

Department of Artificial Intelligence and Data Science

23EET103 – Electrical Circuits and Electron Devices

I B.E CSE-IOT/ II SEMESTER

UNIT IV : ELECTRONIC DEVICES AND APPLICATIONS

Topic : Zener Diode – Working & V-I Characteristics

Let's Recall!!

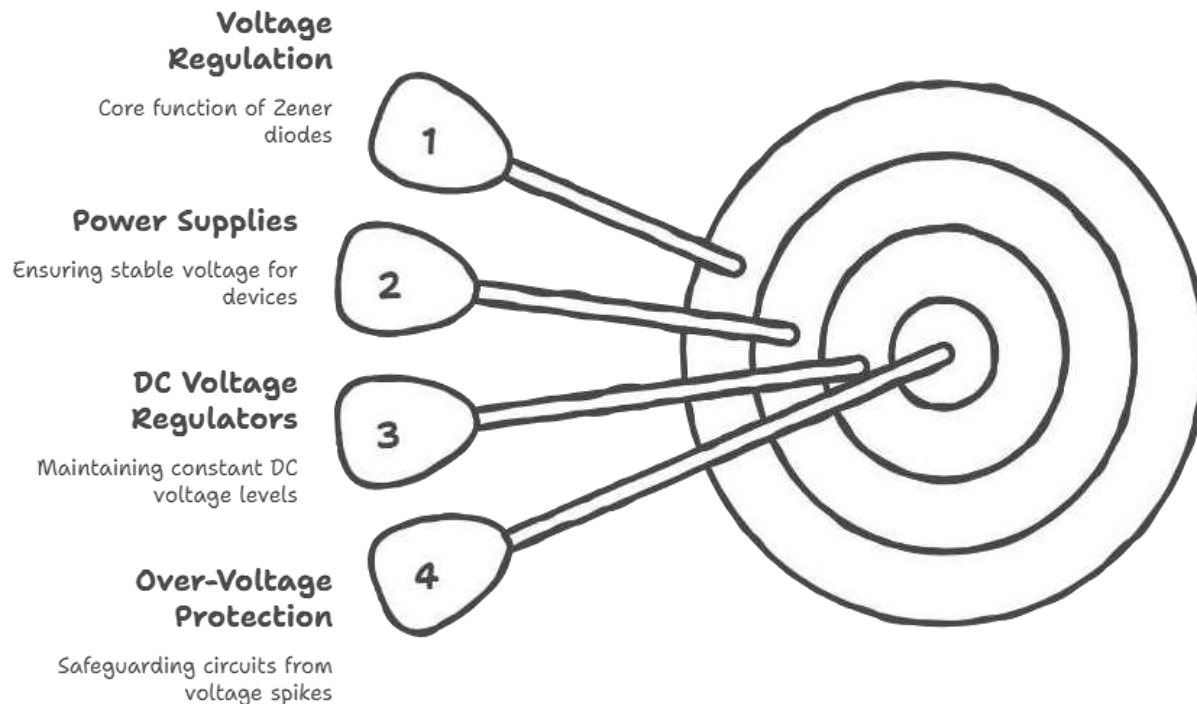
- Diodes conduct current in one direction.
- But when operated in reverse bias, a special diode called the Zener diode can conduct safely in the breakdown region without damage.
- Zener diodes are designed to maintain a constant voltage, making them essential for voltage regulation.

Topics for discussion

- What makes the Zener diode different from a PN diode?
- How does Zener breakdown occur?
- What is avalanche breakdown?
- How does a Zener diode regulate voltage?
- V-I characteristics: forward & reverse regions

Why Study Zener Diode? *DT-Empathize*

Zener Diode Applications



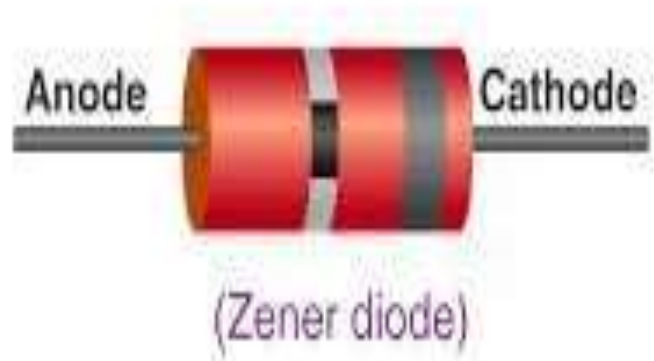
• Zener diodes are the heart of voltage regulation circuits, stabilizing output voltage in:

- Power supplies
- DC voltage regulators
- Over-voltage protection circuits
- Reference voltage generators

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Construction of Zener Diode

DT-DEFINE



A Zener diode is similar to a PN junction diode but heavily doped on both sides.

Features

Narrow depletion layer

Low, precise breakdown voltage (3.3V, 5.1V, 6.8V, etc.)

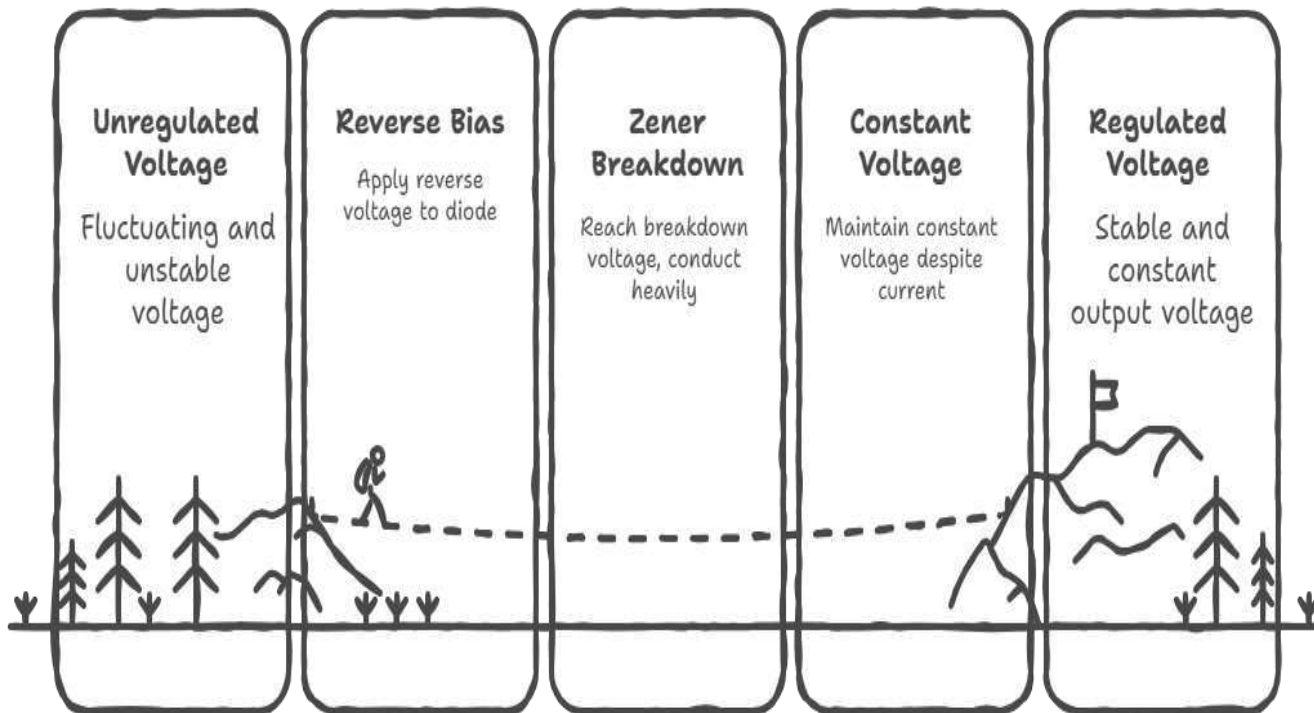
Sharp and controlled reverse breakdown

Symbol:

Same as diode but with a bent line on cathode

Working Principle *DT-DEFINE*

Zener Diode Voltage Regulation



A Zener diode operates in two conditions:

1. Forward Bias Operation
 - Acts like a normal diode
 - Conducts after the forward knee voltage
- 2. Reverse Bias Operation (Important)**

When reverse biased:

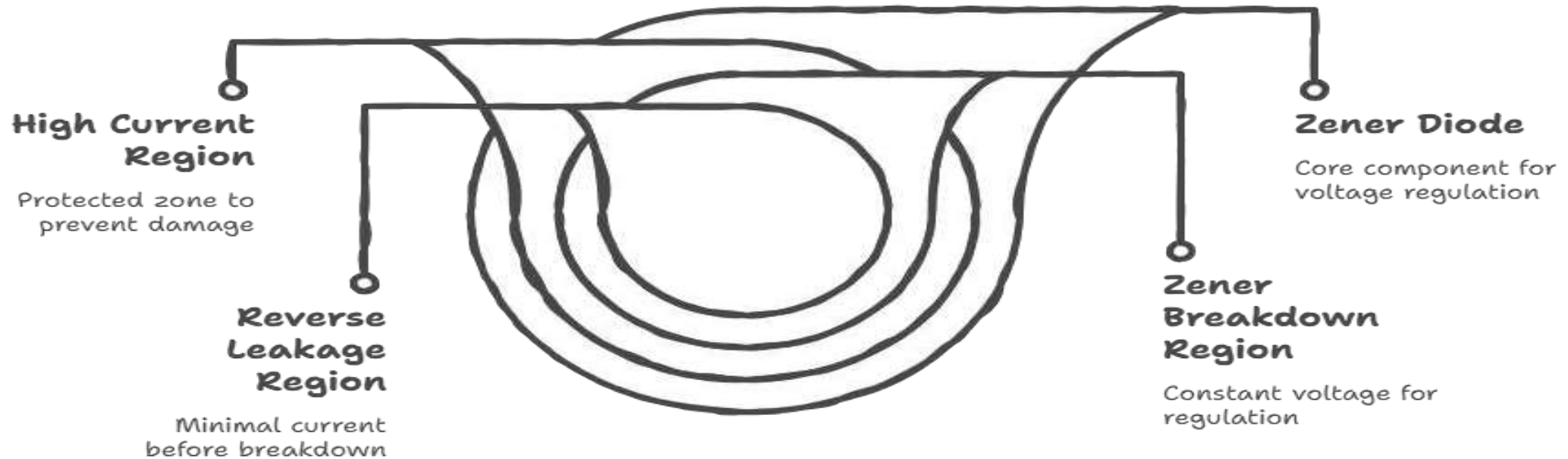
- Reverse current flows very small (μA region)
- At a particular voltage \rightarrow **Zener Breakdown Voltage (V_x or V_z)**

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Ideate: V-I Characteristics of Zener Diode

DT-IDEATE

Zener Diode Characteristics



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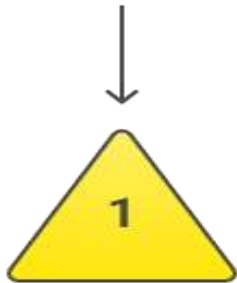
Ideate: Zener Diode as Voltage Regulator

DT-IDEATE

Zener Diode Regulation

Unregulated Input

Varying voltage across load



Excess Voltage

Resistor absorbs excess voltage

Reverse Bias

Zener maintains constant voltage

When connected in reverse bias across a load:

Input voltage varies →

Zener maintains

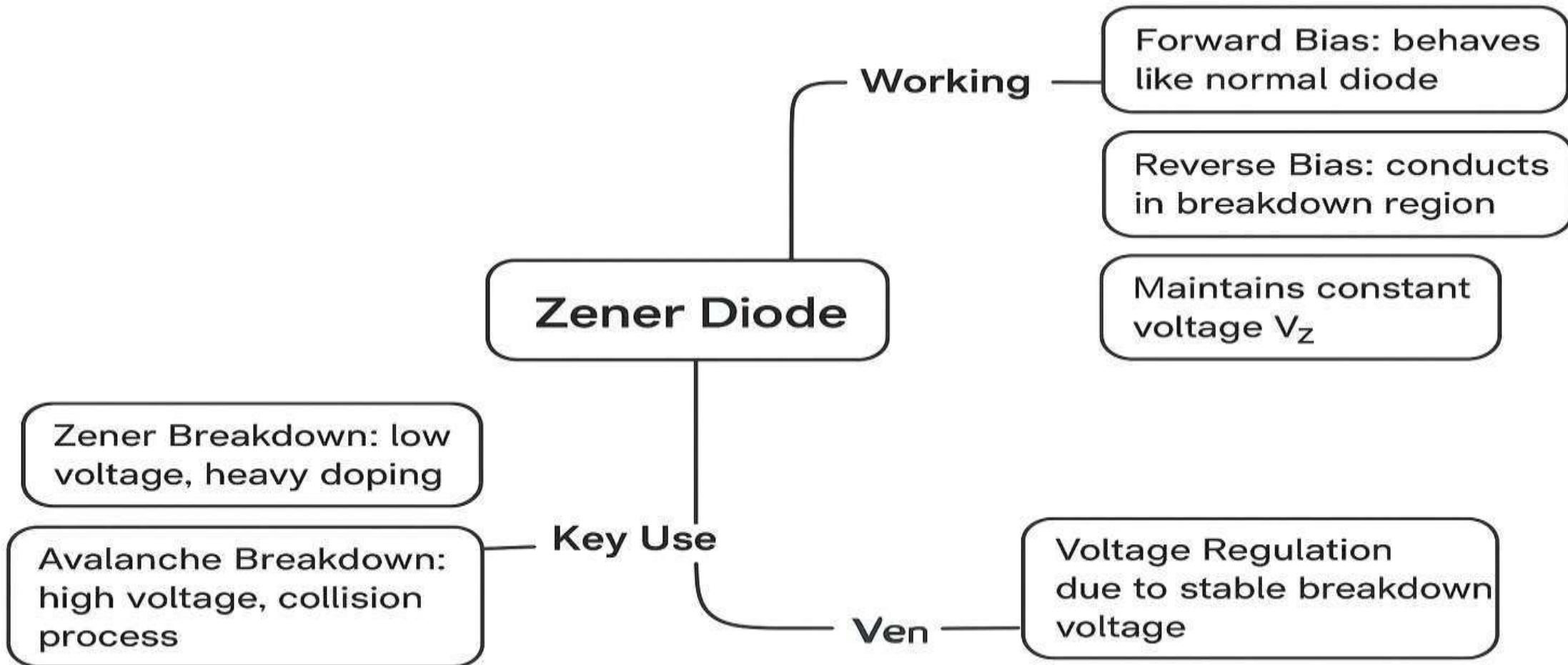
constant output voltage = V_z

Excess voltage appears across series resistor

Output remains stable → **regulated DC**

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Summary



References

1. https://www.electronics-tutorials.ws/diode/diode_7.html
2. <https://www.allaboutcircuits.com/textbook/semiconductors/chapter-3/zener-diodes/>
3. <https://www.tutorialspoint.com/zener-diodes>

Thank You