What is a machine?

"A machine is a device which reduces human effort and makes work easy to do".

OR

"A device which multiplies the effect of human effort"

Some examples of commonly used machines are:-

i:- Bicycle
2:- Ramp
3:- Hammer
4:- Crane etc

Electrical Machine:-

"A device which converts mechanical energy into electrical energy or vice versa".

→ In electrical machines, either input, output or both can be electrical.

Types of electrical machines:-

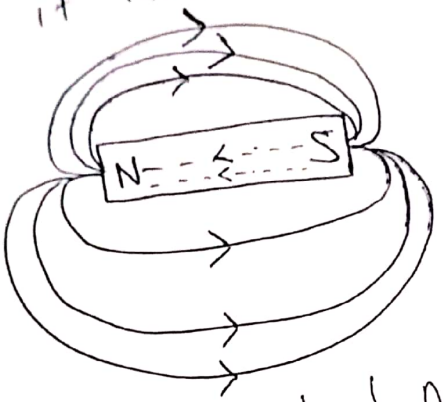
The types of electrical machines are two which are given below:-

i:- Static machines
2:- Dynamic machines

→ The transformer is an example of static electrical machine while motor and generator are both the examples of dynamic electrical machine.

Magnetic Flux:

→ Suppose we have a magnet as shown below. It should be noted that magnet never exists in the form of unipole. It will always exist in the form of dipole (i.e it must have North and South pole)



→ When a material is placed near this magnet, it will be attracted towards this magnet due to some force.

→ This force is represented by magnetic lines

→ magnetic lines are imaginary lines which originates from North pole and terminates in South pole. and again from S to N pole

→ It should be noted that from N to S pole, its path is air while from S to N pole, its path is inside the material.

Hence :-

1:- from material to air
N - S

2:- Inside the material
S - N

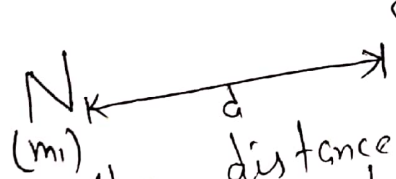
→ "Number of magnetic lines are defined as magnetic flux"
→ It is denoted by phi (ϕ).
→ It unit is weber (wb).

Columb's Law of Magnetism:-

The force of attraction b/w the poles of a magnet is given by columb's law:-

" The mechanical force produced between two poles is directly proportional to the product of their pole strength and inversly proportional to the square of the distance between the poles".

→ Suppose we have 2 poles of a magnet and the poles strength of N pole is (m_1) while the pole strength of S pole is (m_2). as shown below:



where d, is the distance b/w the poles. Then according to Columb's law:

$$F \propto m_1 m_2$$

$$\text{&} \quad F \propto \frac{1}{d^2}$$

$$F \propto \frac{m_1 m_2}{d^2}$$

$$\boxed{F = \frac{m_1 m_2}{\mu_0 \mu_r d^2}}$$

Where:
m_1 = pole strength of North pole
m_2 = " " " South pole
μ_r = Relative permeability
d = distance b/w the poles
μ_0 = $4\pi \times 10^{-7}$ H/m

Note:
Poles cant exist in odd numbers (1, 3, 5, 7 etc) They are always in even numbers (2, 4, 8 etc)

Permeability (μ):

"The ability of a substance to conduct the magnetic lines is called as magnetic permeability of material"

OR

"permeability is the measure of resistance offered against the formation of the magnetic lines."

In Columb's law, μ_0 is called permeability of vaccum or free space and $\mu_0 = 4\pi \times 10^{-7}$ H/m

Relative Permeabity (μ_r):

"It is the ratio of Number of magnetic lines per unit area in a given medium to the number of magnetic line per unit area in air."

means we check what is the permeability of a given material in Compaison to air.

Mathematically:-

$$\mu_r = \frac{\mu_m}{\mu_{air}} = \frac{\mu_m}{\mu_0} = \frac{\mu}{\mu_0}$$

or $\mu = \mu_0 \mu_r$

Relative permeability of air is 1. It is explained below:-

As:- $\mu_r = \frac{\mu_m}{\mu_{air}}$

in case of air; μ_m will be equal to μ_{air}

Hence $\mu_r = \frac{\mu_{air}}{\mu_{air}} = \boxed{1}$

Relative permeability is a unitless quantity.