



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Coimbatore-35



DEPARTMENT OF BIOMEDICAL ENGINEERING

23BMT203 - BIOMEDICAL TRANSDUCERS AND SENSORS

UNIT II- Pressure, Displacement and Temperature II Year/ IV Sem

Dr. K. Manoharan,
ASP / BME / SNSCT



BIOMEDICAL TRANSDUCERS AND SENSORS



- ✓ Resistive Strain Gauges and Bridge circuit
- ✓ Piezoelectric Transducers
- ✓ Potentiometric Transducers
- ✓ Capacitive, Inductive
- ✓ LVDT Transducers - Principle
- ✓ Equivalent Circuit & Linearity Issues
- ✓ Thermo Resistive - Resistance Temperature Detectors (RTDS)
- ✓ Thermistor Thermo Electric - Thermocouple
- ✓ PN Junction Diode



PN Junction Diode

Introduction to PN Junction Diode

A **PN junction diode** is a semiconductor device that allows current to flow in one direction while blocking it in the opposite direction. It is the fundamental building block of many electronic circuits and is widely used in rectifiers, signal processing, and voltage regulation.

Formation of PN Junction

A **PN junction** is formed by joining **P-type** and **N-type** semiconductor materials:

- **P-Type (Positive)**: Has excess **holes** (absence of electrons).
- **N-Type (Negative)**: Has excess **free electrons**.

When these two materials are joined:

- Free electrons from the **N-region** diffuse into the **P-region** and recombine with holes, forming a **depletion region**.
- The depletion region acts as a barrier, preventing further electron movement unless an external voltage is applied.



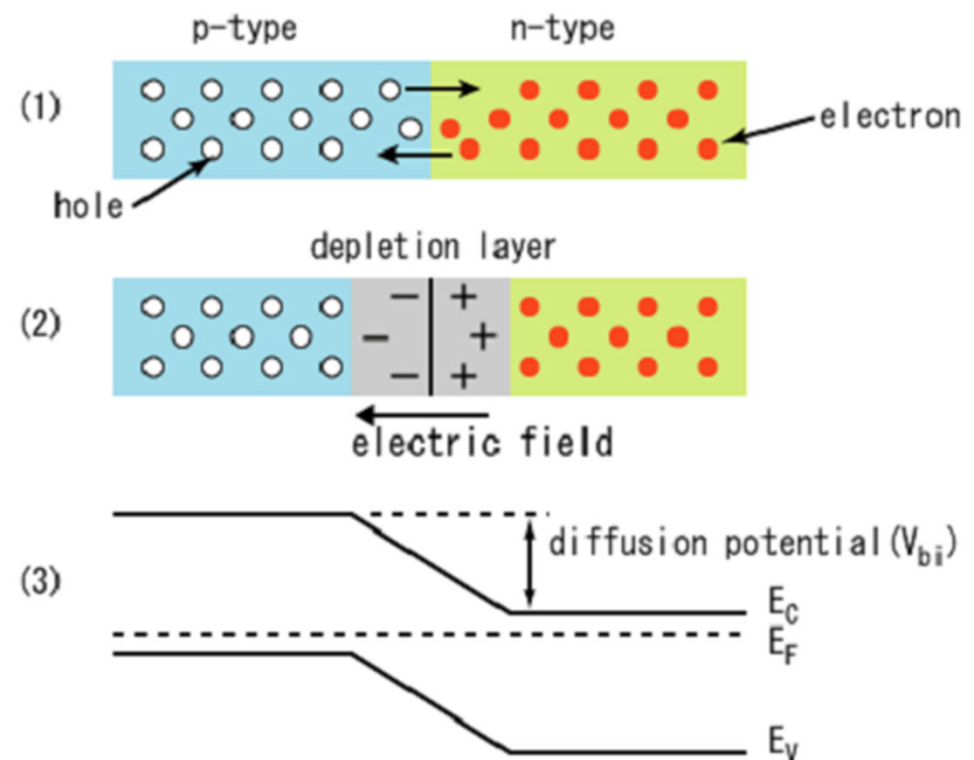
PN Junction Diode

Depletion Region & Barrier Potential

- The **depletion region** is a zone around the PN junction where **mobile charge carriers (electrons and holes)** are depleted.
- This creates an **electric field** that opposes further charge carrier movement.
- The built-in **barrier potential** (V_b) depends on the semiconductor material:

Silicon (Si) - 0.7V

Germanium (Ge) – 0.3V





PN Junction Diode

Biasing of PN Junction Diode

A PN junction diode operates in two modes depending on the applied voltage:

Forward Bias (Conducting Mode)

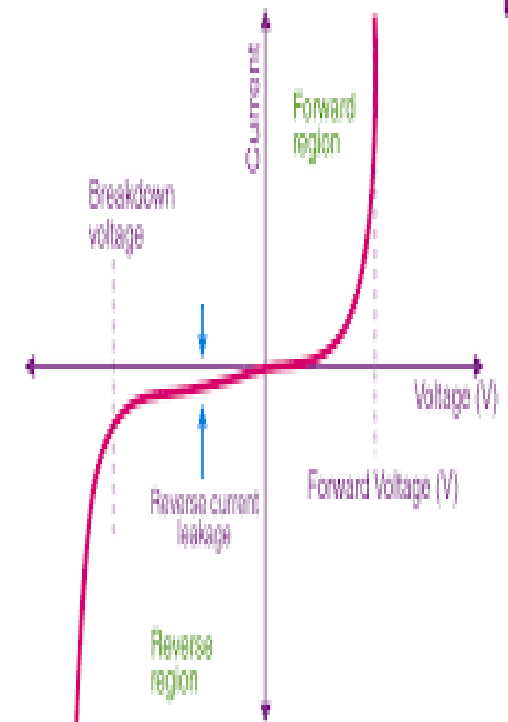
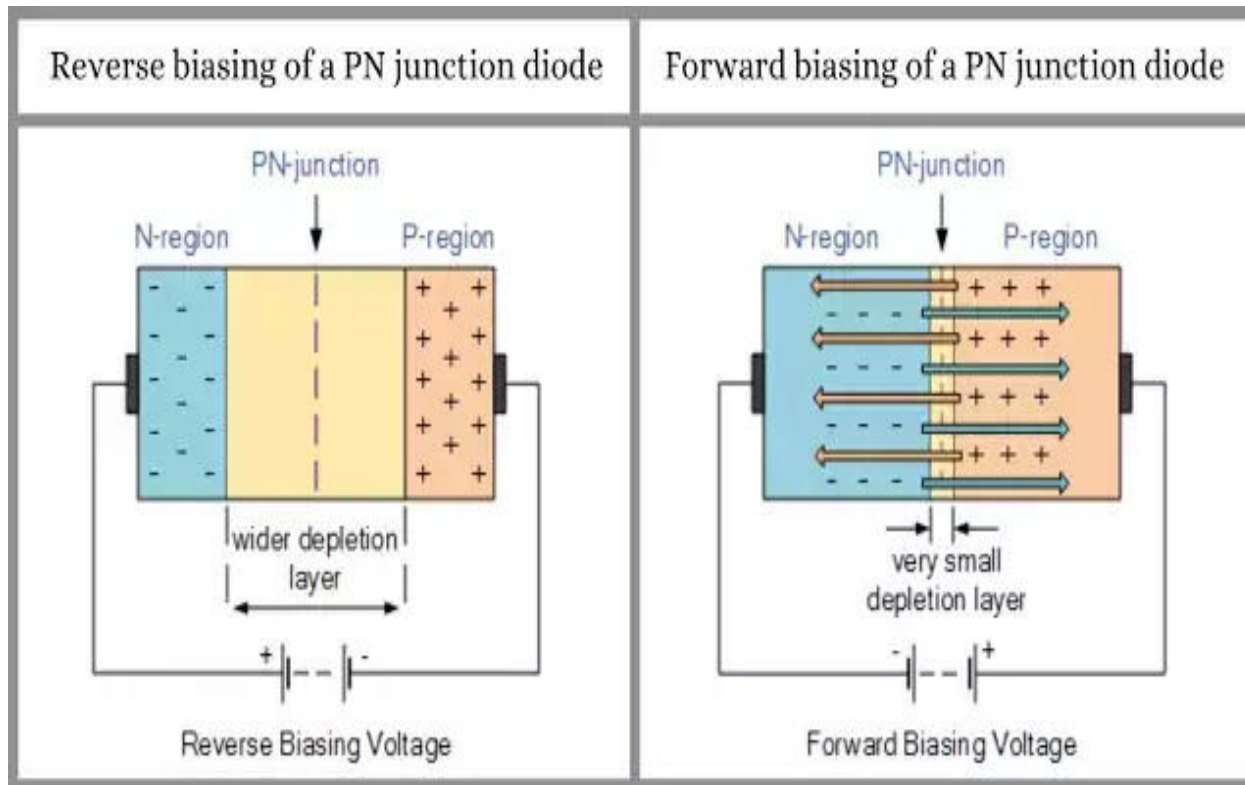
- **External voltage is applied so that P-side is connected to +ve and N-side to -ve.**
- The applied voltage **reduces the barrier potential**, allowing current to flow.
- **Threshold Voltage:** The minimum voltage required to overcome the barrier and conduct:
 - Silicon diode: $\sim 0.7V$
 - Germanium diode: $\sim 0.3V$

Reverse Bias (Blocking Mode)

- **External voltage is applied so that P-side is connected to -ve and N-side to +ve.**
- The depletion region widens, and the diode **blocks current flow**, except for a tiny **reverse leakage current**.
- If the **reverse voltage exceeds a critical value**, the diode undergoes **breakdown** (either **Zener breakdown** or **Avalanche breakdown**).




PN Junction Diode





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Types of PN Junction Diodes & Their Applications

Type	Description	Applications
Standard Diode	Basic PN junction diode	Rectifiers, clamping circuits
Zener Diode	Works in reverse breakdown mode	Voltage regulation
Schottky Diode	Low forward voltage drop ($\sim 0.3V$)	High-speed switching, power applications
LED (Light Emitting Diode)	Emits light when forward biased	Display panels, indicators
Photodiode	Generates current when exposed to light	Optical sensors, solar cells
Varactor Diode	Acts as a variable capacitance 	RF tuning circuits



PN Junction Diode



Applications of PN Junction Diode

- **Rectification:** Converts AC to DC (Bridge Rectifiers).
- **Voltage Regulation:** Zener diodes stabilize voltage.
- **Signal Clipping & Clamping:** Used in wave shaping circuits.
- **Switching Circuits:** Used in logic circuits and microcontrollers.
- **Optoelectronics:** LEDs, photodiodes, and laser diodes.