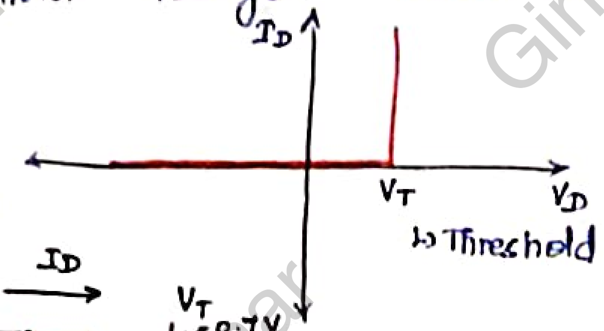
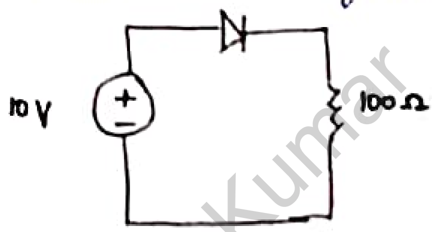
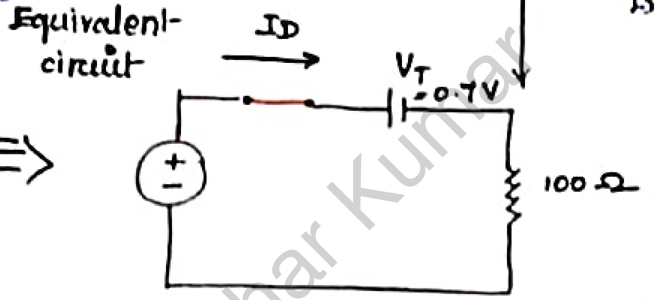
⇒ Practical diode starts conducting current only when it reaches a threshold voltage - which is 0.7 V for silicon.



⇒ consider the following circuit,



⇒

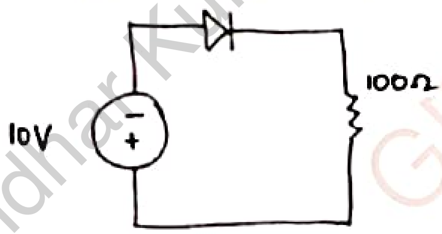


$$I_D = \frac{10V - 0.7V}{100\Omega} = 0.093A \Rightarrow \boxed{I_D = 0.093\ A}$$

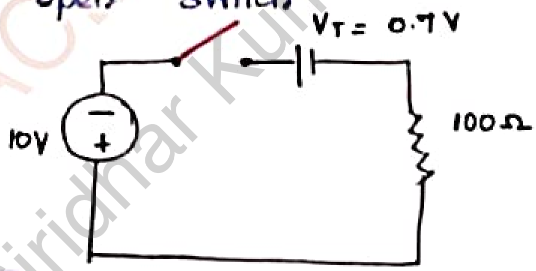
⇒ while in case of ideal diode,

$$I_D = \frac{10}{100} = 0.1\ A \Rightarrow \boxed{I_D = 0.1\ A}$$

⇒ When we supply -10V to the diode, the diode will act as an open switch



⇒

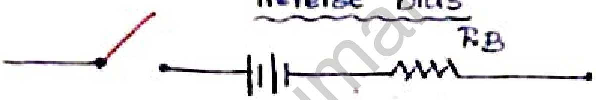


$$\boxed{I_D = 0A}$$

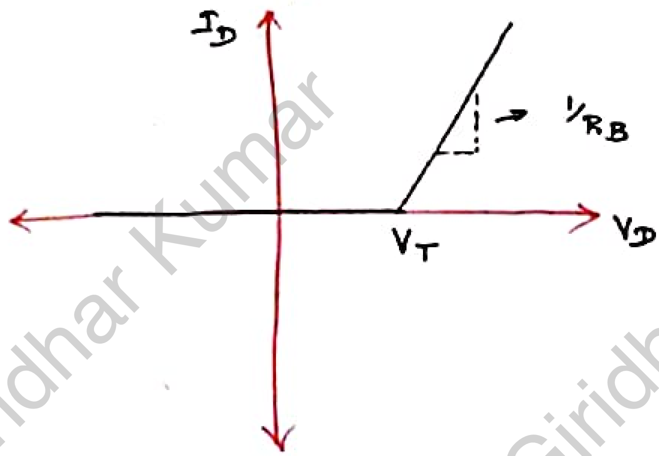
⇒ considering, the diode has some finite resistance

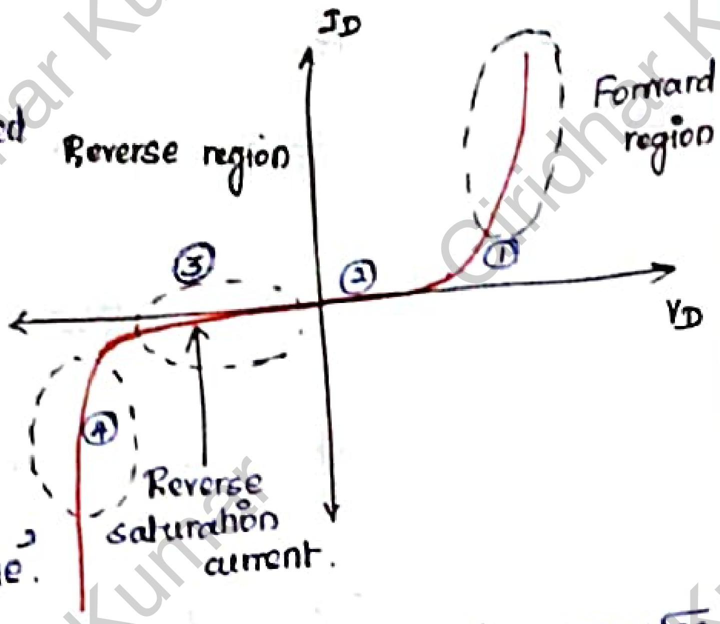
R_B - bulk resistance

Reverse bias



Forward bias





⇒ Forward region. the diode starts conducting once the applied voltage crosses the threshold voltage. ①

⇒ When the applied voltage is less than the threshold voltage the current flowing through the diode is negligible. ②

⇒ When reverse bias is applied to the diode it operates in reverse region ③.

⇒ After certain amount of reverse voltage is given to the diode it operates in breakdown region. ④

APPLICATIONS - PN DIODE

* Rectifiers in d.c. power supplier.
* clamping circuits used as d.c. restorer in TV receivers and voltage multipliers.
* PN diodes in demodulation circuits.
* switch in digital logic circuits in computers.
* clipping circuits used as wave shaping circuits used in TV receivers, radio, computers and radars.
* zener diodes in voltage regulators
* Varactor diodes in tuning sections of radio and TV receivers.
* Detectors in optical communication circuits.
* Tunnel diodes as a relaxation oscillator at microwave frequencies.

4. Zener Diode

⇒ A zener diode is a special purpose diode that is operated in reverse-biased conditions.

→ depends on the zener breakdown phenomenon.

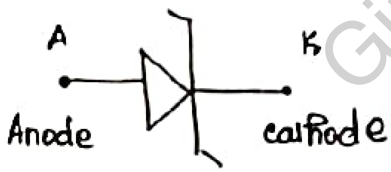
⇒ fabricated using a silicon semiconductor because it has a higher temperature and current rating than Germanium.

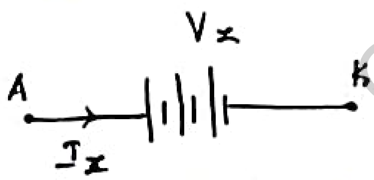
⇒ In the reverse-biased condition, the breakdown of the diode occur at the point when its crystal structure is broken. - at the zenor breakdown voltage

⇒ Due to the breakdown a very large current flow through the diode such that a very small change occurs in the voltage.

⇒ This characteristic of a zener diode makes it useful in regulating the DC voltage of a power supply so that the output remains steady even if there is change in the input voltage or the load current.

Symbol





circuit diagram

V-I characteristics of zener diode

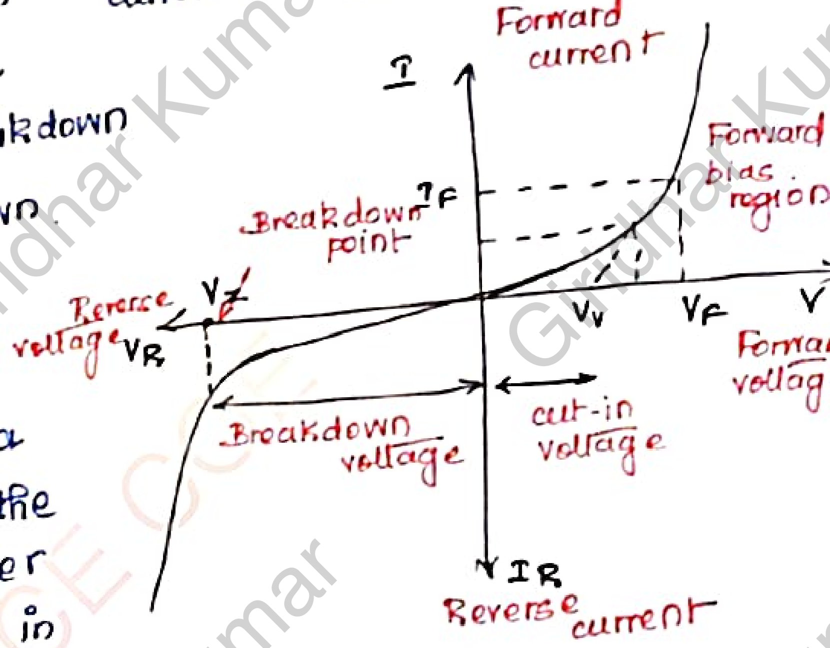
⇒ The voltage is plotted along the horizontal axis and the current is plotted along the vertical axis.

⇒ The operation is same as ordinary p-n diode under forward biased condition, whereas under reverse biased condition breakdown of junction occurs.

⇒ The breakdown voltage depends upon the amount of doping. If the diode is heavily doped, depletion layer will be thin and consequently breakdown occurs at lower reverse voltage and further the breakdown voltage is sharp.

⇒ The sharp increase in current under break down condition is due to :

* Avalanche breakdown
* zener breakdown.

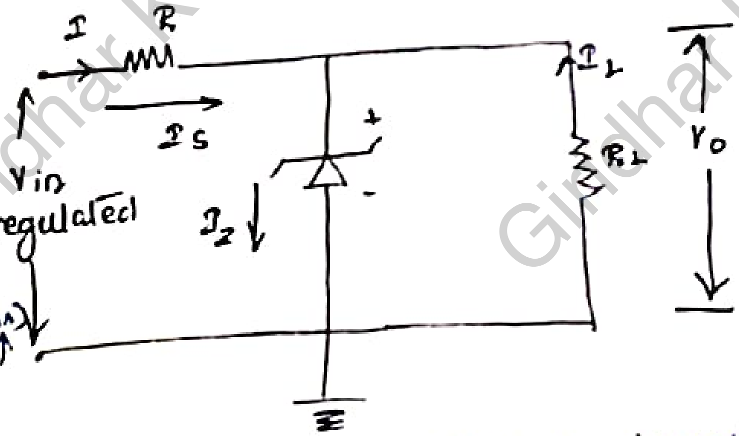


APPLICATIONS:

* As voltage regulator

⇒ voltage regulator is a circuit that maintains the output voltage of DC power supply against variations in

* Input AC voltage
* Load current



i) If $R_L \uparrow$ $I_L \downarrow$, to keep constant, I_Z increases

$R_L \uparrow \rightarrow I_L(min) \downarrow \rightarrow I_Z(max) \uparrow$

$I_L(min) = I - I_Z(max)$

ii) If R_L decreases I_L increases, to keep I constant, I_Z decreases

$R_L \downarrow \rightarrow I_L(max) \uparrow \rightarrow I_Z(min) \downarrow$

$I_L(max) = I - I_Z(min)$

iii) The maximum power dissipation in zener remains same as

$P_D = V_Z I_Z(max)$

$V_0 = V_Z$ is constant

$$V_L = \frac{V_0}{R_L} = \frac{V_Z}{R_L} = \text{constant}$$

$$I = I_L + I_Z$$

If $V_0 \uparrow$ then $I \uparrow$, But I_L is constant as V_Z is constant.

Hence I_Z increases to keep I_L constant.

If $V_0 \downarrow$, the current $I \downarrow$. But to keep I_L constant I_Z decreases.

⇒ The load current I_L will vary if load resistor, R_L is variable.

⇒ $I_L \uparrow$ when $R_L \downarrow$ and $I_L \downarrow$ if $R_L \uparrow$

⇒ The input voltage is constant while R_L is variable.

⇒ As V_S is constant and $V_0 = V_Z$ is constant, then for constant R, current I is constant

$$I = \frac{V_{in} - V_Z}{R}.$$