COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

AC Power Converter

EET 307

Lecture 3

- Half Wave Rectifier -

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Dr. Zaidoon AL-Shammari

Lecturer / Researcher

zaidoon.waleed@mustaqbal-college.edu.iq

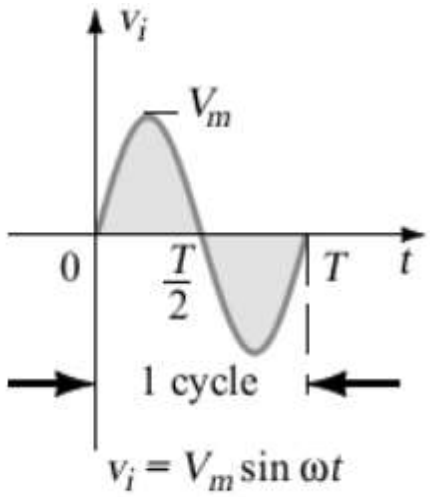
Diode Rectifiers

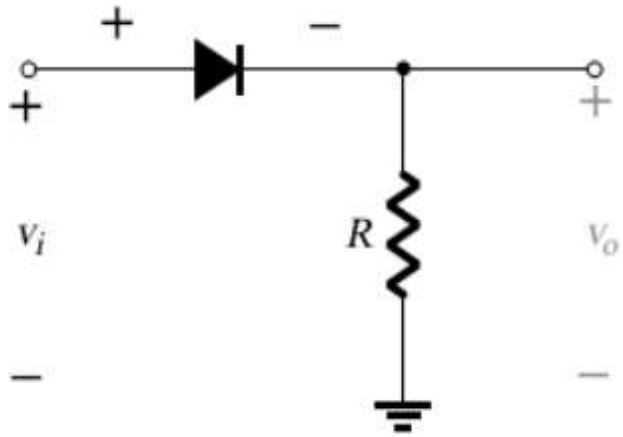
- Because of their ability to conduct current in one direction and block current in the other direction, diodes are used in circuits called rectifiers that convert AC voltage into DC voltage.

- Rectifiers are found in all DC power supplies that operate from an AC voltage source.

Half Wave Rectifier

- In a half-wave rectification, a diode is connected to an AC source that provides the input voltage, V_{in} to a load resistor, as shown in below.





Operation during positive region

- During the interval t = 0 → T/2 the polarity of the applied voltage V_i is such as to establish "pressure" in the direction indicated and turn on the diode with the polarity appearing above the diode.

- When the sinusoidal input voltage goes positive, the diode is forward-biased and conducts current through the load resistor (RL).

- The current produces an output voltage, V_{out}, across the load, which has the same shape as the positive half-cycle of the input voltage.

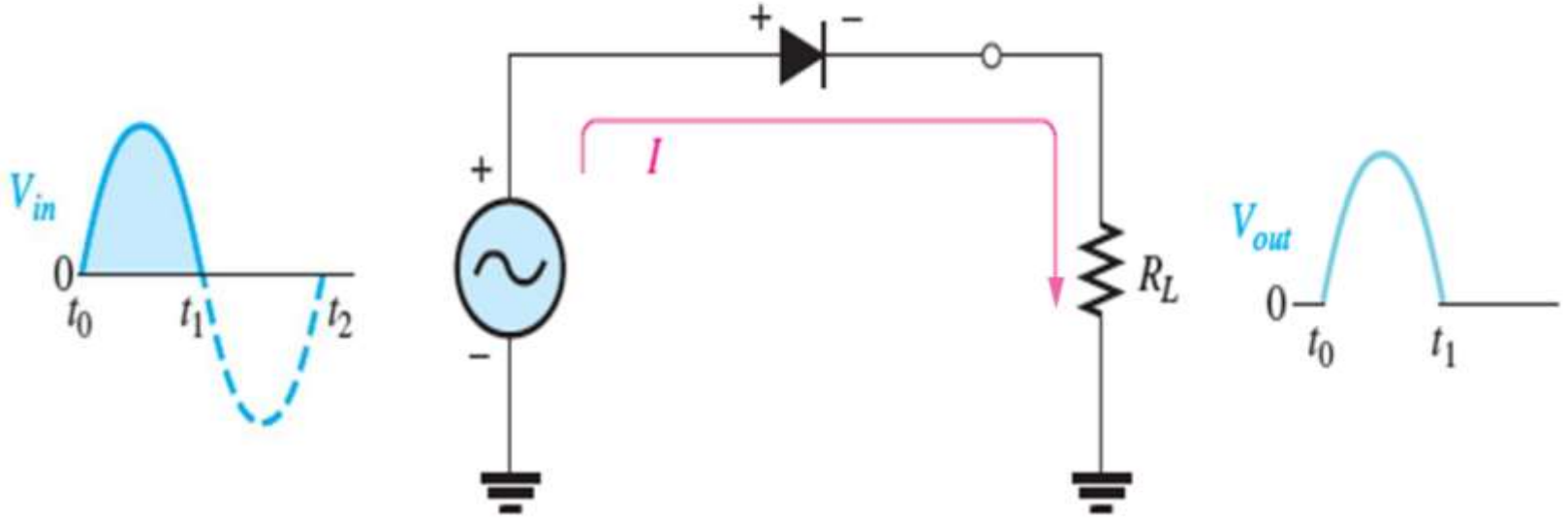
Operation during negative region

- When the input voltage goes negative during the second half of its cycle, the diode is reverse-biased.

- For the period T/2 → T, the polarity of the input V_i and the resulting polarity across the ideal diode produces an “off” state with an open-circuit equivalent.

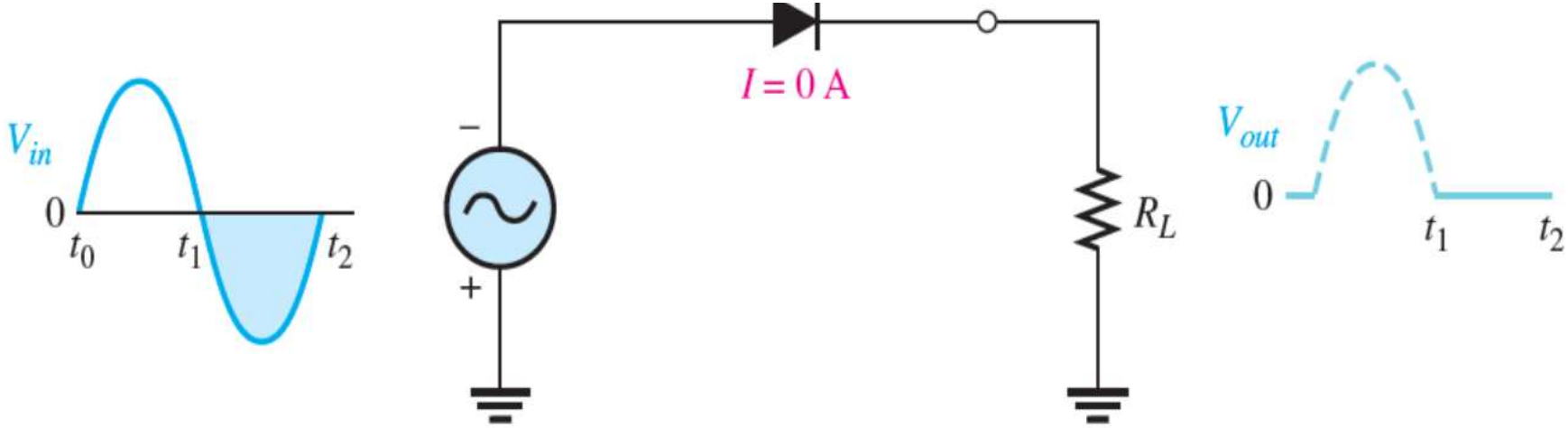
- There is no current, so the voltage across the load resistor is zero, as shown in below.

Operation during positive & negative region



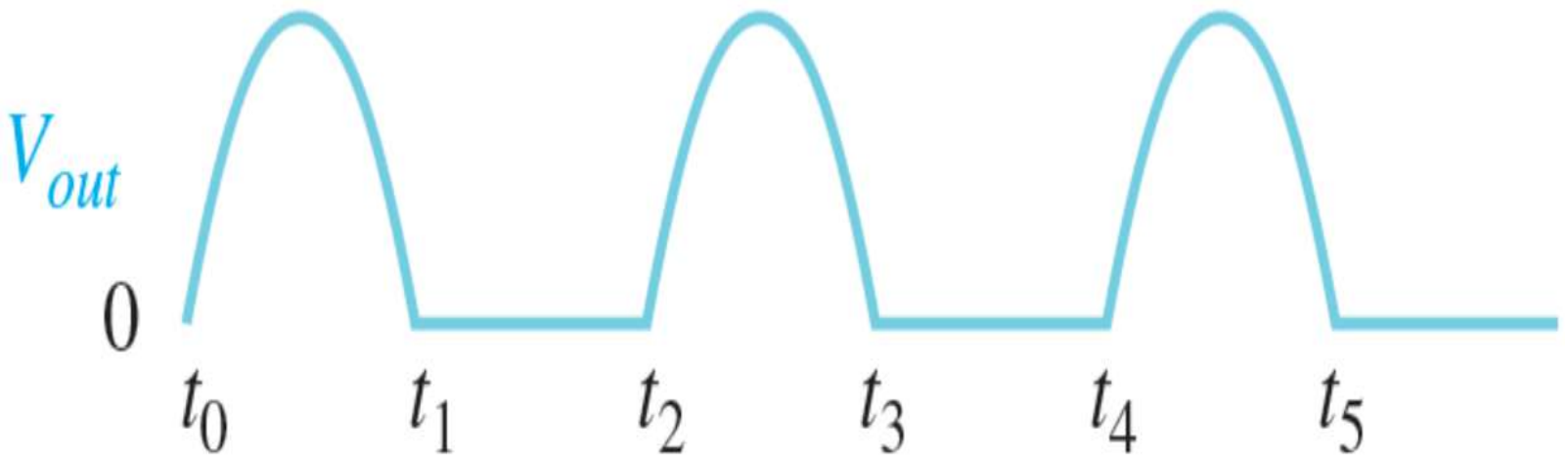
Positive region

Negative region



Half wave output voltage

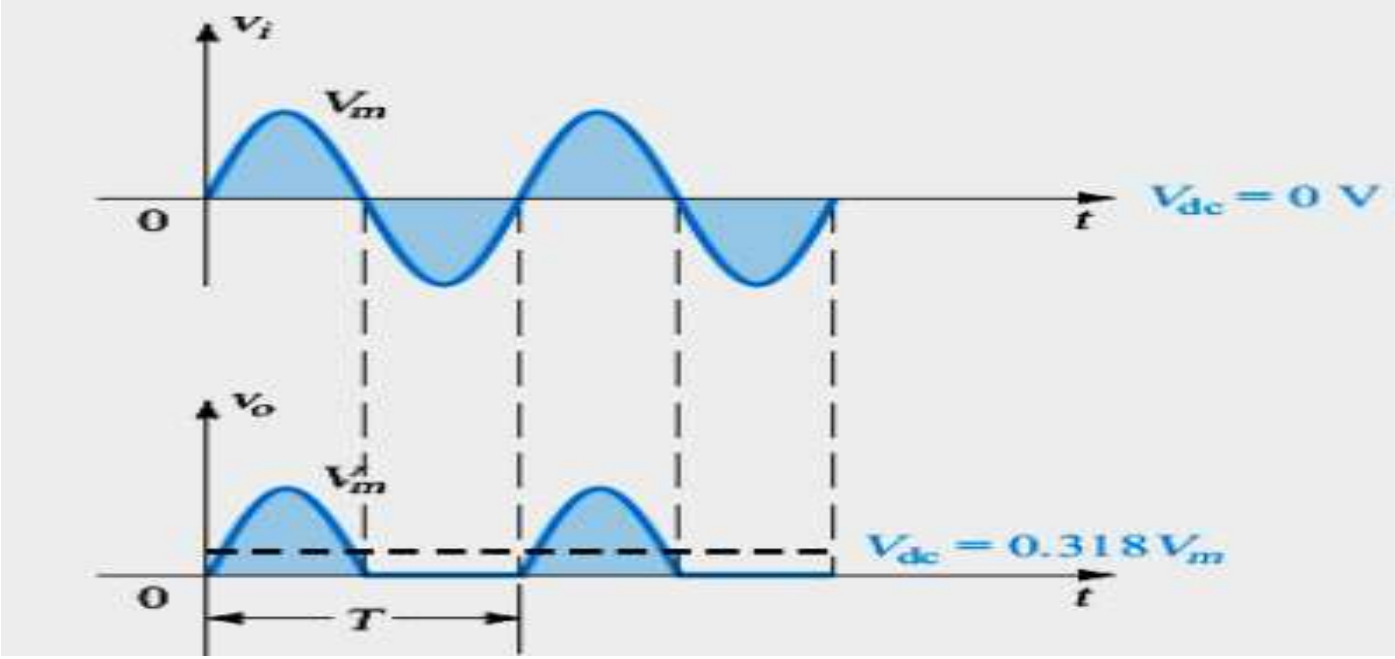
- The net result is that only the positive half-cycles of the AC input voltage appear across the load.



Average value of output voltage

- Average Value of the Half-Wave Rectified Output Voltage.
- The average value of a half-wave rectified output voltage is the value you would measure on a DC voltmeter.
- It can be calculated with the following equation, where $V_{p(out)}$ is the peak value of the half-wave rectified output voltage:

Average value of output voltage



$$V_{AVG} = \frac{V_{p(out)}}{\pi}$$

$$V_o = 0.318 V_m$$

Example 1

Determine is the average value of the half-wave rectified output voltage waveform in Figure below.

Solution:

$$V_{AVG} = \frac{V_{p(out)}}{\pi} = \frac{100}{3.14} = 31.84\,V$$

Example 2

Determine the average value of the half-wave rectified output voltage if its peak amplitude is 12 V.

Solution:

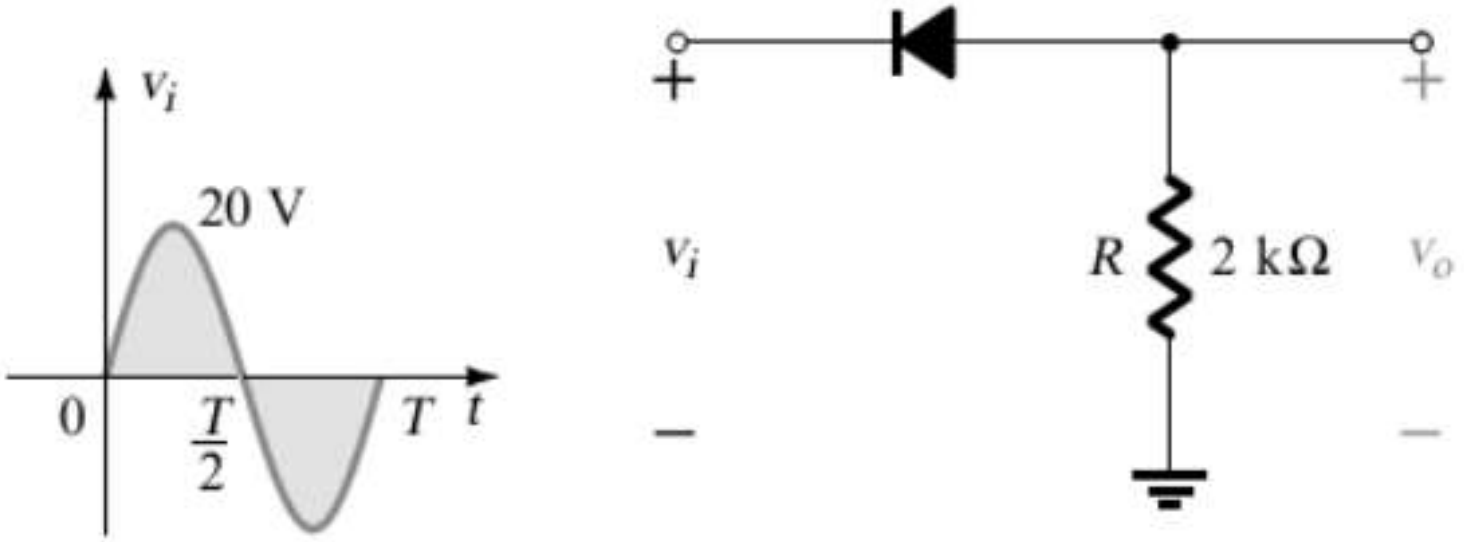
$$V_{AVG} = \frac{V_{p(out)}}{\pi} = \frac{12}{3.14} = 3.82\ V$$

Example 3

(a) Sketch the output V_o and determine the dc level of the output for the network of Figure Below.

(b) Repeat part (a) if the ideal diode is replaced by a silicon diode.

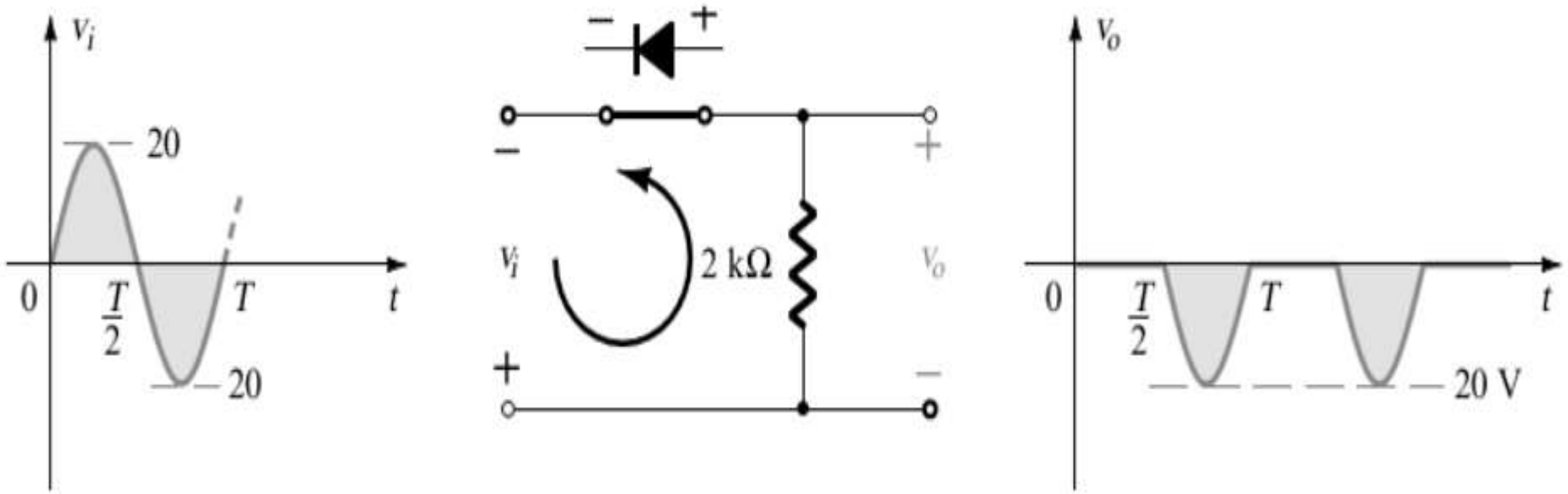
(c) Repeat parts (a) and (b) if V_m is increased to 200 V and compare solutions.



Solution

(a) In this situation the diode will conduct during the negative part of the input

$$V_{dc} = -0.318V_m = -0.318 \times 20 = -6.36V$$



Solution

(b) Using a silicon diode:

$$V_{dc} \cong -0.318(V_m - V_T) \cong -0.318(20 - 0.7) = -0.318 \times 19.3 \cong -6.14V$$

(c) $V_{dc} = -0.318V_m = -0.318 \times 200 = -63.6V$

$$V_{dc} = -0.318(V_m - V_T) = -0.318(200 - 0.7) = -0.318 \times 190.3$$
$$= -63.38V$$