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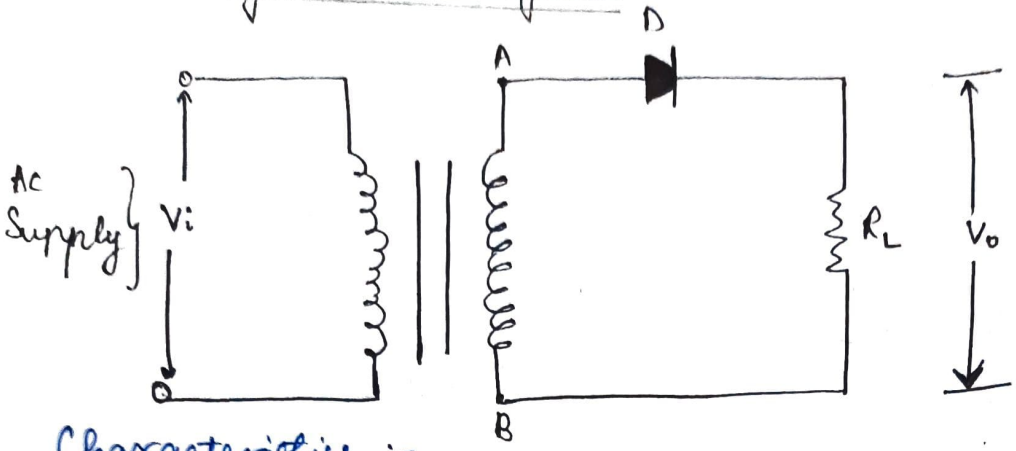
Electronics Assignment

Ans 1) **Half Wave Rectifier**

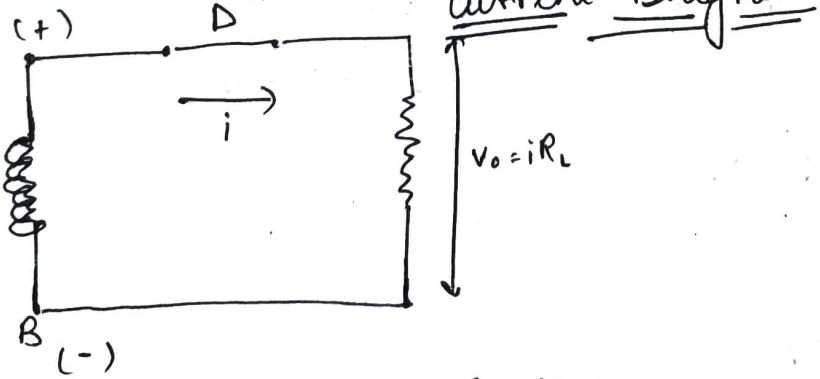


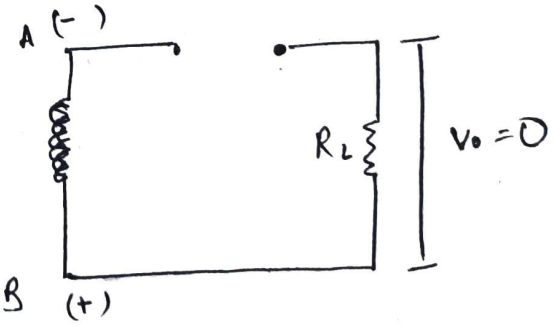
Characteristics :-

i) In half wave rectifier, single diode is used
ii) It gives output only in one cycle.
iii) Step-down transformer is used.

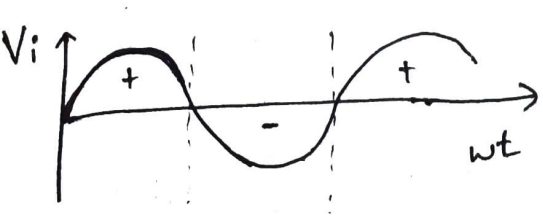
Working :- During the first half cycle of AC input, when terminal A of secondary is suppose positive and B is negative. The diode is forward based, Hence it conducts and current flows through load. During the second half cycle of AC input the terminal A is negative and B is positive. The diode is now reverse based. Hence there is almost zero current and zero output voltage across R_L. The process is repeated. Thus the output current is unidirectional, but intermittant and pulsating.

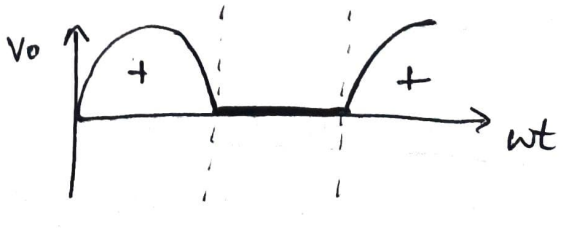
Current Diagram





Waveform :-





Ripple factors:-

$RF = \frac{\text{rms value of ac component of O/P}}{\text{dc value}}$

$V_{rms}^2 = V_{(ac)rms}^2 + V_{dc}^2$

$V_{(ac)rms} = \sqrt{V_{rms}^2 - V_{dc}^2}$

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

$R.F = \sqrt{(F.F)^2 - 1}$ (F.F - form factor)

$F.F = \frac{V_{rms}}{V_{avg}} = \frac{V_{m/2}}{V_{m/\pi}} = \frac{\pi}{2} = 1.57$

$R.F = \sqrt{(1.57)^2 - 1}$

$\boxed{R.F = 1.21 \quad (\text{Ans})}$

* **Efficiency:** $\eta\% = \frac{\text{O/P DC power}}{\text{I/P AC power}} \times 100\%$

$= \frac{I_{dc}^2 R}{I_{rms}^2 R} \times 100\%$ $\quad \{ I_{dc} = I_m/\pi,\ I_{rms} = I_m/2 \}$

$= \frac{4}{\pi^2} \times 100\%$

$\boxed{\eta\% = 40.56\%}$

* **% Regulation:**

$\% = \frac{V_{dc}(\text{no load}) - V_{dc}(\text{full load})}{V_{dc}(\text{full load})} \times 100\%$

V_{dc} (no load) $= V_m / \pi$

V_{dc} (full load) $= I_{dc} \times R_L = \frac{I_m}{\pi} \times R_L$

$= \frac{V_m R_L}{\pi (R_L + R_s + R_f)}$ $\left\{ I_m = \frac{V_m}{R_s + R_f + R_L} \right\}$

On putting these values in equation

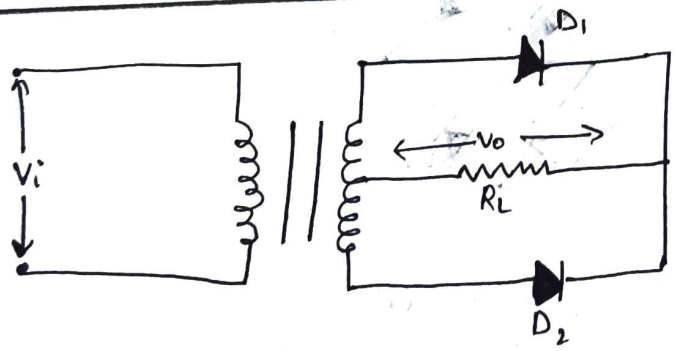
$$\% \text{ regulation} = \frac{\frac{V_m}{\pi} - \frac{V_m R_L}{\pi (R_s + R_L + R_f)}}{\frac{V_m R_L}{\pi (R_L + R_s + R_f)}} \times 100\%.$$

On solving,

$$= \frac{R_L + R_s + R_f - R_L}{R_L} \times 100\%.$$

$$\therefore \quad \% \text{ Regulation} = \frac{R_s + R_f}{R_L} \times 100\%.$$

FULL WAVE RECTIFIER

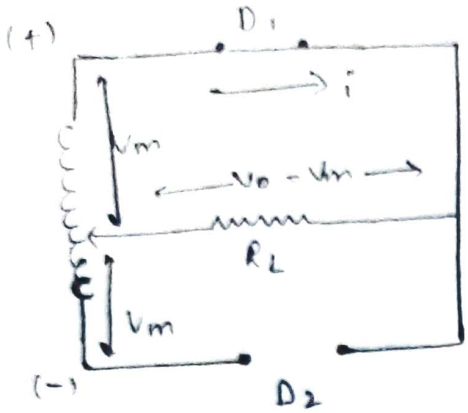


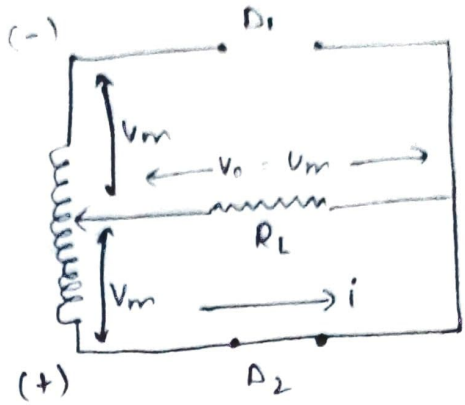
Characteristics :-

- Two diodes are used in full wave centre taped rectifier
- Secondary winding of transformer is centre taped for using TUF (Transformer utilisation factor)

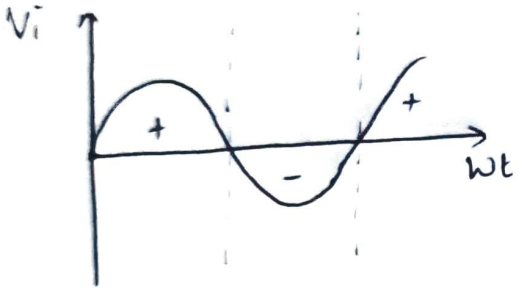
Working – During positive half cycle diode D_1 become forward biased and act as short circuit and diode D_2 become reverse biased and act as open circuit. Diode D_1 conduct the current through R_L

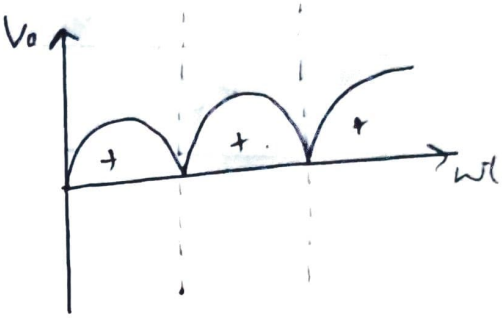
and gives O/P.
During the negative half cycle, diode D_1 become reverse bias and act as open circuit and diode D_2 become forward bias and act as short circuit diode D_2 conducts the current through load resistance R_L and gives output.



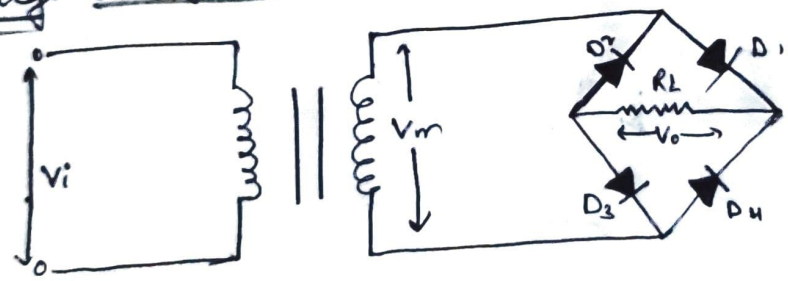


* **Waveform**





* **Bridge Rectifier**

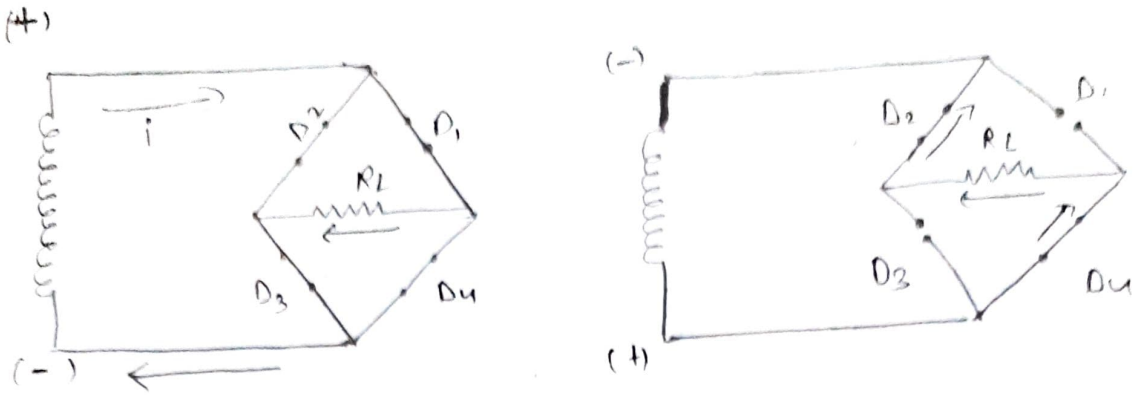


Characteristics :-

* Four diodes are used in bridge rectifier.
* Bridge rectifier offers full wave rectification
* Bridge combination of diode is connected with secondary winding of transformer.

Working :- During positive half cycle, diode D_1 and D_3 become forward bias and D_2, D_4 become reverse bias. Diode D_1 and D_3 acts as short circuit and passes the current through R_L. Diode D_2 and D_4 act as open circuit and do not conduct the current

During the negative half cycle, D_1 and D_4 act as forward bias and D_2 and D_3 become reverse bias. Diode D_2 and D_4 conduct the current through R_L.



* **Ripple factor**

$$R.F = \sqrt{(F.F)^2 - 1}$$

$$F.F = \frac{V_{rms}}{V_{avg}} = \frac{V_m/\sqrt{2}}{2V_m/\pi} = \frac{\pi}{2\sqrt{2}} = 1.11$$

$$R.f = \sqrt{(1.11)^2 - 1} \Rightarrow \boxed{R.F = 0.48}$$

* **Efficiency**

$$\eta\% = \frac{\text{O/P DC power}}{\text{I/P AC power}} \times 100\%.$$

$$= \frac{I_{dc}^2 R}{I_{rms}^2 R} \times 100\% = \frac{4 I_m^2/\pi^2}{I_m^2/2} \times 100\%.$$

$$\left\{ I_{dc} = 2I_m/\pi \right\}$$
$$\left\{ I_{rms} = I_m/\sqrt{2} \right\}$$

$$= \frac{8}{\pi^2} \times 100\%.$$

$$\eta\% = 81.13\%$$

* **% regulation :-**

$$\% \text{ regulation} = \frac{V_{dc}(\text{no load}) - V_{dc}(\text{full load})}{V_{dc}(\text{full load})} \times 100\%.$$

$$V_{dc}(\text{no load}) = 2\frac{V_m}{\pi}$$

$$V_{dc}(\text{full load}) = \frac{2V_m}{\pi} \cdot \frac{R_L}{R_s + R_L + R_f}$$

$$\%\ \text{regulation} = \frac{\frac{2V_m}{\pi} - \frac{2V_m}{\pi}\left\{\frac{R_L}{R_L + R_s + R_f}\right\}}{\frac{2V_m}{\pi} \cdot \frac{R_L}{R_L + R_s + R_f}}$$

$$= \frac{\frac{2V_m}{\pi}\left\{1 - \frac{R_L}{R_s + R_L + R_f}\right\}}{\frac{2V_m}{\pi} \cdot \frac{R_L}{R_L + R_s + R_f}}$$

$$\boxed{\%\ \text{regulation} = \frac{R_f + R_s}{R_L} \times 100\%}$$

* Comparitive study of half wave, centre top and bridge rectifier :-

	Half wave	Centre-top	Bridge
Ripple factor	1.21	0.48	0.48
Efficiency	40.6%	81.13%	81.13%
% regulation	0%	0%	0%