HALF WAVE RECTIFIER
(use of Diodes in Rectifiers)

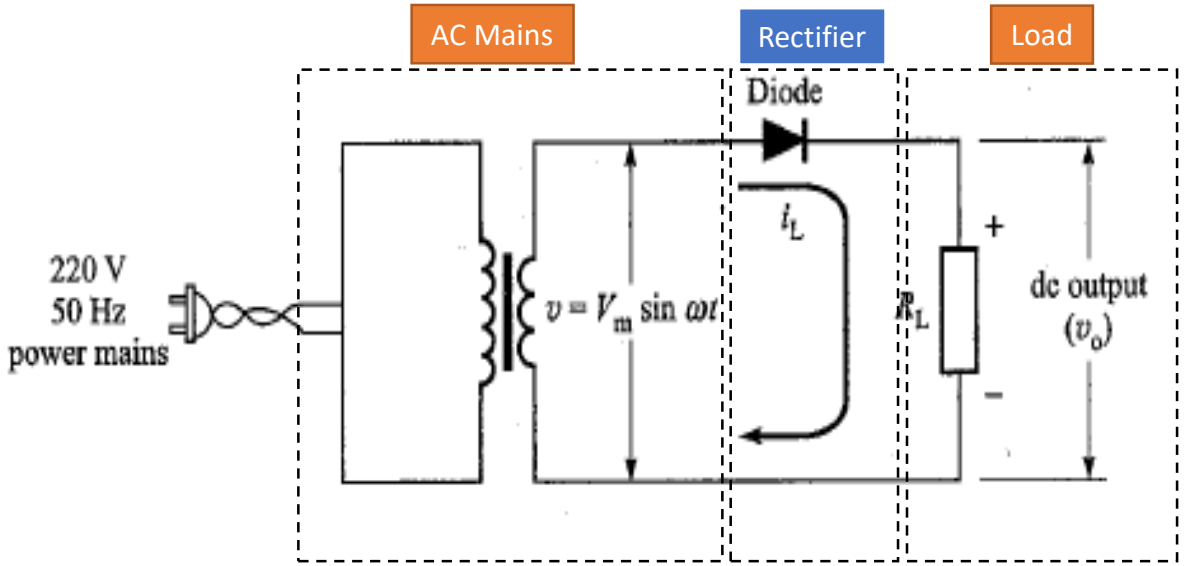

Fig : Half-wave rectifier circuit

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USE OF DIODES IN RECTIFIERS

Available Electrical Energy in (alternating in nature(AC))

INDIA : 220Vrms@50Hz

US :110V @60Hz

Cannot power DC load directly

DC LOADS

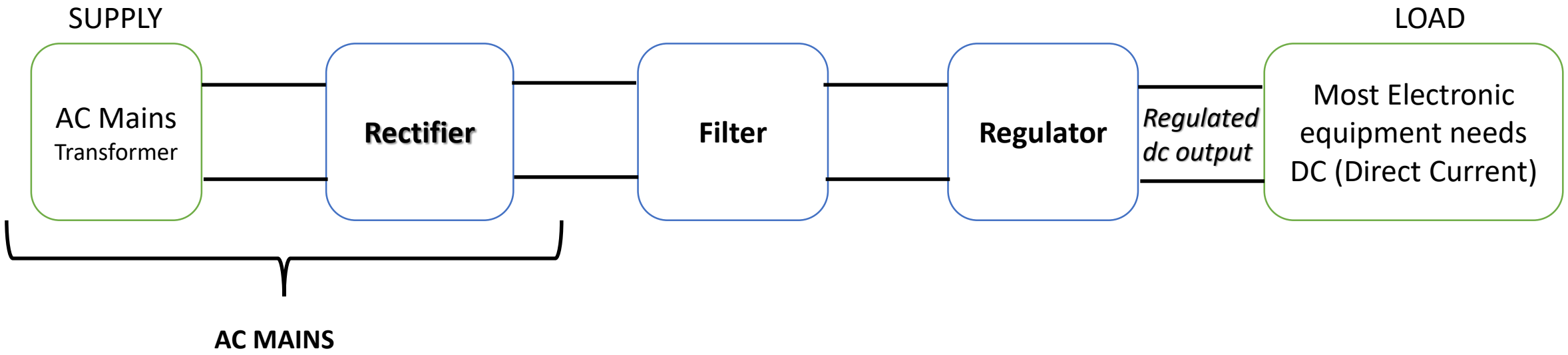
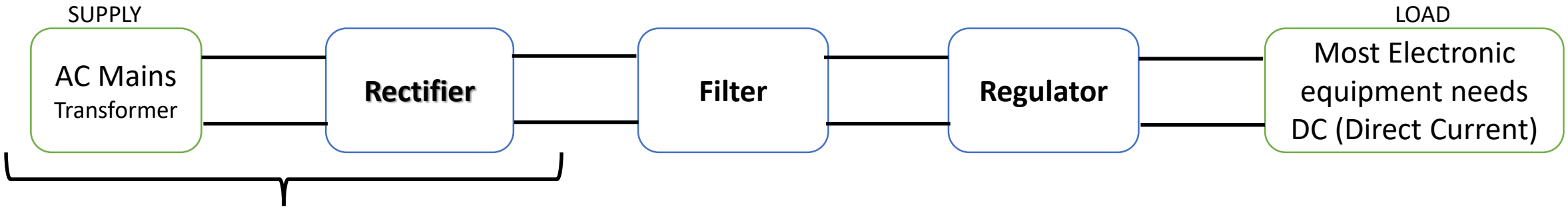


Fig : Block diagram of a power supply



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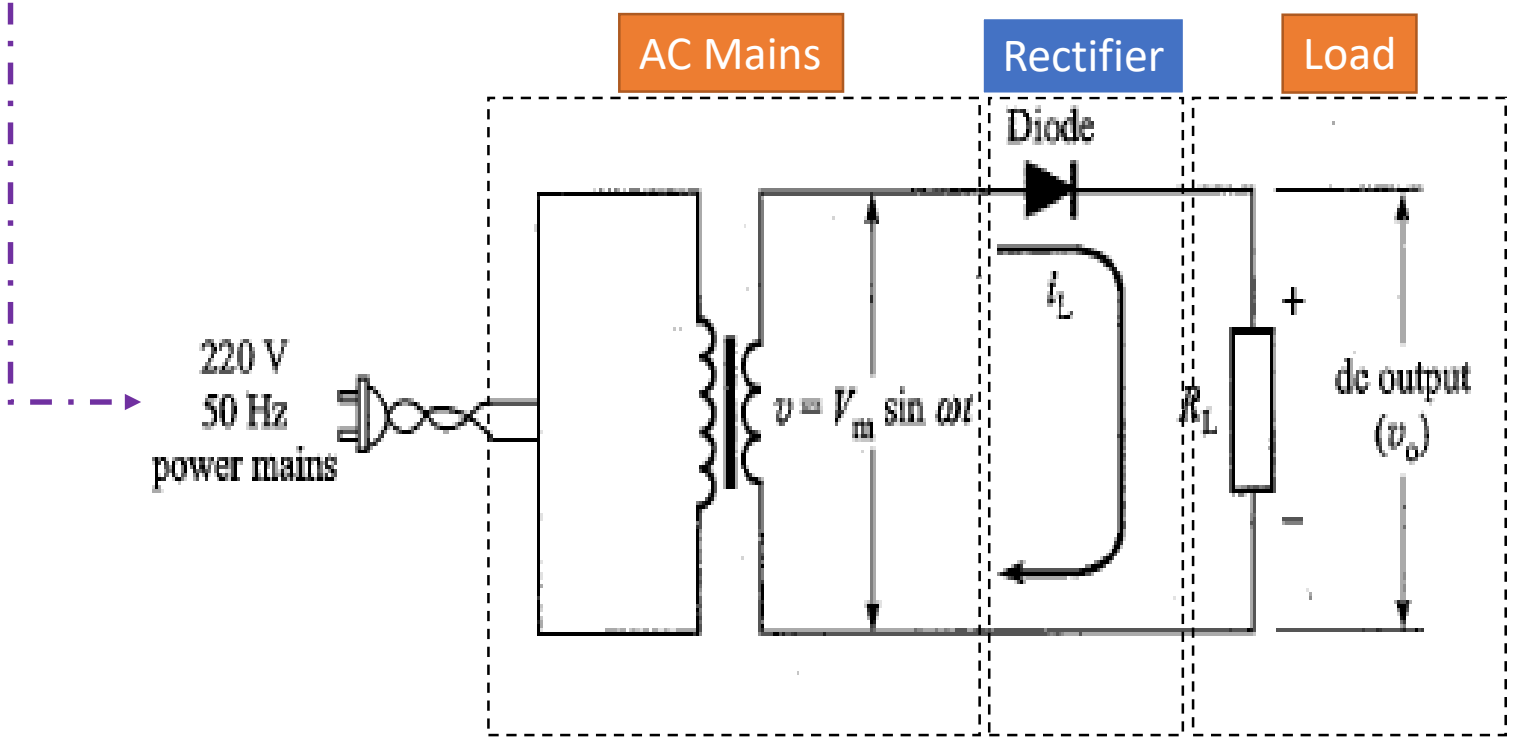
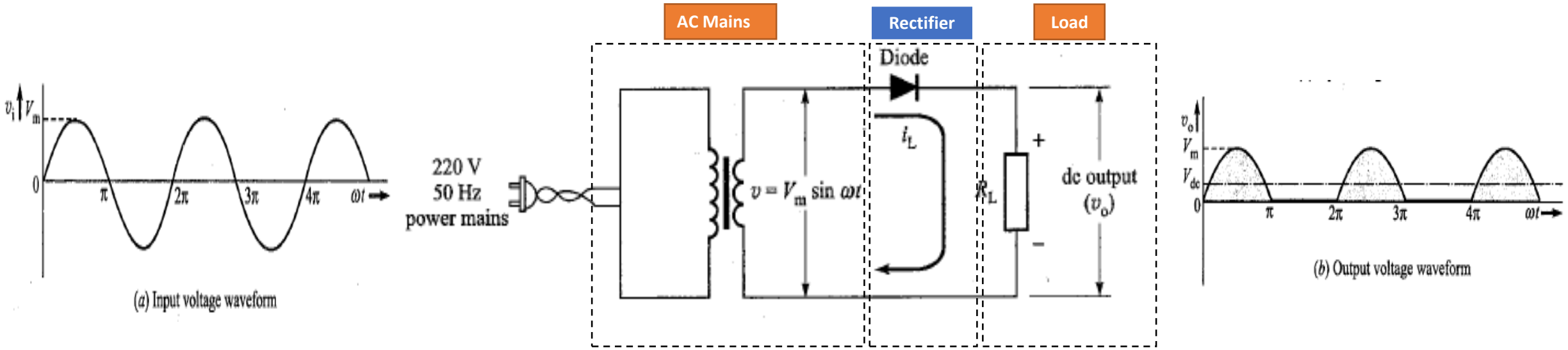


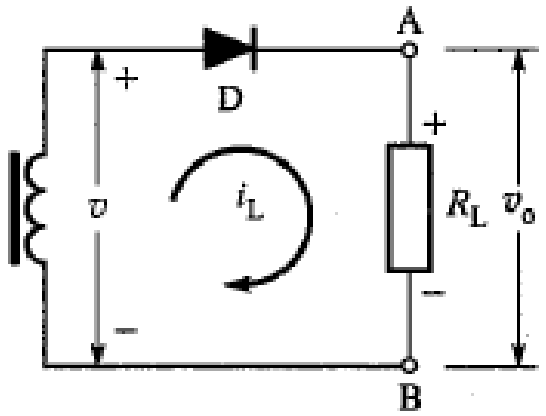
Fig : Half-wave rectifier circuit



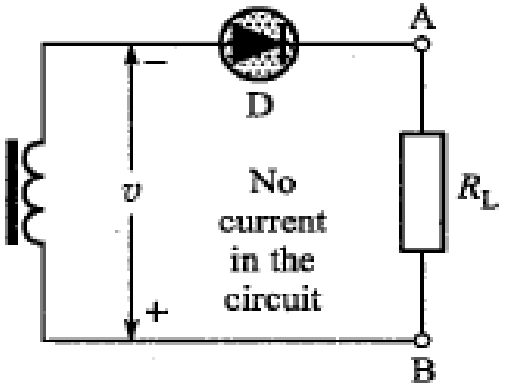
(a) Input voltage waveform

(b) Output voltage waveform

Fig : Half-wave rectifier circuit with input-output voltage waveforms



(a) During positive half-cycle



(b) During negative half-cycle

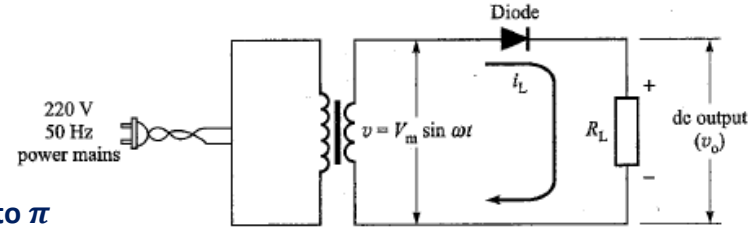
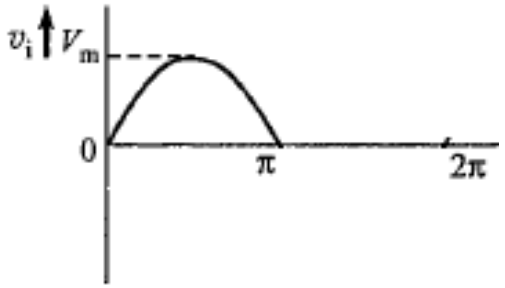
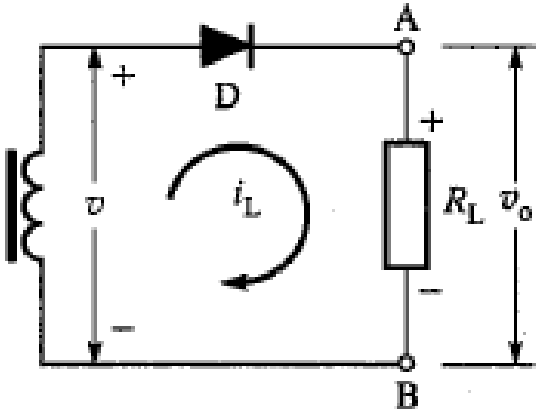


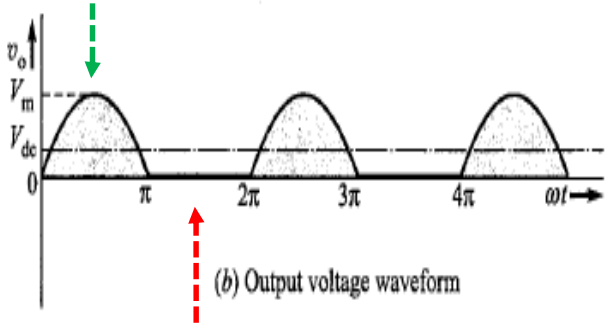
Fig : Half-wave rectifier circuit





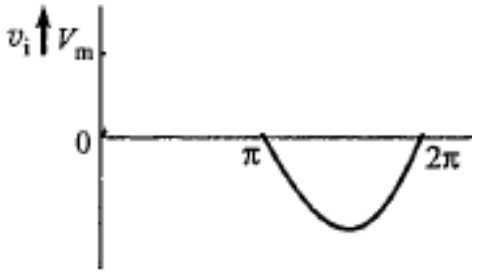
(*a*) During positive half-cycle

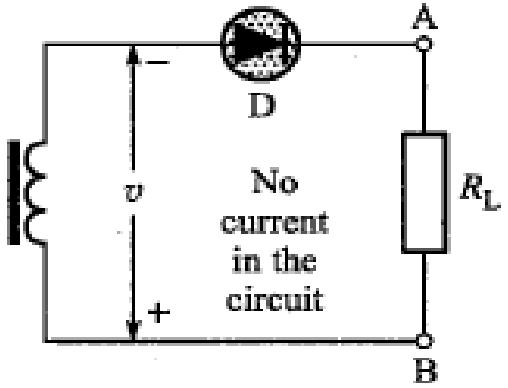
Contributes output between 0 to π



(*b*) Output voltage waveform

PEAK INVERSE VOLTAGE = v_m





(*b*) During negative half-cycle

Contributes output between π to 2π

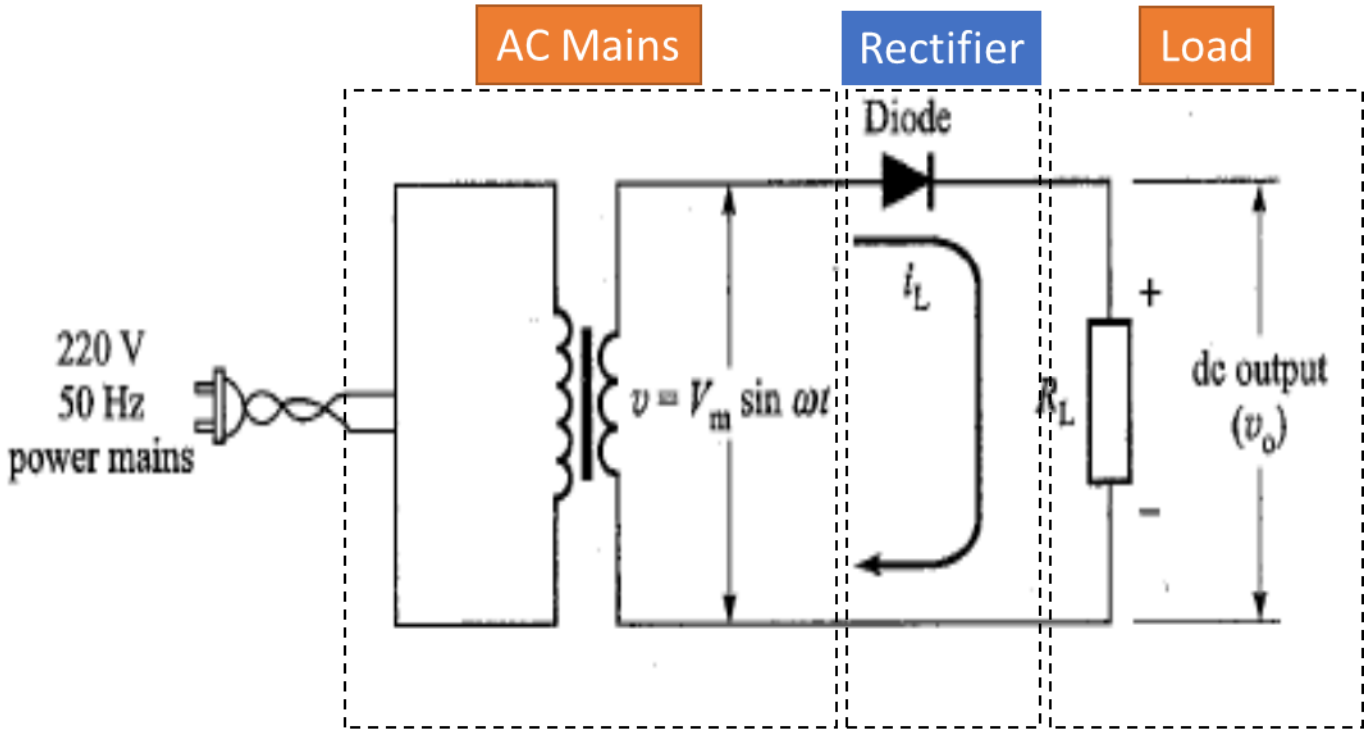
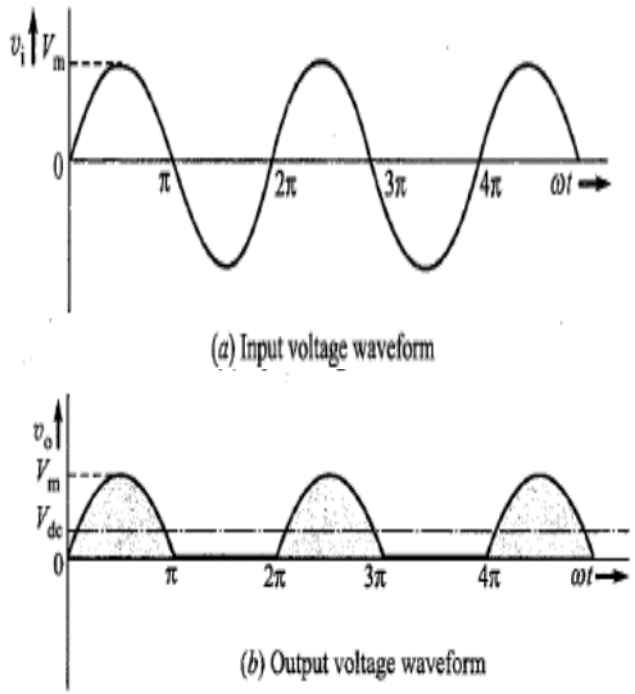
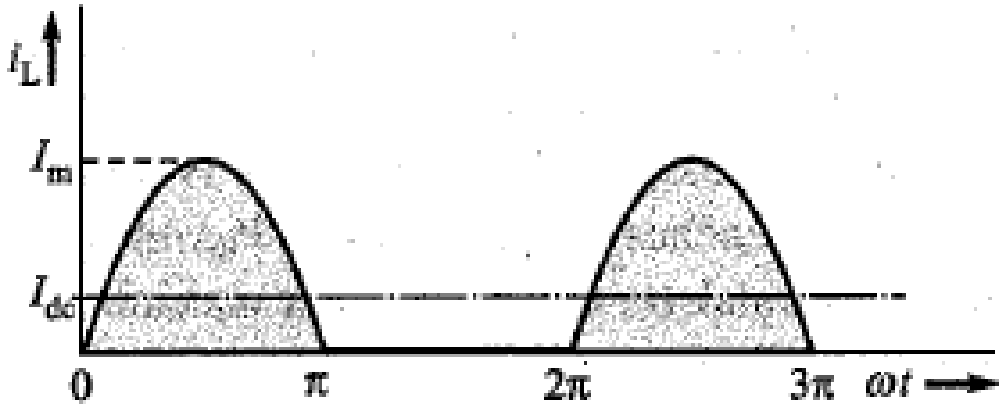


Fig : Half-wave rectifier circuit





Waveform of the current flowing through load R_L in a half-wave rectifier

$i_L = I_m \sin \omega\, t$ for $0 \leq \omega t \leq \pi$

$i_L = 0$ for $\pi \leq \omega t \leq 2\pi$

Here I_m is the peak value of the load current i_L

&

Related to peak value of the voltage v_m

as $I_m = \frac{v_m}{R_L + rd}$

Here, r_d is diode resistance

Output dc voltage: net area under the curve over one complete cycle(0 to 2 π) and then divide this area by base 2π

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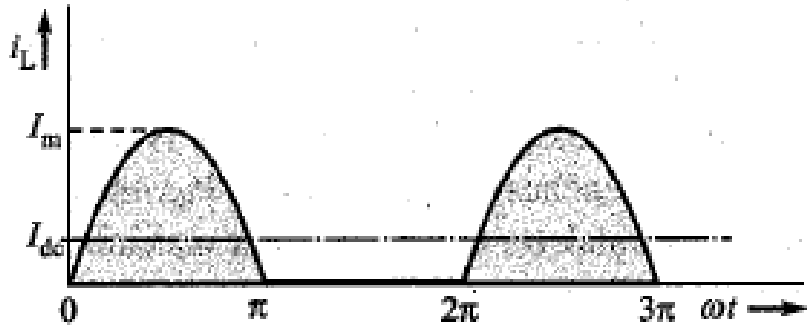


Waveform of the current flowing through load R_L in a half-wave rectifier

Area = $\int_0^{2\pi} i_L d(wt)$

= $\int_0^{\pi} i_L d(wt) + \int_{\pi}^{2\pi} i_L d(wt)$

= $\int_0^{\pi} I_m \sin \omega t \, d(wt) + \int_{\pi}^{2\pi} 0 \, d(wt)$

= $I_m[-coswt]_0^{\pi}$+0

= $I_m\,[-cos\pi - (-cos0)]$

= $2I_m$

Average value of the load current is then

$$I_{avg} = I_{dc} = \frac{Area}{Base} = \frac{2I_m}{2\pi}$$

or

$$I_{dc} = \frac{I_m}{\pi}$$

Peak value of the load current I_m as $I_m = \frac{v_m}{R_L + rd}$

Average value of the load current is then $I_{dc} = \frac{I_m}{\pi}$

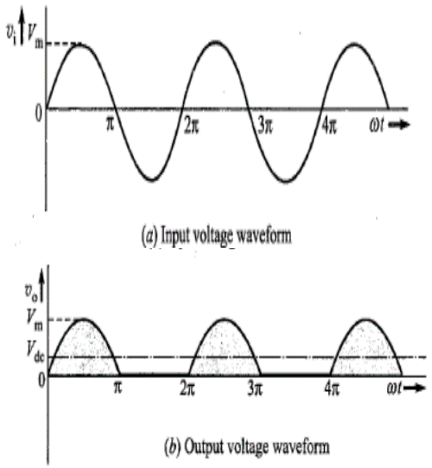
The dc voltage developed across the load R_L is $V_{dc} = I_{dc} \times R_L = \frac{I_m}{\pi} R_L$

The dc voltage across the load resistor R_L can now be written with the help of I_m

$$V_{dc} = \frac{V_m}{\pi(RL+rd)} R_L = \frac{V_m}{\pi\left(1+\left(\frac{rd}{R_L}\right)\right)}$$

$$\approx \frac{V_m}{\pi} \text{ (if } r_d << R_L)$$

SUMMARY



PEAK INVERSE VOLTAGE = v_m

$$I_m = \frac{v_m}{R_L + rd}$$

$$I_{dc} = \frac{I_m}{\pi}$$

$$V_{dc} \approx \frac{V_m}{\pi} \text{ (if } r_d << R_L)$$