Fundamentals of Electronics Devices

Unit-1

Lecture-1

Crystal Properties and Charge Carriers in Semiconductors

- Elemental and compound Semiconductor materials.
- Crystal lattice structure.
- Bonding forces and energy bands in solids.
- Charge carriers in semiconductors.
- Carrier concentrations.
- Drift of carriers in electric and magnetic fields.

Introduction

- Semiconductors are a group of materials having electrical conductivities intermediate between metals and insulators.
- It is significant that the conductivity of these materials can be varied over orders of magnitude by changes in temperature, optical excitation, and impurity content.

Elemental Semiconductor Materials

- Semiconductor materials are found in column IV and neighboring columns of the periodic table.
- The column IV semiconductors, silicon and germanium, are called elemental semiconductors because they are composed of single species of atoms.

Semiconductor: Ge

- The wide variety of electronic and optical properties of these semiconductors provides the device engineer with great flexibility in the design of electronic and optoelectronic functions.
- The elemental semiconductor Ge was widely used in the early days of semiconductor development for transistors and diodes.

Fluorescent Materials

- Fluorescent Materials such as those used in television screens usually are II-IV compound semiconductors such as ZnS.
- Light detectors are commonly made with InSb, CdSe, or other compounds such as PbTe and HgCdTe.

Characteristics of Semiconductors

- One of the most important characteristics of a semiconductor, which distinguishes it from metals and insulators, is its energy band gap.
- This property, we will discuss in detail, determines among other things the wavelength s of light that can be absorbed or emitted by the semiconductor.

Properties

- The electronic and optical properties of semiconductor materials are strongly affected by impurities, which may be added in precisely controlled amounts.
- Such impurities are used to vary the conductivities of semiconductors over wide ranges and even to alter the nature of the conduction processes from conduction by negative charge carriers to positive charge carriers.

Atomic arrangement

- To investigate these useful properties of semiconductors, it is necessary to understand the atomic arrangements in the materials.
- Obviously, if slight alteration in purity of the original material can produce such dramatic changes in electrical properties, then the nature and specific arrangement of atoms in each semiconductor must be of critical importance.