Unit-V

Special purpose devices-

Topics :-

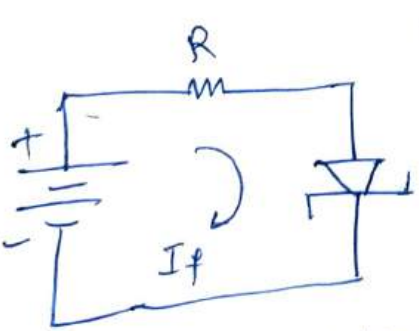
→ Zener diode characteristics, zener diode as voltage Regulator
→ SCR diode
→ Tunnel diode
→ UJT
→ Varactor diode
→ Photo diode
→ Solar cell
→ LED
→ Schottky diode.

} All principles and operations of diode

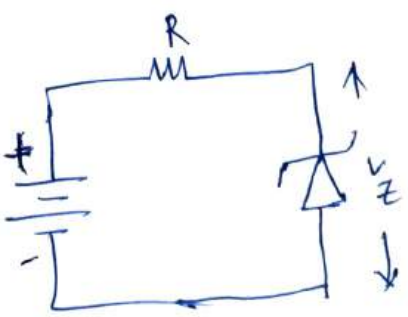
* **Zener diode :-** Zener diode is a heavily doped PN junction diode. which is operated in breakdown region. Due to higher temperature and current capability Silicon is preferred in Comparision to Germanium.

Symbol of zener diode

Fig(i)



fig(ii) Forward biasing zener diode



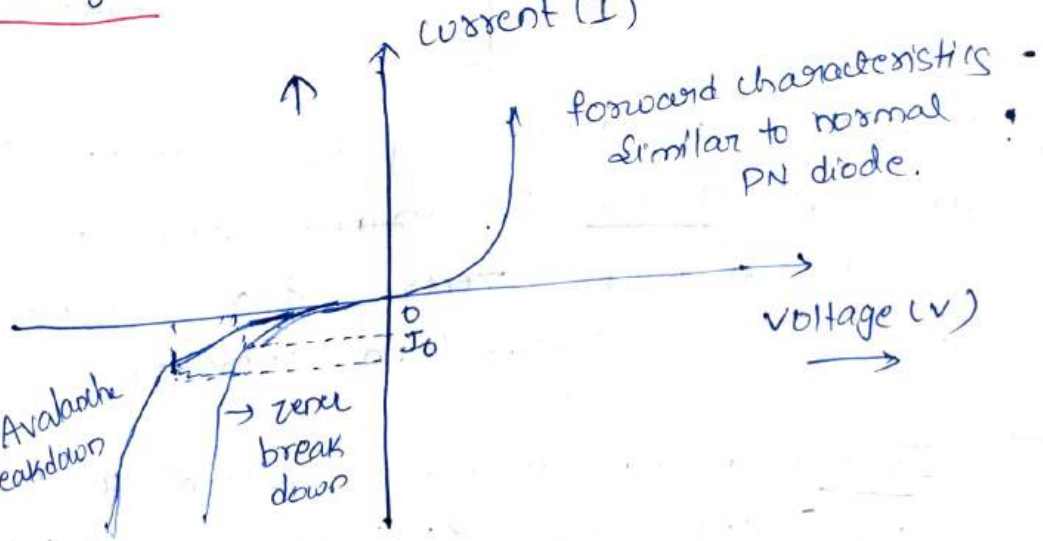
fig(iii) Reverse biasing zener diode

Fig (ii) represent forward biasing of ~~FN~~ zener diode it acts similar to PN diode in forward biased. Fig (iii) shows the reverse biasing of zener diode But in reverse biased it operated in reverse breakdown region.

→ In reverse biased, reverse current of zener diode limited using a series resistance then power dissipation at junction is limited to such a level which will not a damage the diode. and zener diode continous to operate safely in reverse breakdown region.

VI characteristics of zener diode :-

this work efficiently in reverse bias conditions. when reverse voltage increase beyond the breakdown voltage the current increases greatly from its normal cut off value this voltage is called zener voltage or breakdown voltage.



The breakdown occur due to Zener breakdown or Avalanche Breakdown.

Zener breakdown	Avalanche breakdown
1. Breakdown due to intrinsic electric field across the junction	→ Breakdown due to collision accelarated charige carrier with adjacent atoms due to carrier multiplication
→ It occur for zener with zener voltage less than 6V	→ It occur for zener with zener voltage greater than 6V
→ Temperature coefficient is negative	→ Temperature coefficient positive
→ Breakdown voltages decreases junction tem perature increases	→ Breakdown voltage increases as junction Temperature increasey
→ VI characteristis is very shar in Break down Region	→ V-I characteristics not as sharp as zener breakdown

→ For zener diode, practically two currents are specified $I_{Z min}$ is ~~minum~~ minimum current through zener diode maintain its reverse break down operation

→ $I_{Z max}$ is the maximum current which zener diode can take. Safely maintaining its reverse breakdown operation ie Constant

V_Z crossit. If reverse current exceed this value, diode may get damage due to excess power dissipation.

→ zener diode is most suitable for voltage Regulation.

* Zener diode as voltage Regulator :-

→ zener diode used in its reverse biased region the current through the diode is very small of order of μA. when sufficient reverse bias is applied electrical breakdown occur the large current flows through it. Such a breakdown occur at a voltage called zener voltage V_Z. In this condition whatever may be current the voltage across the zener is constant i.e V_Z.

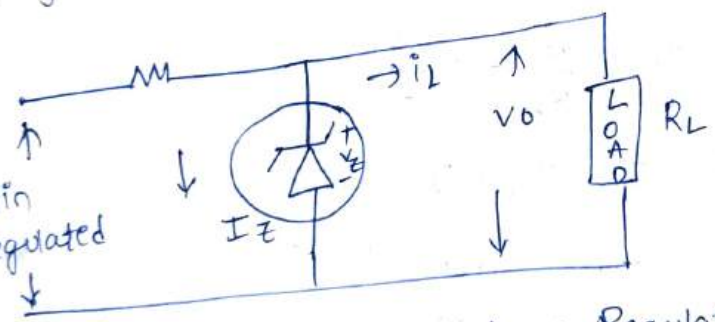
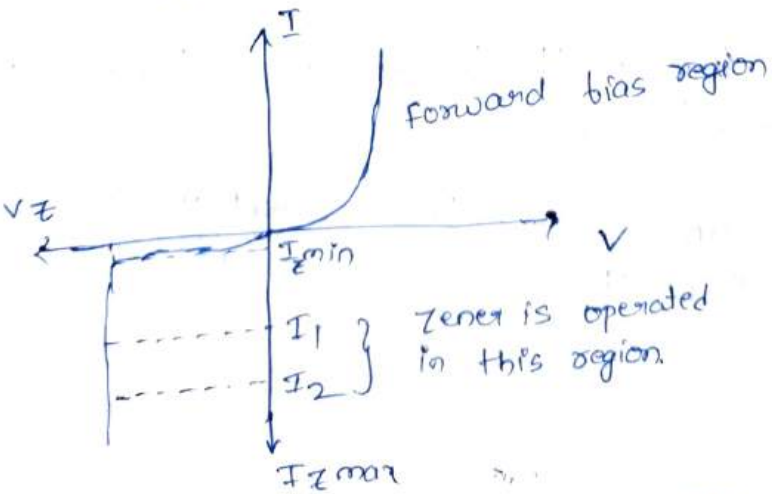
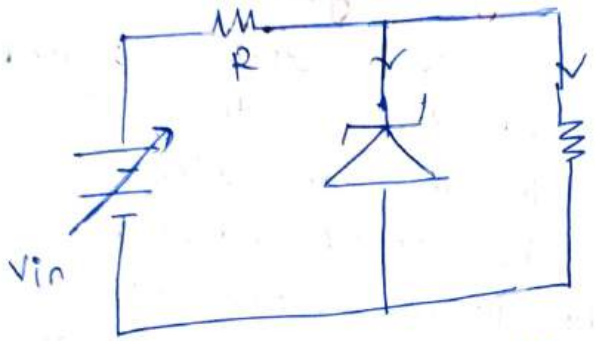


fig :- zener diode as Regulator



As the voltage across the zener diode is constant V_z. it is connected across the load and hence the load voltage is V_D is equal to zener voltage V_z

Regulation with Varying Input voltage :-



Zener Regulator.

Zener Regulator with Varying input voltage Regulation.

$V_o = V_z$ is Constant

$$\therefore I_L = \frac{V_o}{R_L} = \frac{V_z}{R_L}$$

and $I = I_z + I_L$

As V_{in} increases then total current I increases But I_L is constant as V_z is constant hence the current I_z increases to keep I_L constant

As long as I_z in between I_{zmin} and I_{zmax} the V_z is V_D.

If V_{in} decreases then current I decreases but to keep I_L constant I_z decreases.

Analyzation of Zener regulator.

$$I_L = \frac{V_0}{R_L} = \frac{V_Z}{R_L}$$

The current through Zener must be I_{Zmin} to keep in reverse biased

$$I = I_L + I_{Zmin}$$

$$V_{in\,min} = V_Z + IR$$

$$V_{in\,max} = V_Z + IR \quad \text{since}$$

$$I = I_L + I_{Zmax}$$

The maximum power dissipation in Zener diode is given by

$$P_D = V_Z I_{Z(max)}$$

* Silicon Controlled Rectifier:-

→ The SCR is unidirectional device and it allows flow of current in only one direction. But it has built in feature to switch 'on' and 'off'.

→ The SCR switching (on, off) is controlled by gate and biasing conditions.

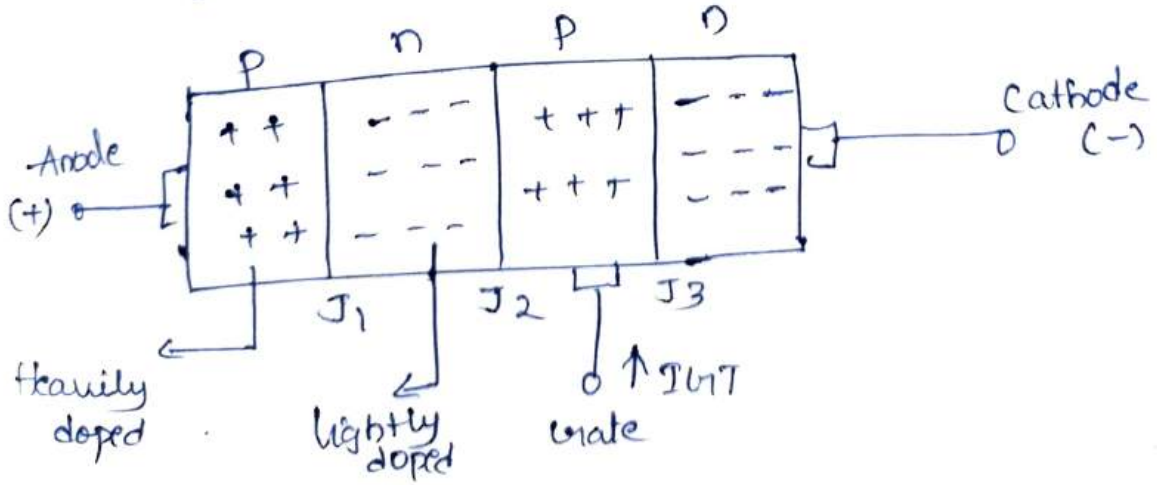
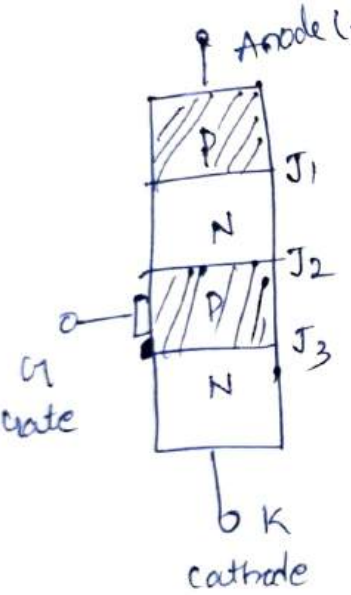


Fig (i) Construction of SCR

→ SCR is a four layer P-N-P-N device where P and N layers alternately arranged. The outer layer are heavily doped.

→ There are three pn junctions called J_1, J_2, J_3. The outer P-layer is called anode. while outer N-layer is called cathode. the middle layer is gate.

→ Anode and cathode are not sufficient to turn 'ON' SCR. To make it ON, a current is to be passed through this gate terminal denoted as I_{GT}. Thus SCR is current operated device.

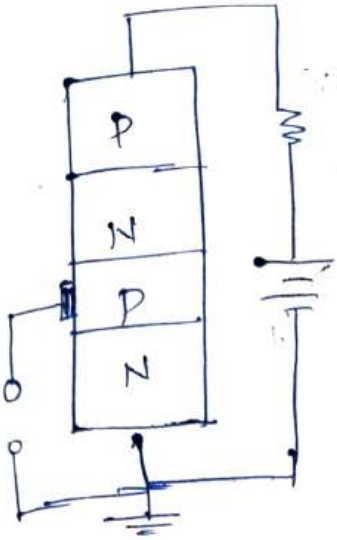


symbol

Operation: Cond(i) gate is open

In SCR a load is connected in series with Anode and kept positive with respect to cathode. the operation of SCR can be Studies when the gate is open.

→ when the gate is open no voltage applied at the gate then J_1 and J_3 are forward biased while J_2 reverse biased

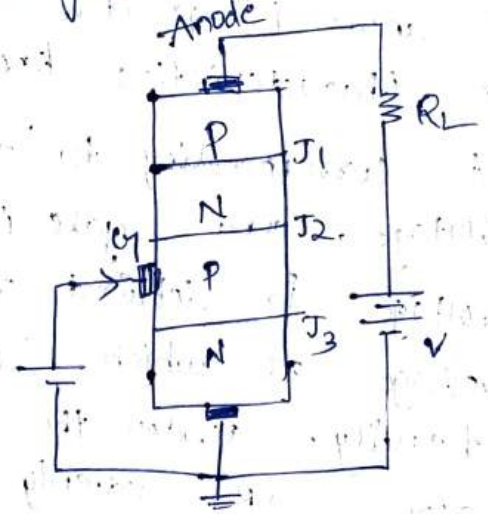


fig(i) gate is open

→ Due to reverse bias of junction J_2 no current flows through R_L and hence SCR is cutoff when anode voltage increased beyond critical value. then Junction J_2 breakdown

→ Now SCR conduct heavily and said to be ON. Hence SCR offer little forward resistance.

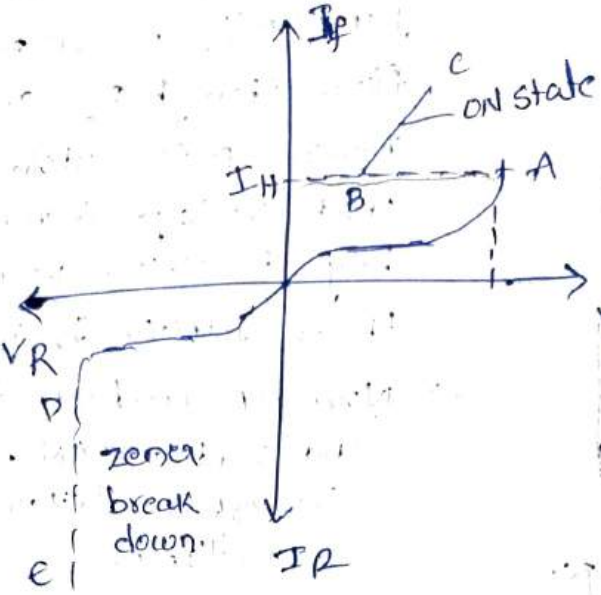
(ii) Applying voltage at gate terminal.



+ when the gate is positive w.r.t cathode J_3 is forward bias. while J_2 is reverse bias electrons from N-type move across junction J_3 towards gate, while hole from p-type move across junction J_3 towards cathode. So gate current start flowing In once SCR Starts conducting the gate loses all control the current keeps flowing indefinitely. Untill circuit is open.

VI characteristics :-

VI characteristics in forward bias condition drawn between Vf and If. Reverse bias Condition drawn between Vr and Ir.



→ VI characteristics of a SCR for $I_{GK}=0$ when the anode is positive w.r.t to cathode the characteristics known as forward characteristics volt corresponding to 'A' is called forward voltage, and gate is open the breaker voltage is defined as minimum forward voltage at which SCR start conducting heavily. Under the condition voltage across SCR suddenly drops as shown by dotted curve AB. The current corresponding to point B is I_H and is known as holding current.

Reverse characteristics: Anode to cathode voltage is reversed then device enter into reverse blocking region, the current is negligible small & practically neglected.

→ If reverse voltage increases similar to diode at particular value avalanche breakdown occur and large current

flows through device called reverse breakdown.
→ forward breakover voltage greater than reverse breakover voltage.

Advantages :-
→ very small amount gate drive required.
→ SCR with high voltage and current ratings available.

disadvantages :-
→ Gate has no control, once SCR turned ON.
→ operating frequency are low.

* Varactor diode :-

→ It is also named as variable capacitor, varicap (or) voltage variable capacitor, Tuner circuit.
→ Varactor diode are mainly preferred under reverse bias condition. it is also a junction diode with small impurity doping at its junction.
→ It has a usebul property that its junction/ transition capacitance is easily varied due to diode preferred for high frequency application.

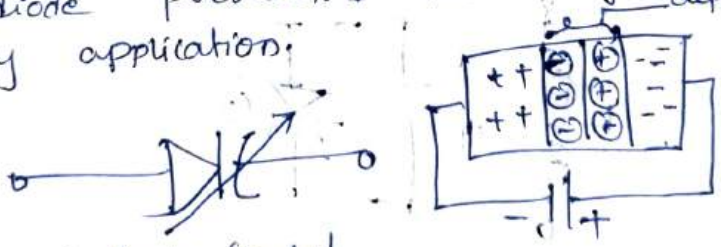


fig :- Symbol.

→ when any diode is reverse bias, a depletion region will form. The larger reverse bias voltage is applied across the diode, the width of depletion Region become wider and by decreasing Reverse voltage become narrower.

varactor diode :

1. Varactor diode acts like variable capacitor under Reverse bias condition.

2- Another names Varicap, Tuning, variable Reactance, variable capacitance diode

3. It is manifactured to show better transition capacitance property than ordinary diodes.

4. Symbol : 

. Two parallel lines at cathode represent two conductive plates and the space b/w two parallel lines represent dielectric

5. When we apply Forward bias voltage is applied, electric current flows through diode As result depletion Region become negligible. [Forward bias of PN diagram draw here

6. We know that depletion region consist of Stored charges. so stored charges become negligable which is undesirable.

7. Designing this to store charges not to conduct electric current.

8. when a Reverse bias voltage applied electrons from n-region & holes from p-region move away from junction. [R.B of PN draw here

9. As a Result, width of depletion Region Increases and capacitance decreases

10. Applied Reverse voltage is low then capacitance is very large. | capacitance $\propto \frac{1}{\text{width of Depletion Region}}$

11). R.B voltage ↑ width of D.R ↑ capacitance ↓

12. the decrease in capacitance means decrease in storage charge. so reverse bias voltage kept at minimum to achieve large storage charge

13. Thus, capacitance varied by varying the voltage.

Fixed capacitor → capacitance will not varied

Variable capacitor → capacitance varies

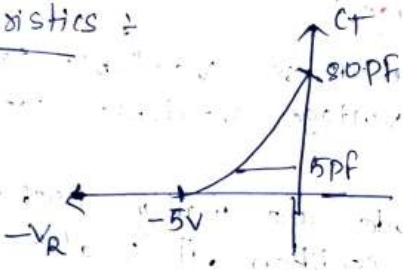
14. Units capacitance measured in picofarads(PF)

→ This depletion Region is constant consist of micority Carrier and act like insulator (dielectric where as two p and n region will acts as plates forming a capacitor.

→ As the capacitance, is inversly proportional to distance between the plates; so the capacitance varies inversly with applied voltage.

i.e $C_T \propto \frac{1}{V_R}$

Characteristics :



Applications :

→ main application of Varactor diode is LC tuned circuit

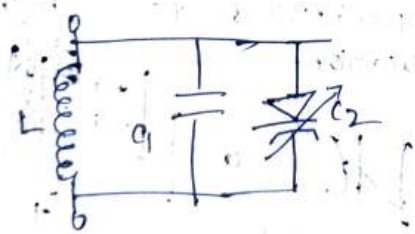


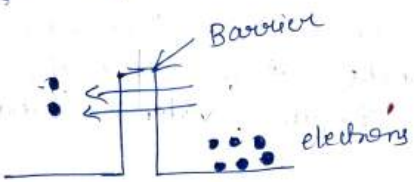
Fig :- Apt use of Varactor diode LC tuned circuit

Resonance frequency $(f_i) = \frac{1}{2\pi\sqrt{L(C_1+C_2)}}$

→ FM modulator
→ Automatic frequency control device
→ Adjustable band pass filter
→ television receivers.

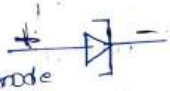
Tunnel diode :

1. Tunnel diode is a heavily doped PN junction diode in which electric current decreases as voltage increases.
2. The tunnel diode is used as very fast switching device in computer. It is also used in high freq oscillator and amplifiers.



→ meaning of Tunneling is moving

3. Symbol of Tunnel diode



→ It is mainly designed using Germanium material other than Germanium these diode are made up of Gallium Arsenide, Gallium Antimonide, Silicon.

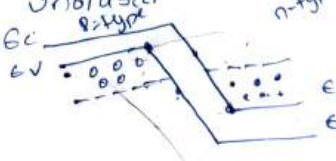
→ Anode is positively charged electrode which attracts electrons. Cathode is negatively charged electrode which emits electron

4. n-type semiconductor emits electron so it is refered to as cathode
p-type semiconductor attracts electron emitted from n-type semiconductor. so p-type refereed as the anode

Working :

Case(i) :- Unbiased tunnel diode :

→ when no voltage is applied to the tunnel diode. It is said to be an unbiased tunnel diode. I



→ In a tunnel diode, conduction band of the n-type material overlaps with valency band of P-type material because of heavy doping.

→ Because of this overlapping the conduction band electrons at n-side and valence band hole at P-side are nearly at the same energy level.

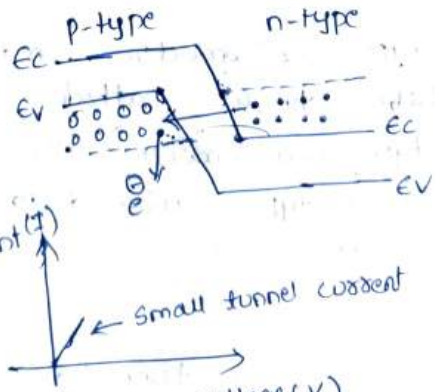
→ So when the temperature increases, some electrons tunnels from conduction band of n-region to the valence band of P-region.

→ In a similar way holes tunnel from valency band of p-region to the conduction band of n-region

(case (ii)) :- Small voltage applied to tunnel diode

→ when small voltage applied to diode i.e less than (critical value (or) built in voltage of depletion layer no current flows through junction

→ Small no of $e^{\ominus}$ in conduction band will move to the empty state of valence band in p-region. This create small forward current



o → hole

• → electron

C.B → conduction band

V.B valency band

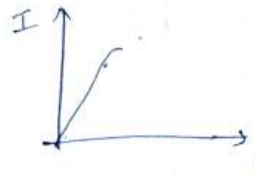
(case iii) Applied voltage slightly increases.

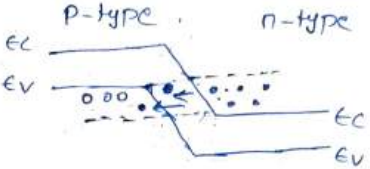
→ when voltage to diode increases, large No of free e⊖, holes generated

→ voltage increases overlapping of conduction band & valency band is increased.

→ Energy levels of C.B & V.B are equal.

maximum current flows

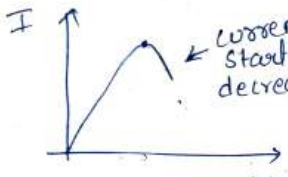




(case iv) Applied voltage further increased:-

If applied voltage is further increased, misalign of C.B & V.B takes place

→ e⊖ from conduction band move to V.B cause small current flow. tunneling current start decreasing



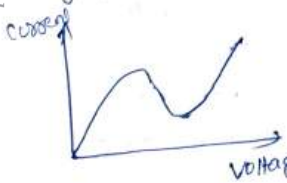
(case (v):- Applied voltage largely Increased.

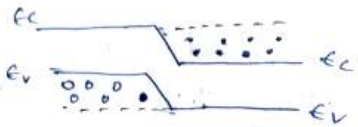
If applied voltage largely increases the tunneling current drop to zero.

→ At this point no longer overlap of C.B & V.B it work smilar to pn diode.

→ If applied voltage greater than built in potential current start flow through diode

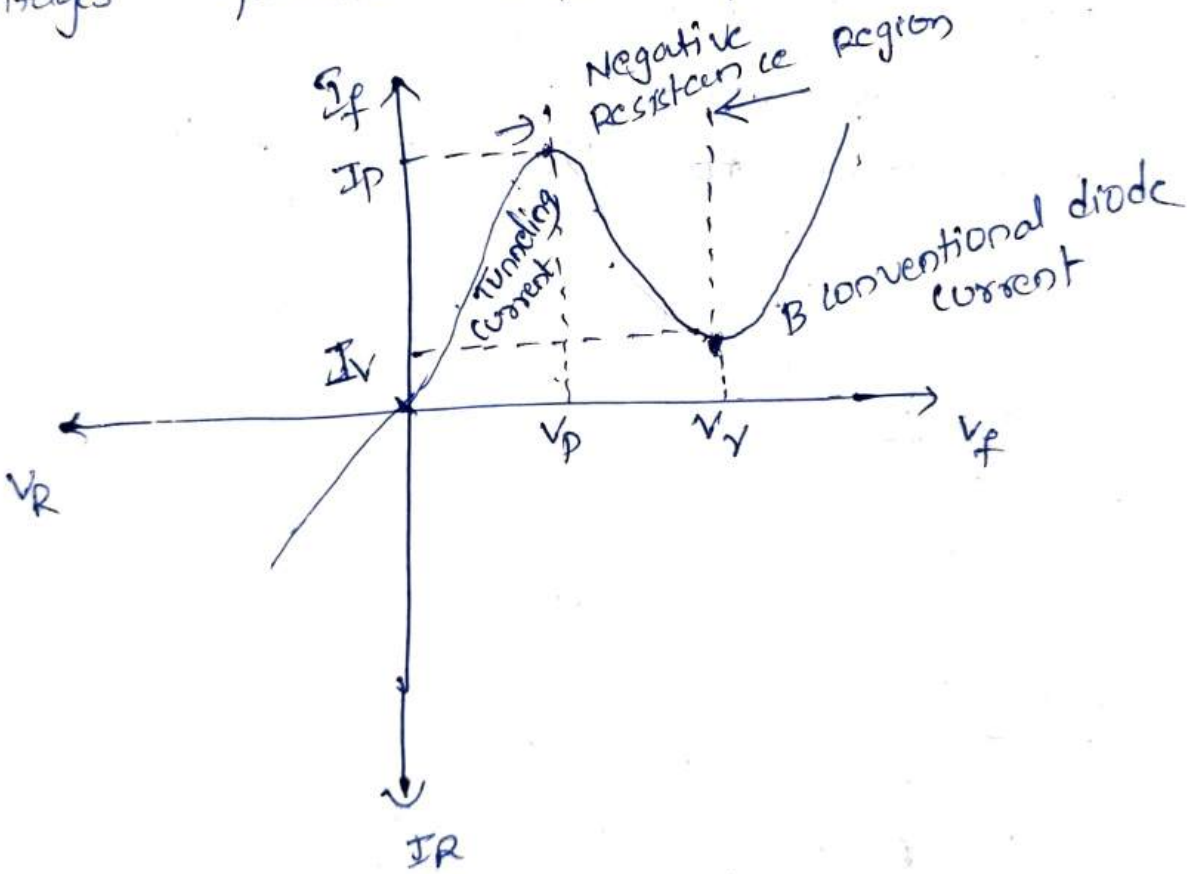
→ The portion of curve in which current decreases as voltage increases it is the negative resistance region of tunnel diode. used in Amplifier & osscilator





VI characteristics :-

As soon as forward bias is applied significant current produced the current reaches its peak value I_p. when forward voltages reaches value V_p.



→ when forward voltage is further increased the diode current start decreasing thus reaches a point I_V corresponding to a valley voltage V_v.

The Region from point A to B is called as negative resistance region. For the voltages greater than V_p the current start raising as in case of normal PN junction diode.

Peak current point: (I_p) :

The voltage at which current flowing through tunnel diode reaches maximum value is named as peak current (I_p).

Valley current (I_v): The voltage which the tunnel diode current increases after a position of decrement and voltage at which tunnel diode is ready to work as p.n diode named as valley voltage. and corresponding current is valley current.

Negative Resistance Region: This region present at particular interval between peak current to valley current. Region wher voltage is increasing but current decreases. i.e negative Resistance Region.

Advantages:

- Low cost
- Low noise
- Low power consumption

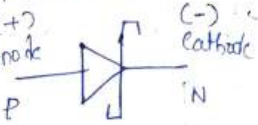
Applications:

- As high speed switch
- In computer logic circuits
- high frequency oscillators, amplifiers

* Schottky Diode :- → unipolar device

→ Schottky diode is a metal semiconductor junction diode that have less forward voltage drop (0.3-0.5) than PN junction diode and can be used in high speed switching application

→ Symbol of Schottky diode



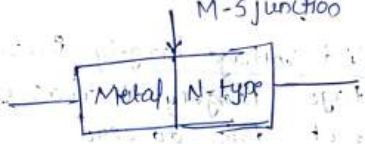
metal acts as anode and n-type semiconductor acts as cathode.

→ Pto metal. like platinum & Aluminium replace the p-type semiconductor (Anode)

→ Another names of Schottky diode are Schottky Barrier diode, Surface barrier diode, Majority carrier device, Hot electron diode

Construction :-

→ When Aluminum, platinum joined with n-type semiconductor. Junction formed between them is called M-S junction (or) metal semiconductor junction. (or) Schottky barrier



→ Schottky diode can switch on and off much faster than PN diode

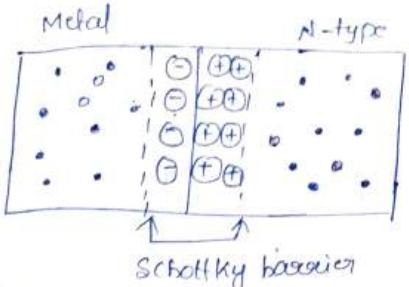
→ produce less unwanted noise than PN diode

→

Working :-

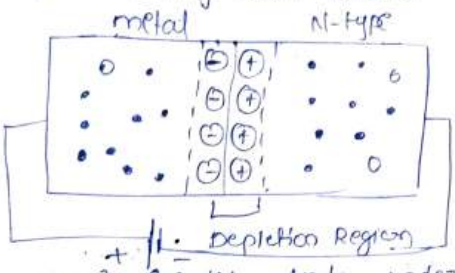
→ In a forward bias the electrons in N side gain enough energy to cross the junction barrier and move into metal with large energy they are called it hot carriers so diode is called as hot carrier diode.

Before applying a forward bias the $e^{\ominus}$ in N-side having less energy level than of metal so $e^{\ominus}$ cannot cross the junction barrier called schottky barrier.



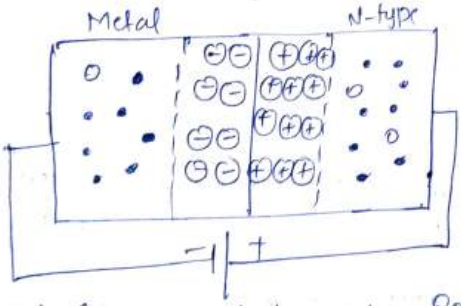
⊕ → positive ion
⊖ → Negative ion

Fig(i) Schottky diode under Unbiased condition



• → free $e^{\ominus}$
o → free hole

Fig(ii) Schottky diode under Forward bias condition



fig(iii) Schottky diode under Reverse bias condition

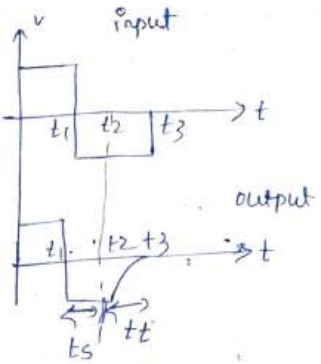
Reverse Recovery time :- (R.R.T)

→ the switching from conducting to non conducting state is called Reverse Recovery time.

→ R.R.T of schottky diode is less than the normal PN junction diode because in schottky diode No minority charge carriers.

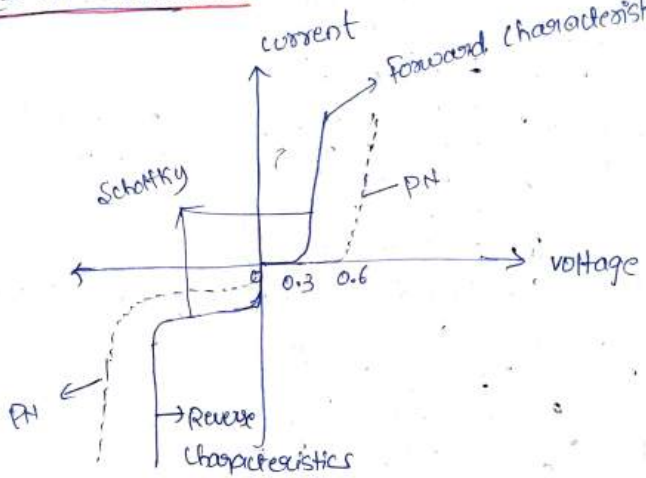
Reverse Recovery time $= t_s + t_r$

→ At time t_1 in output side it should become zero but some finite amount of current is flowing due to minority carriers this time is called storage time.



→ The time at which current start decreasing is called transition time.

VI characteristics :

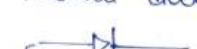


----- dot indicate characteristics of PN junction
——— indicates characteristics of schottky

→ Voltage drop of schottky diode range from 0.3 to 0.5 V

Example :

Normal diode

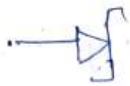


$I = 50A \quad V_f = 0.6V$

$P = V \times I = 50 \times 0.6V$

$P = 30W$

Schottky diode



$I = 50A \quad V_f = 0.3$

$P = V \times I = 50 \times 0.3V$

$= 15W$

Schottky diode discipate less power due to low voltage drop than normal diode.

Advantage:
- less Recovery time
- less voltage drop
- low barrier potential

disadvantages:
- high Reverse leakage current
- low reverse voltage Rating

Applications:
- switching circuits
- RF mixers
- Solar cell applications.

LED :- (Light Emitting Diode)

- opto semiconductors called light emitting diodes (LEDs) it transfers electrical energy into light energy.
- It lights up when we apply the voltages. it has longer life span than lasar diodes.

Construction:-

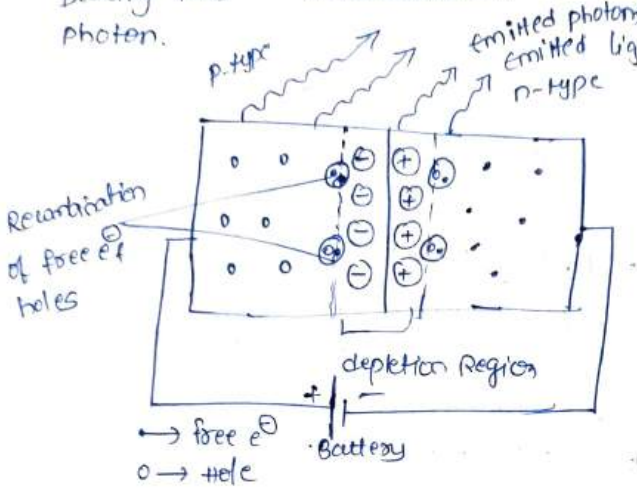
Same like PN junction diode LED also can allow current only in one direction i.e forward bias condition. P type material connected to +ve terminal and n-type material connected to -ve terminal of battery. LED consist of two terminals Anode & cathode.

fig(i) symbol of LED

- Light being emitted by the diode. LEDs comes in variety of colour. like orange, yellow, green red LED are mostly available on LEDs
- Symbol of LED does not Represent any colour
- gallium, phosphorous, arsenic materials are used in construction.

LED working :

LED function only in forward bias condition holes in the psides & electrons in the n-side move towards the junction. $e^{\ominus}$ & recombine with hole. width of depletion Region reduce. During this Recombination produce light or photon.



Fig(i) ; working of LED

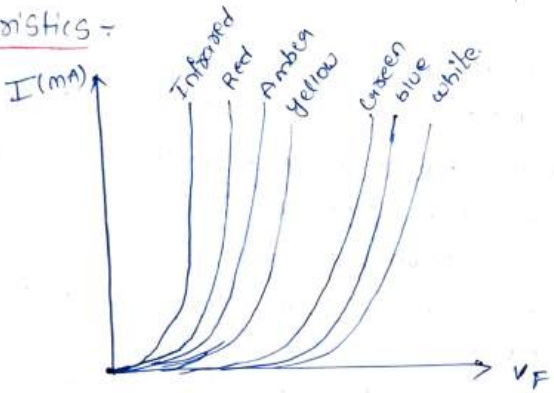
Before recombining with holes in valency band the free $e^{\ominus}$ in conduction band lose the energy inform of light. the gadget may damaged if reverse bias voltage applied to LED's. All diodes produce light (or) photons. but not all of them produce visible light. In just one millisecond LED can turn ON and OFF.

Colours of LED :

Exotic Semiconductor material such as gallium arsenide (GaAs), gallium phosphide (GaP), gallium arsenic phosphide (GaAsP), silicon carbide (SiC) (or) Gallium indium nitride (GaInN) used to make light emitting diode.

semiconductor material	wavelength	colour	(V_F) cutin voltage
GaAs	850 - 940nm	Infra-red	1.2V
GaAlAs	630 - 660nm	Red	1.8V
GaAsP	605 - 620nm	Amber	2.0V
GaAsP-N	585 - 595nm	yellow	2.2V
AlGaP	550 - 570nm	Green	3.5V
SiC	430 - 505nm	Blue	3.6V
GaInN	450nm	White	4.0V

Characteristics :-



Advantages :-

→ long life.
→ Energy efficiency
→ high brightness, Reliability

Disadvantages :-

→ Impact on insects
→ Temperature sensitivity
→ Electrical polarity
→ voltage sensitivity

Applications :-

→ used as bulb in homes & industries.
→ used in motorcycles & cars
→ traffic light signals

* Solar cell :-

→ Solar cell is commonly refered to as photo voltaic cell. it is a electrical device uses photo voltaic effect to transform light energy to electrical energy.

→ A photo electric cell is a type of device whose electrical properties, such as current, voltage or resistance, change in response to light.

→ Solar panels also knows as modules or solar cells are made up of individual solar cells.

Construction :-

→ Design of solar cell slightly different from PN junction diode in terms of manufacturing.

→ On the top of a thick N-type semiconductor, a very thin layer of P-type semiconductor is formed on bottom.

→ P-type semiconductor cover with two thinner electrodes.

→ The band gap of materials used to make solar cells must be close to 1.5 eV.

→ GaAs, CdTe, CuInSe are materials used in construction.

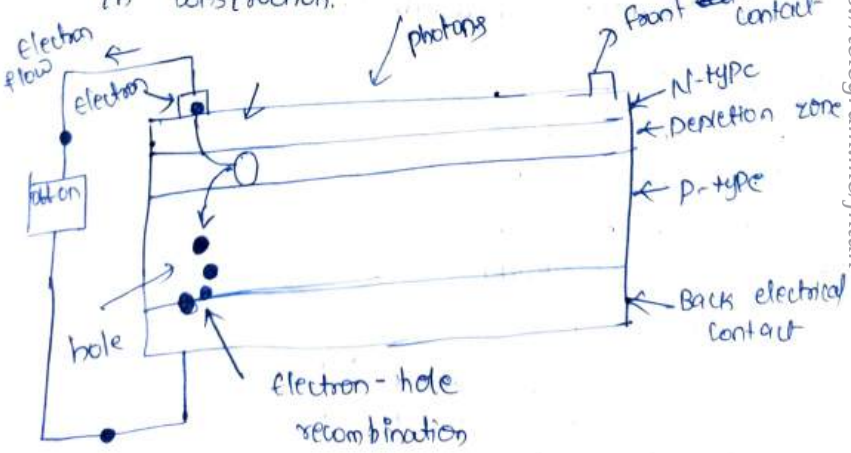


Fig Construction of solar cell

Working :-

Light photons easily pass through the incredibly thin p-type layer to enter the PN junction when light reaches.

photons from light source give the junction enough energy to make many $e^{\ominus}$ hole pairs.

The junction's thermal equilibrium condition broken by incident light

In depletion region free $e^{\ominus}$ move quickly to junction's N-type side. similarly p-type side of junction can be readily reached by hole.

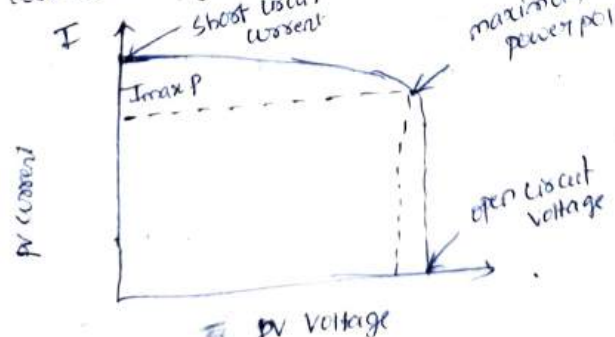
PN junction will act like miniature battery cell as concentration of holes increases on one side ie p-type side of junction. $e^{\ominus}$ increases on other side N-type side of junction.

A voltage known as photo voltage is set up.

V-I characteristics :-

x-axis represent photo voltage. y-axis represent photo current.

the photocurrent is at its greatest at zero photo voltage and it decline as photo voltage rise above zero. the term " highest power point " refer to voltage at which the photo current begins to decline



Advantage :-

→ No pollution associated with it.
→ It must last for long time
→ No maintaince cost

Disadvantage :-

→ It has hight cost of installation
→ It has low efficiency

Applications :-

→ Supply electricity for telecommunication repeater stations, water pumps, cottages

* photodiode :-

→ It transforms light energy into electrical energy very quickly
→ Another names photo detector, light detector, photo sensor. It operate under reverse bias condition

Types of photodiodes :-

a) PN photodiode :- It is first developed. it has poor sensitivity compared to other

b) PIN photodiode :- mostly widely used photo diode.

c) Avalanche breakdown :- Due to its high gain Levels, this type of diode utilise in low light environment

d) Schottky photodiode :- It is used in optical communication. it has low voltage drop.

Symbol of photodiode :-

Construction :-

→ P-type & N-type semiconductors can be used to create photodiode.

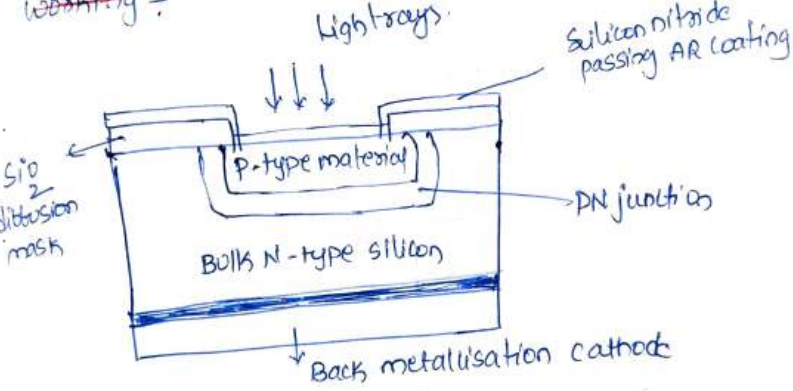
→ Diffusion of P-type substrate, which is midly doped. P+ ion layer formed due to diffusion

→ N-type epitaxial layer can form on N-type substrate.

→ Metals are used in the contact's construction to create two terminal that resemble an anode and cathode.

→ Active and non-Active surfaces present- non-Active surface prevents light rays from striking., but active surface allows light rays to pass across it.

working :-

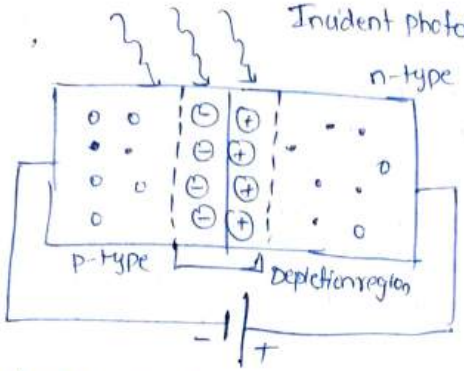


working :-

→ when photon of light strike the diode it create hole & $e^{\ominus}$ recombination due to inner photoelectric effect.

→ carrier are move away from the junction

→ hole move towards cath The sum of photocurrent and absence of . light make up total current flow through diod



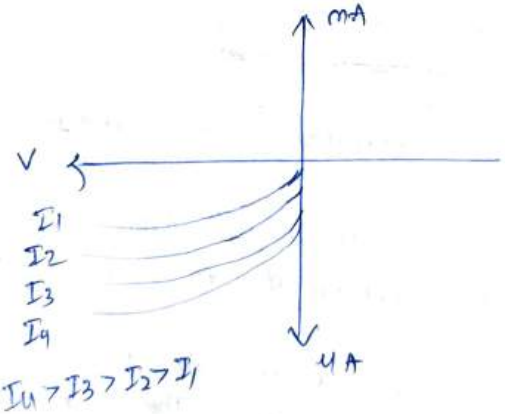
Modes of operation :-

Photovoltaic mode :- This referred as zero bias mode

Photo conductive mode :- width of Depletion region more with applying reverse voltage.

Avalanche breakdown :- operate with high reverse bias. breakdown occurs.

V-I characteristics :-



$I_4 > I_3 > I_2 > I_1$

→ photocurrent · Esentially unaffected by applying reverse voltage. with exception tiny dark current. Photo current is zero

→ photocurrent rises linearly along with optical power.

Advantages :-

→ Less resistance
→ long life span
→ Less noise
→ loss weight

Disadvantages :-

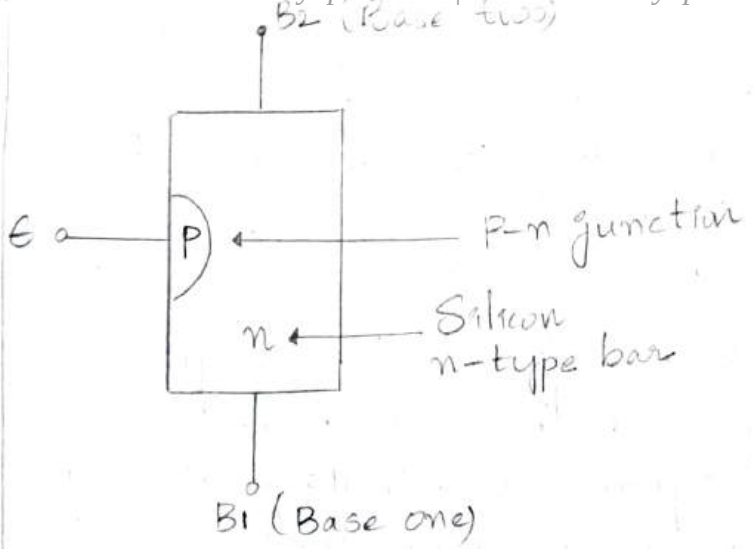
→ Temperature stability is poor
→ less sensitivity
→ It uses offset voltage

Applications :-

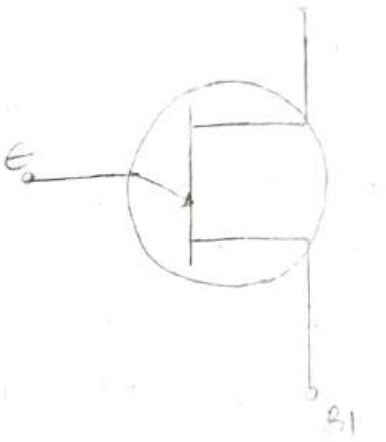
→ Smoke detector, Compact disc player, television
→ Photo conductor, photo multiplier tubes.
→ Used for lightning regulation and optical communication.

UJT (Unijunction Transistors) :-

It is a three teaminal device having two layers
It consists of lightly doped n type silicon slab to which aluminium rod is alloyed at the one end with a p-type material, forming a p-n junction.
At other end of slab, two base contacts B1 and B2 are attached. The third teaminal emitter e is taken out from aluminium rod



Structure of UJT



Symbol of UJT

→ The fig shows the construction and symbol of UJT

→ It has only one P-n junction hence called Unijunction.

→ The P-n junction can be treated as a diode D while internal resistance of two bases are denoted as R_{B1} and R_{B2}. The resistance R_{B1} is greater than R_{B2}.

→ When emitter diode is not conducting, the resistance between two bases is called interbase resistance given by $R_{BB} = R_{B1} + R_{B2}$

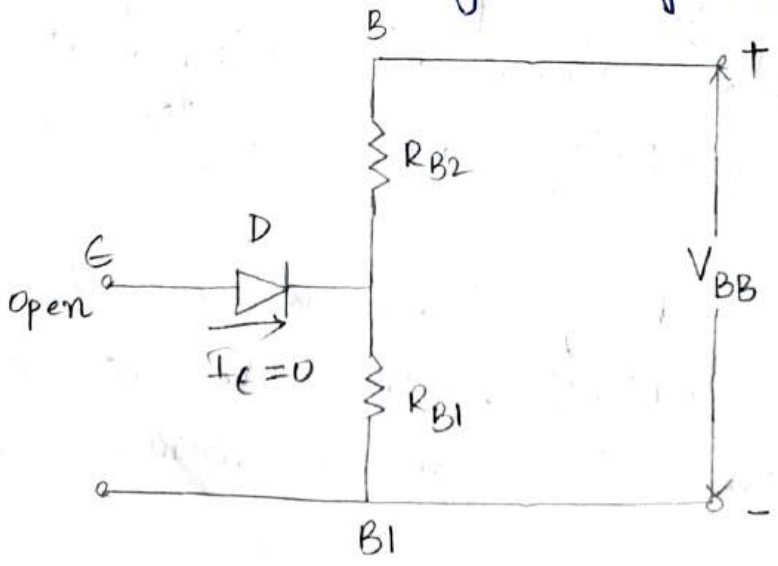


fig: Equivalent circuit of UJT

The fig shows the equivalent circuit of UJT when $I_E = 0$, then the voltage drop across R_{B1} is given by,

$$V_{RB1} = \frac{V_{BB} R_{B1}}{R_{B1} + R_{B2}} = \eta V_{BB}$$

$$\eta = \frac{R_{B1}}{R_{B1} + R_{B2}} \Big|_{I_E = 0} = \frac{R_{B1}}{R_{BB}} \Big|_{I_E = 0} = \text{Intrinsic stand off ratio}$$

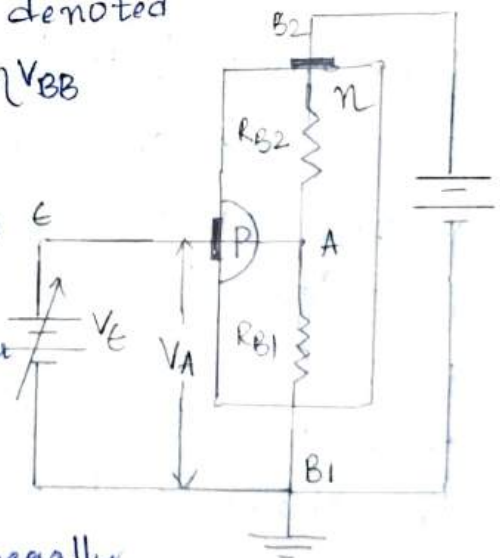
∴ The value of η is between 0.5 to 0.8

Working of UJT:-

The supply voltage V_{BB} is connected between B_1 and B_2 while variable emitter voltage V_E is applied to emitter. This shown in the fig

The V_E is used to forward bias the diode. The drop across diode is V_D.

The potential of A is denoted by η and is equal to ηV_{BB}



Case(i) $V_E < V_A$

As long as V_E is less than V_A the p-n junction is reverse biased. Hence emitter current I_E will not flow.

Case(ii) $V_E > V_P$

The diode drop V_D is generally between 0.3 to 0.7V.

Hence we can write

$$V_P = V_A + V_D = \eta V_{BB} + V_D$$

When V_E becomes equal to or greater than V_P the p-n junction becomes forward biased and current I_E flow.

→ Due to this the charge carriers are injected in the R_{B1} region of the bar.

→ Due to this additional charge carriers, the conductivity of the R_{B1} region increases i.e resistance and due to which the drop across it also decreases.

→ This makes the p-n junction more forward biased which further increases the current and more charge carriers are injected.

→ The current I_E is increases to a value determined by the source resistance.

→ Under these conditions, the UJT is said to be ON and remains in this condition till the input is open or the current I_E gets reduced to very low value.

UJT characteristics:-

→ The graph of emitter current against emitter voltage plotted for a particular value of V_{BB} is called the characteristics of UJT

→ For a particular fixed value of V_{BB} such characteristic is shown in the fig

→ The characteristics can be divided into three main regions which are

1) Cut-off region:- The emitter voltage V_E is less than V_p and the p-n junction is reverse biased. A small amount of reverse saturation current I_{EO} flows through the device, which is negligibly small of the order of μA.

This condition remains till the peak point.

Negative resistance region:- When the emitter voltage V_E becomes equal to V_p the p-n junction becomes forward biased and I_E starts flowing. The voltage across the device decreases in this region, though the current through the device increases. Hence the region is called negative resistance region. This decreases the resistance R_{B1}. This region is stable and used in many applications. This region continues till valley point.

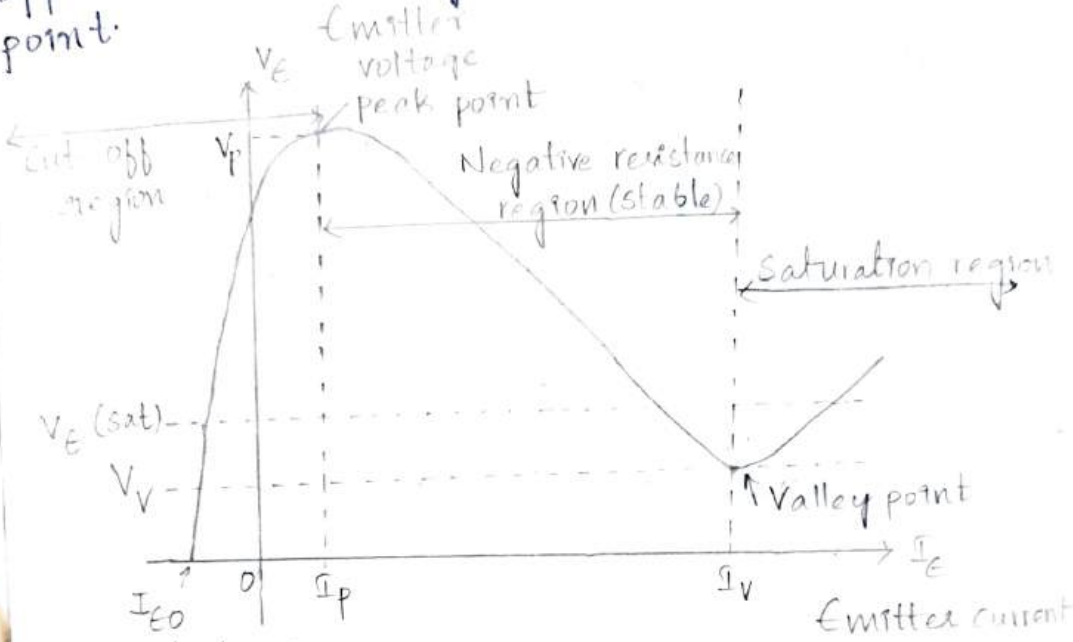


Fig: UJT characteristics

3) Satuaation Region:-

Increase in I_E further valley point current I_V drives the device in the saturation region. The voltage corresponding to valley point, denoted as V_V. In this region, further decrease in voltage does not take place. The characteristics is similar to that of a semiconductor diode, in this region

→ The active region i.e negative resistance region, the holes which are large in number on p-side, get injected into n-side. This causes increases in free electrons in the n-type slab.

This increases the conductivity i.e decreases the resistivity. Hence the resistance R_{B1} decreases in the region.

→ As the V_{BB} increases, the potential Vp corresponding to peak point will increase.

→ The typical UJT emitter characteristics for $I_{B2} = 0$; $V_{BB} = 20V$ and $V_{BB} = 5V$ are shown in the fig.

Applications of UJT:-

The various applications of UJT are:

→ Triggering of other devices like SCR
→ In a sawtooth waveform generator
→ In a relaxation oscillator
→ In timing circuits
→ In automobile Ignition circuits.