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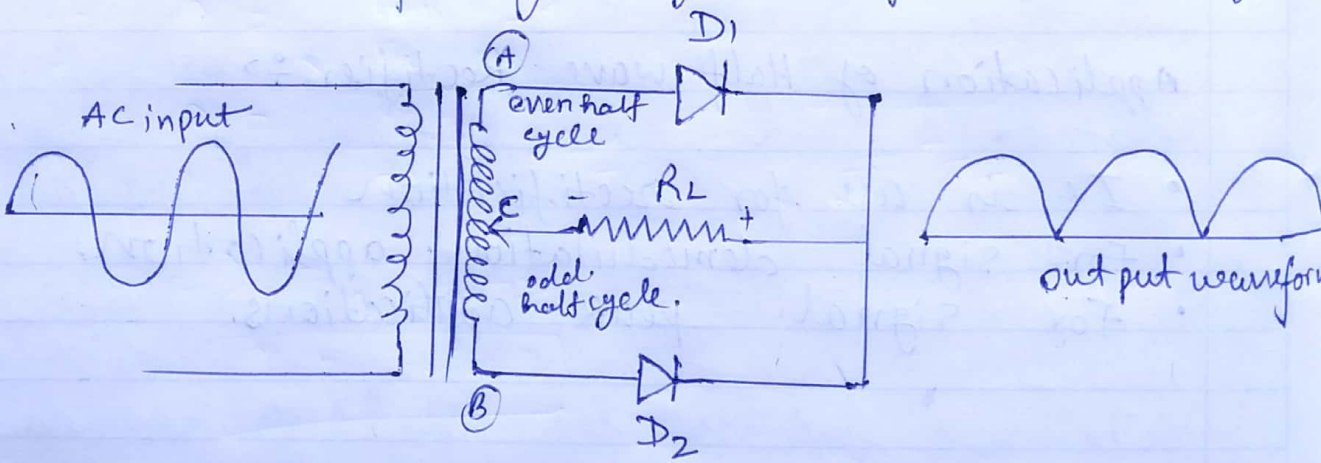
B. Sc. Part-2, Physics (Hons), Paper-IV
Lecture-No-41

- Full wave Rectifier :-
A Full wave rectifier is a circuit, which convert an AC voltage into a pulsating dc voltage using both half cycles of the applied AC voltage. It uses two diodes of which one conduct during one half cycle while the other conducts during the other half cycle of the applied AC voltage.



During the positive half cycle of the input voltage, Diode D_1 becomes forward biased and D_2 becomes reverse biased. Hence D_1 conduct and D_2 remain off. The load current flows through D_1 and the voltage drop across R_L will be equal to the input voltage.

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During the negative half cycle of the input voltage, diode D_1 becomes reverse biased and D_2 becomes forward biased. Hence D_1 remains off and D_2 conducts. The load current flows through D_2 and the voltage drop across R_L will be equal to the input voltage.

- **Ripple Factor :->**

The ripple factor for a Full wave rectifier is given as

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

Now the average voltage or DC voltage available across the load resistance is

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

where V_m is the maximum peak voltage. Peak inverse voltage of the full wave rectifier is $2V_m$.

$$V_{dc} = \frac{1}{\pi} V_m \left(-\cos \omega t\right)_0^{\pi}$$

$$\boxed{V_{dc} = \frac{2V_m}{\pi}}$$

$$I_{dc} = \frac{V_{dc}}{R_L} = \frac{2V_m}{\pi R_L}$$

$$I_{dc} = \frac{2}{\pi}\left(\frac{V_m}{R_L}\right)$$

$$\boxed{I_{dc} = \frac{2I_m}{\pi}} \qquad \left(\because I_m = \frac{V_m}{R_L}\right)$$

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Rms value of the voltage at the load resistance is

$$V_{rms} = \left[\frac{1}{\pi}\int_0^{\pi} V_m^2 \sin^2 \omega t \, d(\omega t)\right]^{1/2}$$

$$V_{rms} = \left[\frac{1}{\pi} \times V_m^2 \times \frac{\pi}{2}\right]^{1/2}$$

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

$$I_{rms} = \frac{V_{rms}}{R_L} = \frac{1}{\sqrt{2}}\left(\frac{V_m}{R_L}\right)$$

$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

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

$$\gamma = \sqrt{\left(\frac{V_m/\sqrt{2}}{2V_m/\pi}\right)^2 - 1} = \sqrt{\left(\frac{\pi}{\sqrt{8}}\right)^2 - 1}$$

$$\gamma = \sqrt{\frac{\pi^2}{8} - 1}$$

$$\boxed{\gamma = 0.482}$$

Efficiency :-

Efficiency (η) is the ratio of dc output power to AC input power.

$$\eta = \frac{P_{dc}}{P_{AC}} = \frac{V_{dc}^2/R_L}{V_{rms}^2/R_L}$$

$$\eta = \frac{(2V_m/\pi)^2}{(V_m/\sqrt{2})^2} = \frac{4 \times 2}{\pi^2} = 0.812$$

$$\boxed{\eta = 81.2\%}$$

The maximum efficiency of a full wave rectifier is 81.2%.

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