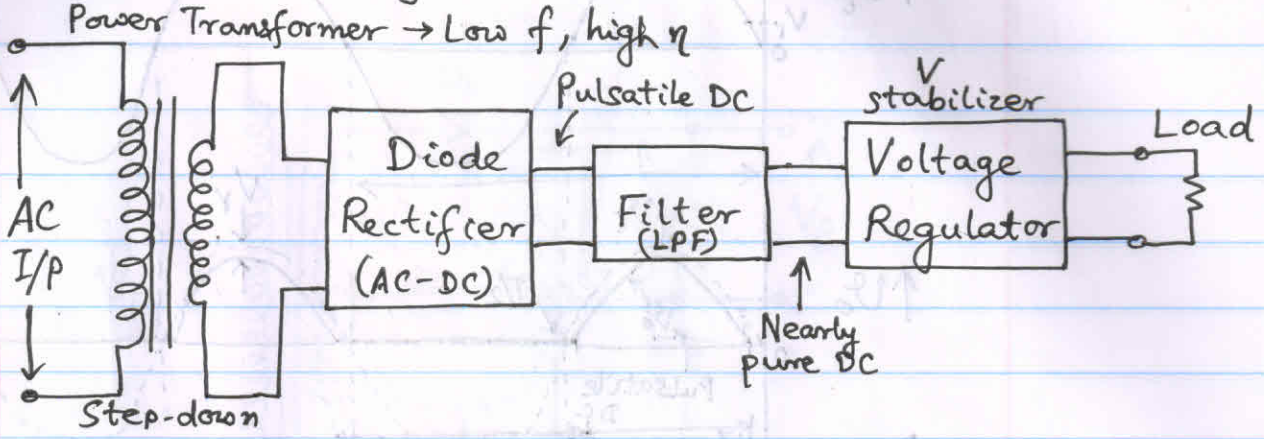
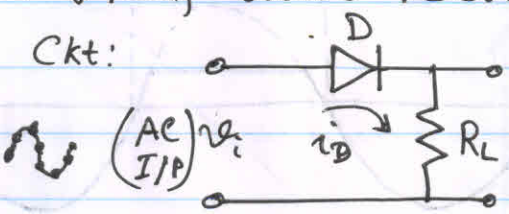
Diode Circuits

1. Power Supply architecture (DC Linear)



2. Half-wave rectifier:



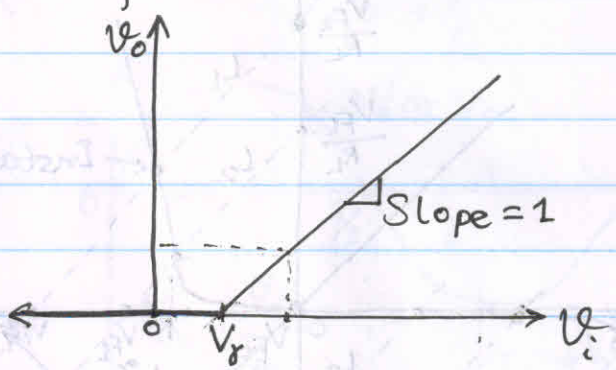
V-drop across D: v_D

$$i_D = \frac{v_i - V_\gamma}{R_L}$$

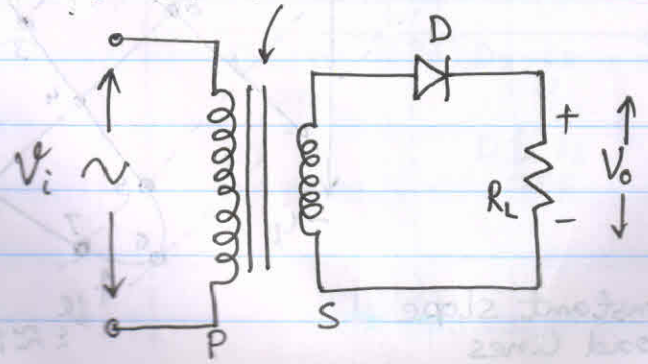
$$v_o = v_i - V_\gamma = i_D \cdot R_L$$

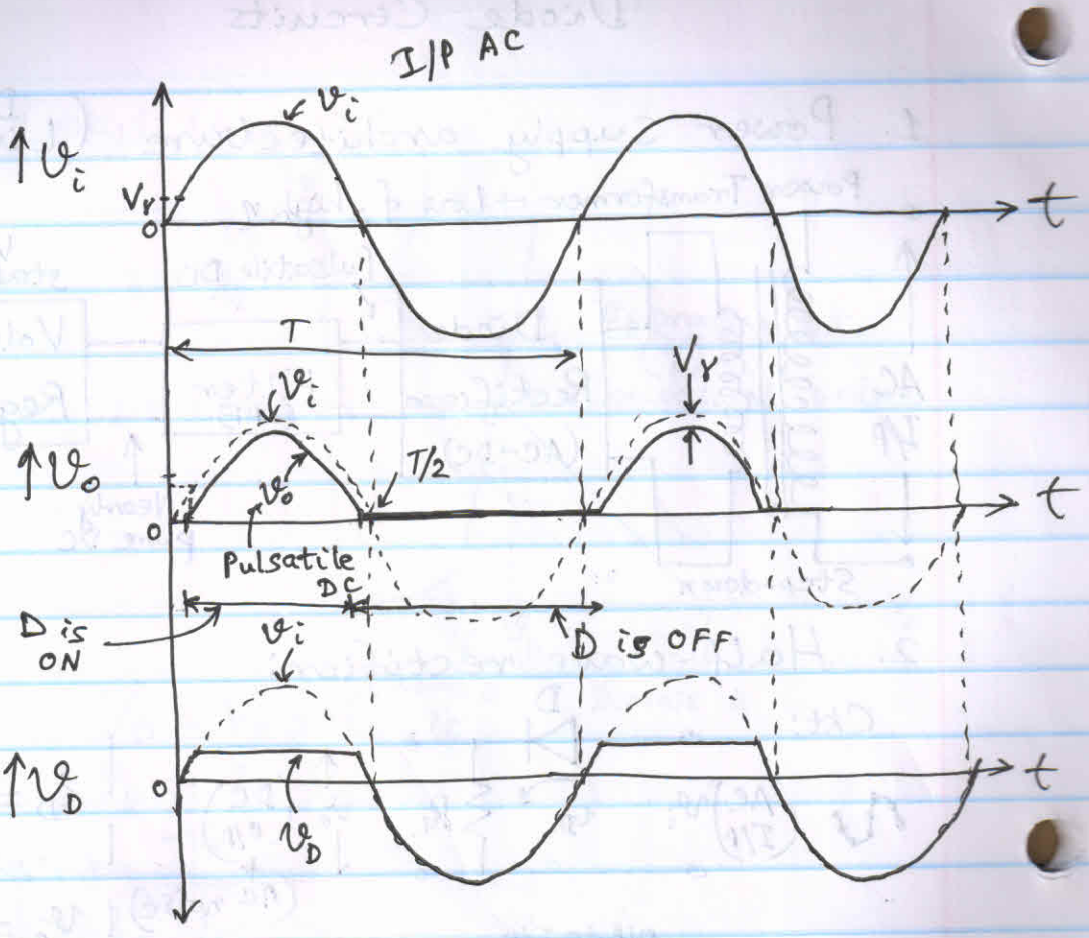
O/P to I/P →

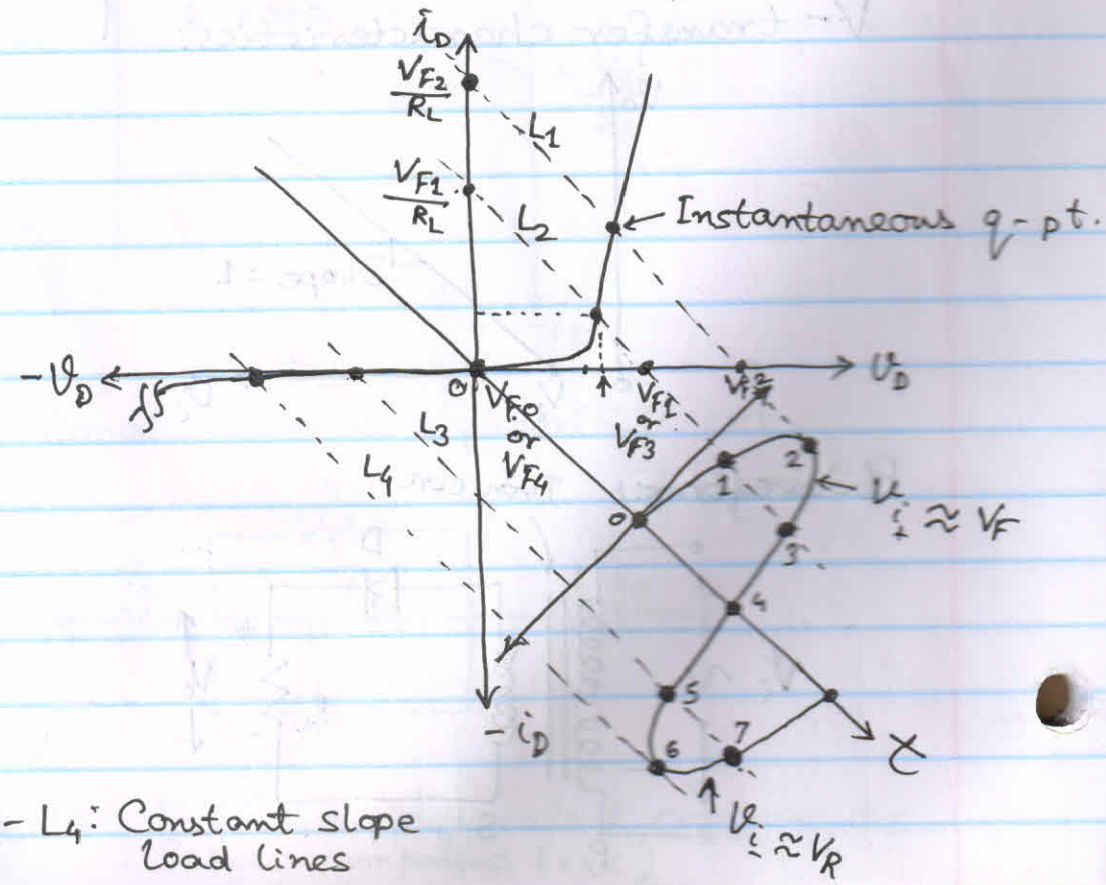
V- transfer characteristics:



Practical ckt: Iron core

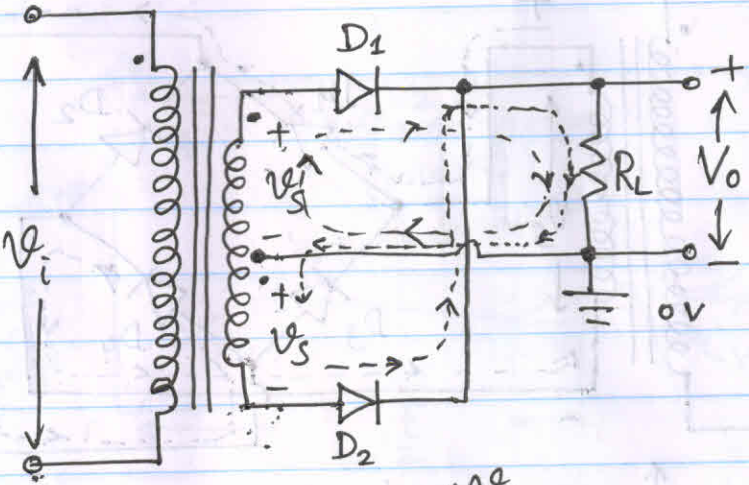


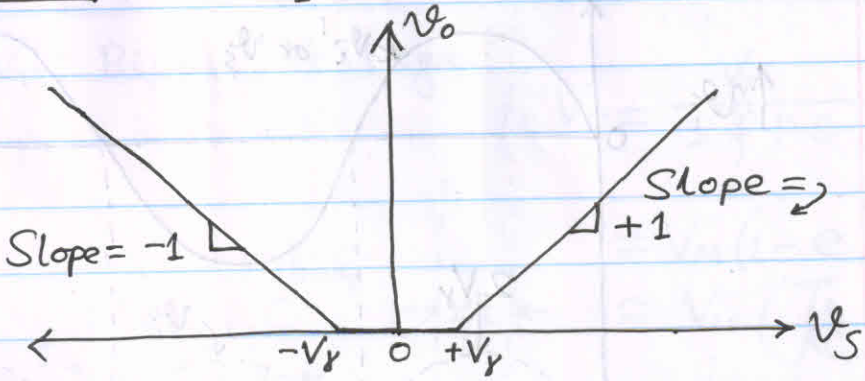


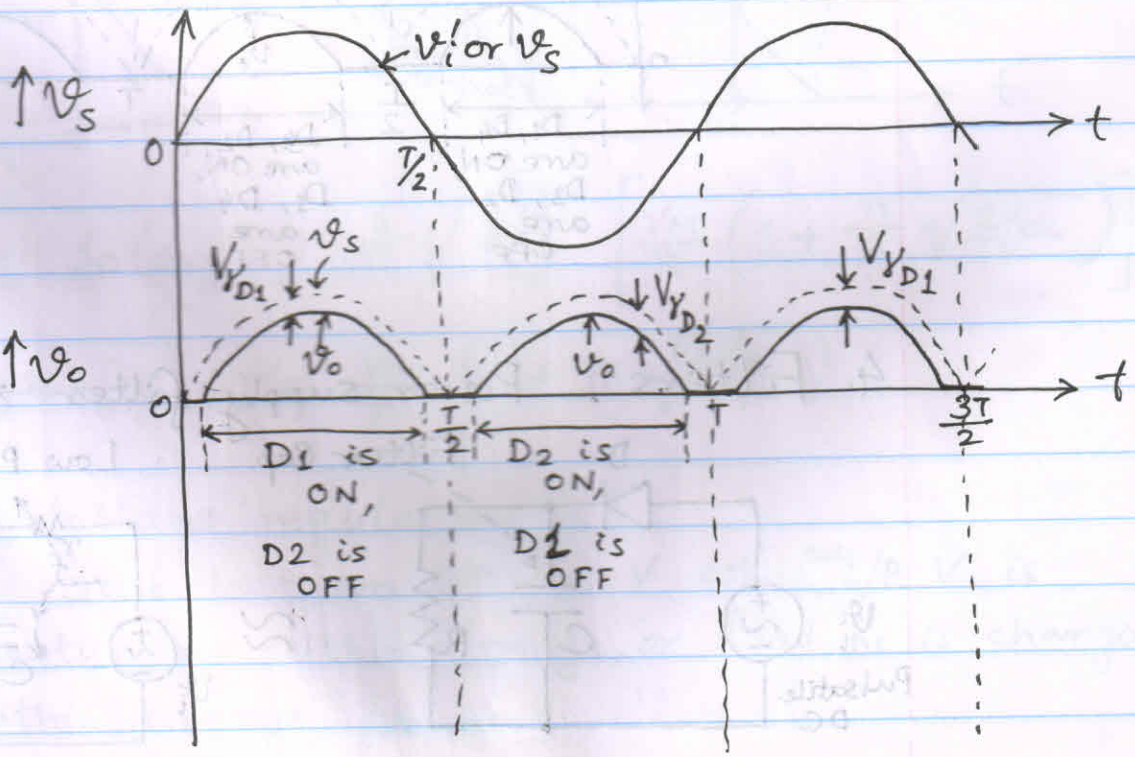


$L_1 - L_4$: Constant slope load lines

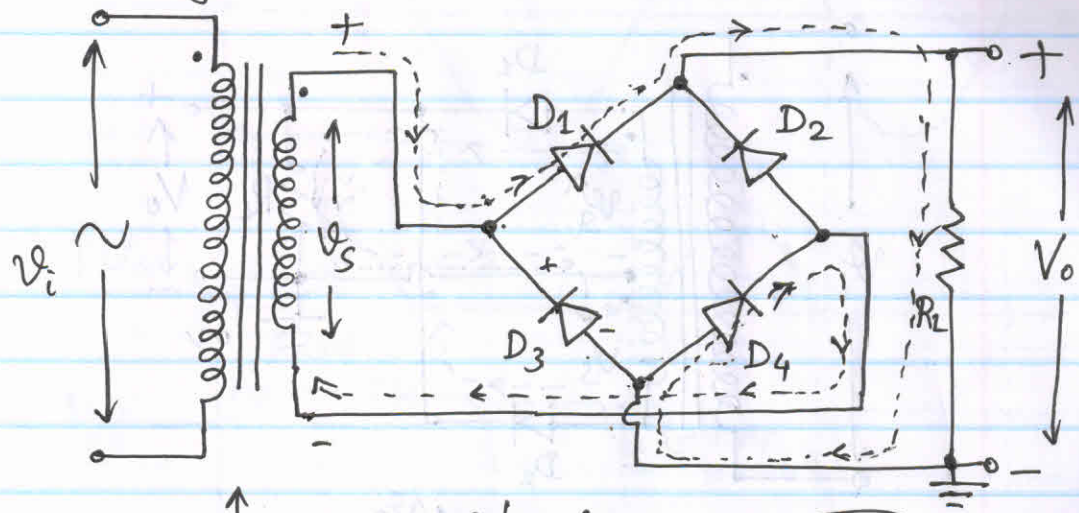
2. Full-wave rectifier:

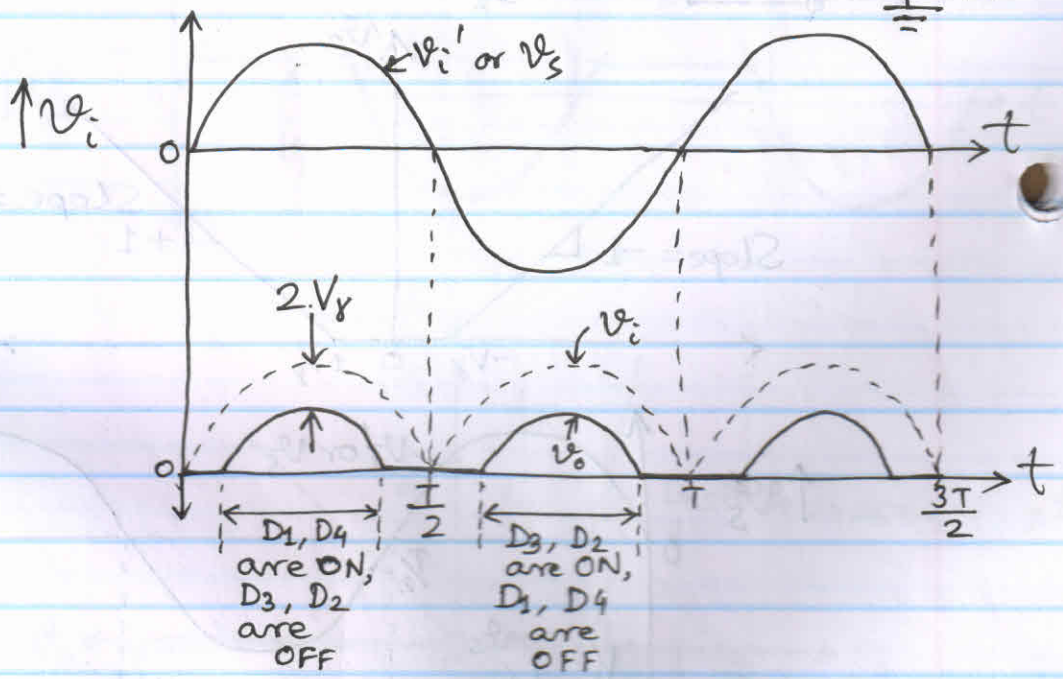




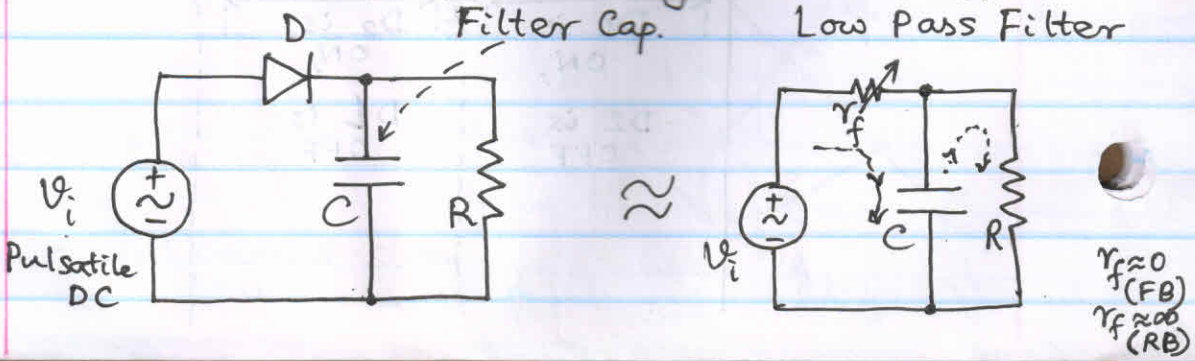


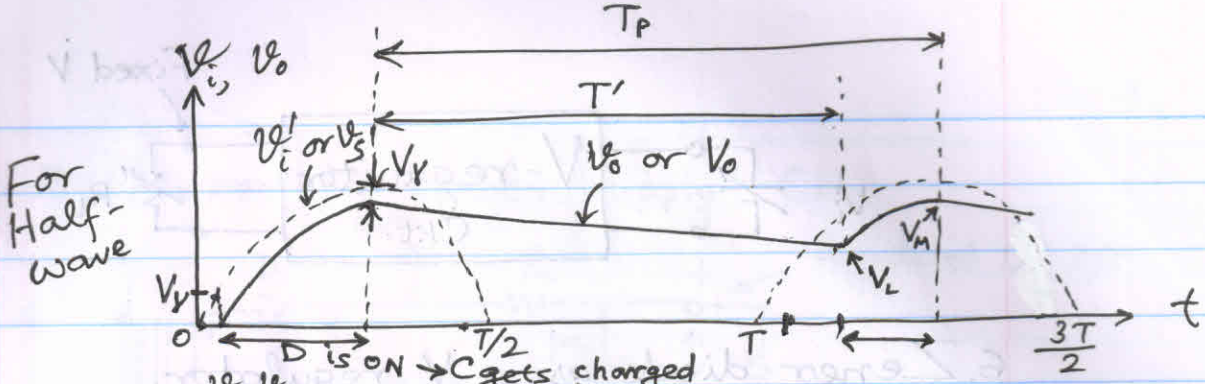
3. Bridge Rectifier:

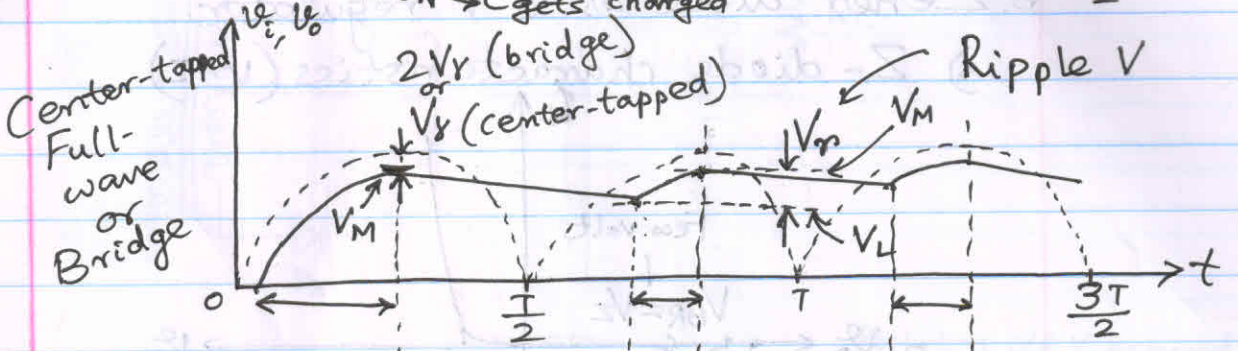




4. Filters: Power supply filter → LPF or Low Pass Filter





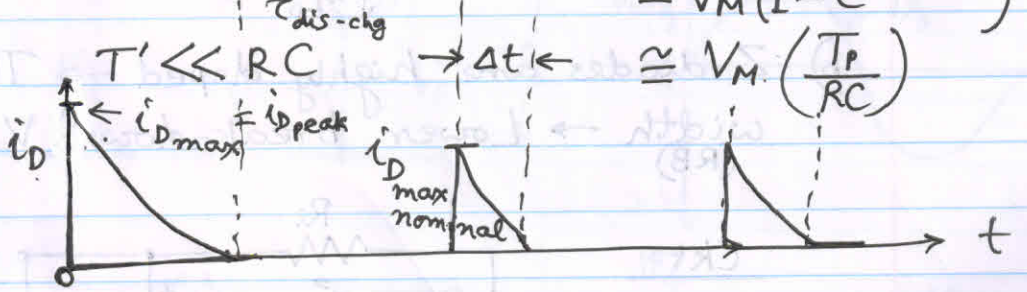


V_r : Ripple Voltage

$$V_r = \frac{V_M}{2fRC} = V_M - V_L$$

$$= V_M\left(1 - e^{-\frac{T'}{RC}}\right)$$

$$\cong V_M\left(\frac{T_P}{RC}\right)$$

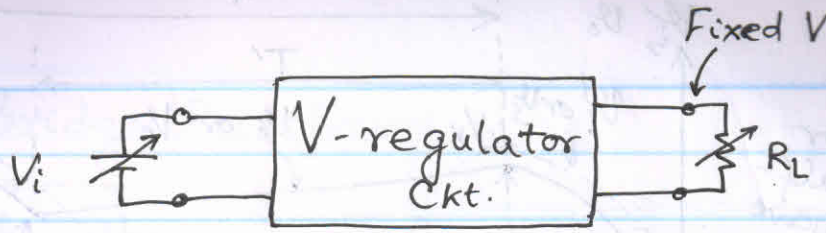


$$i_D(avg.) = \frac{1}{\pi}\sqrt{\frac{2.V_r}{V_M}} \cdot \left[\frac{V_M}{R}\cdot\left(1 + \frac{\pi}{2}\sqrt{\frac{2V_M}{V_r}}\right)\right]$$

$$i_{D_{max}} \cong i_D(peak) = \frac{V_M}{R}\cdot\left(1 + \pi.\sqrt{\frac{2.V_M}{V_r}}\right)$$

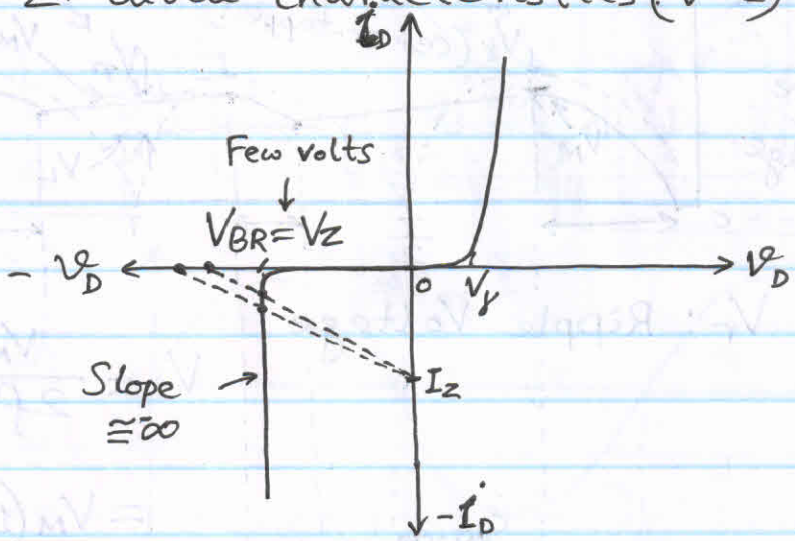
5. Voltage regulator:

Stabilizes an O/P DC V while an I/P V is fluctuating within a range, or load R_L is changing within a range.



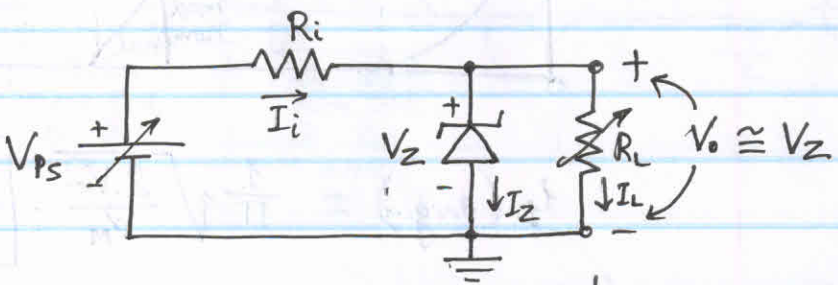
6. Zener diode as a V-regulator.

a) Z-diode characteristics (V-I)



b) Z-diodes are highly doped → Thinner junc^n width → Lower break-down V.
(RB)

Ckt.

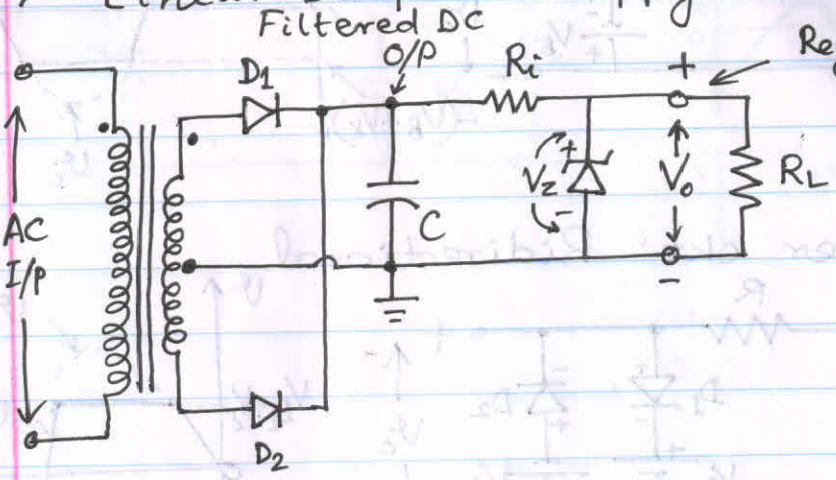


$$R_i = \frac{V_{PS} - V_Z}{I_i} = \frac{V_{PS} - V_Z}{I_L + I_Z} \quad \Big| \quad I_Z = \frac{V_{PS} - V_Z}{R_i} - I_L$$

$$R_i = \frac{V_{PS_{min}} - V_Z}{I_{Z_{min.}} + I_{L_{max}}} \cong \frac{V_{PS_{max}} - V_Z}{I_{Z_{max}} + I_{L_{min}}}$$

$$P_Z = V_Z \cdot I_Z \quad \Big| \quad I_{Z_{min}} = \frac{V_{PS_{min}} - V_Z}{R_i} - I_{L_{max.}}$$

7. Linear DC power supply: Ckt.



8. Clipper & Clampers (Voltage limiter ckts.)

Restricts O/P V beyond a limit

a) Clipper ckt: Uni-directional: