ELECTROMAGNETIC FIELDS AND WAVES

Electric Flux Density

Fundamental concept in electrostatics that represents the distribution of electric flux per unit area in a given region.

It is related to the electric field intensity (E) and the permittivity (ε) of the medium.

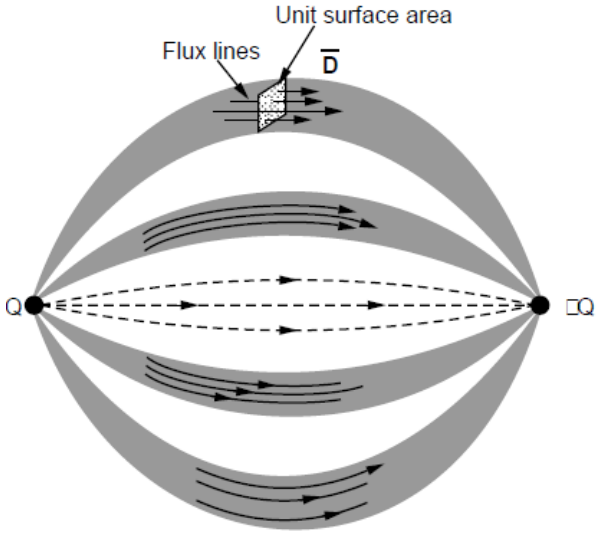
$$D=\varepsilon E$$

E = Electric field intensity (V/m)

ε = Permittivity of the medium (F/m)

D = Electric flux density (C/m^2)

Consider a unit surface area, the net flux passing normal through the unit surface area is D.

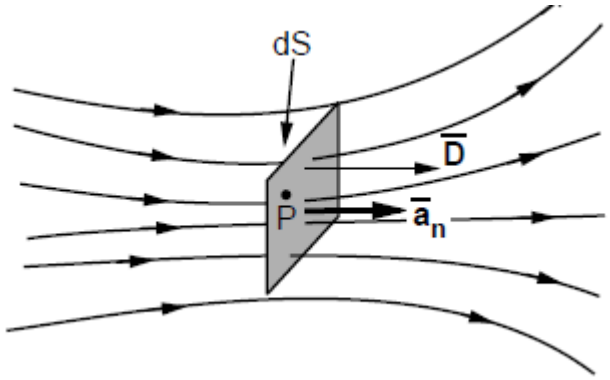


Electric Flux Density Due to a Point Charge

$$D = \frac{Q}{4\pi r^2}\hat{r}$$

Vector form of Electric Flux Density

$$\overline{D} = \frac{d\psi}{dS}\,\bar{a}_n \quad C/m^2$$



$d\psi$ = Total flux lines crossing normal through the differential area dS

dS = Differential surface area

$\bar{a}_n$ = Unit vector in the direction normal to the differential surface area

Properties of Electric Flux Density

- Vector quantity directed radially outward (for positive charges) or inward (for negative charges).
- Independent of the material's permittivity, unlike E, which depends on ε
- Measured in Coulombs per square meter (C/m^2).
- Useful for solving electrostatic problems using Gauss's Law.

Thank you