Electronic Circuits 1

ENEE 2303

Mr. Mohammad AL-Jubeh

Course number and name: **ENEE2303 - ELECTRONICS 1**

Credits and contact hours: Credit: 3 (Lecture: 3, Lab.: 0)

Instructor's or course coordinator's name: Mr.Mohammad AL-Jubeh

- **Office hours**: will be announced

Textbook:

- **Office**: Masri220, email: jjubeh@birzeit.edu
- Microelectronic Circuits, Sedra & Smith, sixth edition, 2009 .

Reference:

- Electronic Devices and Circuit Theory , Boylestad &Nashelstky , 10th edition,2009
- Electronic Circuits Discrete and Integrated, Schilling&Belove

Specific course information

- **Description**: Semiconductor materials and PN junction, diode circuit applications, bipolar junction transistor structure and operation, BJT biasing circuits, small signal BJT amplifiers (CB, CE, and CC). Field effect transistor structures and operations, FET biasing circuits small signal FET amplifiers (CG, CS, CD), multistage amplifiers, frequency response of amplifiers, PnPn and other devices, using simulation tools for the design, and analysis of electronic circuits
- **Prerequisites:** ENEE2301
- Core course for Electrical engineering

Specific goals for the course

By the end of the course the students will be

- Familiar with basic physics and operation of diodes, BJTs, MOSFETs and JFETs.
- Able to analyze diode circuits using linear models techniques.
- Able to design diode circuits using linear models techniques.
- Able to analyze BJT and FET transistor biasing circuits.
- Able to design BJT and FET transistor biasing circuits.
- Able to perform small-signal analysis of basic BJT and FET amplifier circuits.
- Able to perform small-signal design of basic BJT and FET amplifier circuits.
- Able to analyze single and multistage amplifier at low, and high frequency .
- Able to describe the operational characteristics of the PNPN devices such as Shokley diode , SCR , DIAC , TRIAC,… and their applications
- Able to use the circuit simulator PSPICE for analysis of electronic circuits.

(ABET) Relationship of course to Computer Engineering Program Student Outcomes:

- (a) Ability to apply mathematics, science and engineering principles.
- (c) Ability to design a system, component, or process to meet desired needs.
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Brief list of topics to be covered

- Chapter 1 Electronics and Semiconductors .
- Chapter 3 Diodes .
- Chapter 4 Bipolar Junction Transistors (BJTs).
- Chapter 5 MOS field-Effect Transistors (MOSFETs) .
- Chapter 6 Building Blocks of Integrated- Circuit Amplifiers .
- Chapter 8 Frequency Response .
- Chapter A Multistage Amplifiers.
- Chapter B PNPN and Other Devices.

Tentative Grading:

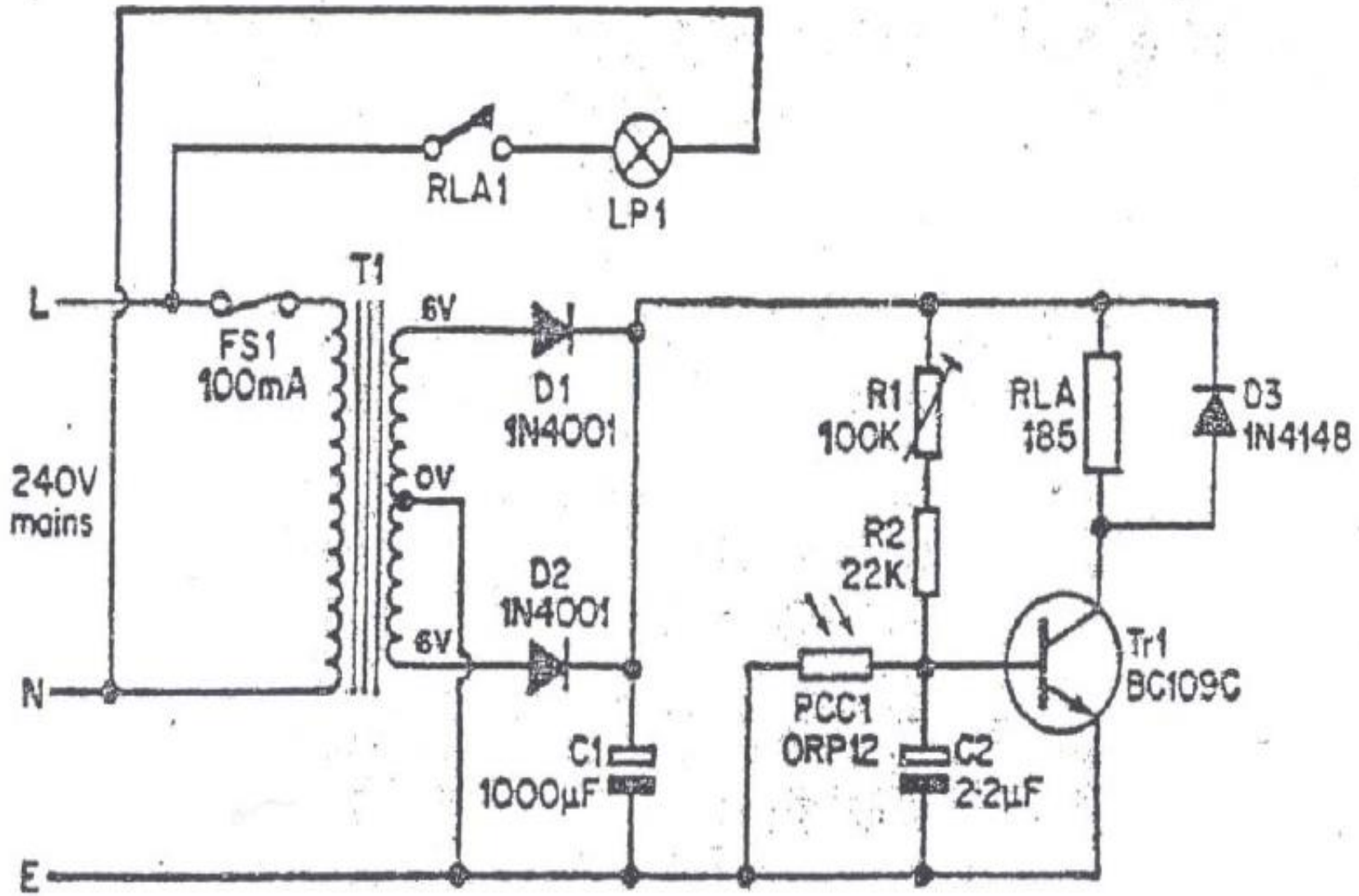
- First and Second Exams 35%
- Final Exam 45%
- Quizzes and Projects 20%

Policies:

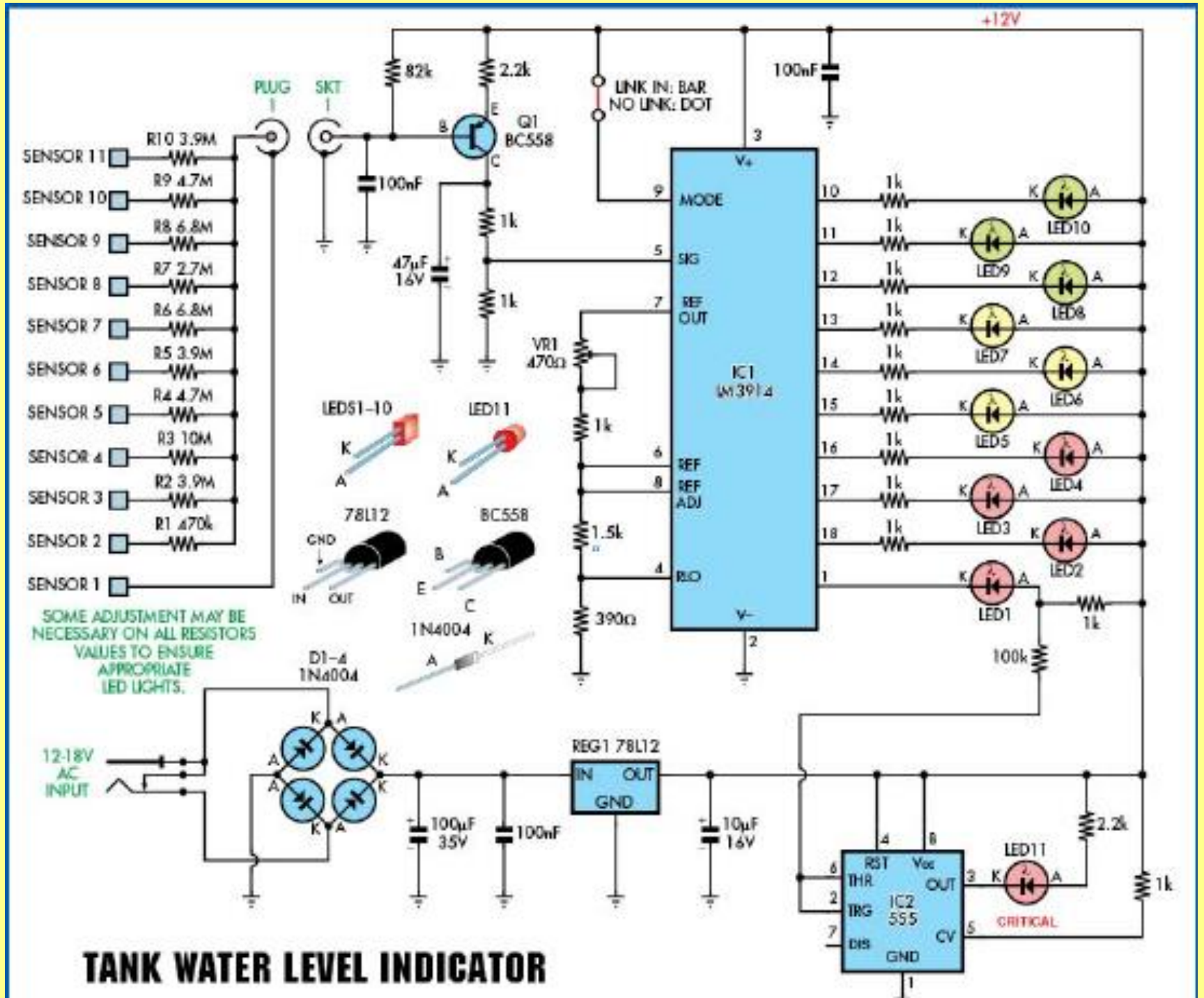
- No late submissions will be accepted.
- Class attendance is required by the university regulations. Come to All lectures and activities.
- Make-up will be allowed only for students who miss the final exam with an acceptable excuse according to the university regulations.
- All students are expected to comply with University rules and regulations on academic Integrity and honesty.

ENEE2303 Project #1

Automatic Light Controller



ENEE2303
Project #2



at a glance (green is good, yellow not so good and red is a warning) as well as the specific levels represented by the individual LEDs.

A further red LED lights when the tank level drops below a critical threshold. This can simply be to warn you of impending localised drought (hey, your tank's empty!) – or it (or indeed any of the ten-LED 'string') could be used to trigger an audible alarm or turn on a pump, as we will discuss later.

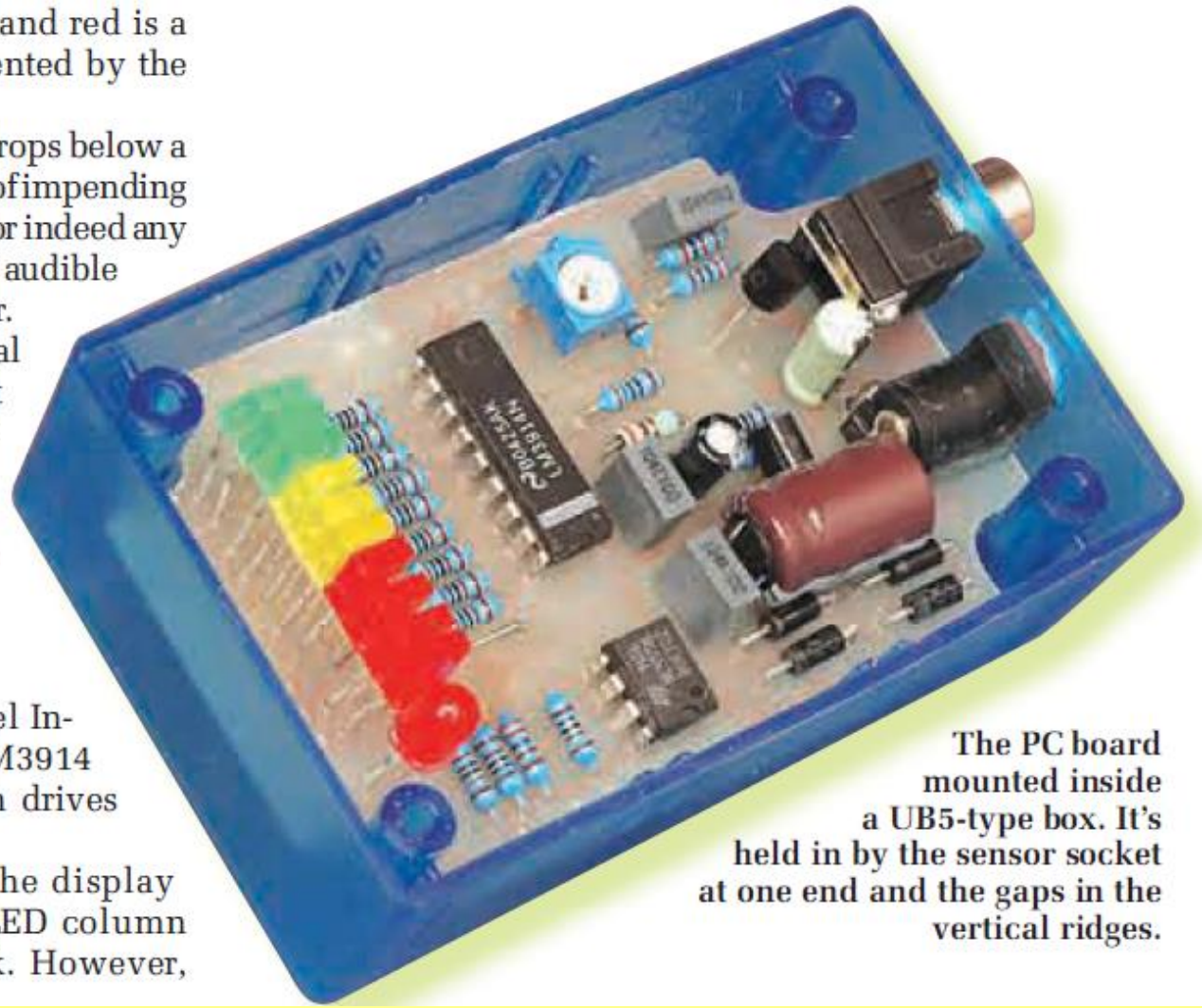
There are no fancy microcontrollers or digital displays used in this project. Instead, it uses just a handful of common parts to keep the cost as low as possible.

It can be used in virtually any type of tank. As long as you can get access inside the tank from the top to the bottom, this circuit will work.

Circuit description

The circuit diagram for the Tank Water Level Indicator is shown in Fig.1. It is based on an LM3914 linear LED dot/bar display driver (IC1) which drives ten LEDs (LEDs 1 to 10).

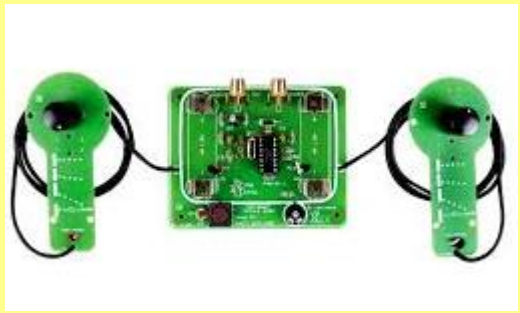
Pin 9 of the LM3914 is tied high so that the display is in bargraph mode and the height of the LED column indicates the level of the water in the tank. However,

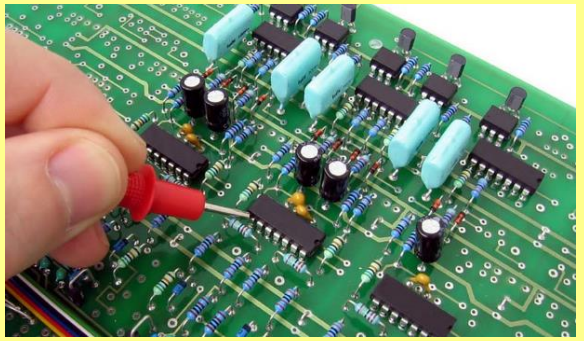


The PC board mounted inside a UB5-type box. It's held in by the sensor socket at one end and the gaps in the vertical ridges.

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 .

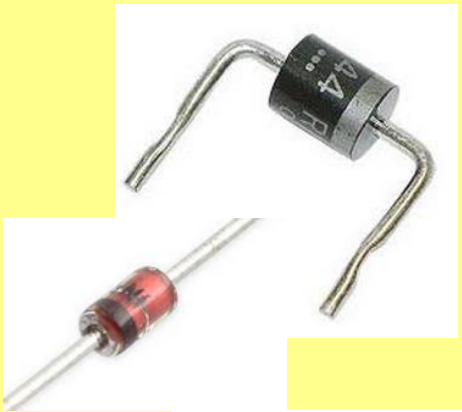


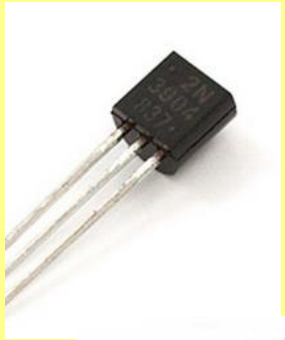


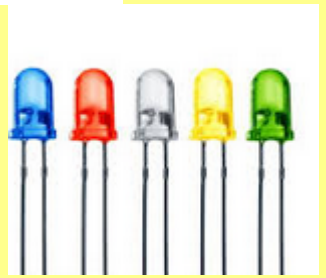
- The field of electronics deals with the design and applications of electronic devices .

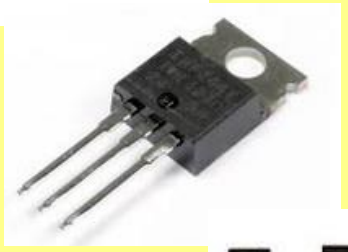
Electronics Devices

- 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)







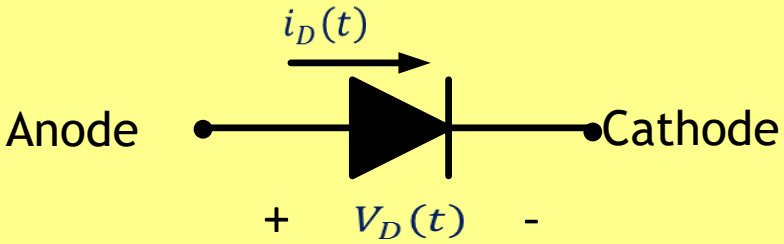


Nobel Prize in Physics 1956

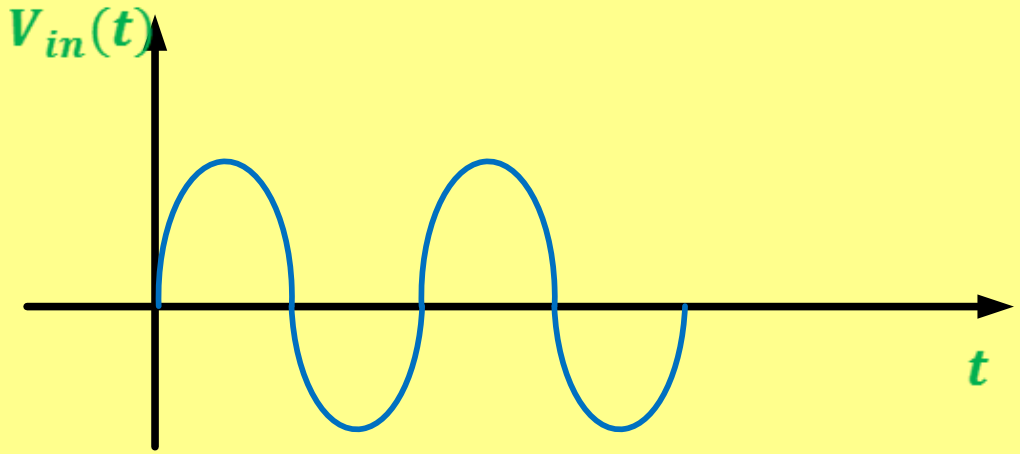
Diode

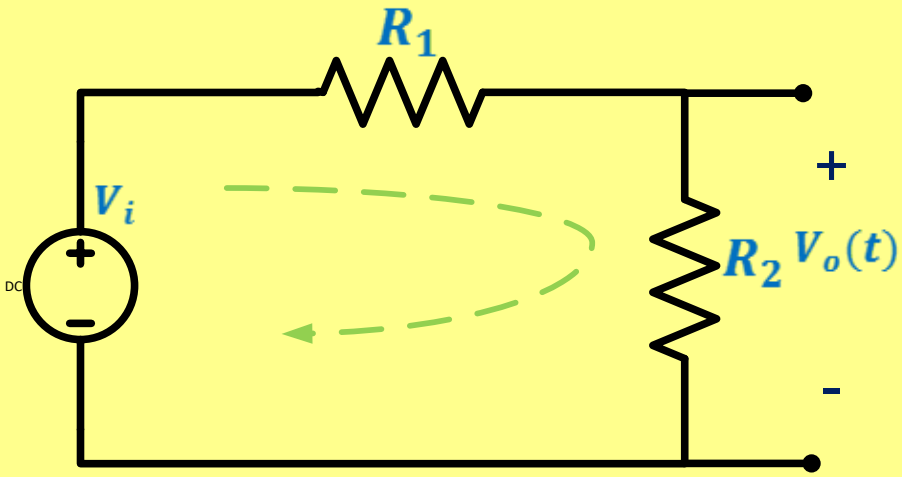
- It is an electronic device with a single p-n junction and it has the ability to conduct current in one direction while blocking current in the other direction.

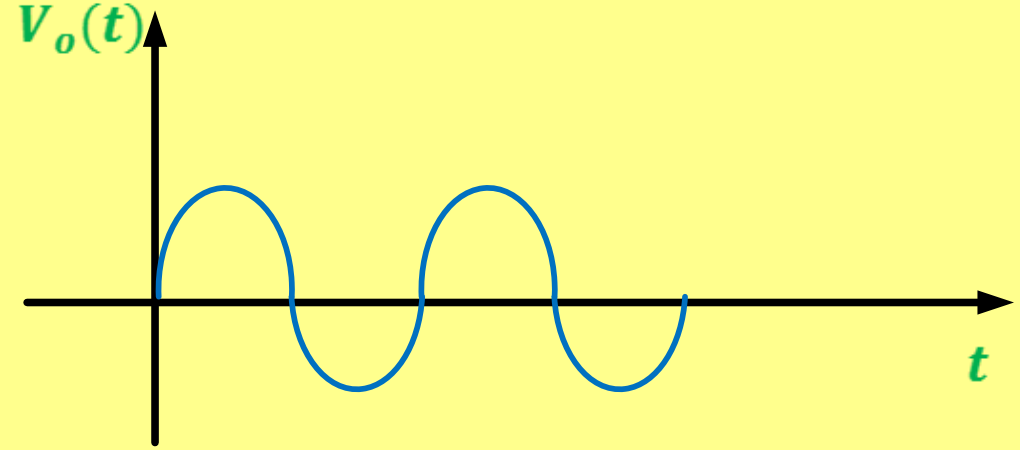
- Circuit Symbol :

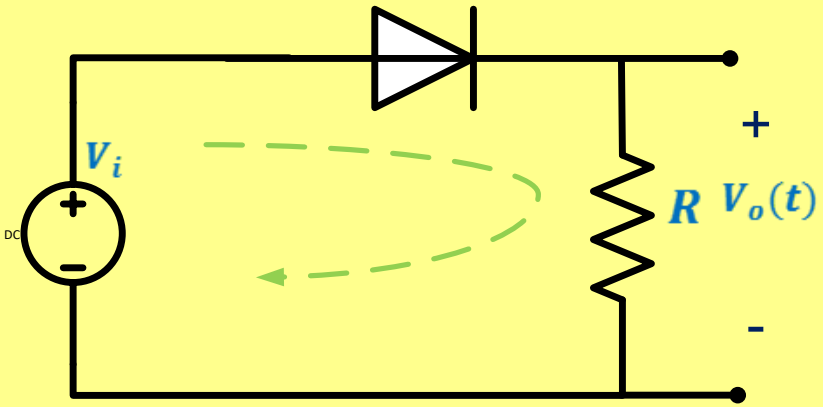


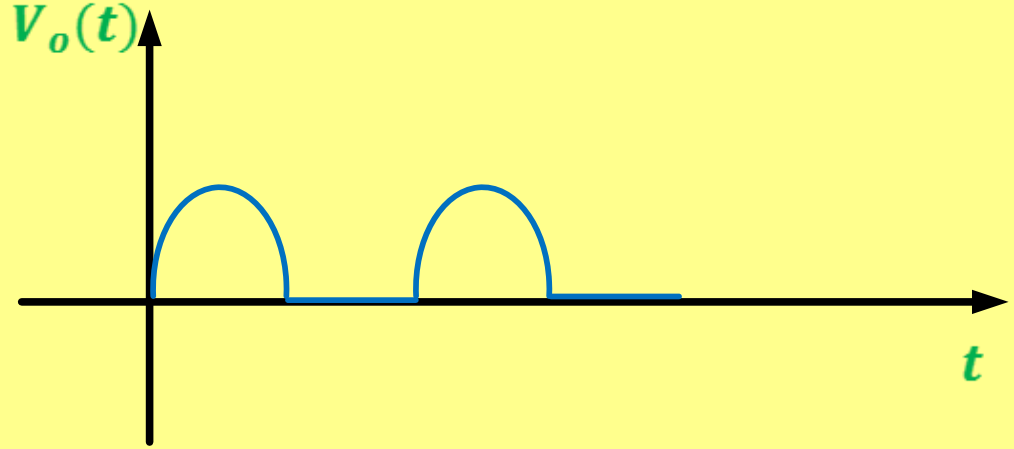
  - Physical construction


$V_{in}(t)$
t


R_1
V_i
DC
R_2
$V_o(t)$
+
-


$V_o(t)$
t


V_i
DC
R
$V_o(t)$
+
-


$V_o(t)$
t

- Electronic devices such as diodes, transistors, and integrated circuits are made of a semiconductor material.
- To understand how these devices work, you should have a basic knowledge of the structure of atoms and the interaction of atomic particles.
- An important concept introduced in this chapter is that of the *pn* junction that is formed when two different types of semiconductor material are joined.
- The *pn* junction is fundamental to the operation of devices such as the solar cell, the diode, and certain types of transistors.

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 .

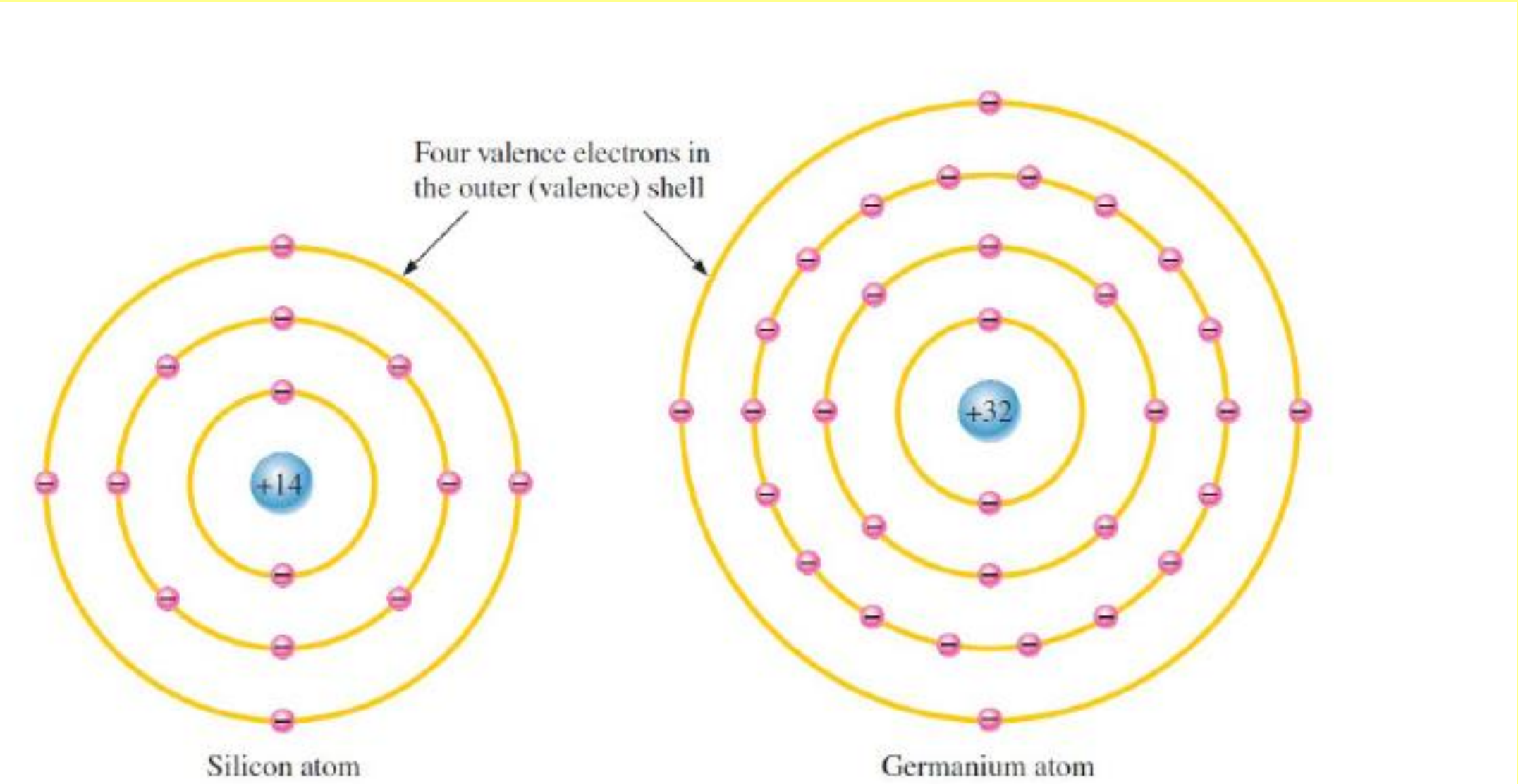
Materials can be classified by their ability to conduct electricity.

1 - Conductors : Materials that easily conduct electrical current

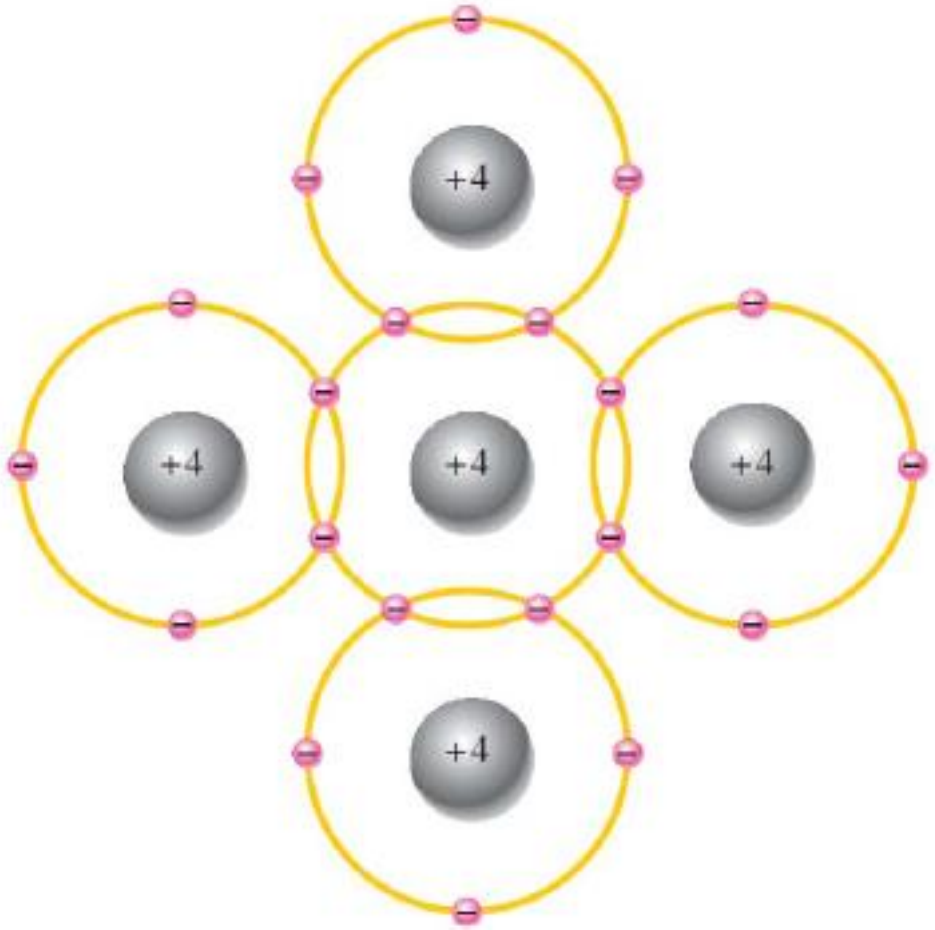
2 - Insulators : Materials that do not conduct electrical current under normal condition

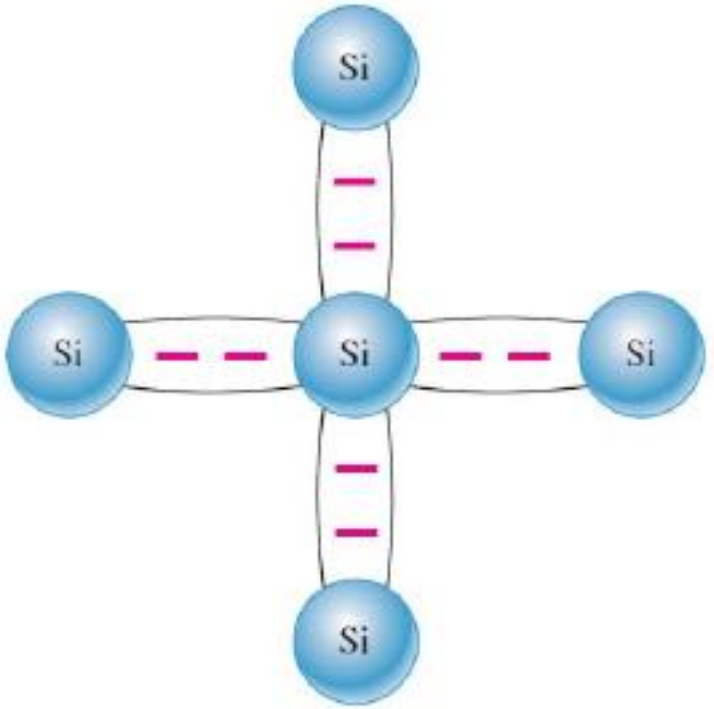
3 - Semiconductors: Material that are between conductors and insulators in their ability to conduct electrical current

Atomic structure



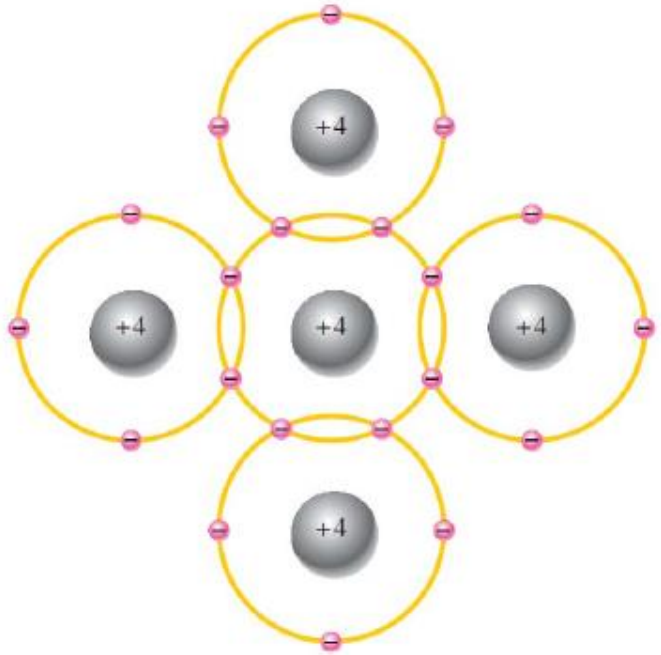
Covalent bond



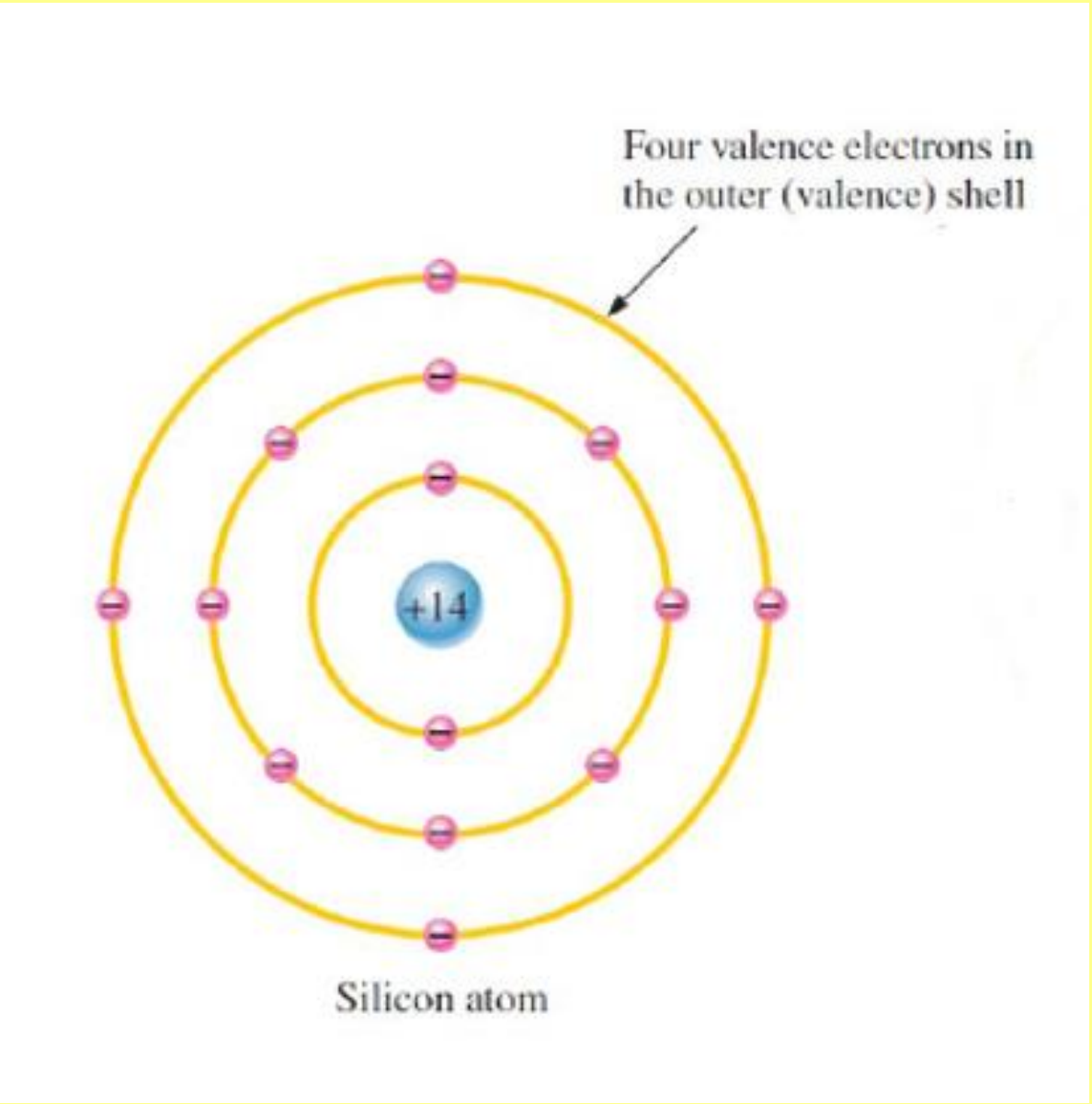


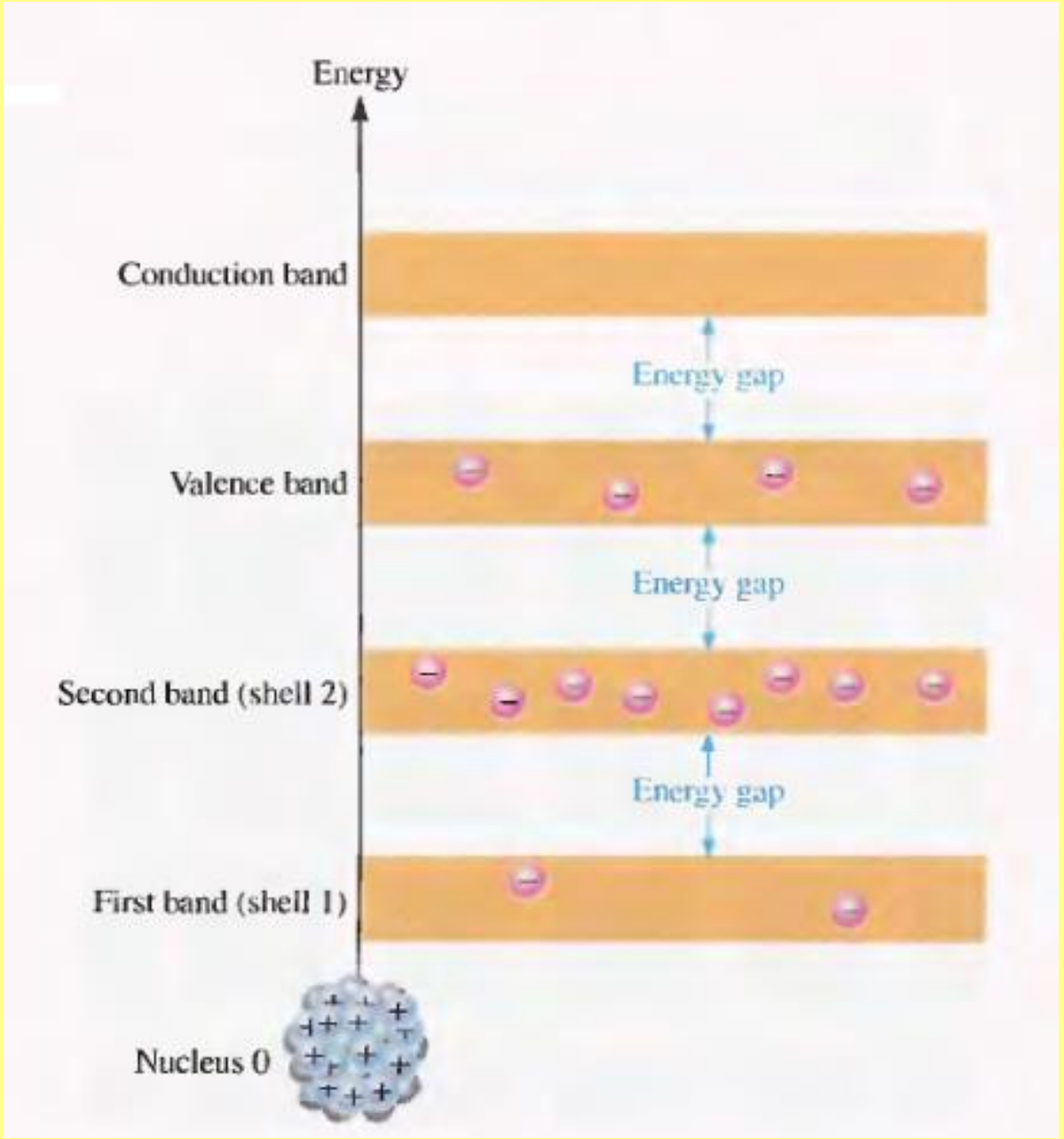
Covalent bond

- 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 .



Conduction in Semiconductors

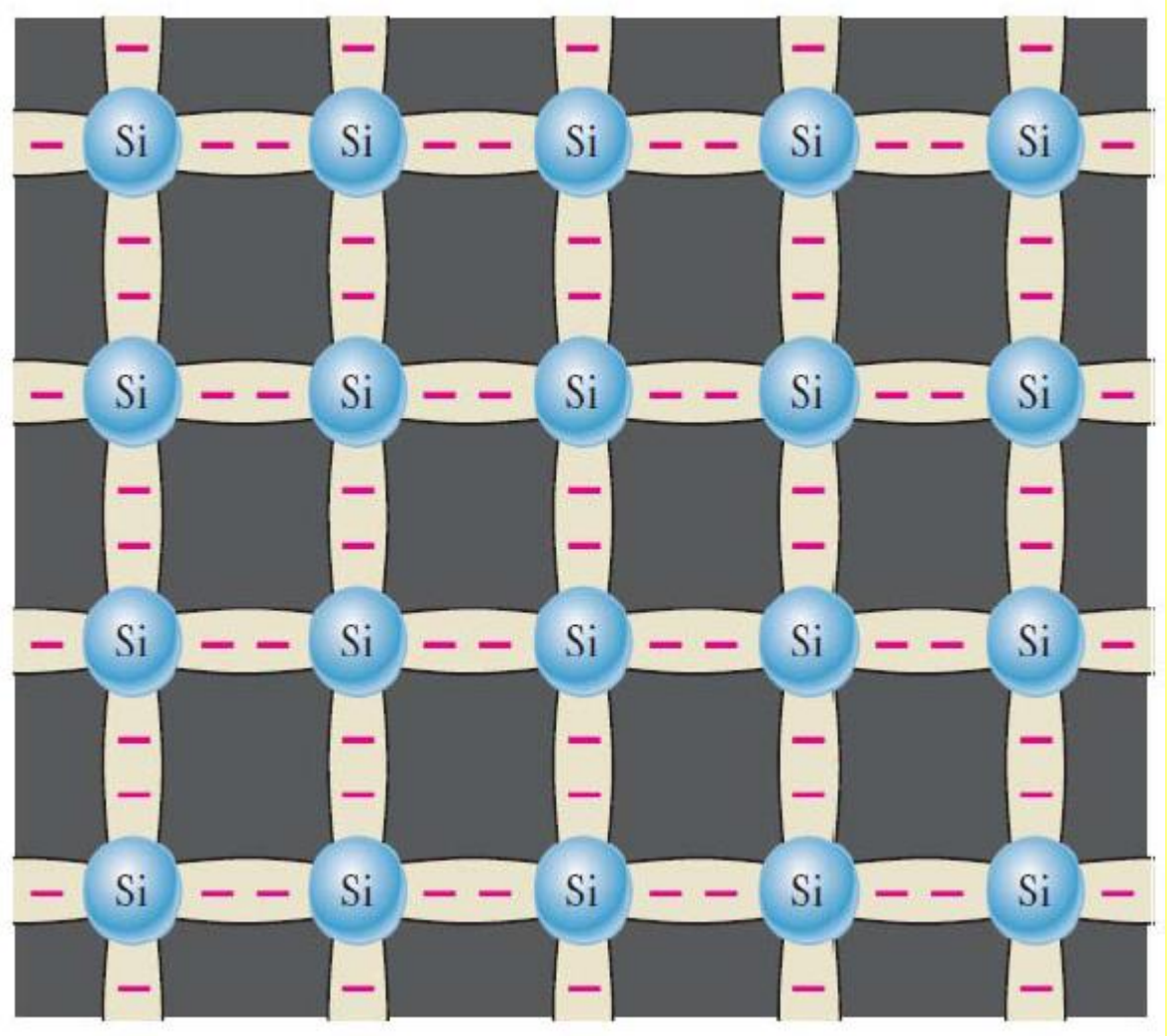




Energy Band Diagram for an unexcited Si atom

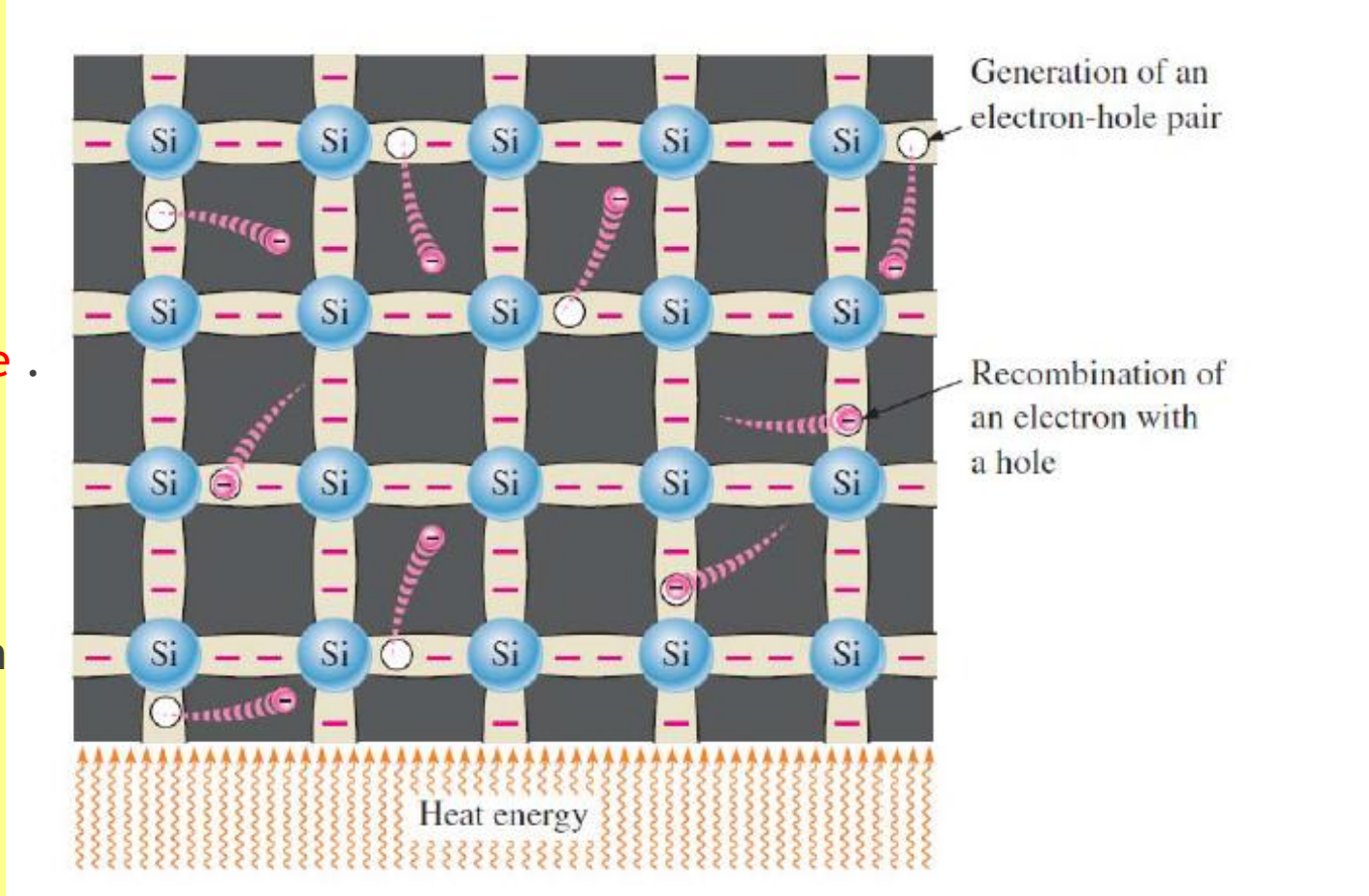
Covalent bond in silicon crystals

- 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 $5x10^{12}$ pure Si atoms .
- At room temperature there are few available charge carriers (free electrons + holes)
- At room temperature pure Si is poor conductor .



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.