SNS COLLEGE OF TECHNOLOGY
Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECB101 – CIRCUIT ANALYSIS AND DEVICES

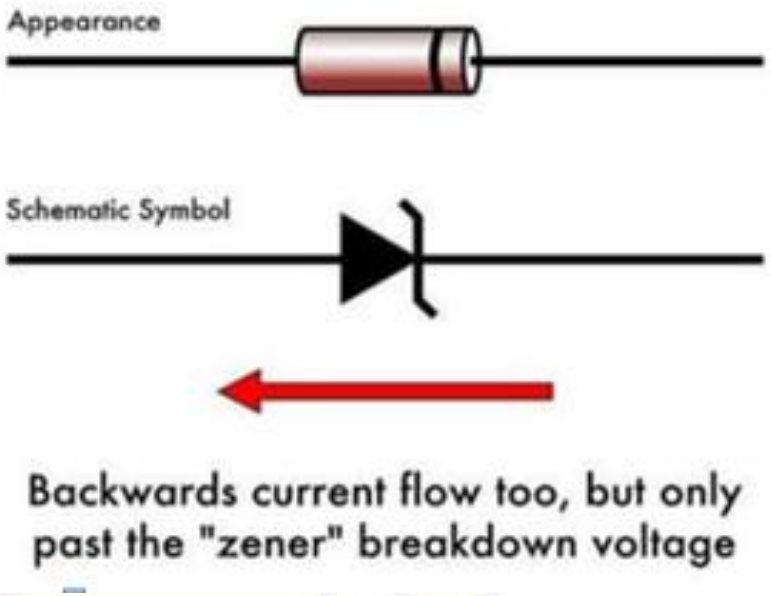
I YEAR/ II SEMESTER

UNIT 4 – SEMICONDUCTOR DIODES AND THEIR APPLICATIONS

TOPIC - Zener diode

Introduction

- A Zener diode is a type of diode that permits current not only in the forward direction like a normal diode, but also in the reverse direction if the voltage is larger than the breakdown voltage known as “Zener knee voltage” or “Zener voltage”



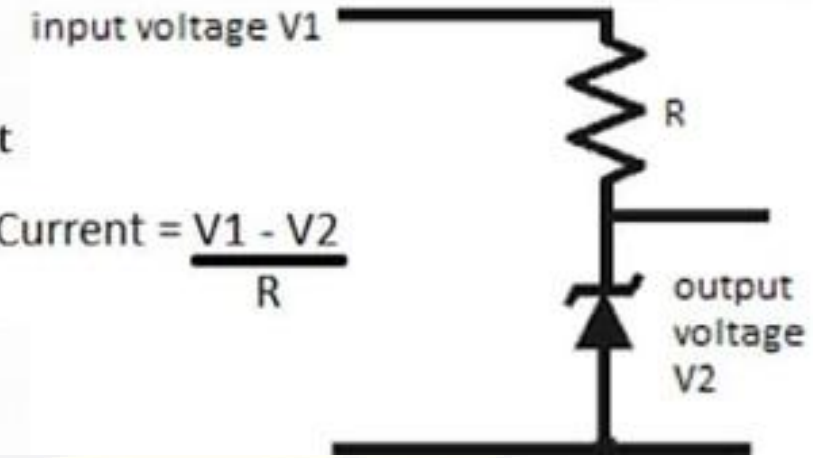
Introduction

- The arrowhead on a Zener diode symbol points in the direction of forward current when the diode is forward biased.
- The Zener diode is normally operated in reverse breakdown and the current direction is then from anode to cathode

Zener Diode - Circuit

- The most basic Zener diode circuit consist of a single Zener diode and a resister.
- The Zener diode provides the reference voltage, but a series resistor must be in place to limit the current into the diode otherwise a large amount of current would flow through it and it could be destroyed.
- The value of resistor calculated to give required value of current for supply voltage used.

$$\text{Current} = \frac{V1 - V2}{R}$$



Zener Diode – Forward Bias

- When a Zener diode is forward biased, it operates as a normal diode.
- In forward biased P side connected to +ve and N side connected to –ve terminal of battery. In this case the electrons and holes are swept across the junction an large current flow through it.

Forward bias of Zener Diode

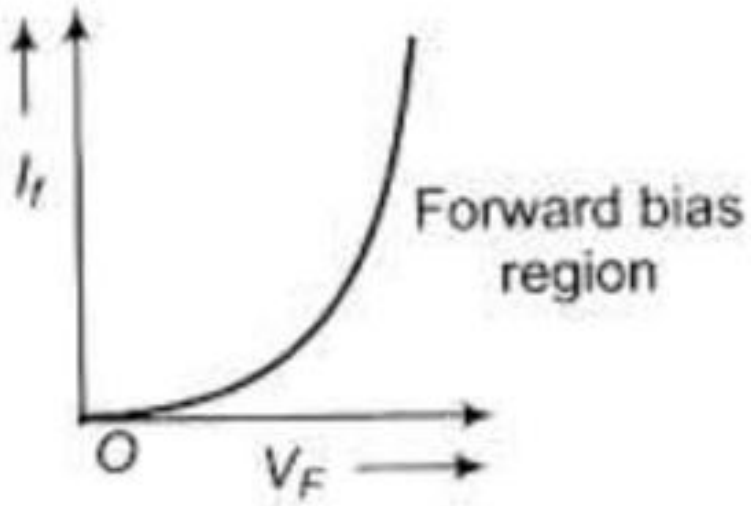
Zener Diode – Reverse Bias

- In case of reverse biased current practically zero and at certain voltage which called Zener voltage the current increases sharply.
- Each Zener diode has breakdown rating which specifies the max voltage that can be dropped across it.

Reverse bias of Zener Diode

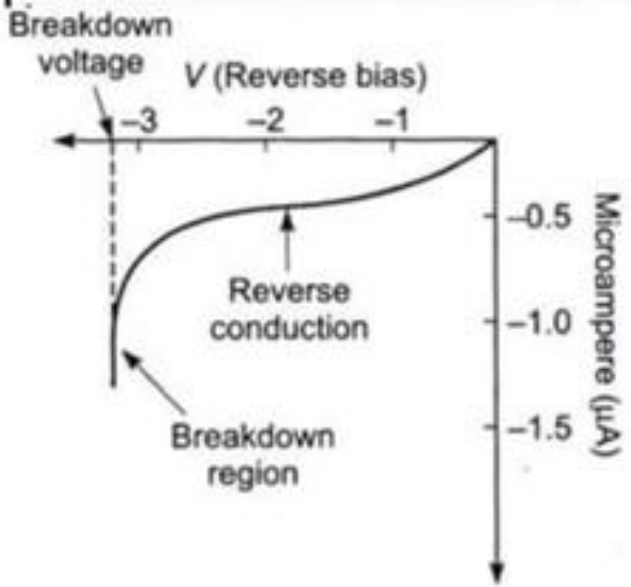
Zener Diode – Characteristics

- The figure shows, the forward characteristics is same as that of ordinary forward biased junction diode.



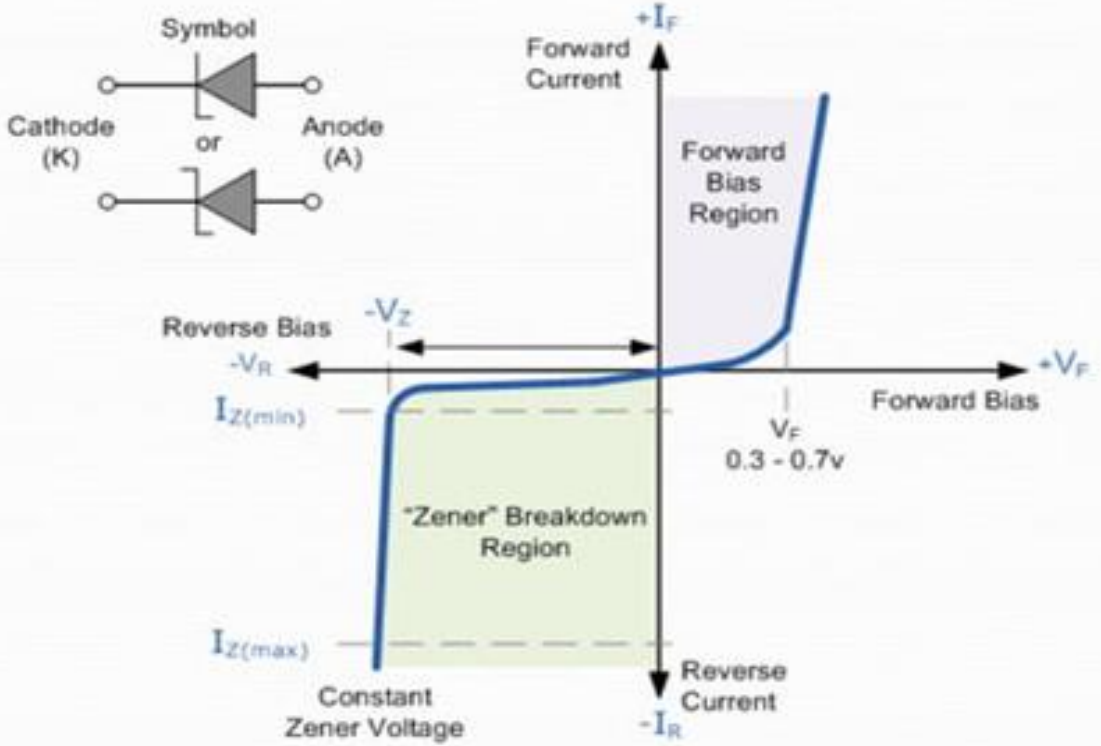
Zener Diode – Characteristics

- In reverse direction however there is a very small leakage current between OV an the Zener voltage –i.e. tiny amount of current is able to flow.
- Then, when the voltage reaches the breakdown voltage (V_Z), suddenly current flow through it.



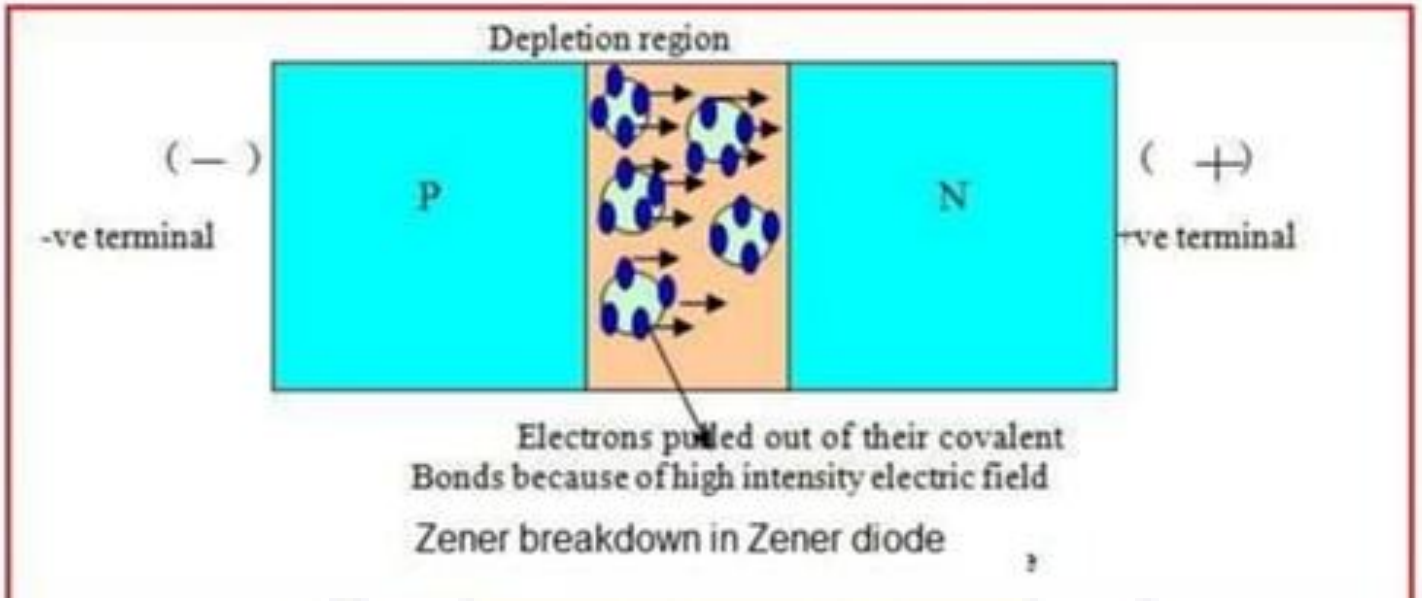
Zener Diode – Characteristics

- Notice that as the reverse voltage is increased the leakage current remains essentially constant until the breakdown voltage is reached where the current increases dramatically.



Zener Breakdown

- The Zener effect is a type of electrical breakdown in a reverse biased p-n diode in which the electric field enables tunneling of electrons from the valence to the conduction band of a semiconductor, leading to a large number of free minority carriers, which suddenly increase the reverse current.



Zener breakdown in Zener diode

Applications

1. Zener Regulator
2. Zener Comparator
3. Zener Limiters
4. Zener in Power Supplies

Assessment Questions

1. Zener diodes are also known as
a) Voltage regulators
b) Forward bias diode
c) Breakdown diode
d) None of the mentioned

2. Which of the following is true about the resistance of a Zener diode?
a) It has an incremental resistance
b) It has dynamic resistance
c) The value of the resistance is the inverse of the slope of the i-v characteristics of the Zener diode
d) All of the mentioned

3. Which of the following can be used in series with a Zener diode so that combination has almost zero temperature coefficient?
a) Diode
b) Resistor
c) Transistor
d) MOSFET


THANK YOU