Electrical Technology

Electrical Engineering Materials

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Credit:2

Conducted By:

Abdullah Al Mamun

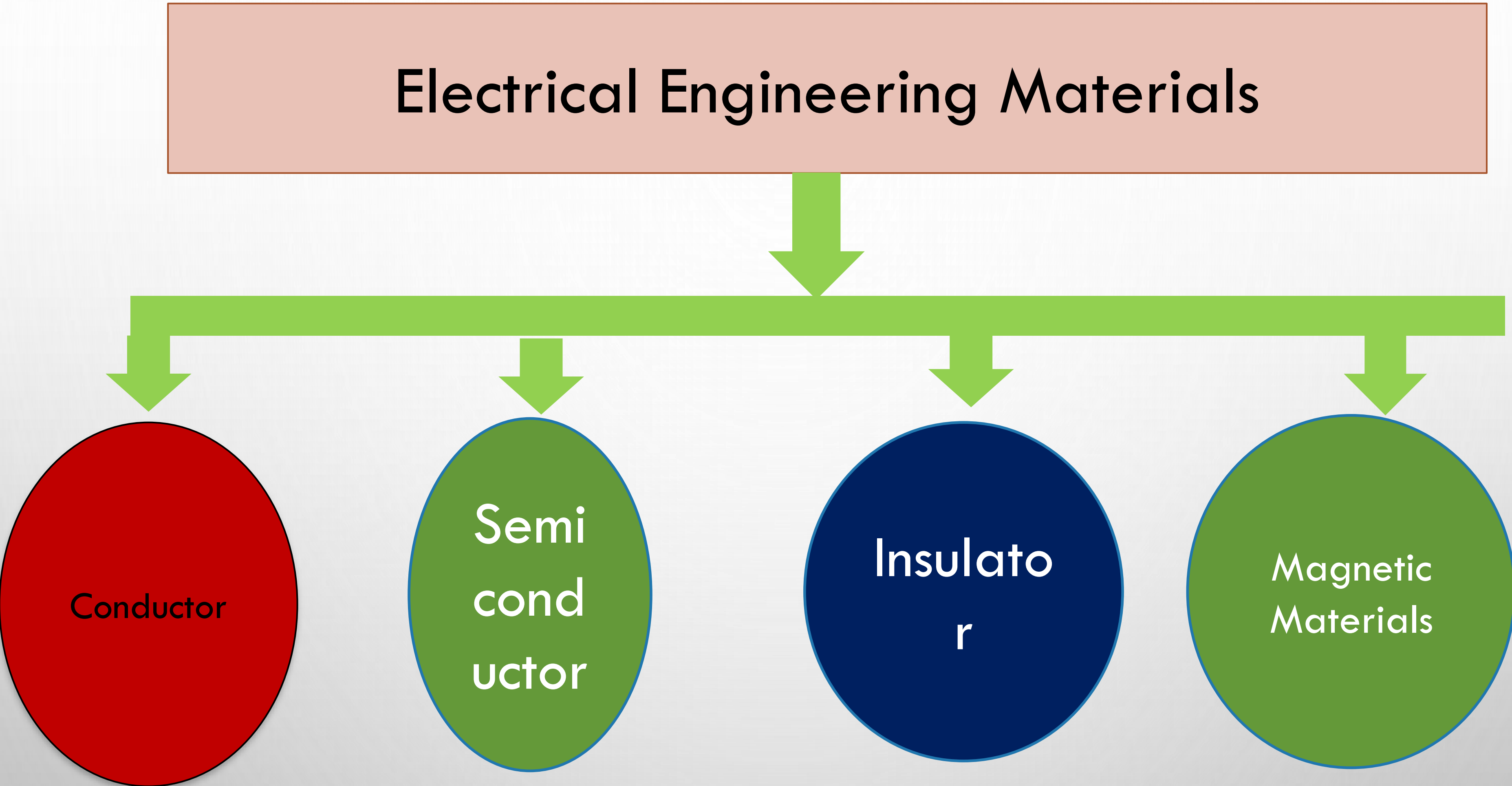
Junior Instructor(Tech),

Sherpur Polytechnic Institute

mamun749813@gmail.com

CHAPTER 1

CONDUCTING & NON-CONDUCTING MATERIALS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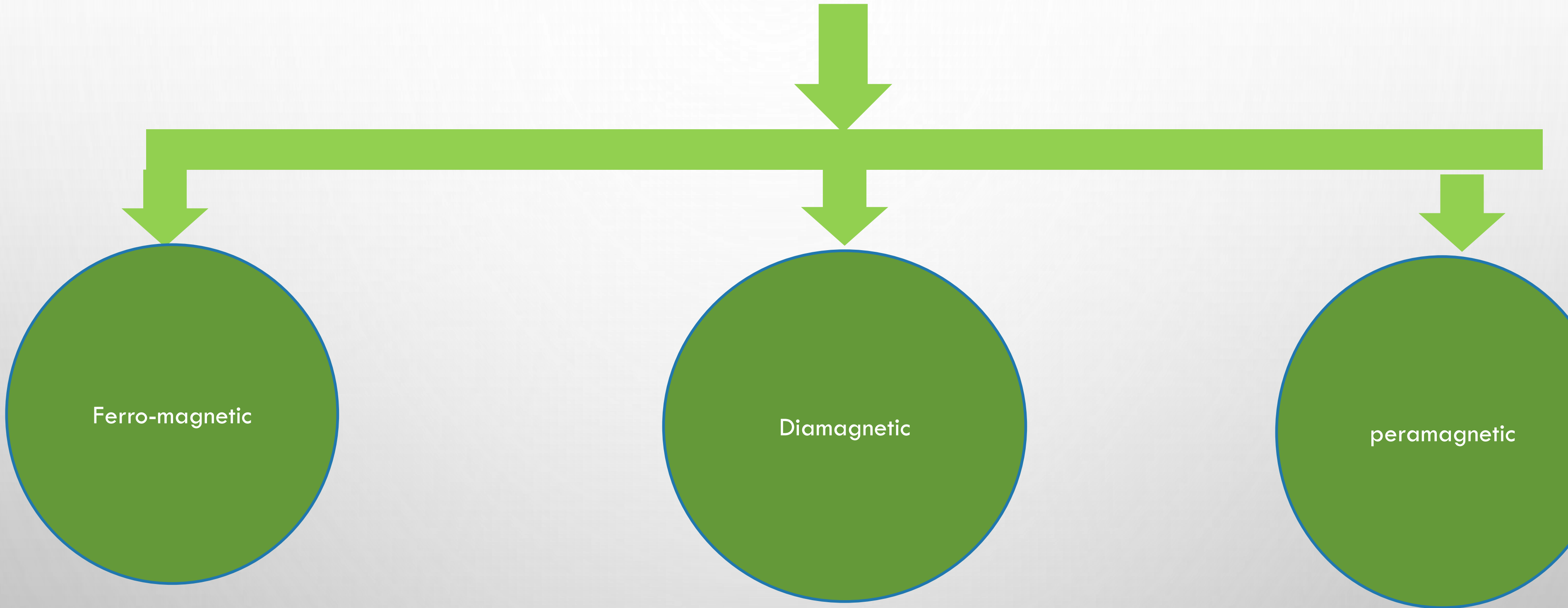
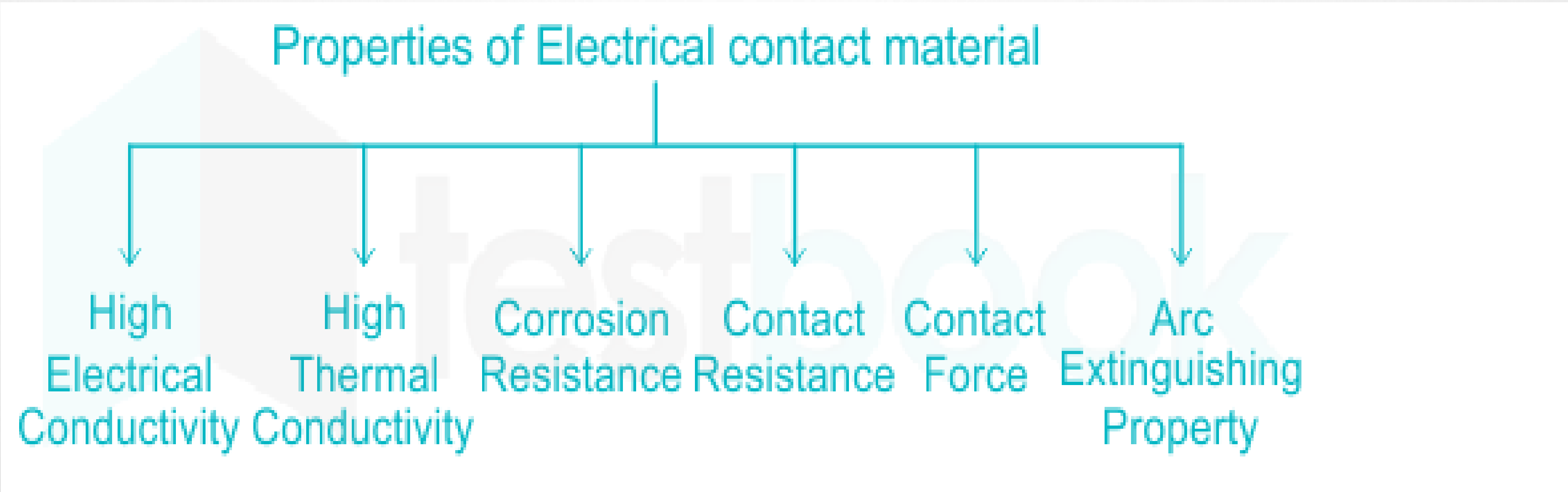


CHAPTER 2

- **CONTACT MATERIALS**

Contact materials," especially in the context of food safety, refers to any material or article that is intended to come into contact with food, including packaging, containers, kitchen equipment, and cutlery.



CHAPTER 3

HIGH RESISTIVE MATERIAL

A high resistive material, or insulator, is one that strongly opposes the flow of electric current, meaning it has a high resistance to electricity.

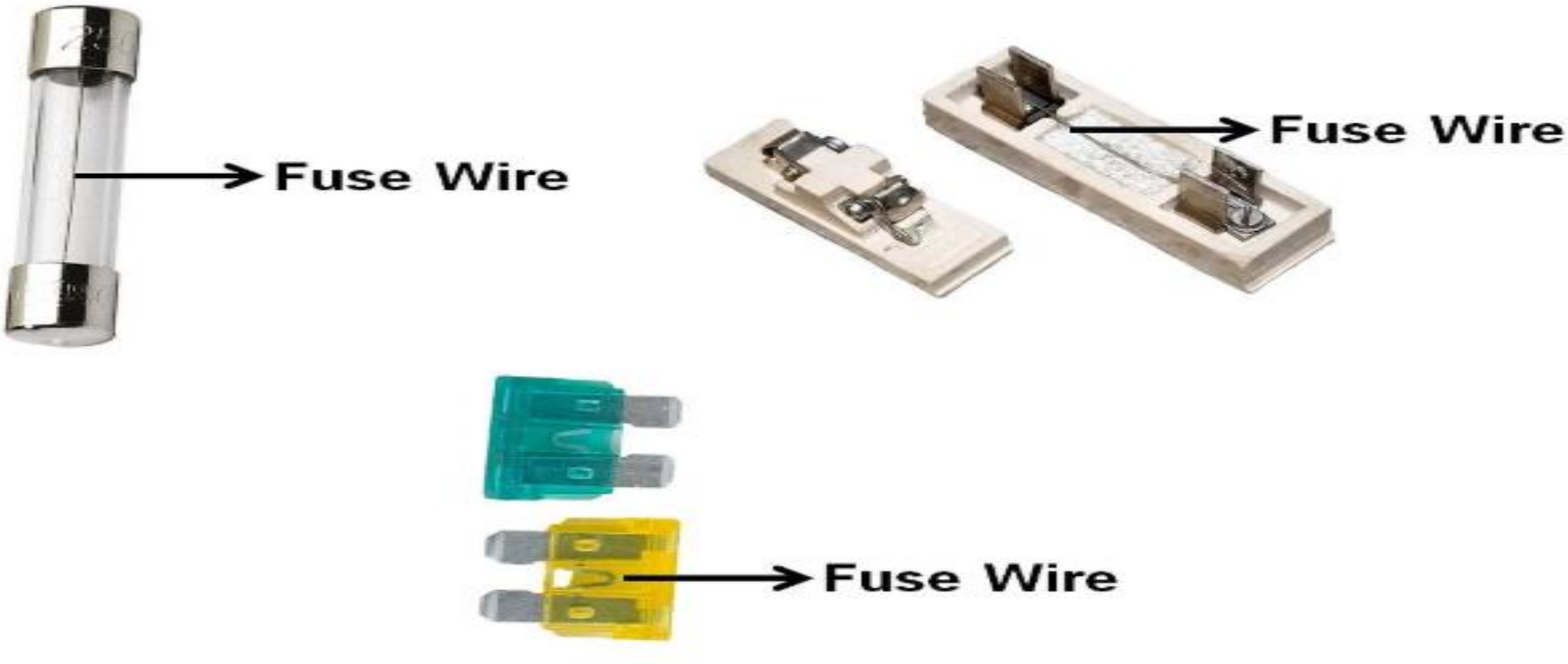
Some of Materials having High Resistivity or Low Conductivity are listed below

1. Tungsten
2. Carbon
3. Nichrome
4. Manganin
5. Eureka
6. Nirosta
7. Chromal
8. German-Silver

CHAPTER 5

FUSING MATERIALS

Electrical fusing materials are metals with low melting points, like tin, lead, zinc, or their alloys, designed to melt and break a circuit when excessive current flows, preventing damage to equipment.



The key properties of fusing materials include:

1. Low Melting Point

- The material should melt quickly when excessive current flows.
- Common materials: Lead, tin, and their alloys.

2. High Electrical Conductivity

- Ensures minimal resistance under normal operating conditions.
- Prevents unnecessary power loss.

3. High Thermal Conductivity

- Helps in the quick dissipation of heat, ensuring efficient fuse operation.

4. Stable and Predictable Fusing Characteristics

- The melting behavior should be consistent for reliable protection.
- Should not deteriorate over time due to oxidation or aging.

5. Non-Deteriorating and Oxidation Resistance

- The material should not degrade over time, ensuring long-term reliability.
- Silver is often used due to its high resistance to oxidation.

6. Good Mechanical Strength

•Prevents breakage or deformation during normal handling and operation.

7. Low Cost and Availability

•Should be affordable and readily available for practical use.

Common Fusing Materials

CHAPTER 5

MAGNETIC PROPERTIES OF MATERIALS

Magnetic materials are materials that can be influenced by a magnetic field and exhibit magnetism. These materials contain atoms with unpaired electrons, which generate a magnetic moment. Based on their response to a magnetic field, magnetic materials are classified into different types, such as:

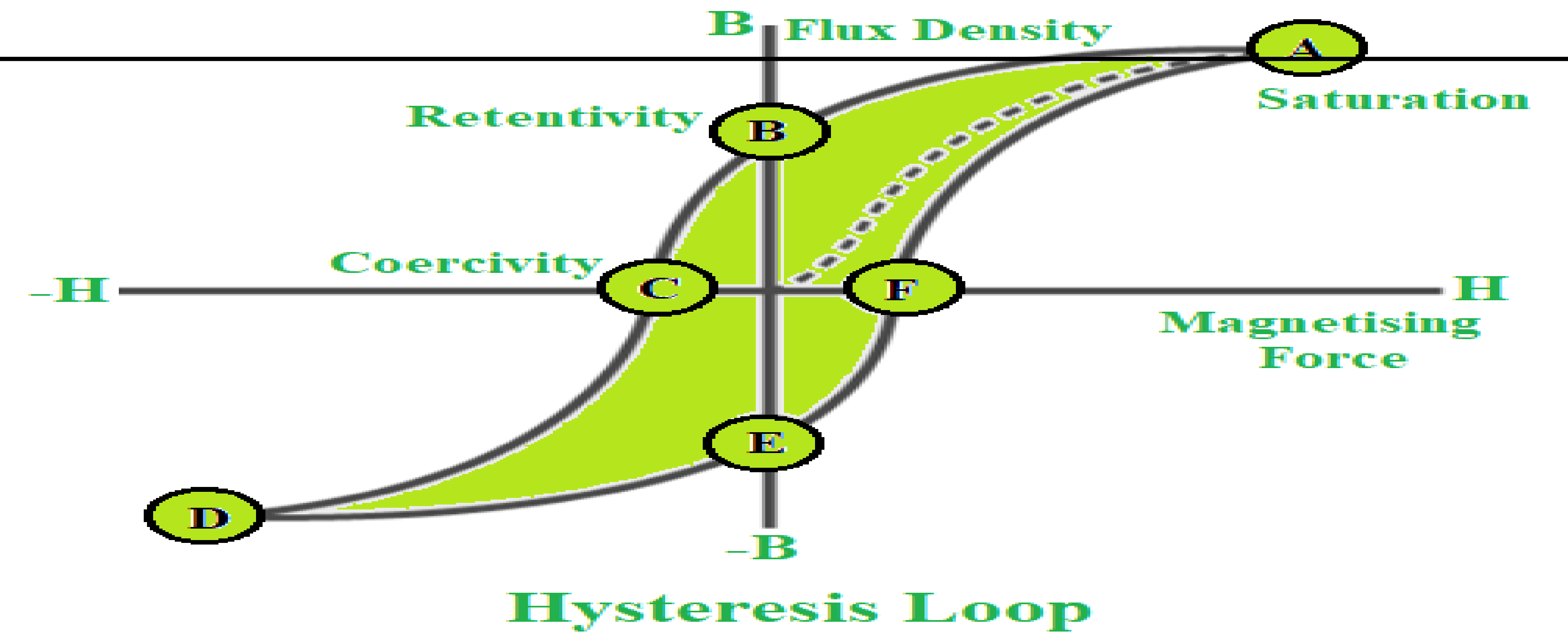
1.Ferromagnetic Materials – Strongly attracted to magnets (e.g., iron, nickel, cobalt).

2.Paramagnetic Materials – Weakly attracted to magnets (e.g., aluminum, platinum).

3.Diamagnetic Materials – Weakly repelled by magnets (e.g., copper, gold).

4.Antiferromagnetic Materials – Magnetic moments cancel each other out (e.g., manganese oxide).

5.Ferrimagnetic Materials – Exhibit magnetism similar to



The hysteresis loop represents the relationship between magnetic flux density (B) and magnetizing force (H) when a magnetic material undergoes cyclic magnetization. It demonstrates the lag between the applied magnetic field and the resulting magnetization.

Formation of the Hysteresis Loop

1.**Initial Magnetization**: When a magnetic field **H** is applied to an unmagnetized material, the magnetization **B** increases and follows an initial curve.

2.**Saturation (Bs)**: As **H** increases, **B** reaches a maximum level called **saturation magnetization.**

3.**Reducing H to Zero**: When the applied field is removed (**H = 0**), **B** does not return to zero but retains some magnetization, called **remanence (Br)**.

4.**Applying Reverse Field (Hc)**: A negative **H** must be applied to bring **B** to zero. This value is called **coercivity (Hc)**.

5.**Reverse Saturation**: Further increasing **H** in the negative direction drives **B** to **negative saturation.**

6.**Repeating the Cycle**: Reversing **H** again traces a similar curve in the opposite direction, completing the loop.

Key Parameters in a Hysteresis Loop

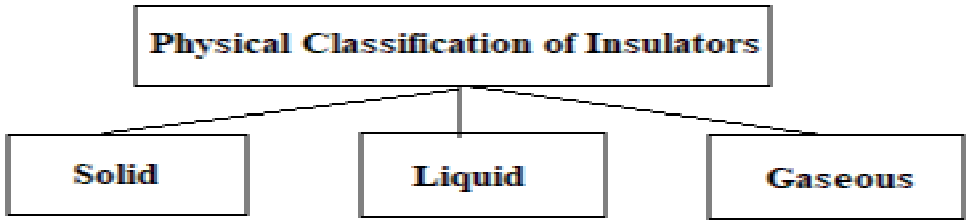
- **Remanence (Br): The retained magnetization when H = 0.**
- **Coercivity (Hc): The reverse field needed to demagnetize the material.**
- **Saturation Magnetization (Bs): The maximum magnetic flux density in the material.**
- **Hysteresis Loss: The area inside the loop, representing energy loss per cycle due to heat dissipation.**

CHAPTER 6

INSULATING MATERIALS

Insulating materials are substances that resist the flow of heat, electricity, or sound, and commonly include materials like fiberglass, mineral wool, cellulose, polystyrene, and polyurethane foam.

The physical classification of insulating material is classified into three types they are solid, liquid, and gaseous. The physical classification of insulators is shown in the below figure.



The solid insulating materials are fibrous, ceramic, mica, glass, rubber, and resinous. The liquid insulating materials are mineral oils, synthetic oils, transformer oils, and miscellaneous oils. The gaseous insulating materials are air, hydrogen, nitrogen, and Sulphur hexafluoride.

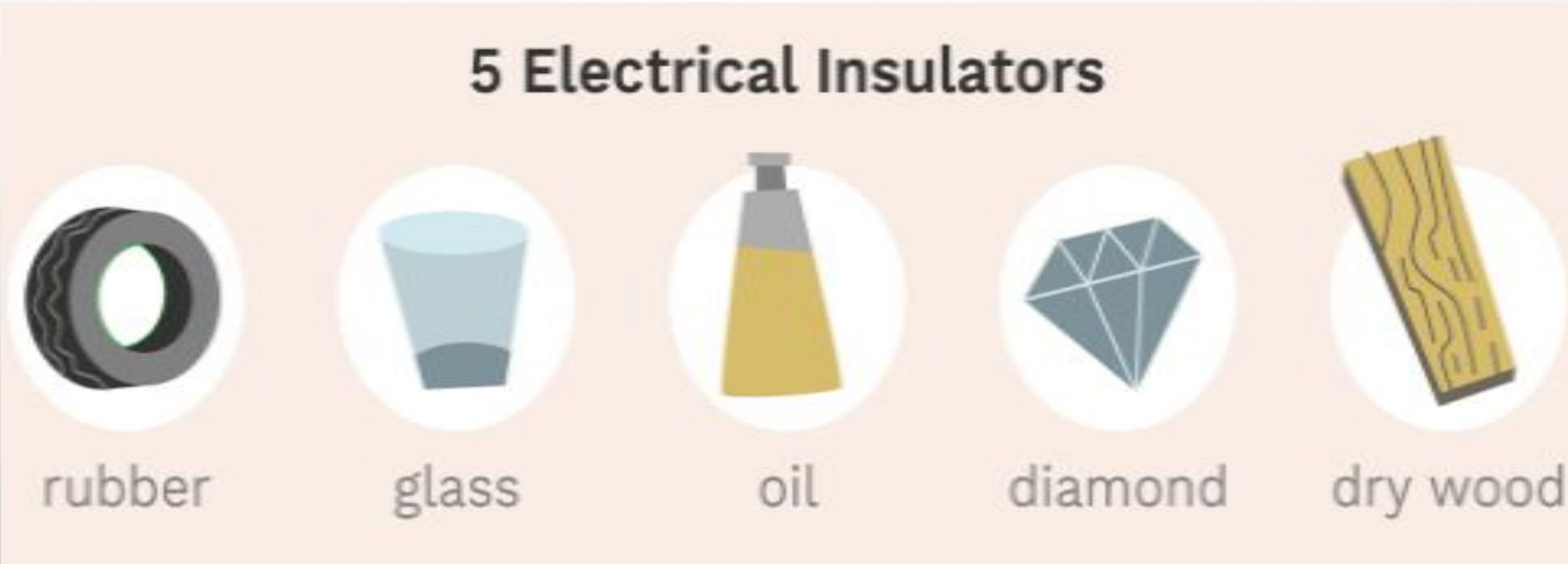
CHAPTER 7

SOLID INSULATING

MATERIALS

Solid Insulating Materials

Solid insulating materials (or solid dielectrics) are materials that do not conduct electricity but provide electrical insulation and mechanical support in electrical and electronic systems. These materials have high resistivity and dielectric strength, preventing current leakage and electrical breakdown.



Properties of Solid Insulating Materials

1. **High Dielectric Strength** – Can withstand high voltage without breakdown.
2. **High Electrical Resistivity** – Prevents leakage currents.
3. **Low Dielectric Loss** – Minimal energy dissipation in AC applications.
4. **Good Thermal Stability** – Resists degradation at high temperatures.

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