# EXPERIMENT No. 13.

**AIM** → To study the rectifying circuits.

**APPARATUS** → Transformer, ~~power~~ diodes, resistance box, CRO.

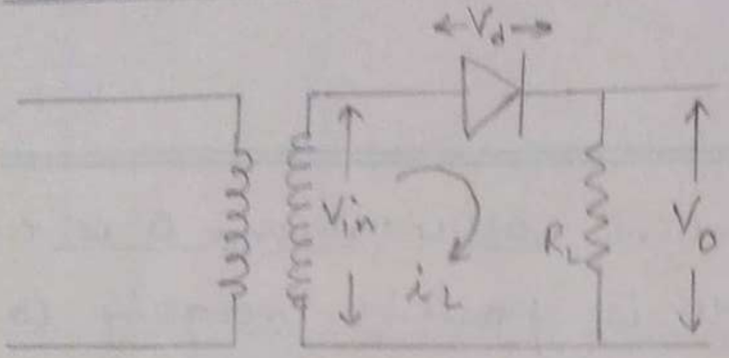


**THEORY** → Rectifier is a device which is used to transform or convert an alternating signal to a direct current signal. This type of device consists of an arrangement which presents a much higher resistance to an electric current flowing in one direction than in the other. These circuits are of two types :-

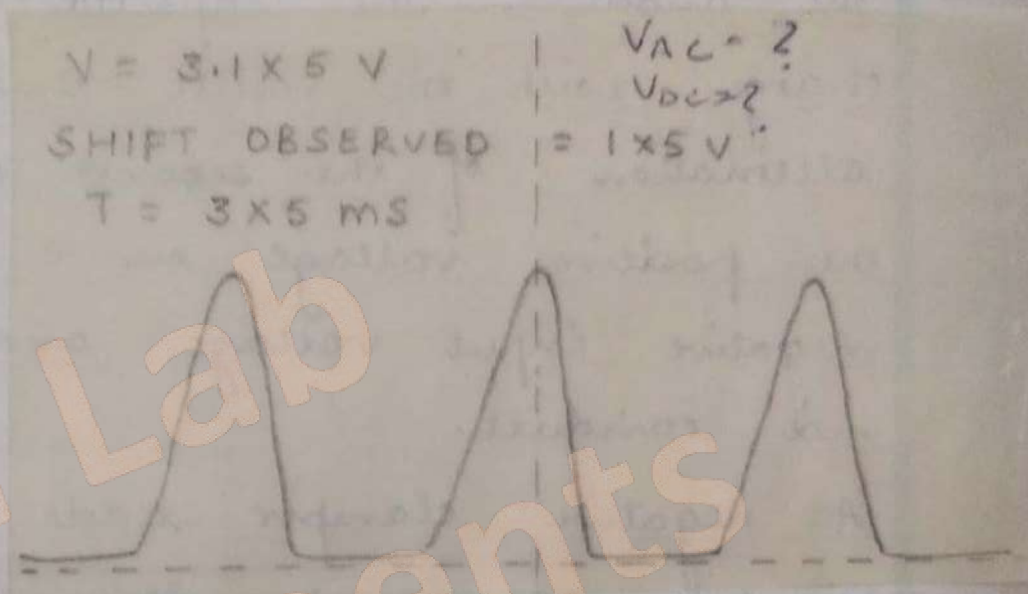
(i) Half wave Rectifier – It rectifies only half of the input signal. It consists of only one diode which conducts only when it is forward biased. Thus, the output is half rectified.

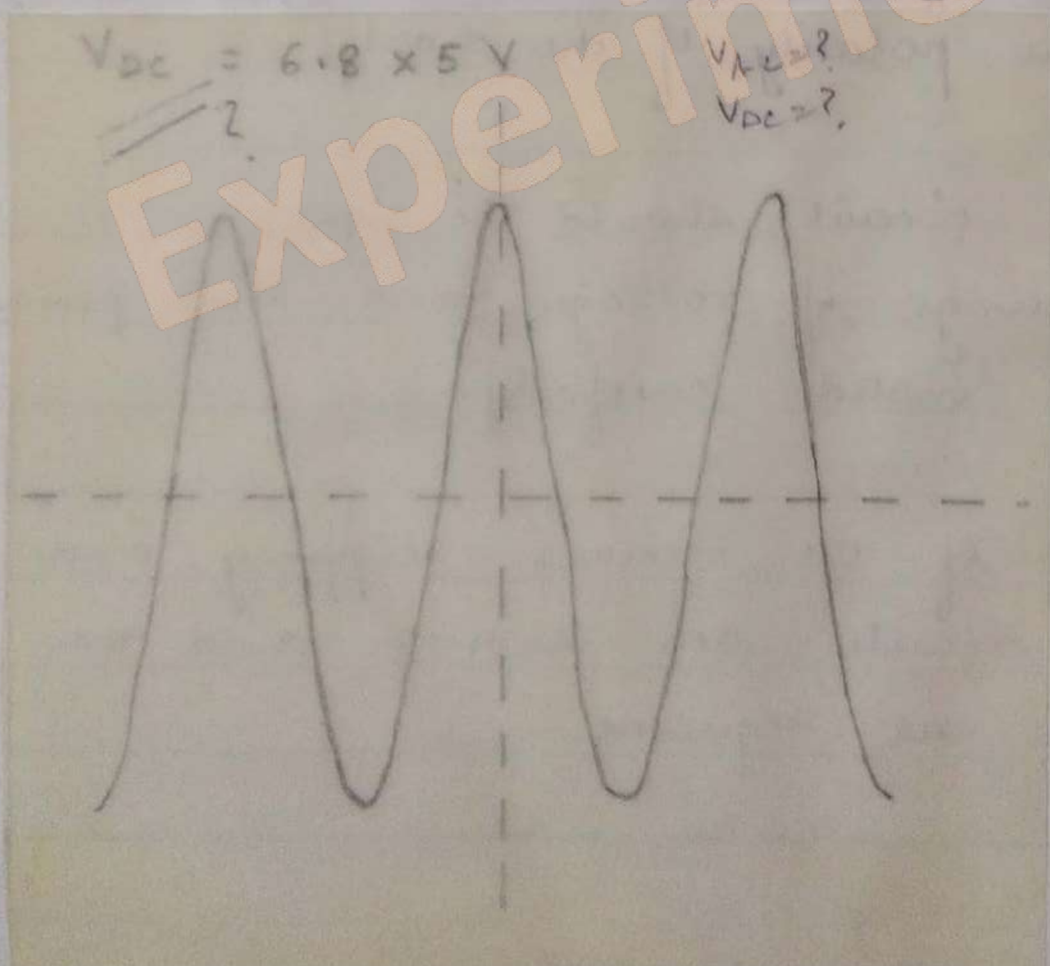
(ii) Full wave rectifier – This device converts the whole ac input into dc output. There is are two diodes which are arranged in such a manner that only one of them conducts in

# HALF WAVE RECTIFIER

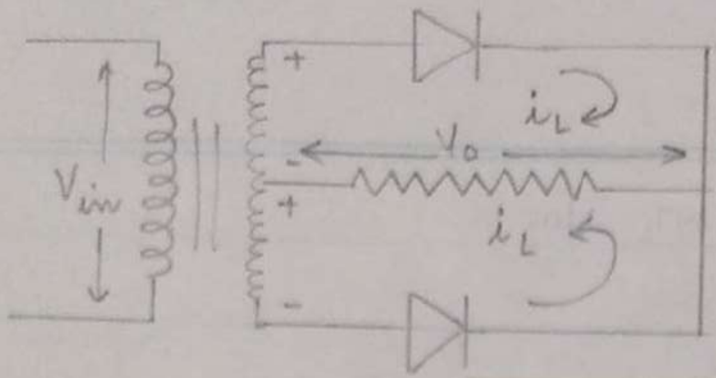




## FULL WAVE RECTIFIER.

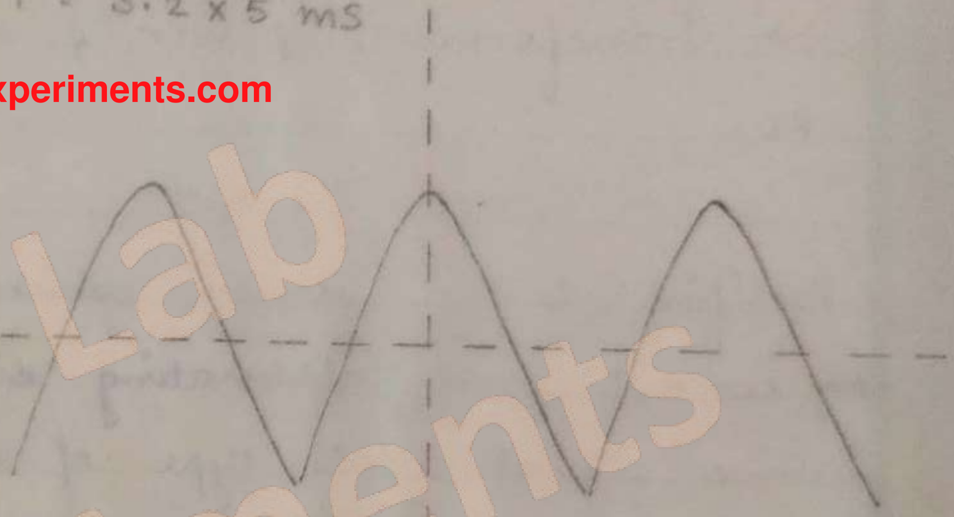



V = 3.4 x 5 V $V_{AC}$ = ?

SHIFT OBSERVED = 2 x 50 mV $V_{DC}$ = ?

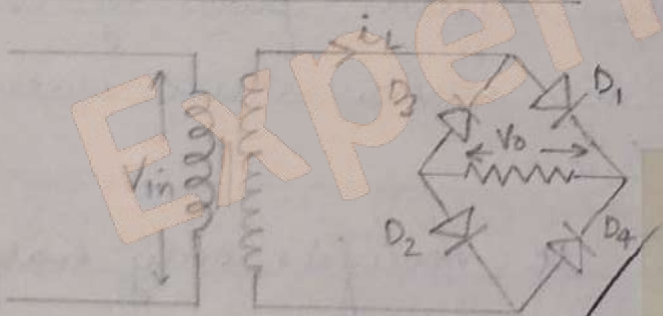
T = 3.2 x 5 ms







## BRIDGE RECTIFIER -

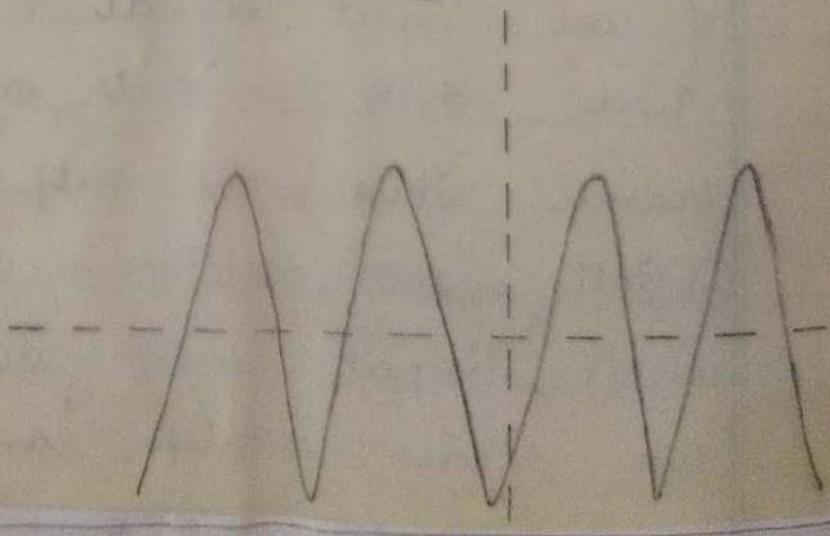



V = 3.8 x 5 V $V_{AC}$ = ?

$V_{DC}$ = ?

SHIFT OBSERVED = 2.5 x 5 V

T = 1.8 x 5 ms



positive half of the cycle and other conducts in the second half.



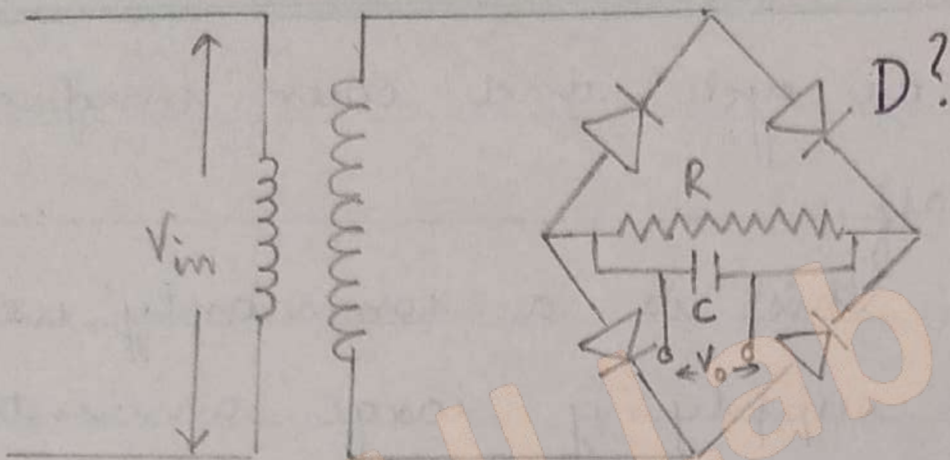
**Bridge Rectifier** – This is a commonly used circuit used for supplying large amounts of dc power. The network of this device contains 4 diodes. During the positive half of the cycle $D_1$ and $D_2$ conduct and give a voltage across $R_L$. In negative half of the cycle, $D_3$ and $D_4$ conduct. Thus, both the cycles are being conducted and full rectification can be seen.

RIPPLE FACTOR – The object of a rectifier to convert ac to dc. A measure of how successful a circuit is doing, is called the Ripple Factor, r.

$$r = \frac{V_{rms}}{V_{dc}} = \frac{I_{rms}}{I_{dc}}.$$

For a half wave rectifier, the ripple factor is 1.21. This shows that a significant amount of ac component is present in the dc output i.e. the rectification of this device is very poor.

For a full wave rectifier, the ripple factor is 0.482, which is very small as compared to that of a half wave rectifier. This shows that only small




$V = \cdot 5 \times \cdot 5\,V$

$V_{AC} = ?$
$V_{DC} = ?$

SHIFT OBSERVED = $\cdot 2 \times \cdot 5\,V$

$T = 1\cdot 8 \times 5\,ms$

$C = 220\,\mu F$

amount of ac is present in the dc output rectification.

PROCEDURE → 1. Make the connections as shown the diagram.

2. First measure the dc voltage across the transformer.

3. Then connect the CRO across the resistor and take the output.

4. Measure the shift in the waveform keeping the terminal of the CRO to dc and then to ac.

5. Repeat the same procedure for the full wave and bridged rectifier.



OBSERVATIONS → $V_{dc} = 6.8 \times 5$ V

$R_L = 1000\ \Omega$ for half wave rectifier and full wave rectifier

$R_L = 2000\ \Omega$ for bridge rectifier.

$C = 220\ \mu F$.

$V_{dc} = 1V$

$I_{dc} = 1.53\ mA$



$V_{rms} = \frac{V_m}{2} = 1.5V$ ($V_m = 3V$)

$r = \sqrt{\frac{V_{rms}^2 - V_{dc}^2}{V_{dc}}} = \sqrt{\frac{2.25 - 1}{1}}$

$= \sqrt{1.25} = 1.12$

~~$I_{rms} =$~~ $= \frac{I_m R_L}{\pi}$

$I_m = \frac{V_{dc}}{R_L} \times \pi = \frac{1}{1000} \times \pi = 3.14\ mA$

$I_{dc} = 1.53A$

$I_{dc} = \frac{V_{dc}}{R_L} = \frac{1}{1000} = 1mA$

$I_{rms} = \frac{I_m}{2} = 1.57\ mA$

$r = \sqrt{\frac{I_{rms}^2 - I_{dc}^2}{I_{dc}}} = \sqrt{\frac{(1.57)^2 - (1.53)^2}{1}}$

$=$

CALCULATIONS → 1. Half Wave Rectifier

$$V_{dc} = \frac{I_m R_L}{\pi} \quad \therefore, \quad I_m = \frac{V_{dc} \times \pi}{R_L}$$

$$I_m = \frac{6.8 \times 5 \times 3.14}{1000} = 106.76 \times 10^{-3} A$$

Now, $$I_{dc} = \frac{V_{dc}}{R_L} = \frac{6.8 \times 5}{1000} = 34 \times 10^{-3} A$$

$$I_{rms} = \frac{I_m}{2} = \frac{106.76 \times 10^{-3}}{2} = 53.38 \times 10^{-3} A$$

$\therefore$, ripple factor $$\gamma = \frac{\sqrt{I_{rms}^2 - I_{dc}^2}}{I_{dc}}$$

$$= \frac{\sqrt{(53.38 \times 10^{-3})^2 - (34 \times 10^{-3})^2}}{34 \times 10^{-3}}$$

$$= \frac{\sqrt{2849.424 \times 10^{-6} - 1156.000 \times 10^{-6}}}{34 \times 10^{-3}}$$



$$= \frac{41.151}{34} = 1.21$$

## FWR

$V_m = 2.4V$ $V_{dc} = 1.4V$ $I_{dc} = 2.6mA$

$V_{rms} = \frac{V_m}{\sqrt{2}} = 1.69 V$

$$r = \frac{\sqrt{V_{rms}^2 - V_{dc}^2}}{V_{dc}} = \frac{\sqrt{1.69^2 - 1.4^2}}{1.4V} = \frac{.96}{1.4}$$

$= 0.684$

(multimeter)

$I_{dc} = 2.6mA$

$I_{rms} =$

2. Full wave Rectifier.

$V_{dc} = \frac{2 I_m}{\pi} \times R_L$ where $I_{dc} = \frac{2 \cdot I_m}{\pi}$

$\therefore I_{dc} = \frac{V_{dc}}{R_L} = \frac{6.8 \times 5}{1000} = 34 \times 10^{-3}$ A

$I_m = \frac{\pi}{2} I_{dc} = \frac{3.14 \times 34 \times 10^{-3}}{2}$

$= 53.38 \times 10^{-3}$ A

$I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{53.38 \times 10^{-3}}{1.414} = 3.775 \times 10^{-2}$ A

$\therefore$ Ripple factor $\gamma = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$

$= \sqrt{\left(\frac{37.75 \times 10^{-3}}{34 \times 10^{-3}}\right)^2 - 1}$

$= \sqrt{\frac{1425.0 \times 10^{-6}}{1156.0 \times 10^{-6}} - 1}$



$= 0.482$

3. The ripple factor of bridge network is same as that of full wave rectifier $= 0.482$