Brainbox learn easy

Chapter 01

ELECTRIC CHARGES AND FIELDS

Gauss Law:

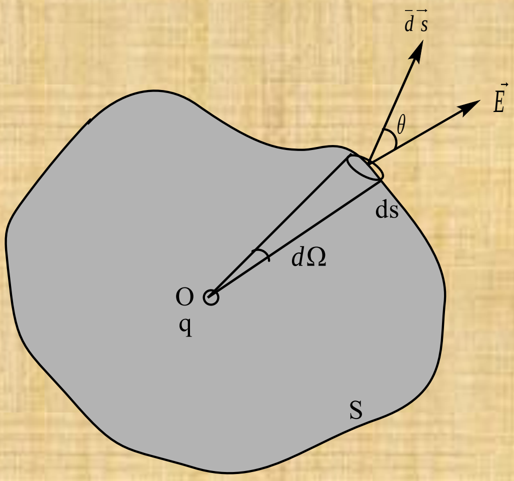
The total flux linked with a closed surface called gaussian surface is $\frac{1}{\epsilon_0}$ times the net charge enclosed by the closed surface.

$$\boxed{\phi = \oint \vec{E}.\overline{dA} = \frac{q}{\epsilon_0}}$$

Proof:

Let us consider a point charge '+q' is placed in a closed surface at 'O'.

Consider a small elemental area 'ds' at 'P' at distance 'r' from 'O'.



Then the flux through $\overrightarrow{ds}$

$$d\theta = \vec{E}.\overrightarrow{ds} = Eds\cos\theta$$

But $\vec{E}$ at P, $E = \frac{1}{4\pi \in_0} . \frac{q}{r^2}$

$$\therefore d\theta = \frac{1}{4\pi \in_0} \frac{q}{r^2} ds \cos\theta$$

Flux through the whole closed surface

$$\oiint d\theta = \oiint \frac{1}{4\pi \in_0} \frac{q}{r^2} ds \cos\theta$$

$$= \frac{q}{4\pi \in_0} \oiint \frac{ds \cos\theta}{r^2}$$

$$= \frac{q}{4\pi \in_0} \oiint d\Omega$$

$$= \frac{q}{4\pi \in_0} 4\pi$$

Where $d\Omega$ = solid angle subtended by ‘ds’ at ‘O’. But

$\oiint d\Omega = 4\pi$.

$$\therefore \theta = \frac{q}{\in_0}.$$