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NAAC Accredited at 'A' Grade With CGPA 3.10

Department of Physics

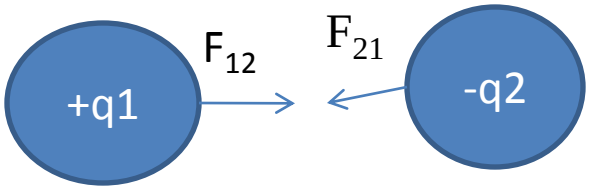
Subject:-Electricity and Magnetism

1.Electrostatics

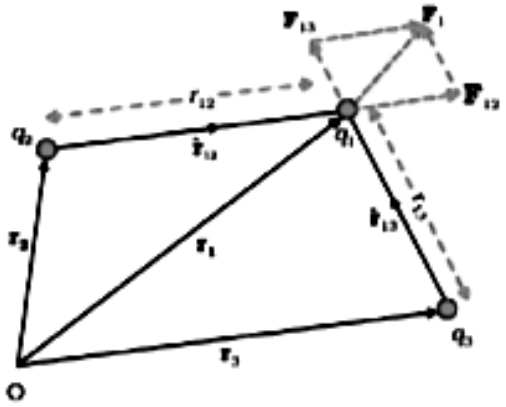
- Coulomb's Law:-

The law states that the magnitude of the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them.

$$|\mathbf{F}| = k\frac{|q_1 q_2|}{d^2}$$



FORCES BETWEEN MULTIPLE CHARGE



The force on one charge, say q1, due to two other charges q2, q3 can therefore be obtained by performing a vector addition of the forces due to each one of these charges. Thus, if the force on q1 due to q2 is denoted by F12, F12 is given by following Eqn. even though other charges are present. In the same way, the force on q1 due to q3, denoted by F13.

$$\mathbf{F}_1 = \mathbf{F}_{12} + \mathbf{F}_{13} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r_{12}^2}\mathbf{f}_{12} + \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_3}{r_{13}^2}\mathbf{f}_{13}$$

For n number of charged particles

$$\mathbf{F}_1 = \mathbf{F}_{12} + \mathbf{F}_{13} + \ldots + \mathbf{F}_{1n}$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1 q_2}{r_{12}^2}\hat{\mathbf{r}}_{12} + \frac{q_1 q_3}{r_{13}^2}\hat{\mathbf{r}}_{13} + \ldots + \frac{q_1 q_n}{r_{1n}^2}\hat{\mathbf{r}}_{1n}\right]$$

$$= \frac{q_1}{4\pi\varepsilon_0}\sum_{i=2}^{n}\frac{q_i}{r_{1i}^2}\hat{\mathbf{r}}_{1i}$$

Above equation gives general equation of superposition principle.

Concept of electric field

- The electric field is defined at each point in space as the force per unit charge .

$$\mathbf{E}(\mathbf{x}_0) = \frac{\mathbf{F}}{q_0} = \frac{1}{4\pi\epsilon_0}\frac{q_1}{(\mathbf{x}_1 - \mathbf{x}_0)^2}\hat{\mathbf{r}}_{1,0}$$

Superposition principle

- If charges $q_1, q_2, \ldots, q_n$ are stationary charges in space at points $y_1, y_2, \ldots, y_n$, the resultant electric field is the sum of fields.
- $E = E_1 + E_2 + E_3 \ldots\ldots\ldots\ldots + E_n$

Electric Flux

- electric flux is the measure of the electric field lines crossing the surface.

Gauss law in electrostatics

The net electric flux through any hypothetical closed surface is equal to $1/\varepsilon 0$ times the net electric charge enclosed within that closed surface