Applications of diode:

Half wave Rectifier:

The single phase half wave rectifier is shown in **fig. 1**.

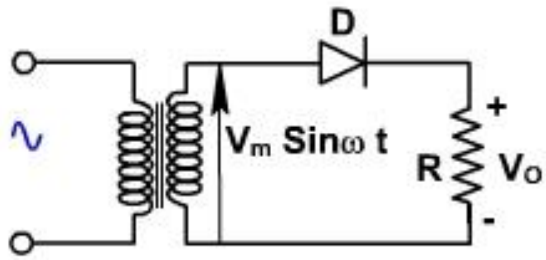

Fig. 1

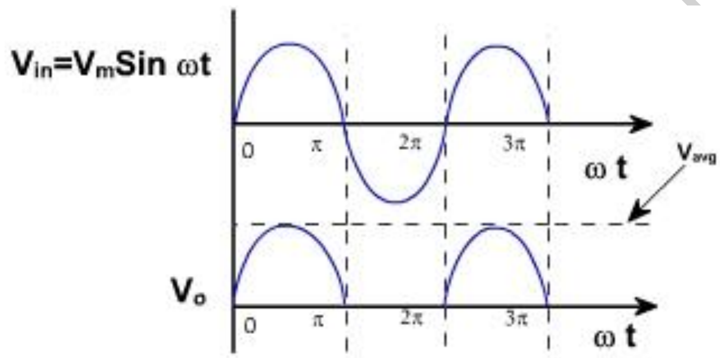

Fig. 2

In positive half cycle, D is forward biased and conducts. Thus the output voltage is same as the input voltage. In the negative half cycle, D is reverse biased, and therefore output voltage is zero. The output voltage waveform is shown in **fig. 2**.

The average output voltage of the rectifier is given by

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

$$= \frac{V_m}{\pi} = 0.318 V_m$$

The average output current is given by

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

When the diode is reverse biased, entire transformer voltage appears across the diode. The maximum voltage across the diode is V_m. The diode must be capable to withstand this voltage. Therefore PIV half wave rating of diode should be equal to V_m in case of single-phase rectifiers. The average current rating must be greater than I_{avg}

Full Wave Rectifier:

A single phase full wave rectifier using center tap transformer is shown in **fig. 3.** It supplies current in both half cycles of the input voltage.

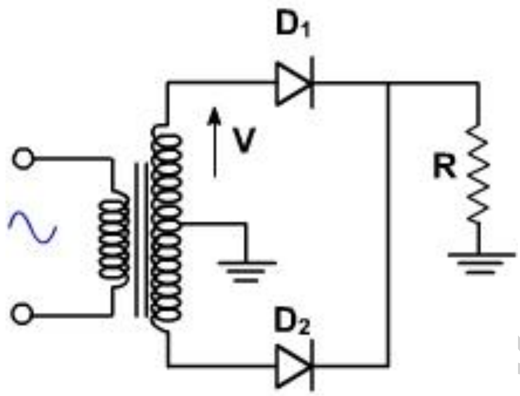

Fig. 3

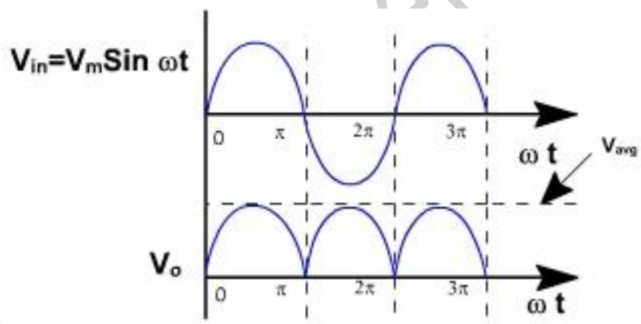

Fig. 4

In the first half cycle D_1 is forward biased and conducts. But D_2 is reverse biased and does not conduct. In the second half cycle D_2 is forward biased, and conducts and D_1 is reverse biased. It is also called 2 Pulse midpoint converter because it supplies current in both the half cycles. The output voltage waveform is shown in **fig. 4**.

The average output voltage is given by

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

And, the average load current is given by

$$I_{avg} = \frac{2V_m}{\pi R}$$

When D_1 conducts, then full secondary voltage appears across D_2, therefore PIV rating of the diode should be $2V_m$.

Bridge Rectifier:

The single phase full wave bridge rectifier is shown in **5.** It is the most widely used rectifier. It also provides currents in both the half cycle of input supply.

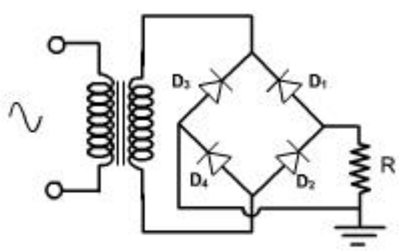

Fig. 5

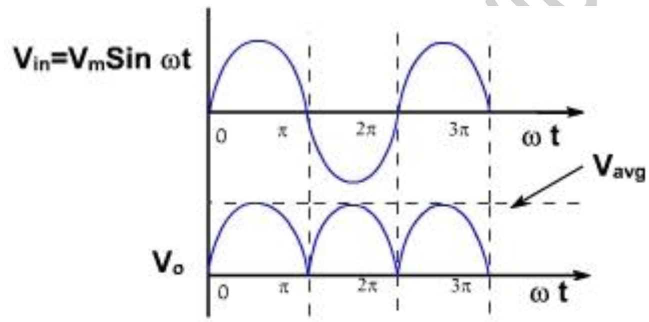

Fig. 6

In the positive half cycle, D_1 & D_4 are forward biased and D_2 & D_3 are reverse biased. In the negative half cycle, D_2 & D_3 are forward biased, and D_1 & D_4 are reverse biased. The output voltage waveform is shown in **fig.** 6 and it is same as full wave rectifier but the advantage is that PIV rating of diodes are V m and only single secondary transformer is required.

The main disadvantage is that it requires four diodes. When low dc voltage is required then secondary voltage is low and diodes drop (1.4V) becomes significant. For low dc output, 2-pulse center tap rectifier is used because only one diode drop is there.

The ripple factor is the measure of the purity of dc output of a rectifier and is defined as

$$\text{Ripple factor} = \frac{\text{r.m.s value of the ac output voltage}}{\text{average dc output voltage}}$$

$$= \sqrt{V_0^2 + \sum_{n=1}^{\infty} V_n^2}$$

Therefore,

$$\text{Ripple factor} = \frac{\sqrt{V_{rms}^2 - V_o^2}}{V_o}$$

$$= \sqrt{\left(\frac{V_{rms}}{V_o}\right)^2 - 1}$$