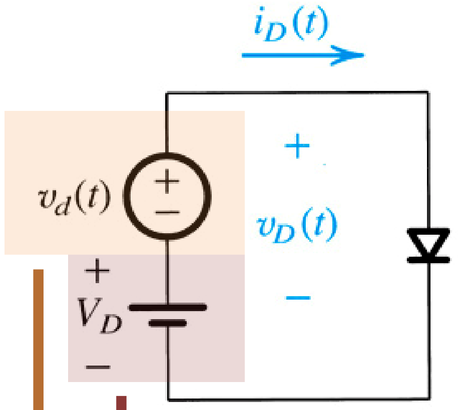
Bate → Examen #1

Todo estudiante podrá traer su propio bate al examen. No obstante, dicho bate deberá circunscribirse a las siguientes características y normas establecidas:

1. **Una hoja tamaño carta por ambos lados**
2. **Solo formulas**
3. **No se permiten:**
   - **problemas resueltos**
   - **esquemáticos**
   - **explicaciones**
   - **procedimientos**
4. **Deberá ser entregado junto a su examen**

***** La falta de cumplimiento de dichas normas resultara en un reducción de la nota obtenida en proporción a dicha falta.**

Last Lecture → Small Signal Model



$$i_D = I_S e^{v_D/V_T}$$

$$i_D(t) = I_S e^{v_D(t)/V_T}$$
$$= I_S e^{(V_D + v_d(t))/V_T}$$
$$= I_{bias} e^{v_d(t)/V_T}$$

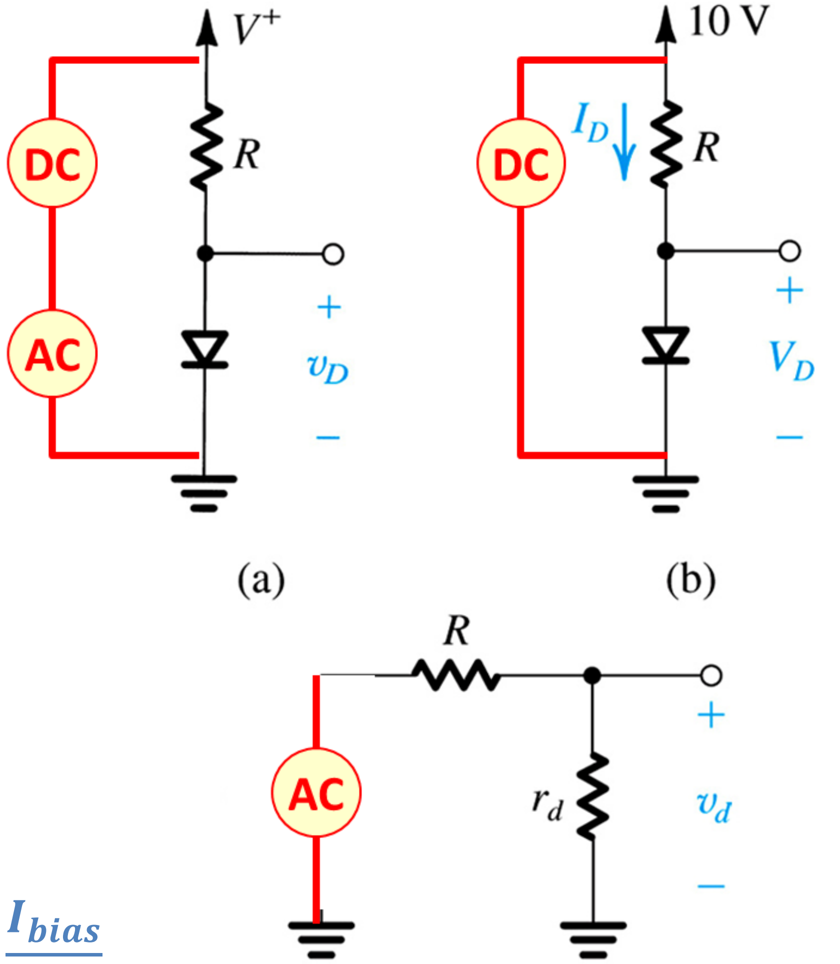
I_D $\Delta I_D = i_d$

$$i_D(t) \approx I_{bias} + \frac{I_{bias}}{V_T} v_d(t)$$

$$\frac{1}{r_d} = \frac{\Delta i_D}{\Delta v_D} = \frac{i_d}{v_d} = \frac{I_{bias}}{V_T}$$

DC Signal
→ stablishes the bias point

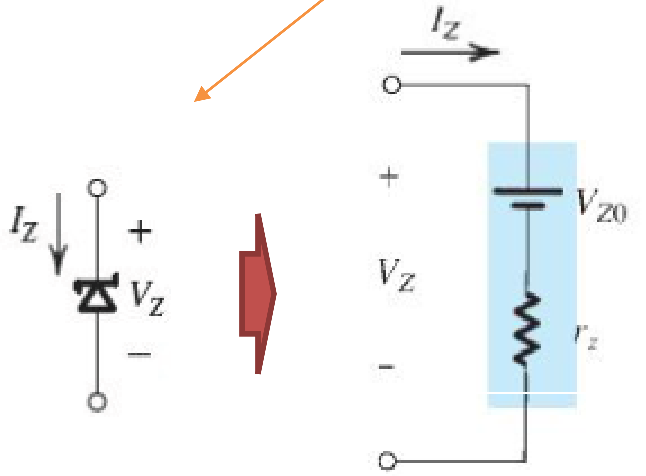
AC Signal
→ small changes at the bias point



(a) (b) (c)

Zener Diodes → Chapter 4.4

- Under certain circumstances, diodes may be intentionally used in the reverse breakdown region.
- These are referred to as Zener Diodes.

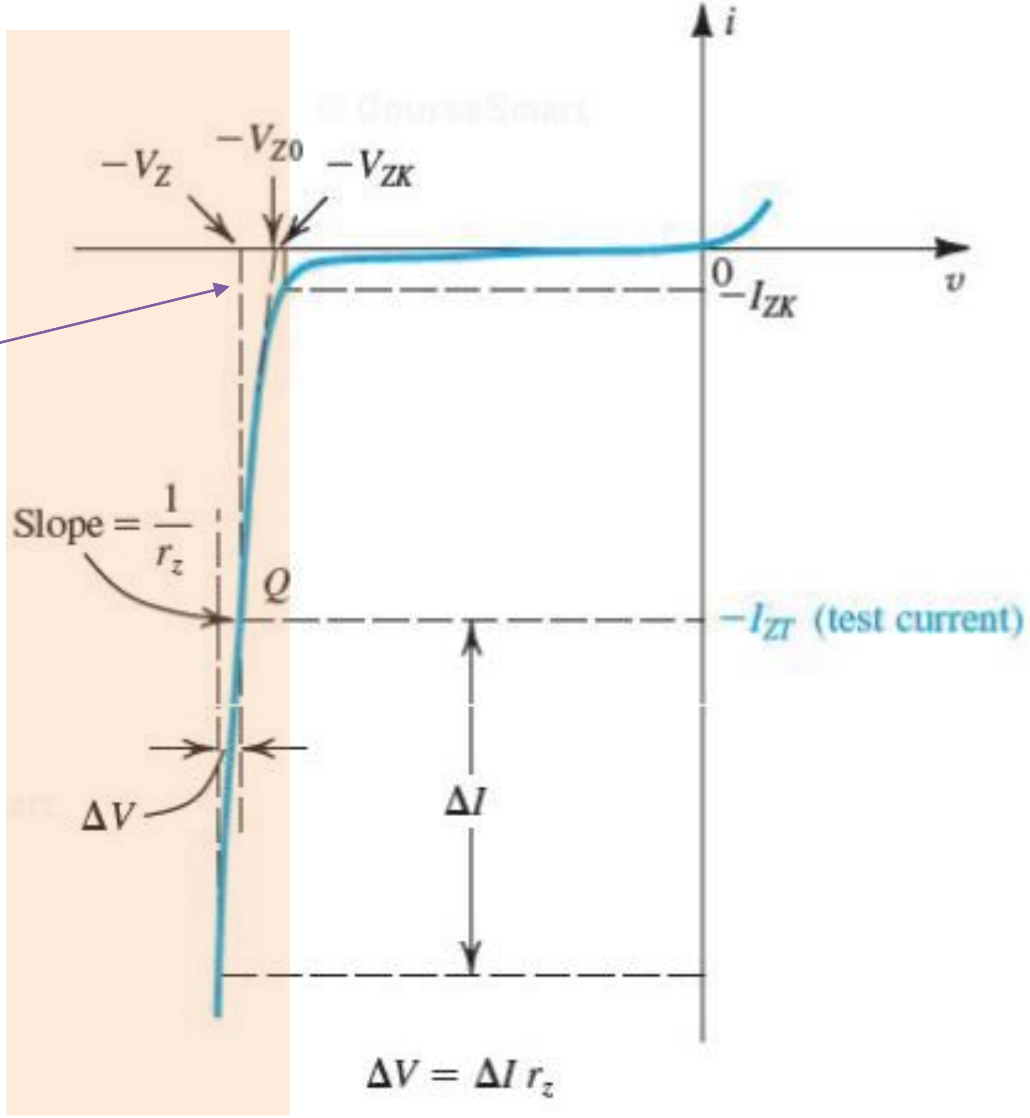


Zener-Knee Voltage (V_{ZK})

$$V_z = V_z + r_z \cdot I_z$$

*** for $V_Z > V_{Z0}$

$I_Z > I_{ZK}$



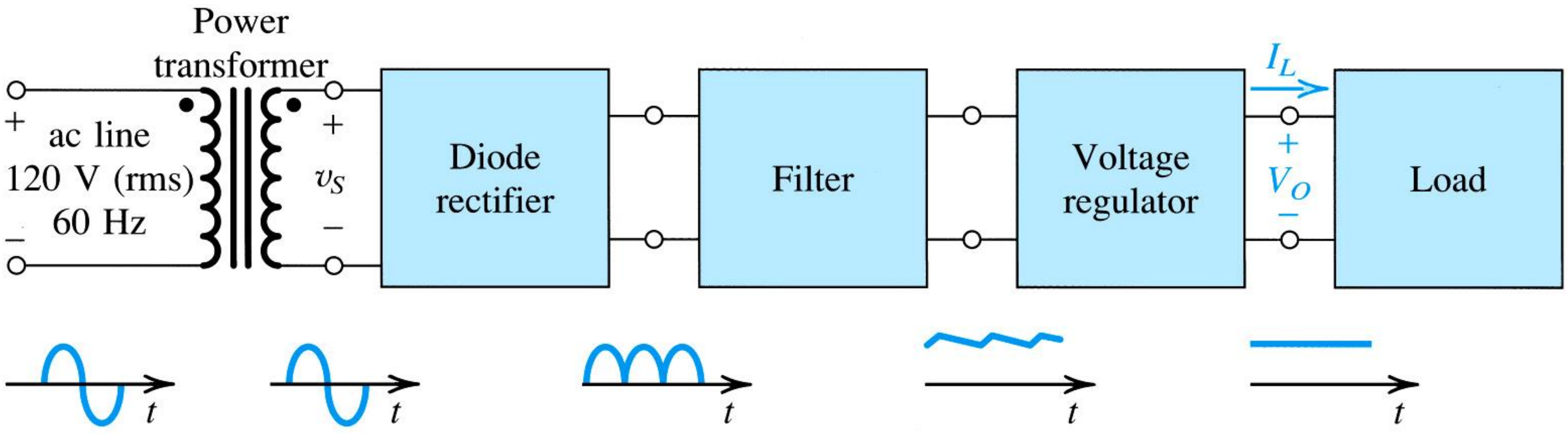
Exercise 4.17

A zener diode exhibit a constant voltage of 5.6V for current greater than five times the knee current. I_{ZK} is specified to be 1mA. The zener is to be used in the design of a shunt regulator fed from a 15-V supply. The load current varies over the range of 0mA to 15mA. Find a suitable value for the resistor R. What is the maximum power dissipation of the zener diode?

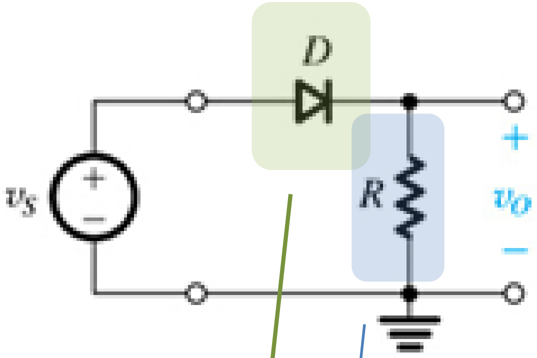
Rectifier Circuits → Chapter 4.5

DC Power Supply

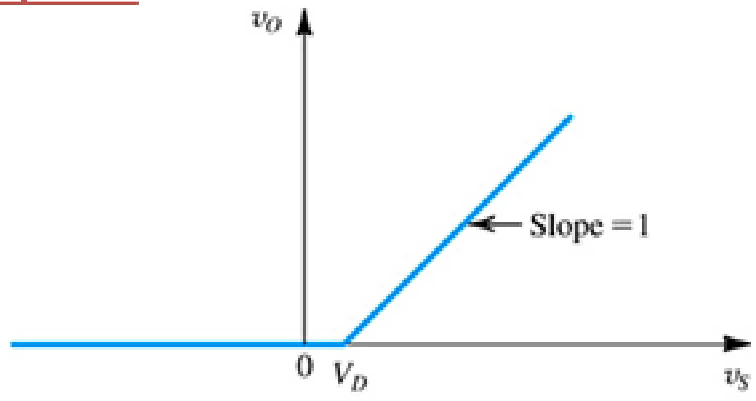
- **Power Transformer** – lowers down the 120V-AC input voltage and provides electrical isolation
- **Diode rectifiers** – converts the AC signal to an unipolar output
- **Filter** – reduces the voltage fluctuations of the rectified signal
- **Voltage Regulator** - reduces the ripple and stabilizes the output voltage from variations caused by changes in the load current



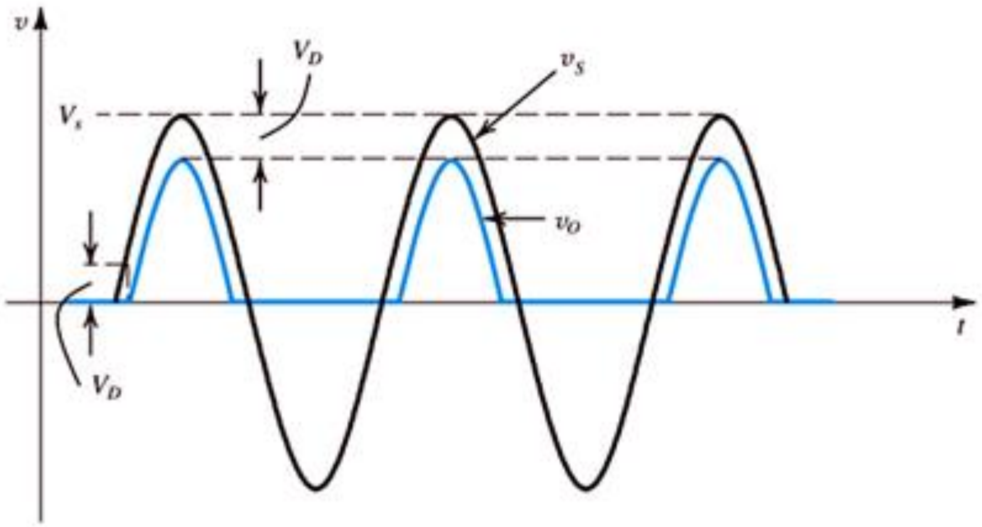
The Half-Wave Rectifier



DC Response



Transient Response



Diode Parameter Specifications:

- Current-handling capability – $I_{D(max)}$
- Peak inverse voltage –

  PIV = $V_{D_{reverse}(max)}$

Output Specifications:

- Average Voltage – $V_{0(avg)}$
- Average Current – $I_{L(avg)}$

- **Diode Ratings**

$$I_{max} = \frac{V_S - V_D}{R}$$

$$PIV = V_S$$

- **Conduction Angle**

$$\theta = \sin^{-1}\left(\frac{V_D}{V_S}\right)$$

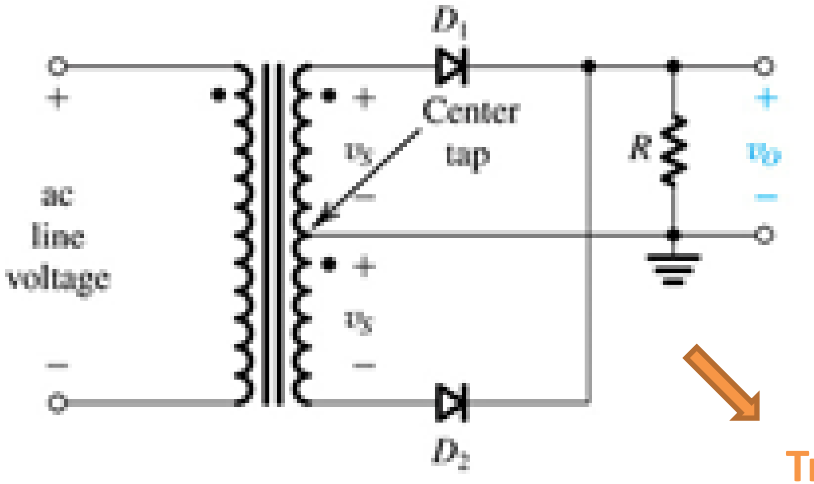
$$\Delta\theta = \pi - 2\theta$$

- **Average Output**

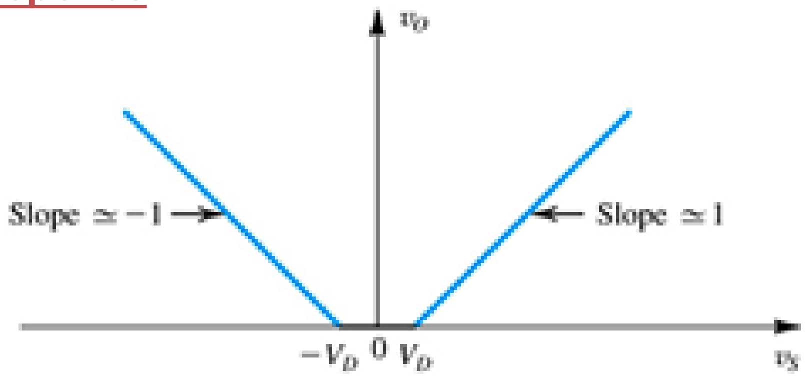
$$\overline{V_0} \approx \frac{V_S}{\pi} - \frac{V_D}{2}$$

$$\overline{I_L} \approx \frac{\overline{V_0}}{R}$$

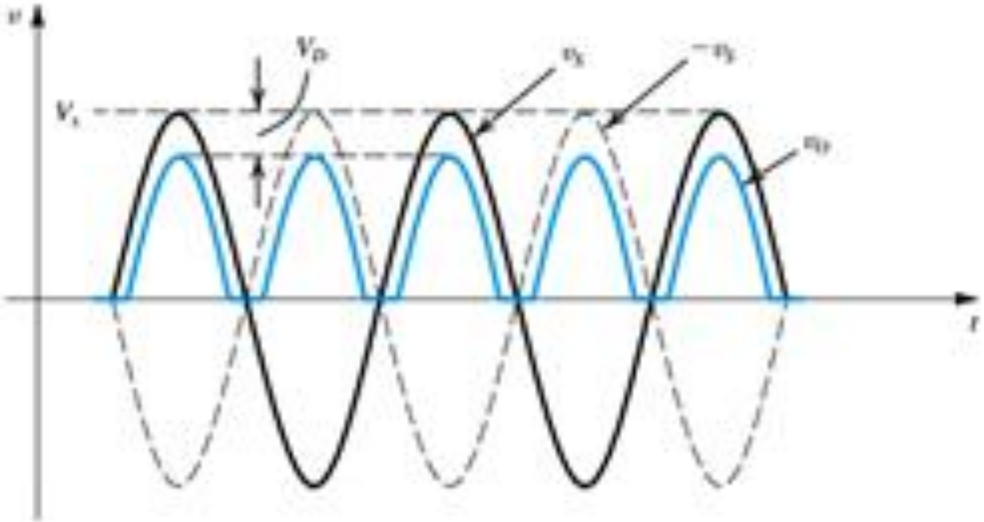
The Full-Wave Rectifier



DC Response



Transient Response



Diode Parameter Specifications:

- **Current-handling capability – $I_{D(max)}$**
- **Peak inverse voltage – PIV**

Output Specifications:

- **Average Voltage – $V_{0(avg)}$**
- **Average Current – $I_{L(avg)}$**

- **Diode Ratings**

$$I_{max} = \frac{V_S - V_D}{R}$$

$$PIV = 2V_S - V_D$$

- **Conduction Angle**

$$\theta = \sin^{-1}\left(\frac{V_D}{V_S}\right)$$

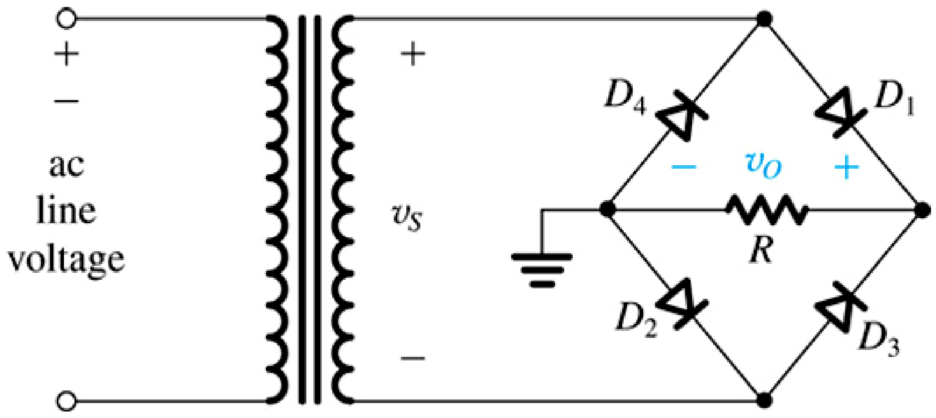
$$\Delta\theta = \pi - 2\theta$$

- **Average Output**

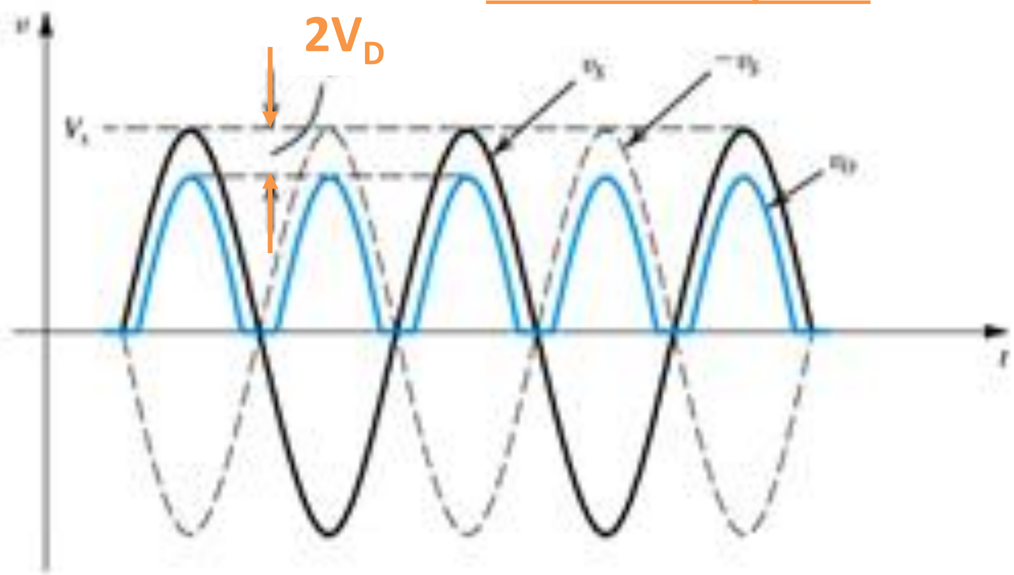
$$\overline{V_0} \approx \frac{2V_S}{\pi} - V_D$$

$$\overline{I_L} \approx \frac{\overline{V_0}}{R}$$

The Bridge Rectifier



Transient Response



<u>Diode Parameter Specifications:</u>

- Current-handling capability – $I_{D(max)}$
- Peak inverse voltage –
  $PIV = V_{D_{reverse}(max)}$

<u>Output Specifications:</u>

- Average Voltage – $V_{0(avg)}$
- Average Current – $I_{L(avg)}$

- **Diode Ratings**

$$I_{max} = \frac{V_S - 2V_D}{R}$$

$$PIV = V_S - V_D$$

- **Conduction Angle**

$$\theta = \sin^{-1}\left(\frac{V_D}{V_S}\right)$$

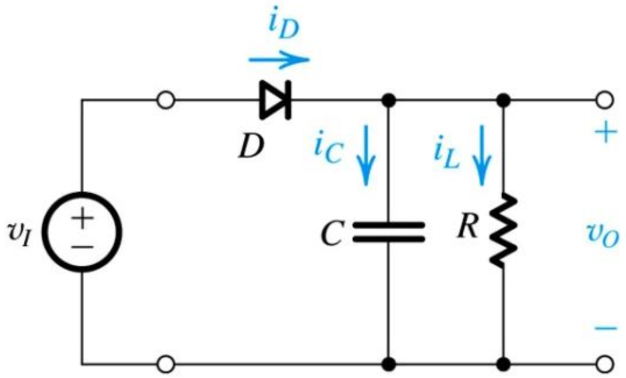
$$\Delta\theta = \pi - 2\theta$$

- **Average Output**

$$\overline{V_0} = \frac{2V_S}{\pi} - 2V_D$$

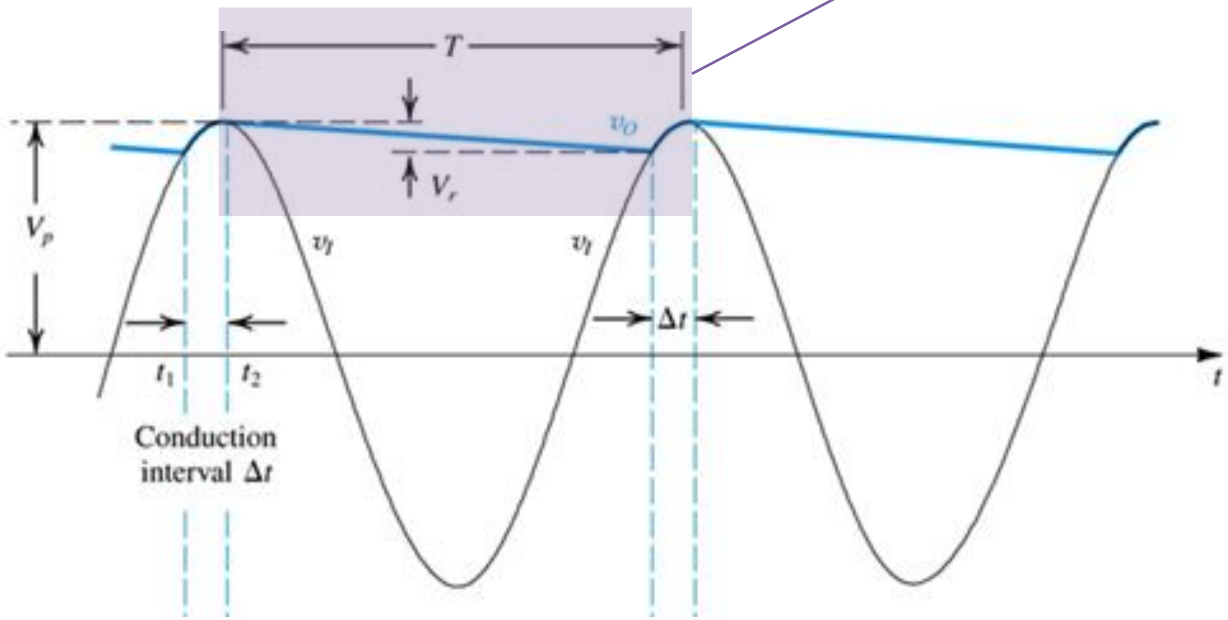
$$\overline{I_L} = \frac{\overline{V_0}}{R}$$

The Rectifier with a Filter Capacitor



$$v_0(t) = V_s e^{-t/CR}$$

assume CR>>T



- **Half-Wave**

$$\overline{V_0} = V_S - \frac{V_r}{2}$$

$$\overline{I_L} = \frac{\overline{V_0}}{R}$$

$$V_r = \frac{V_S}{fCR} \approx \frac{I_L}{fC}$$

$$\Delta\theta \approx \sqrt{2V_r/V_S}$$

$$i_{Davg} = I_L\left(1 + \pi\sqrt{2V_S/V_r}\right)$$

$$i_{Dmax} = I_L\left(1 + 2\pi\sqrt{2V_S/V_r}\right)$$

- **Full-Wave**

$$\overline{V_0} = V_S - \frac{V_r}{2}$$

$$\overline{I_L} = \frac{\overline{V_0}}{R}$$

$$V_r = \frac{V_S}{2fCR} \approx \frac{I_L}{2fC}$$

$$\Delta\theta \approx \sqrt{2V_r/V_S}$$

$$i_{Davg} = I_L\left(1 + \pi\sqrt{V_S/2V_r}\right)$$

$$i_{Dmax} = I_L\left(1 + 2\pi\sqrt{V_S/2V_r}\right)$$