

Lecture Notes: Conductors and Insulators

1. Definition of Conductors and Insulators

A. Conductors

- **Definition:** Conductors are materials that **allow electric charges (electrons) to move freely** through them.
- Conductors have **free electrons** (also called conduction electrons) that move under the influence of an electric field.
- They facilitate the flow of **electric current**.

Examples of Conductors:

1. **Metals** – Copper, Aluminum, Silver, Gold
 2. **Electrolytes** – Saltwater, Acid solutions
 3. **Human Body** – Because of water and electrolytes
 4. **Graphite (Carbon)** – A non-metal but a good conductor
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B. Insulators

- **Definition:** Insulators are materials that **do not allow electric charges to move freely** through them.
- They have **very few or no free electrons**, making them poor conductors of electricity.
- They are used to **prevent electric current from flowing where it is not needed**.

Examples of Insulators:

1. **Rubber** – Used in insulating wires
 2. **Plastic** – Found in electrical coverings
 3. **Wood** – A poor conductor of electricity
 4. **Glass and Ceramic** – Used in high-voltage power lines
 5. **Distilled Water** – Lacks free ions and does not conduct electricity
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2. Nature of Charge in Conductors

- **In a conductor, free electrons are present and can move easily.**
- When a conductor is charged, **the charge spreads over the entire surface.**
- If a conductor is connected to the ground (**earthing**), the excess charge flows away, making it neutral.

Important Properties of Charge in Conductors:

1. Charge Redistribution:

- If a charged conductor is touched to another conductor, charge distributes **until both have equal potential**.

2. Charge Concentration:

- On irregularly shaped conductors, charge accumulates at **sharp points** (this is why lightning rods are pointed).

3. Electrostatic Shielding:

- Conductors protect against external electric fields (e.g., **Faraday Cage** shields sensitive electronics).
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3. Summary

- **Conductors** allow electric charge to flow freely (e.g., metals, electrolytes).
 - **Insulators** restrict the flow of electric charge (e.g., rubber, plastic).
 - **In conductors, charge is free to move and redistributes itself** across the surface.
 - Conductors exhibit **charge transfer, electrostatic shielding, and grounding** properties.
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Real-World Applications

1. **Copper wires** – Used for electrical wiring in homes.
 2. **Rubber coatings** – Used in electrical cables for insulation.
 3. **Lightning rods** – Conduct charge safely into the ground.
 4. **Electrostatic shielding** – Protects sensitive electronic devices.
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