

"Electronic Circuits I"

ENEE 233

We encounter electronics in our daily life in form of telephones, radios, televisions, audio equipments, home appliances, Computers, and equipments for industrial Control and automation.

The field of electronics deals with the design and applications of electronic devices.

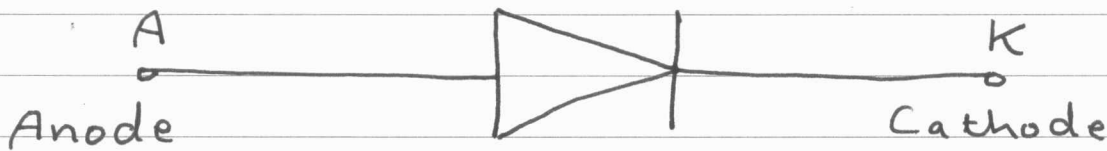
Electronic Devices

- 1) Diodes
 - a) Rectifier diode
 - b) Zener diode
 - c) Light emitting diode
- 2) Transistors
 - a) Bipolar junction Transistor : BJT
 - b) Field Effect Transistor : FET
- 3) Integrated Circuits : IC

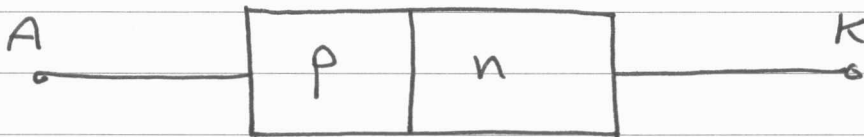
Diode

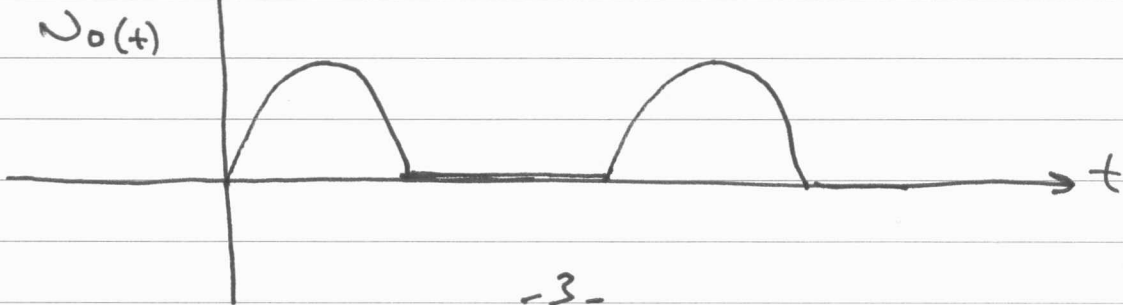
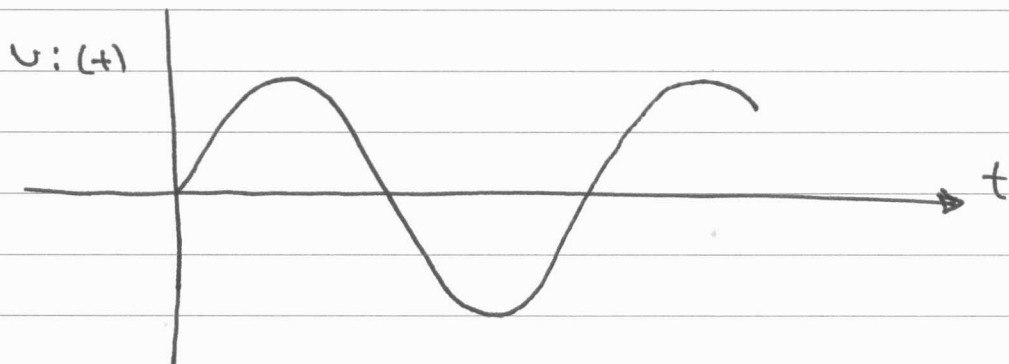
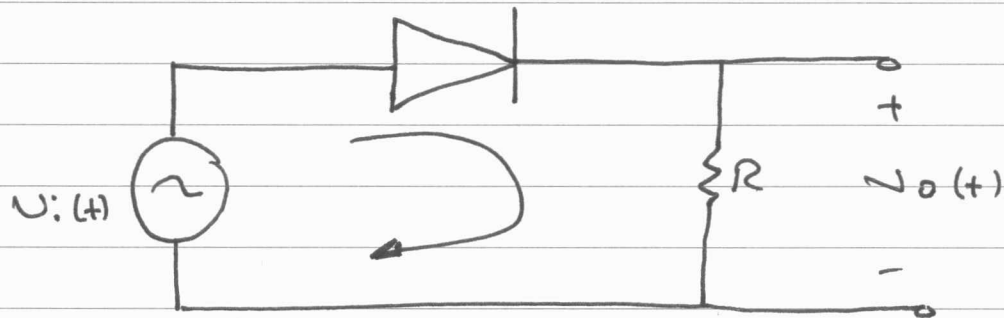
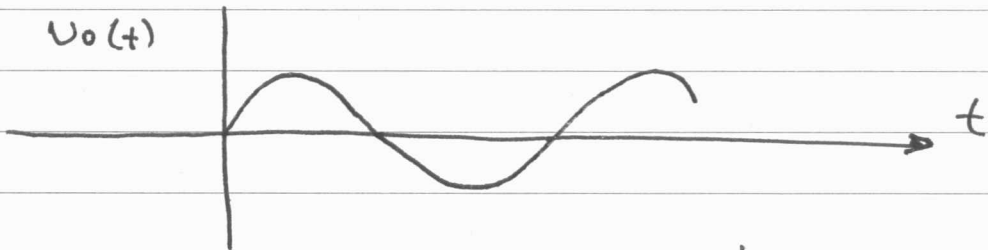
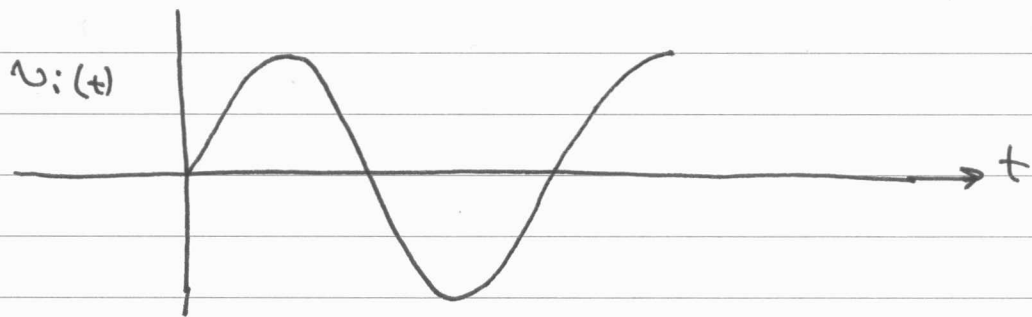
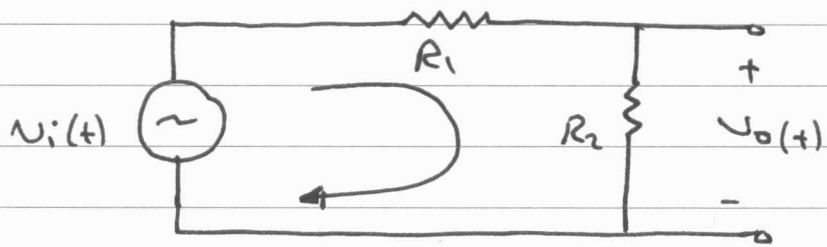
It is an electronic device with a single pn junction and it has the ability to conduct current in one direction while blocking current in the other direction.

Circuit symbol :



Physical Construction :



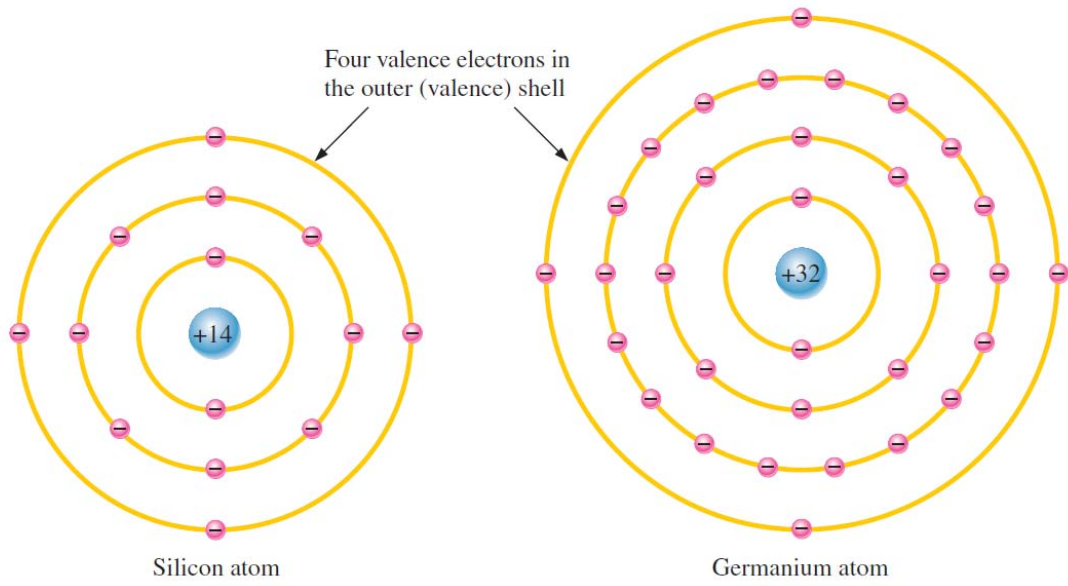


Semiconductors

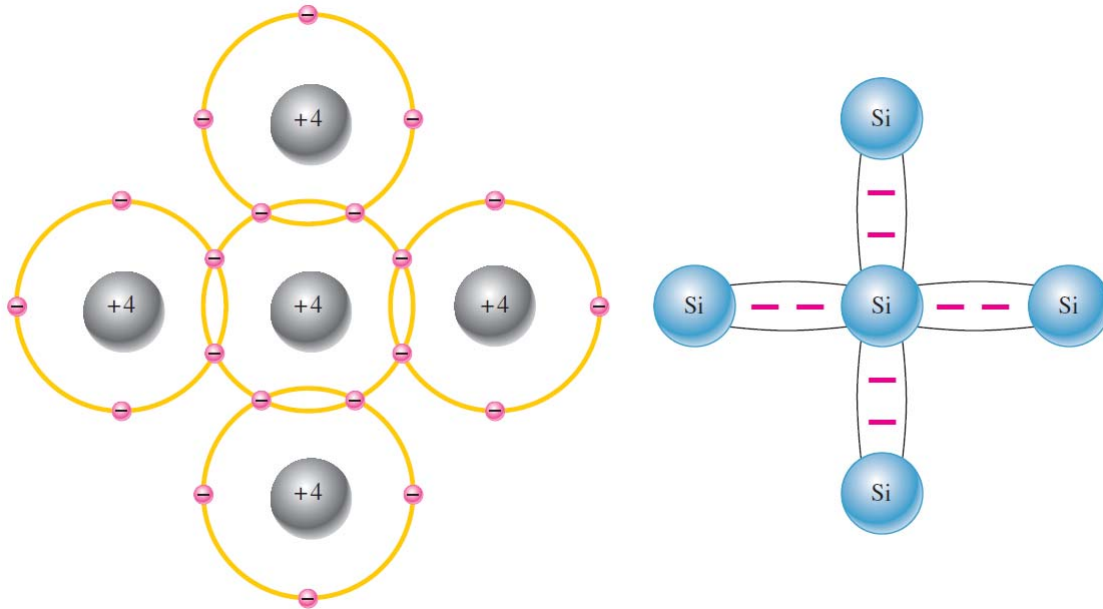
Electronic devices such as diodes, transistors, and integrated circuits are made of a semiconductor material.

Semiconductors : materials whose resistance lies between the low resistance of a conductor and the high resistance of an insulator.

Atomic Structure



Covalent bond

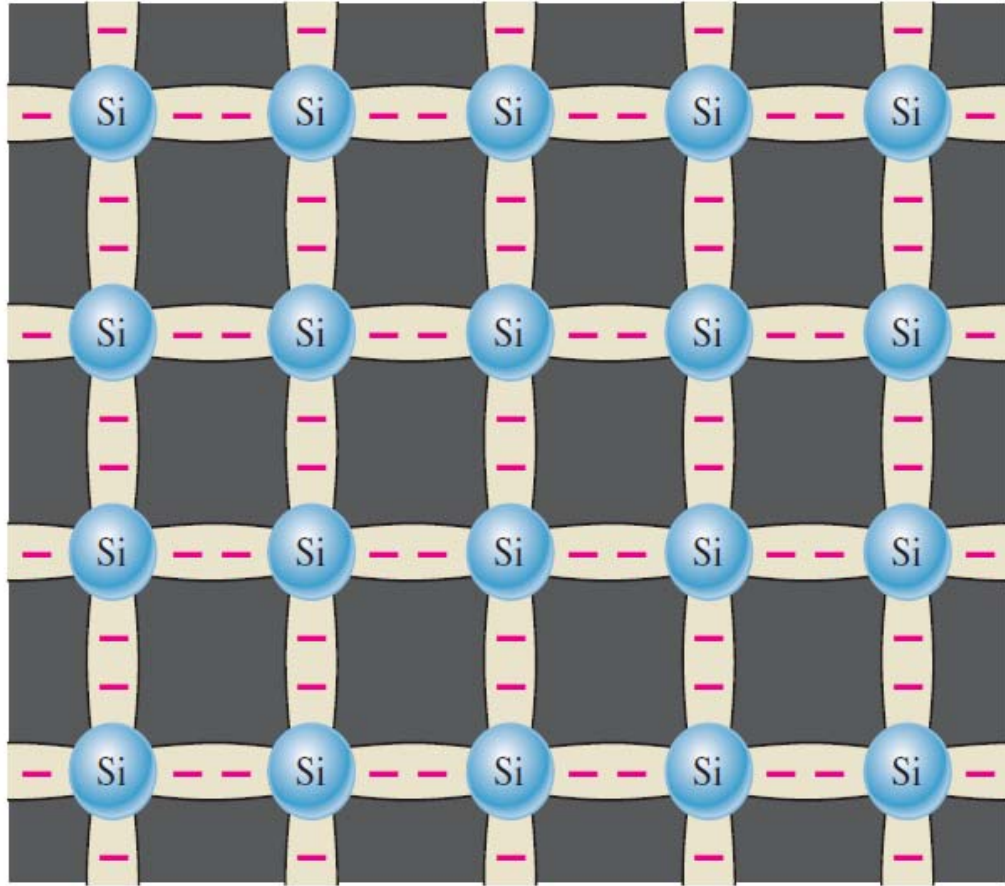


A silicon (Si) atom with its four valence electrons shares an electron with each of its four neighbors.

This effectively creates eight shared valence electrons for each atom and produces a state of chemical stability.

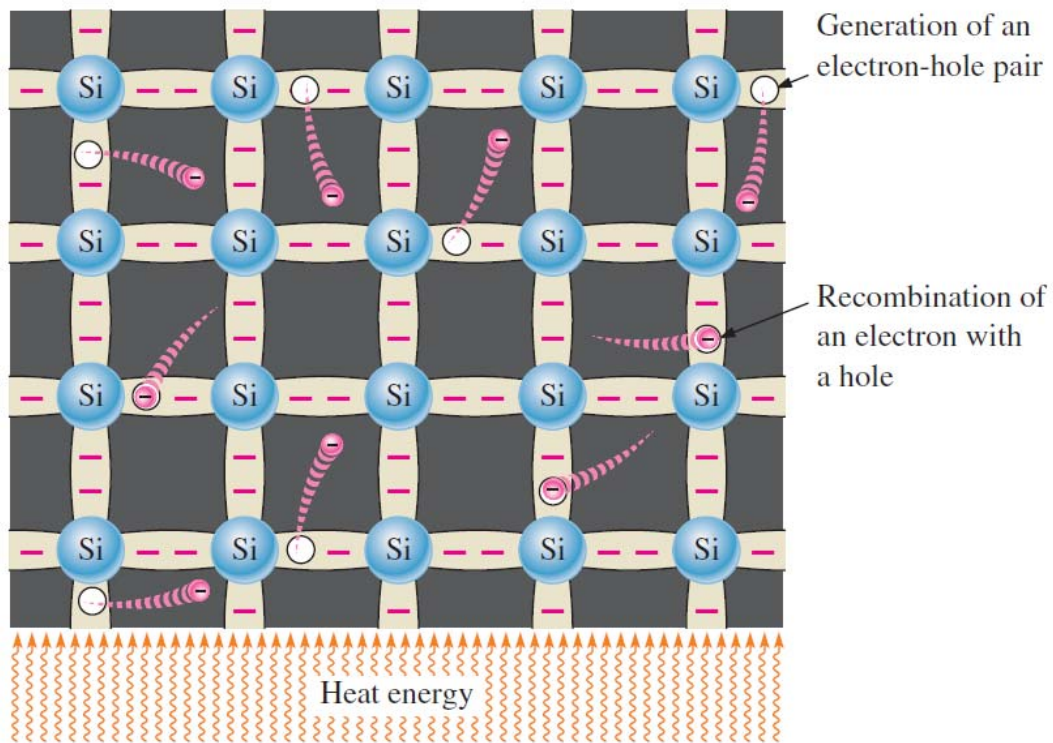
Also, this sharing of valence electrons produces the covalent bonds that hold the atoms together; each valence electron is attracted equally by the two adjacent atoms which share it.

Covalent bond in silicon crystal



At absolute zero degree (-273 c) all valence electrons are tightly bonded to their atoms and there is no free electrons , so the silicon behave as an insulator .

Rupture of the a covalent bond



When an electron becomes free that is unattached to any atom , a vacancy is left in the valence band within the crystal. This vacancy is called a **hole**.

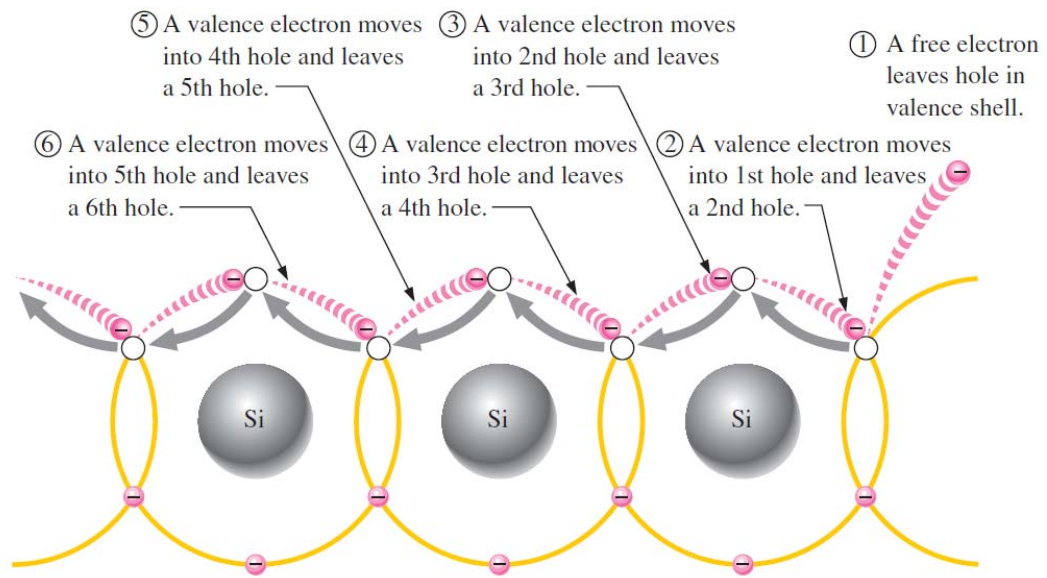
For every free electron, there is one hole left in the valence band.

One broken covalent bond → one free electron + one hole.

At room temperature there is one broken covalent bond for *every* 3×10^{12} pure Si atoms.

At room temperature there are few available charge carriers (free electrons + holes).

Hole Motion



When a valence electron moves left to right to fill a hole while leaving another hole behind, the hole has effectively moved from right to left