

# **ELECTRONICS DEVICES AND CIRCUITS**

## **SECTION - B**

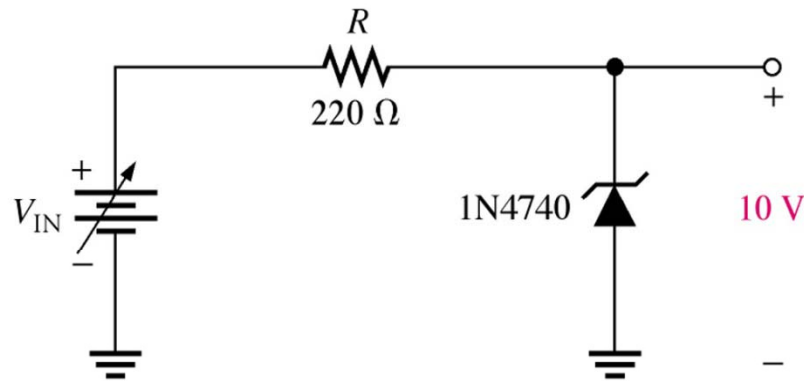
**Semiconductors, Construction & Characteristics  
of Devices**

OBJECTIVE

**ZENER DIODES**

# Introduction

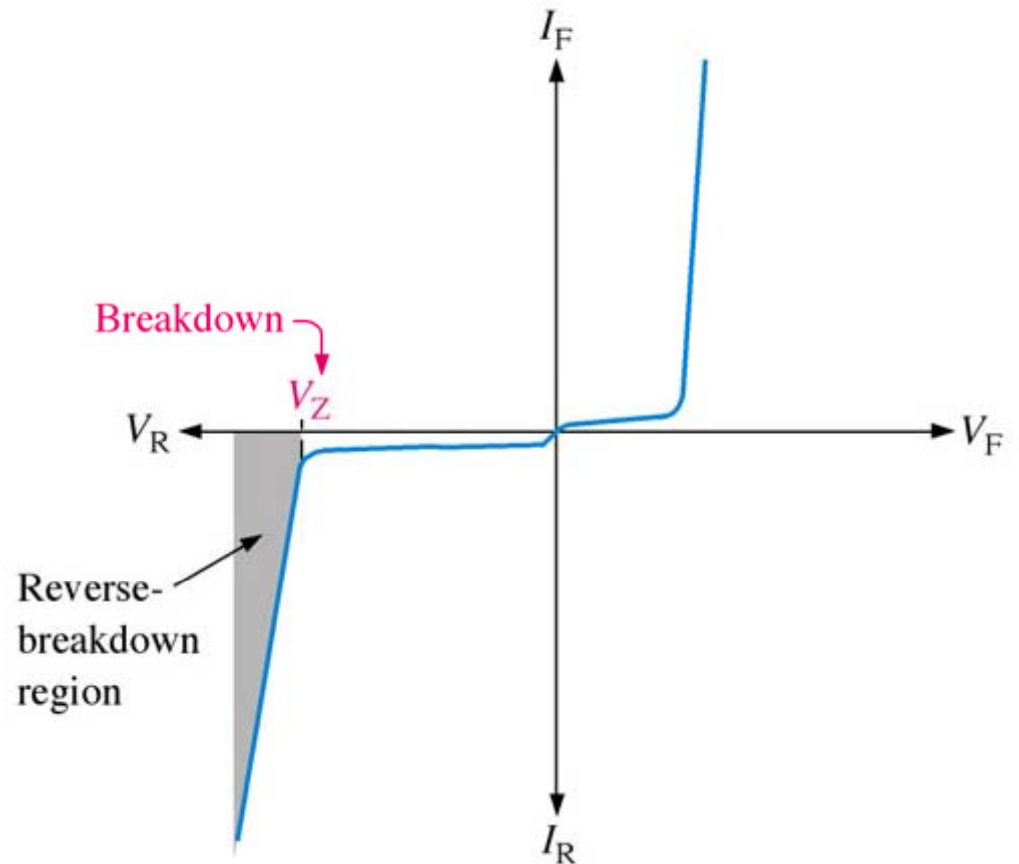
The basic function of **zener diode** is to maintain a specific voltage across its terminals within given limits of line or load change. Typically it is used for providing a stable reference voltage for use in power supplies and other equipment.



**This particular zener circuit will work to maintain 10 V across the load.**

# Zener Diodes

A **zener diode** is much like a normal diode, the exception being is that it is placed in the circuit in reverse bias and operates in reverse breakdown. This typical characteristic curve illustrates the operating range for a zener. Note that its forward characteristics are just like a normal diode.



(b) The normal operating region for a zener diode is shaded.

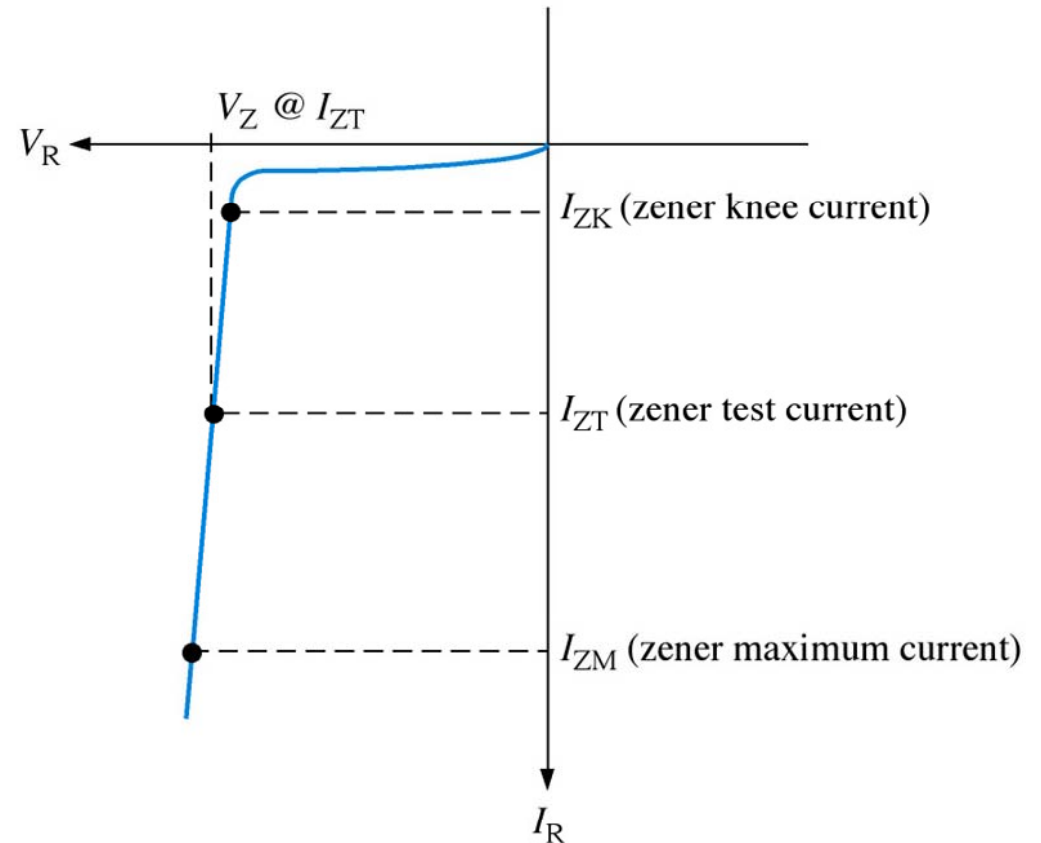
# Zener Diodes

The zener diode's breakdown characteristics are determined by the **doping process**.

Low voltage zeners less than 5V operate in the zener breakdown range.

Those designed to operate more than 5 V operate mostly in avalanche breakdown range. Zeners are available with voltage breakdowns of 1.8 V to 200 V.

$$Z_z = \Delta V_z / \Delta I_z$$



This curve illustrates the minimum and maximum ranges of current operation that the zener can effectively maintain its voltage.

# Zener Diodes Characteristics

- Example: What is the voltage across the zener IN4736 terminals when the current is 50 mA? When the current is 25 mA? (Check the table in page 116)

- Temperature Coefficient

$$\Delta V_z = V_z \times TC \times \Delta T \text{ (TC: \% / } ^\circ\text{C)}$$

$$\Delta V_z = TC \times \Delta T \text{ (TC: V / } ^\circ\text{C)}$$

- Power Dissipation  $P_D = V_z I_z$

- Power Derating  $P_{D(\text{derated})} = P_{D(\text{max})} - \Delta T(\text{mW} / ^\circ\text{C})$

# Zener Diodes

As with most devices, zener diodes have given characteristics such as –

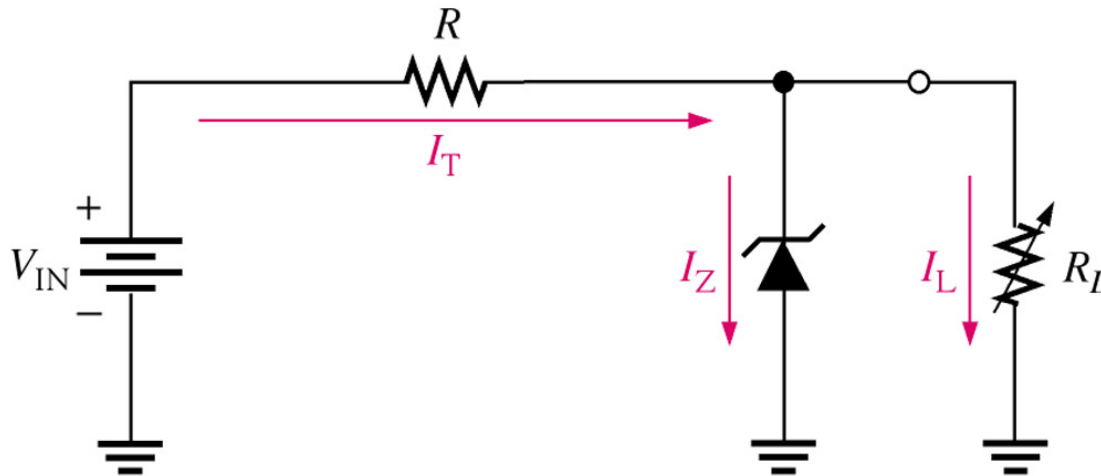
- Temperature coefficients
- Power ratings

# Zener Diode Applications

## Regulation

Simple illustration of **ZENER REGULATION CIRCUIT**, the zener diode will “adjust” its impedance based on varying input voltages and loads ( $R_L$ ) to be able to maintain its designated zener voltage. Zener current will increase or decrease directly with voltage input changes. The zener current will increase or decrease inversely with varying loads.

Again, the zener has a finite range of operation.





# Zener Diode Application— Regulator

- Minimum and maximum input voltage of IN4733
- No load, Full load of zener regulator

# Zener Limiting

Zener diodes can be used for limiting just as normal diodes.

The difference to consider for a zener limiter is its zener breakdown characteristics.

