LECTURE NO 15

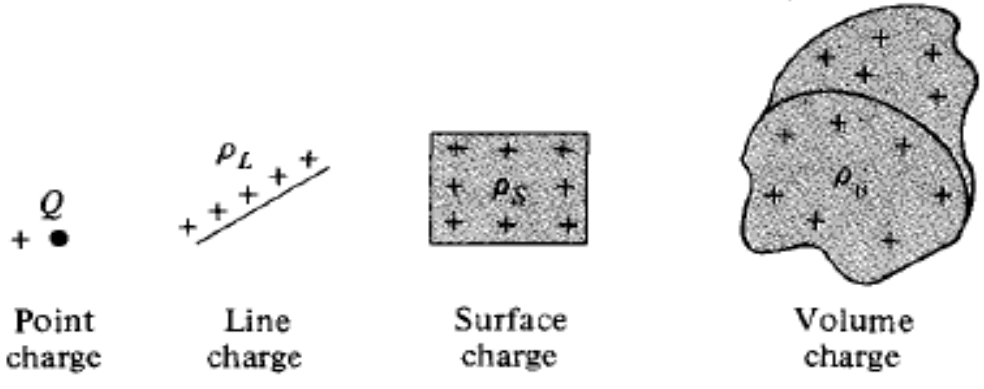
Electrostatics

Topics

- Electric field due to charge distribution,
- Point charge
- Surface charge
- Volume Charge
- Electric flux density

Continuous Charge Distribution

$$dQ = \rho_L \, dl \rightarrow Q = \int_L \rho_L \, dl$$



$$dQ = \rho_S \, dS \rightarrow Q = \int_S \rho_S \, dS \qquad \text{(surface charge)}$$

$$dQ = \rho_v \, dv \rightarrow Q = \int_v \rho_v \, dv \qquad \text{(volume charge)}$$

$$\mathbf{E} = \int \frac{\rho_L \, dl}{4\pi\varepsilon_o R^2} \mathbf{a}_R \qquad \text{(line charge)}$$

$$\mathbf{E} = \int \frac{\rho_S \, dS}{4\pi\varepsilon_o R^2} \mathbf{a}_R \qquad \text{(surface charge)}$$

$$\mathbf{E} = \int \frac{\rho_v \, dv}{4\pi\varepsilon_o R^2} \mathbf{a}_R \qquad \text{(volume charge)}$$

ELECTRIC FLUX DENSITY

$$\mathbf{D} = \varepsilon_o \mathbf{E}$$

We define *electric flux* Ψ in terms of **D** using eq. (3.13), namely,

$$\Psi = \int \mathbf{D} \cdot d\mathbf{S} \tag{4.36}$$

In SI units, one line of electric flux emanates from +1 C and terminates on −1 C. Therefore, the electric flux is measured in coulombs. Hence, the vector field **D** is called the *electric flux density* and is measured in coulombs per square meter. For historical reasons, the electric flux density is also called *electric displacement.*