

Importance of Materials

- Use of materials is an indispensable requirement for the development of engineering and technology.
- They provide the basis for manufacturing, fabrication, operations, and constructions etc.
- It may be the construction of a building, manufacturing of a machine, generation of electricity, transmission of message from one place to another, or control instruments; they all make use of some materials.
- These materials are of different natures viz., R.C.C. (reinforced cement concrete), steel and iron, copper and aluminium, mica and rubber, alloy and glass etc.

Depending upon the areas in which they are used, the materials may be known as

1. Civil engineering materials,
2. Electrical engineering materials,
3. Mechanical engineering materials,
4. Electronics engineering materials,
5. Nuclear engineering materials, and
6. Computer engineering materials etc.

Importance of Electrical and Electronic Materials

- Advancement of any engineering discipline is not possible without the development of materials suitable for appropriate uses.
- The development necessitates progress in the science: physics and chemistry, engineering and technology of the materials.
- Rapid advancement in electron-based computers, revolutionary changes in electronics engineering from vacuum valves to very large scale Integration (VLSI);
- developments of conducting polymers, ferroelectrics as a modern breed of dielectrics, and ferrites as a superb magnetic material (in addition to several other versatilities) are some illustrations which are the outcome of developments in electrical materials technology

Importance of Electrical and Electronic Materials

- Further advancement in electrical, electronics, computers, and instrumentation fields are likely to be in the form of whisker-based fiber optics,
- light-based computers, high temperature superconductors etc.
- But dreams of these futuristic advances will become a reality only after achieving a breakthrough in certain materials properties.
- Most likely the 21st century will see the high voltage transmission through hair- sized conducting wires,
- the hybrid magnets of more than 100 T (tesla) capacities,
- the magnetic refrigerators operating well above 100 K (kelvin),
- and hybrid crystals (e.g. Hg-Cd-Te) serving as sensor elements.

Importance of Electrical and Electronic Materials

- Smart materials, ferrites, ferroelectrics, garnets, whiskers and ceramic superconductors are the latest kind of materials of today and tomorrow.
- More materials in this list are ruby laser, superalloys, crystalline carbon 60 (C60) etc.

Classification of Electrical and Electronic Materials

- Electrical engineering materials can be classified into following types:
 1. Conductors
 - i. high voltage and low voltage conductors
 - ii. high temperature and low temperature conductors
 - iii. bared and insulated conductors
 2. Semiconductors
 - i. intrinsic (or element) type
 - ii. extrinsic (compound and alloy) type
 - n type
 - p type

Classification of Electrical and Electronic Materials

- Electrical engineering materials can be classified into following types:

3. Dielectrics (or Insulators)

- i. solid type
- ii. liquid type
- iii. gaseous type
- iv. ceramic type
- v. polymeric type
- vi. fibrous type

4. Superconductors

- i. metallic type
- ii. ceramic type
- iii. ideal and hard types
- iv. low and high temperature types
- v. magnetic and non-magnetic types

Classification of Electrical and Electronic Materials

- Electrical engineering materials can be classified into following types:

5. Magnetic materials

i. diamagnetic

ii. paramagnetic

iii. ferromagnetic

iv. antiferromagnetic

v. ferrimagnetic (or ferrites)

6. Ferroelectrics

- i. Zirconates ii. Hafnates iii. Titanates
- iv. PLZT (lead lanthanum zirconate titanate)

Classification of Electrical and Electronic Materials

- Electrical engineering materials can be classified into following types:

7. Piezoelectrics

- i. natural (as rochelle salt)
- ii. artificial (as tourmaline, metaniobate)

8. Perovskites (or mixed oxides)

9. Spinel, Garnets, and Magnetoplumbites

- i. normal spinel (as ZnFe_2O_4)
- ii. inverse spinel (as magnetite)
- iii. metallic garnet
- iv. rare earth garnet