

Introduction to Semiconductor Materials

- **Semiconductors:** Materials with electrical conductivity between conductors and insulators.
 - Common semiconductor materials: **Silicon (Si)**, **Germanium (Ge)**, **Gallium Arsenide (GaAs)**.
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Doping in Semiconductors

- **Doping:** Process of adding impurities to a semiconductor to change its electrical properties.
 - **Types of Doping:**
 - **N-type:** Adding **pentavalent** impurities (e.g., Phosphorus, Arsenic) to introduce free electrons.
 - **P-type:** Adding **trivalent** impurities (e.g., Boron, Gallium) to create holes.
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Intrinsic & Extrinsic Semiconductors

- **Intrinsic Semiconductor:** Pure semiconductor material with equal electrons and holes.
 - **Extrinsic Semiconductor:** Doped semiconductor with excess electrons (N-type) or holes (P-type).
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PN Junction Diode

- **Structure:** Formed by joining P-type and N-type semiconductors.
 - **Characteristics:**
 - **Forward Bias:** Low resistance, current flows easily.
 - **Reverse Bias:** High resistance, minimal current flows.
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Diffusion & Depletion Capacitance

- **Diffusion Capacitance:** Due to charge carrier movement in forward bias.
 - **Depletion Capacitance:** Due to charge storage in the depletion region in reverse bias.
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Rectifiers

- **Purpose:** Converts AC to DC.
 - **Types:**
 - **Half-Wave Rectifier:** Uses a single diode, rectifies only one half-cycle of AC.
 - **Full-Wave Rectifier:** Uses two or four diodes (Bridge Rectifier) to rectify both half-cycles of AC.
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Zener Diode

- **Characteristics:** Operates in reverse breakdown region with stable voltage.
 - **Zener Diode as Voltage Regulator:** Maintains constant output voltage despite variations in input voltage or load.
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Light Emitting Diode (LED)

- **Function:** Emits light when forward biased.
 - **Applications:** Indicator lights, displays, communication devices.
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Solar Cell

- **Function:** Converts light energy into electrical energy using the photovoltaic effect.
- **Applications:** Solar panels, calculators, satellites.