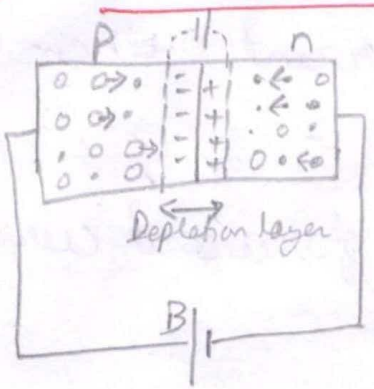
Biasing of P-N Junction

(i) Forward biasing



+ive terminal of ext. battary (B) is connected to p-side & -ive to n side of P-n Junction.

- applied voltage V of B mostly drops across depletion region as its resistance is very high (∵ No free charge carrier).
- Forward voltage oppose potential barrier V_B ∴ height of pot. barrier is reduced & width of depletion layer decreased.

effective height = $V_B - V$

- Forward current – due to migration of Majority carriers across P-n Junction.

(ii) Reverse biasing

-ive terminal of ext. Battery (B) is connected to p & +ive to n-side.

- applied voltage (V), drop across depletion region & its direction of voltage is same as that of potential barrier. ∴ barrier height inc. & width of depletion region inc.

effective barrier height $(V_B + V)$

Reverse current – As no motion of majority carriers So by minority charge carriers.

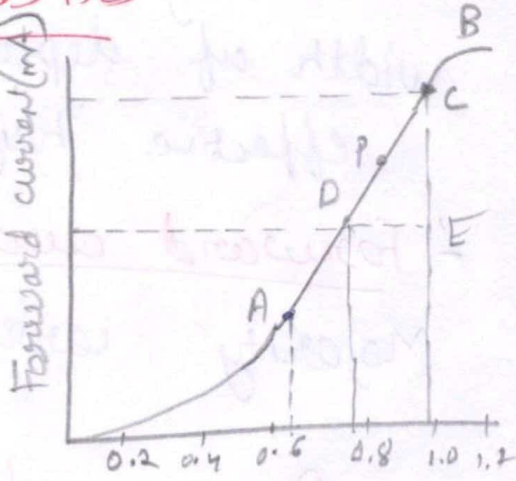
* Resistance of p-n Junction is low to flow of current when forward biased.
* High to flow of current when Reverse biased.

* → Pot. barrier oppose the forward current & support reverse current.

⇒ Characteristic of P-N Junction Diode.

(i) Forward characteristics

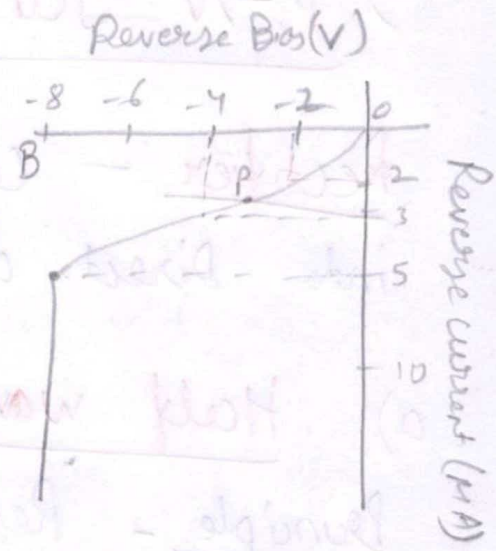
Knee voltage: it is forward voltage beyond which the current through Junction starts increasing rapidly with voltage — linear variation.



But below knee voltage — Non-linear variation.

Dynamic resistance $\Delta R = \frac{DE}{CE}$

(ii) Reverse characteristics



From graph:
Reverse current is very small & is voltage independent upto certain reverse bias voltage know as **Breakdown voltage**

If reverse bias voltage is = OB (breakdown voltage) the reverse current will increase abruptly.

Dynamic Resistance — Ratio of small change in voltage ΔV applied across p-n Junct to small change in junction current ΔI.

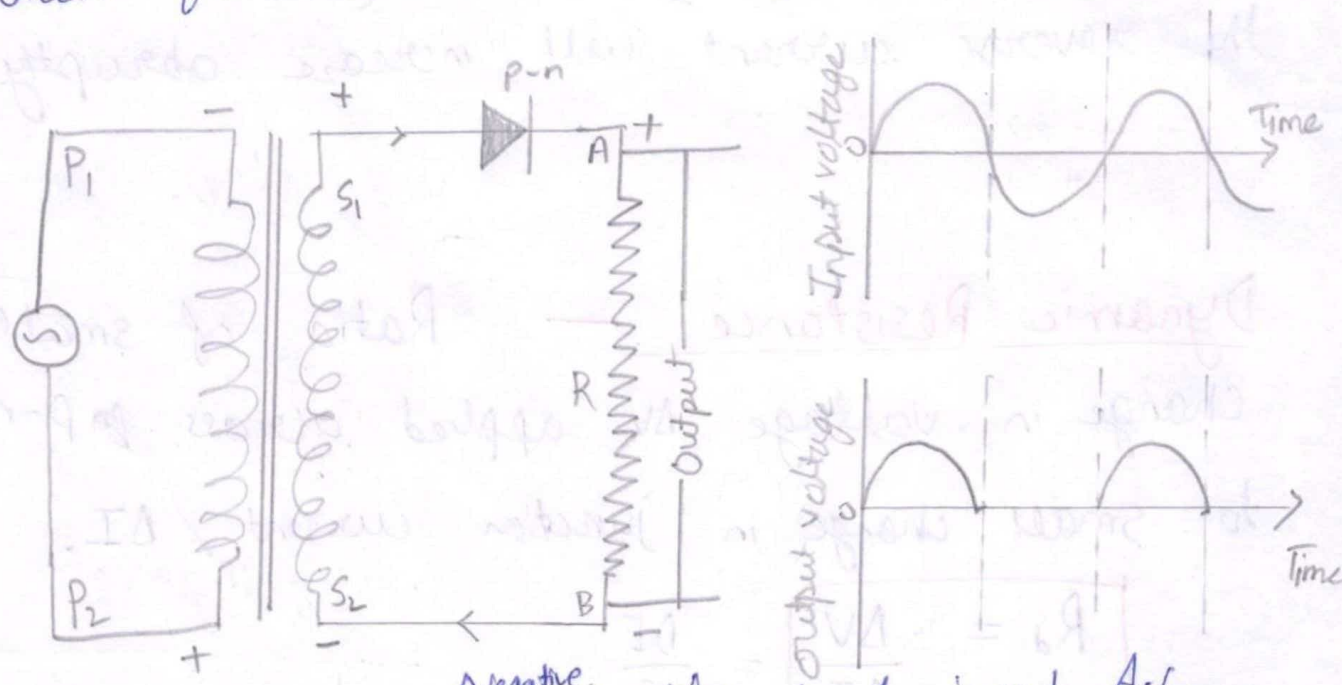
$$R_d = \frac{\Delta V}{\Delta I} = \frac{DE}{CE}$$

→ P-N Junction Diode As a Rectifier

Rectifier – Convert Alt. current/voltage into Direct current/voltage.

a) Half wave Rectifier

Principle – Resistance of p-n Junction become low when forward biased & high when reverse biased.



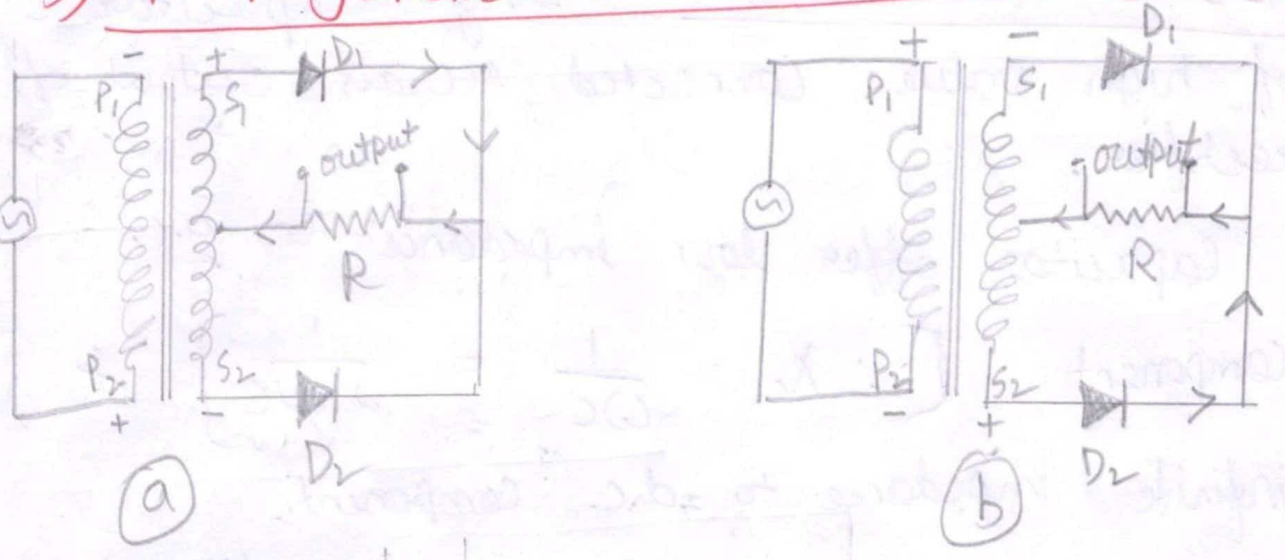
- **Working During Negative half cycle of input A.C.**

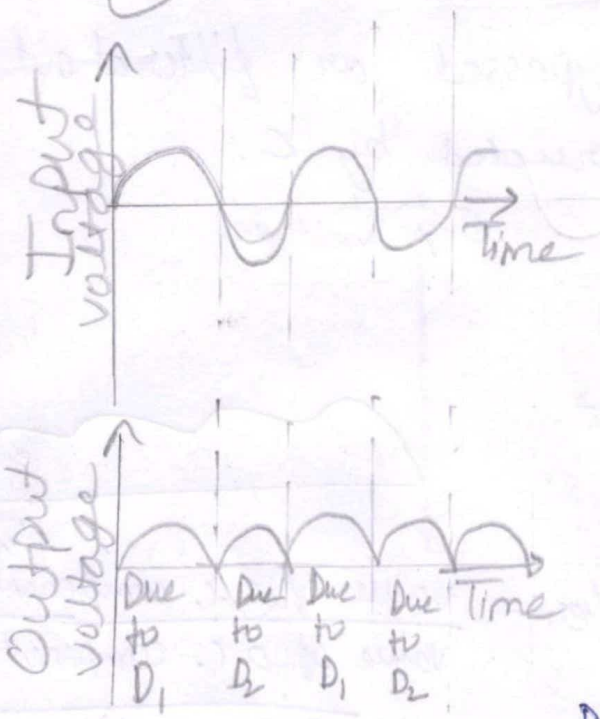
let P_1 be +ive & P_2 be –ive so due to induction S_1 become –ive & S_2 +ive. i.e. P-n Junction is reverse biased. So High resistance → No current → No output.

→ **Working During +ive half cycle of input A.C.**

P_1 be –ive & P_2 +ive. So by induction S_1 become +ive & S_2 –ive. i.e. P-n Junction is forward biased So low resistance → curren flows → output across work load.

b) P-n junction diode as Full wave rectifier





During positive half cycle of input A.C., D_1 is forward biased & D_2 is reverse biased.

So forward current flows on account of majority carries of junction Diode D_1.

During Negative half cycle, D_2 is forward & D_1 is reversedbia

So forward current flows due to D_2.

* In both halves, current throug & flows in same direction

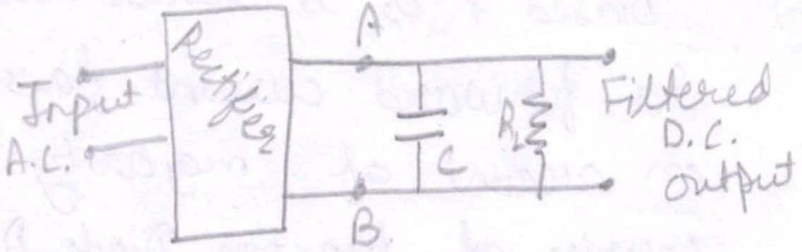
However the output signal voltage is having ripple content. i.e, d.c. compenent & A.C. compenent

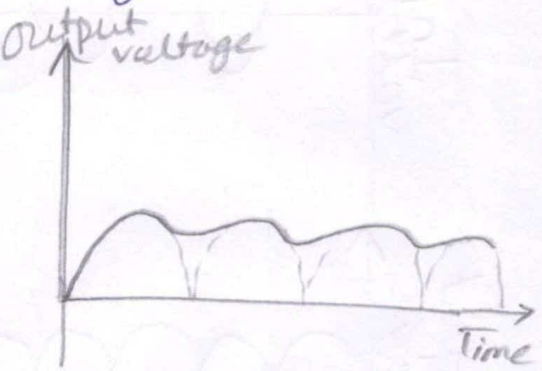
It can be made d.c. by Filtering with a Filter circuit.

Filter circuit — Single capacitor C of high value connected across output of rectifier.

Capacitor offer low impedance to a.c. component $\left[\because X_c = \frac{1}{\omega C} = \frac{1}{2\pi \nu C}\right]$ & infinite impedance to d.c. component.

∴ A.C. component is bypassed or filtered out
D.C. component obstructed by C.





Ripple factor of rectifier = $\frac{\text{value of a.c. component}}{\text{value of d.c. component}}$

$= \frac{I_{a.c}}{I_{d.c.}} = \frac{E_{a.c.}}{E_{d.c.}} = \sqrt{\left(\frac{I_{r.m.s.}}{I_{d.c.}}\right)^2 - 1}$

Efficiency of rectifier, $\eta = \frac{\text{output d.c power} \times 100}{\text{input A.C. Power.}}$

η for half wave rectifier = 40.6% → so of very little use.
η " full " " = 81.2%.