ELECTROSTATICS OF CONDUCTORS

In metallic conductors, these charge carriers are **electrons**. In a metal, the outer (**valence**) electrons part away from their atoms and are **free** to **move**.

These electrons are free within the metal but not **free to leave** the metal. The free electrons form a kind of ‘**gas**’; they **collide** with each other and with the ions, and move **randomly** in different directions. In an **external** electric field, they **drift** against the direction of the field.

Inside a conductor, electrostatic field is zero

In the static situation, the free charges have so distributed themselves that the electric field is zero everywhere inside. Electrostatic field is zero inside a conductor.

At the surface of a charged conductor, electrostatic field must be normal to the surface at every point

In the static situation, E should have no tangential component. Thus electrostatic field at the surface of a charged conductor must be normal to the surface at every point.

If E has tangential component the charge may move. It is not possible in static situation

The interior of a conductor can have no excess charge in the static situation

by Gauss's law there is **no net charge** enclosed by a surface **if** the electrostatic field is **zero**

This means there is **no net charge** at any point **inside** the conductor, and any excess charge must **reside** at the **surface**

Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface

Since E = 0 inside the conductor and has no tangential component on the surface, no work is done in moving a small test charge within the conductor and on its surface.

That is, there is no potential difference between any two points inside or on the surface of the conductor

Electric field at the surface of a charged conductor

where σ is the surface charge density and n is a unit vector normal to the surface in the outward direction

$$\mathbf{E} = \frac{\sigma}{\varepsilon_0}\hat{\mathbf{n}}$$

Electrostatic shielding

Whatever be the charge and field configuration outside, any cavity in a conductor remains shielded from outside electric influence: the field inside the cavity is always zero. This is known as electrostatic shielding. The effect can be made use of in protecting sensitive instruments from outside electrical influence