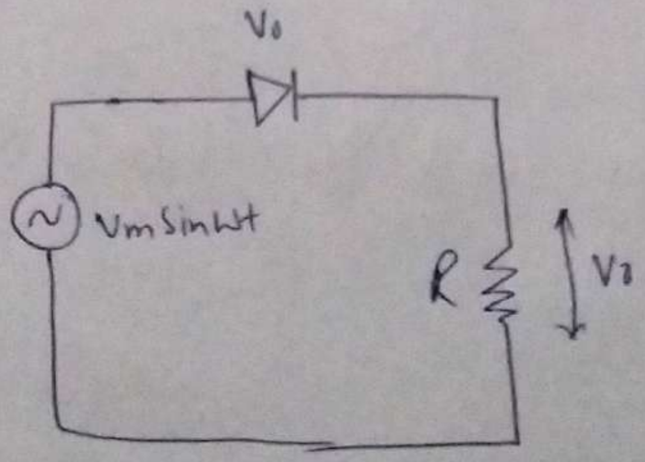
Rectifier Module

- 1 Phase
  - Half wave
    - Uncontrolled
      - R
      - L
      - RL
      - RL-FWD
      - RE
      - RLE
    - Controlled
      - R
      - L
      - RL
      - RL-FWD
      - RE
      - RLE
  - Full wave
    - UnControlled
    - Controlled
    - Semi Controlled
      - Symmetrical
      - Asymmetrical
      - Full Converter + FWD
      - (R, RL, RE, RLE Load)
- 3 Phase
  - Half Wave
    - Uncontrolled
    - Controlled
  - Full wave
    - controlled only

In this lecture we will cover 1-Phase Half wave Diod uncontrolled rectifier with R and L load.

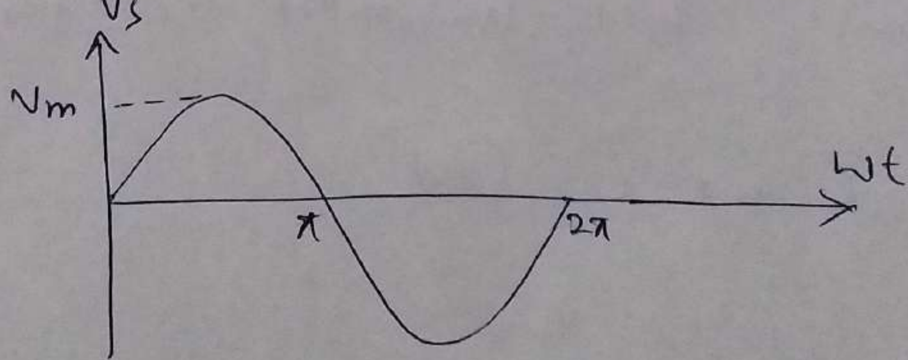


This is a Single Phase half wave uncontrolled rectifier.

Here we are given AC voltage and get DC voltage on the output

I conect one diode with ac source and converting it getting DC signal.

See this is nothing but a diode with R load.

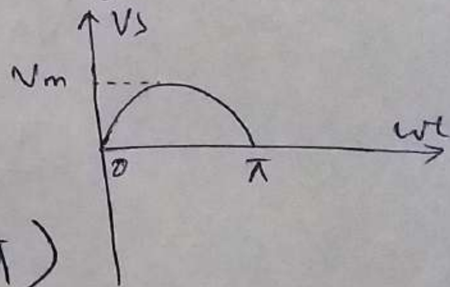


Vm Sin wt will be like this shown above.

When anode potential is greater than cathode potential

$V_A > V_K$

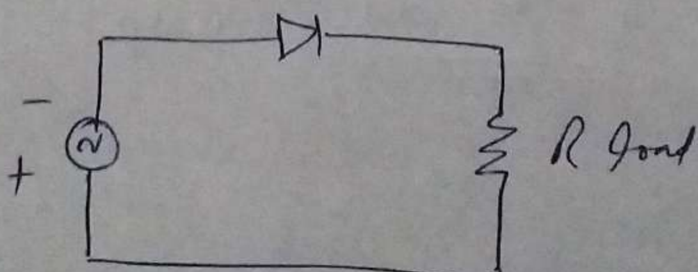
This diode will act like conducting. i-e from 0 to π this diode will conducting.



So,

$V_o = V_s$ (0 to π)

Now when supply voltage get reversed means



Now supply is reversed from

π to 2π. Now diode is

reversed bias and act as open

Circuit. Now Anode is -ive and

cathode is +ive.

$$V_o = I_o R$$

$$I_o = 0 \quad \text{So} \quad \boxed{V_o = 0}$$

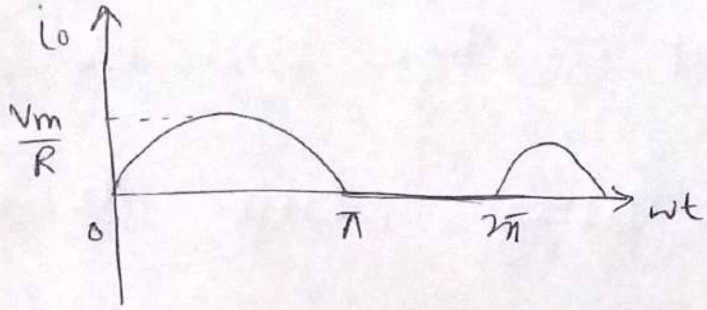
So we can say that

from

<u>0 to π</u> $\quad V_{output} = V_s = V_m \sin \omega t$

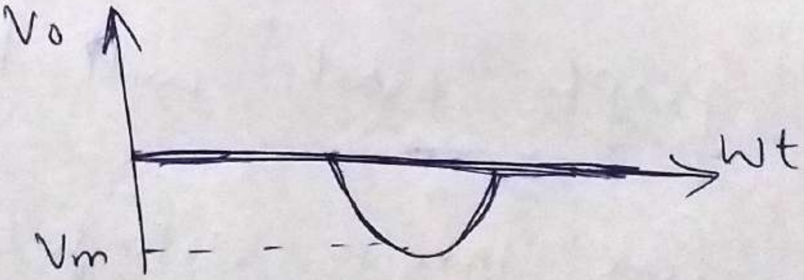
<u>π to 2π</u> $\quad V_{output} = 0$

Here output current is equal to output voltage so



So $i_o = \frac{V_m}{R}$

Now see the voltage across the diode.
From 0 – π Diode is conducting means it is sorted.



Means voltage across the diode will be zero. and from π – 2π it is acting like open circuited.

Now applying KVL.

output voltage will be zero

and voltage across the diode

V_D will be same as

the supply voltage.

So If i will ask from

you people what will be

the Peak inverse voltage (PIV)

So $\boxed{PIV = V_m}$ and always +ive

So we are getting output voltage only from 0 to π means we are getting only one pulse in one cycle so ~~it~~ this type of circuit is called one pulse converter.

Now take a Note and This type of note is important for all type of rectifier. Despite of changing of load. i.e R, L, RL, RE etc

Note:-

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

$$V_{avg} = \frac{1}{2\pi}\int_0^{\pi} V_m \sin \omega t \, d\omega t$$

$$V_{avg} = \frac{V_m}{\pi}$$

② $I_{o\,avg} = \frac{V_{o\,avg}}{R}$

$$I_{o\,avg} = \frac{V_m}{\pi R}$$

③ $V_{rms} = \sqrt{\frac{1}{T}\int_0^T V_o^2(t) \, dt}$

$$V_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi} V_m^2 \sin^2 \omega t \, d\omega t}$$

$$V_{rms} = \sqrt{\frac{1}{2\pi} V_m^2 \int_0^{\pi} \left(\frac{1-\cos 2\omega t}{2}\right) d\omega t}$$

$$V_{rms} = \frac{V_m}{2}$$

(4) $I_{orms} = \frac{V_{orms}}{R}$

(5) P_o = Output Power = $\boxed{\frac{V_{orms}^2}{R} = I_{orms}^2 R}$

(6) Input Power Factor, IPF $\Rightarrow P_{in} = P_o$

Losses = zero

$P_{in} = P_{out}$

$V_s I_s \cos\phi = I_{orms}^2 R$

Here Source Rms current is equal to output Rms current.

$\therefore \quad I_s = I_{orms}$

So finally $\cos\phi = \frac{I_{or} R}{V_s} = \frac{V_{or}}{V_s}$ }

So If Input Power Factor is to be determined, no need to remember this whole formula but only remember

$$P_{in} = P_o$$

and see whether the source current is equal to the output RMS current or not

If source current is equal to output RMS current then cut the source current $= I_{or}$ and then find Power Factor

So

$$IPF = \frac{V_{or}}{V_s}$$

(7) Conduction angle of diode = γ_D (Gamma) and Diode is conducting from 0 – π

$$\gamma_D = \pi$$

(8) Extension Angle, β = upto what angle diode is conducting. upto what angle you are getting current.

$$\beta = \pi$$

In this case $\gamma_D = \beta$ (In all the Diode rectifier)

(9) Peak Inverse Voltage, PIV = V_m

(10) Circuit turnoff time, t_c = The time for which the diode is in reverse bias.

$$\omega t_c = \pi$$

$$t_c = \pi / \omega$$

So these all points, I will derive for every type of Converters for different types of load.

This is taken as a note, So that It will be easier to remember. and thats all about the R load.