Analog Electronics

ENEE 2360

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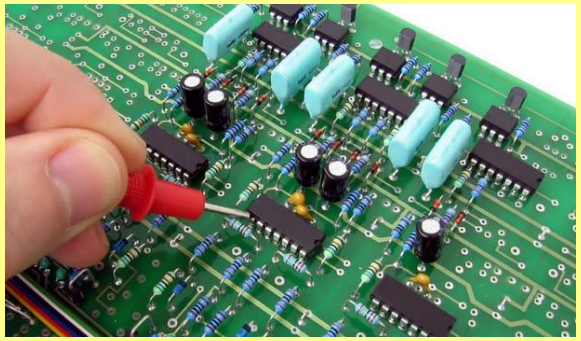
Electronic Circuits

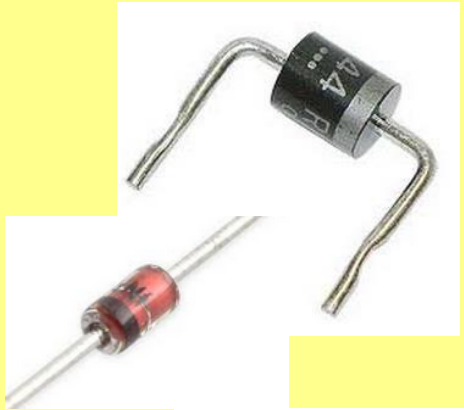
- We encounter electronics in our daily life in form of telephones, radios, television, audio equipment, home appliances, computer and equipment for industrial control and automation .

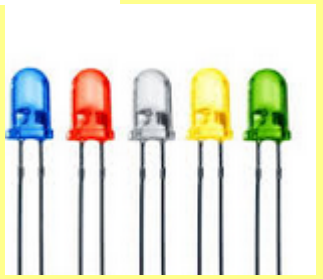


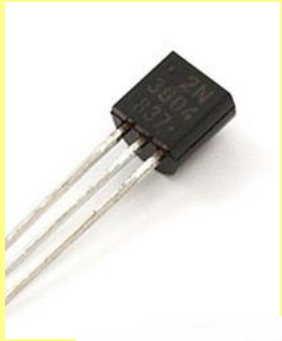
- The field of electronics deals with the design and applications of electronic devices .

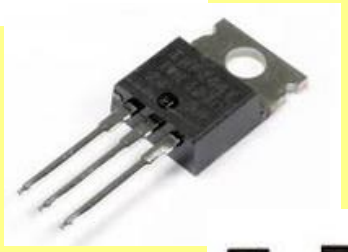
Electronics Devices

- Diodes
  - a) Rectifier diode
  - b) Zener diode
  - c) Light Emitting Diode (LED)
- Transistors
  - a) Bipolar Junction Transistor (BJT)
  - b) Field Effect Transistor (FET)
- Integrated Circuit (IC)





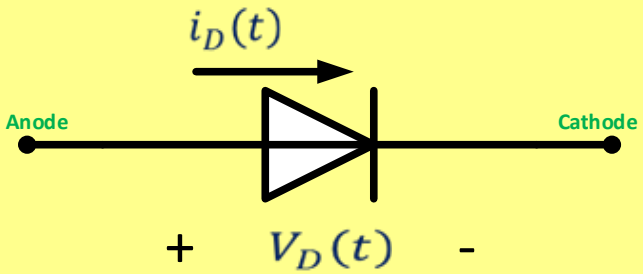




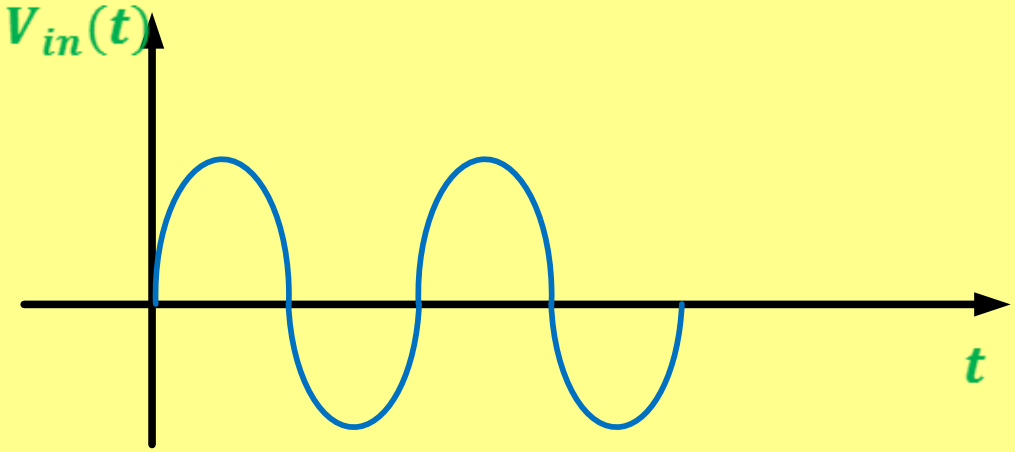
Diode

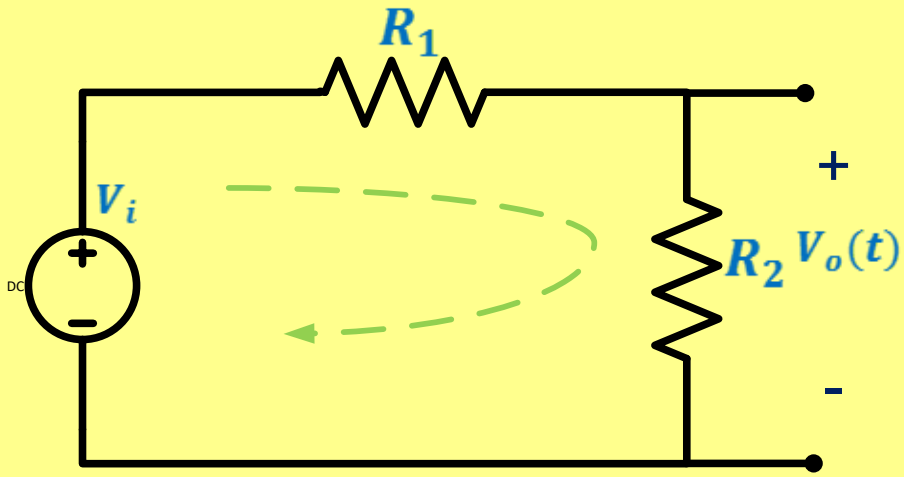
- It is an electronic device with a single p-n junction and it has the ability to conduct current in one direction while blocking current in the other direction.

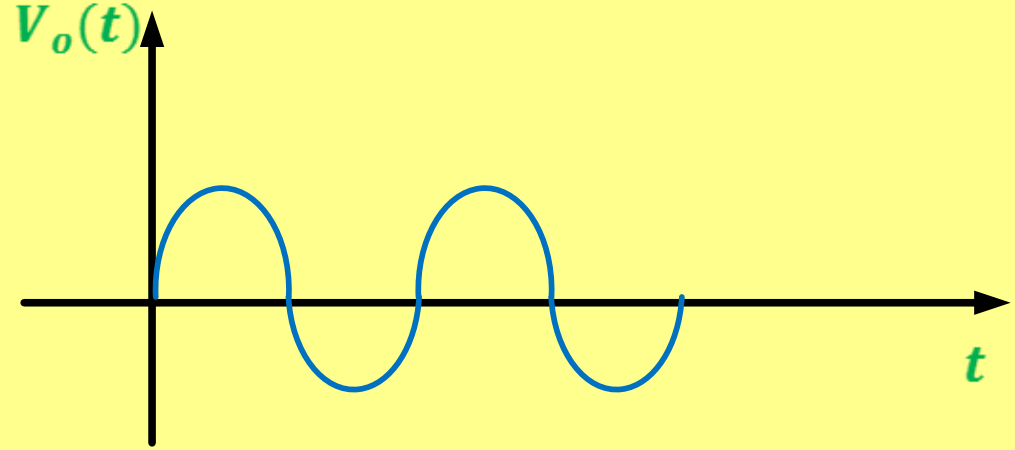
- Circuit Symbol :

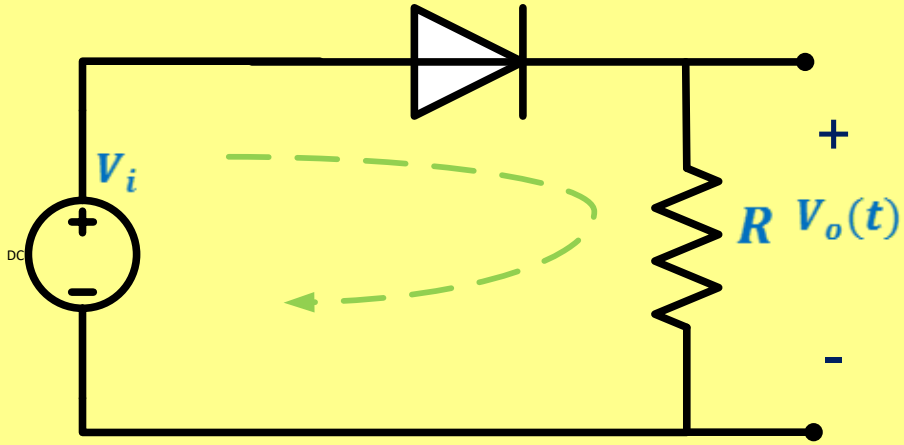


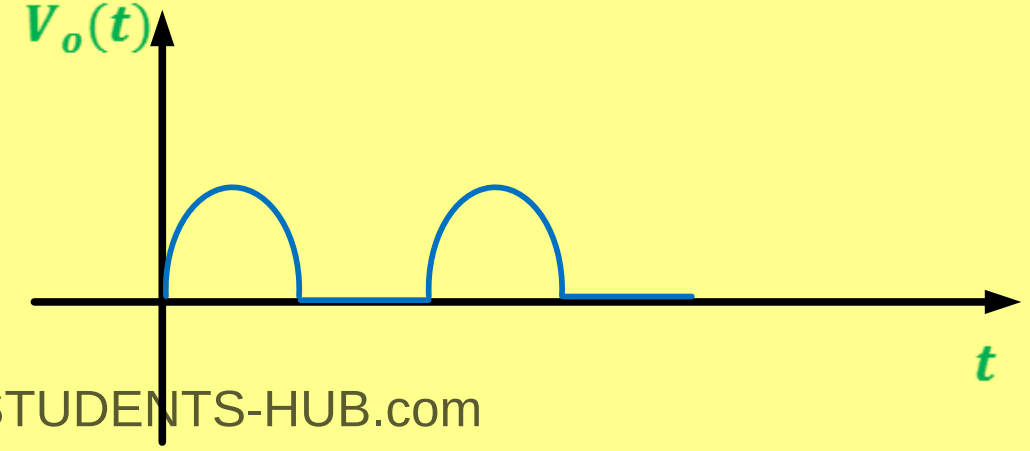
- Physical construction









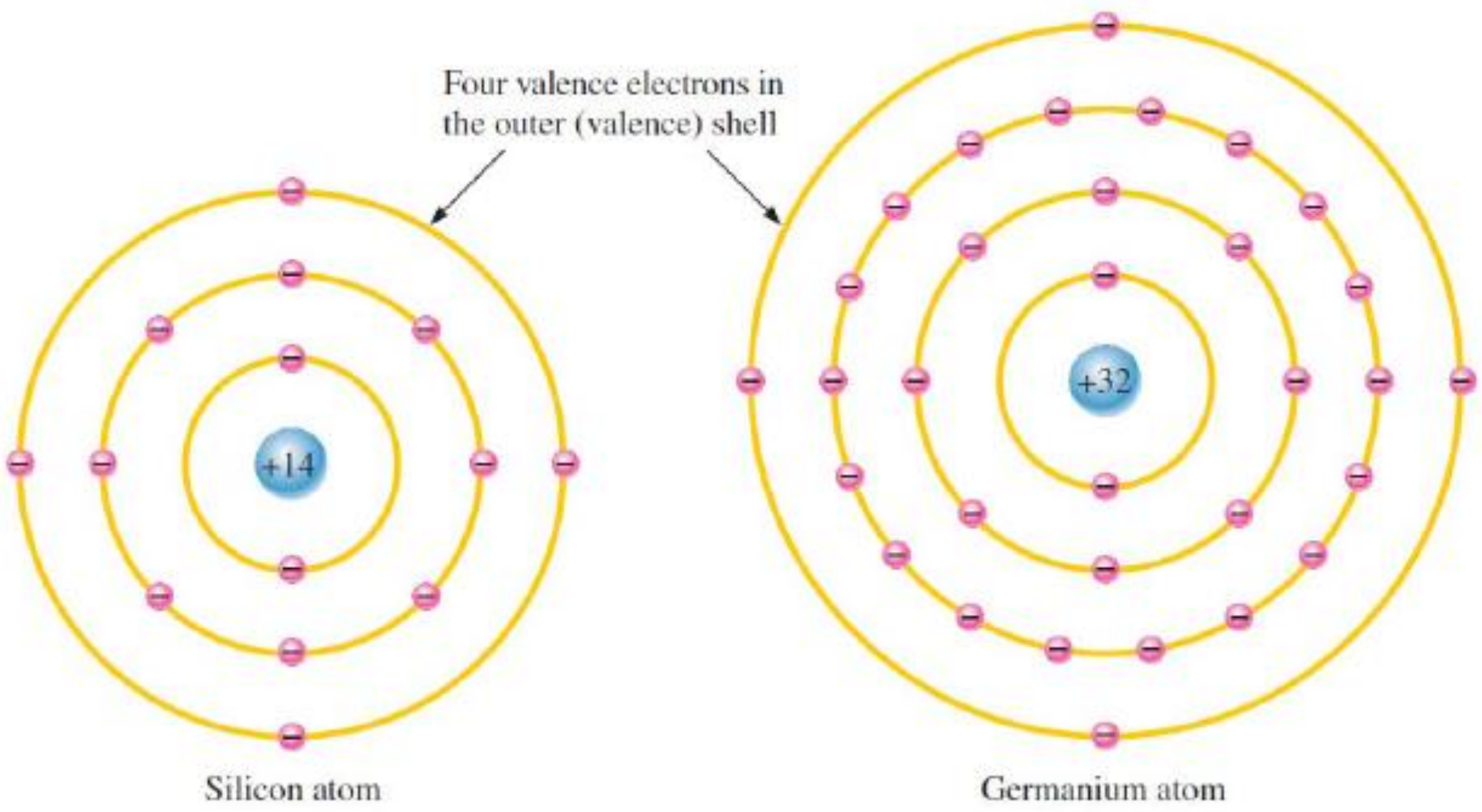


Semiconductor

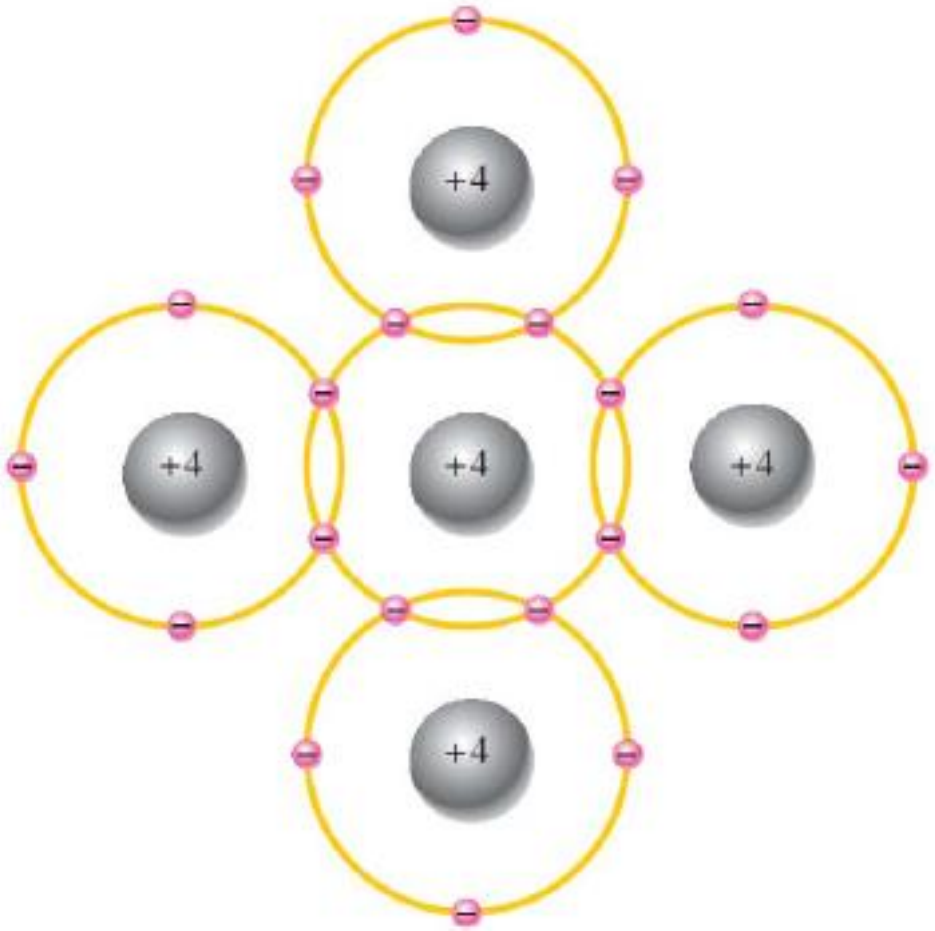
- Electronic devices such as diodes, transistors and integrated circuits are made of a semiconductor material .

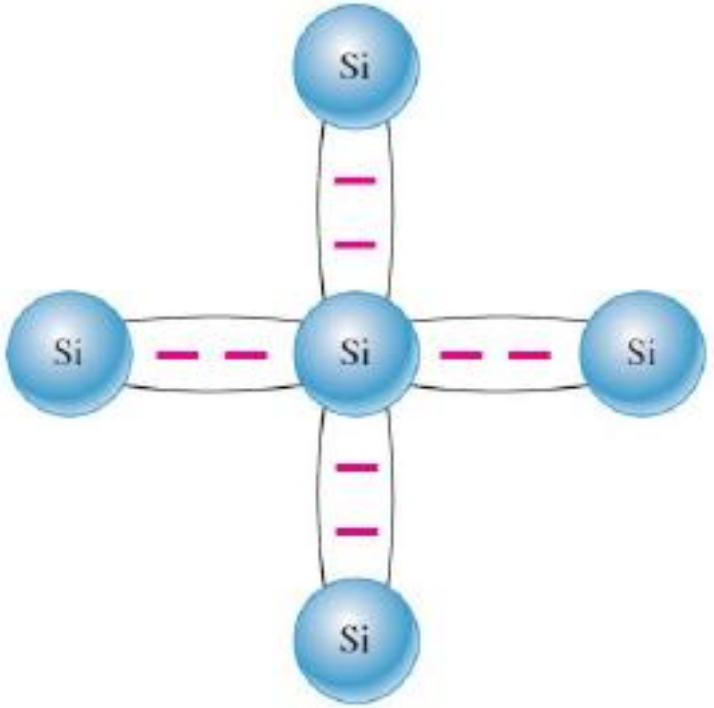
- Semiconductors : materials whose resistance lies between low resistance of conductor and the high resistance of insulator .

Atomic structure



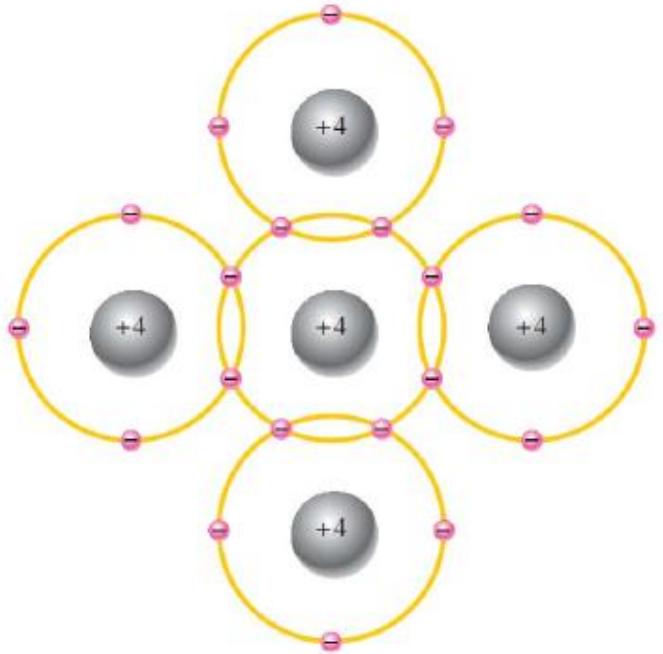
Covalent bond

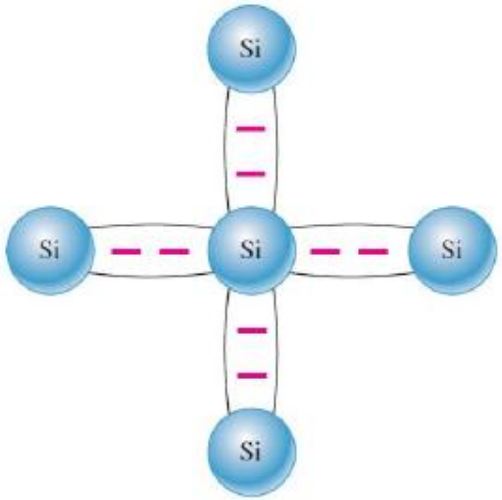




Covalent bond

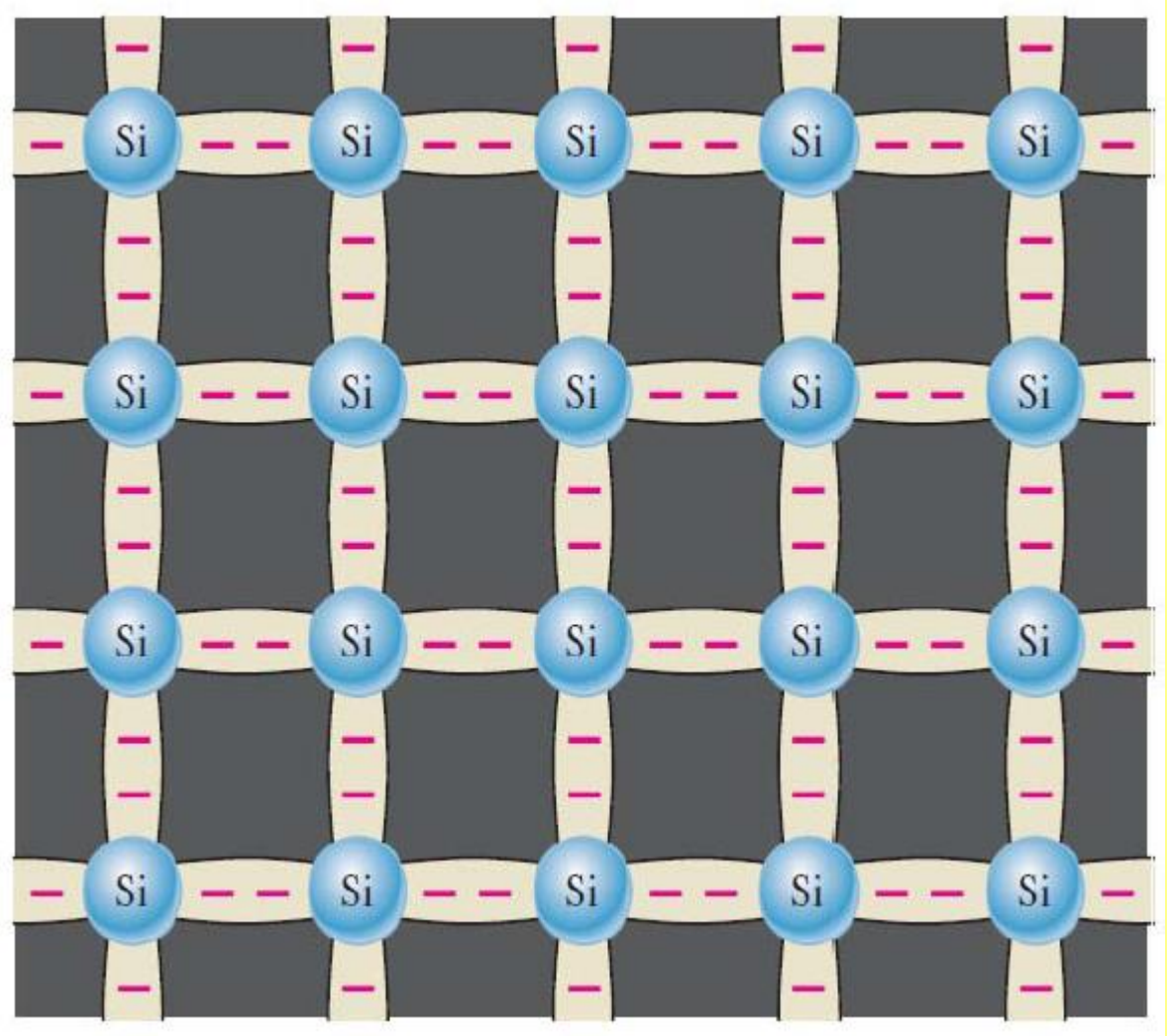
- A silicon (Si) atom with its four valence electrons shares an electron with each of its four neighbors
- This effectively creates eight shared valence electrons for each atom and produces a state of chemical stability .
- Also, this sharing of valence electrons produce the covalent bonds that hold the atom together; each valence electron is attracted equally by the two adjacent atoms which share it .





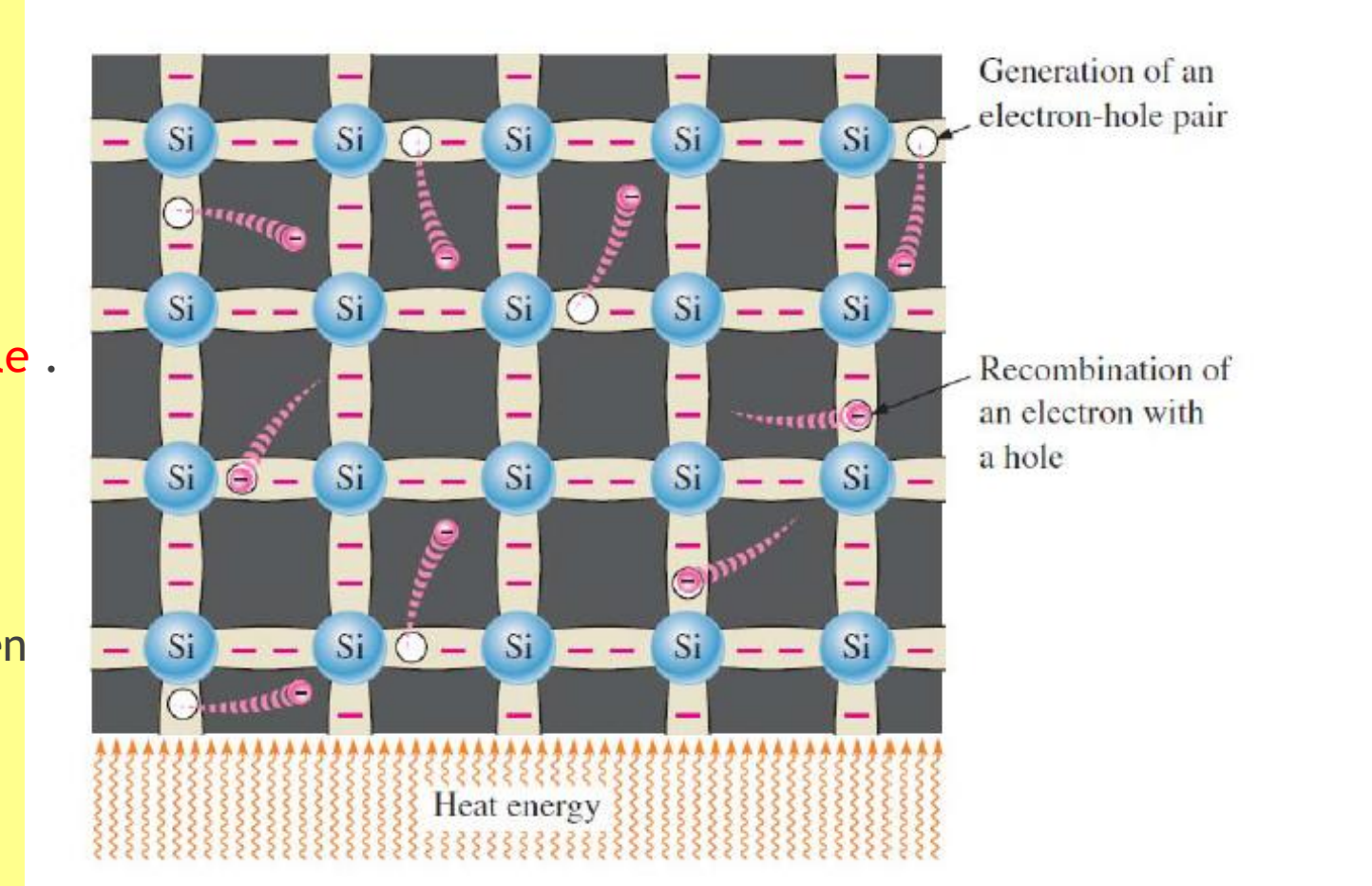
Covalent bond in silicon crystals

- 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 hole .
- For every free electron, there is one hole .
- One broken covalent bond → one free electron + one hole
- At room temperature there is one broken covalent bond for every $3x10^{12}$ 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.