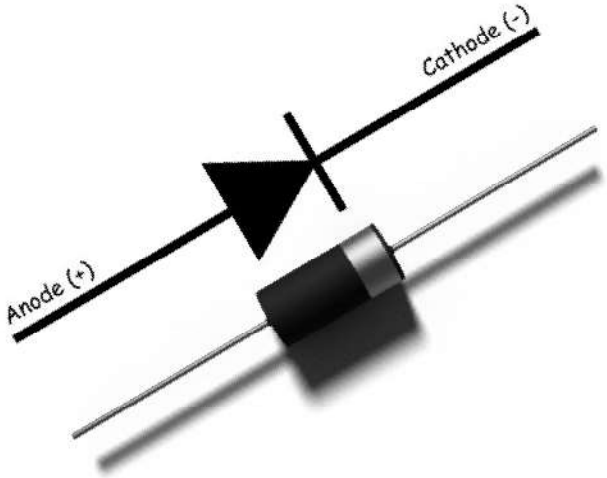
SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
COIMBATORE-35
Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

23EET101 / BEEE
I YEAR / I SEMESTER



UNIT-4: ANALOG ELECTRONICS

DIODE

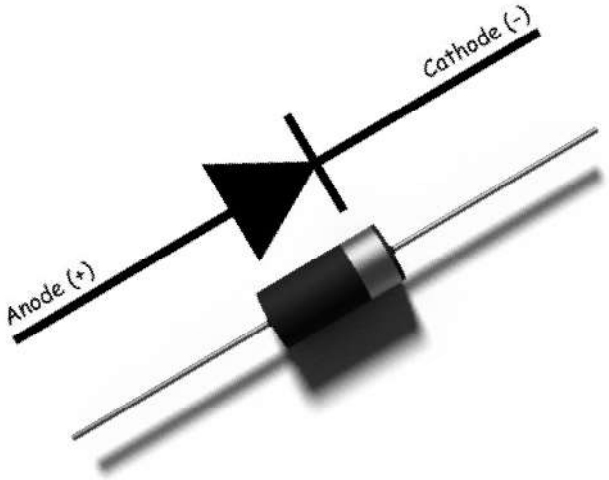
TOPIC OUTLINE

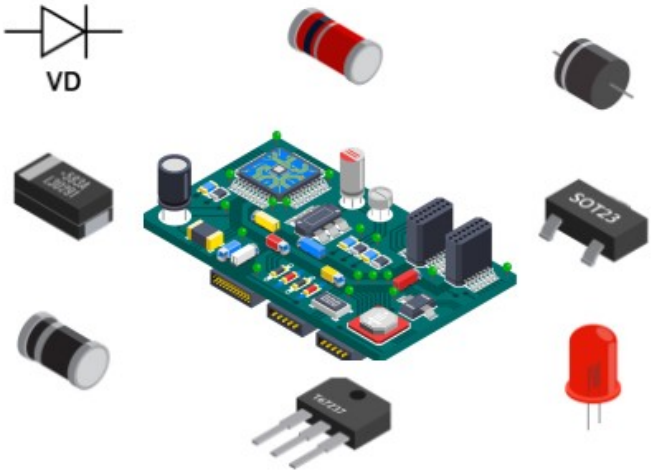
- ✓ Introduction
- ✓ Diodes
- ✓ Electrical Properties of Solids
- ✓ Semiconductors
- ✓ PN Junctions
- ✓ Semiconductor Diodes
- ✓ Special-Purpose Diodes
- ✓ Diode Circuits

Introduction

A diode is defined as a two-terminal electronic component that only conducts current in one direction (so long as it is operated within a specified voltage level).

An ideal diode will have zero resistance in one direction, and infinite resistance in the reverse direction.





Electrical Properties of Solids

Based on conductivity, materials are classified as

- **Conductors**
- **Semiconductors**
- **Insulators**

Valence Electrons – Electrons in outermost orbit of an atom.

Good conductor – no. of valence electrons is 1 or 2.

Electrical Properties of Solids

- **Conductors**
  - Good conductor of electricity
  - e.g. copper or aluminum
  - have a cloud of free electrons (at all temperatures above absolute zero). If an electric field is applied electrons will flow causing an electric current
- **Insulators**
  - Poor conductor of electricity.
  - e.g. polythene
  - electrons are tightly bound to atoms so few can break free to conduct electricity

Contd.,

- **Semiconductors**
  - Conductivity between two extremes.
  - e.g. silicon or germanium
  - at very low temperatures these have the properties of insulators
  - as the material warms up some electrons break free and can move about, and it takes on the properties of a conductor
  - however, semiconductors have several properties that make them distinct from conductors and insulators

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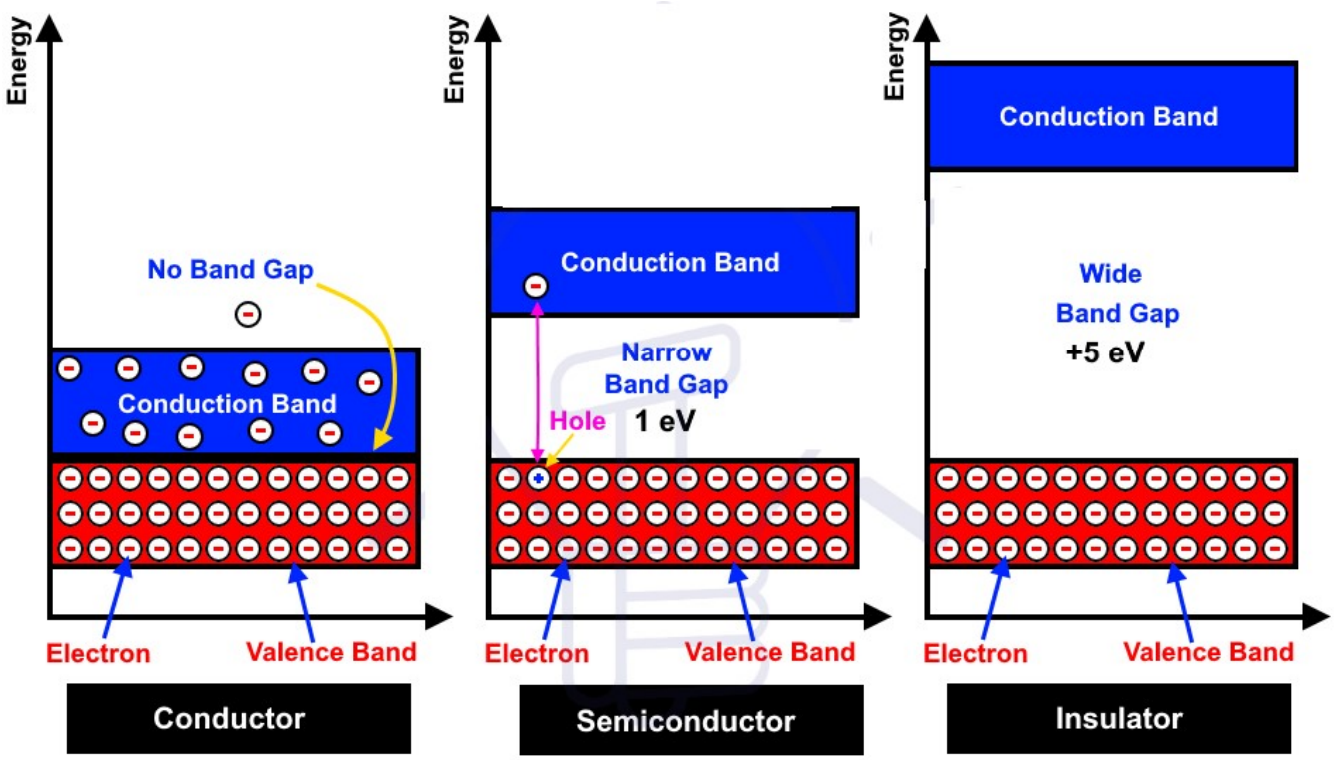

Energy
No Band Gap
Conduction Band
Electron
Valence Band
Conductor
Energy
Conduction Band
Narrow
Band Gap
Hole
1 eV
Electron
Valence Band
Semiconductor
Energy
Conduction Band
Wide
Band Gap
+5 eV
Electron
Valence Band
Insulator

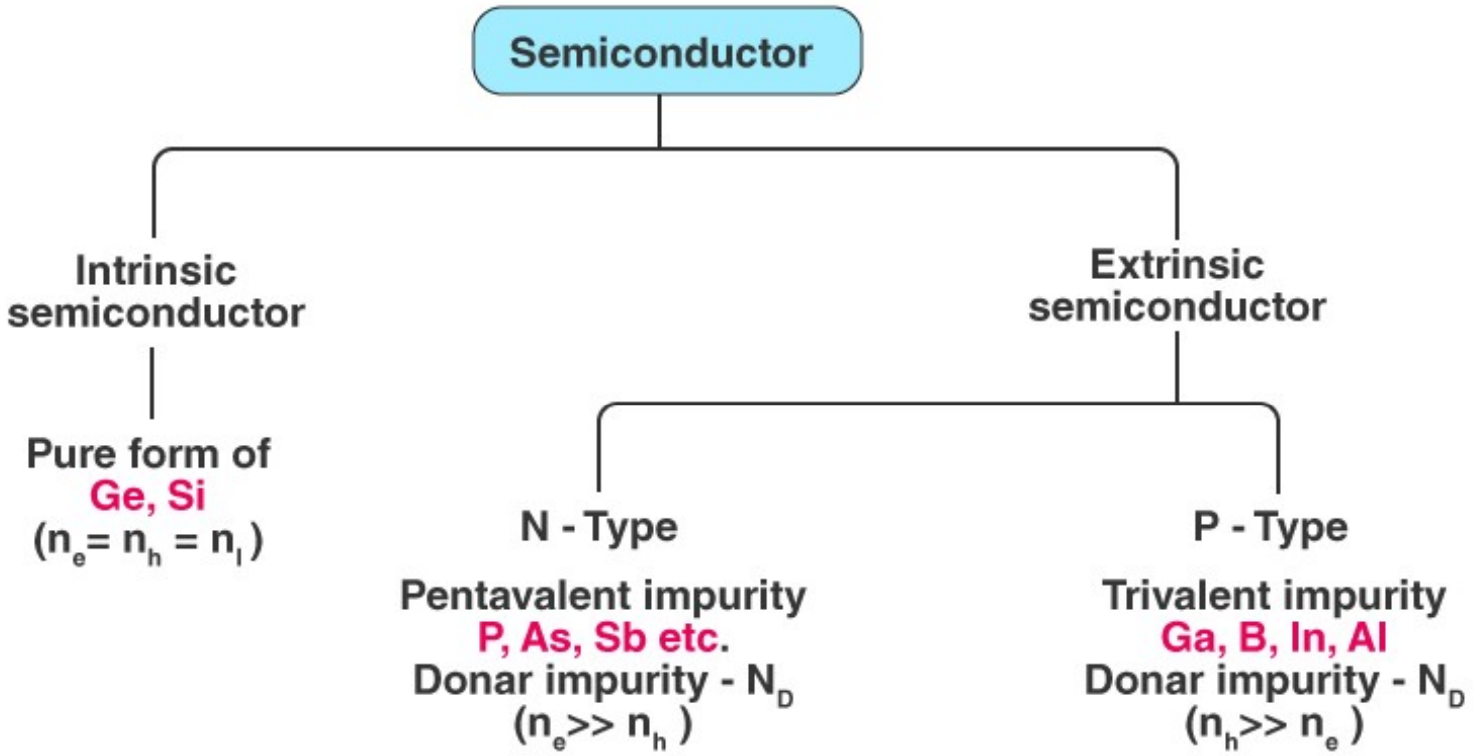
Semiconductors

- **Pure semiconductors**
  - thermal vibration results in some bonds being broken generating **free electrons** which move about
  - these leave behind **holes** which accept electrons from adjacent atoms and therefore also move about
  - electrons are **negative charge carriers**
  - holes are **positive charge carriers**
- At room temperatures there are few charge carriers
  - pure semiconductors are poor conductors
  - this is **intrinsic conduction**

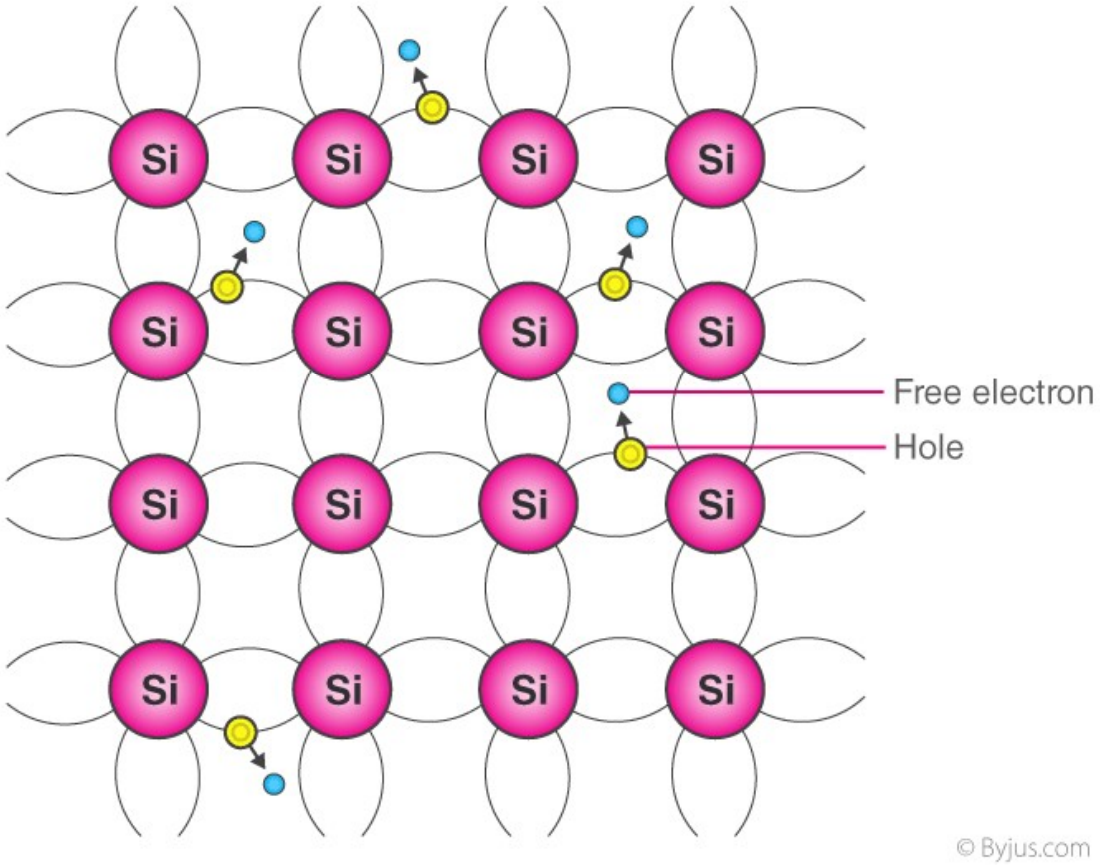
Contd.,

- **Doping**
  - the addition of small amounts of impurities drastically affects its properties
  - some materials form an excess of *electrons* and produce an ***n*-type semiconductor**
  - some materials form an excess of *holes* and produce a ***p*-type semiconductor**
  - both *n*-type and *p*-type materials have much greater conductivity than pure semiconductors
  - this is **extrinsic conduction**

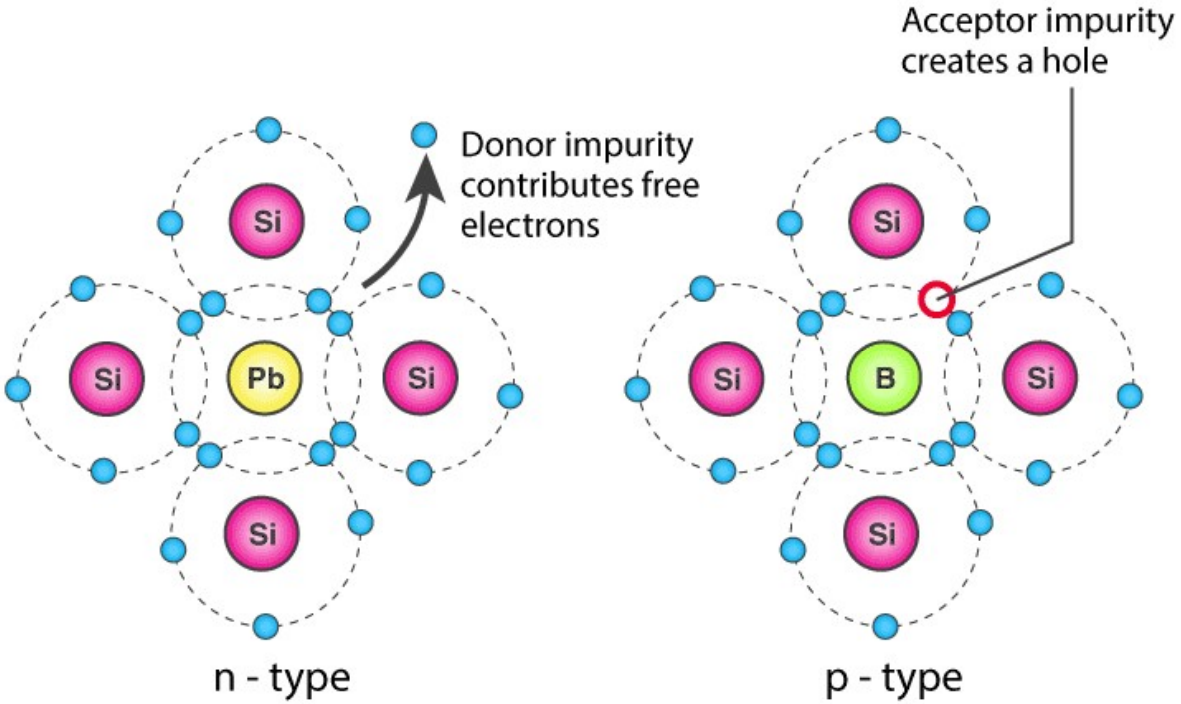
Contd.,


Semiconductor
Intrinsic semiconductor
Pure form of
Ge, Si
$(n_e = n_h = n_i)$
Extrinsic semiconductor
N - Type
Pentavalent impurity
P, As, Sb etc.
Donar impurity - N_D
$(n_e >> n_h)$
P - Type
Trivalent impurity
Ga, B, In, Al
Donar impurity - N_D
$(n_h >> n_e)$

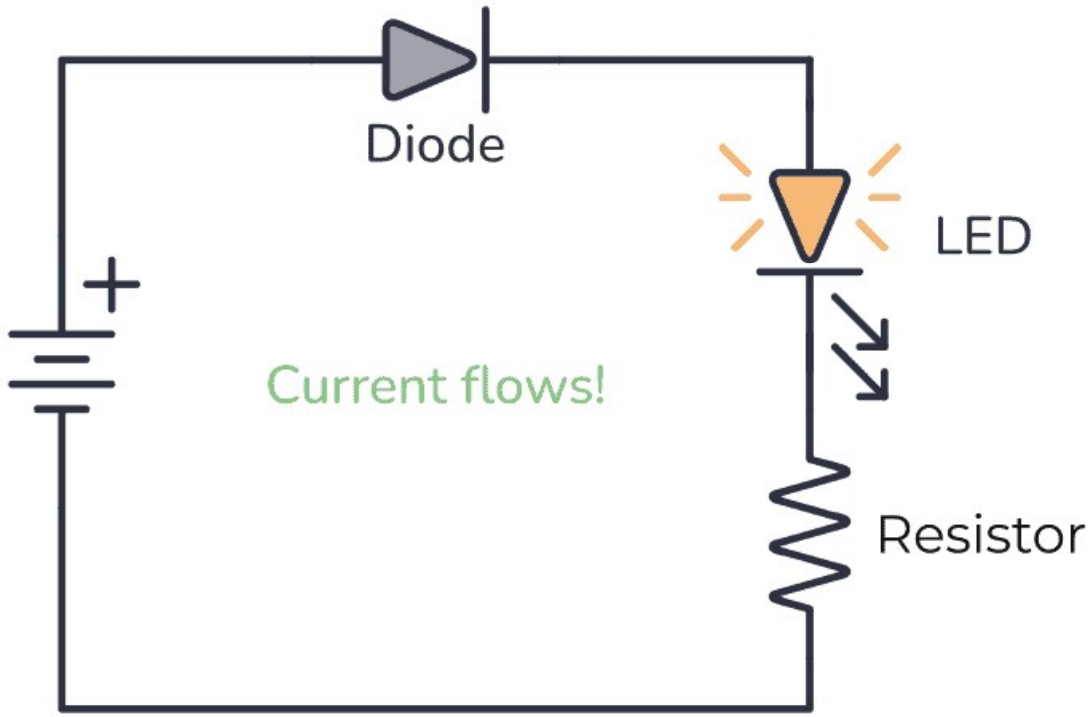
INTRINSIC SEMICONDUCTORS



EXTRINSIC SEMICONDUCTORS



Diode circuit



Assessment

1. Which among the following is the most commonly used semiconductor?

a. Silicon

b. Carbon

c. Germanium

d. Sulphur

2. A semiconductor has generally …… valence electrons.

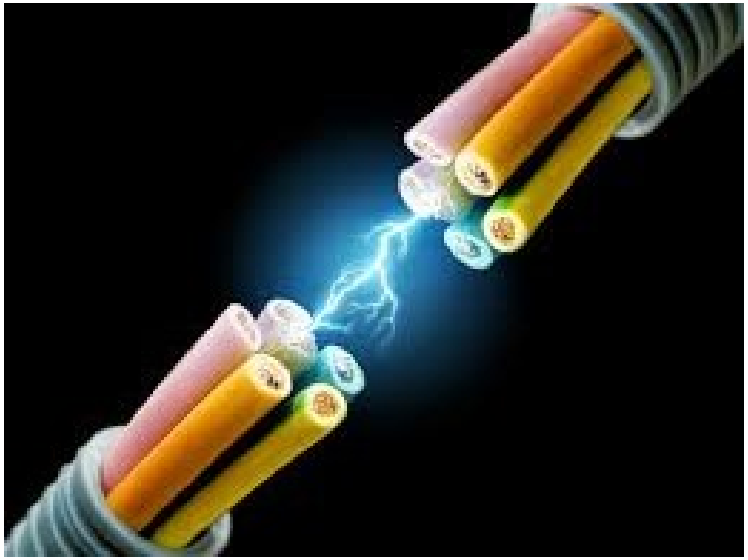
a. 2

b. 3

c. 6

d. 4

RECAP….



…THANK YOU