

Unit II

Conductors & Dielectrics

Conductors & dielectrics in static Electric field

Just as electric fields can exist in free space, they can exist in material media.

Materials are broadly classified in terms of their electrical properties as conductors and nonconductors.

Non conducting materials are usually referred to as insulators or dielectrics.

Current and current density:

The current is defined as the rate of flow of charge and is measured in amperes.

A current of 1 ampere is said to be flowing across the surface when a charge of one Coulomb is passing across the surface in one second.

The current which exists in the conductors due to the drifting of electrons under the influence of the applied voltage is called drift current.

While in dielectrics there can be flow of charges under the influence of the electric field intensity.

Such a current is called the displacement current or

The current flowing across the capacitor, through the dielectric is an example of displacement current.

Convection current \Rightarrow current flows through an insulating medium such as liquid, rarefied gas, or a vacuum. A beam of electrons in a vacuum tube is a convection current.

Current density :

The current density is defined as the current passing through the unit surface area, when the surface is normal to the direction of current.

unit : A/m^2 .

$$J = \frac{\Delta I}{\Delta S}$$

$$\Delta I = J \cdot \Delta S$$

Total current flowing through a surface S

$$I = \int_S J \cdot dS$$

Convection current density

$$\vec{J} = \rho v \vec{v}$$

\vec{v} - velocity vector

Conduction current density

$$J = \sigma E \rightarrow \text{Point form of ohm's law}$$