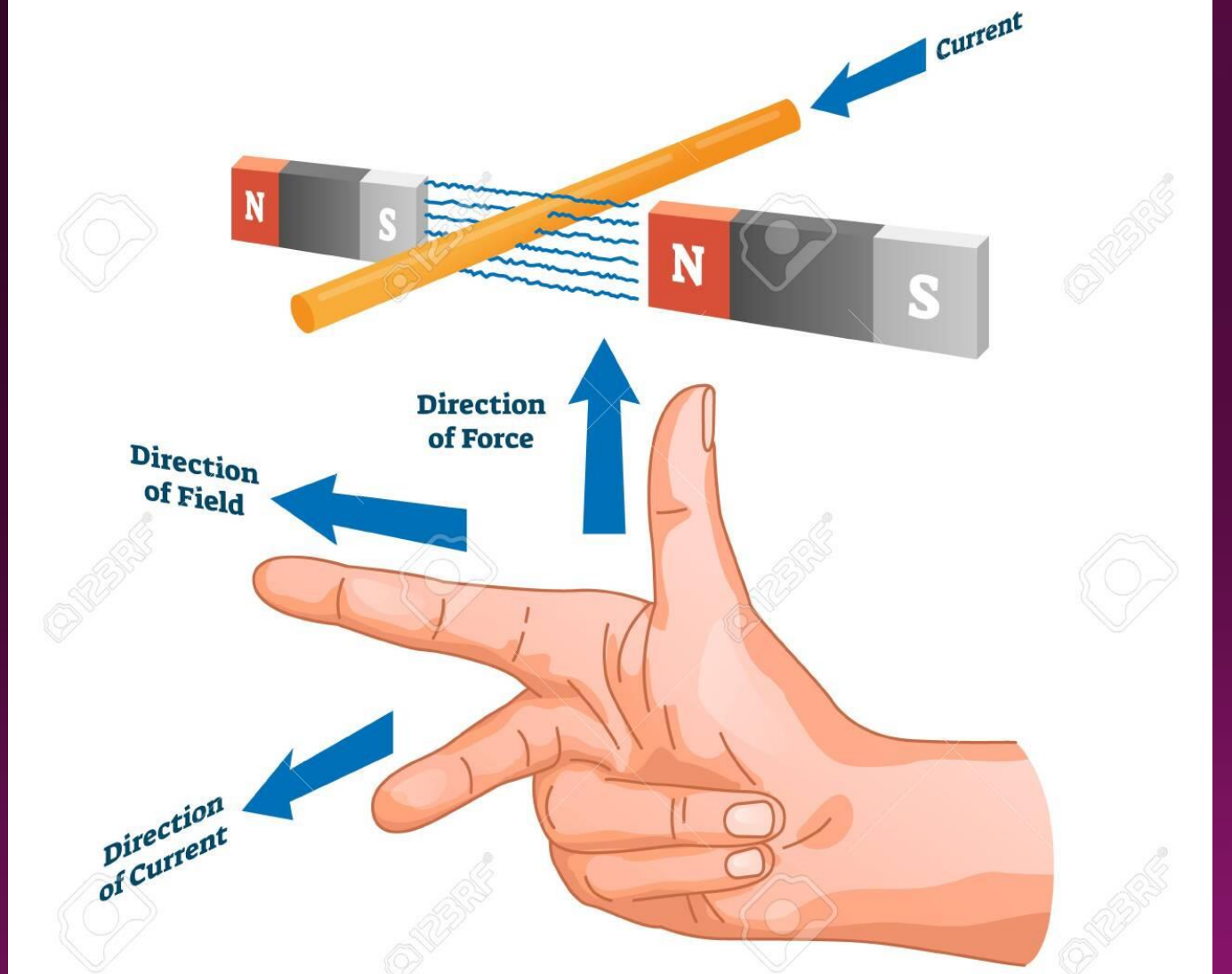
Braking systems on train

AC generators

Card readers

Microphones

FLEMING'S
RIGHT HAND RULE



Induction

Induction is the magnetic field which is proportional to the rate of change of the magnetic field.

Induction is also known as inductance. L is used to represent the inductance and Henry is the SI unit of inductance.

Factors Affecting Inductance

The number of turns of the wire used in the inductor.

The material used in the core.

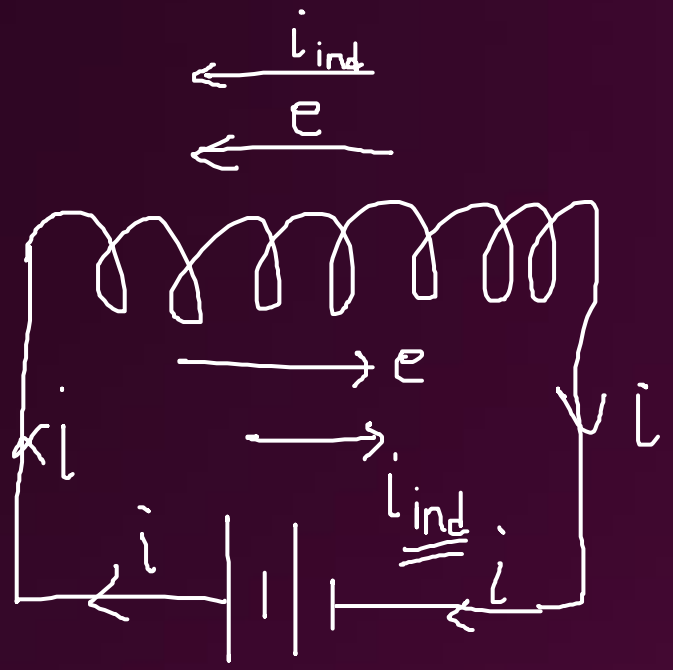
The shape of the core.

- **Types of Inductance**

Self Induction (स्व: प्रेरण)

Mutual Induction (अन्योन्य प्रेरण)

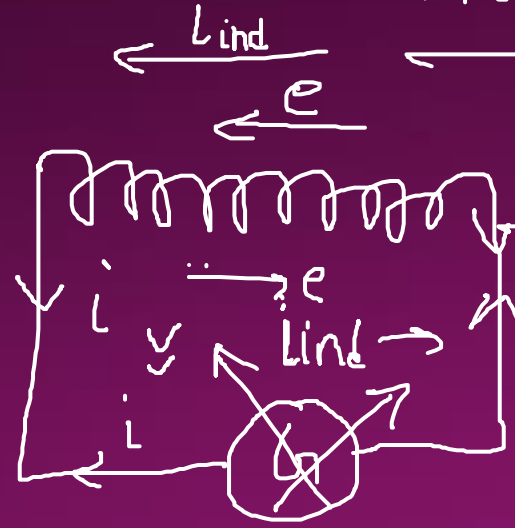
Self Induction

① 

circuit current (i) Change

Mutual Induction

② 

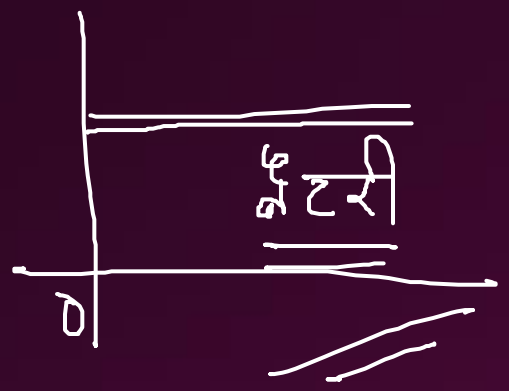


circuit current

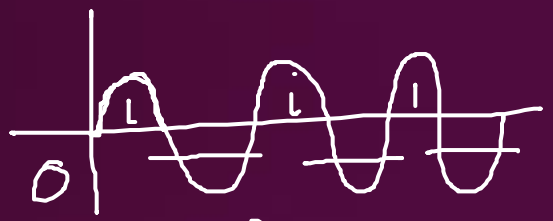
i → change

Direct Current & Alternating Current

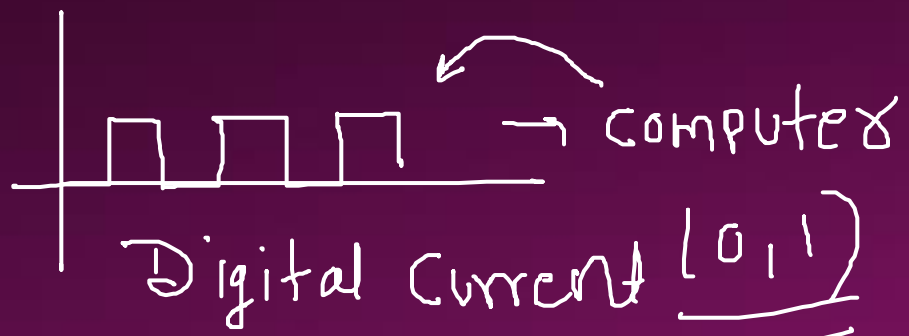
दिष्ट धारा



प्रत्यावर्ती धारा



घर में

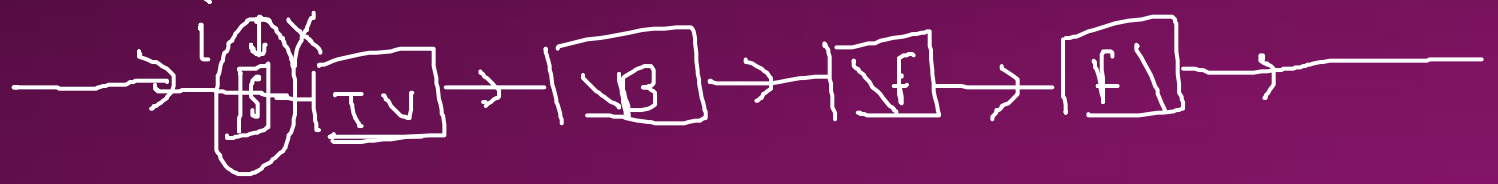


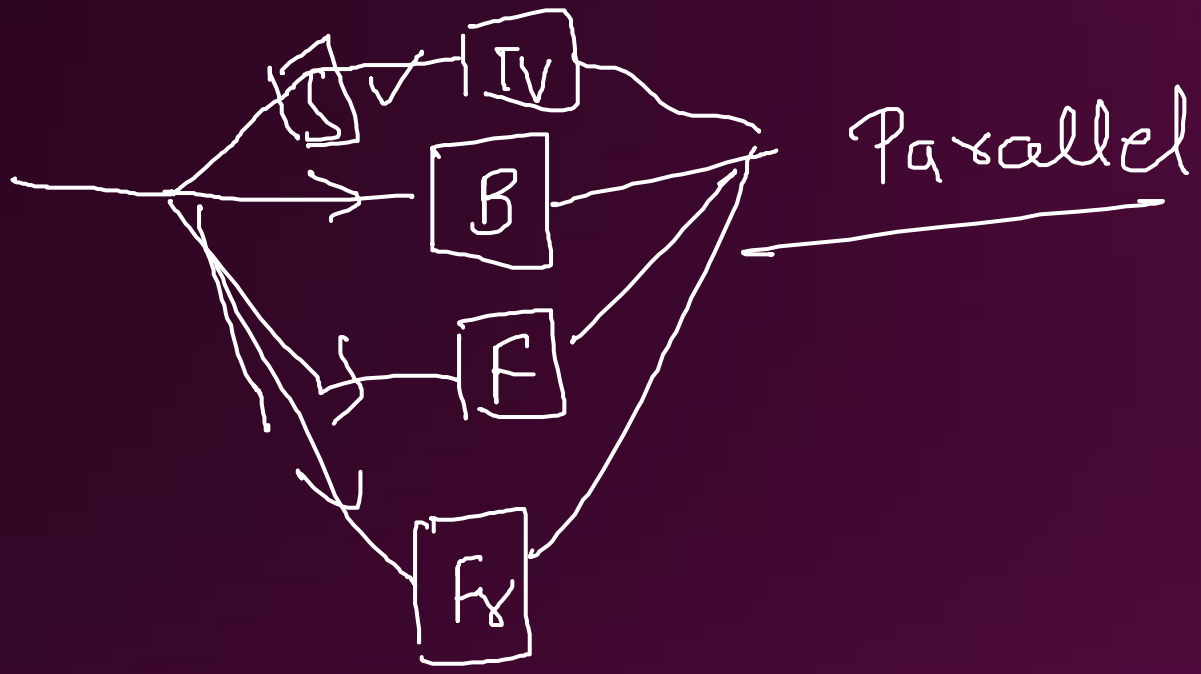
प्रत्यावर्ती धारा (AC) → Rectifier → दिष्ट धारा (DC)

दिष्ट धारा (DC) → परिवर्तित्र → प्रत्यावर्ती धारा (AC)

⇒ घरों में wiring → Series या Parallel

↳ ⇒ Parallel Comection





⇒ Live wire → Red (लाल)

Neutral wire → Black (काला)

Earth wire → Green (हरा)

* 220V

110V → Night की वजह से 110V current अटके से flow.

www.Youtube.com/safaltaclass

www.Facebook.com/safaltaclass

www.Instagram.com/safaltaclass

Google Play Store

SAFALTACLASS