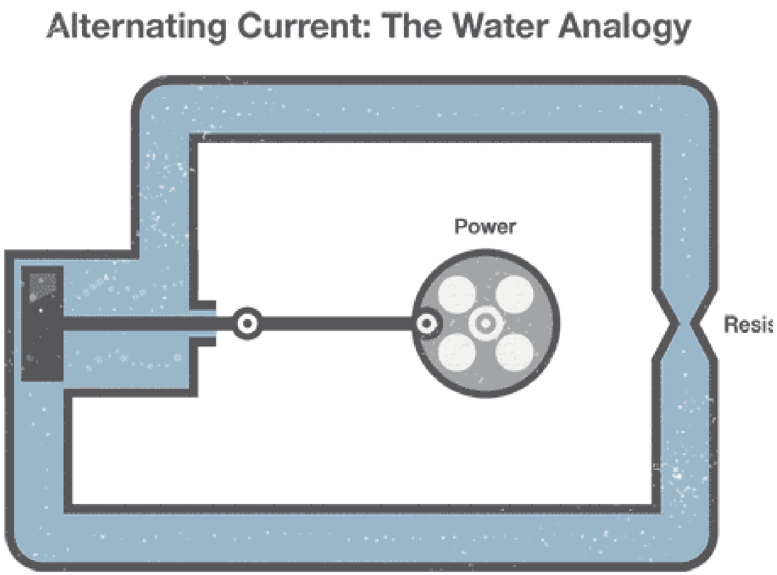
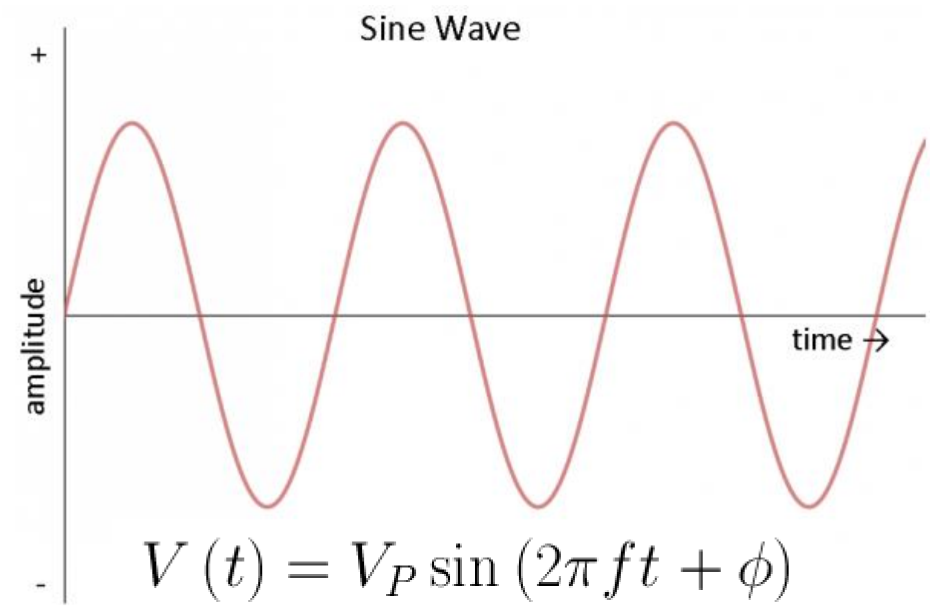
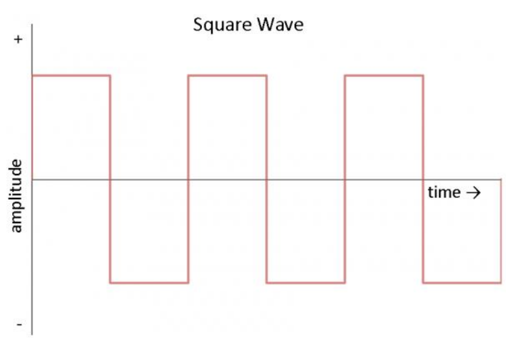
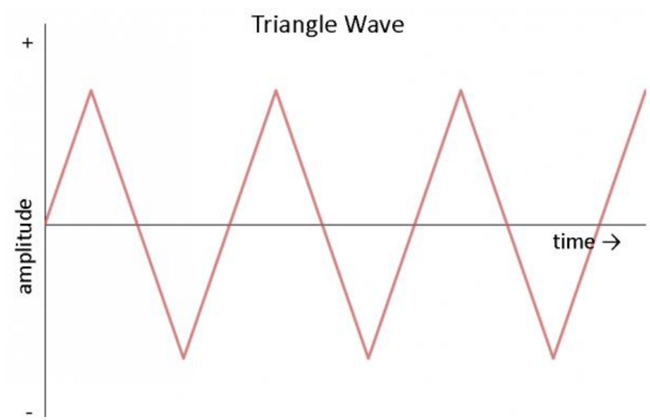
Doğrultucu Devreler
YDD, TDD,
Temel Güç Kaynağı

Alternatif Akım



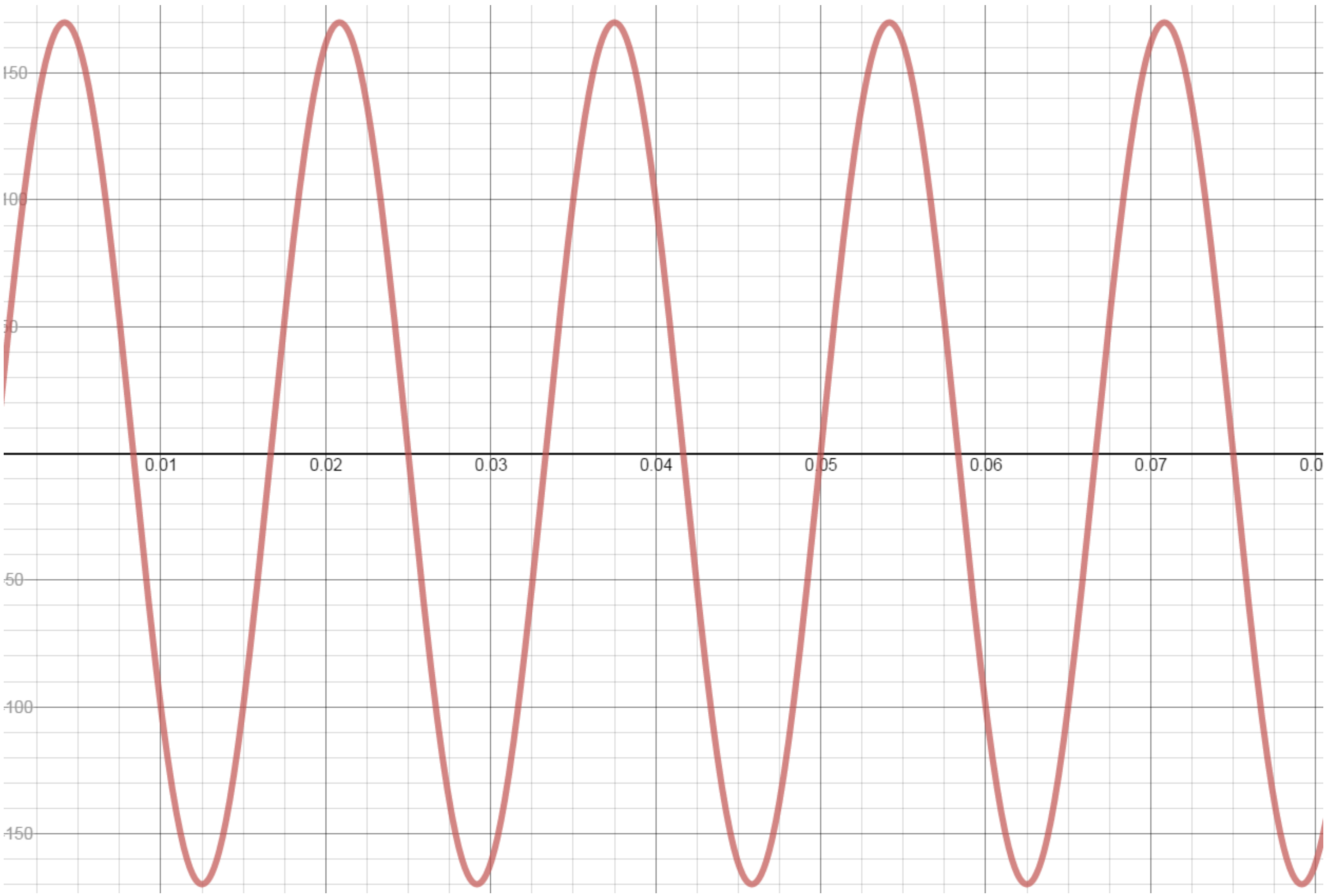






Vmax
Vpp
V_{DCort}

$$V(t) = 170 \sin(2\pi 60 t)$$



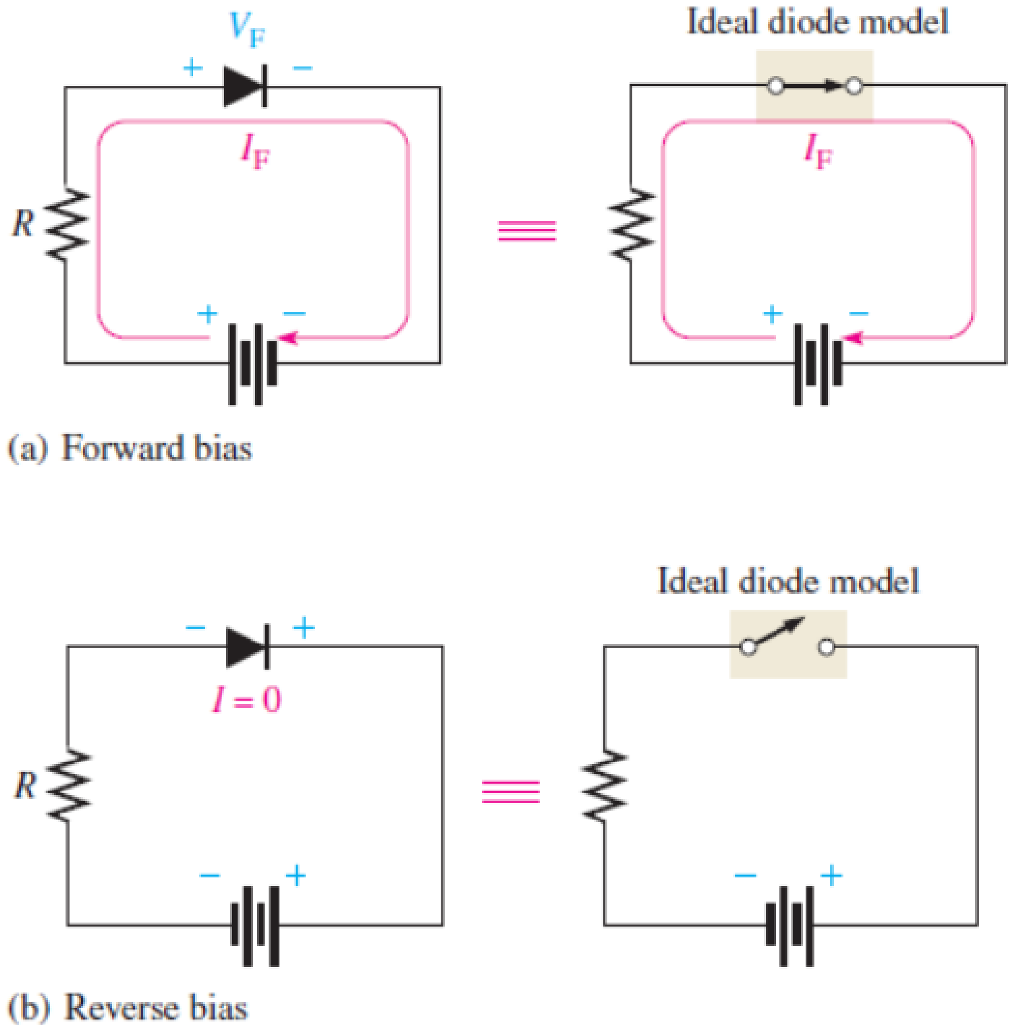


Figure 3.4 The ideal model of a diode. [5]

(a) Equivalent circuit under forward bias (on or short circuit).

(b) Equivalent circuit under reverse bias (off or open circuit).

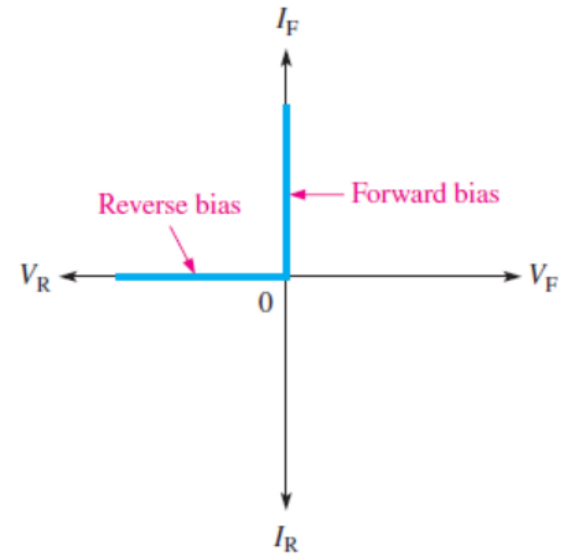
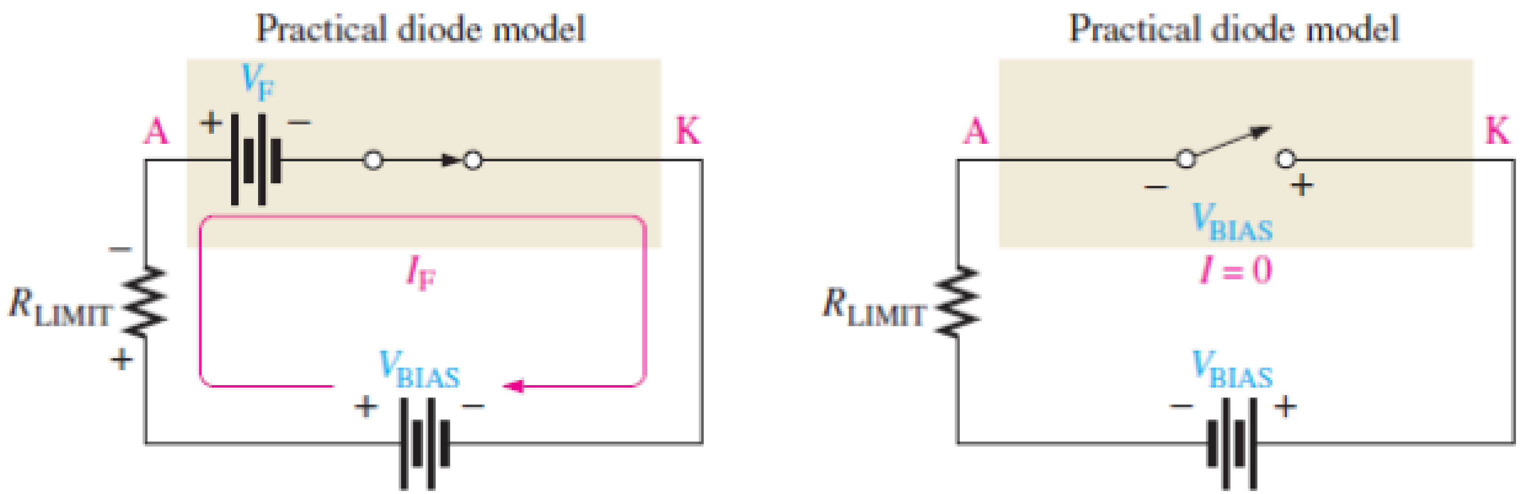


Figure 3.5 Ideal V-I characteristic curve (blue) [5]

For forward bias: $V_F = 0$ V, and $I_F = \frac{V_S}{R}$

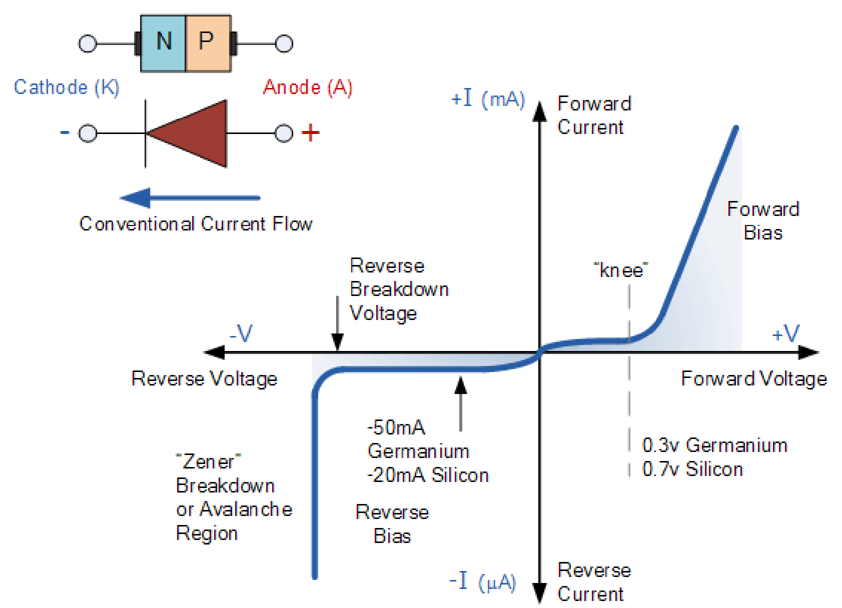
For reverse bias: $I_R = 0$ A , and $V_R = -V_S$

Practical Diode Model

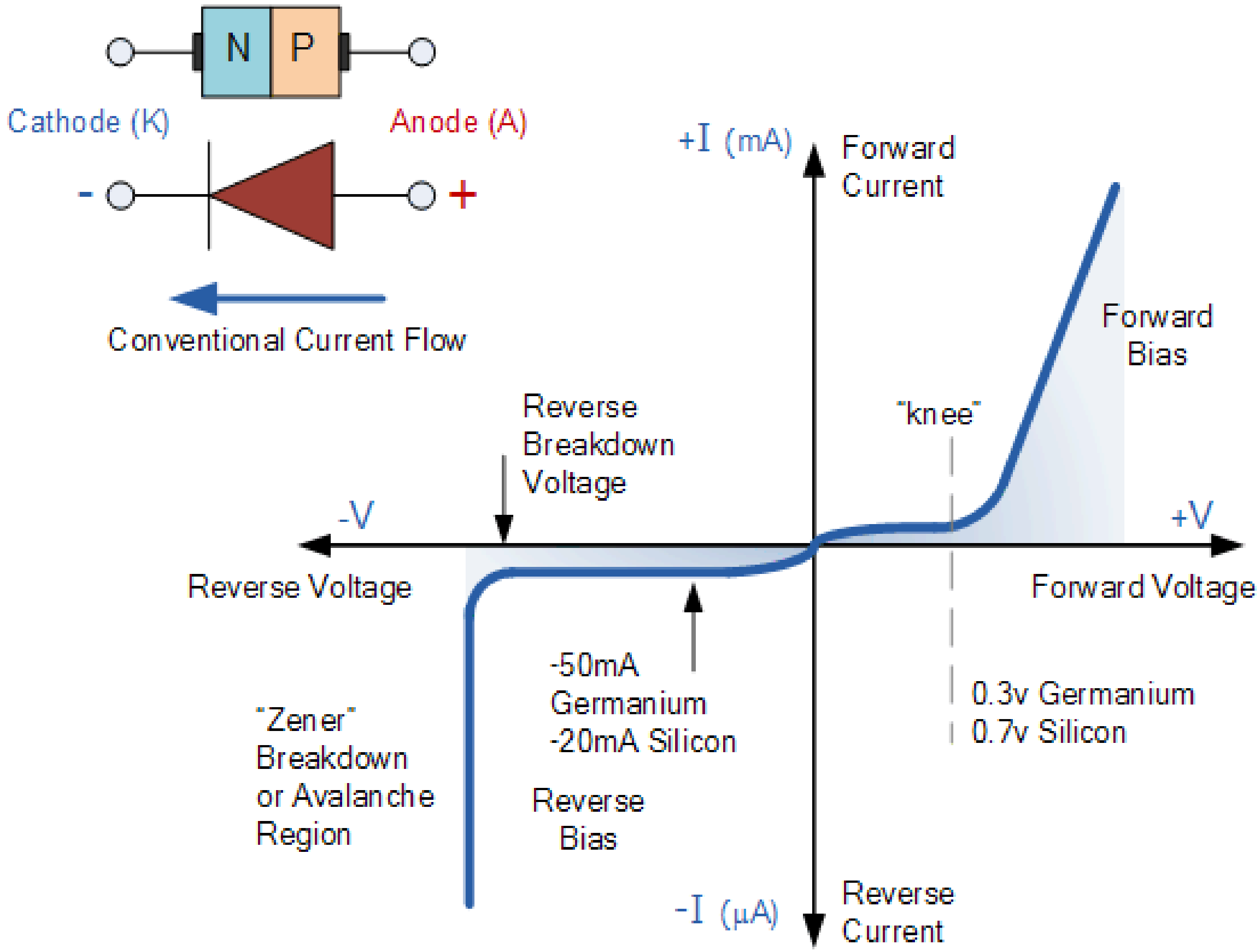


(a) Forward bias

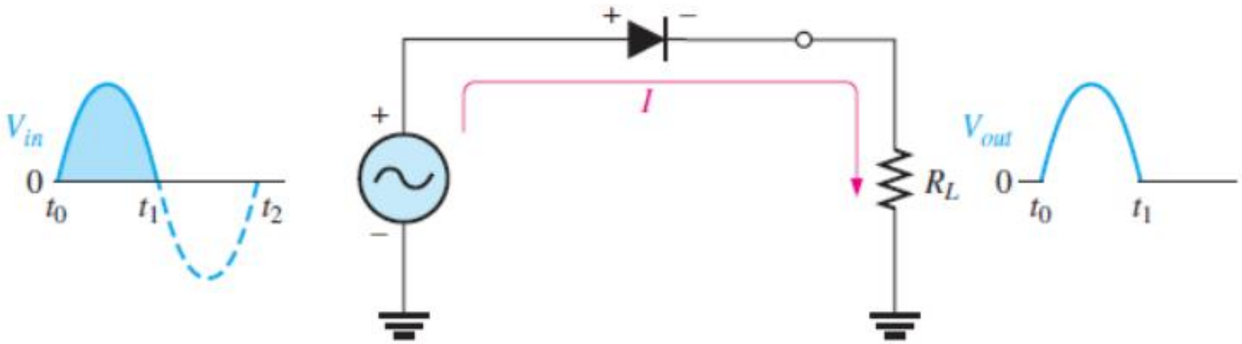
(b) Reverse bias



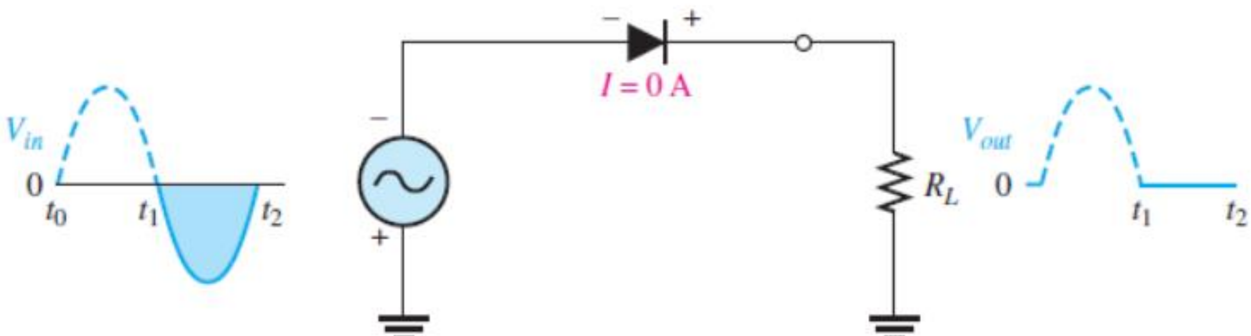
Diyot I-V Karakteristiği



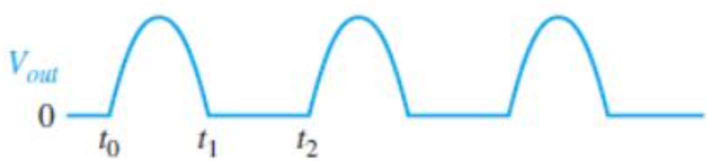
Yarım Dalga Doğrultucu



(a) During the positive alternation of the 60 Hz input voltage, the output voltage looks like the positive half of the input voltage. The current path is through ground back to the source.



(b) During the negative alternation of the input voltage, the current is 0, so the output voltage is also 0.



(c) 60 Hz half-wave output voltage for three input cycles

Tam Dalga Doğrultucu

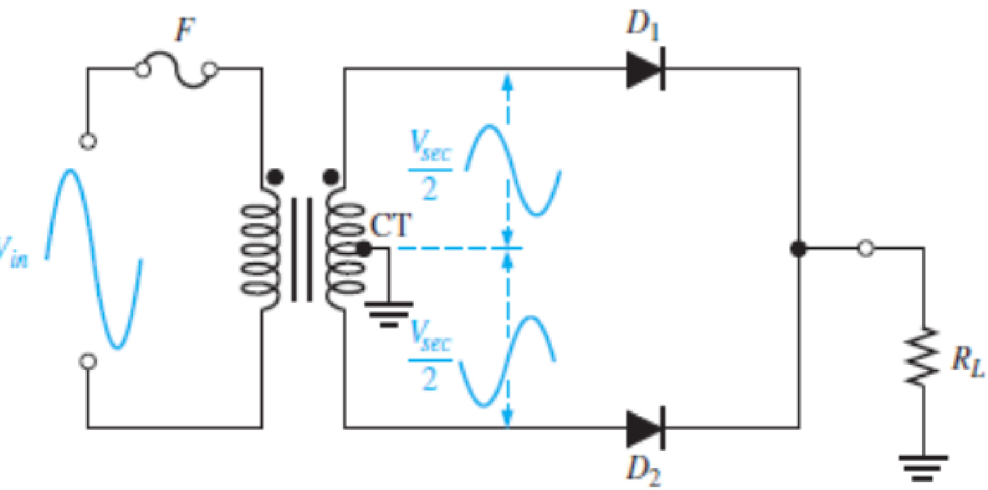
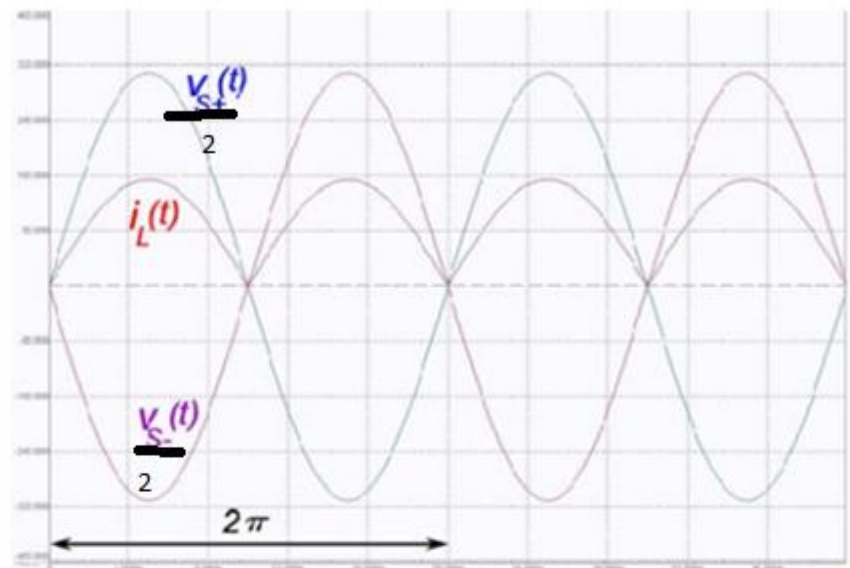
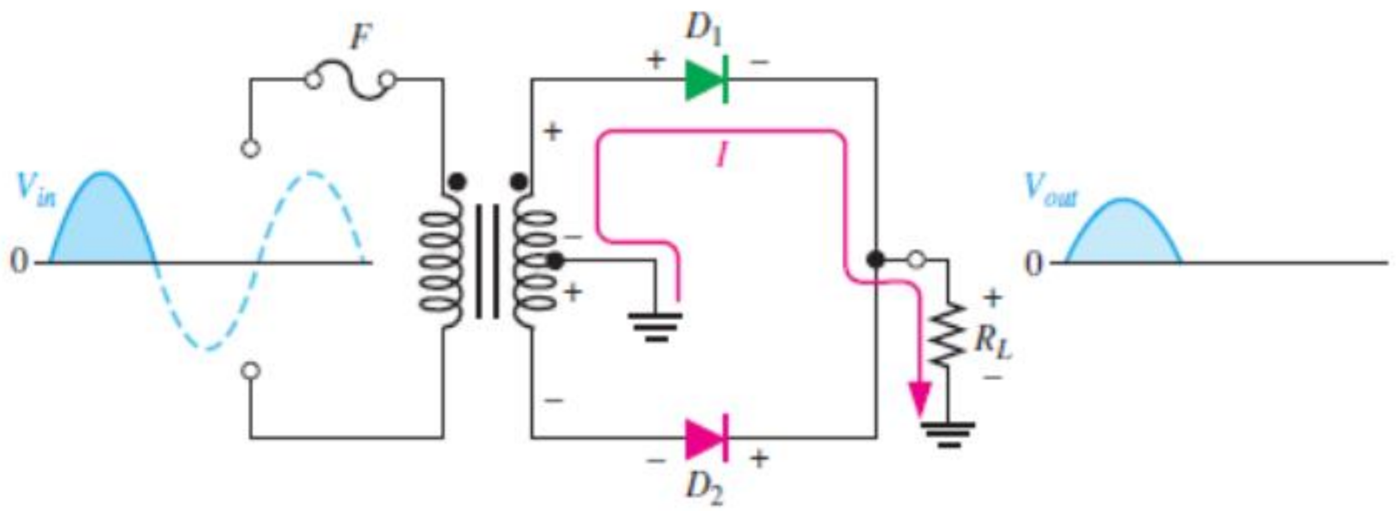


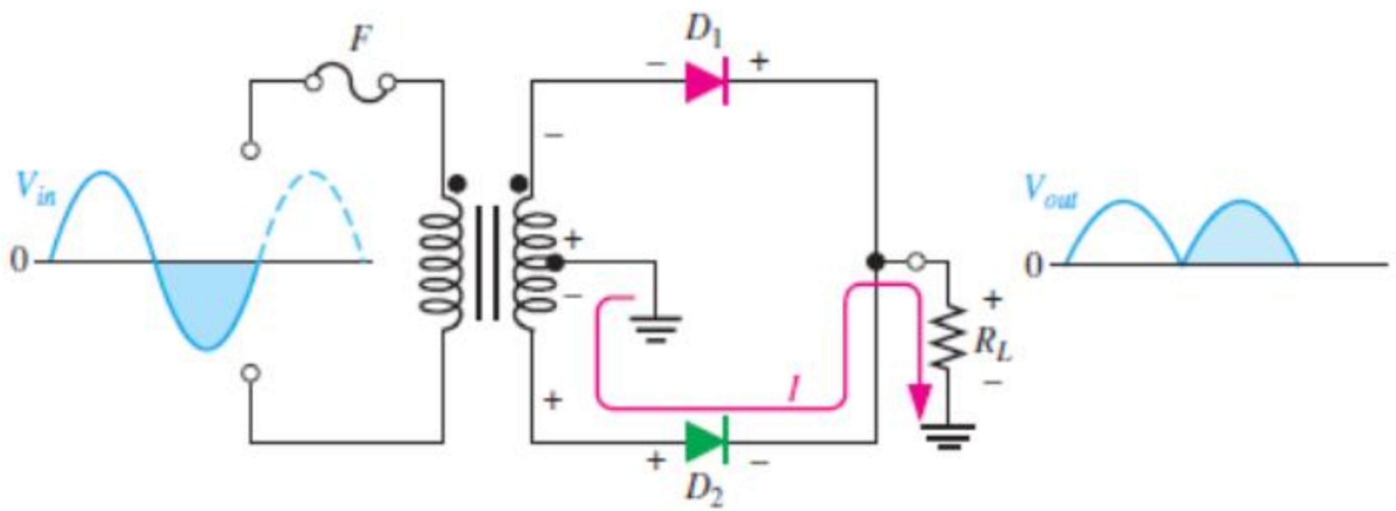
Figure 3.51 A center-tapped full-wave rectifier.



g. 5: Waveforms of the single-phase, single-way, full-wave rectifier

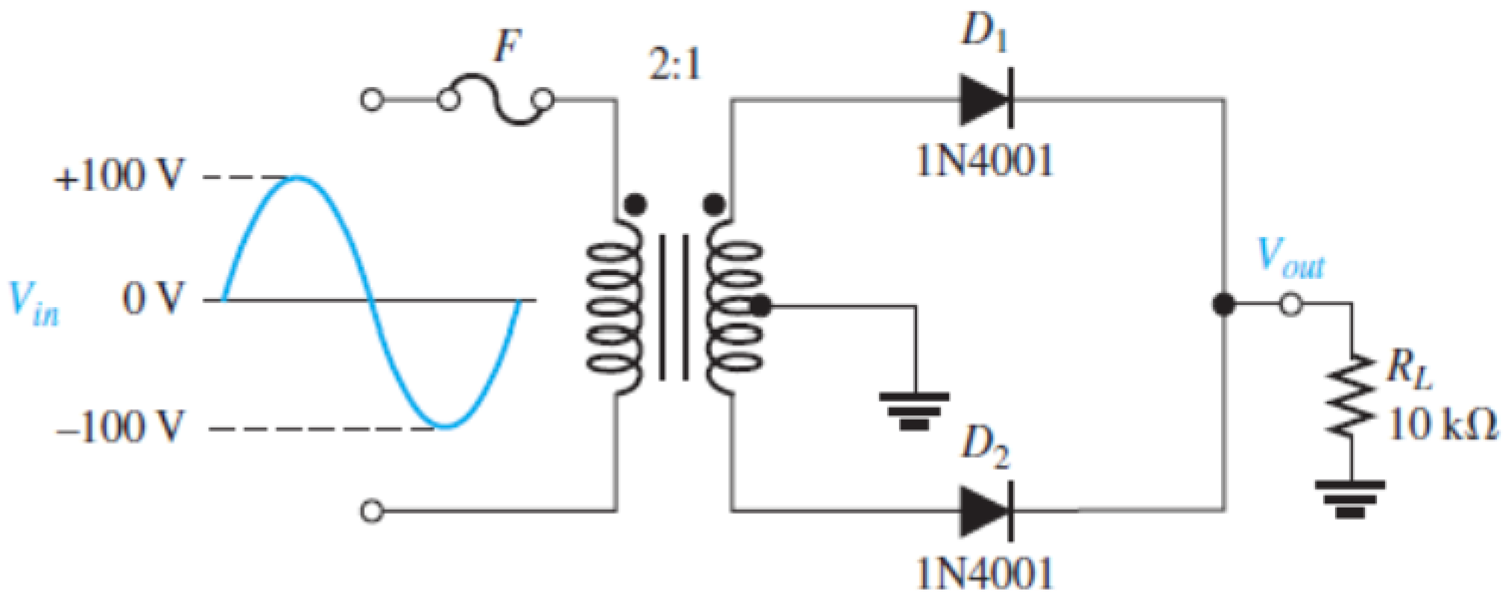


(a) During positive half-cycles, D_1 is forward-biased and D_2 is reverse-biased.



(b) During negative half-cycles, D_2 is forward-biased and D_1 is reverse-biased.

Örnek



- (a) Show the voltage waveforms across each half of the secondary winding and across RL when a 100 V peak sine wave is applied to the primary winding in Figure 3.55.
- (RL yük direnci üzerindeki çıkış gerilimi Vo’nun grafiğini ve değerini elde ediniz. Giriş gerilimi primer sargı için Vmax=100 Volt veriliyor, diyot gerilim düşmelerini de hesaba katınız).

Solution:

(a) The transformer turns ratio n = 0.5. The total peak secondary voltage is

$$V_{p(\sec)} = 0.5\ (100\ V) = 50\ V$$

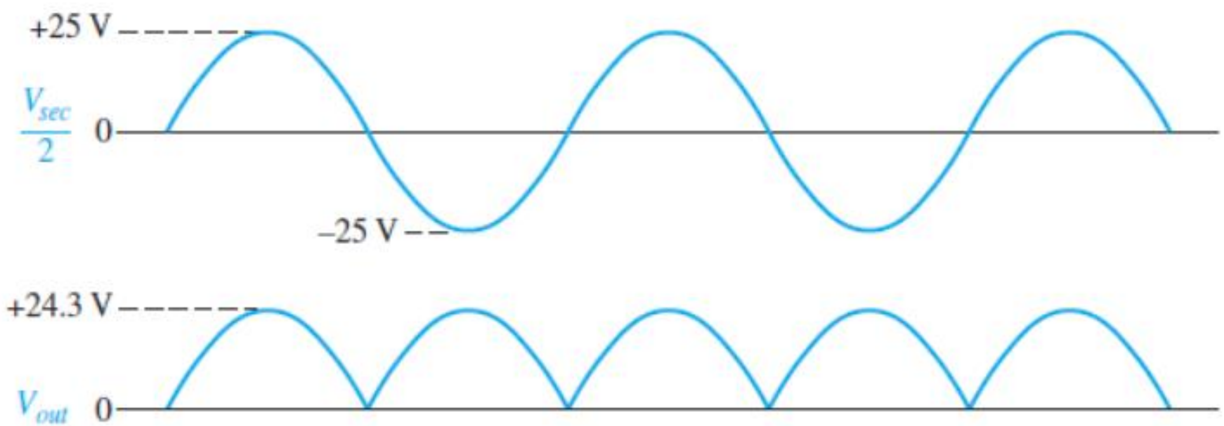
$$\frac{V_{p(\sec)}}{2} = 25\ V$$

This is a 25 V peak across each half of the secondary with respect to the ground.

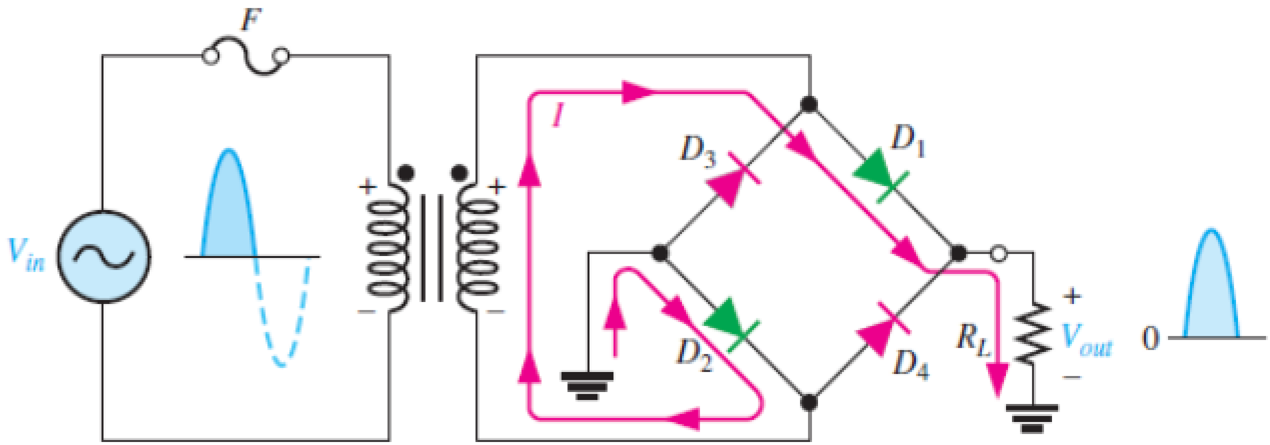
$$V_{out\ (peak)} = \frac{V_{p(\sec)}}{2} - V_{on}$$

$$= 25 - 0.7 = 24.3\ V$$

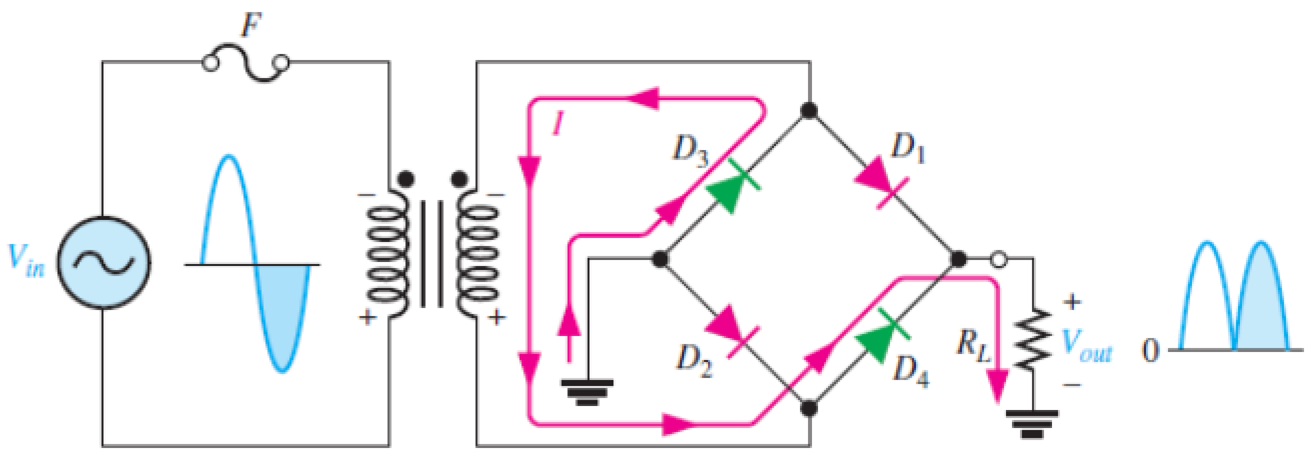
The waveforms are shown in Figure 3.56.



Tam Dalga Köprü Doğrultucu



(a) During the positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



(b) During the negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

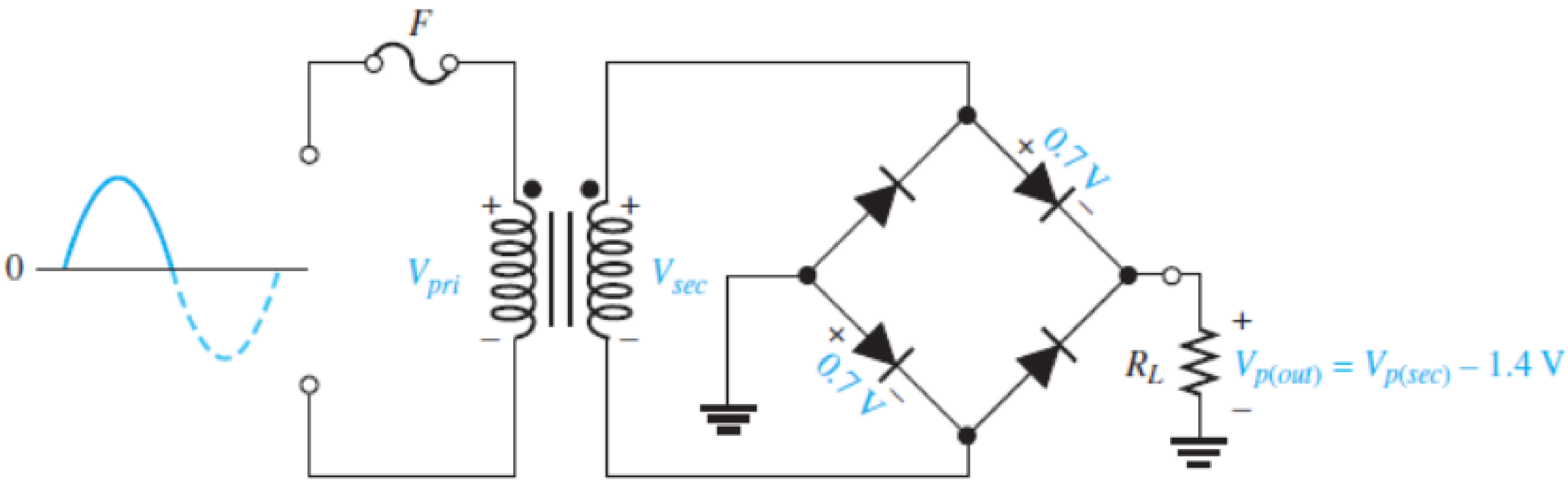


Figure 3.61 Bridge operation during a positive half-cycle of the primary and secondary voltages. [5]

DC Güç Kaynakları

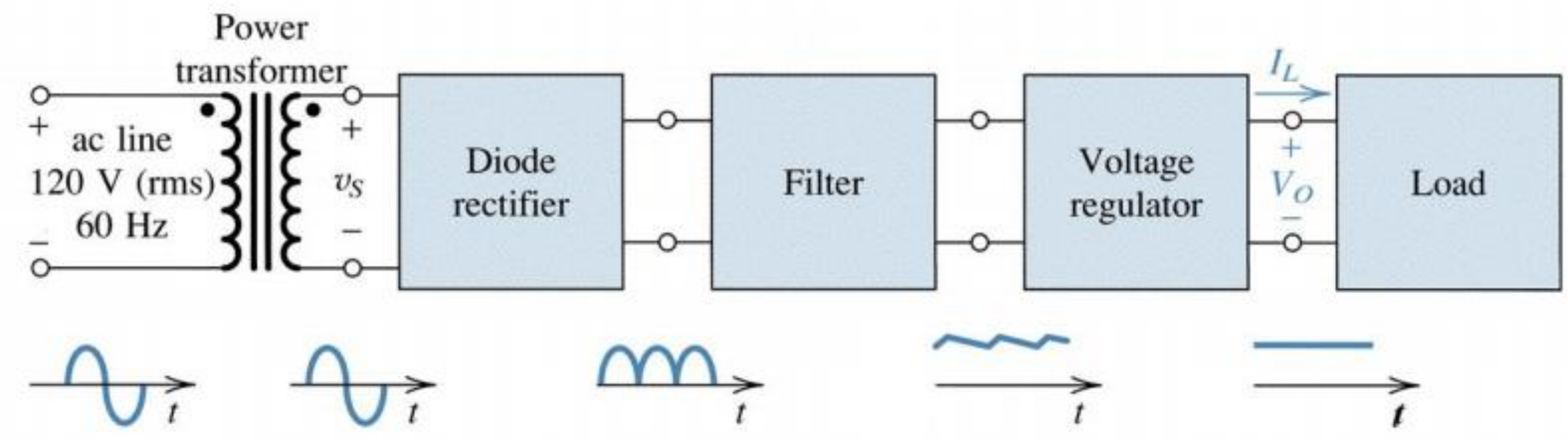
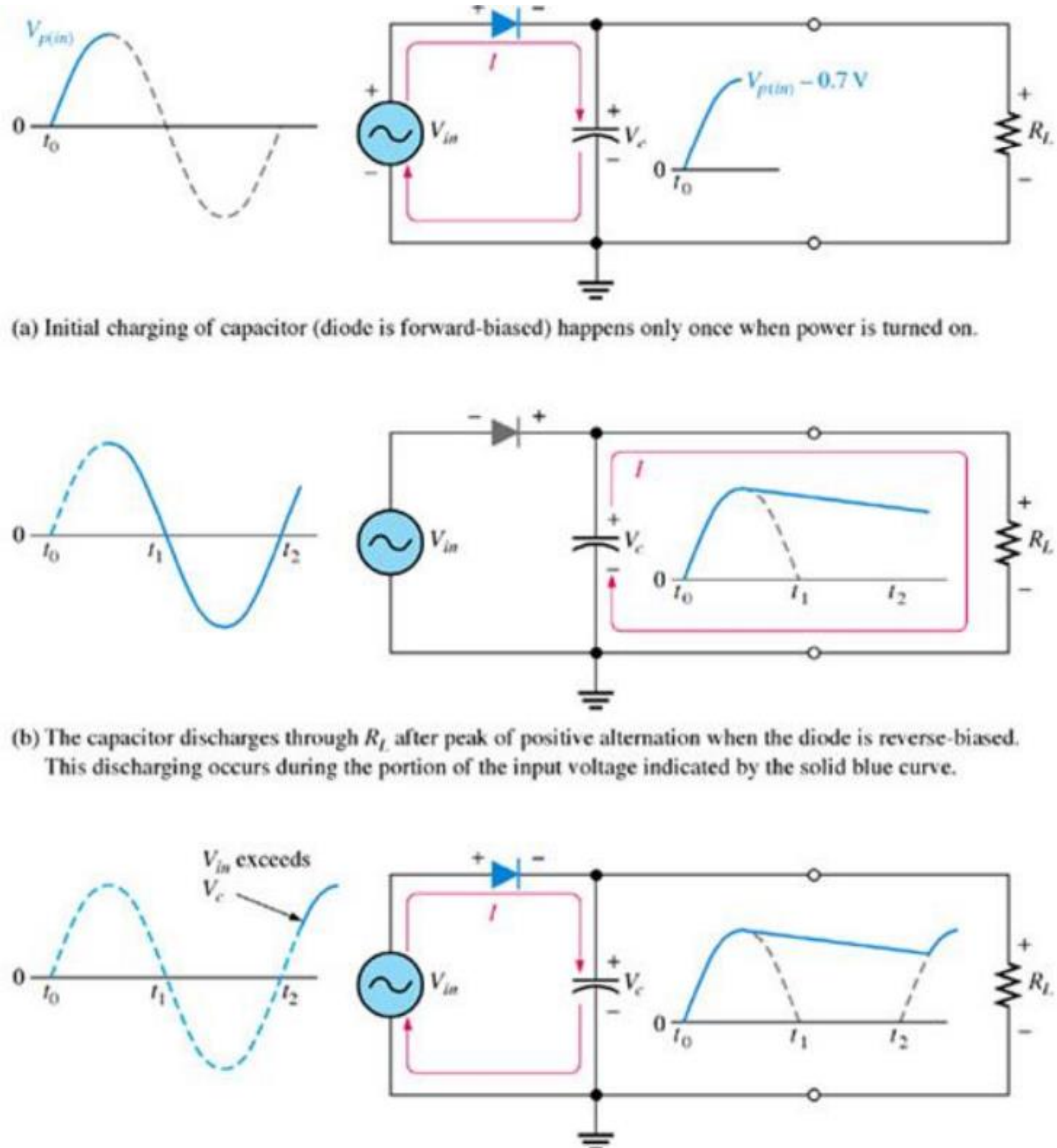


Figure 3.33 Block diagram of a line-operated dc power supply. [6]

Figure 3.78 Operation of a half-wave rectifier with a capacitor-input filter. The current indicates charging or discharging of the capacitor. [5]



(a) Initial charging of capacitor (diode is forward-biased) happens only once when power is turned on.

(b) The capacitor discharges through R_L after peak of positive alternation when the diode is reverse-biased. This discharging occurs during the portion of the input voltage indicated by the solid blue curve.

(c) The capacitor charges back to peak of input when the diode becomes forward-biased. This charging occurs during the portion of the input voltage indicated by the solid blue curve.

Ripple Voltajı

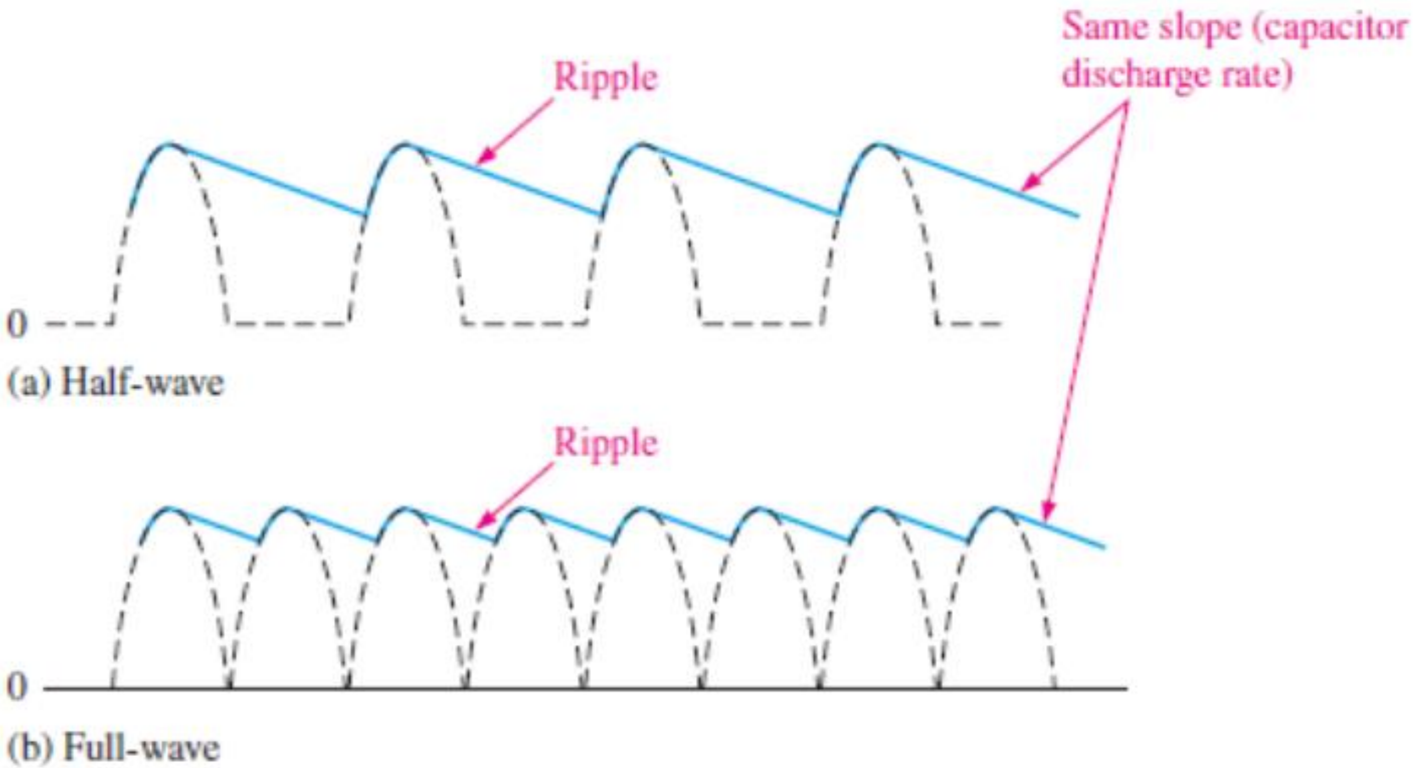


Figure 3.81 Comparison of ripple voltages for half-wave and full-wave rectified voltages with the same filter capacitor and load and derived from the same sinusoidal input voltage. [5]

Ripple Factor:

The ripple factor (r) is an indication of the effectiveness of the filter and is defined as

$$r = \frac{V_{r(pp)}}{V_{DC}}$$

r = Ripple Factor

$V_{r(pp)}$ = peak – to – peak ripple voltage

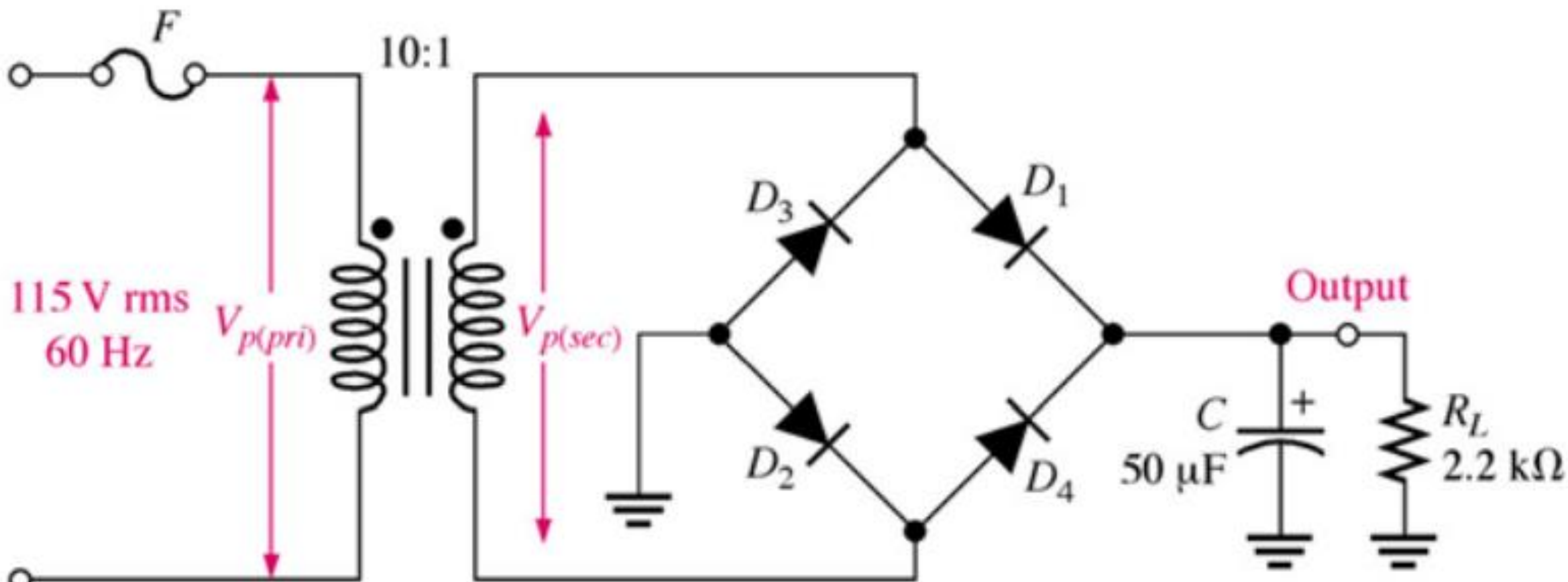
V_{DC} = DC (average) Voltage of the filter's output vol tage

Here,

$$V_{DC} \cong \left(1 - \frac{1}{2fR_L C}\right) V_{p(rect)}$$

$$V_{r(pp)} = \left(\frac{1}{fR_L C}\right) V_{p(rect)}$$

Example 15: Determine the ripple factor for the filtered bridge rectifier with a load as indicated in Figure 3.83.



Solution :

$$V_{P(pri)} = \sqrt{2}V_{rms(pri)} = \sqrt{2}\times 115 \cong 163\ \text{V}$$

$$V_{P(sec)} = \frac{n_2}{n_1}\times V_{P(pri)} = \frac{1}{60}\times V_{P(pri)} = \frac{1}{60}\times 163 = 16.3\ \text{V}$$

$$V_M = V_{P(sec)} - 2V_{on} = 16.3 - 1.4 = 14.9\ \text{V}$$

For full-wave rectifier:

$$f_r = 2f_{line} = 2\times 60 = 120\ \text{Hz}$$

$$V_r = \frac{V_M}{R_L f_r C} = \frac{14.9}{2.2\ \text{k}\Omega\times 120\ \text{Hz}\times 50\mu\text{F}} = 1.13\ \text{V}$$

$$V_{DC} = V_M - \frac{V_r}{2} = V_{P(sec)} - 2V_{on} - \frac{V_r}{2} = 16.3 - 1.4 - \frac{1.13}{2} = 14.3\ \text{V}$$

or

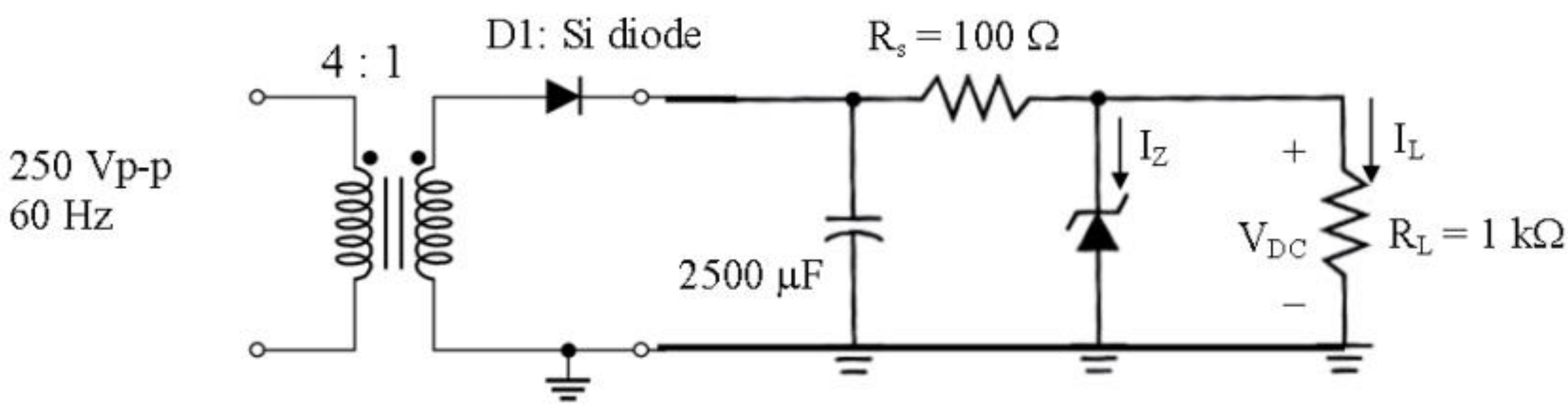
$$V_{DC} = V_M\left(1 - \frac{1}{2f_r RC}\right) = 14.9\times\left(1 - \frac{1}{(240\ \text{Hz})(2.2\ \text{k}\Omega)(50\ \mu\text{F})}\right) = 14.3\ \text{V}$$

$$\text{ripple factor (r)} = \frac{V_{r(P-P)}}{V_{DC}} = \frac{1.13}{14.3} = 0.079$$

Example 19:

(a) Determine the values of V_{DC}, $V_{r(out)}$, and I_L for the power supply shown in Figure 3.98.

(b) Can we use the zener diode in this circuit as the voltage regulator or not? Why?



Zenoe diode specification

$V_Z = 10$ V
$I_{ZK} = 100$ µA
$I_{ZM} = 300$ mA
$Z_Z = 50$ Ω

Solution :

(a)

$$V_{dc} = V_Z = 10\,\text{V}, \quad I_L(\text{or } I_{DC}) = \frac{V_{dc}}{R_L} = \frac{10\,\text{V}}{1000\,\Omega} = 10\,\text{mA}$$

$$V_{P(\text{primary})} = \frac{250\,\text{V(p - p)}}{2} = 125\,\text{V(p)}$$

$$V_{P(\text{secondary})} = \frac{1}{4} \times V_{P(\text{primary})} = \frac{1}{4} \times 125 = 31.5\,\text{V(p)}$$

$$V_M = V_{P(\text{secondary})} - 0.7 = 31.25 - 0.7 = 30.55\,\text{V(p)}$$

$$I_{R_s} = \frac{V_M - V_S}{R_S} = \frac{30.55 - 10}{100} = 0.2055\,\text{A} = 205.5\,\text{mA}$$

$$V_r \cong \frac{I_{R_S}}{f_r C}, f_r = f_{line} = 60\text{Hz} \quad (\text{half} - \text{wave rectifier})$$

$$= \frac{0.2055}{(60)(2500 \times 10^{-6})} = 1.37\,\text{V}_{(\text{p-p})}$$

$$V_{r(out)} = \frac{(Z_Z // R_L)}{(Z_Z // R_L) + R_S} V_r = \frac{(50 // 100)}{(50 // 100) + 100} 1.37\,\text{V}_{(\text{p-p})}$$

$$\cong 442\,\text{mV}_{(\text{p-p})}$$

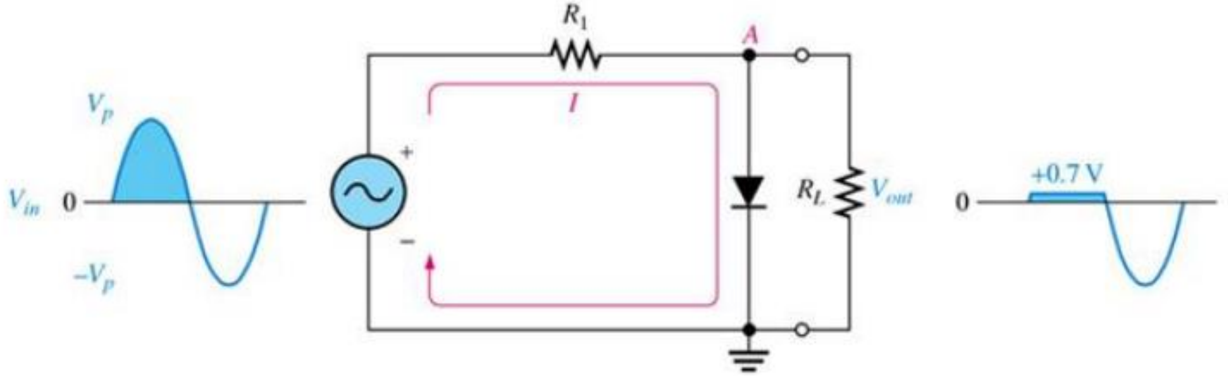
(b) $I_{RS} = I_Z + I_L$

Here $I_Z = I_{RS} - I_L = 205.5 - 10 = 195.5$ mA

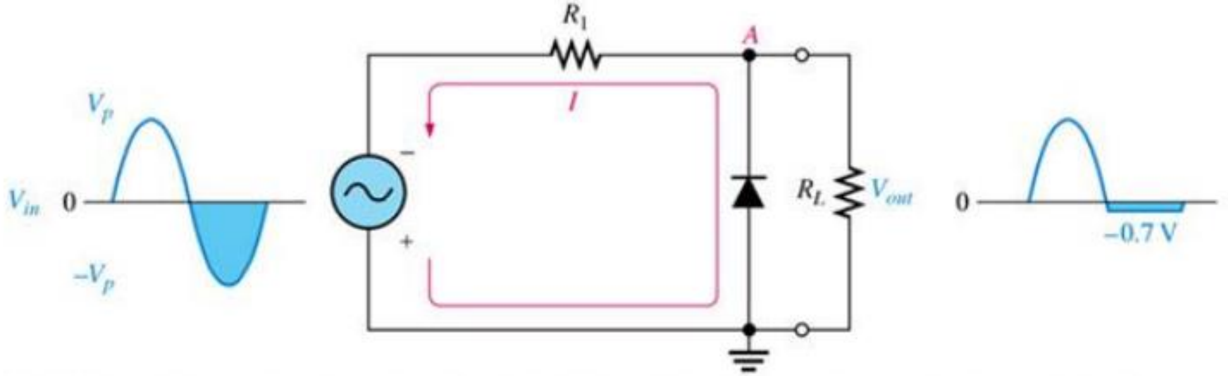
*** As $I_Z < I_{ZM}$ (195.5 mA < 300 mA), we can use this zener diode as the voltage regulator ***

Kırpıcı Devreler (Diode Limitters)

$$V_{out} = \left(\frac{R_L}{R_1 + R_L} \right) V_{in}$$



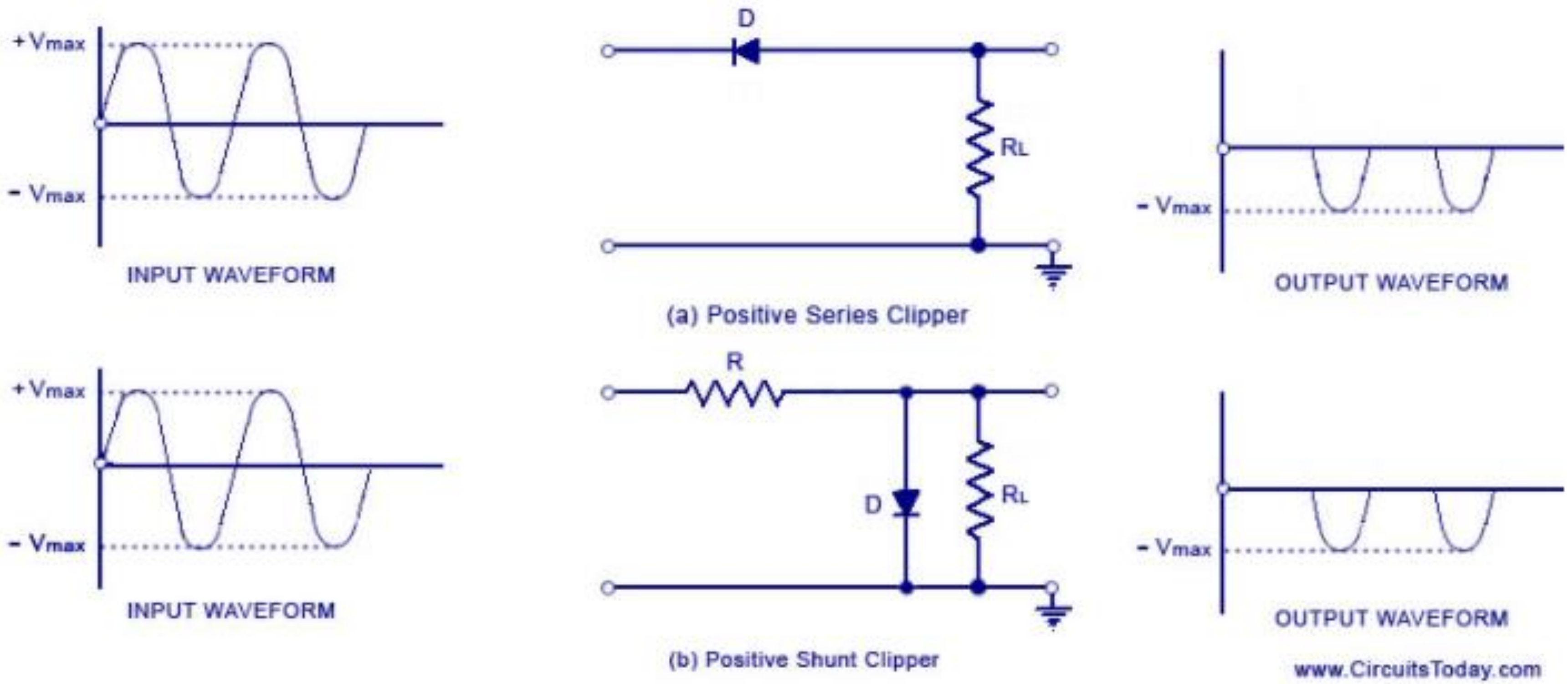
(a) Limiting of the positive alternation. The diode is forward-biased during the positive alternation (above 0.7 V) and reverse-biased during the negative alternation.



(b) Limiting of the negative alternation. The diode is forward-biased during the negative alternation (below −0.7 V) and reverse-biased during the positive alternation.

Figure 3.105 Examples of diode limiters (clippers). [5]

Positive Series Clipper and Positive Shunt Clipper

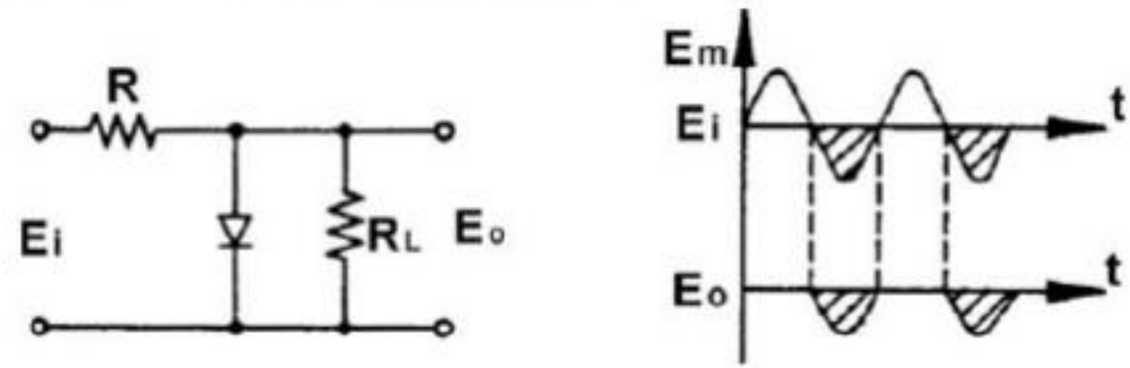


(a) Positive Series Clipper

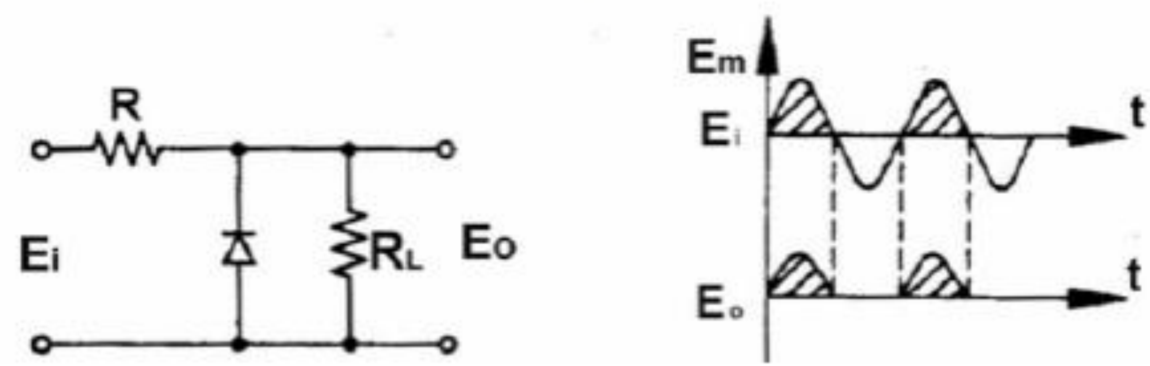
(b) Positive Shunt Clipper

2.2.a.2 Parallel Diode Clipping Circuit

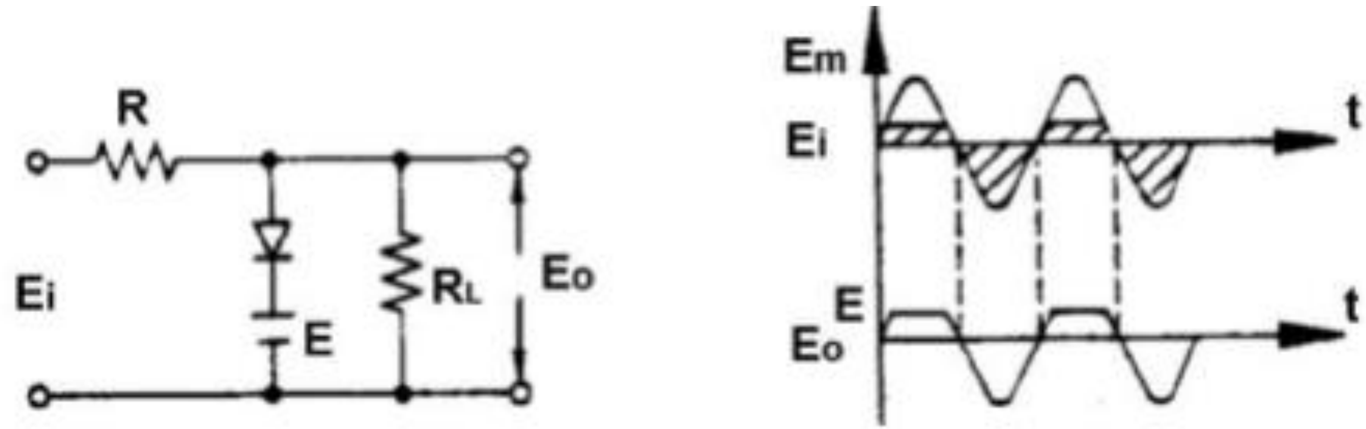
In this type of clippers, the diode is connected between output terminals. The on/off state of diode directly affects the output voltage. These type of clippers may also have a non-zero threshold voltage by addition of a voltage series with diode. Following figures illustrate the clipping process.



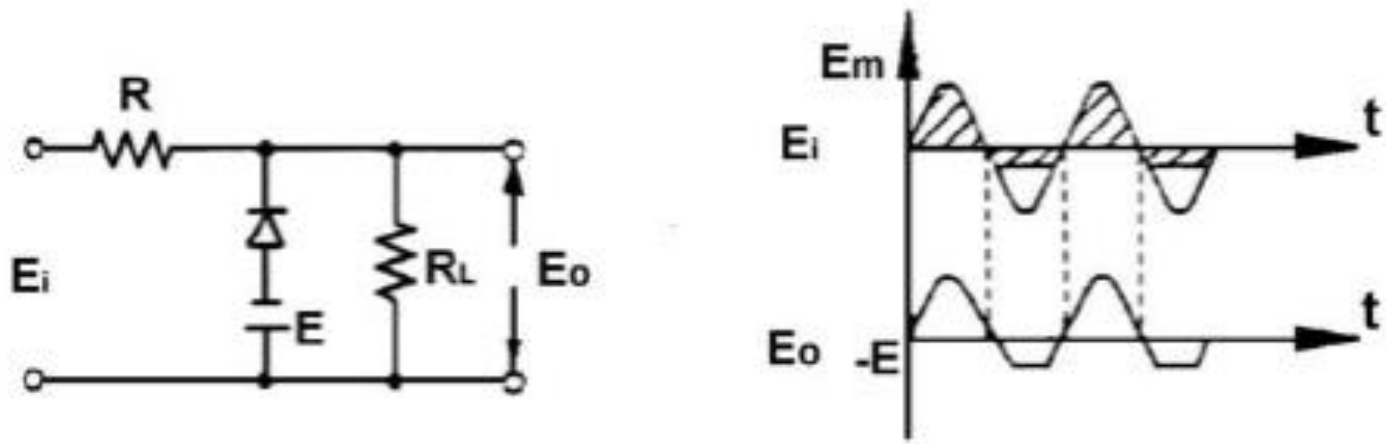
a



b



a



b

Fig. 2.7 – Thresholded Parallel Clippers

Biased Clippers

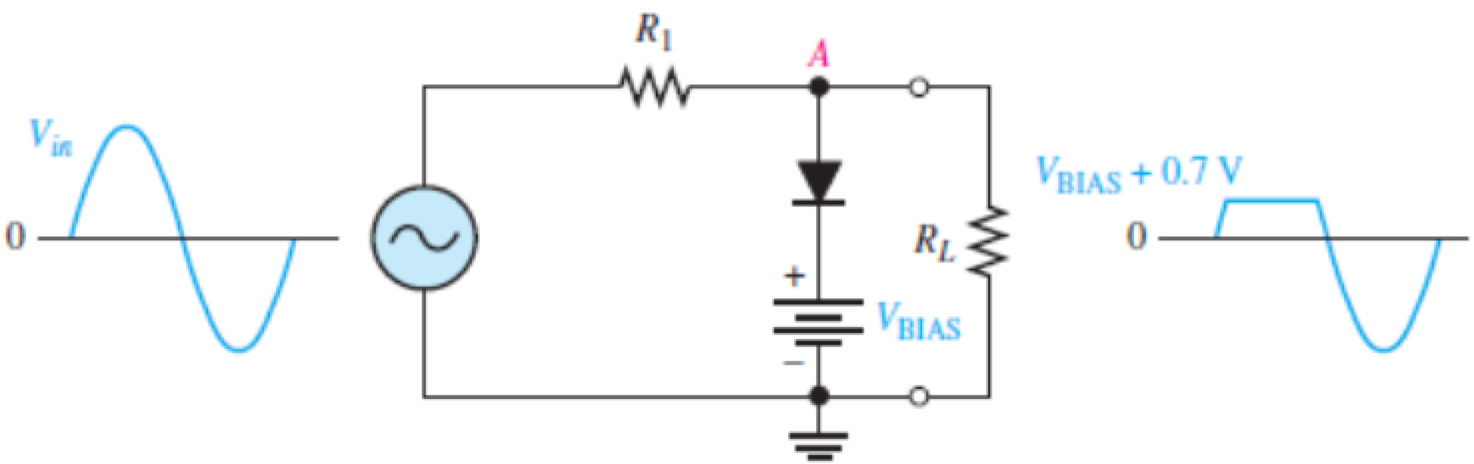


Figure 3.108 A positive limiter. [5]

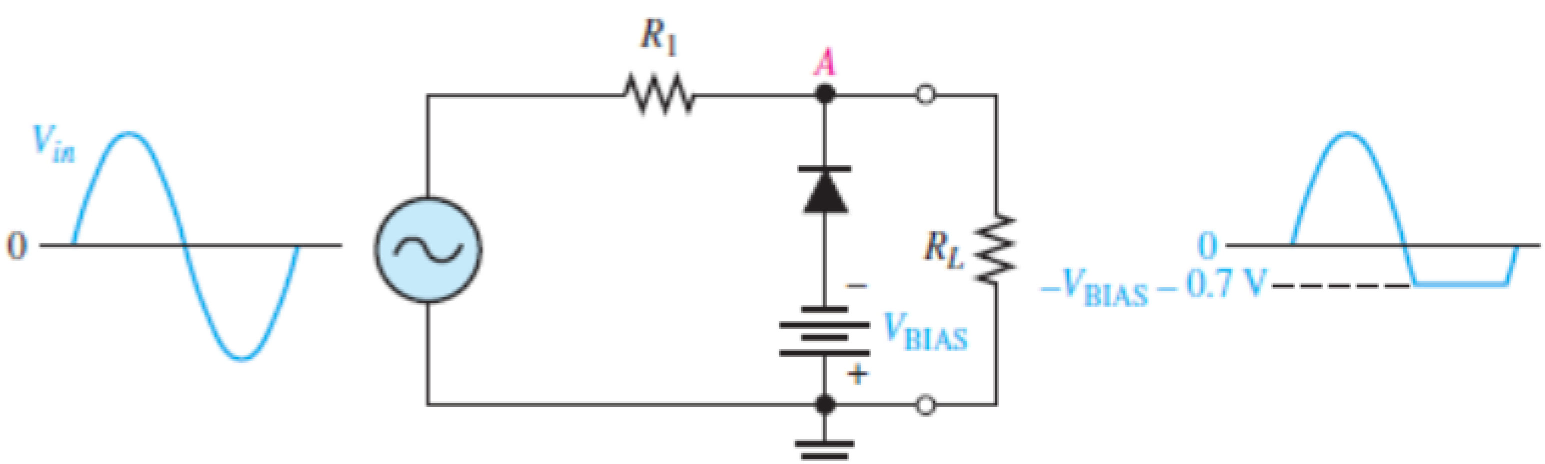
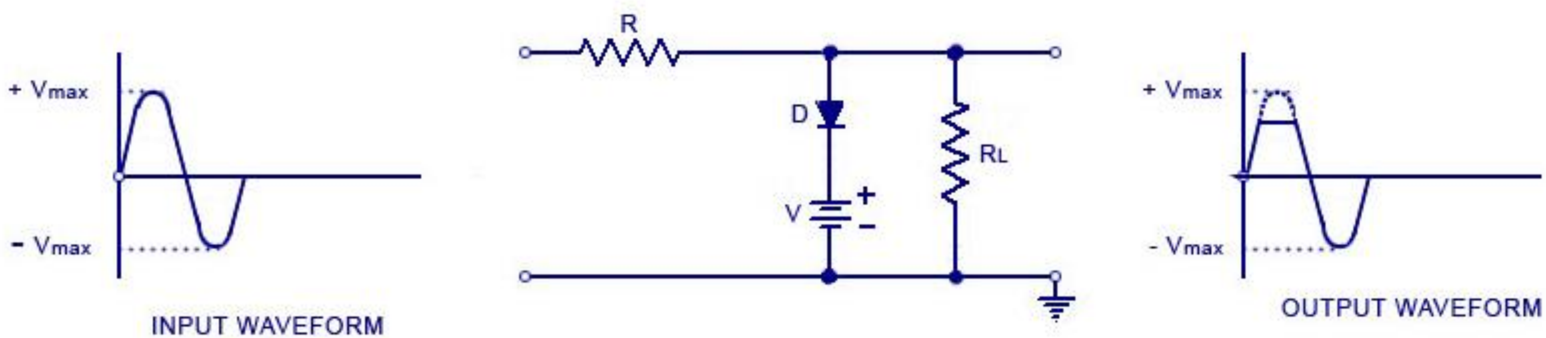


Figure 3.109 A negative limiter. [5]

BIASED POSITIVE CLIPPER



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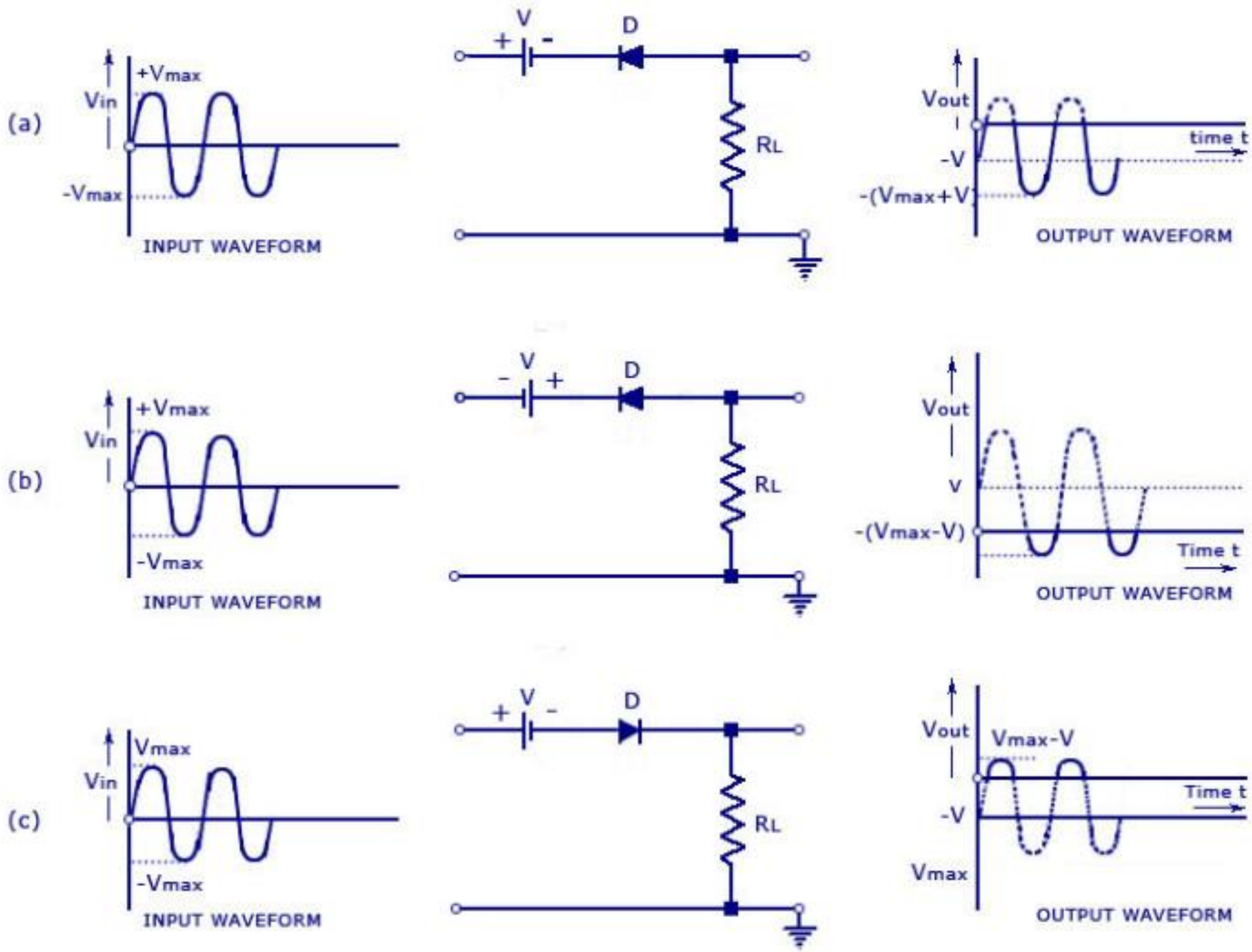
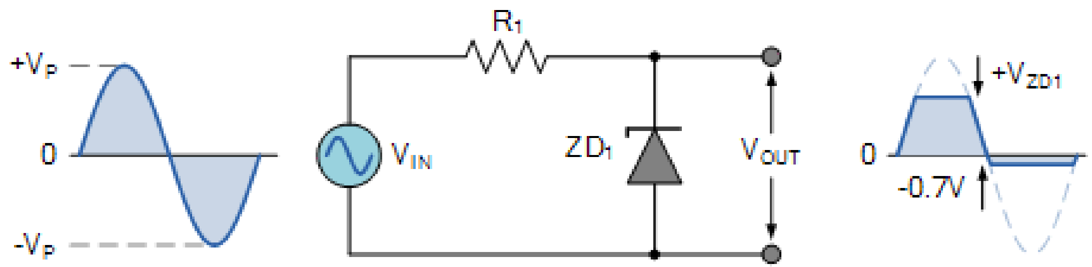
Different Clipping Circuits



Zener Diode Clipping



Full-wave Zener Diode Clipping