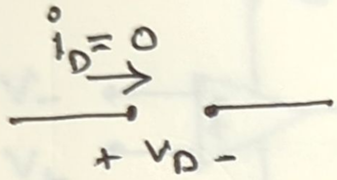
Tue Aug 5 11:42 PM

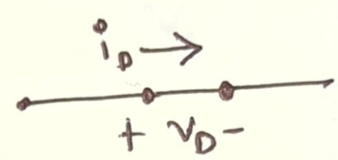
Rectifiers

Diode Models:

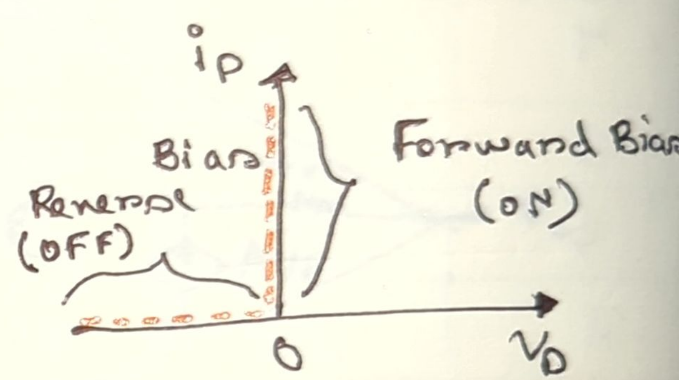
Ideal



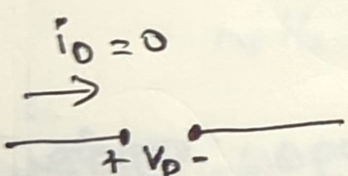
$(V_D < 0, \; i = 0)$



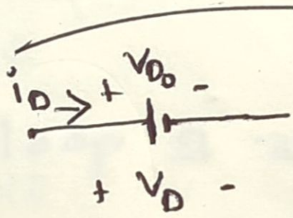
$(i_D > 0, \; V_D = 0)$



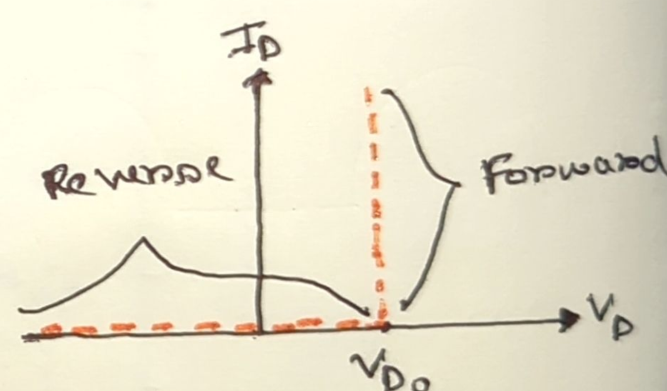
CVD



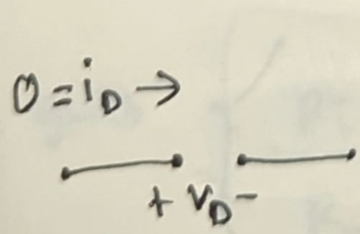
$(V_D < V_{D0}, \; i_D = 0)$



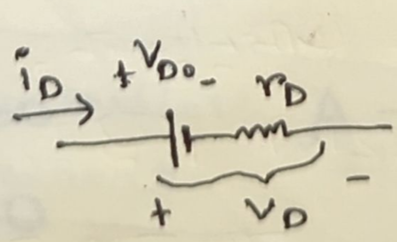
$(i_D > 0, \; V_D = V_{D0})$



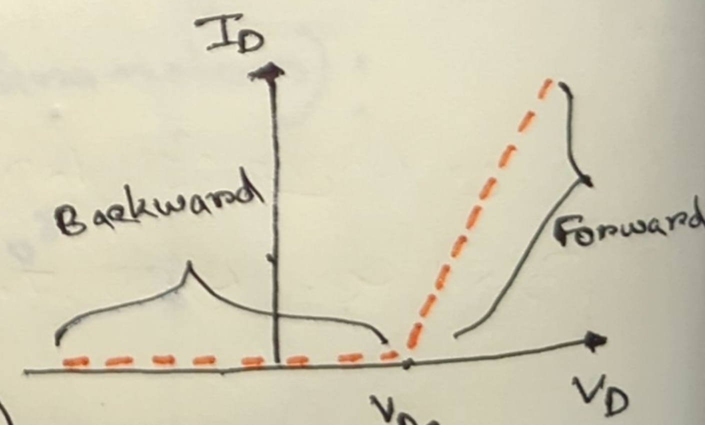
CVD + R



$(V_D < V_{D0}, \; i_D = 0)$



$(i_D > 0, \; V_D = V_{D0} + i_D r_D)$

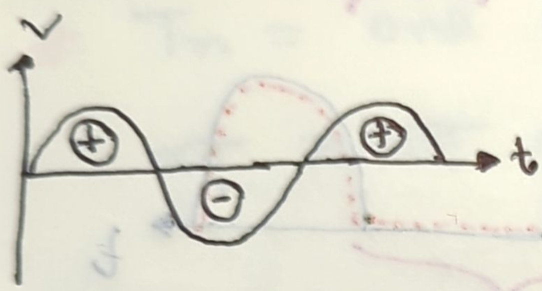


Rectifier এর কাজ কি?

= AC signal কে DC তে পরিণত করা।

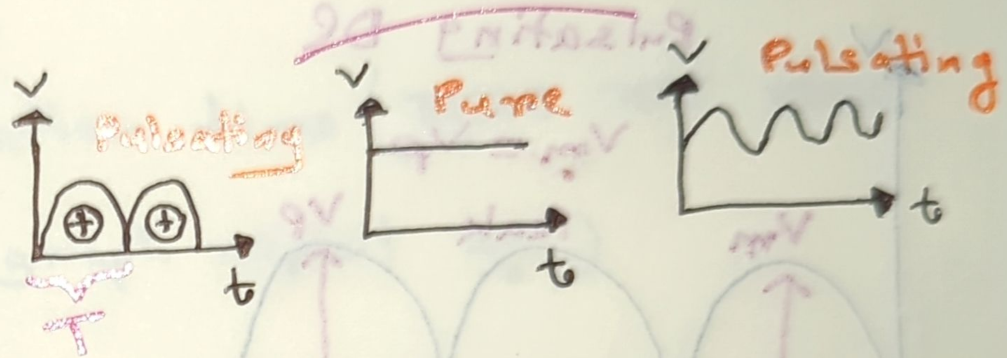
AC signal আর DC signal কি?

AC signal



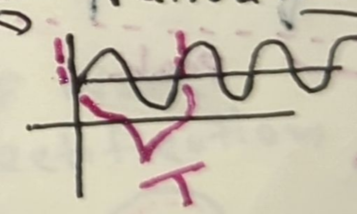
+ এবং - উভয় Polarity থাকবে।

DC signal

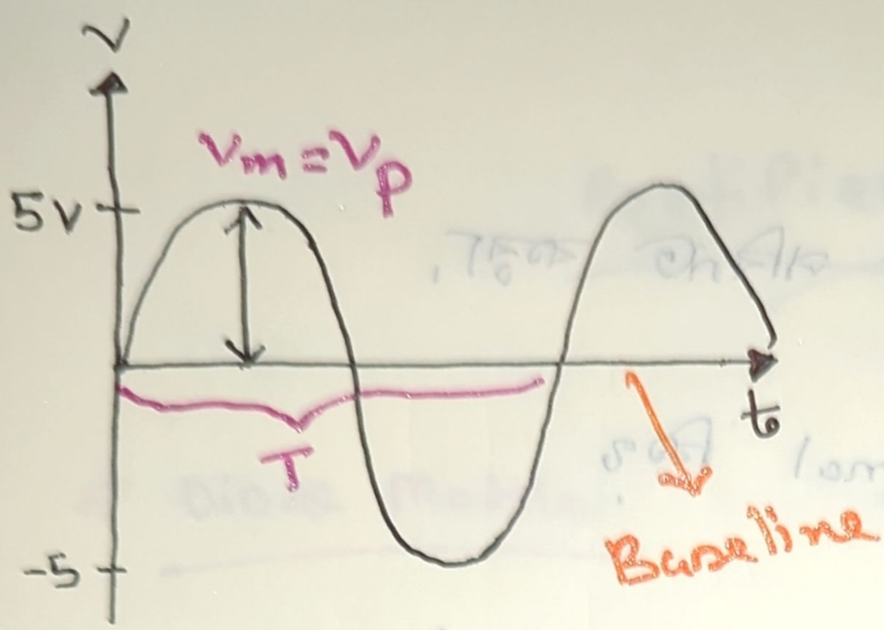


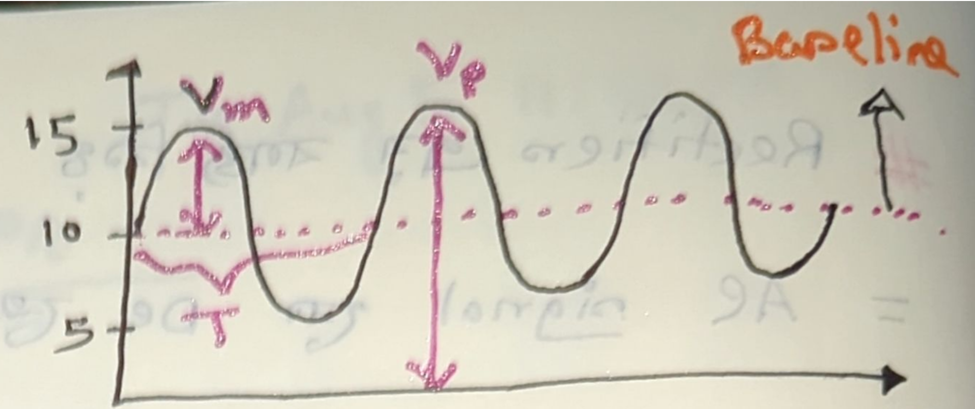
শুধু একটা পোলারিটি থাকবে। আমরা আবার মত + নিয়েই কাজ করি।

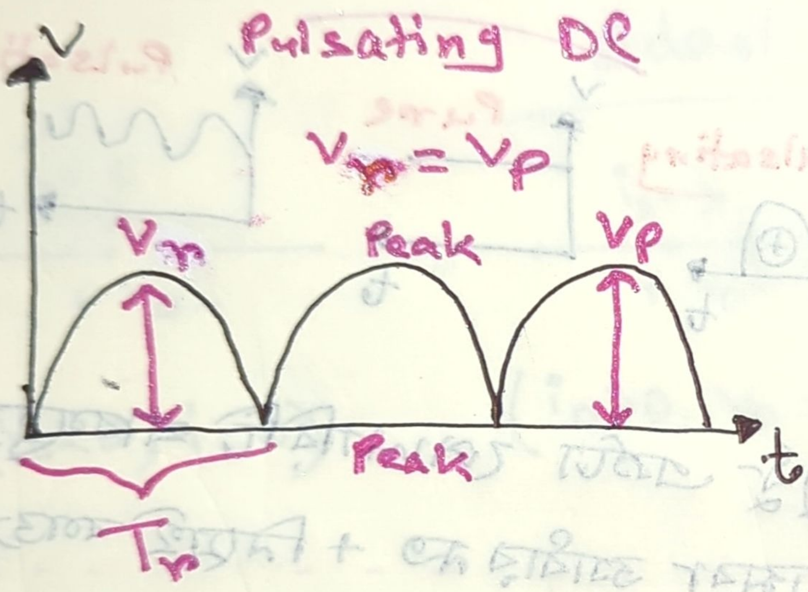
যেই DC signal এর Period থাকে তাকে Pulsating DC বলে।

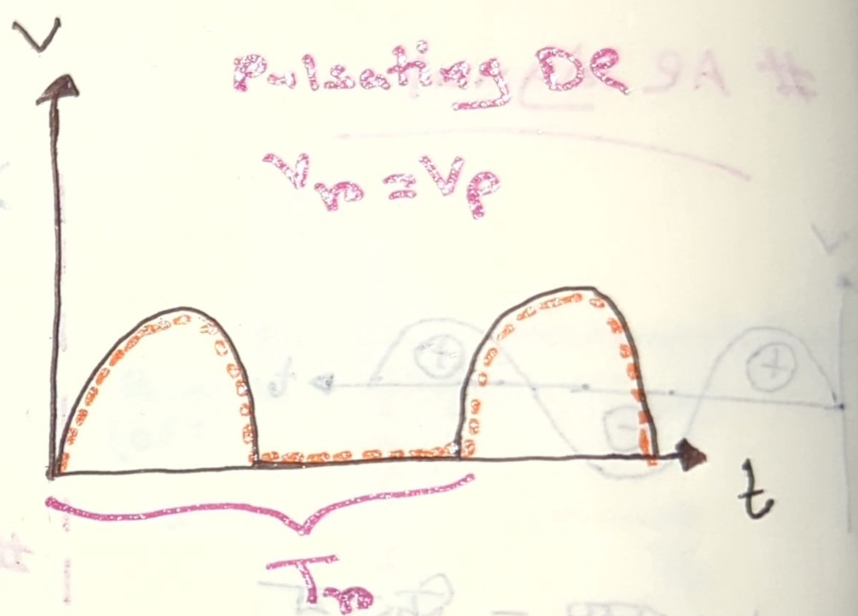


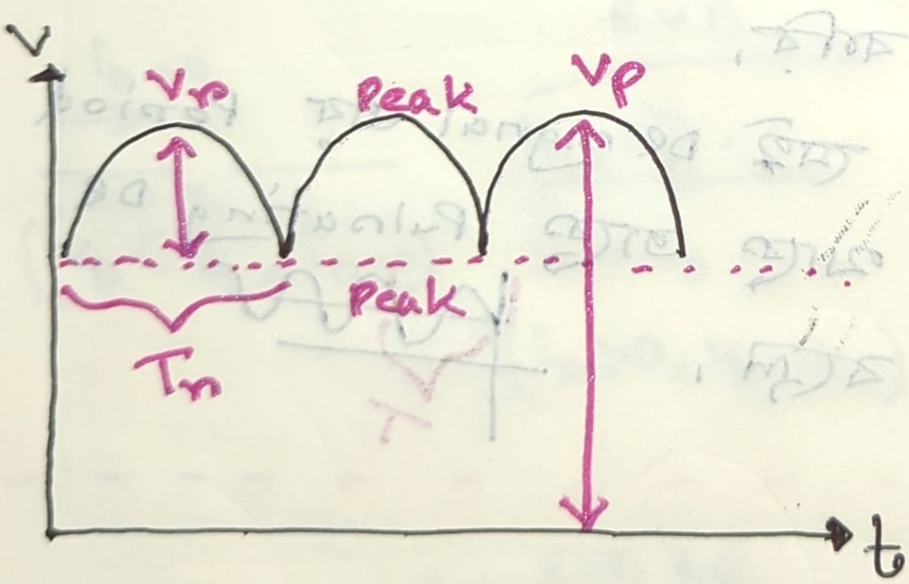
আমরা এখানে Phase(φ) ও V_{DC} (Offset) নিয়ে কাজ করব না।

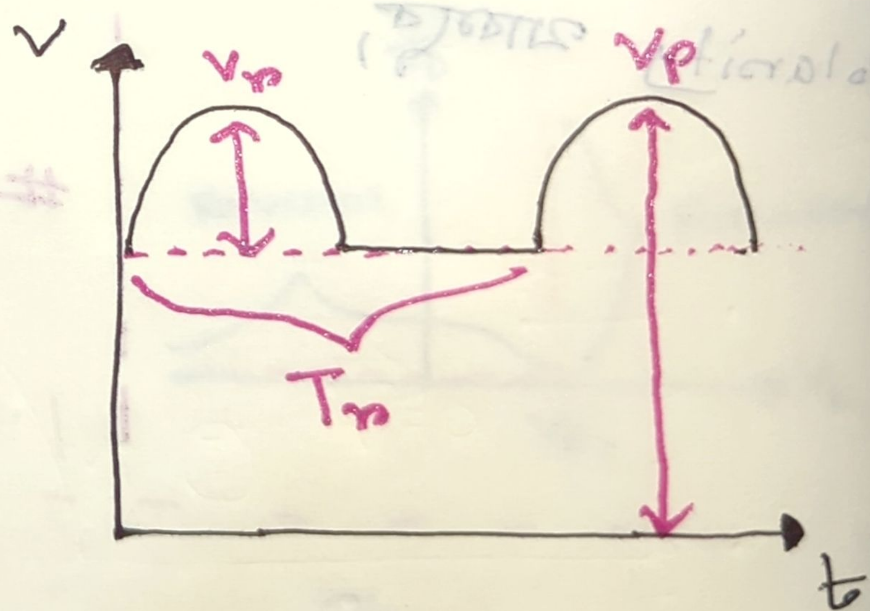












Baseline হয় শুধুমাত্র AC signal / DC signal by offseting AC এর ক্ষেত্রে। Pulsating এর ক্ষেত্রে উপর দিয়ে বের করা যায় না।

$$\boxed{\text{Baseline} = \frac{\max + \min}{2}}$$

Pulsating DC

Have to be a periodic signal.

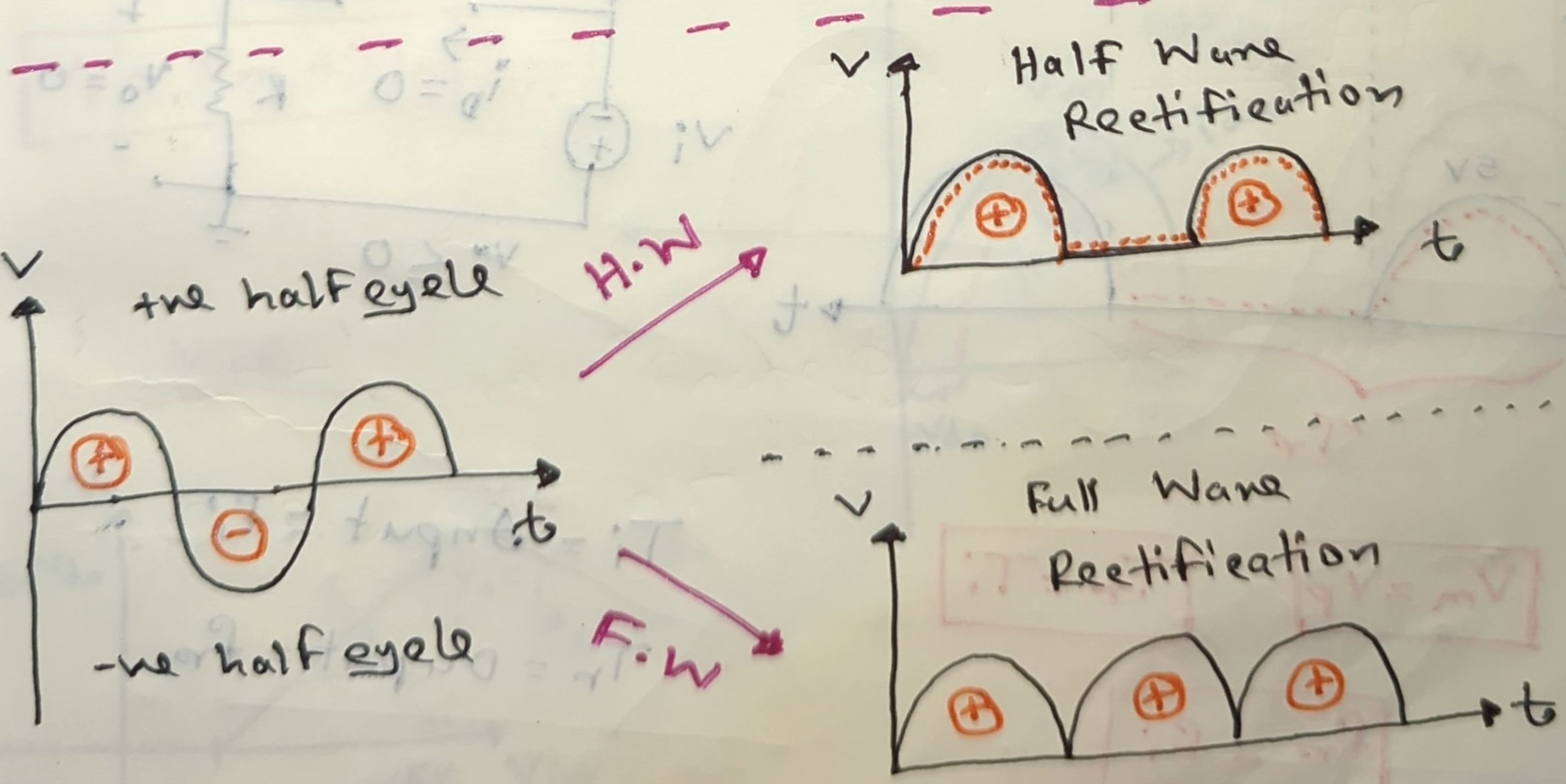
Here one oscillation called one ripple and denoted $\boxed{r}$.

T_r = one oscillation time (মূলত কত সময় পর আবার same graph repeat হয়)

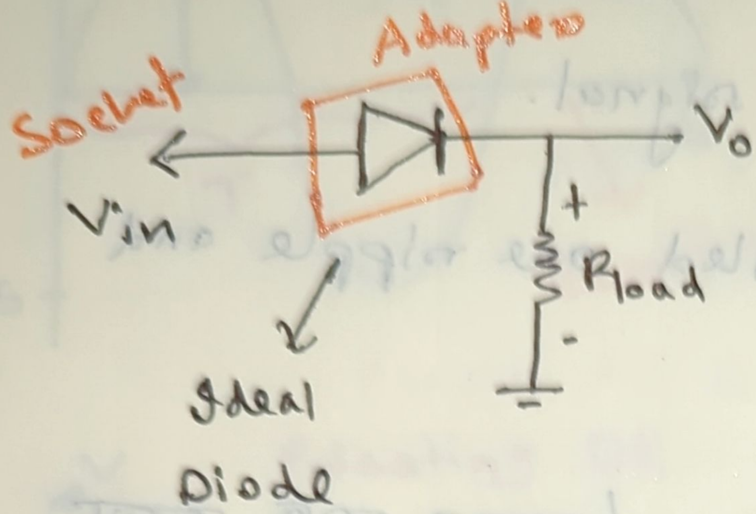
V_p = Value of the peak from zero.

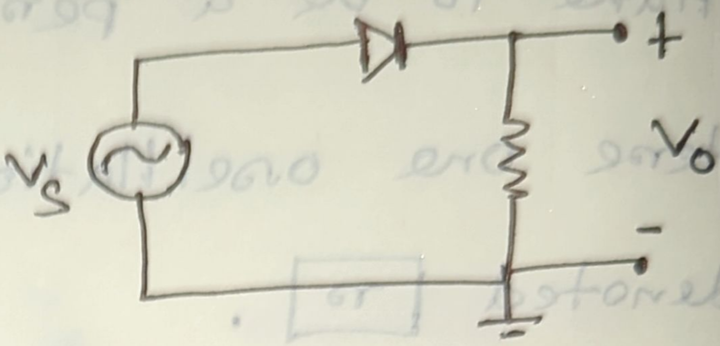
V_m = of the signal

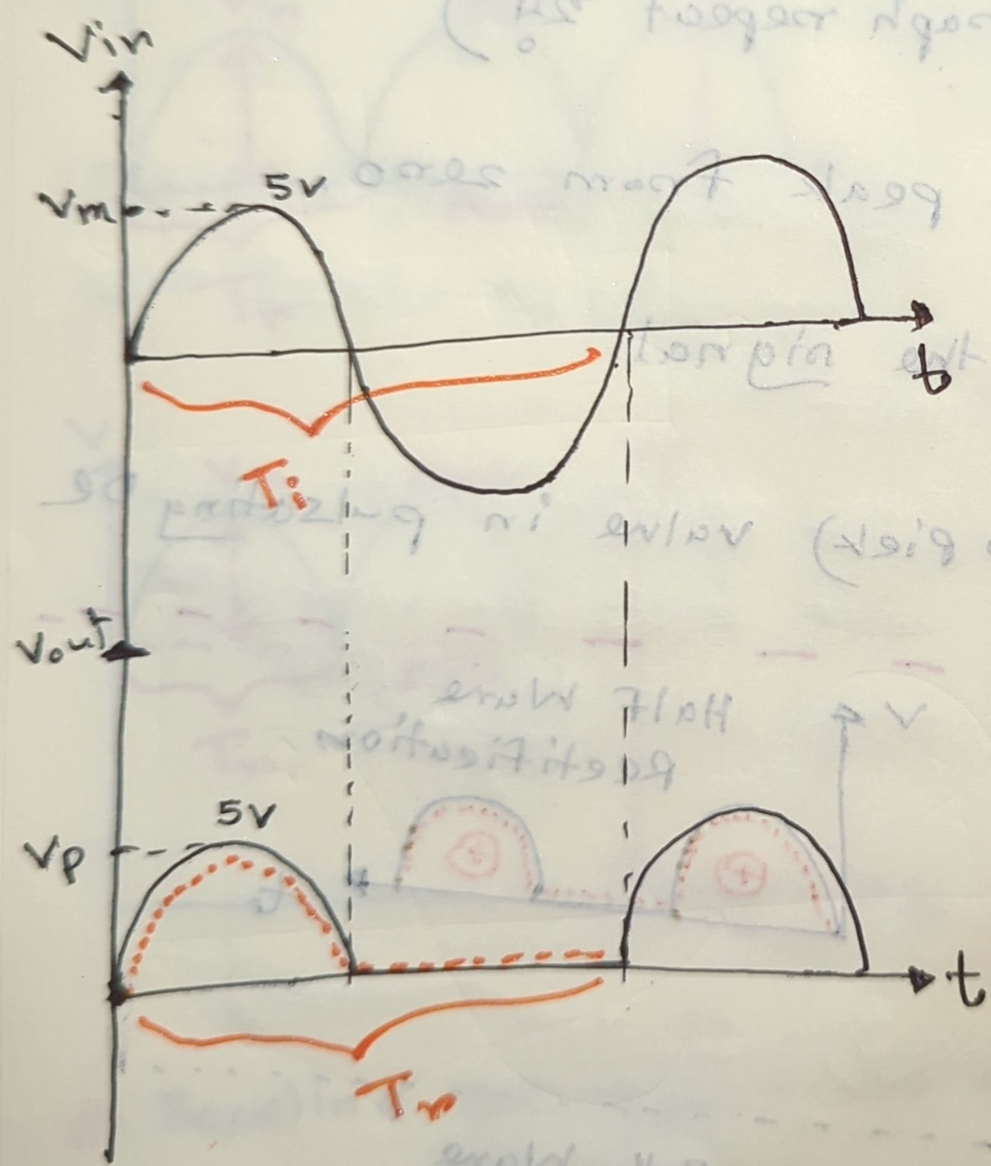
V_r = P2P (piek to piek) value in pulsating DC

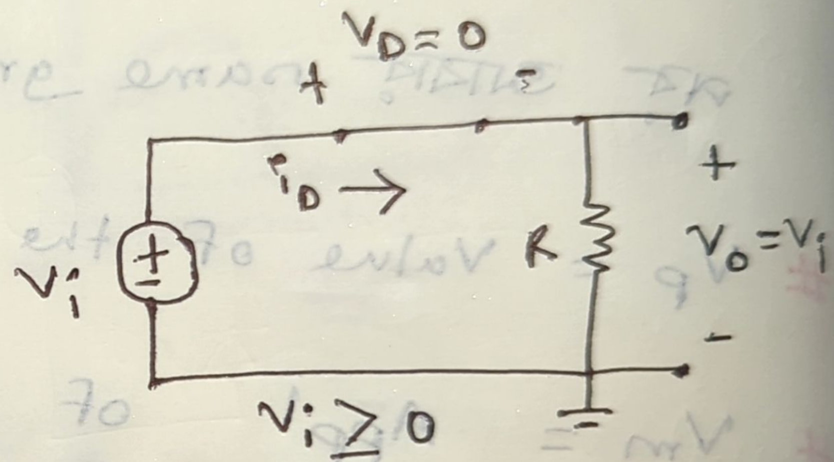


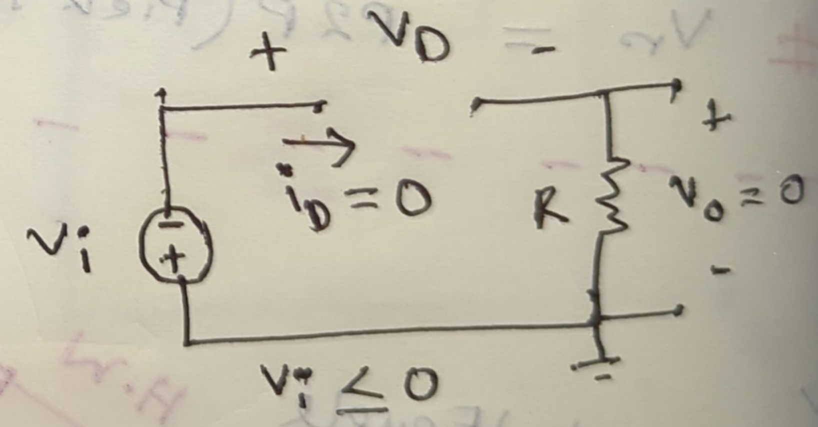
H.W











$\boxed{V_m = V_p}$ $\boxed{T_r = T_i}$

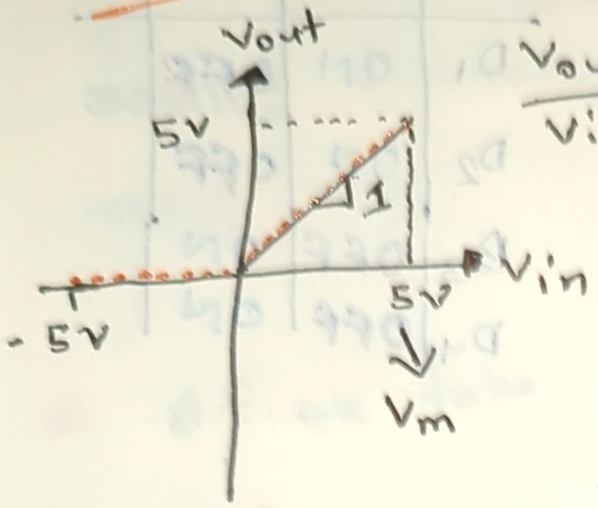
$\boxed{f_r = f_i}$

T_i = Input = f_i

T_r = Ouput = f_r

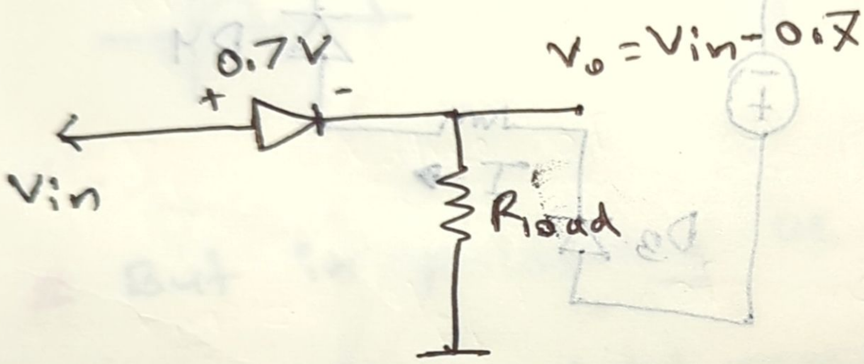
f → frequency

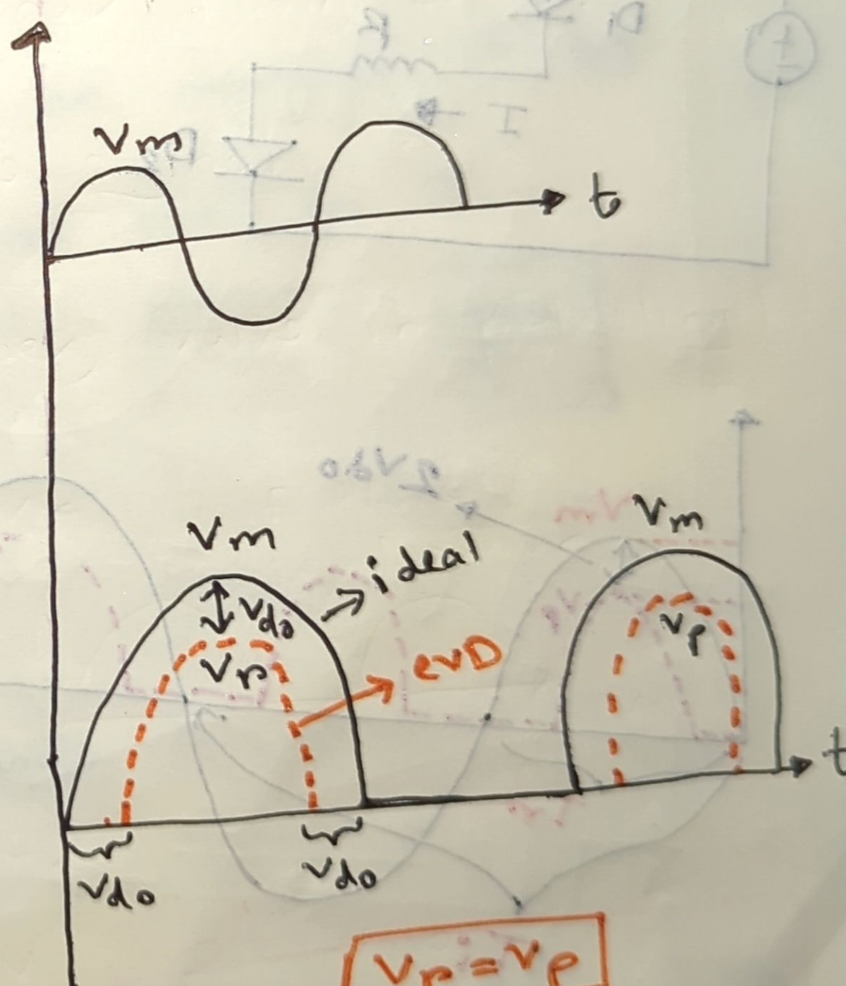
VTC graph



$$\frac{V_{out}}{V_{in}} = 1 \quad \boxed{V_{in} = V_{out}}$$

CVD





$$V_p = V_m - 0.7$$

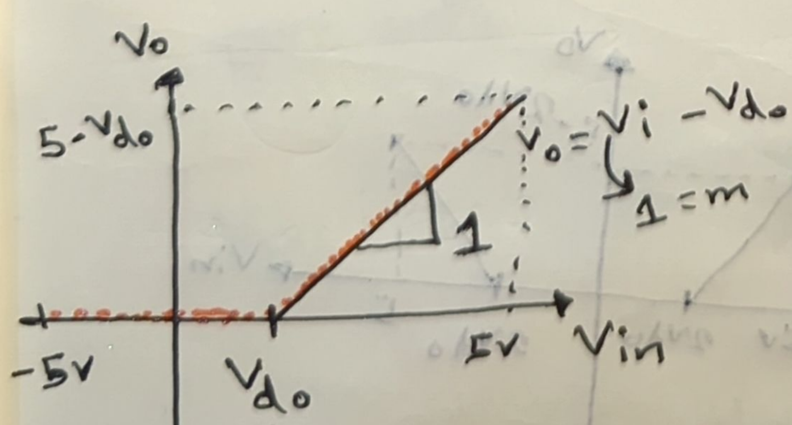
$$\boxed{V_p = V_m - V_{d_0}}$$

$$\boxed{V_r = V_p}$$

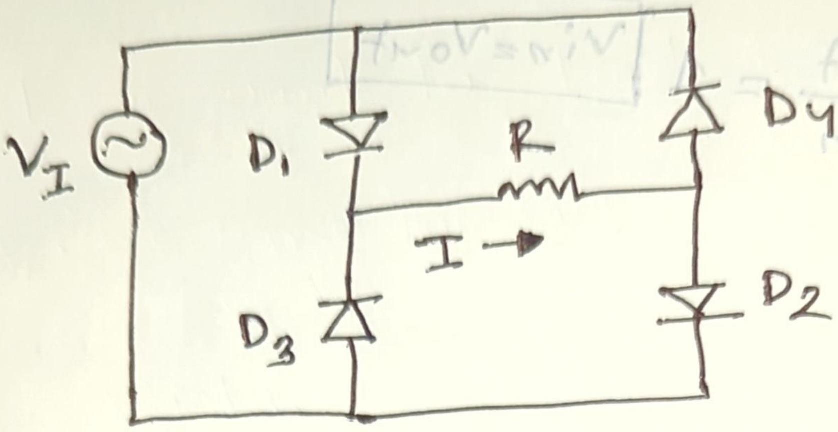
$$\boxed{T_r = T_i}$$

$$\boxed{f_r = f_i}$$

VTC

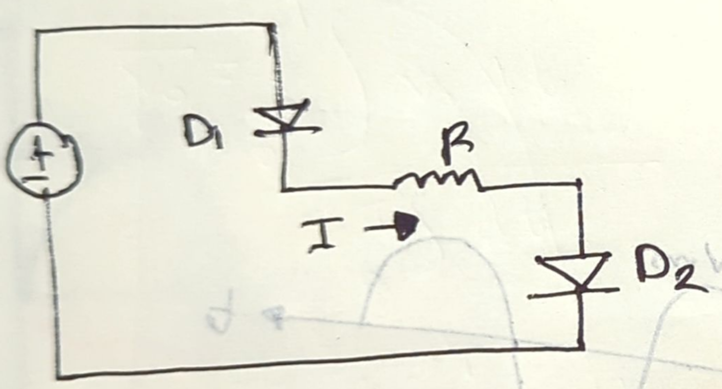


F.W

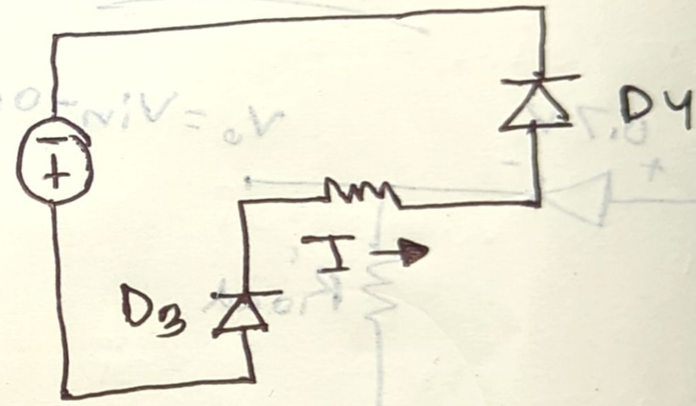


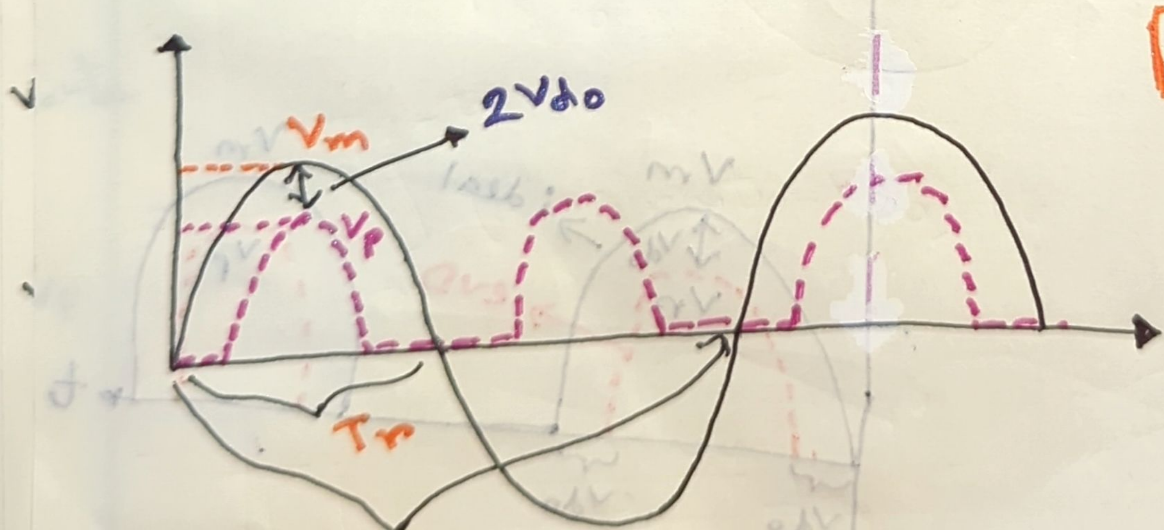
	+ve	-ve
D_1	ON	OFF
D_2	ON	OFF
D_3	OFF	ON
D_4	OFF	ON

V_I (⊕ half cycle)



V_I (⊖ half cycle)

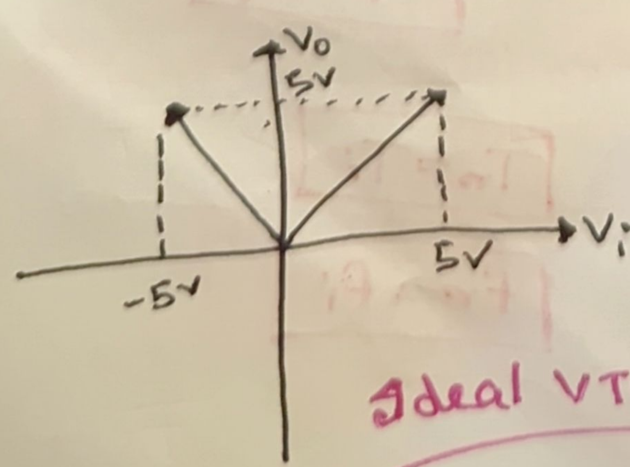




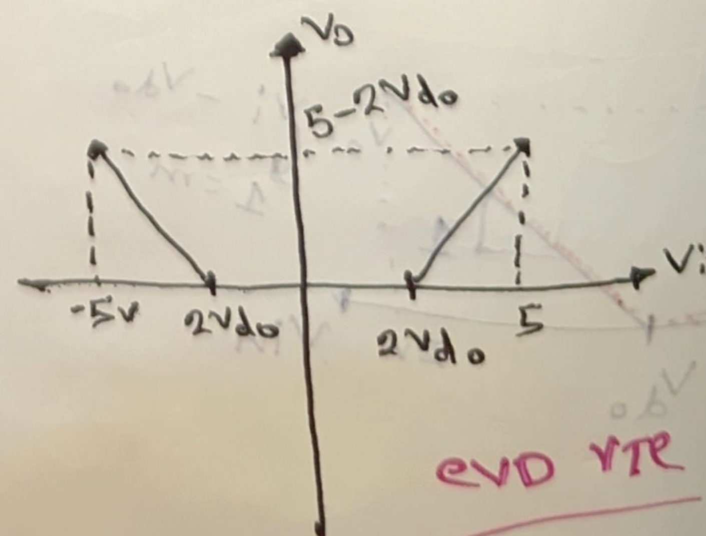
$\boxed{V_p = V_r}$

$\boxed{T_r = \frac{1}{2} T_i}$

$\boxed{f_r = 2 f_i}$



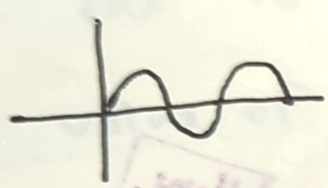
Ideal VTC



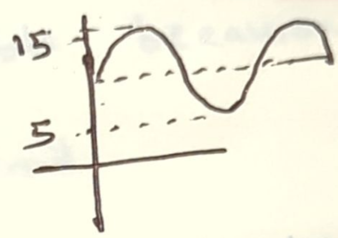
CVD VTC

এখন আমরা $\boxed{V_{dc} = V_{avg}}$ বের করা শিখব। কারণ আমাকে Ultimately একটা constant voltage এ প্রকাশ করতে হবে।

If we take avg of a pure AC signal, then it will be zero means baseline basically.

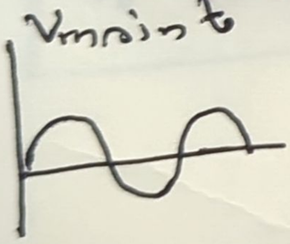


$V_{avg} = 0$

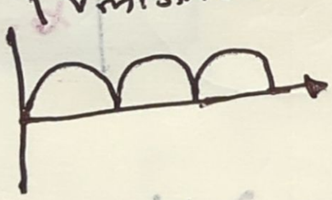


$V_{avg} = 10$

But in pulsating DC we measure it by dividing the total covered area by T.



$\rightarrow$



$$\boxed{V_{avg} = \frac{area}{T}}$$

আমরা এটি area টা মূলত Integration করে বের করি,

$$\boxed{V_{avg} = V_{DC} = \frac{V_m}{\pi} - \frac{V_{do}}{2}}$$

H.W

$$\boxed{V_{avg} = V_{DC} = \frac{2V_m}{\pi} - 2V_{do}}$$

F.W

* From where the π comes dude. → Let's see

* Let's assume $y = f(x)$ is a function of x.

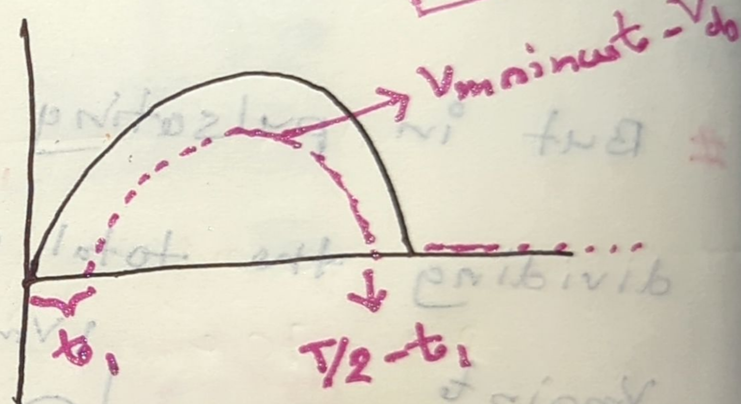
So, if we want to find the average value of of y. We have to do:

$$\boxed{\bar{y} = \frac{\int y\,dx}{\int dx}}$$

For,

$$\overline{V_o} = \frac{\int_0^T V_o\,dt}{\int_0^T dt}$$

H.W.



$$\overline{V_o} = \frac{1}{T}\int_0^T V_o\,dt$$

$$= \frac{1}{T}\int_{t_1}^{T/2-t_1} (V_m \sin\omega t - V_{D0})\,dt$$

$$= \frac{1}{T}\left\{\left[-\frac{V_m \cos\omega t}{\omega}\right]_{t_1}^{T/2-t} - V_{D0}\left[t\right]_{t_1}^{T/2-t_1}\right\}$$

$$= \frac{1}{T}\left\{-\frac{V_m}{\omega}\left[\cos\omega T/2 - \cos\omega 0\right] - V_{D0}\left[T/2 - 0\right]\right\}$$

[assuming $t_1 = 0$]

$$= \frac{1}{T}\; -\frac{V_m}{\omega}\left(\cos\frac{2\pi}{\cancel{T}}\cdot\cancel{T}/\cancel{2} - 1\right) - \frac{1}{\cancel{T}} V_{D0}\cdot \cancel{T}/2$$

$$\overline{V_o} = \frac{1}{\cancel{T}} \times \frac{V_m}{\frac{\cancel{2}\pi}{\cancel{T}}} \times \cancel{2} - \frac{V_{D0}}{2}$$

$$\boxed{\overline{V_o} = \frac{V_m}{\pi} - \frac{V_{D0}}{2} = V_{DC}} \rightarrow \text{H.W}$$

for full wave the V_{D0} becomes double and the $\overline{V_o}$ becomes double because we got the value of -ve cycles end.

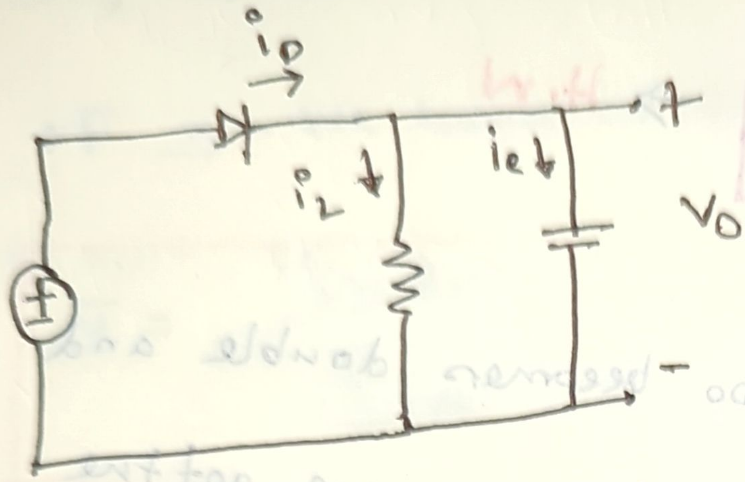
$$\overline{V_o} = 2\left(\frac{V_m}{\pi} - \frac{2V_{D0}}{2}\right)$$

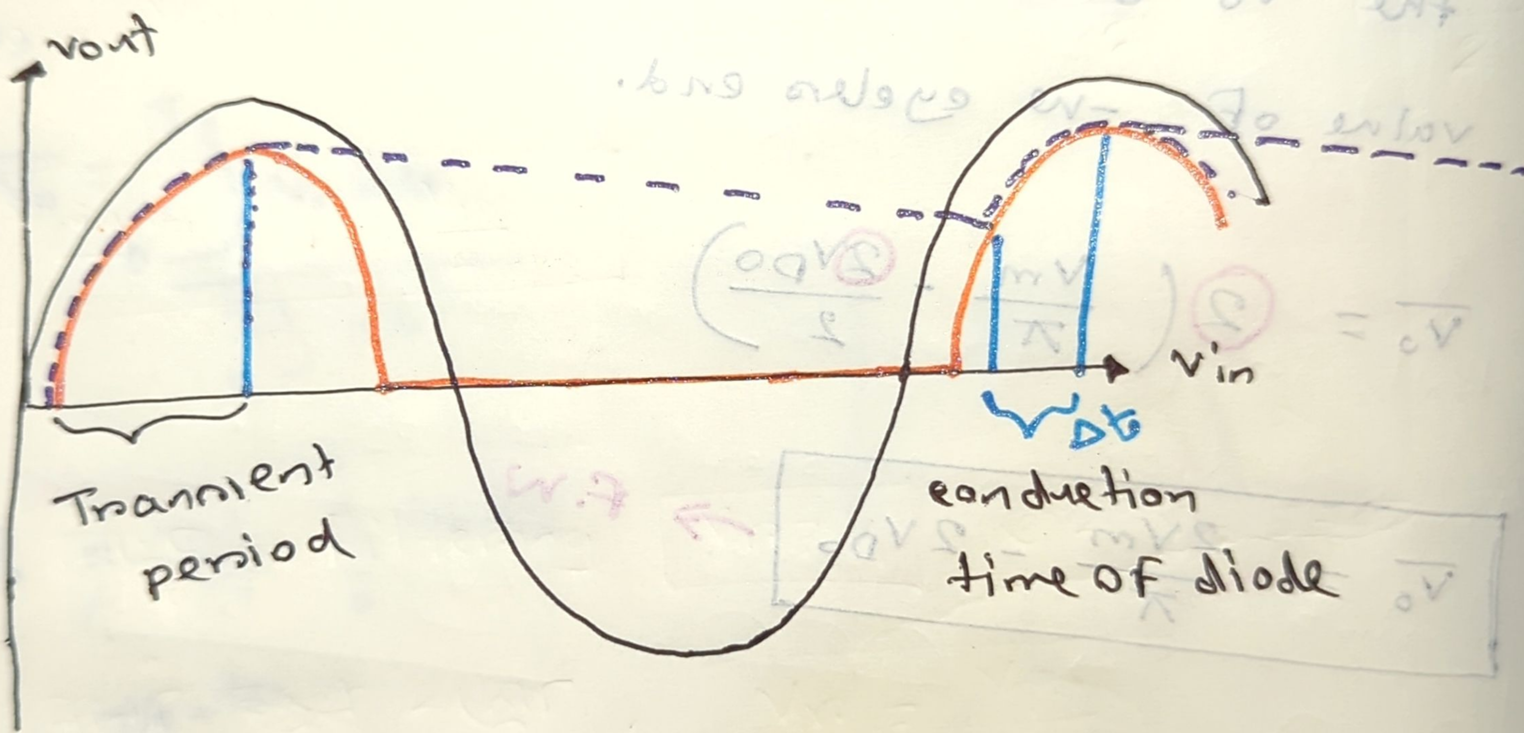
$$\boxed{\overline{V_o} = \frac{2V_m}{\pi} - 2V_{D0}} \rightarrow \text{f.W}$$

এখনও আমরা শান্তি পাই নাই, আমরা আরও ভালো avg পাওয়ার জন্য capacitor যোগ করে. নতুন output signal বের করে; আবার avg বের করব।

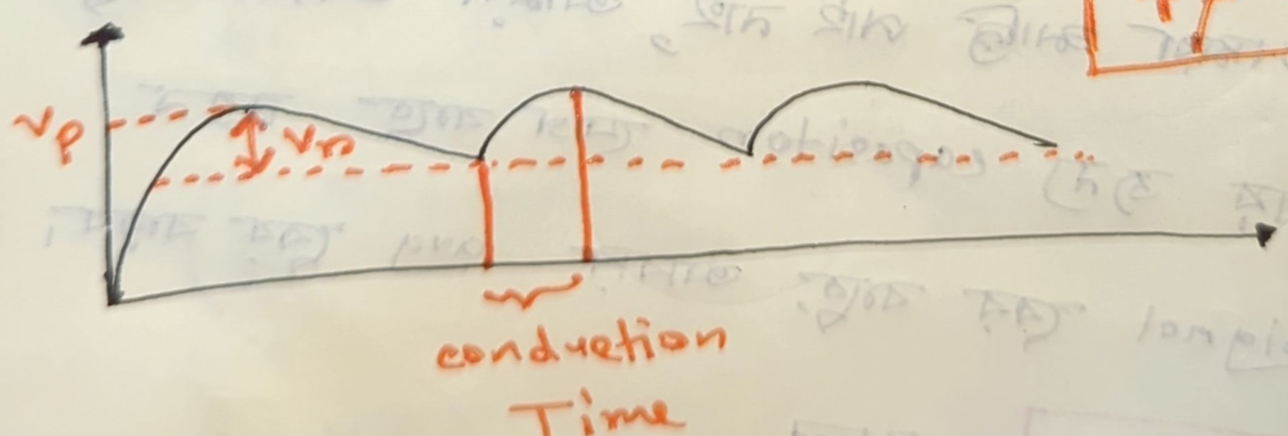
এটাকে **filtering** বলে।

Filtering





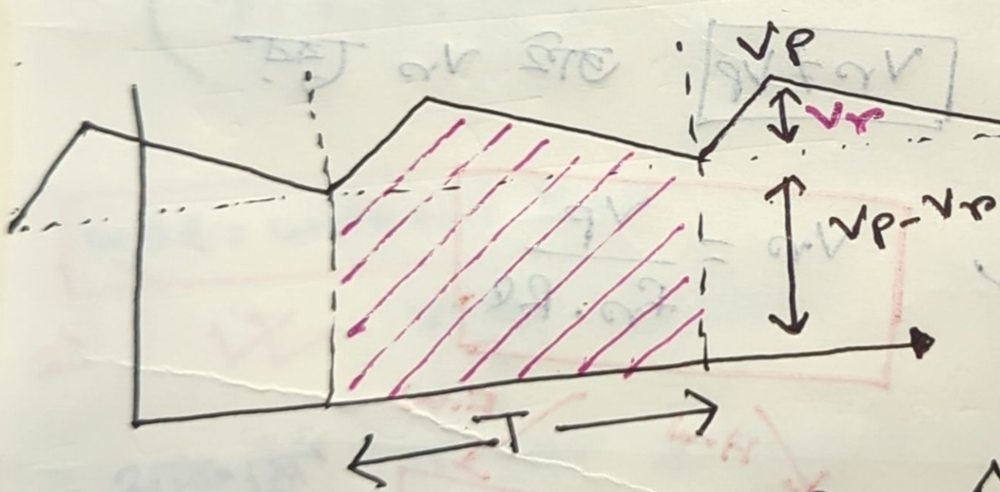
$\boxed{V_P \neq V_r}$



আসলে voltage যখন peak থেকে নিচে নামে, তখন capacitor এর মধ্যে জমাকৃত voltage হয়, তাই votage আস্তে আস্তে পরিবর্তন হয় করে.

আর প্রথমে Transient period capacitor চার্জ হয়, তারপর বাকি সব সময়ে, conduction time এ চার্জ হয়। Diode শুধু এই সময় টুকুই কাজ করে। কারণ conduction time শেষ হওয়ার পর Diode এর - এ বেশি voltage থাকে capacitor এর কারণে এবং + প্রান্তে কম voltag থাকে।

finding the avg: (taking as a triangle signal) to calculate precisely



area = △ + □

triangle

rectangle

$$= \frac{1}{2} \times V_r \times T + (V_p - V_r)T$$

$$\boxed{area = \frac{V_r T}{2} + (V_p - V_r)T}$$

$$V_{avg} = \frac{area}{T}$$

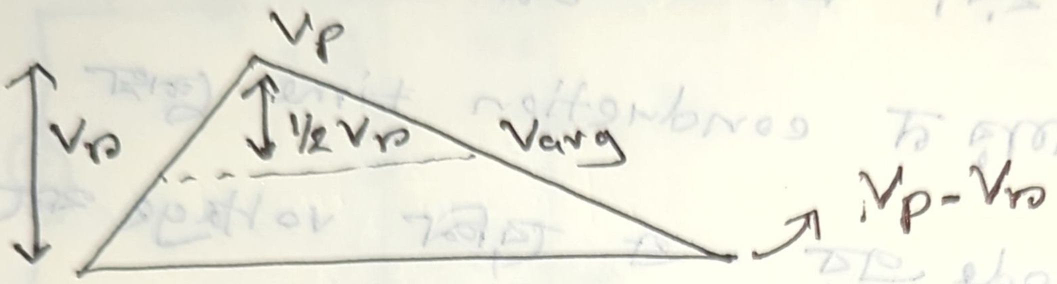
$$V_{avg} = \frac{V_r}{2} + V_p - V_r$$

$$\boxed{V_{avg} = V_p - \frac{V_r}{2}}$$

H.W.

আমরা একটি অন্য উপায়ে ভাবতে পারি যে,

যেহেতু avg হলো মধ্যমান বা mid value



so $V_{avg} = \frac{V_p + (V_p - V_r)}{2} = \frac{2V_p - V_r}{2} = V_p - \frac{V_r}{2}$

$$\boxed{V_{avg} = V_p - \frac{V_r}{2}}$$

যেহেতু Filtering $\boxed{V_r \neq V_p}$ তাই V_r এর

মান অল্প হলো, $\boxed{V_r = \frac{V_p}{f_r \cdot R_L}}$

H.W $\rightarrow \boxed{f_i}$

F.W $\rightarrow \boxed{2f_i}$

Formulla

H.W	F.W
$f_r = f_i$	$f_r = 2f_i$
$V_p = V_m - V_{do}$	$V_p = V_m - 2V_{do}$
$V_{dc} = \begin{cases} \frac{V_m}{\pi} - \frac{1}{2}V_{do} & [woc] \\ V_p - \frac{1}{2}V_r & [wc] \end{cases}$	$V_{dc} = \begin{cases} \frac{2V_m}{\pi} - 2V_{do} & [woc] \\ V_p - 1/2\, V_r & [wc] \end{cases}$
$V_r = \begin{cases} V_p & (woc) \\ V_p / f_r R_L & (wc) \end{cases}$	$V_r = \begin{cases} V_p & [woc] \\ V_p / f_r R_L & [wc] \end{cases}$

woc = without cap

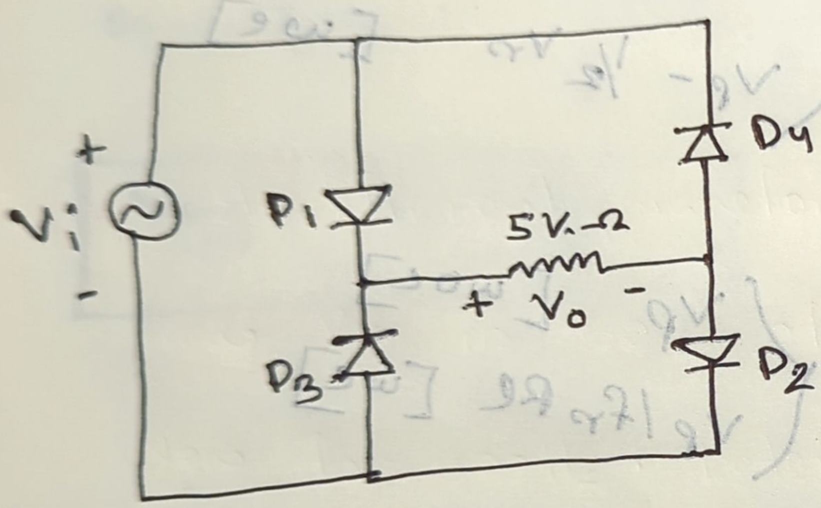
wc = with cap

কয়টা জিনিস হলো capacitor থাকলে বা না থাকলেও একই মান থাকে.

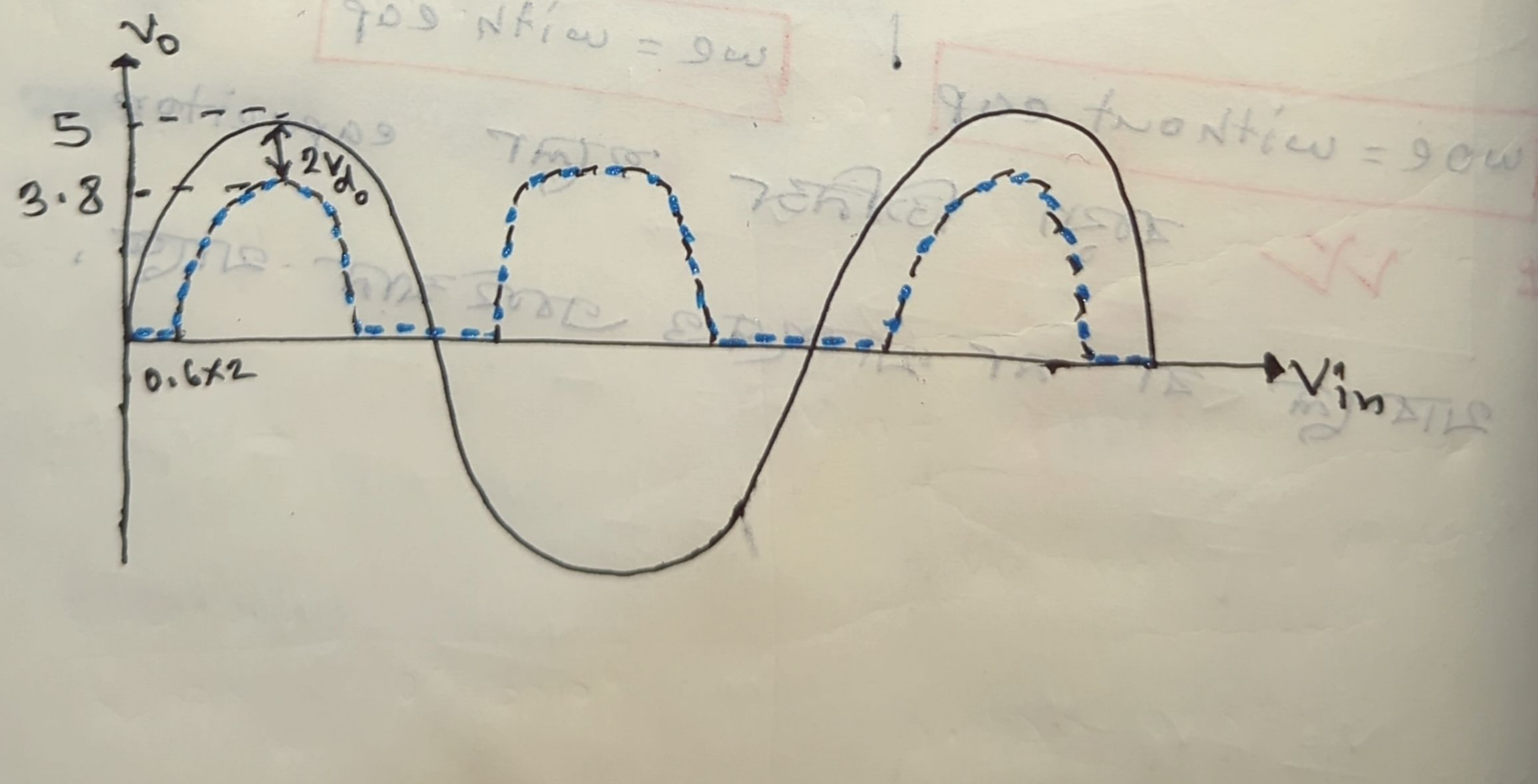
Diode Rectifier Problem

1] $V_i = 5\sin(200\pi t)$, $R = 5k\Omega$, $V_{D_0} = 0.6$ $\boxed{\text{Full wave}}$

AQ: Draw circuit. Label input and output voltage
Briefly explain the application of the circuit.



	+ve	-ve
D_1	ON	OFF
D_2	ON	OFF
D_3	OFF	ON
D_4	OFF	ON



BQ: Calculate V_{dc} and output frequency f_o.

Given, $V_i = 5\sin(200\pi t)$ comparing to

$$V_i = V_m \sin(2\pi f t)$$

$f_i = 200/2 = 100$ Hz

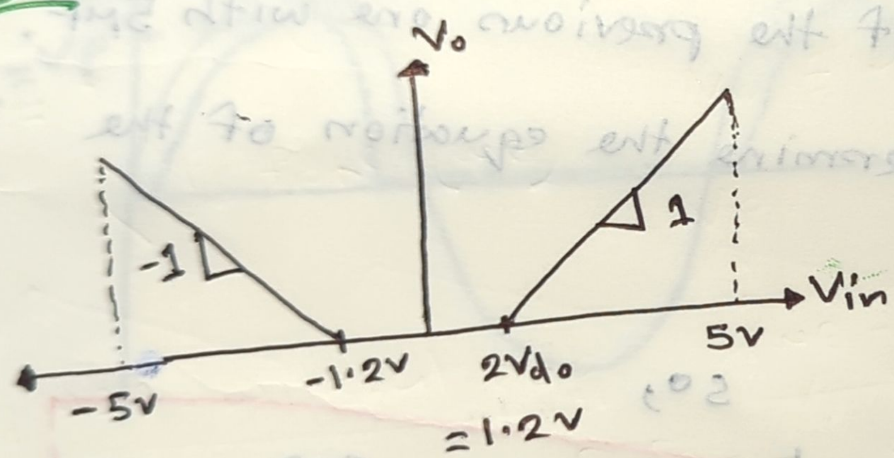
$\boxed{f_o = 2\times100 = 200 Hz}$ $[F.W \rightarrow f_o = 2f_i]$

$$V_{dc} = \frac{2V_m}{\pi} - 2V_{do}$$

$$V_{dc} = \frac{2\times5}{\pi} - 2\times0.6$$

$$\boxed{V_{dc} = 1.983 V}$$

CQ: Draw VTC and Label it.



DQ: connect a capacitor with the circuit parallaled and we have two options to choose 5μF/ 1μF. Which one will you choose explain breifly.

when, $\boxed{5\mu F}$,

$$V_{dc} = V_p - \frac{1}{2}V_r$$

$$= V_m - 2V_{do} - \frac{V_p}{2f_r RC}$$

$$= V_m - 2V_{do} - \frac{V_m - 2V_{do}}{2f_r RC}$$

$$V_p = V_m - 2V_{do}$$

$$V_r = \frac{V_p}{f_r RC}$$

$f_r = f_o = 200$ Hz

$R = 5 k\Omega$

$C = 5\mu F$

$V_m = 5V$

$$V_{dc} = 5 - 2\times0.6 - \frac{5-2\times0.6}{2\times200\times5\times10^3\times5\times10^{-6}}$$

$\boxed{V_{dc} = 3.42V}$

when, $\boxed{1\mu F}$

$\boxed{V_{dc} = 1.9V}$

So, to get the highest V_{dc} we will use $5\mu F$

EQ: A different waveform fed into F.W. The new V_r is 50% of the previous one with $5\mu F$. New $f_o = 300Hz$. Determine the equation of the input waveform.

Given,

$f_o = 300Hz$

new $V_r = \frac{V_p}{f_r R C} / 2$

$= \frac{5-2\times0.6}{2\times200\times5\times10^3\times5\times10^{-6}}$

$V_r = 0.38V$

So,

$\boxed{f_i = f_o/2 = \frac{300}{2} = 150Hz}$

$V_m = V_p + 2V_{d_o}$

$= V_r f_r R C + 2V_{d_o}$

$= 0.38\times300\times5\times10^3\times5\times10^{-6} + 2\times0.6$

$\boxed{V_m = 4.05V}$

$\boxed{V_i = 4.05\sin(300\pi t)\ V}$

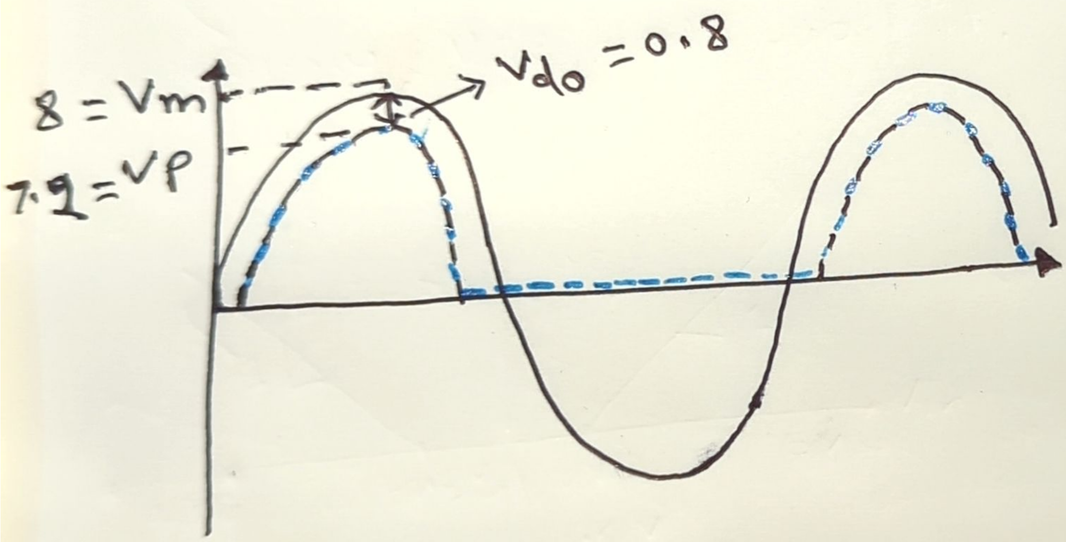
2| $V_i = 8\sin(2000\pi t)\,V$, H.W, $R = 50k\Omega$

$V_{do} = 0.8\,V$

Aq: Same as $\boxed{1|\,Aq}$ → asked to do it in F.W.

Bq: Draw waveforms for input and output voltages.

Label peak values.



cq: Find V_{dc}.

$$V_{dc} = \frac{V_m}{\pi} - \frac{V_{do}}{2}$$

$$V_{dc} = \frac{8}{\pi} - \frac{0.8}{2}$$

$$\boxed{V_{dc} = 2.146}$$