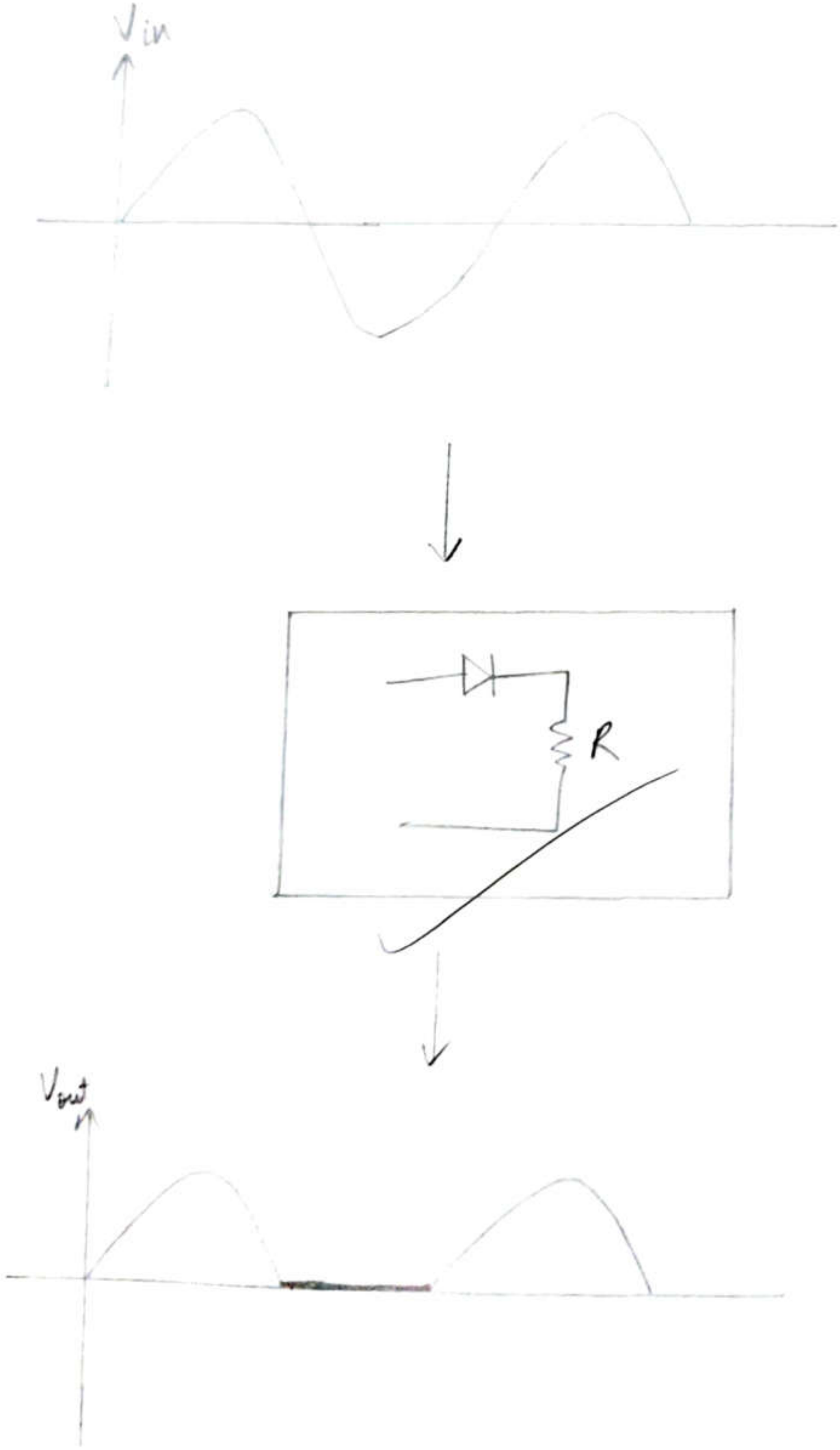

Vin
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EXPERIMENT - 5

Objective - Study of single phase half wave uncontrolled rectifier.

(1.) explain rectification.
(2.) explain Half wave rectification
(3.) explain Half wave rectification : For +ve half cycle.
(4.) explain Half wave rectification : For -ve half cycle.

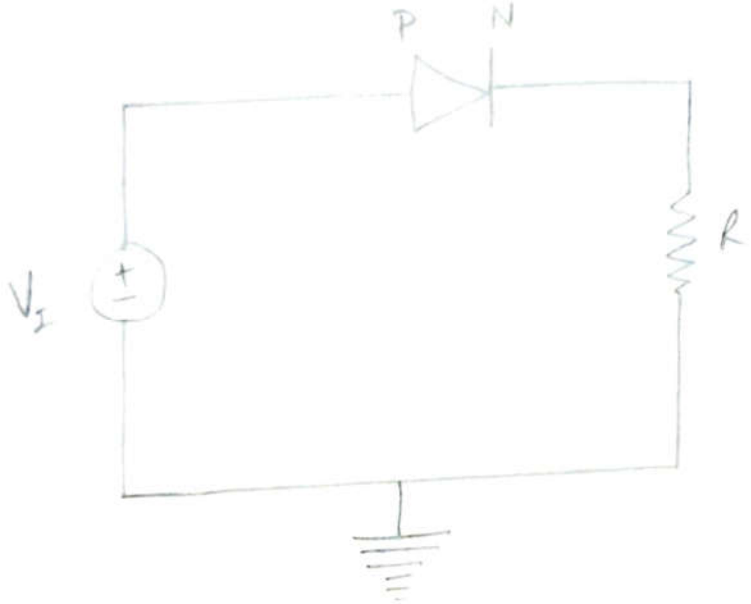
Apparatus Required - AC source, Resistive load, diode.

- Rectification -

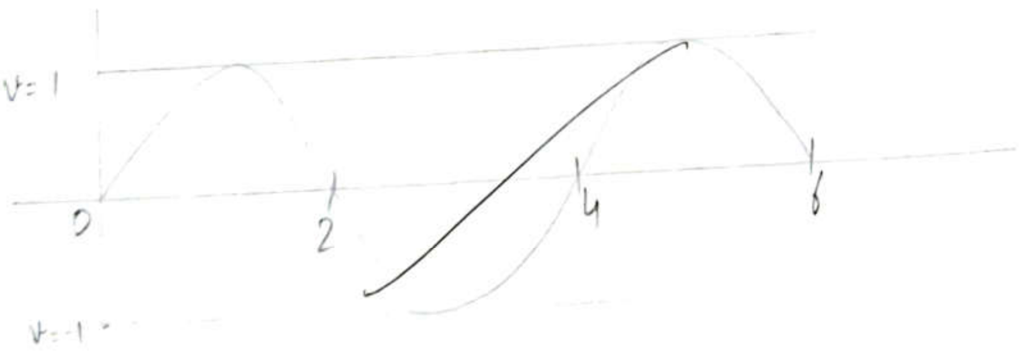
Alternating current → (Rectifier) → Direct current

A rectifier is a device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers are essentially of two types - a half wave rectifiers and a full wave rectifier.

- Half Wave Rectification -
On the positive cycle the diode is forward biased. By using a diode we have converted an AC source into a pulsating DC source. In summary we have 'rectified' the AC signal.
The simplest kind of rectifier circuit is the half wave rectifier. The half wave rectifier is a circuit that allows only part of an input signal to pass.



Half Wave Rectifiers - Waveforms



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The circuit is simply the combination of a signal diode in series with a resistor, where the resistor is acting as a load.

- Half wave Rectifiers -

The output DC voltage of a half wave rectifier can be calculated with the following two ideal equations.

$$V_{peak} = V_{rms} \times \sqrt{2}$$

$$V_{AC} = \frac{V_{peak}}{\pi}$$

where, V_I = Input voltage
V_b = bar

- Half wave Rectification - For +ve half cycle :

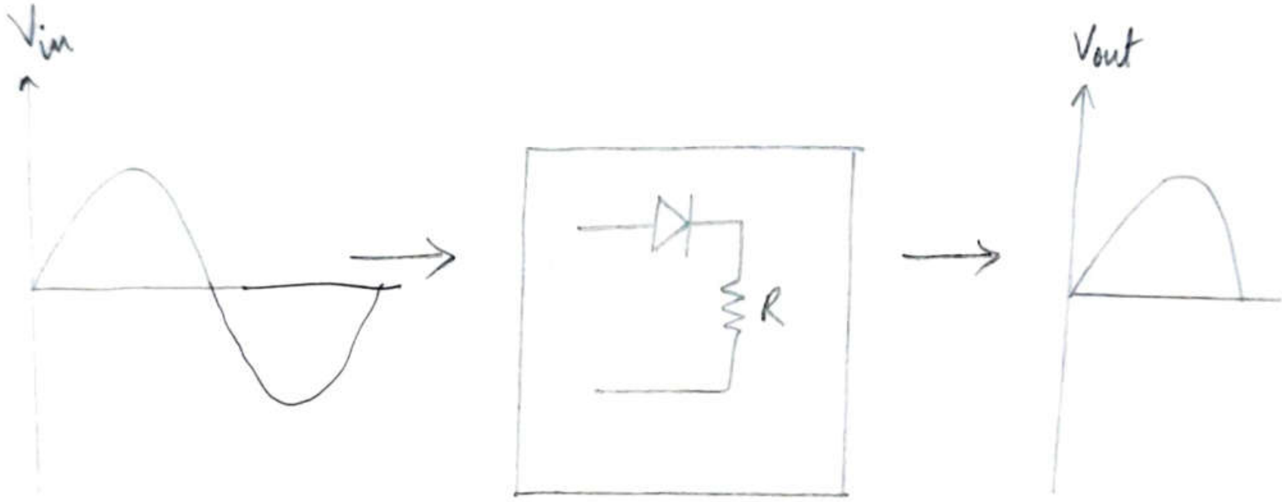
Diode is forward biased, acts as a short circuit passes the waveform through.

For +ve half cycle :

$$V_I - V_b - I r_d - IR = 0$$

where, V_I = input voltage
V_b = barrier potential
r_d = diode resistance
I = total current
R = resistance

$$I = \frac{V_I - V_b}{r_d + R}$$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$$V_0 = IR$$

$$V_0 = \frac{V_I - V_b}{r_d + R} \times R$$

for $r_d << R$

$$V_0 = V_I - V_b$$

V_b is 0.3 for germanium.
V_b is 0.7 for silicon.

- For $V_I < V_b$:
  The diode will remain off. The output voltage will be
  $$V_0 = 0$$

- For $V_I > V_b$:
  The diode will remain on. The output voltage will be,
  $$V_0 = V_I - V_b$$

Average output voltage-

$$V_0 = \cancel{V_m} \sin \omega t \quad , \forall \ 0 \leq \omega t \leq \pi$$

$$V_0 = 0 \quad , \forall \ \pi \leq \omega t \leq 2\pi$$

$$V_{av.} = \frac{V_m}{\pi} = 0.318 \ V_m$$

Observation Table -

Max. Input V	Theoritical V_{rms}	Practical V_{rms}
10V	5V	5.09V

Calculations -

$$\text{diff. percentage} - \frac{|\text{practical} - \text{Theo.}|}{\text{Theo.}} \times 100$$

$$= \frac{|5.09 - 5|}{5} \times 100$$

$$= \underline{\underline{18\%}}$$

- RMS load voltage -

$$V_{rms} = I_{rms} R = \frac{V_m}{2}$$

- Average load current -

$$I_{av} = \frac{V_{av}}{R} = \frac{\frac{V_m}{\pi}}{R}$$

$$I_{av} = \frac{V_m}{\pi R} = \frac{I_m}{\pi}$$

- RMS load current -

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

- Form factor - It is defined as the ratio of rms load voltage and average load voltage

$$F.F. = \frac{V_{rms}}{V_{av.}}$$

$$F.F. = \frac{\frac{V_m}{2}}{\frac{V_{av}}{2}} = \frac{\pi}{2} = 1.57$$

$F.F. \geq 1$

$rms \geq avg.$

for a time duration ΔT

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- Ripple Factor -

$$\gamma = \sqrt{F.F^2 - 1} \times 100\%$$

$$\gamma = \sqrt{1.57^2 - 1} \times 100\%$$

$$\gamma = 1.21\%$$

- Efficiency - It is defined as the ratio of dc power available at the load to the input ac power

$$\eta\% = \frac{P_{load}}{P_{in}} \times 100\%$$

$$\eta\% = \frac{I_{dc}^2 \times R}{I_{rms}^2 \times R} \times 100\%$$

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

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

$$= 40.56\%$$

Result - We have studied a single phase Half wave rectifier and wave forms are shown.

24/01/22