Table of Contents

- 1. General Information
- 2. Isotopes of Silicon
- 3. Physical Properties
- 4. Chemical Properties
  - Reaction with Oxygen (Oxidation):
  - Reaction with Hydrofluoric Acid:
- 5. Occurrence and Abundance
- 6. Industrial Production of Silicon
- 7. Uses of Silicon
- 8. Important Silicon Compounds
- 9. Biological Importance of Silicon
- 10. Silicon in Technology
- 11. Environmental Role of Silicon
- 12. Safety and Hazards
  - Handling Precautions:
  - Fun Facts About Silicon:

1. General Information

- Symbol: Si
- Atomic Number: 14
- Atomic Mass: 28.09 u
- Group: 14 (Carbon Group)
- Period: 3
- Block: p-block
- Electron Configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
- Valence Electrons: 4
- Phase at Room Temperature: Solid

---

2. Isotopes of Silicon

Isotope	Protons	Neutrons	Abundance	Notes
^{28}Si	14	14	92.23%	Most abundant.
^{29}Si	14	15	4.67%	Stable.
^{30}Si	14	16	3.1%	Stable.

---

3. Physical Properties

- Color: Gray with metallic luster
- Odor: Odorless
- Density: 2.33 g/cm^3
- Melting Point: 1,414°C
- Boiling Point: 3,265°C
- State at STP: Solid
- Hardness: Brittle, crystalline structure (like glass).

---

4. Chemical Properties

- Moderately Reactive:
  - Forms silicon dioxide (SiO_2) in air.
  - Resists corrosion by water and acids but reacts with halogens.
- Forms Covalent Bonds:
  - Tetravalent (can form four bonds).
- Semiconductor Properties:
  - Conducts electricity better than non-metals but worse than metals.

Reaction with Oxygen (Oxidation):

$Si + O_2 \rightarrow SiO_2$ (Silicon Dioxide)

Reaction with Hydrofluoric Acid:

$SiO_2 + 6HF \rightarrow H_2SiF_6 + 2H_2O$

5. Occurrence and Abundance

- Second most abundant element in Earth’s crust (after oxygen).
- Found in:
  - Rocks and Sand: Quartz, granite, feldspar.
  - Silicates: Form the majority of Earth’s minerals.
- Not found in Free State: Always in compounds (e.g., SiO_2).

---

6. Industrial Production of Silicon

- Extracted from Quartz (SiO_2):

  $SiO_2 + 2C \rightarrow Si + 2CO$ (Reduction with carbon in electric arc furnaces)

- Refined Further for Electronics:
  - Zone Refining: Produces ultra-pure silicon.

---

7. Uses of Silicon

Application	Description
Semiconductors	Microchips, transistors, solar cells.
Construction	Concrete, glass, and bricks.
Alloys	Aluminium-silicon alloys for automotive parts.
Cosmetics and Sealants	Silicone-based products.
Glass and Ceramics	Silica (SiO_2) used in glassmaking.
Aerospace and Defense	High-strength silicon carbide (SiC).
Medical Implants	Silicone for surgical implants.

---

8. Important Silicon Compounds

Compound	Formula	Use
Silicon Dioxide	SiO_2	Glass, sand, concrete.
Silicones	$(R_2SiO)n$	Lubricants, sealants, medical devices.
Silicon Carbide	SiC	Abrasives, cutting tools.
Silicon Tetrachloride	$SiCl_4$	Optical fibers, semiconductors.
Sodium Silicate	Na_2SiO_3	Detergents, water treatment.

---

9. Biological Importance of Silicon

- Trace Element in Humans and Plants:
  - Supports bone strength and connective tissue.
  - Promotes plant growth and cell wall strength.
- Essential for Diatoms: Microscopic algae use silica to form protective shells.

---

10. Silicon in Technology

- Key Material in Electronics:
  - Used in transistors and microchips for computers and phones.
- Solar Panels:
  - Photovoltaic cells are made from silicon wafers.
- Silicon Valley:
  - Named after the use of silicon in the tech industry.

---

11. Environmental Role of Silicon

- Rock Cycle:
  - Forms minerals that shape Earth’s crust and geological processes.
- Silica Dust:
  - Can cause lung diseases (silicosis) if inhaled.

- Sustainable and Abundant:
    - Silicon-based materials are widely recyclable.

---

12. Safety and Hazards

- Inert in Pure Form:
    - Does not pose direct health risks.
- Silica Dust (SiO_2):
    - Prolonged exposure can lead to respiratory issues.
- Silicon Compounds:
    - Some are corrosive (e.g., $SiCl_4$ reacts with moisture to form HCl).

Handling Precautions:

- Ventilation when working with silica dust.
- Use respirators and safety goggles during cutting or grinding.

Fun Facts About Silicon:

- Named after the Latin word “silex” meaning flint or hard stone.
- Silicon makes up 27% of Earth’s crust.
- Silicon-based life forms are a common science fiction trope!
- The first transistor was made from silicon and germanium.