Zener Diode Voltage Regulators

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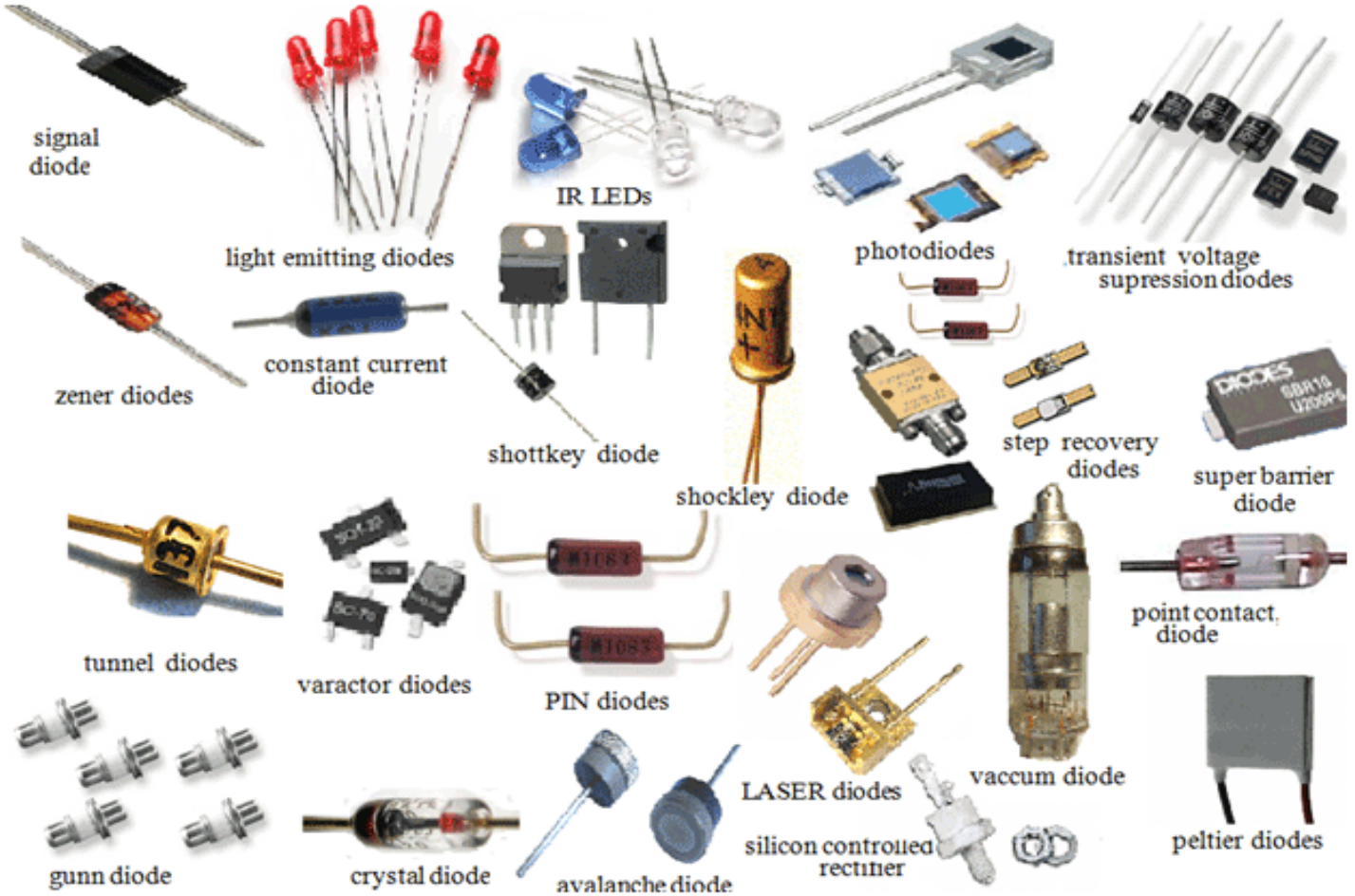
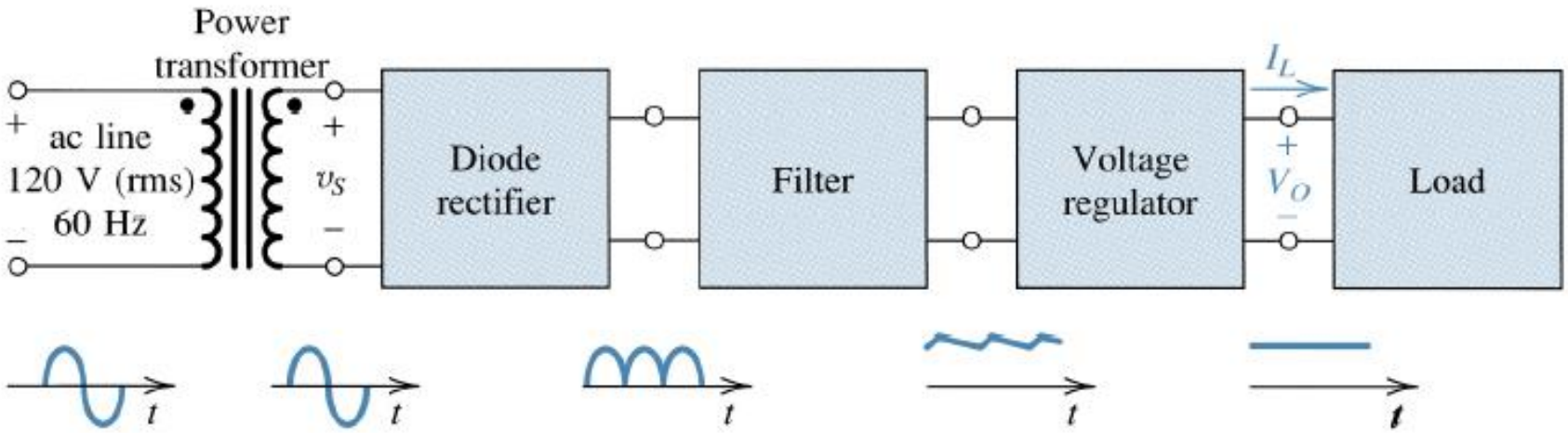
Types of Diodes



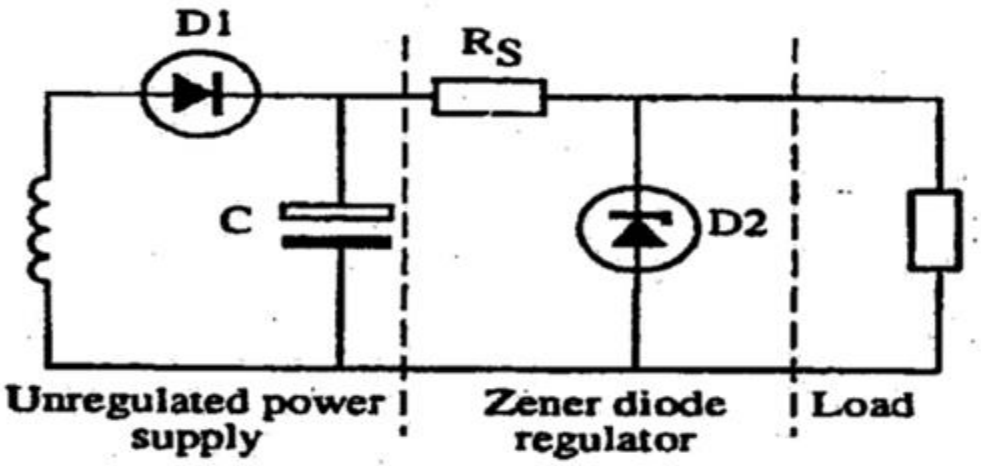
Types of Diode

Rectifier Circuits

One of the most important applications of diodes is in the design of rectifier circuits. Used to convert an AC signal into a DC voltage used by most electronics.



Regulator Circuits



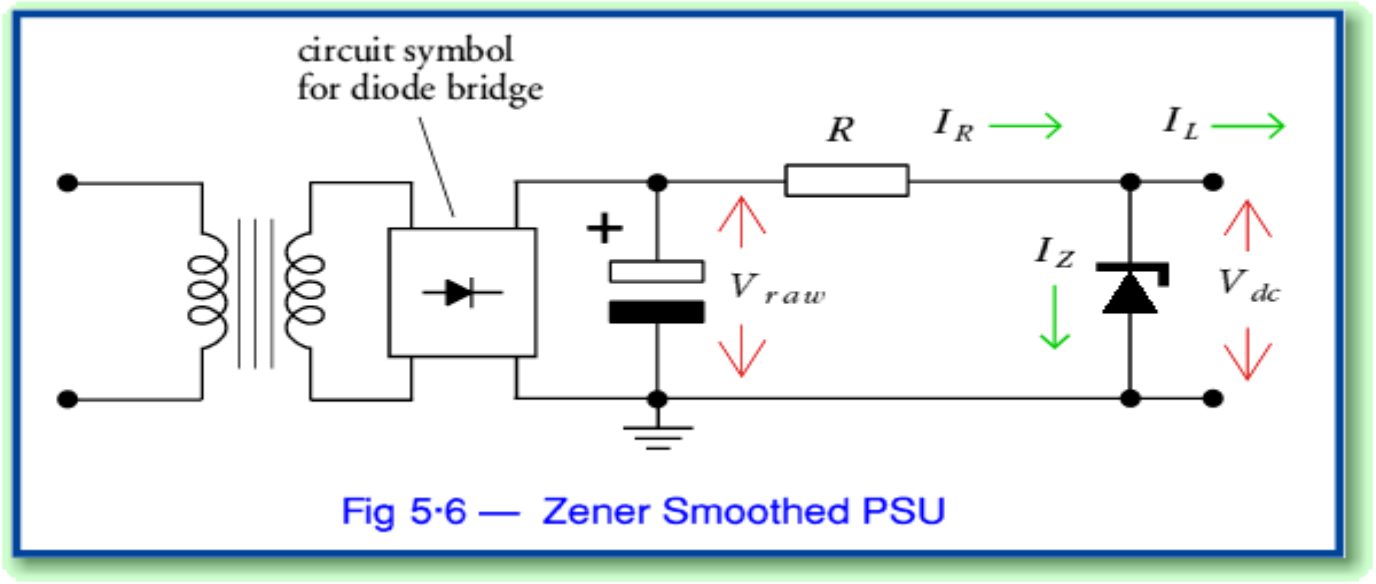
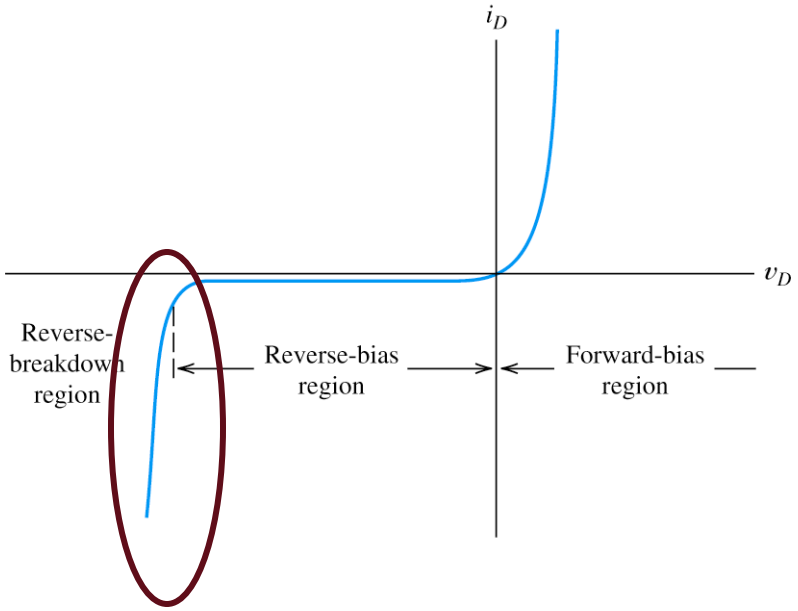


Fig 5·6 — Zener Smoothed PSU

The Zener Diode

* *Zener diode* is designed for operation in the reverse-breakdown region.
* The *breakdown voltage* is controlled by the doping level *(-1.8 V to -200 V)*.
* The major application of Zener diode is to provide an output reference that is stable despite changes in input voltage – power supplies, voltmeter,…



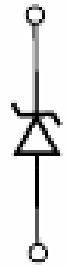


Figure 7.3 Zener diode symbol.

Zener-Diode Voltage-Regulator Circuits

* Sometimes, a circuit that produces constant output voltage while operating from a variable supply voltage is needed. Such circuits are called *voltage regulator*.

* The Zener diode has a breakdown voltage equal to the desired output voltage.

- The resistor limits the diode current to a safe value so that Zener diode does not overheat.
- Zener Diode is a reversed-biased heavily-doped PN-Junction diode which operates in the breakdown region.
- The breakdown voltage of a zener diode can be set by controlling the doping level.
- For zener diodes, silicon is preferred to Ge because of its higher temperature and current capability

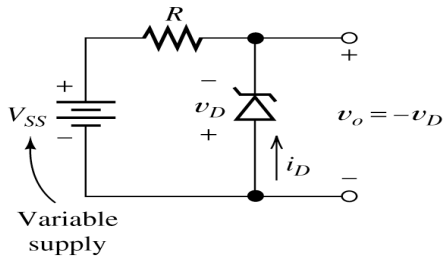
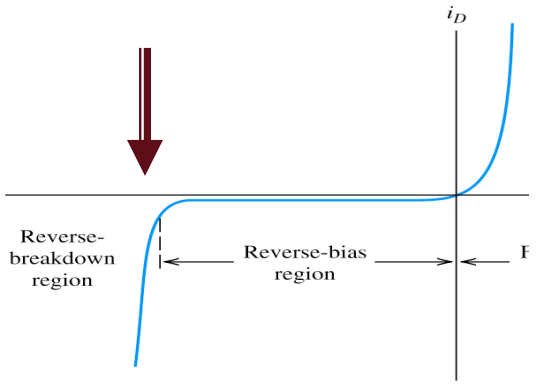
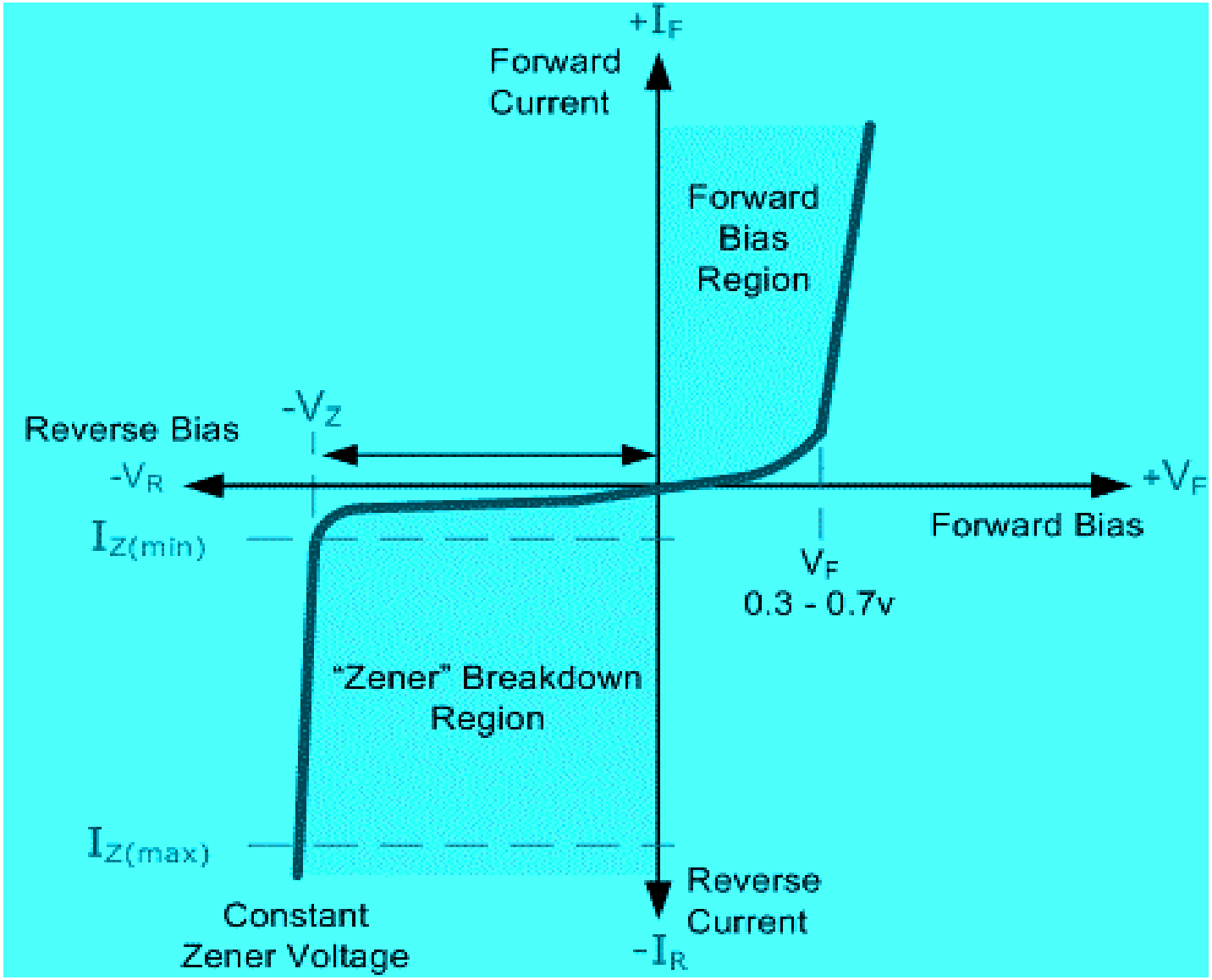


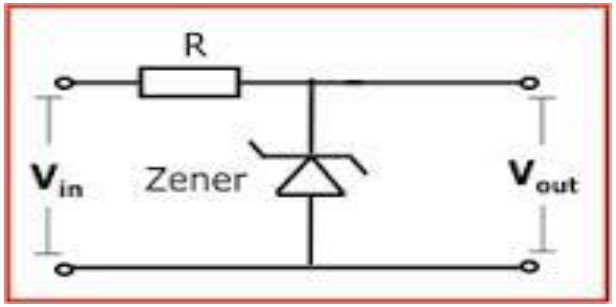
Figure 10.9 A simple regulator circuit that provides a nearly constant output voltage v_o from a variable supply voltage.



I-V Characteristics



Zener Diode - Voltage Regulator (reverse biased)

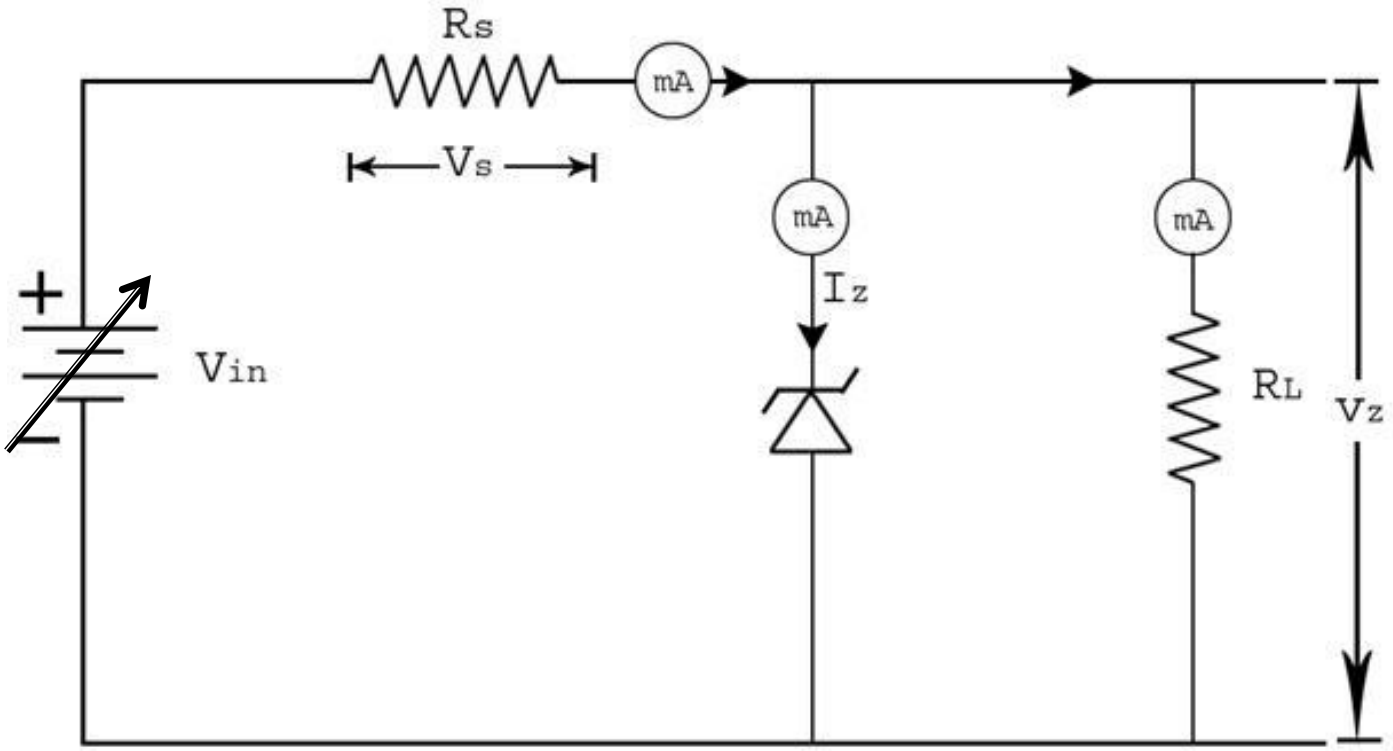


- A **Zener diode** is a type of diode that permits current not only in the forward direction like a normal diode, but also in the reverse direction if the voltage is larger than the breakdown voltage known as "Zener knee voltage" or "Zener voltage".
- The zener breakdown voltage or zener voltage can be precisely controlled by controlling the doping levels of P and N regions at the time of manufacturing a zener diode
- After breakdown has occurred, the voltage across zener diode remains constant equal to Vz.
- Any increase in the source voltage will result in the increase in the reverse zener current.
- The zener current after reverse breakdown must be controlled by connecting a resistor R as shown. This is essential to avoid any damage to the device due to excessive heating

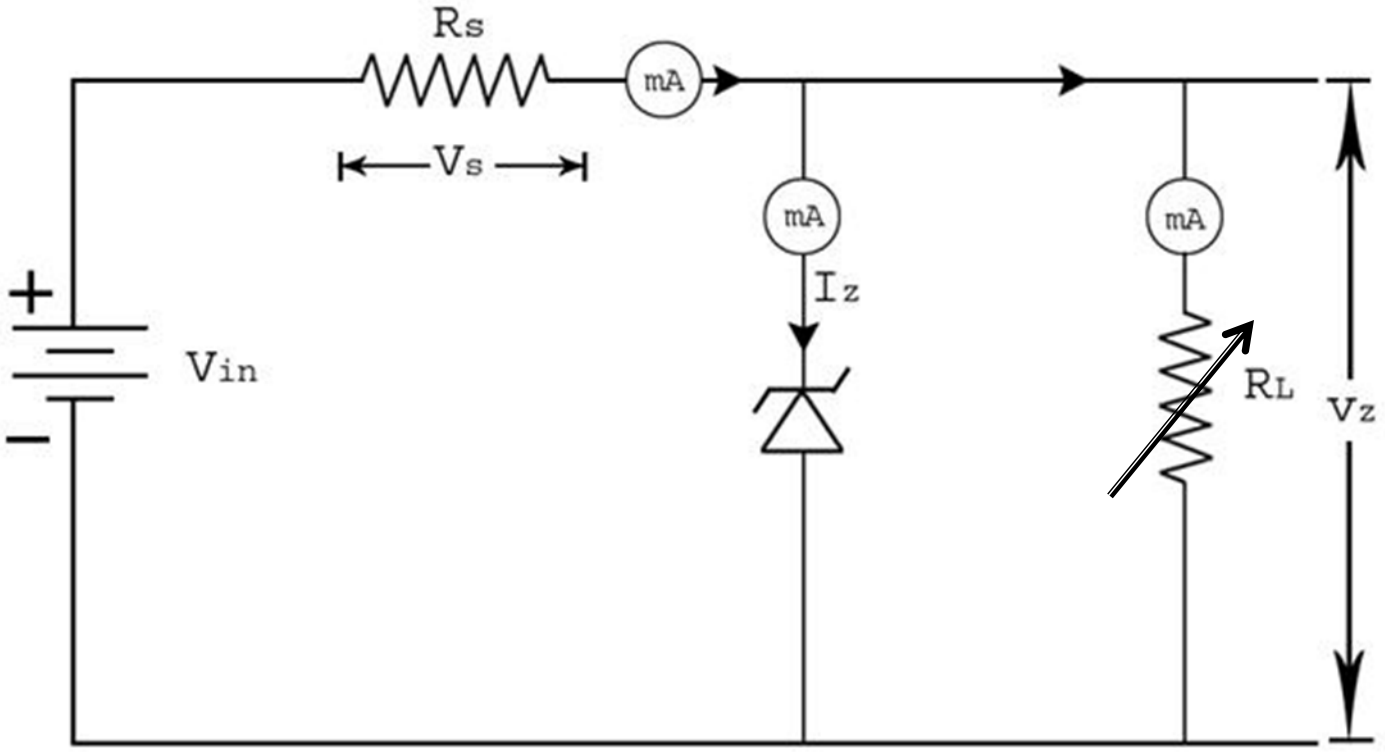
Working of Zener Diode

- Case 1: Regulation when input voltage is varied
- Case 2: Regulation when load resistance is varied

Case 1: Regulation when input voltage is varied



Case 2: Regulation when load resistance is varied



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