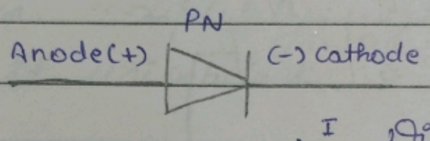
Module-1

1. P-N junction Diode →

- P-N junction diode is also known as Semiconductor diode.

- When a p-type semiconductor is joined to n-type semiconductor, the contact surface is called p-n junction

- It is two-terminal device that conducts current only in one direction.



Dirn of current flows

(symbolic representation).

- Formation of P-N junction diode →

We use diff. S/c materials to make a P-N junction there will be a boundary that inhibit the movement of e- from one side to another side, by scattering the e- and holes,
Thus we use the process of dopings, If we add a part of the p-type Silicon will get converted to N- type Silicon. This side sheet will contain both the P & N - Type region & a junction of b/w these two regions.
The process that follows after forming a p-n junction are of two types (i) Diffusion
(ii) Drift.

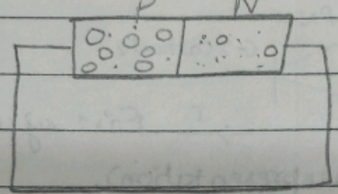
Biasing Condition for P-N junction diode →

There are three biasing condition for P-N junction diode.

(i) Zero biasing (I ⊗)
(ii) Forward Bias (++, --)
(iii) Reverse Bias (+-, -+)

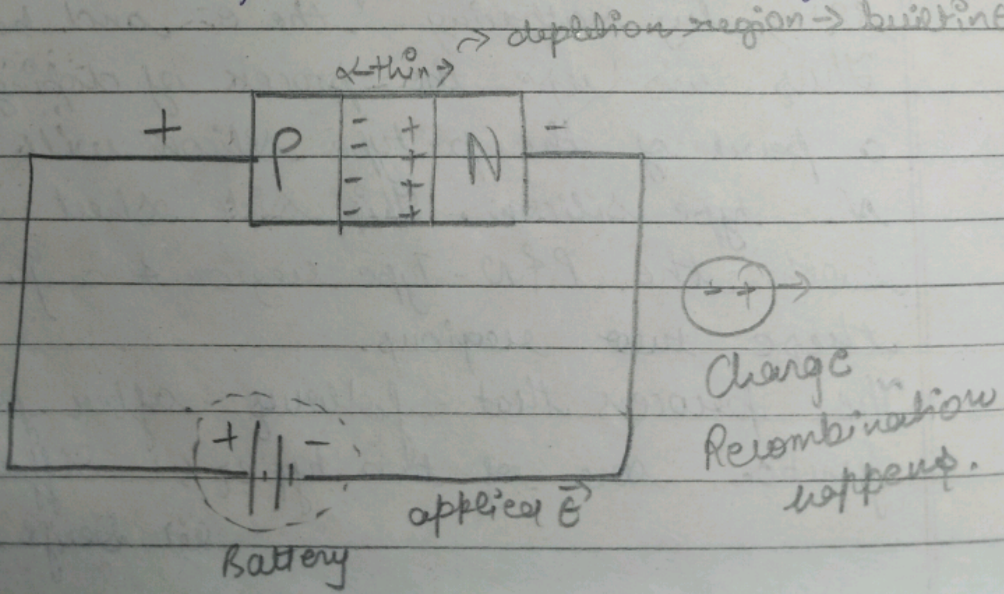
(i) <u>Zero Biasing</u> → when no external voltage is applied to the P-N junction diode,

→ There is no flow of current.



(ii) <u>Forward biasing</u> → (++, --)

when the P-type is connected to the battries (+) terminal and the N type is connected to the (-) terminal, then the P-N junction is said to be <u>forward Bias</u>

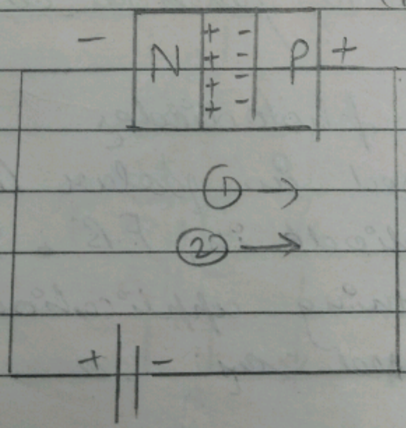


When the P-N junction is forward biased the built in electric field at the P-N junction & the applied electric field are in opp. dirⁿ. When both the e.f add up, the resultant electric field has a mag. lesser then the built-in electric field. This results in less resistive and thinner depletion region.

- The Depletion Region's, resistance becomes negligible when the applied voltage is large.
- In Silicon, At 0.6V the resistance of the depletion region becomes completely negligible, & current flows across it unimpeded.

(iii) Reverse bias ⇝ (+ −, − +)

- When the p-type is connected to the battery's (−) terminal & the N-type is connected to the (+) side, this is called P-N junction reverse Bias (No current flows).



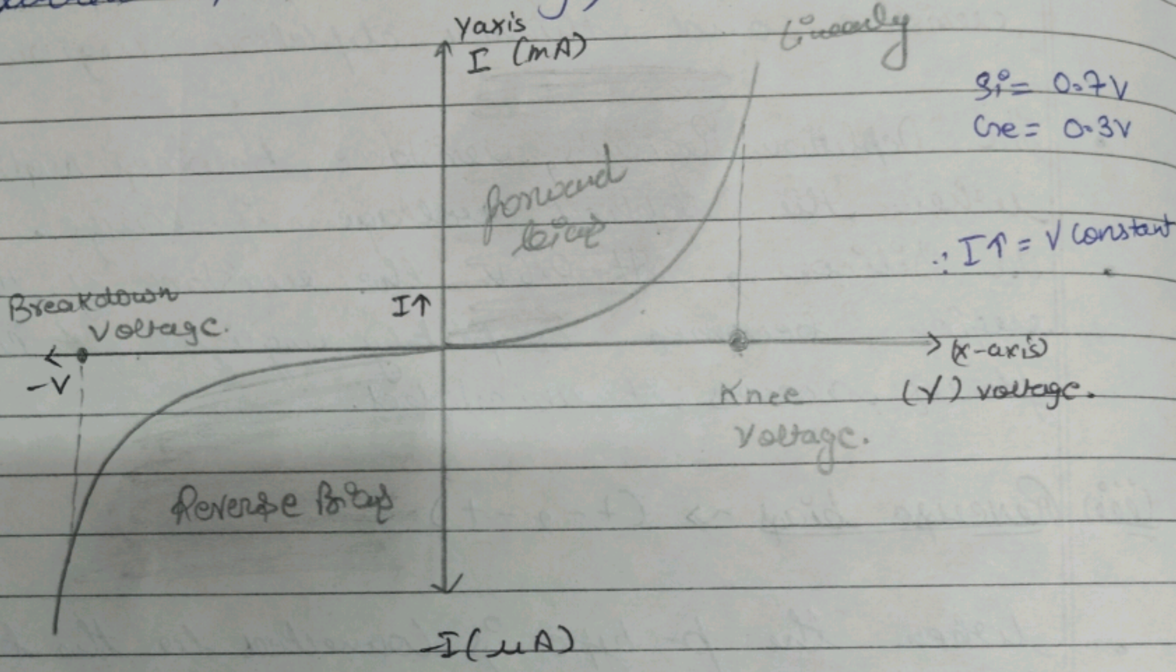
① → built in e.f
② → battery induced e.f

- The built-in ef and the applied ef are in the same dirⁿ.
- Depletion region becomes more resistive & thicker if the applied voltage becomes larger.

Page No.

☆ V-I Characteristics of P-N junction diode →

It is a curve b/w the V and I through the circuit.
voltage is taken along x-axis while the current is taken along y-axis.



☞ Application of P-N junction diode →

- It is used as photodiodes
- It can be used in solar cells.
- when the diode in F.B. It can be used in LED lightning application.
- They also used as a voltage controlled occilator

Date : / /
Page No.

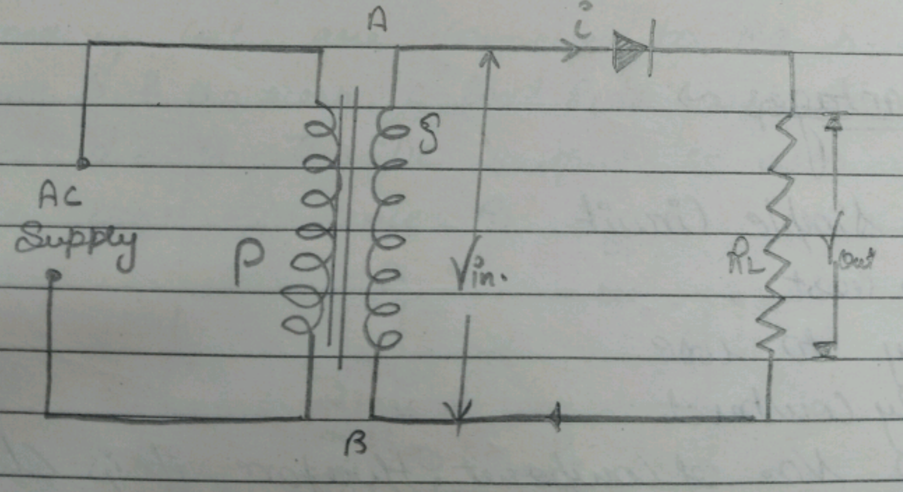
★ **Rectifiers** → A rectifier is a device which converts an AC input voltage into a DC output. Voltage.

- **Principle** → A rectifier's principle is to convert AC into direct current (DC) by allowing current to flow in one dirⁿ, while resisting it in other. This process is called rectification.

- P-N junction diode can be used either as
(a) Half wave rectifier
(b) full wave rectifier.

(a) **Half wave rectifier** →

Construction → • The AC - input voltage is fed across the primary coil P. of a step-down transf.
• The Secondary coil S. of transf. connected with S/C p-n junction diod D. and a load resistance R_L.

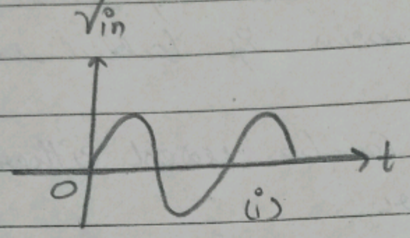


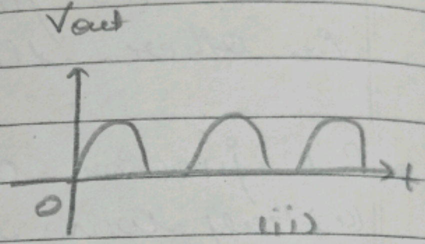
Working → • During 1st half cycle → Of AC input the end A be at +ve potential & end B at -ve potential in Secondary S of transf. In this Diode is F.B & current flows in ckt. & An output voltage across load R_L obtained.

Date : / /
Page No.

- During 2nd half of AC input →

End A is at +ve potential & Diode D is in R.B., so, No current flows through load R_L & there is No output voltage across R_L





(we get output voltage).

In the end next +ve half cycle of AC input, we again get the output & so on.

- Since the rectified output of the circuit is obtained only for half of the input AC wave, the device is called half-wave rectifier.

- Advantages ~>

(i) It is simple Circuit
(ii) low cost
(iii) easy to use.
(iv) easily construct
(v) low No. of component, therefore it is Cheap.

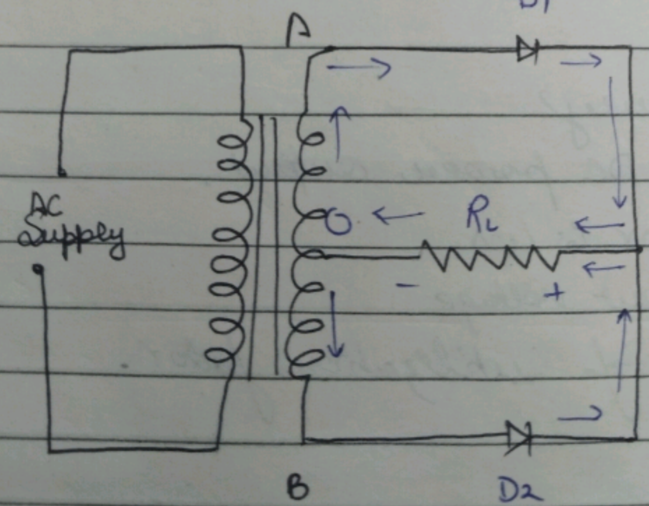
Date : / /
Page No.

- **Disadvantages →**

(i) transformer utilization factor is low.
(ii) produce low output voltage.
(iii) DC saturation of transf. core resulting in → magnetizing current & also some hysteresis losses & generation of harmonics.
(iv) Ripple factor is high & elaborate filtering is, therefore req. to give steady dc output.

(ii) **Full wave Rectifier →**
A full wave rectifier is the rectifier which rectifies both halves of each AC input cycle & gives a unidirectional output voltage continuously.

Construction → In full wave rectifier, we use two semiconductor diode which operate in a complimentary mode. The AC input supply fed across primary coil P. The two ends A & B of the secondary coil are connected to the p-ends of diode D_1 & D_2 resp. A load R_L is connected b/w both of the diodes. The DC output is obtained across the load resistence R_L.

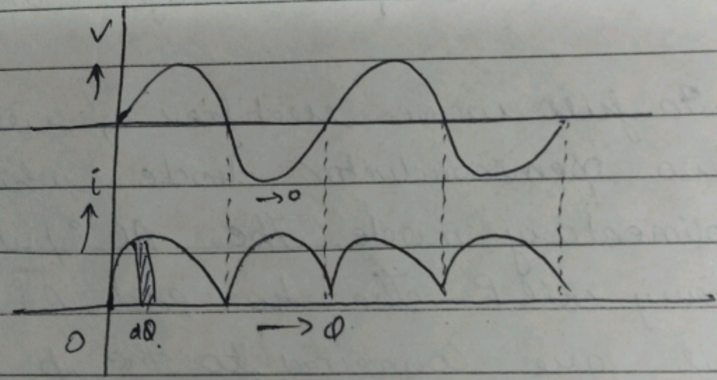


(full wave rectifier).

working →

During 1st half cycle of the Input Voltage →
A terminal is +ve with respect to O while
B terminal is -ve " " " O. Diode 1st is
F.B & 2nd diode is R.B. & Does not conduct the
current flow through R_L from D to O.

During 2nd half cycle →
A is -ve and B is +ve w.r.t to O, thus
diode 1st is R.B & 2nd diode is F.B.
The current flows through R_L in same dirn.
The resulting output current is a continuous series.



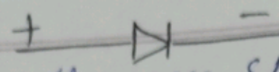
- Advantages →

- high Efficiency
- The large DC power output.
- Ripple factor is less
- Higher output voltage.
- Higher transf. utilization factor.

Date : / /
Page No.

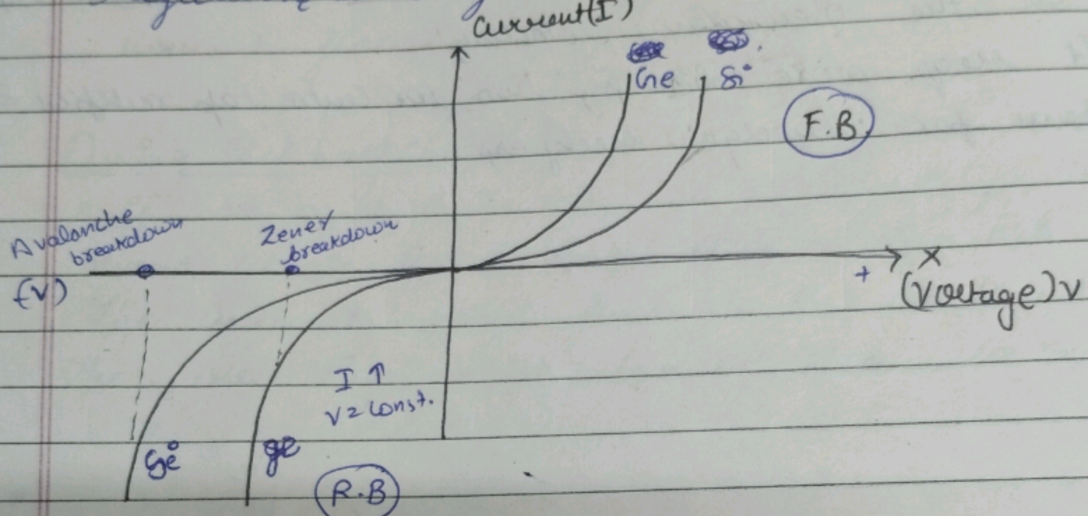
Disadvantages →

- More complicated than half wave rectifier.
- PIV rating of the diode is higher.
- The cost of the centre tap of transf. is high.
- The rectifier is diff. to locate the centre tap. On the secondary winding.
- It req. more diodes, two for centre tap rectifier & four for bridge rectifiers.



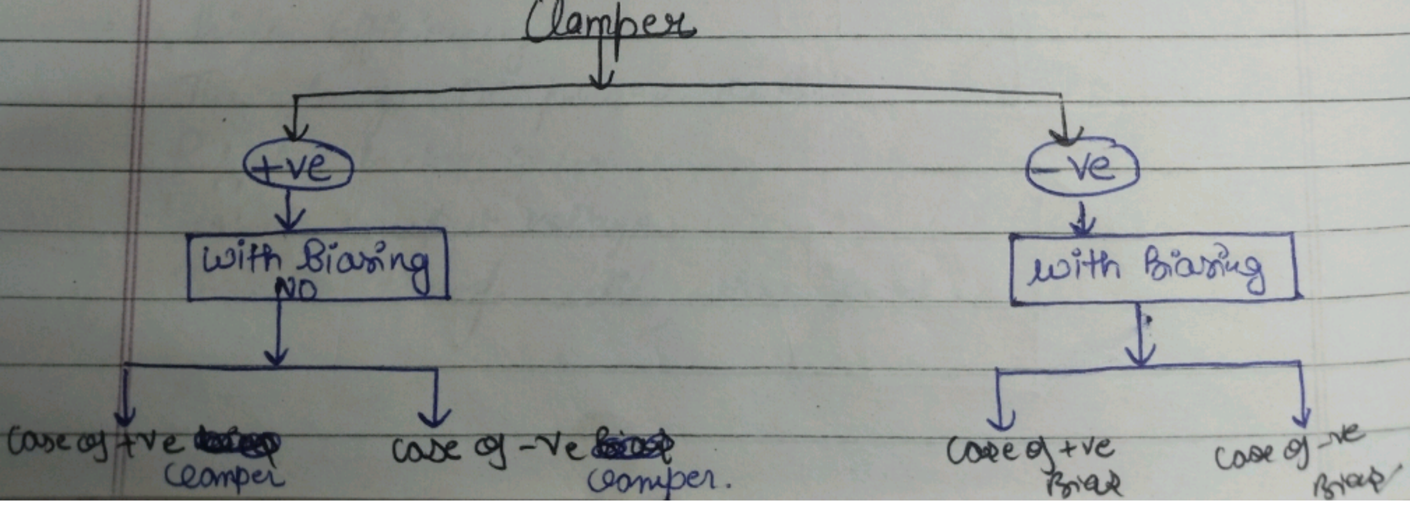
★ **Zener diode** → They are S/C devices that allows current to flow in both dir^n but specialize in current flowing in reverse.

- Also known as Breakdown diodes.
- used as voltage references and as shunt regulators to regulate the voltage across small ckt.

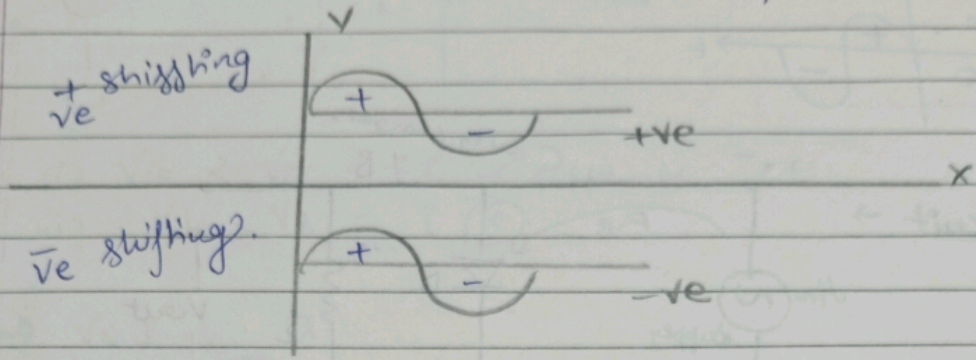


☞ **Clamper Circuit** → They are the electronic ckt. that shifts the DC level of the AC signal.

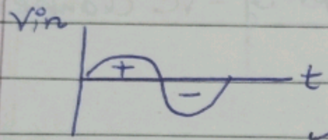
- Also known as DC voltage restorers or level shifter
- It is used to shift the waveform upward & downward.



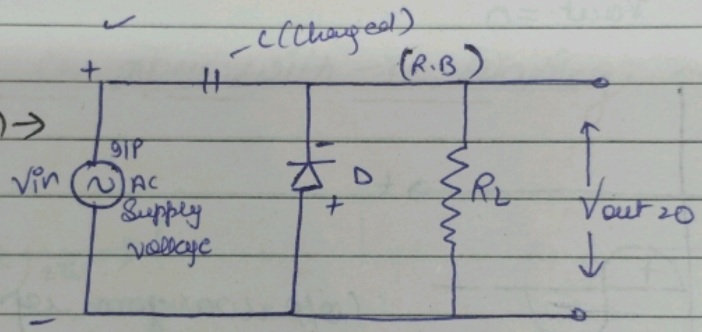
- The working of Clamper Ckt. depend upon the Variation in the time Constant of the Capacitor.

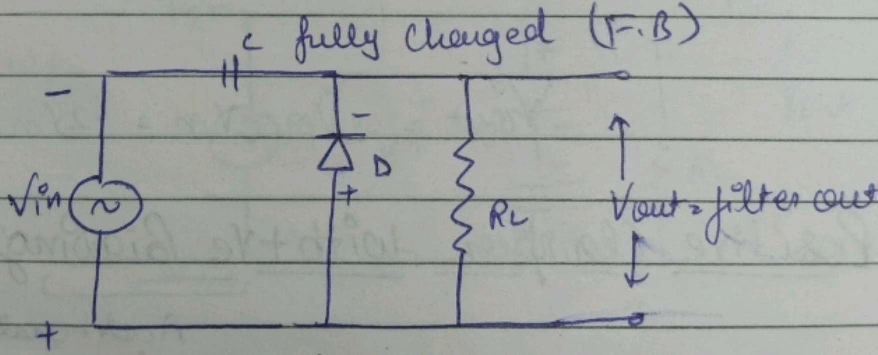


- **+ve Clamper → (+ve Shifting)**

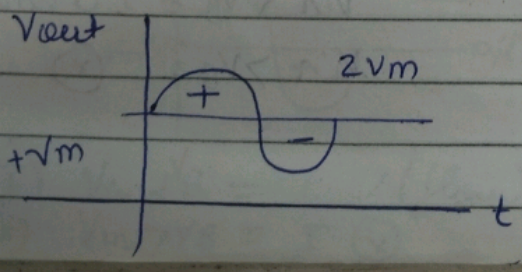


Circuit (CDR) →





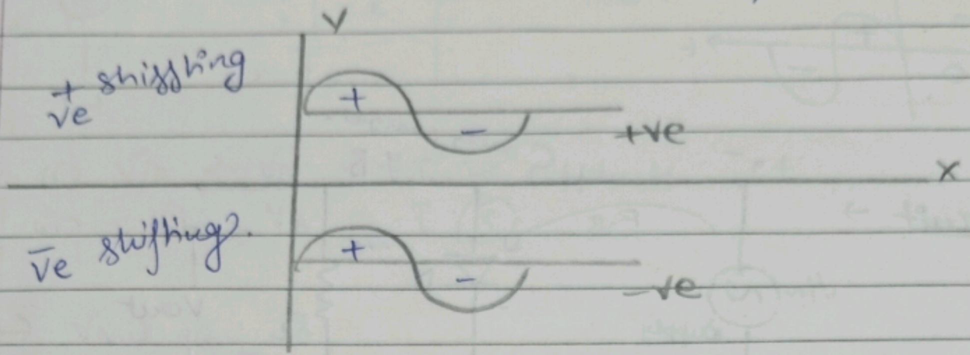
(+ve Clamper)



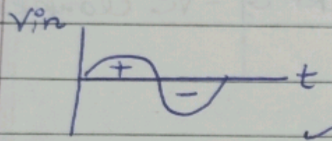
$V_{out} = \underset{+ve\ cycle}{V_m} + \underset{-ve\ cycle}{V_m} = 2V_m$

Date : / /
Page No.

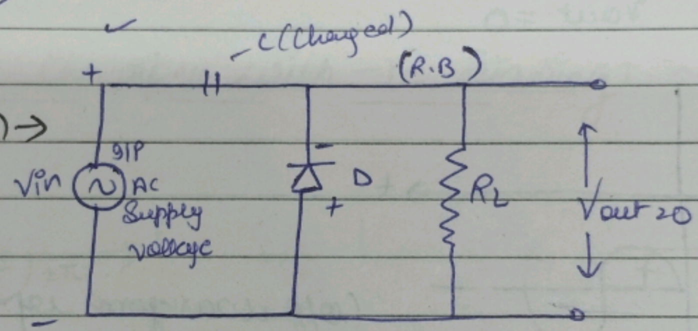
- The working of Clamper ckt. depend upon the - Variation in the time Constant of the Capacitor.

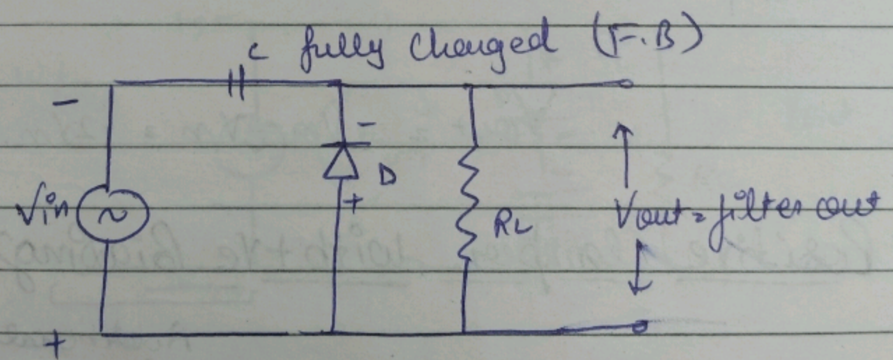


- **+Ve Clamper → (+Ve Shifting)**

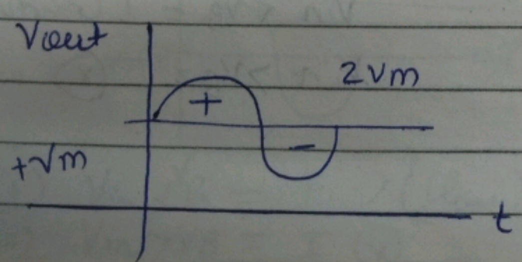


Circuit (CAR) →



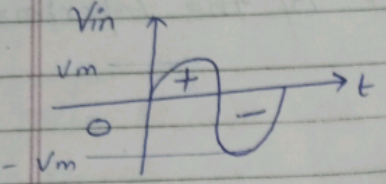


(+Ve Clamper)

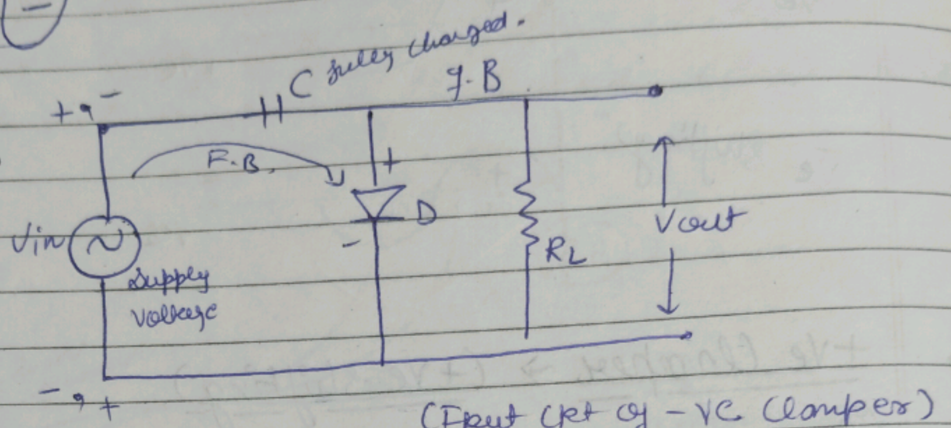


$$V_{out} = \underbrace{V_m}_{+ve\ cycle} + \underbrace{V_m}_{-ve\ cycle} = 2V_m$$

(2) -ve Clamper - (-ve shifting)



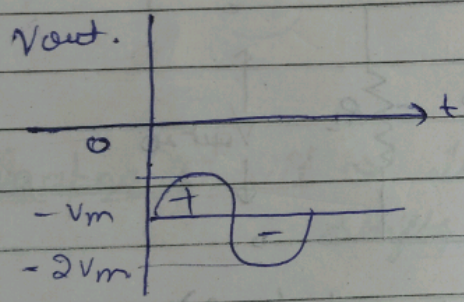
Circuit →



(I/put ckt of -ve clamper)

when R.B (open circuit).

Vout = 0

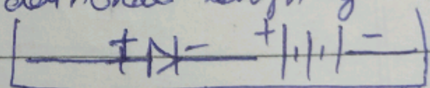


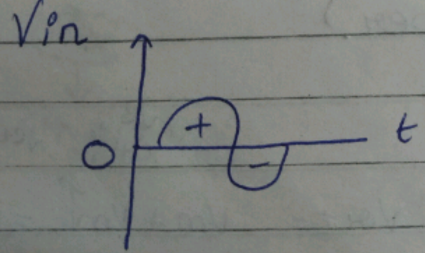
(o/p waveform of -ve clamper)

$V_{out} = -V_m - V_m = -2V_m$.

✲ Positive Clamper with +ve Biasing →

Additional shifting

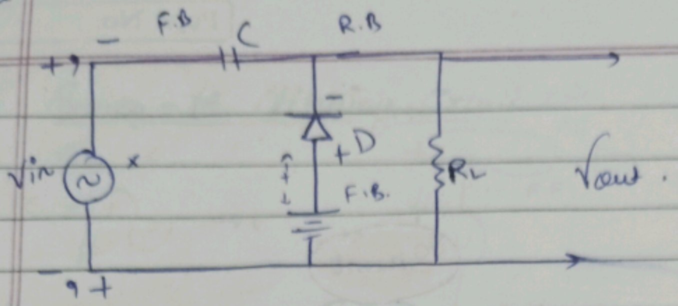




$V_{in} < V_B$ = I Conducts

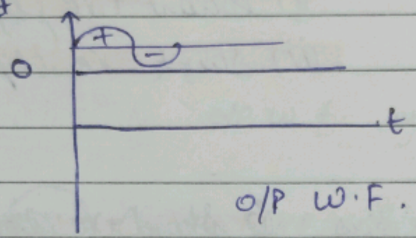
$V_{in} > V_B$ = I ⊗

Due to Vin ← D does not conduct.



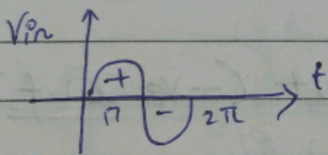
(i) $V_{in} < V_B$ − I ✓ conducts.
(ii) $V_{in} > V_B$ − I ⊗

→ Vout

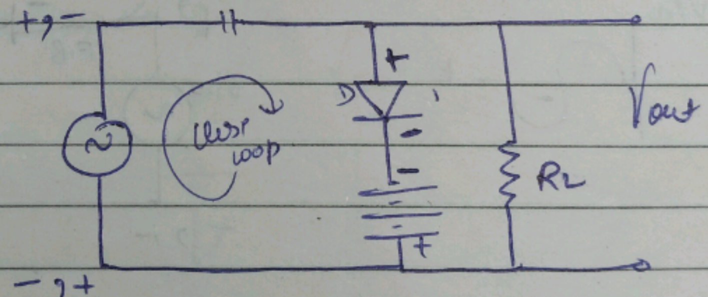


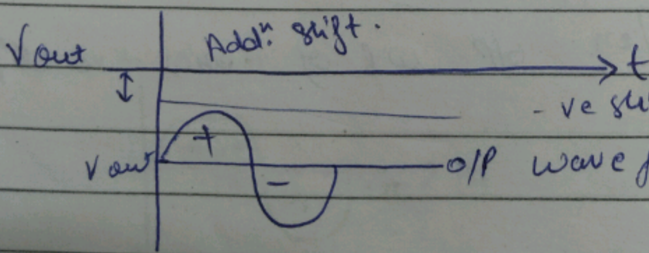
O/P W.F.

(ii) <u>Negative clamper with −Ve biasing</u> →



I/P W.f





− ve shifting

O/P wave form.

(I) $V_{in} < V_B$ = I ✓ (flow)
(ii) $V_{in} > V_B$ = I ⊗

Clipping circuit →

Clip-cut

- Series
  - +ve
  - -ve
- Shunt
  - +ve
  - -ve

(A) unbiased →

(i) series +ve clipping
(ii) Series -ve clipping

(i) Shunt +ve Clipp.
(ii) Shunt -ve Clipp.

(B) Biased →

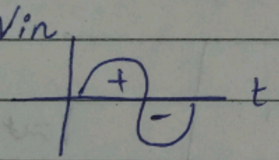
(i) Series +ve Clipp with +ve Bias
(ii) Series -ve Clipp with -ve Bias

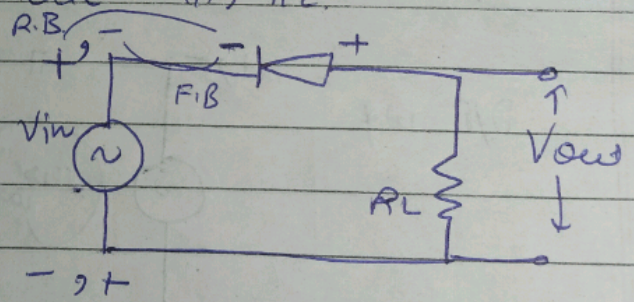
(i) Shunt +ve Clipp with +ve Bias
(ii) Shunt -ve Clipp with -ve Bias.

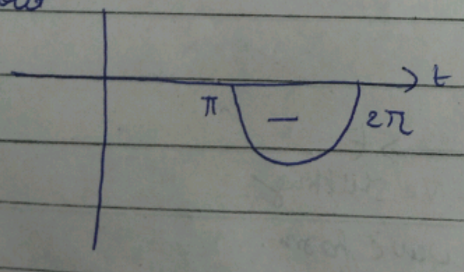
(i) Series →

(a) Series +ve clipping circuit (-ve w.f)

2 component (i) Diode (ii) RL.

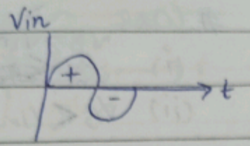


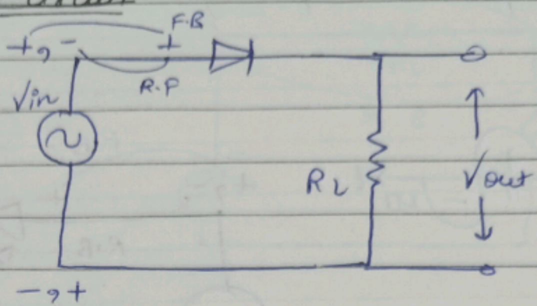


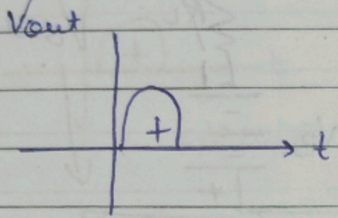


O/P w.f of Series +ve clipping.

(ii) <u>Series -ve Clipping Circuit</u> ~>

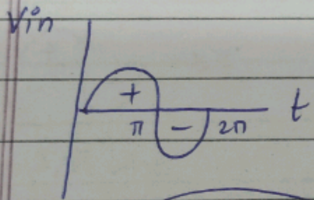






O/P w.f. of -ve C. Ckt.(Series).

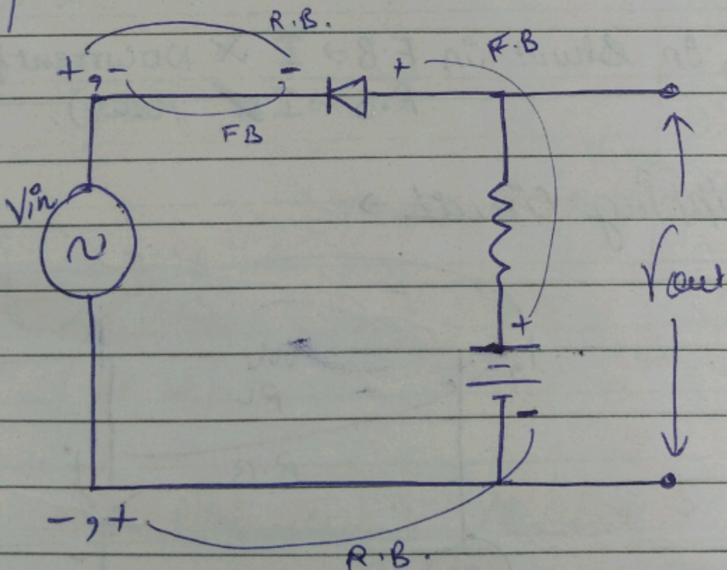
(i) <u>Series +ve. Clipp. Ckt with +ve Biasing</u> ~>

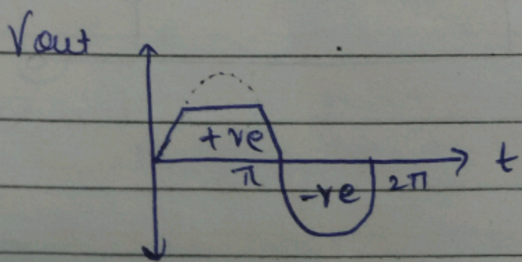


\# Case ~>

(i) $V_{in} < V_B$ - I flow

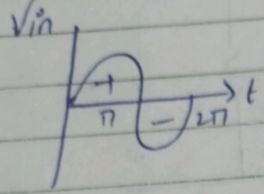
(ii) $V_{in} > V_B$ - I X

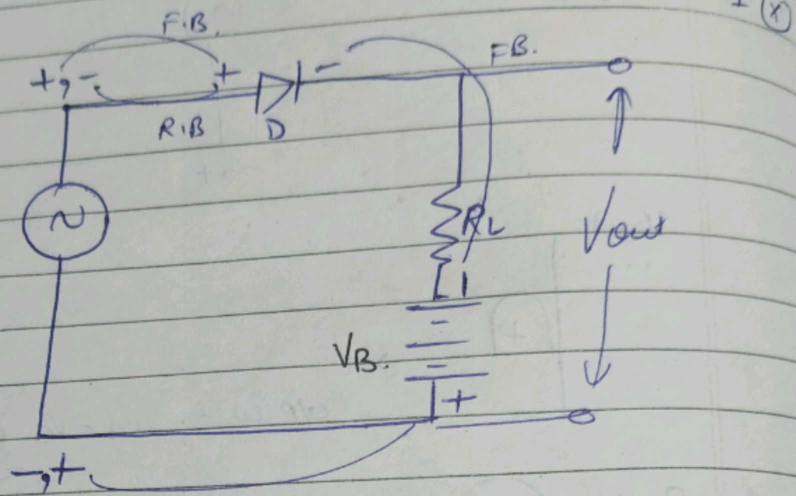


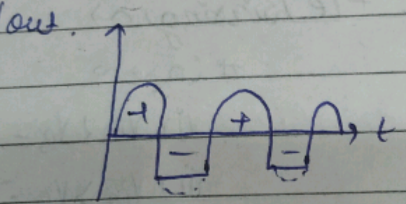


(ii) Series -ve clipping with -ve bias →

\# Case →
(i) $V_B > V_{in}$ = I ✓
(ii) $V_B < V_{in}$ = I ✗

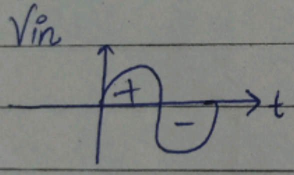




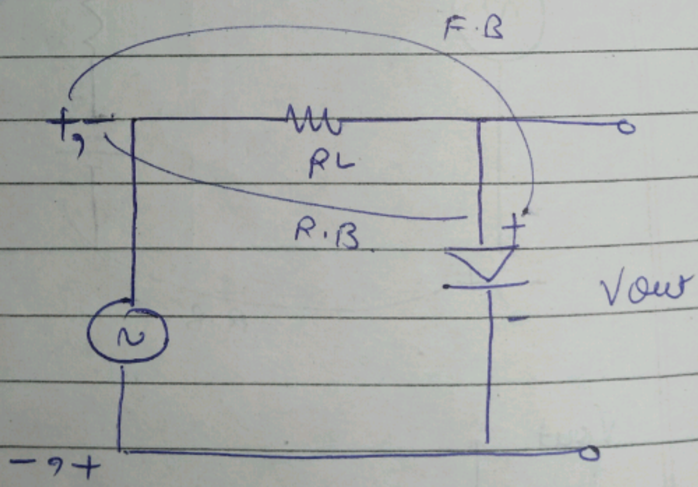


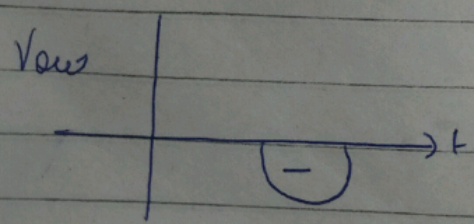
★ **Shunt** → {In shunt in F.B → I ✗ (No current flow) ; R.B → I ✓ (flow).}

(i) Shunt +ve clipping circuit →



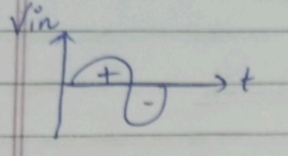
inp. w.f



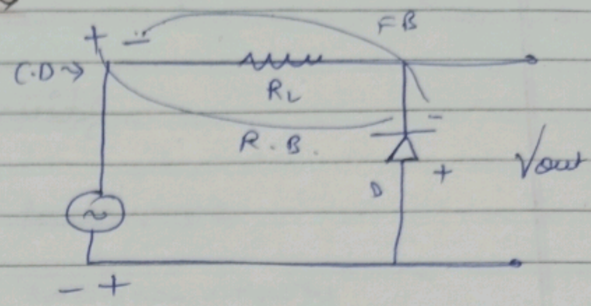


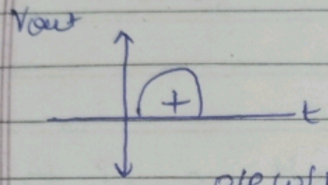
O/P w.f.

(ii) Shunt -ve Clipping cut →



I/P w.f

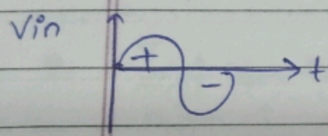




O/P w/F.

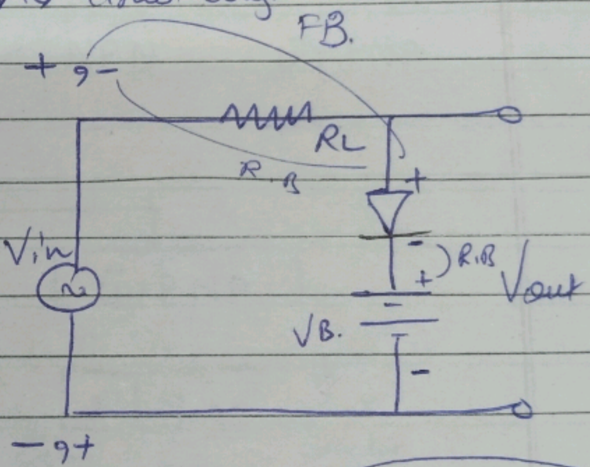
VB > Vin - R.B I ✓
VB < Vin - F.B I ✗

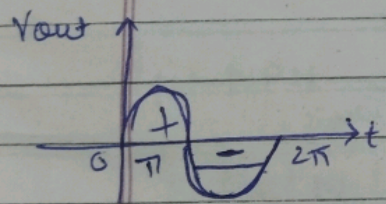
(a) Shunt +ve clipping with +ve biasing →



I/P w.f

C.D → Circuit diag. →

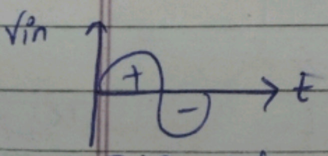




O/P w.f

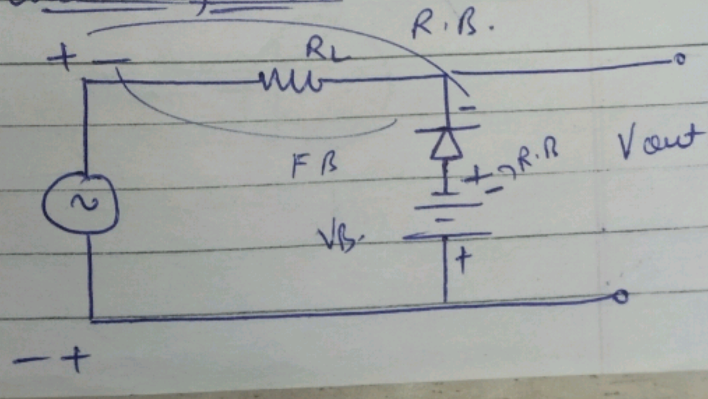
Vin < VB - I ✓
Vin > VB - I ✗

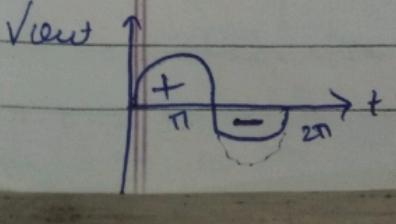
(b) Shunt -ve clipp. with -ve bias →



I/P w.f

Circuit Diag - (CD) →





O/P