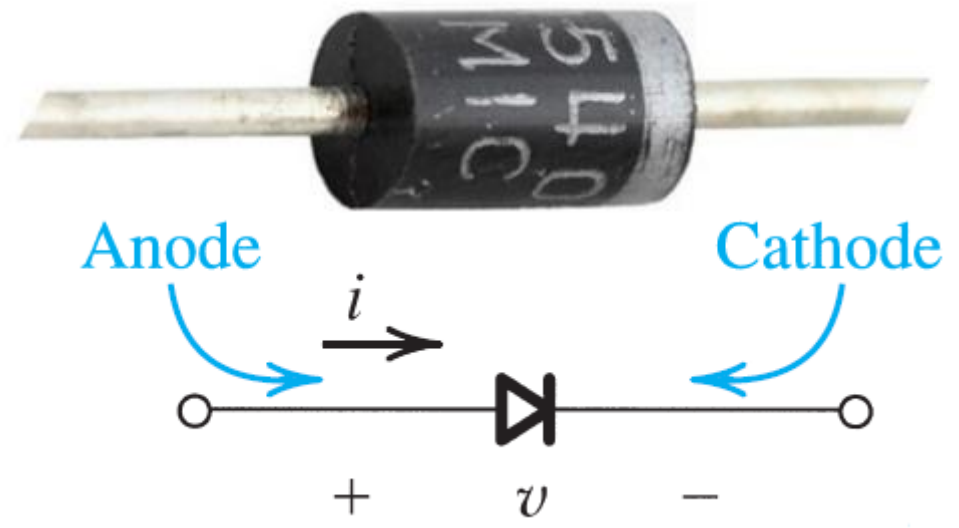


Diodes

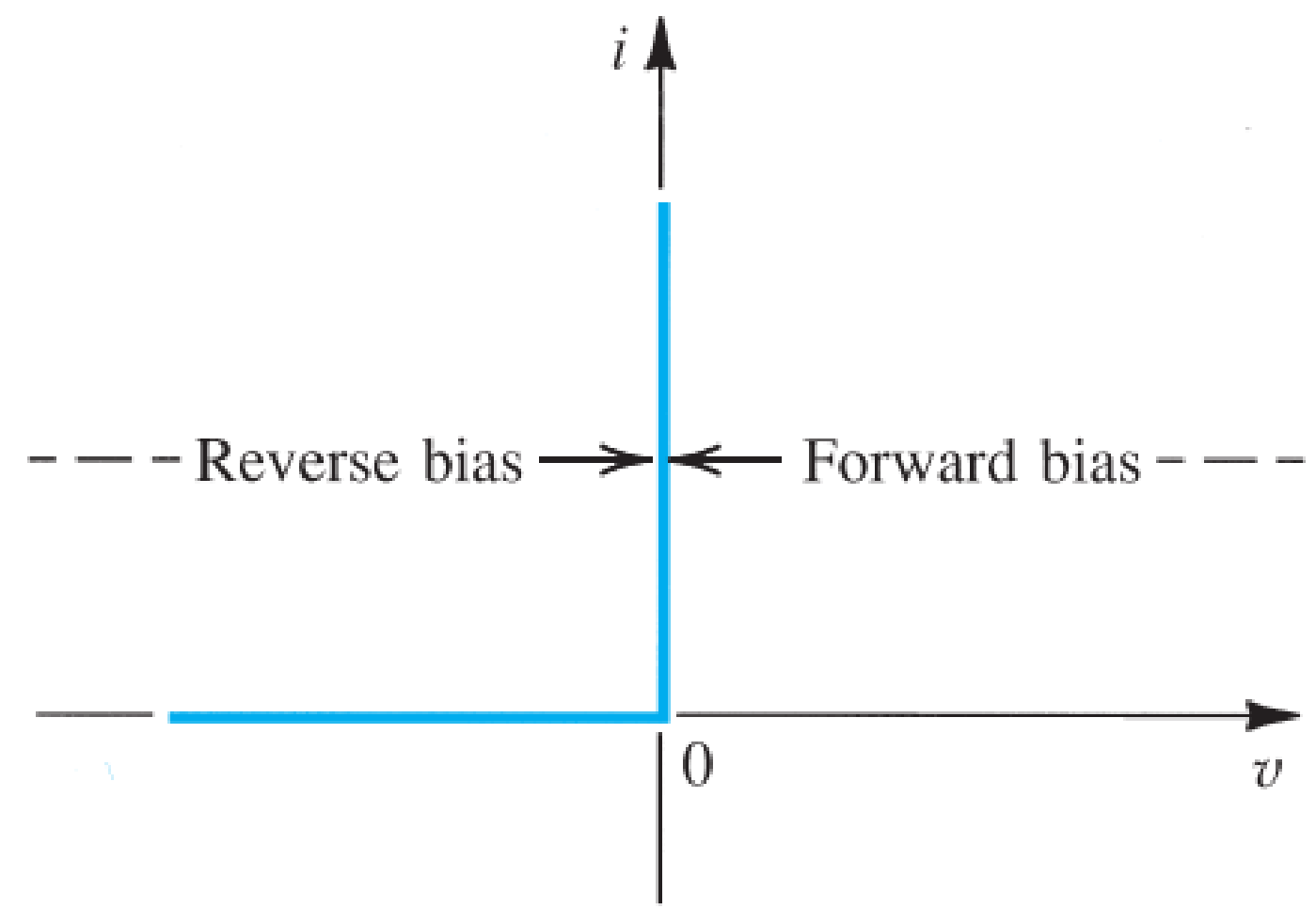
By: Dr. Mustafa Shiple

“Microelectronic Circuits” , Adel Sedra

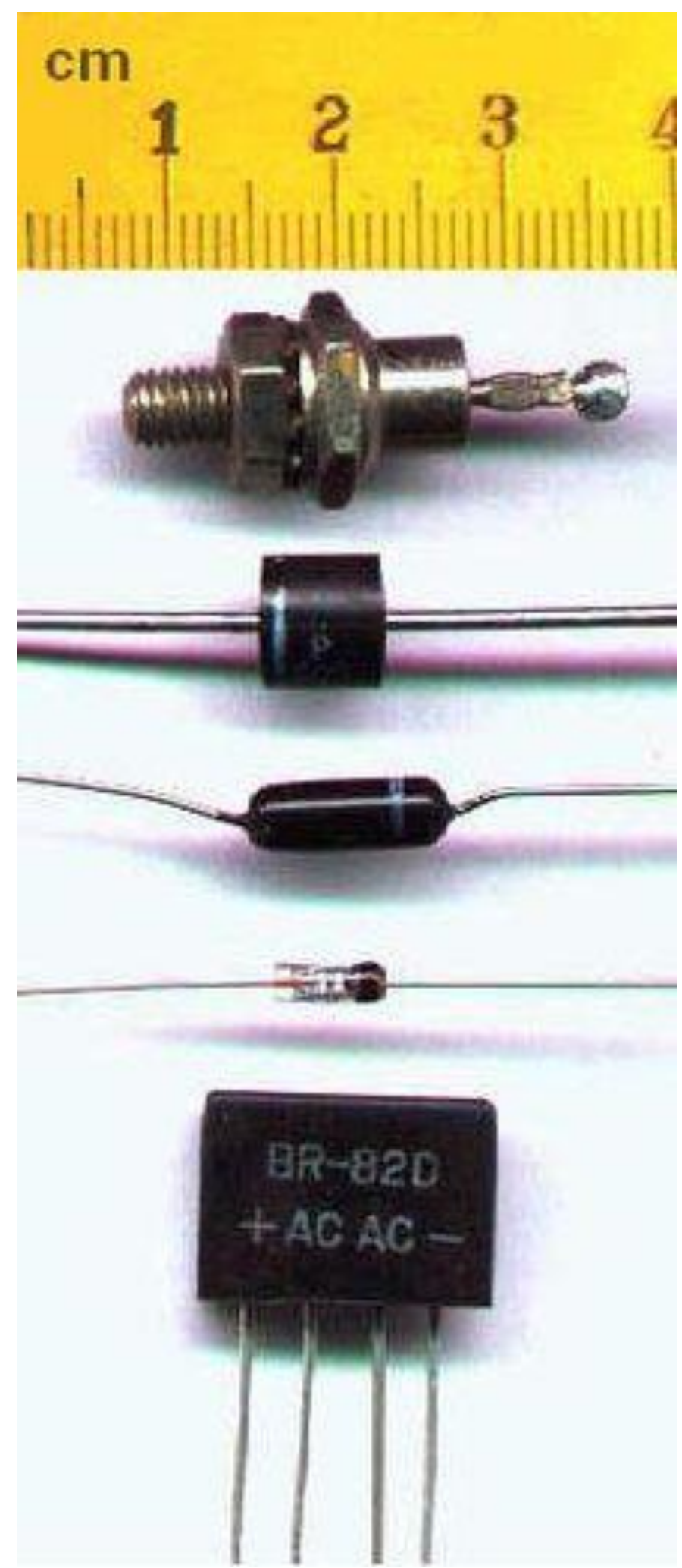
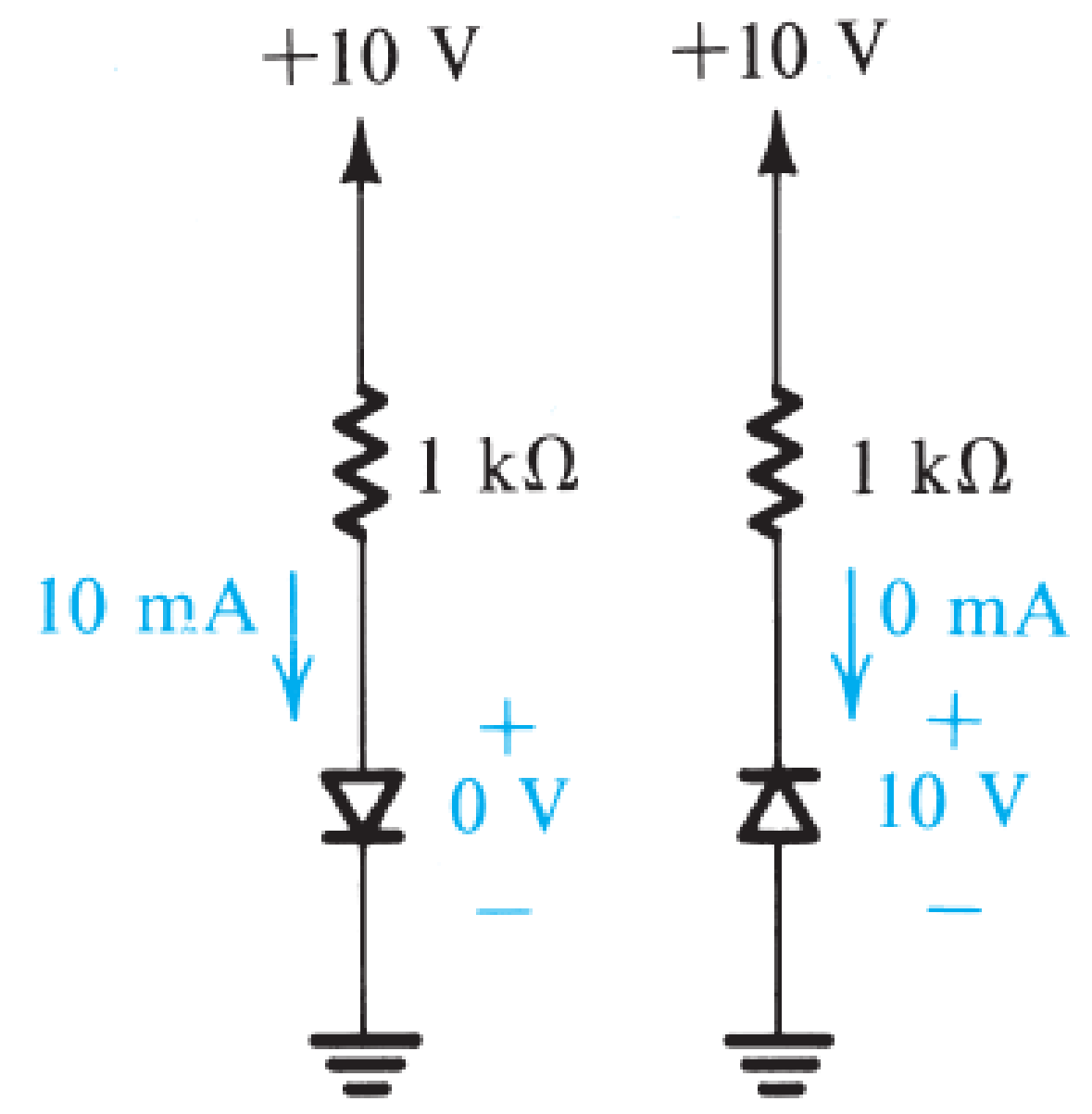
The Ideal Diode



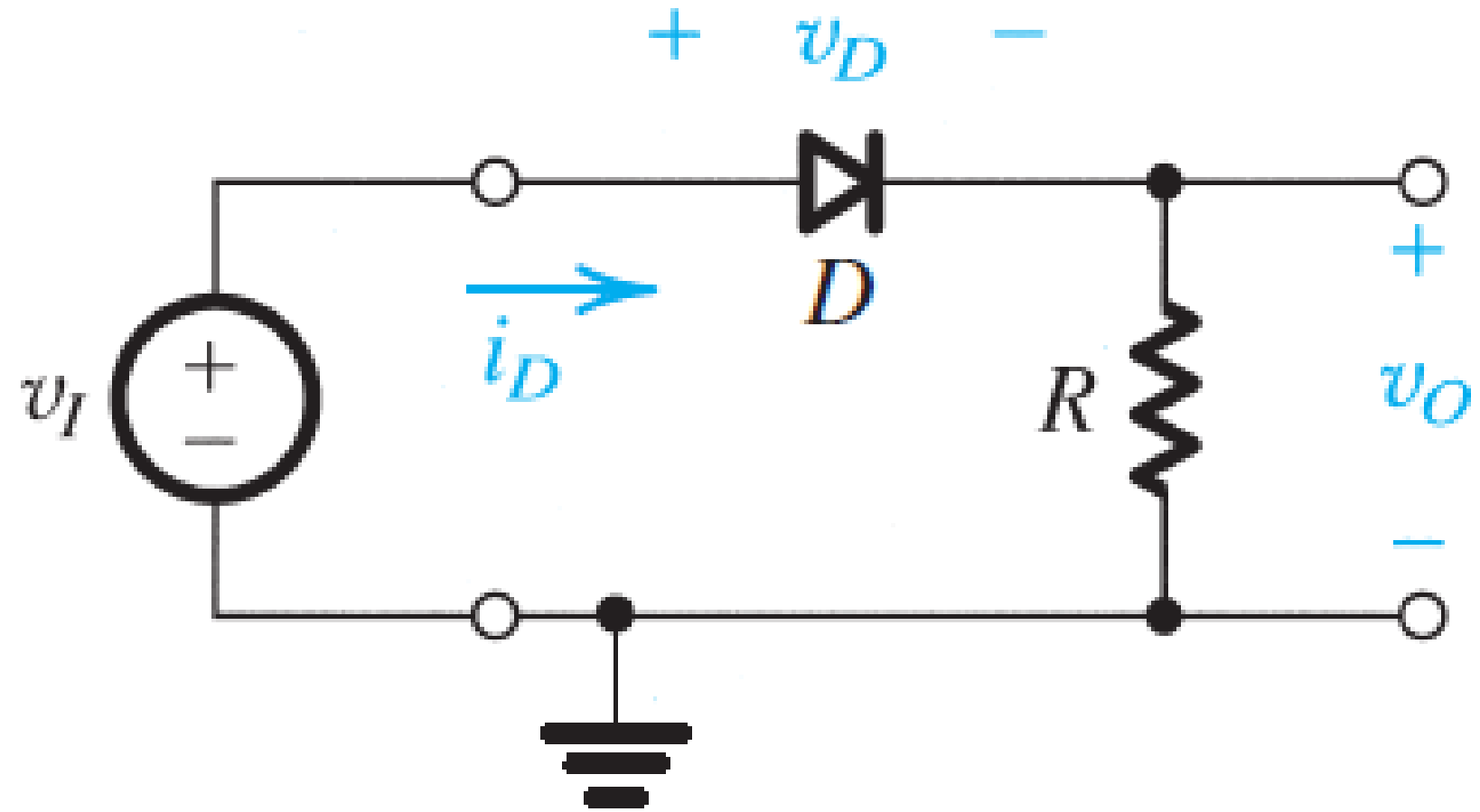
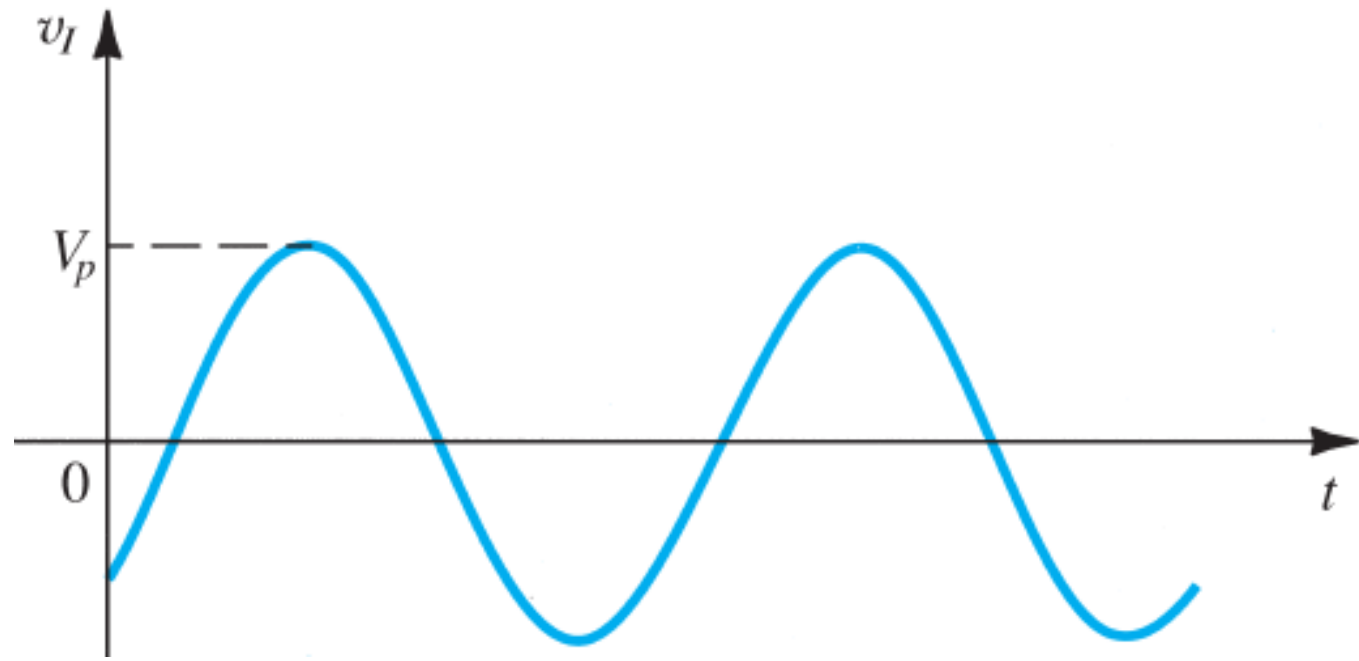
IV characteristics



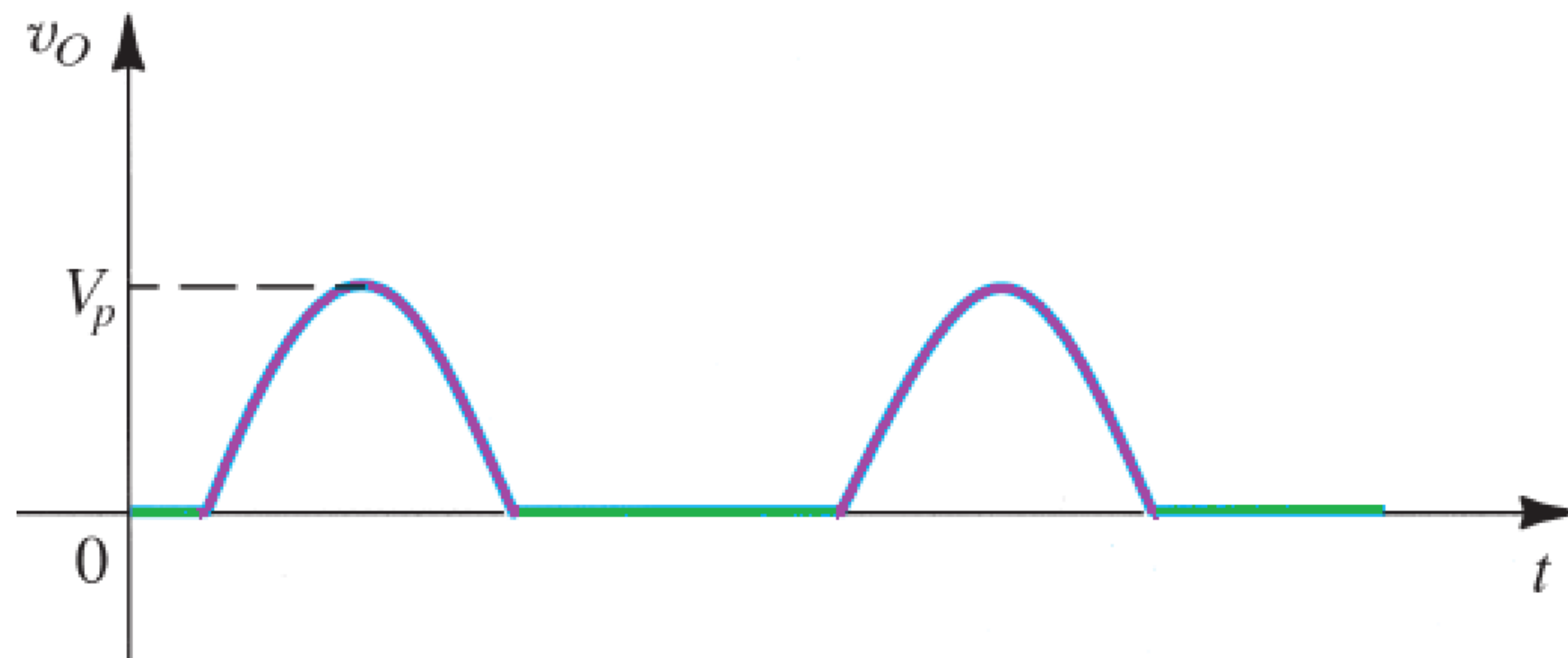
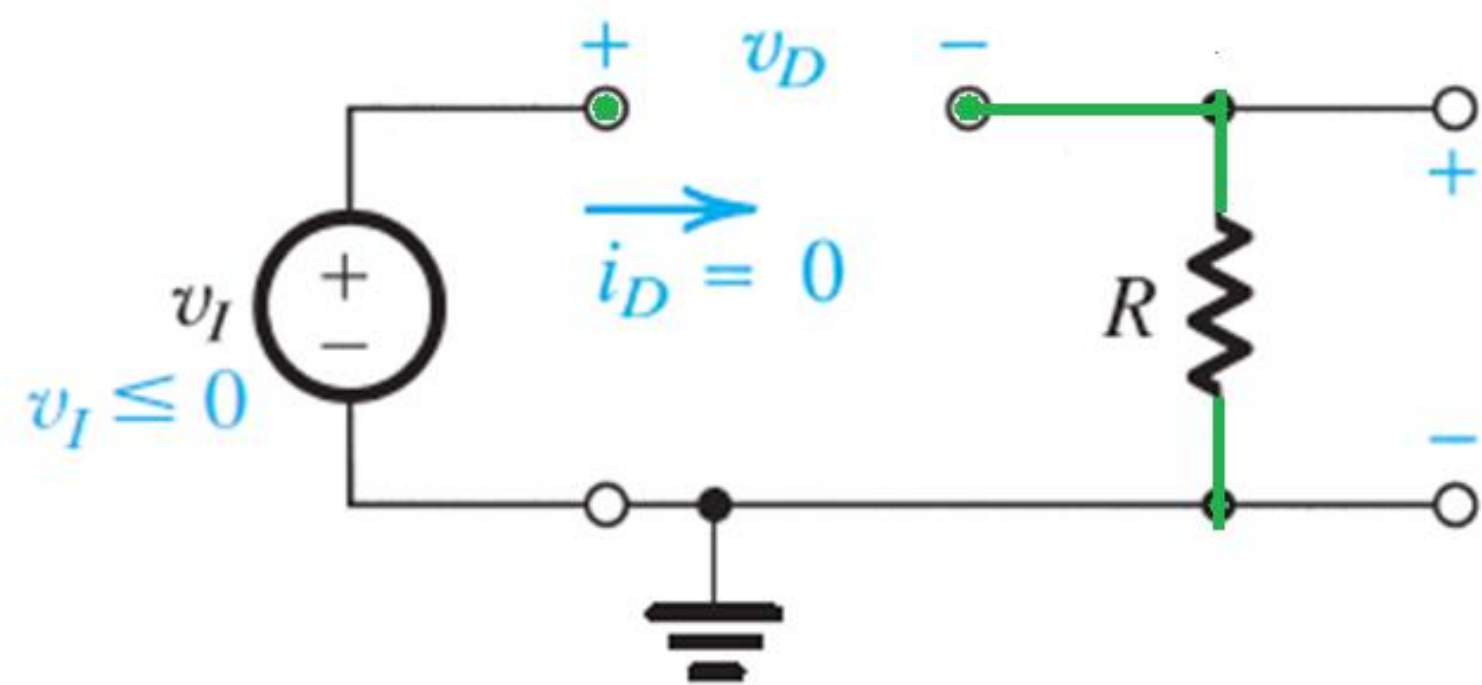
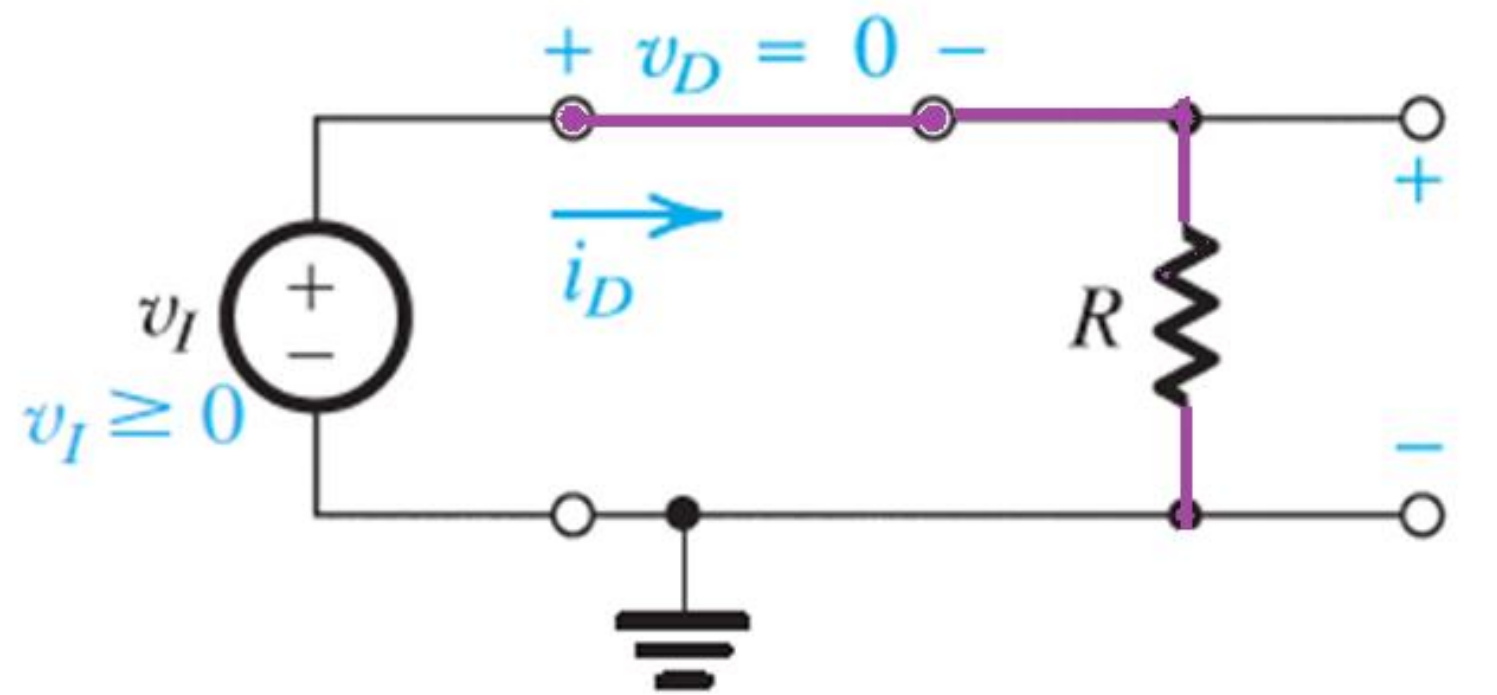
Example



Application: The Rectifier

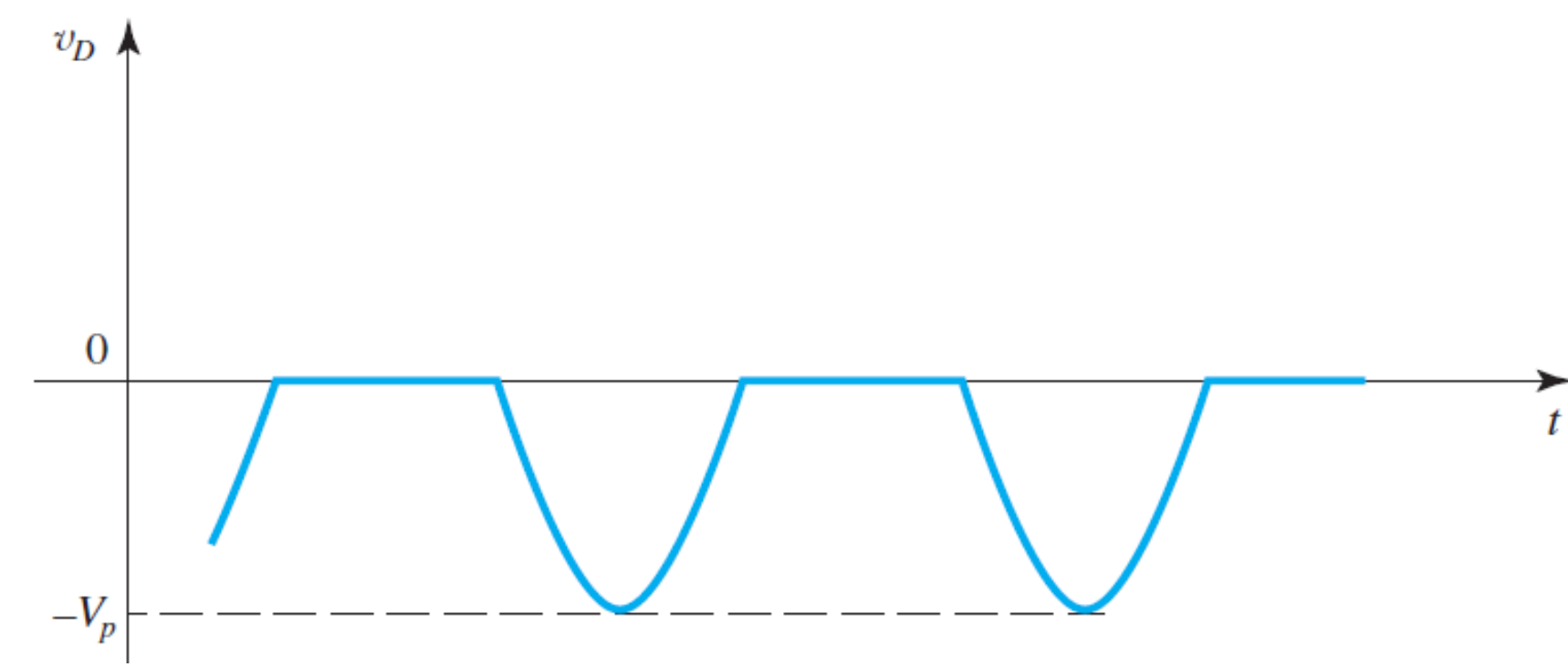
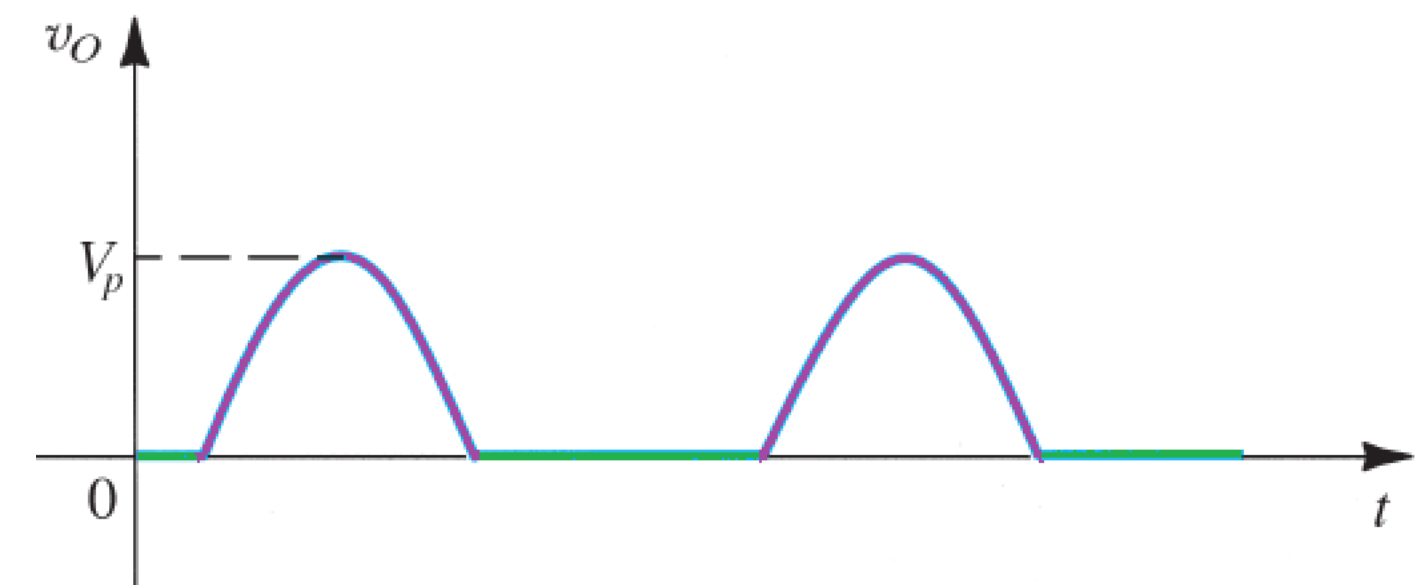
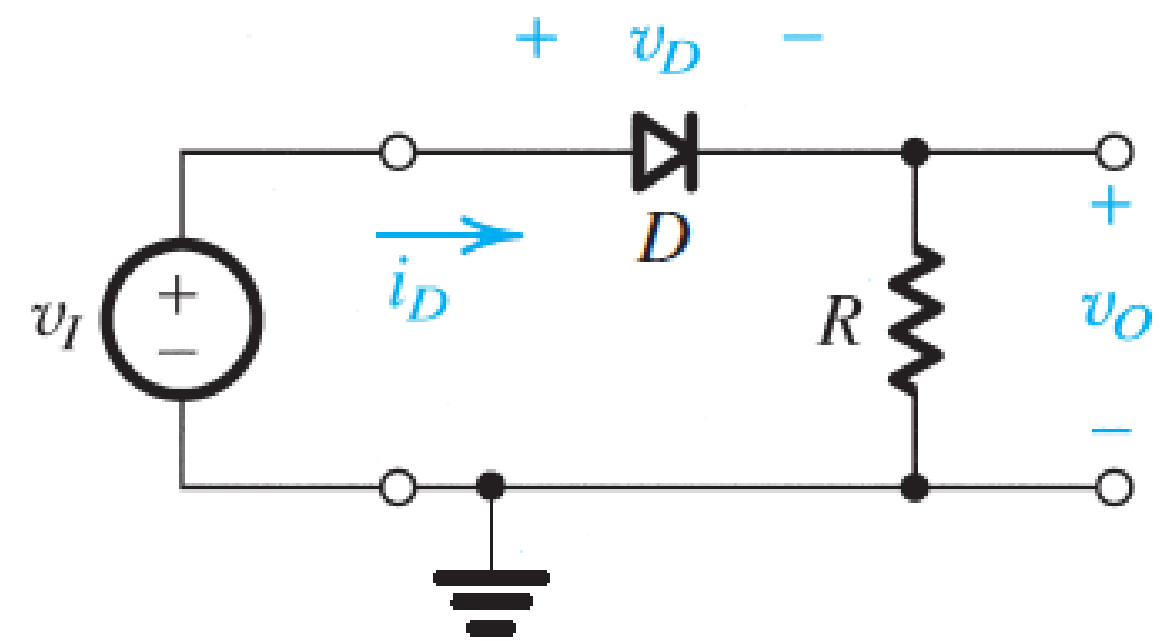
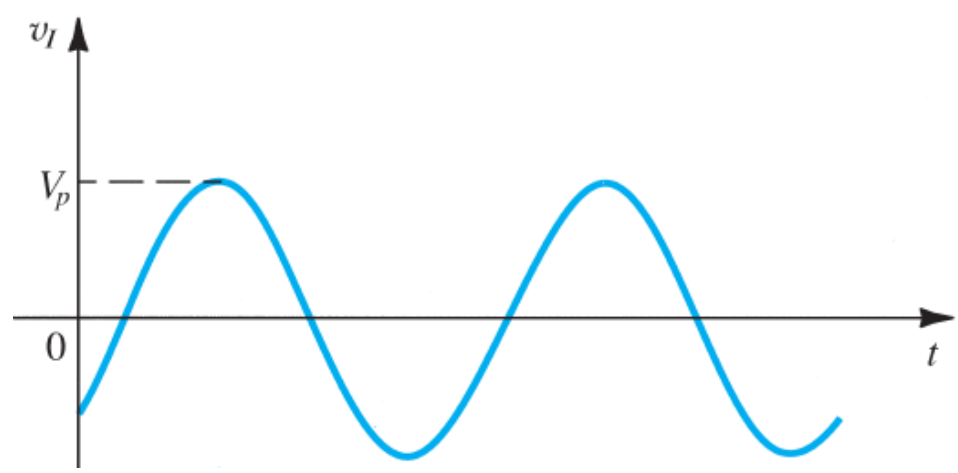


Application: The Rectifier



Application: The Rectifier

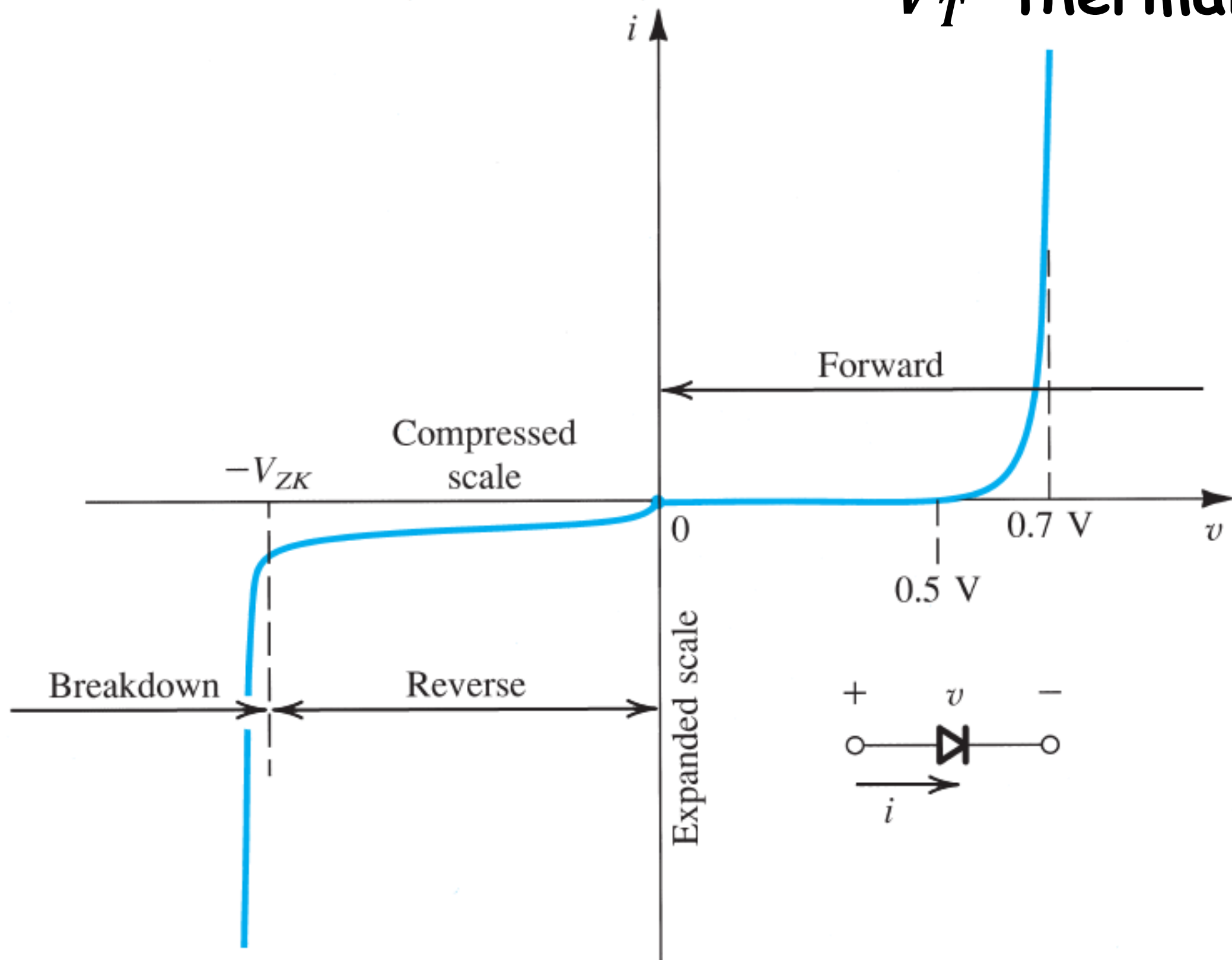
For the shown circuit, sketch the waveform of v_D .



The Forward-Bias Region

$$i = I_s (e^{v/V_T} - 1)$$

I_s saturation current
 V_T thermal voltage



Example

D_1	D_2
0	0
0	1
1	0
1	1

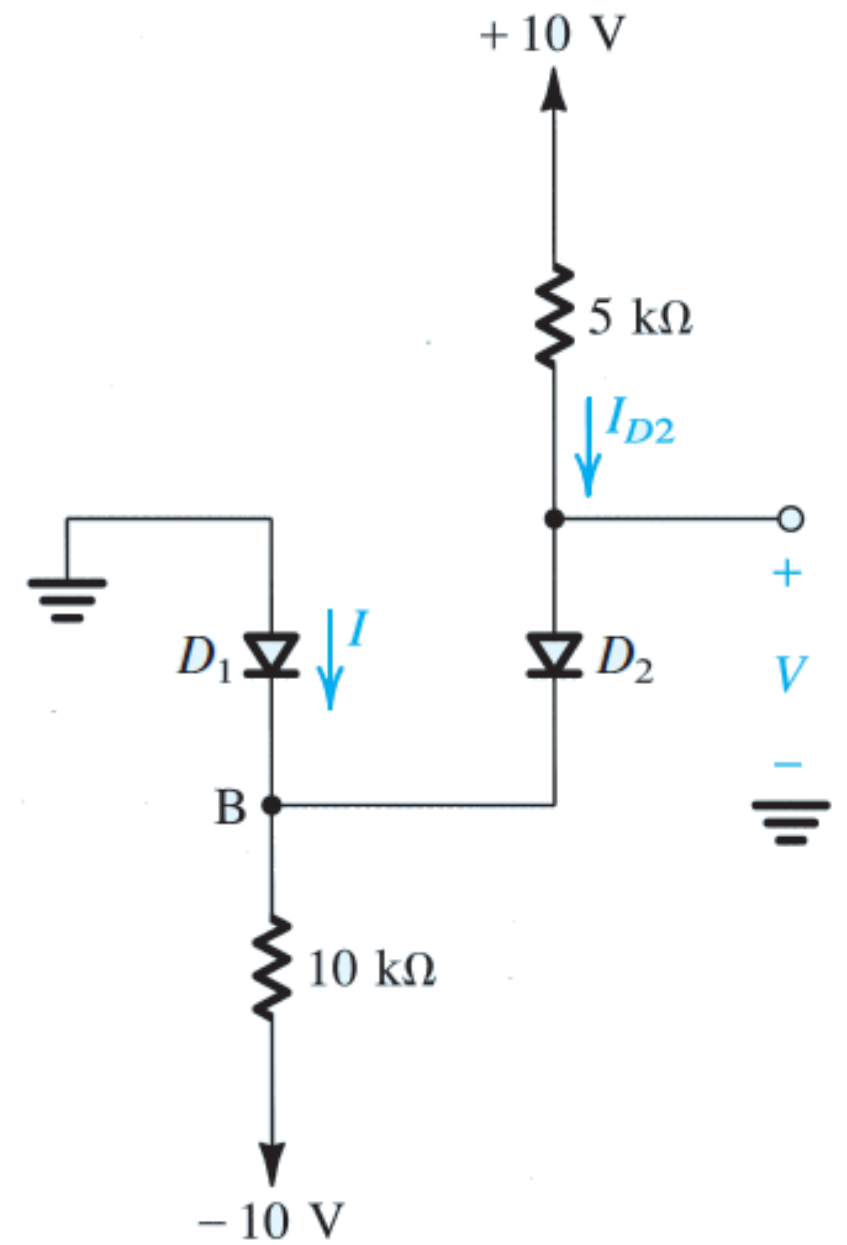
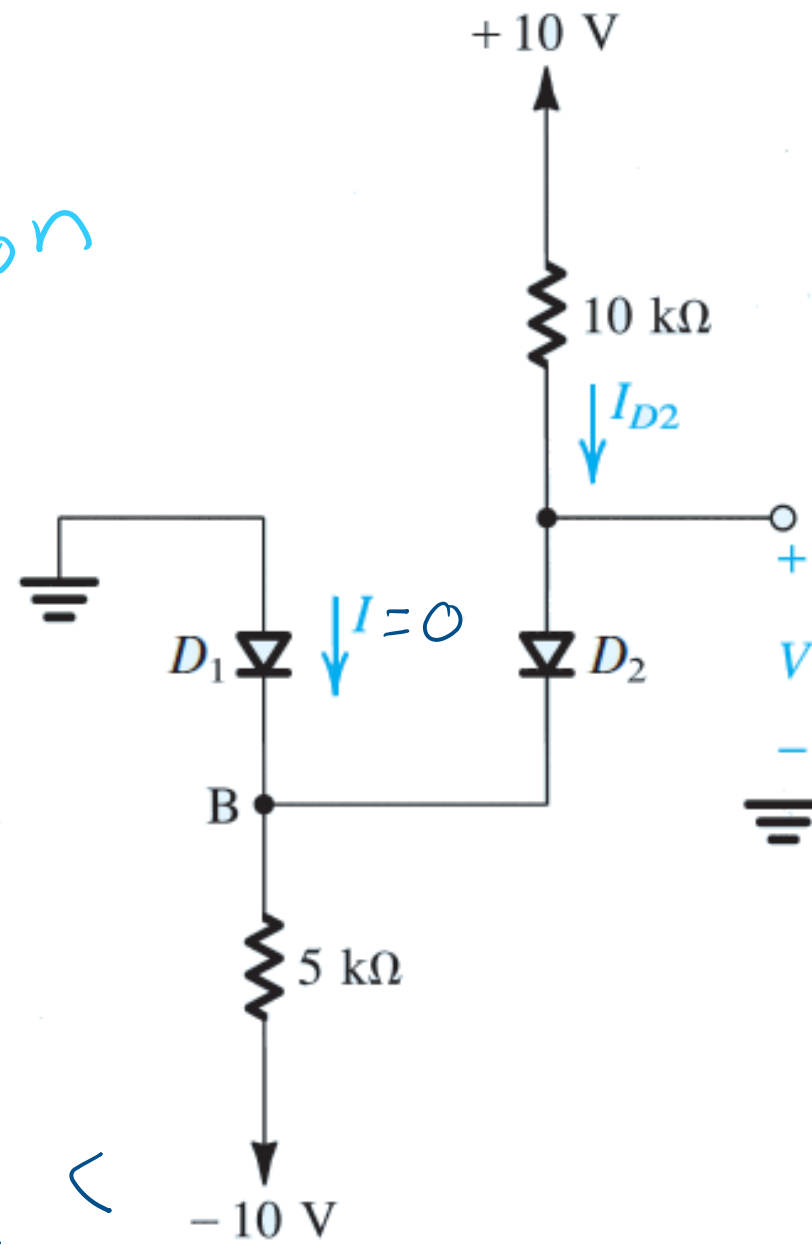
Bad assumption
 $I_{D2} = 0 \text{ A}$
 $V = \text{floating point}$

$$V_B = 10 - (-10) \times \frac{5 \text{ k}}{15 \text{ k}} < -10 \text{ V}$$

$$= 6.67 \text{ V}$$

$$\therefore I_{D2} = \frac{10 - 6.67}{10 \text{ k}} = 333 \mu\text{A}$$

$$I_{D2} = \frac{10 - (-10)}{15 \text{ k}} = 1.3 \text{ mA}$$



Bad assumption

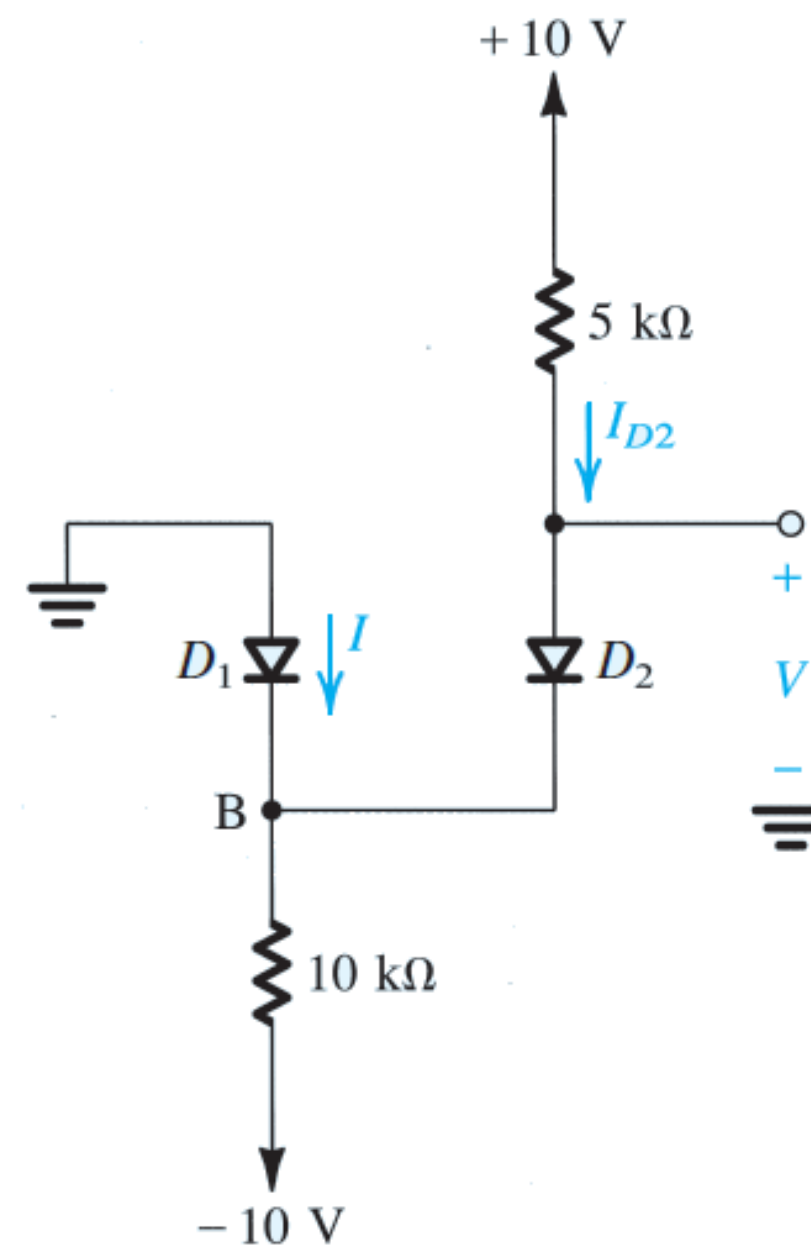
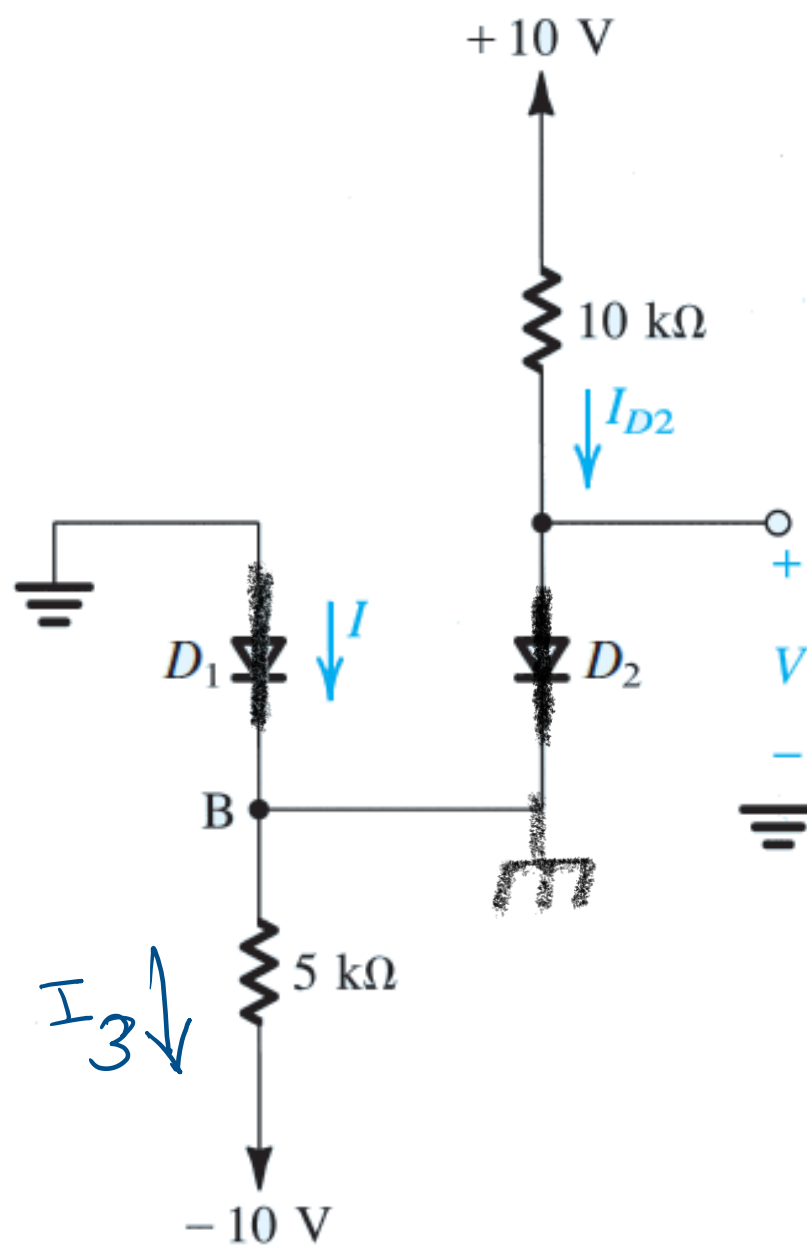
Example

D_1	D_2
0	0
0	1
1	0

$$I_{D2} = \frac{10}{10k} = 1 \text{ mA}$$

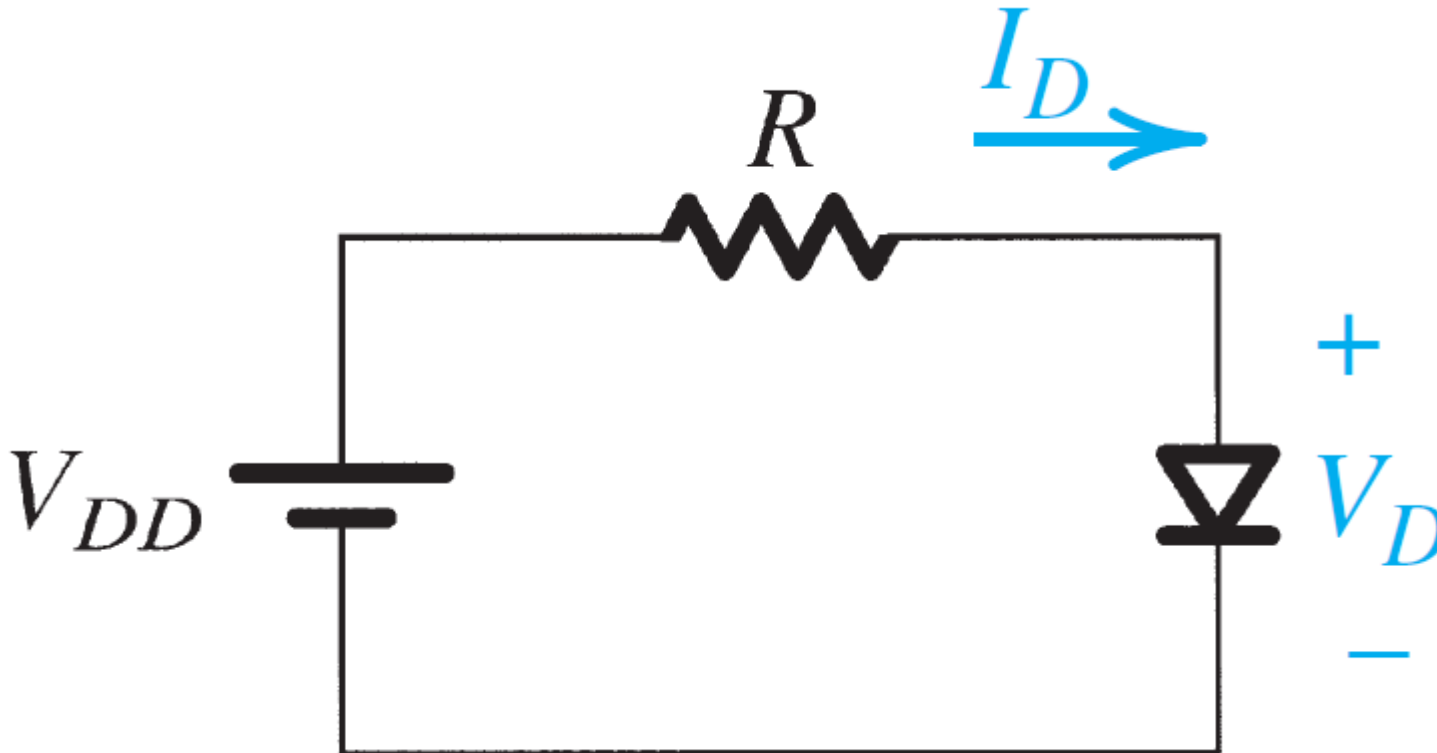
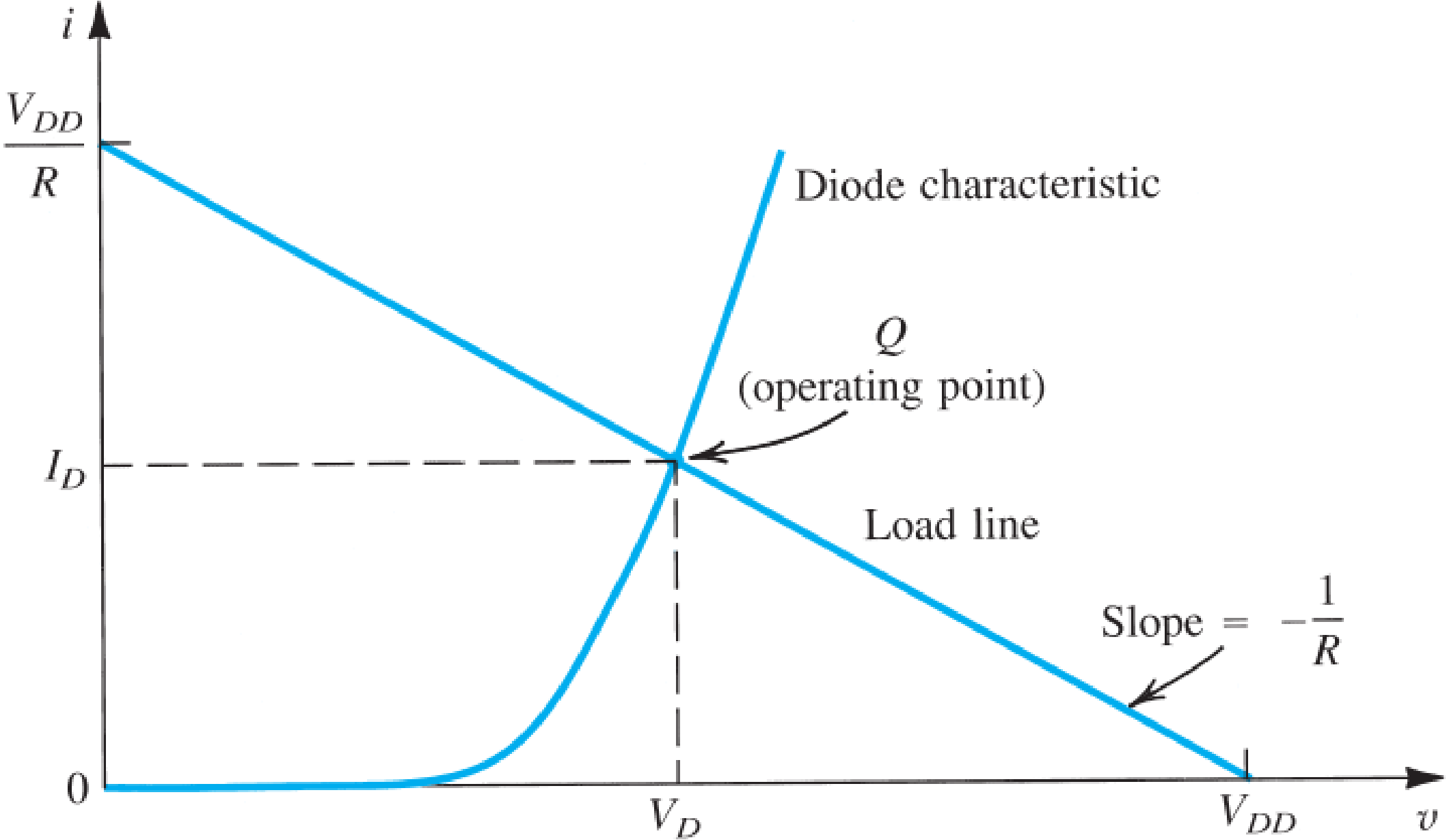
$$I_3 = \frac{0 - (-10)}{5k} = 2 \text{ mA}$$

$$I_3 = I + I_{D2} \Rightarrow I = 1 \text{ mA}$$

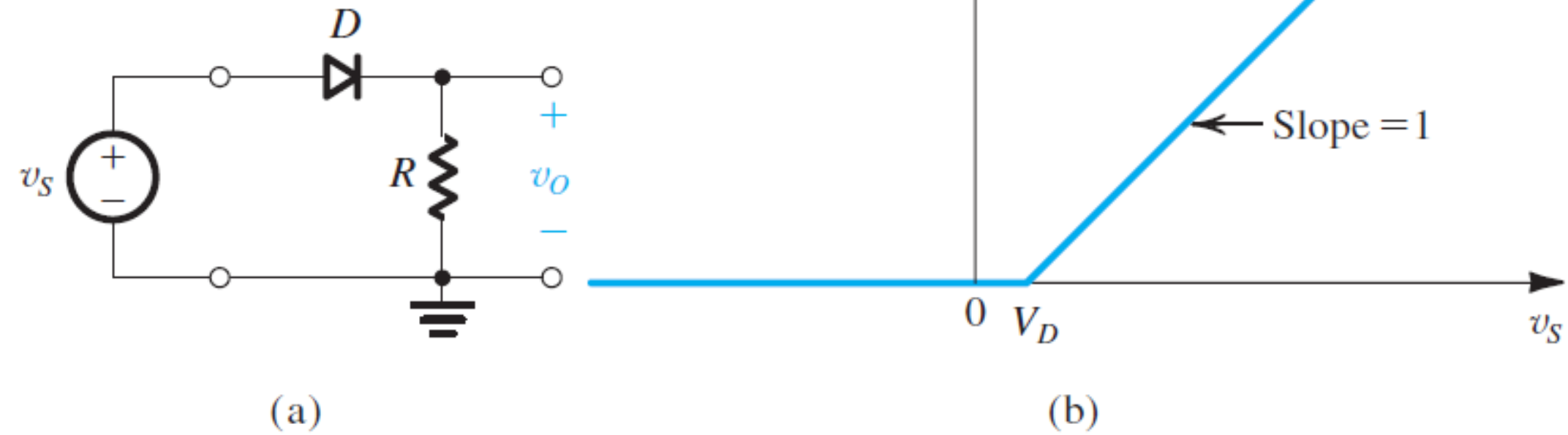


Circuit is stable !!

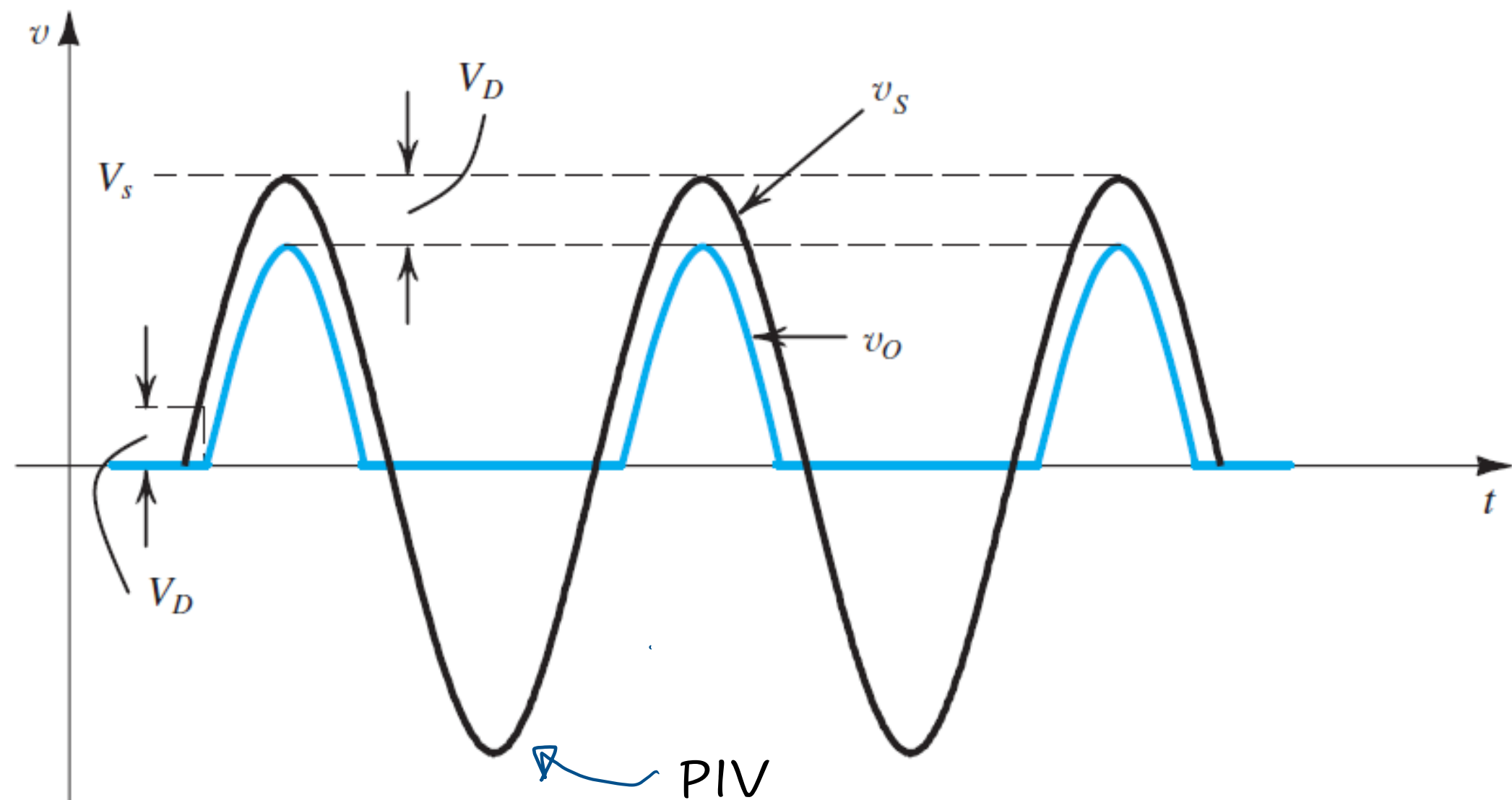
Graphical Analysis Using the Exponential Model (4.3.2)



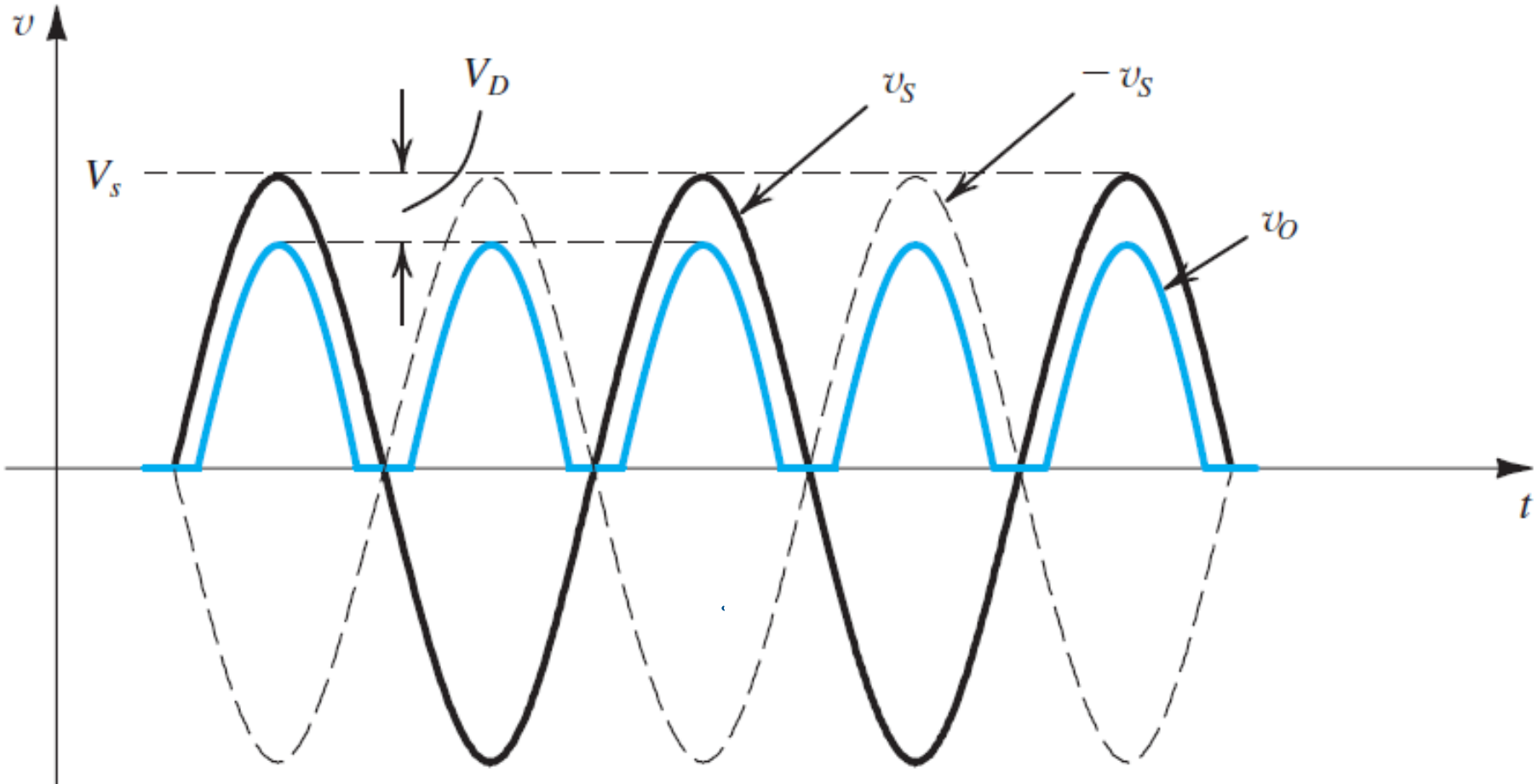
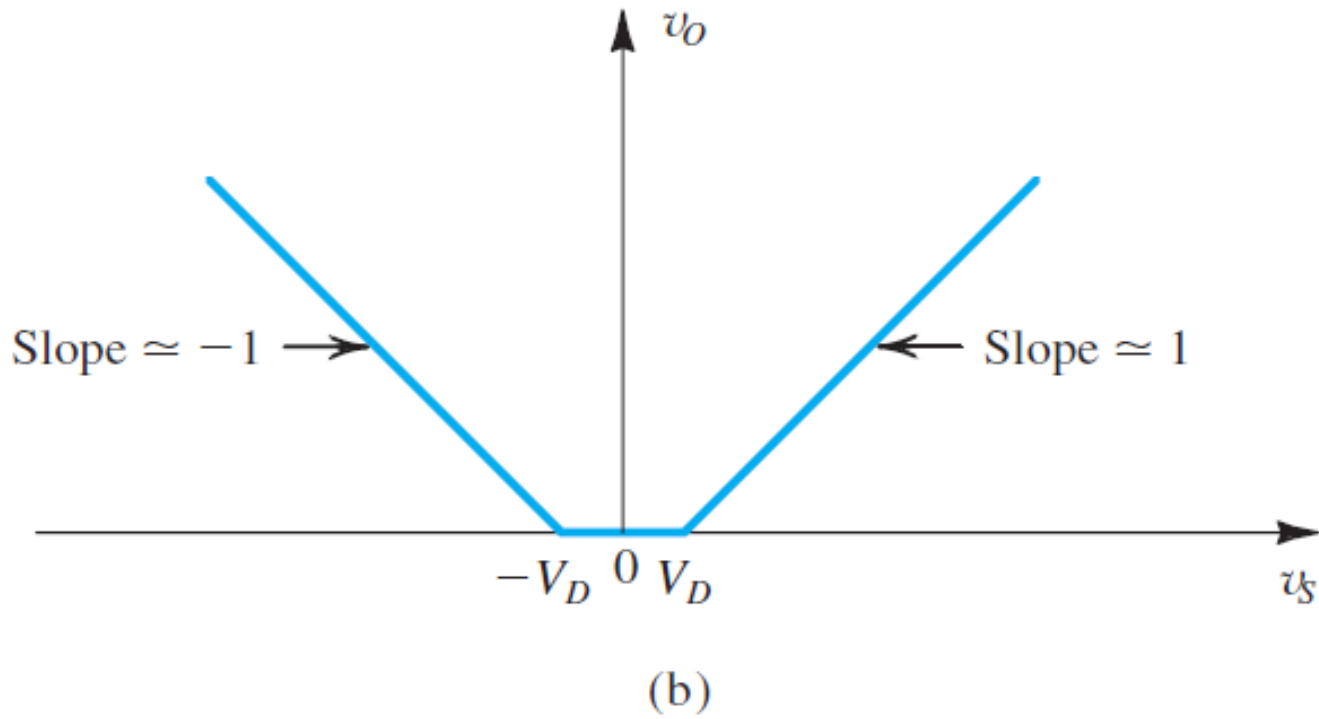
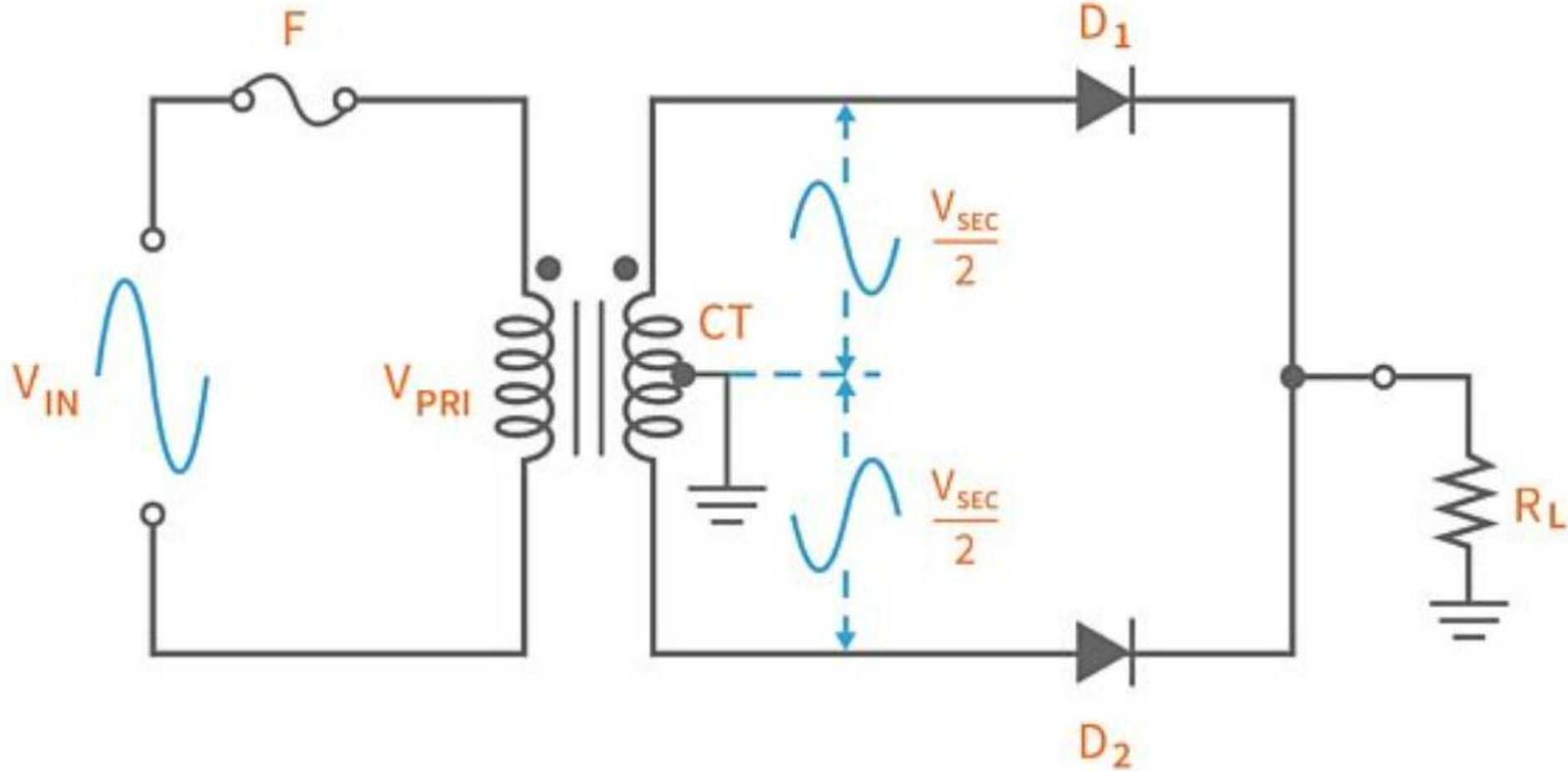
Halfwave rectifier (4.5)



peak inverse voltage (PIV) that the diode must be able to withstand without breakdown,, reverse breakdown voltage at least 50% greater than the expected PIV.



Full wave rectifier (center tapped)

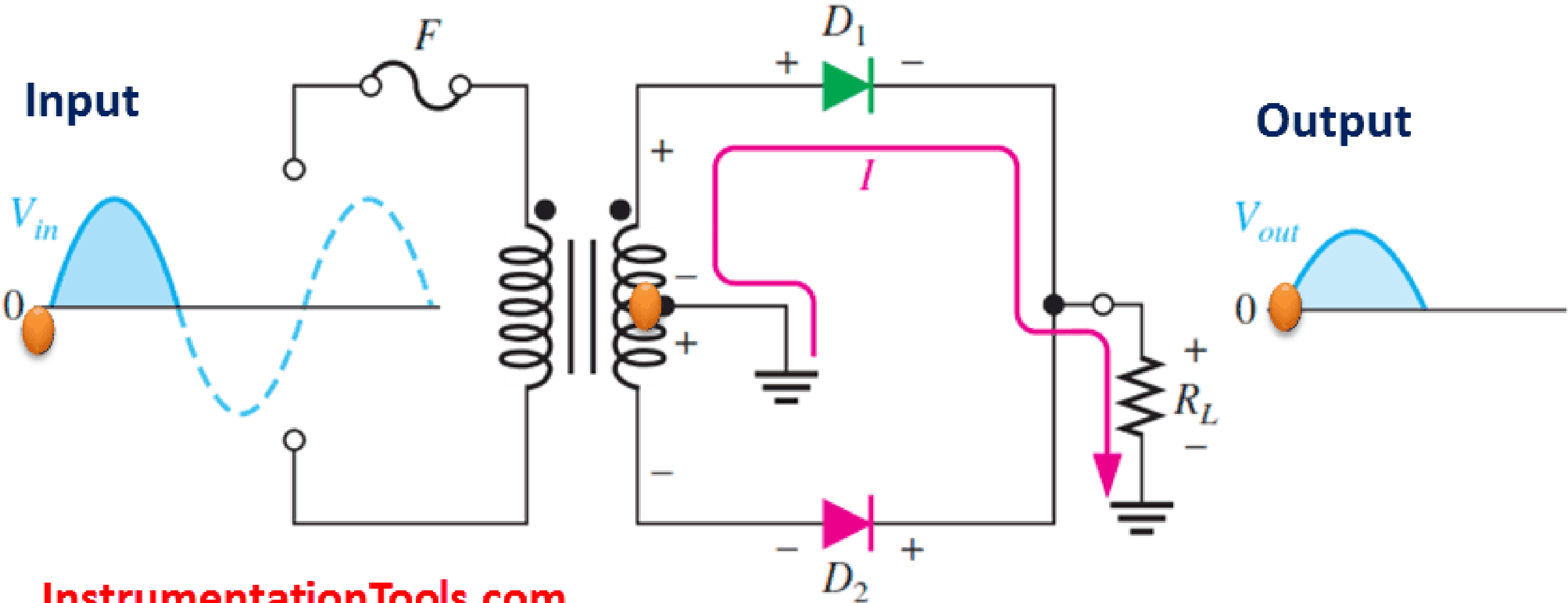


Full wave rectifier

Center Tapped Full Wave Rectifier

During Positive Half Cycle

D1 : Forward Bias – Closed Circuit



InstrumentationTools.com

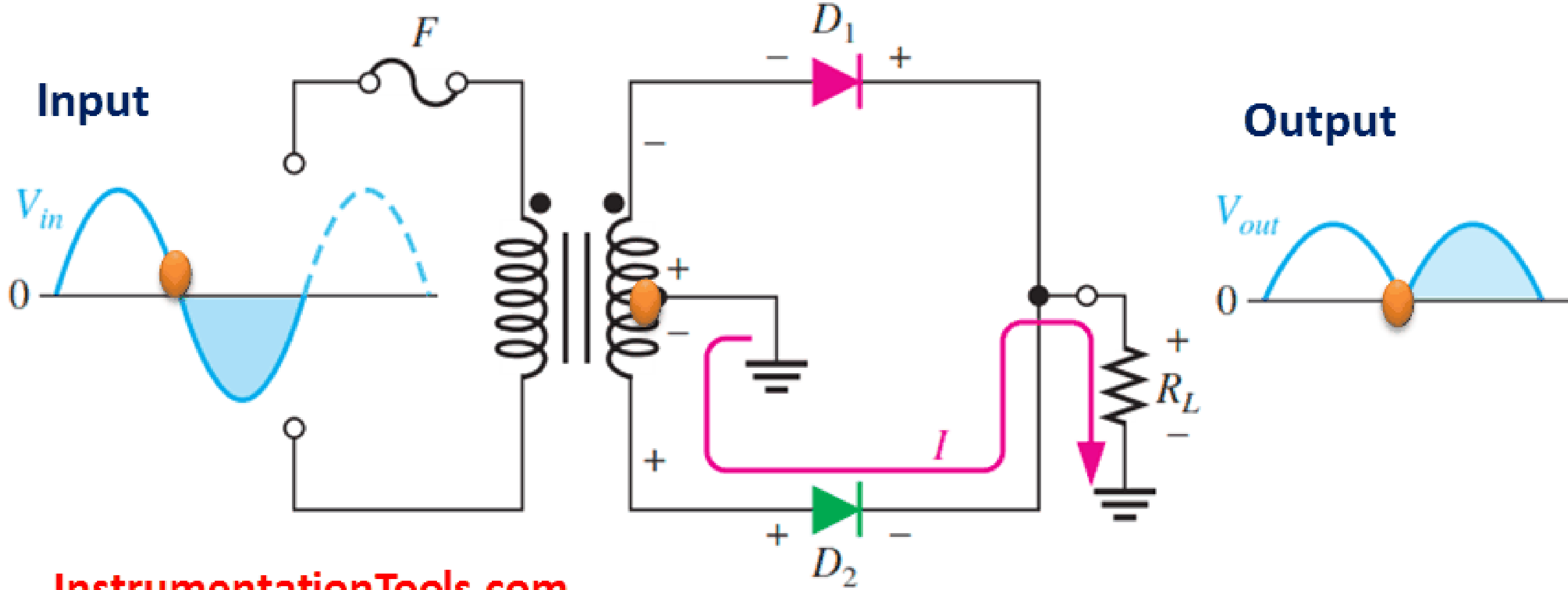
D2 : Reverse Bias – Open Circuit

Full wave rectifier

Center Tapped Full Wave Rectifier

During Negative Half Cycle

D1 : Reverse Bias – Open Circuit



InstrumentationTools.com

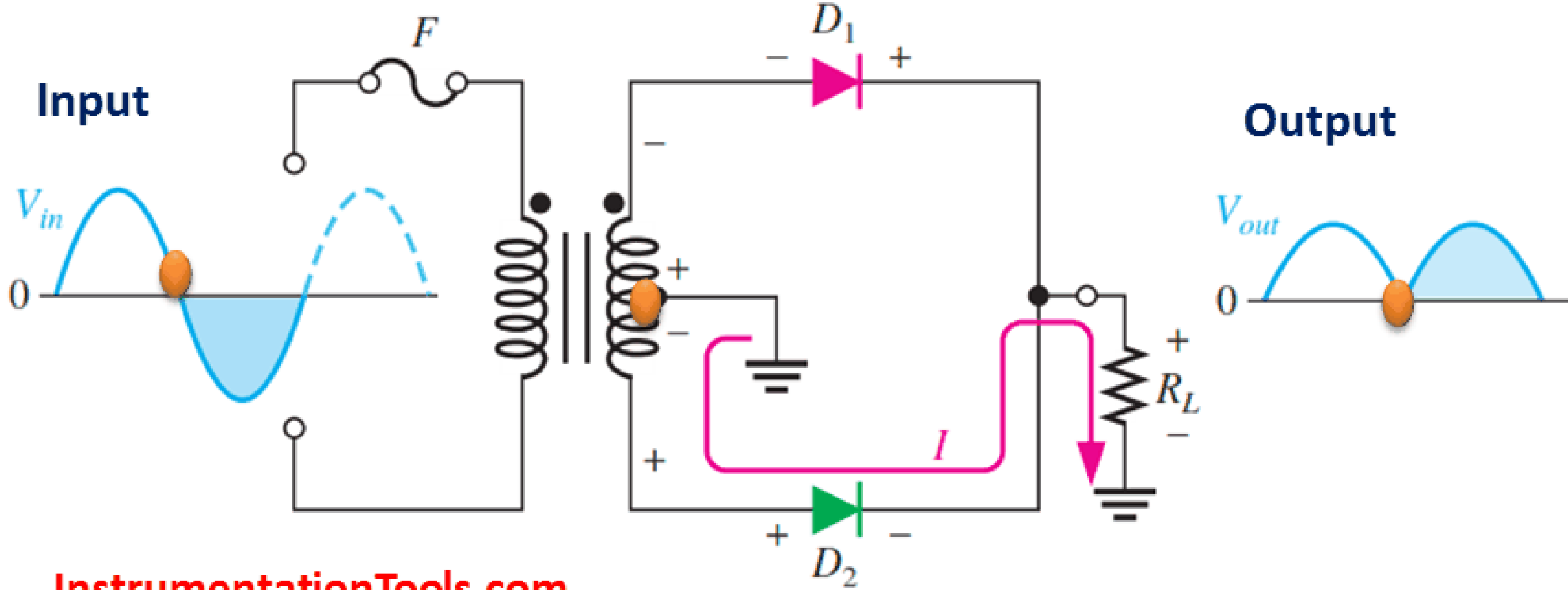
D2 : Forward Bias – Closed Circuit

Full wave rectifier

Center Tapped Full Wave Rectifier

During Negative Half Cycle

D1 : Reverse Bias – Open Circuit

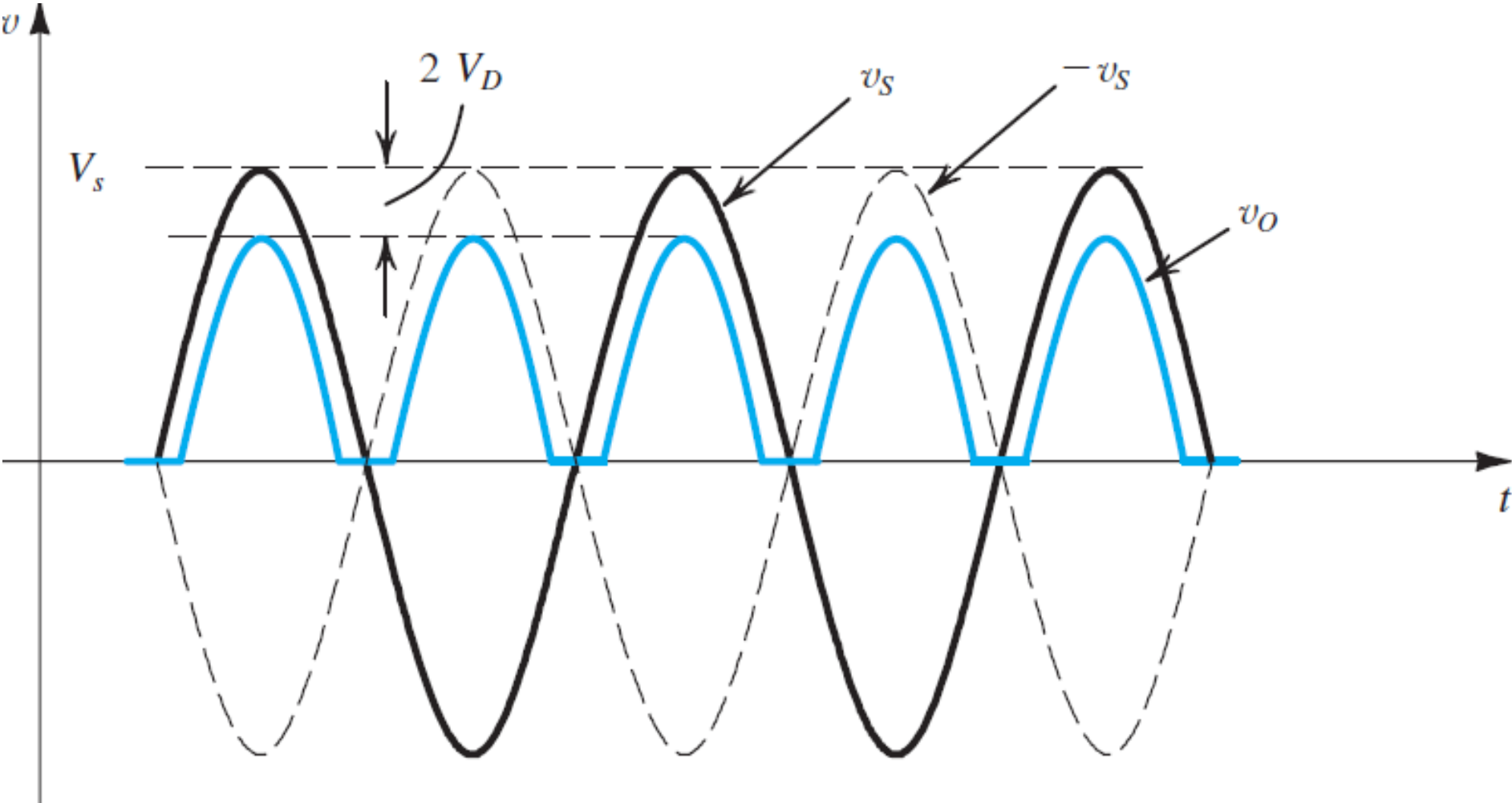
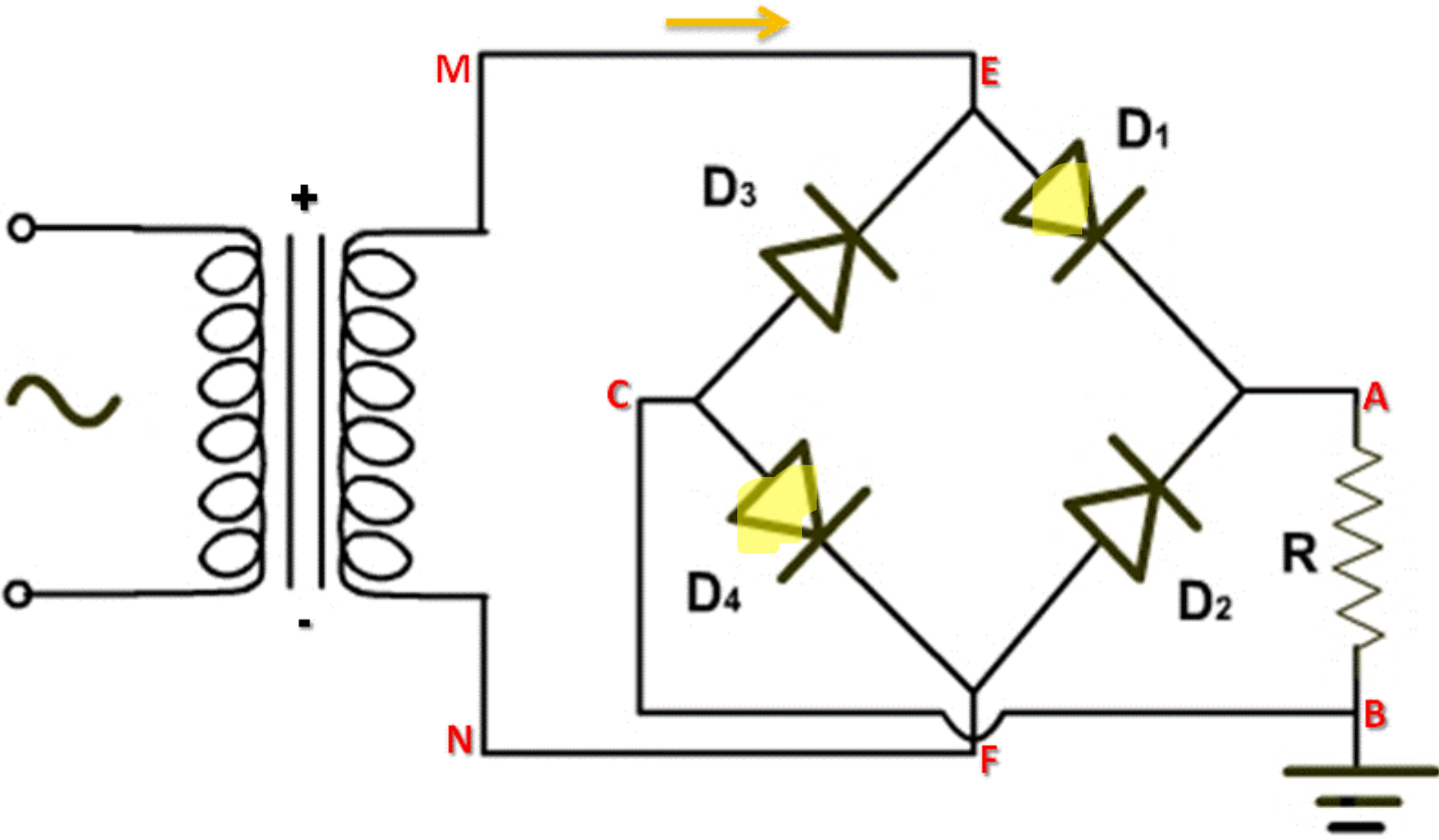


InstrumentationTools.com

D2 : Forward Bias – Closed Circuit

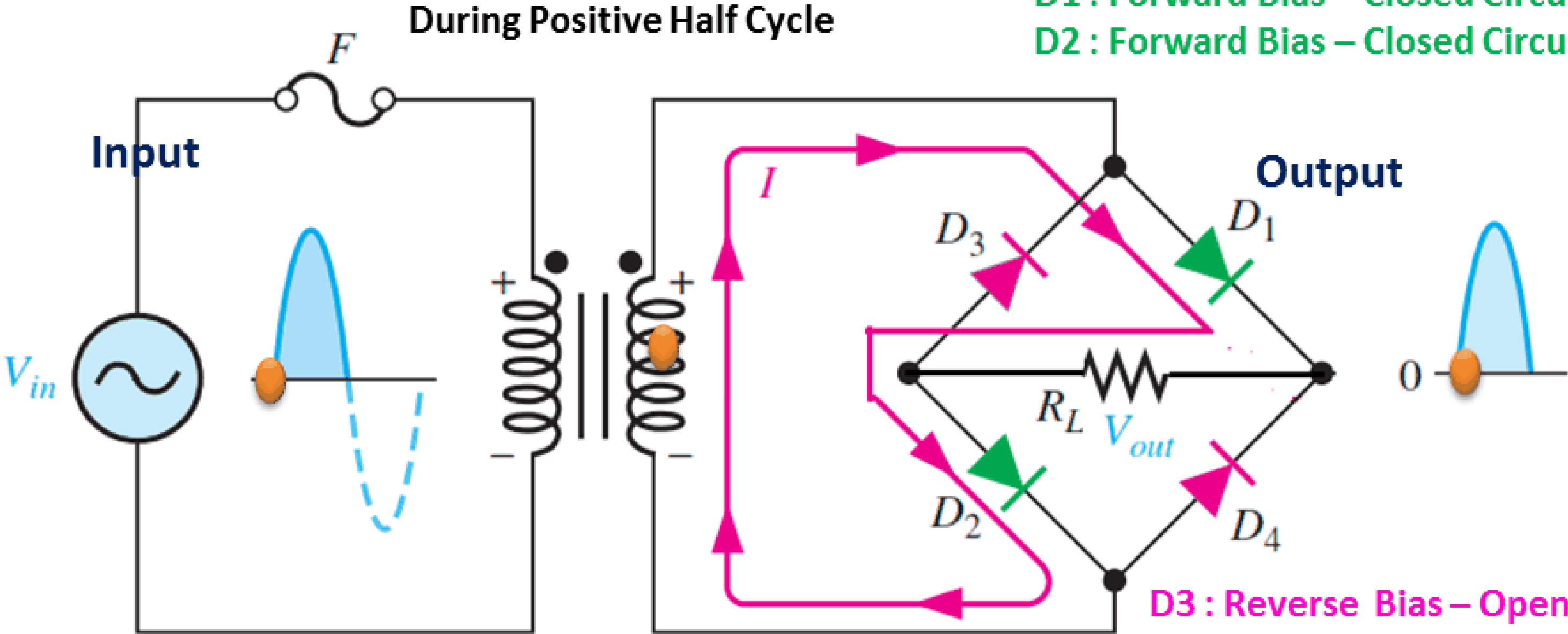
The Bridge Rectifier (4.5.3)

Full Wave Bridge Rectifier



The Bridge Rectifier (4.5.3)

Bridge Full Wave Rectifier

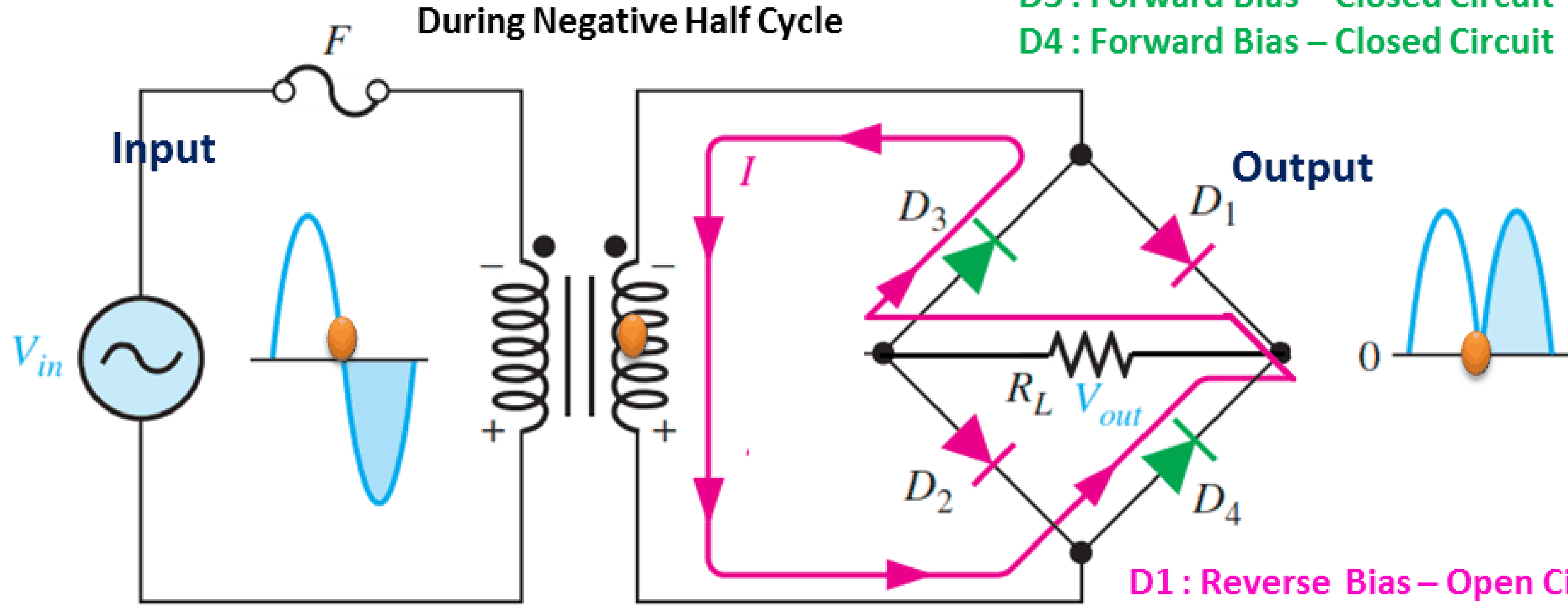


D1 : Forward Bias – Closed Circuit
D2 : Forward Bias – Closed Circuit

D3 : Reverse Bias – Open Circuit
D4 : Reverse Bias – Open Circuit

The Bridge Rectifier (4.5.3)

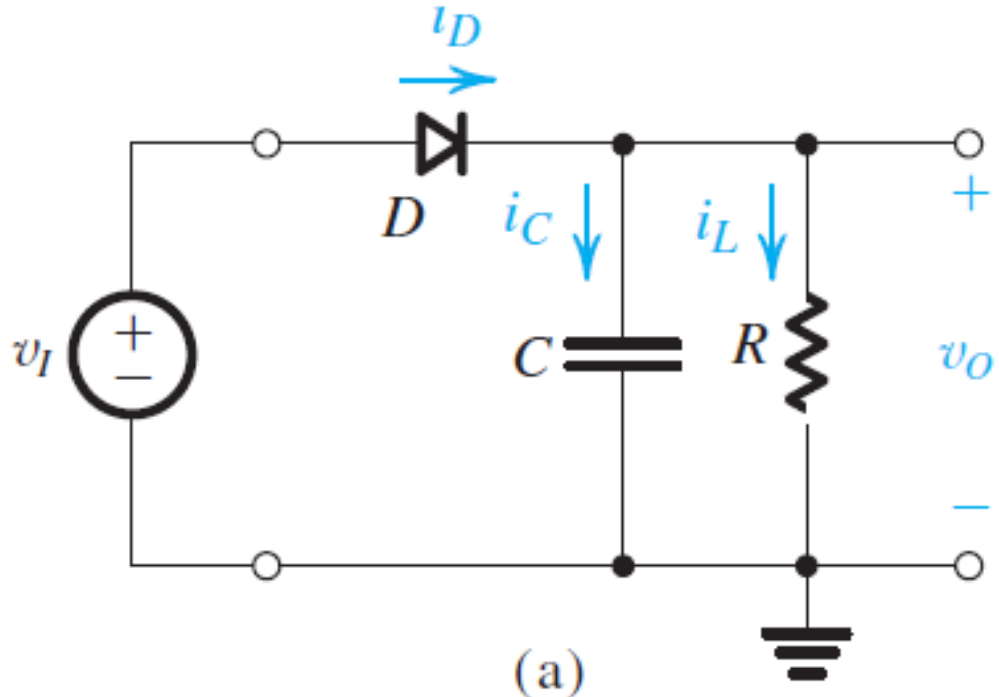
Bridge Full Wave Rectifier



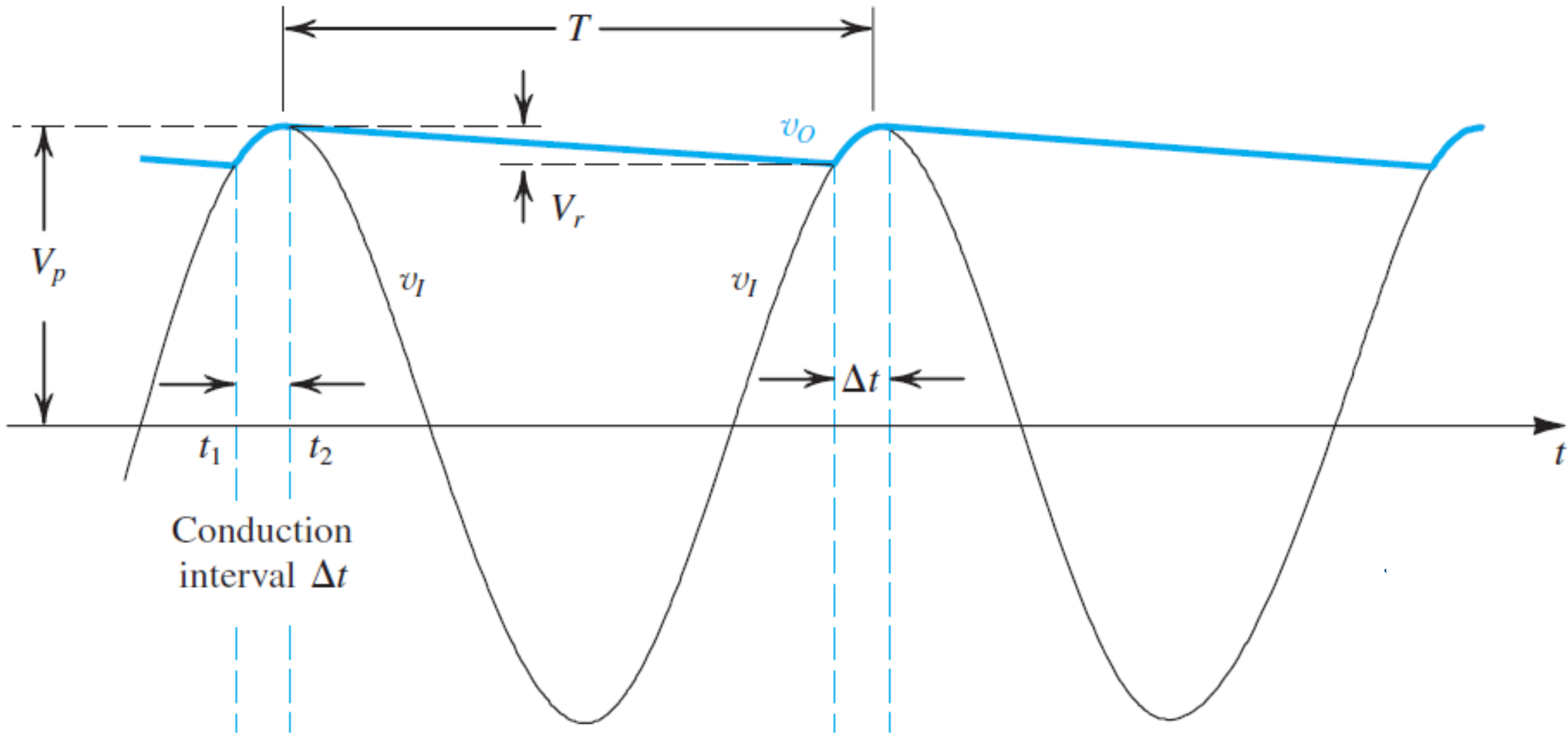
D3 : Forward Bias – Closed Circuit
D4 : Forward Bias – Closed Circuit

D1 : Reverse Bias – Open Circuit
D2 : Reverse Bias – Open Circuit

The Rectifier with a Filter Capacitor (4.5.4)



$CR \gg T$, where T is the period of the input sinusoid.



End