SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COULOMB'S LAW-ELECTRIC FIELD INTENSITY

Coulomb’s Law:

Coulomb's law states that:

“The magnitude of the electrostatic force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distance between them. The force is along the straight line joining them. If the two charges have the same sign, the electrostatic force between them is repulsive; if they have different sign, the force between them is attractive.”

$$|\boldsymbol{F}| = k_e \frac{|q_1 q_2|}{r^2}$$

Where,

F =electrostatic force

q= charge

r=distance between charges

Electric Field:

- The electric field describes the electric force experienced by a motionless positively electrically charged test particle at any point in space relative to the source(s) of the field.
- The concept of an electric field was introduced by Michael Faraday.

Electric lines of Force:

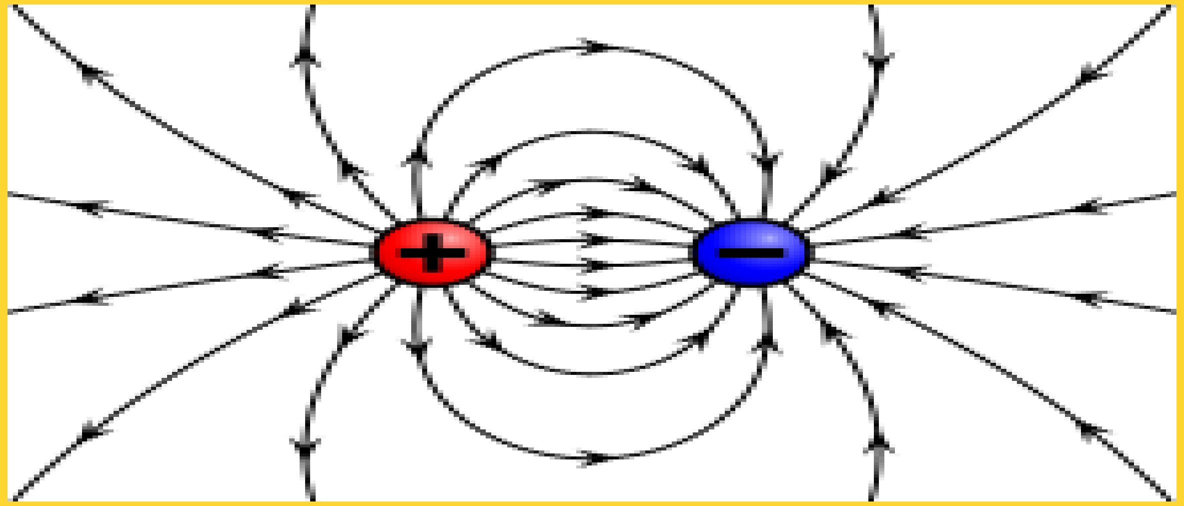
Properties :

1) They always originate on a positive charge and terminate on a negative charge.

2) They always leave or enter a conducting surface at right angles to it.

3) They never cross or touch each other.

4) Lines of force which have same direction repel each other and having opposite direction attract each other.



Electric flux density:

It is defined as the flux per unit cross sectional area emanating normally from surface.

It is independent of relative permittivity of dielectric medium.

$$|\mathbf{D}| = \frac{Q}{A}$$

Where ,

D= flux density

Q= total flux

A= surface area

Electric field intensity:

- It is the force experienced by a unit positive charge placed at that point.

$$\mathbf{E}(x, y, z) \equiv \frac{\mathbf{F}_{\text{on q}}(x, y, z)}{q}$$

- It is equal to electric potential gradient in magnitude.
- It is equal to the lines of force passing through a unit cross sectional area at that point.

Electric potential:

- The electric potential at a point is equal to the electric potential energy (measured in joules) of any charged particle at that location divided by the charge(measured in coulombs) of the particle. Since the charge of the test particle has been divided out, the electric potential is a "property" related only to the electric field itself and not the test particle.
- The electric potential can be calculated at a point in either a static (time-invariant) electric field or in a dynamic (varying with time) electric field at a specific time, and has the units of joules per coulomb ($J\ C^{-1}$), or volts (V).

$$V_{\mathbf{E}} = -\int_C \mathbf{E} \cdot d\boldsymbol{\ell}$$

Electric potential difference:

- Potential difference is defined as the work done in moving a unit positive charge within an electric field from a point of lower potential difference to a point of higher potential difference
- It`s unit is ‘volts’.

$$\Delta V_{BA} = V_B - V_A = -\int_{r0}^{B} \vec{E}\cdot d\vec{l} - \left(-\int_{r0}^{A} \vec{E}\cdot d\vec{l}\right)$$

$$= \int_{B}^{r0} \vec{E}\cdot d\vec{l} + \int_{r0}^{A} \vec{E}\cdot d\vec{l} = \int_{B}^{A} \vec{E}\cdot d\vec{l}$$

THANK YOU