Electro magnetic

Chapter one : Vectors and scalars

Unit vector
Vector addition and subtraction
Vector multiplication
Cartesian coordinates
Cylindrical coordinates
Spherical coordinates
Differential length , area , volume.

Chapter two : coulombs law and electrical field intensity

Coulombs law
Electrical field intensity
Field of a line charge
Field of a sheet charge
Field due to a continuous volume charge distribution

Chapter three : Gauss s law

Is defined as the total electric flux φ through any closed surface is equal to the total charge enclosed by that surface.

$\varphi = Q_{enc}$

$\varphi = \oint_s dj = \oint_S D^{\rightarrow} . dS^{\rightarrow}$

$D^{\rightarrow} = e_o E^{\rightarrow}$ $\quad C / m^2$ **electric flux density**

Application of Gauss s law

a) **point charge in spherical coordinate system for a closed surface (S).**

$\oint D^{\rightarrow} . dS^{\rightarrow} = Q$

$\oint D^{\rightarrow} . rdqr \sin qdqar^{\rightarrow} = Q$

$D^{\rightarrow} . r^2 \int_0^p \sin qdq \int_0^{2p} dfar^{\rightarrow} = Q$

$$D^{\rightarrow}.r^{2}(-\cos q)(2p)ar^{\rightarrow} = Q$$

$$D^{\rightarrow}.ar^{\rightarrow} = \frac{Q}{4pr^{2}}$$

$$D^{\rightarrow} = \frac{Q}{4pr^{2}} ar^{\rightarrow}$$

b) a uniform line charge distribution ρ_L lying a long the Z axis and extending from -∞ to ∞
let a Gauss surface as a cylinder with L $\rightarrow \infty$ and radius = r.

$$\oint D^{\rightarrow}.dS^{\rightarrow} = Q$$

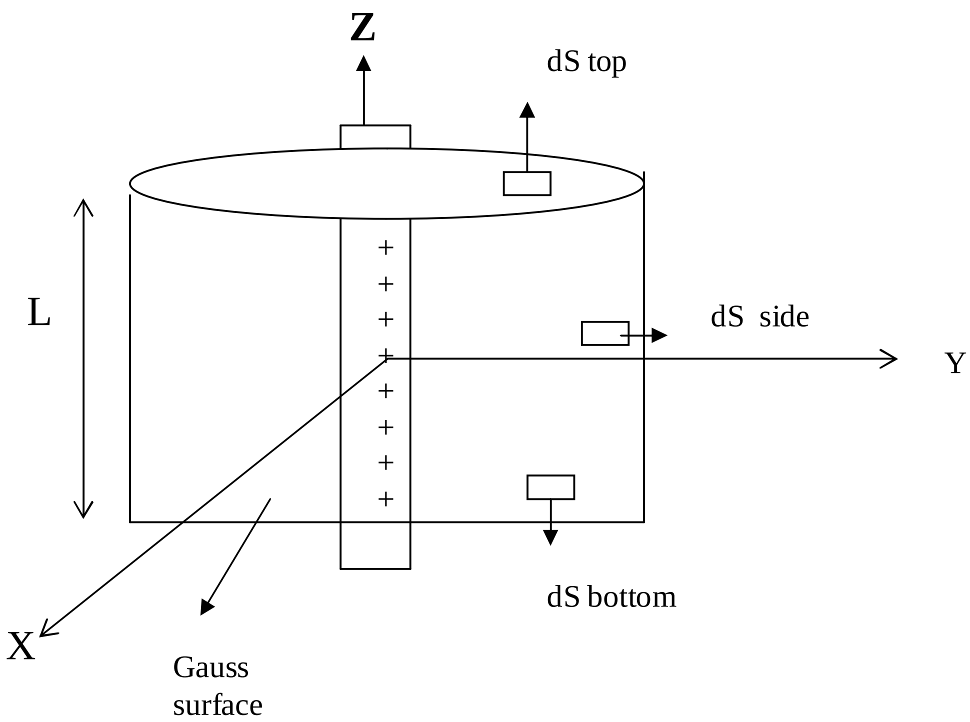
$$\int_{side} D^{\rightarrow}.dSar^{\rightarrow} + \int_{top} D^{\rightarrow}.dSar^{\rightarrow} + \int_{bottom} D^{\rightarrow}.dSar^{\rightarrow} = Q$$

$$\int_{0}^{L}\int_{0}^{2p} D^{\rightarrow}.rdfdZar^{\rightarrow} = Q$$

$$D^{\rightarrow}.r2pLar^{\rightarrow} = \int r_{L}dL = r_{L}L$$

$$D^{\rightarrow}.2prar^{\rightarrow} = r_{L}$$

$$D^{\rightarrow} = \frac{r_{L}}{2pr} ar^{\rightarrow}$$



c) spherical shell

d) solid sphere

example : find the total charge lying within the sphere r =2 if

$D^{\rightarrow}$ equal $[(\sin q)/r]ar^{\rightarrow} + [(\cos q \ln r)/r]aq^{\rightarrow}$

Solution

$$\oint D^{\rightarrow}.dS^{\rightarrow} = Q$$

$$\oint D^{\rightarrow}.r^{2}\sin q dq df ar^{\rightarrow} = Q$$

$$\oint (\frac{\sin q}{r}ar^{\rightarrow} + \frac{\cos(\ln r)}{r}aq^{\rightarrow})r^{2}\sin q dq df ar^{\rightarrow} = Q$$

$$r\int_{0}^{p}\sin^{2} q dq \int_{0}^{2p} df = Q$$

$$r\int_{0}^{p}\frac{1-\cos 2q}{2}\int_{0}^{2p} df = Q$$

$$r([\frac{1}{2}f]_{0}^{p} - [\frac{1}{4}\sin 2q]_{0}^{p})2p = Q$$

$$r(\frac{p}{2} - 0)2p = Q$$

$$Q = rp^{2} = 2p^{2}19.7C$$

Dell operator

Gradient of scalar

Relationship between E and V Maxwell s equation

Electric Dipole

Energy density in electrostatic field

Chapter four : Electric field in material space

Properties of materials

Current and current density

Convection current density

Conduction current density

Polarization in Dielectrics

Dielectric constant and strength

Chapter five :

Continuity of current
Poisson s and Laplace s equations
Parallel – plate capacitor
Coaxial capacitor
Spherical capacitor
Boundary conditions
Dielectric – Dielectric boundary conditions
Conductor – Dielectric boundary conditions
Conductor – free space boundary conditions

Chapter six : Magnetostatic field

Biot – Savart law
Ampere s circuital law
Magnetic flux and magnetic flux density
The scalar and vector magnetic potentials

Chapter seven : Electromagnetic induction

Electromagnetic induction
The flux cutting rule
Mutual inductance
Self inductance

References

1) **David J. Griffiths ," Introduction to electrodynamics ," third edition, copyright 1999 by Pearson Education, Inc.**
2) **Sadyac, " Introduction to electromagnetic ," 1987, John Wiley & Sons, New York .**