SEMICONDUCTOR DIODE

EEE 1221

ELECTRONICS

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Reference Book

- Electronic Devices- Thomas L Floyd.
- Electronic Devices and Circuit Theory- Robert Boylestad

This presentation slide only contains the overview of the related topics. Students are advised to take decent class-notes and read thoroughly from the prescribed text books.

OUTLINE

- Diode
- Forward Bias
- Reverse Bias
- Characteristics Curve
- Si vs Ge
- Temperature Effect
- Different types of resistance
- Diode Model

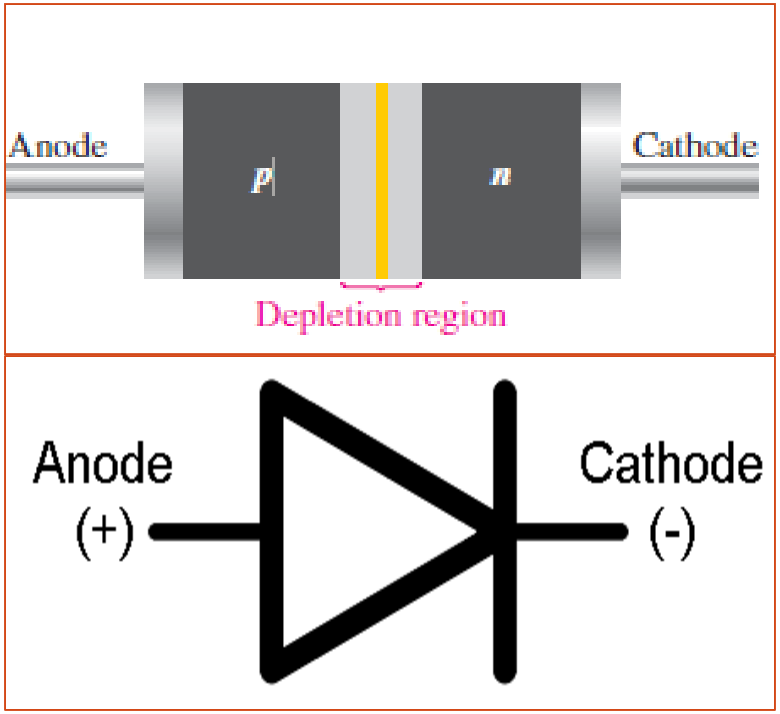
What is Diode?

- Diode is a **two terminal semiconductor device** which allow alternating current to flow only in one direction.
- Its use in rectifier is the most common application.

Structure & Symbol

✓A diode is made from a small piece of semiconductor material.

✓Half is doped as a ***p region*** and half is doped as an ***n region*** .

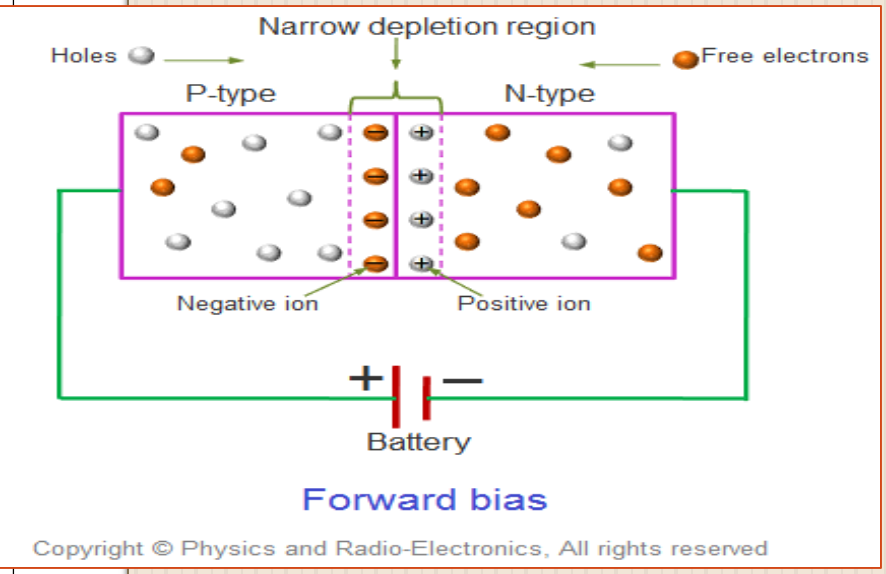


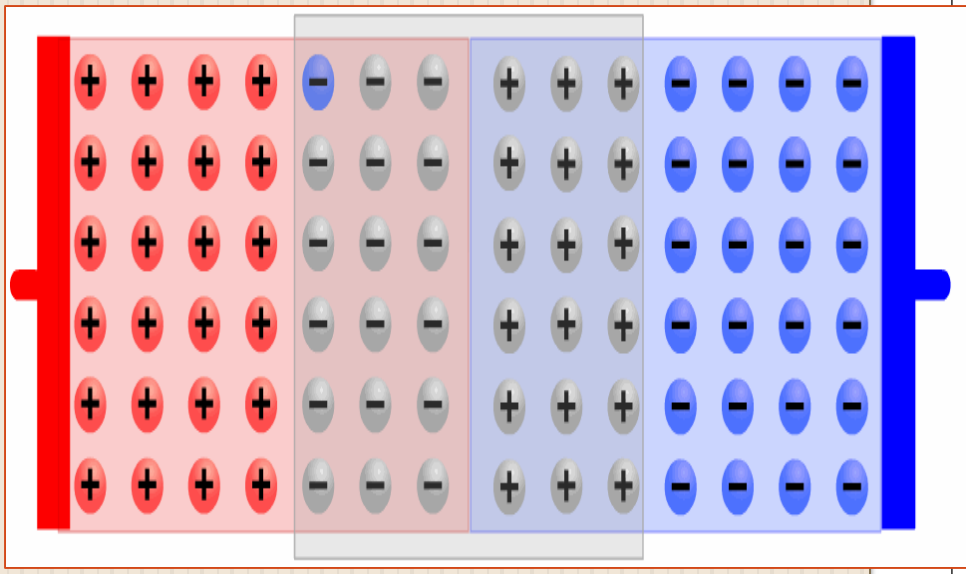
✓The ***p region*** is called the ***anode***.

✓The ***n region*** is called the ***cathode.***

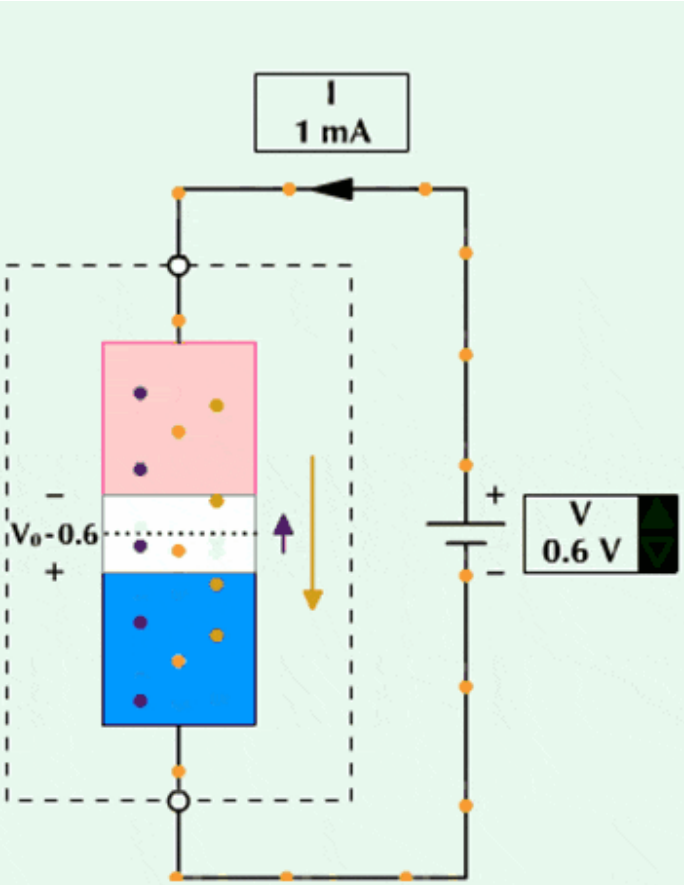
Forward Bias

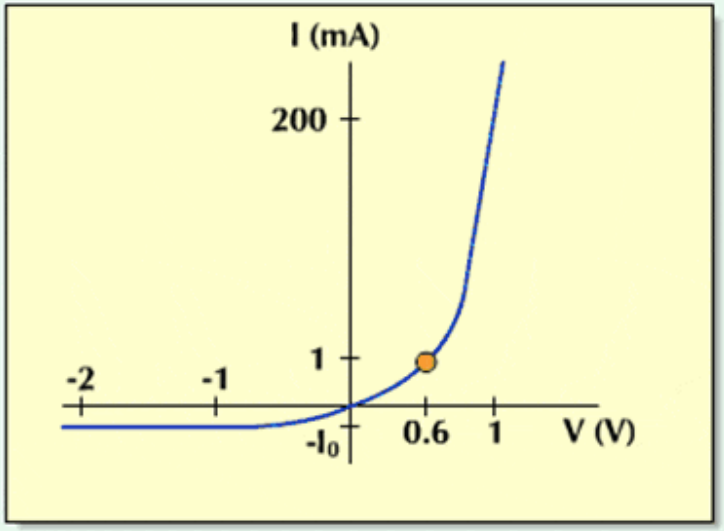
- **Forward bias is the condition that allows** current through the *p-n junction*.





Forward Bias





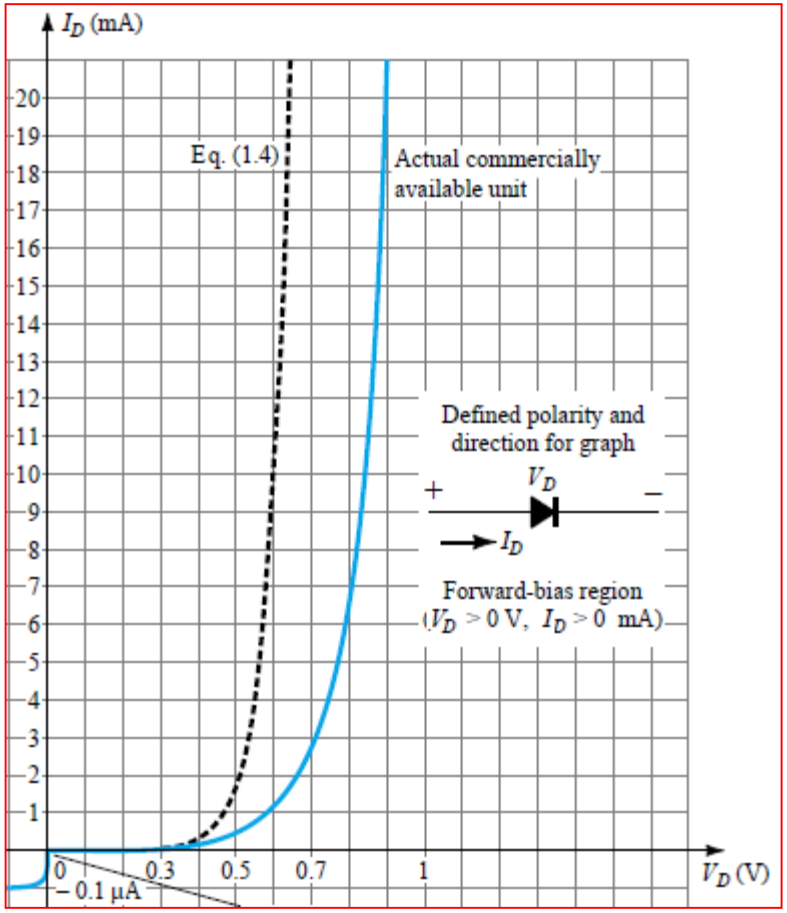
Making the p-side more positive than the n-side ($V > 0$) reduces the width of the depletion region. The electric field across the junction decreases. This significantly increases the diffusion current (since more holes and electrons can now overcome the field) but does not affect the drift current.

This situation is called **forward biasing**.

Forward Bias

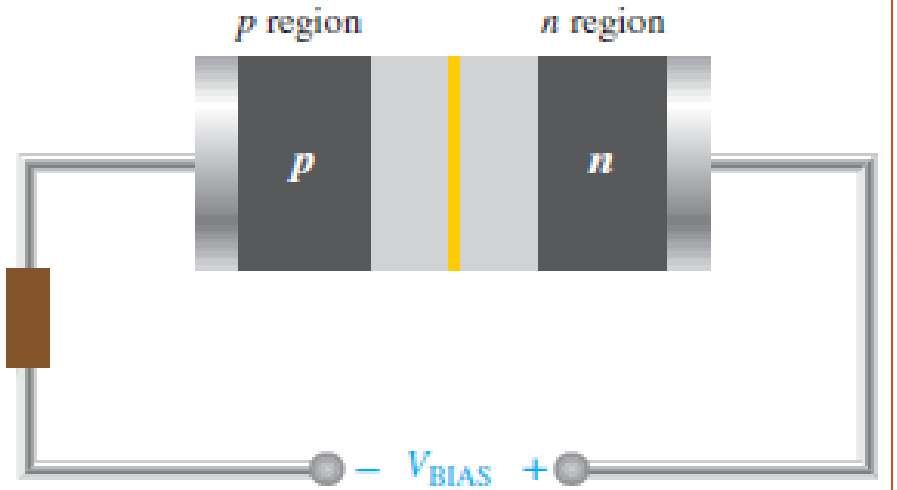
- **Forward Current:** The current that flow through a diode in forward bias condition.

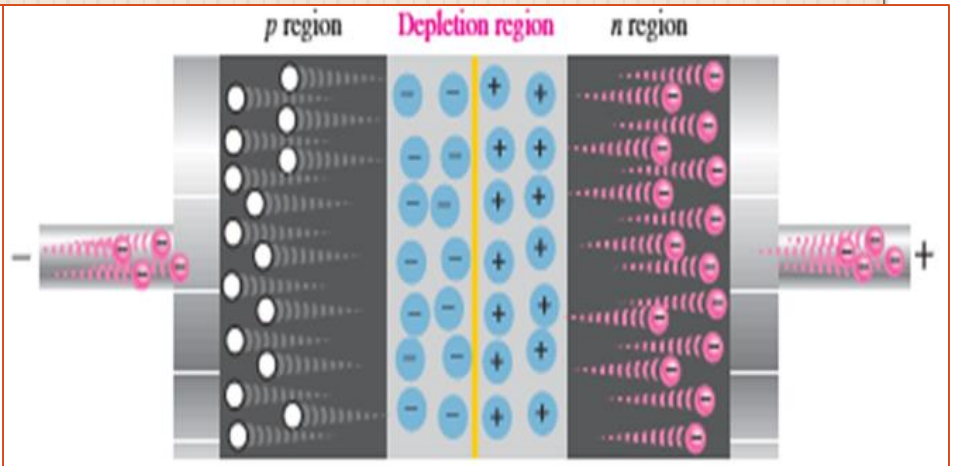
- **Forward Knee Voltage:** The forward voltage at which the current through the junction starts to increase rapidly.



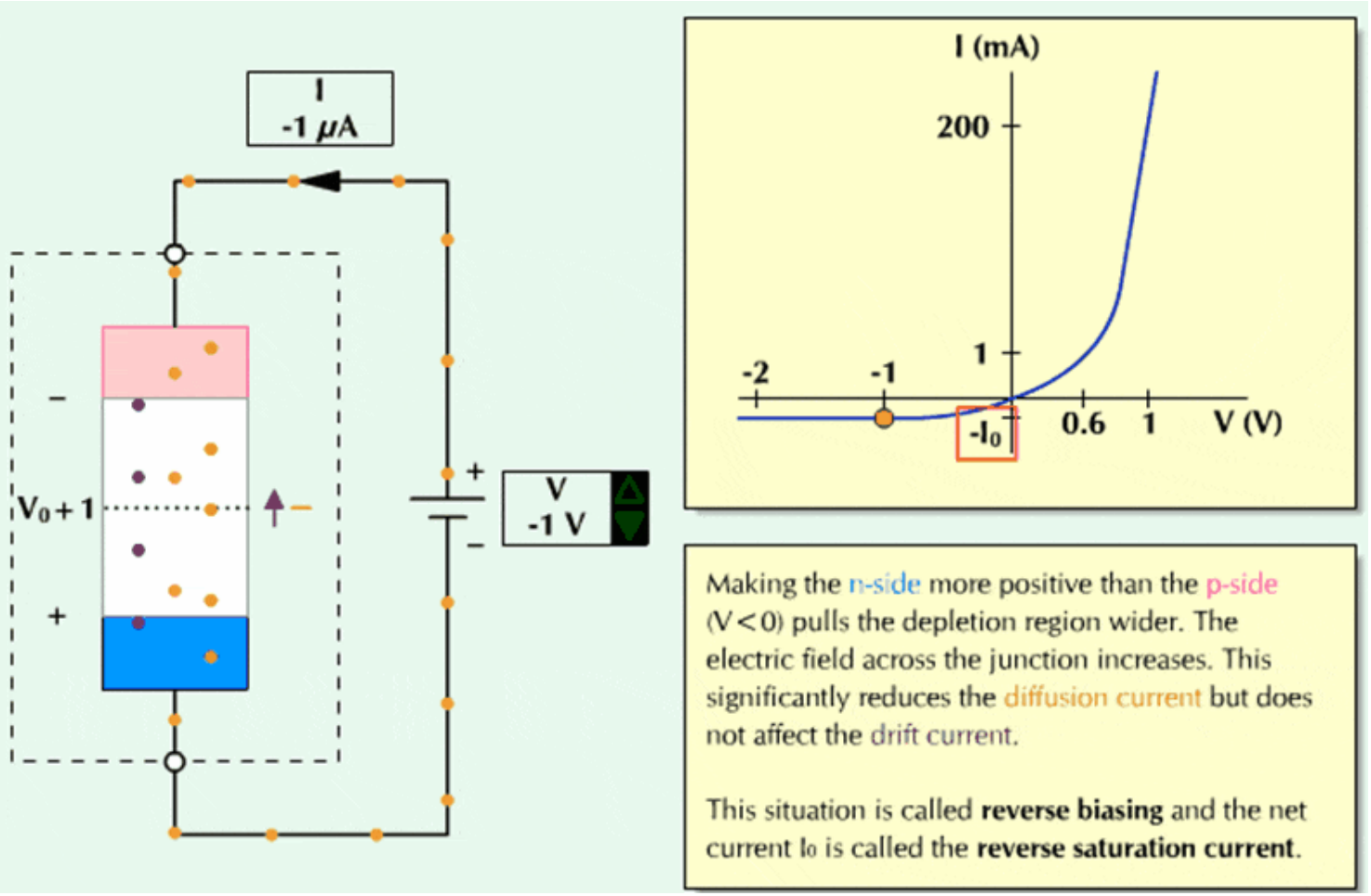
Reverse Bias

- **Reverse bias is the condition** that essentially prevents current through the diode.





Reverse Bias



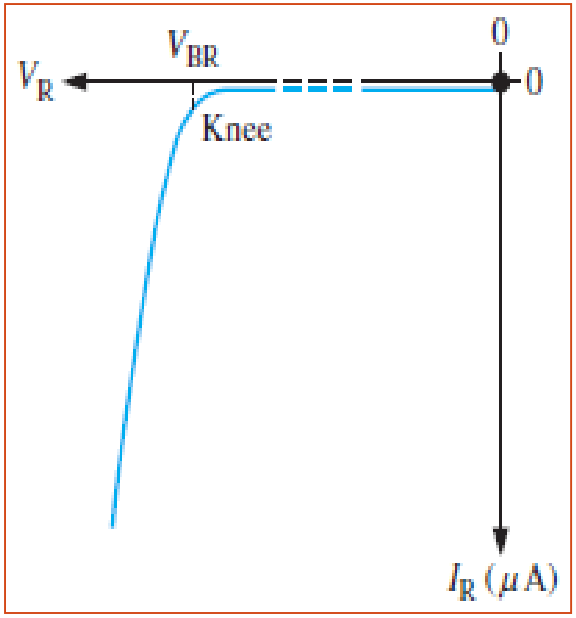
Making the n-side more positive than the p-side ($V < 0$) pulls the depletion region wider. The electric field across the junction increases. This significantly reduces the diffusion current but does not affect the drift current.

This situation is called **reverse biasing** and the net current I_0 is called the **reverse saturation current**.

Reverse Bias

- **Reverse Current:** The small current that flow through a diode in reverse biased condition.

- **Break-down Voltage:** The minimum reverse voltage at which p-n junction breaks down with sudden rise in reverse current.

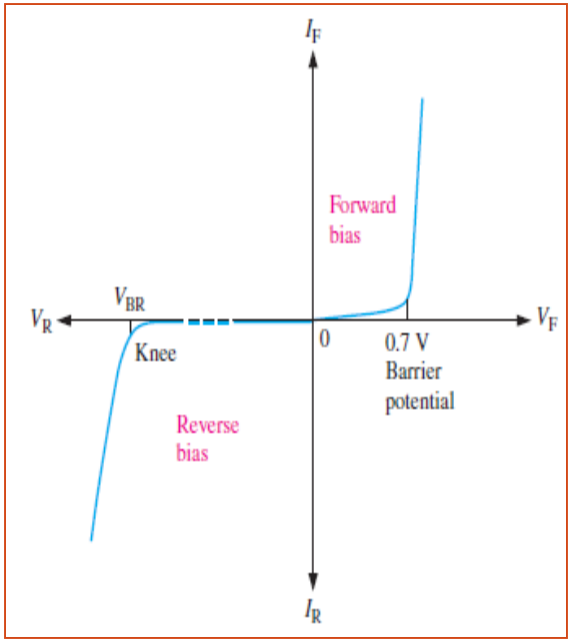


Peak inverse voltage

- The maximum reverse voltage that a diode can withstand without destroying the junction.

Diode characteristic curve

A semiconductor diode can be defined by the following equation for the forward- and reverse-bias regions.



$$I_D = I_s(e^{kV_D/T_K} - 1)$$

where I_s = reverse saturation current
$k = 11{,}600/\eta$ with $\eta = 1$ for Ge and $\eta = 2$ for Si for relatively low levels of diode current (at or below the knee of the curve) and $\eta = 1$ for Ge and Si for higher levels of diode current (in the rapidly increasing section of the curve)
$T_K = T_C + 273°$

Thank You !!