COLLEGE OF ENGINEERING AND TECHNOLOGIES
ALMUSTAQBAL UNIVERSITY

Electronics

CTE 207

Lecture 10

- Full-Wave Rectifier (Center-Tapped) -

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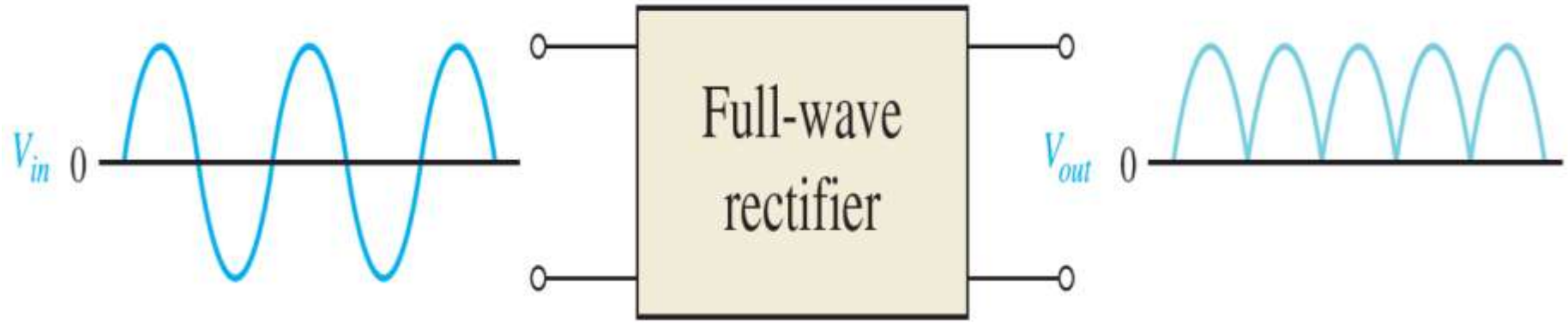
The Full-Wave Rectifier (FWR)

The result of full-wave rectification is a DC output voltage that pulsates every half-cycle of the input, as shown in Figure below.



The average value for a full-wave rectified output voltage is twice that of the half-wave rectified output voltage, expressed as follows:

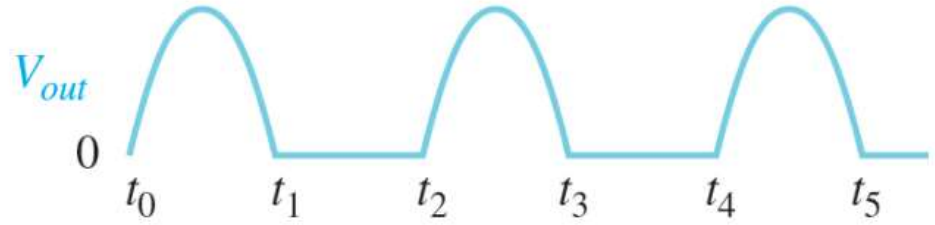
$$V_{AVG} = \frac{2V_{p(out)}}{\pi}$$

Center-Tapped Full-Wave Rectifier

The difference between half-wave and full-wave rectification is that:

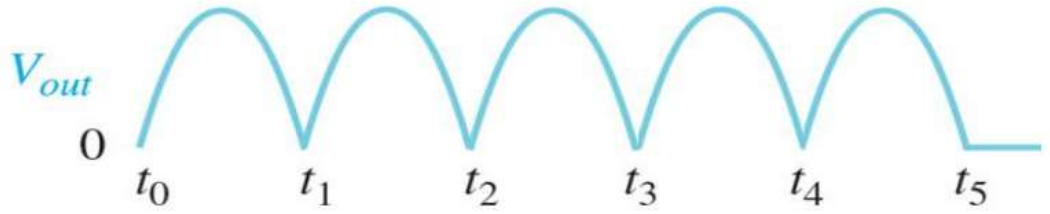
- Half-wave rectifier:

Allows only one-half of the current to the load during the entire input cycle.

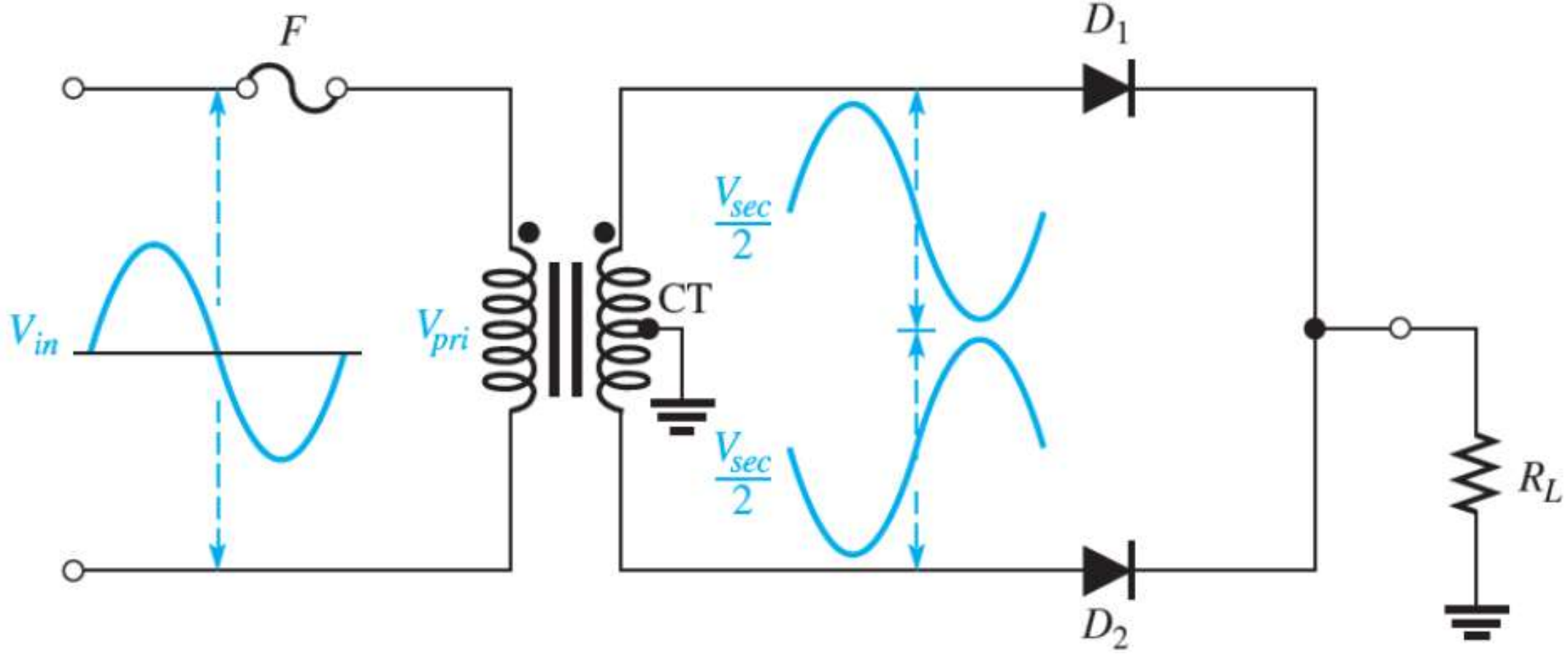


- Full-wave rectifier :

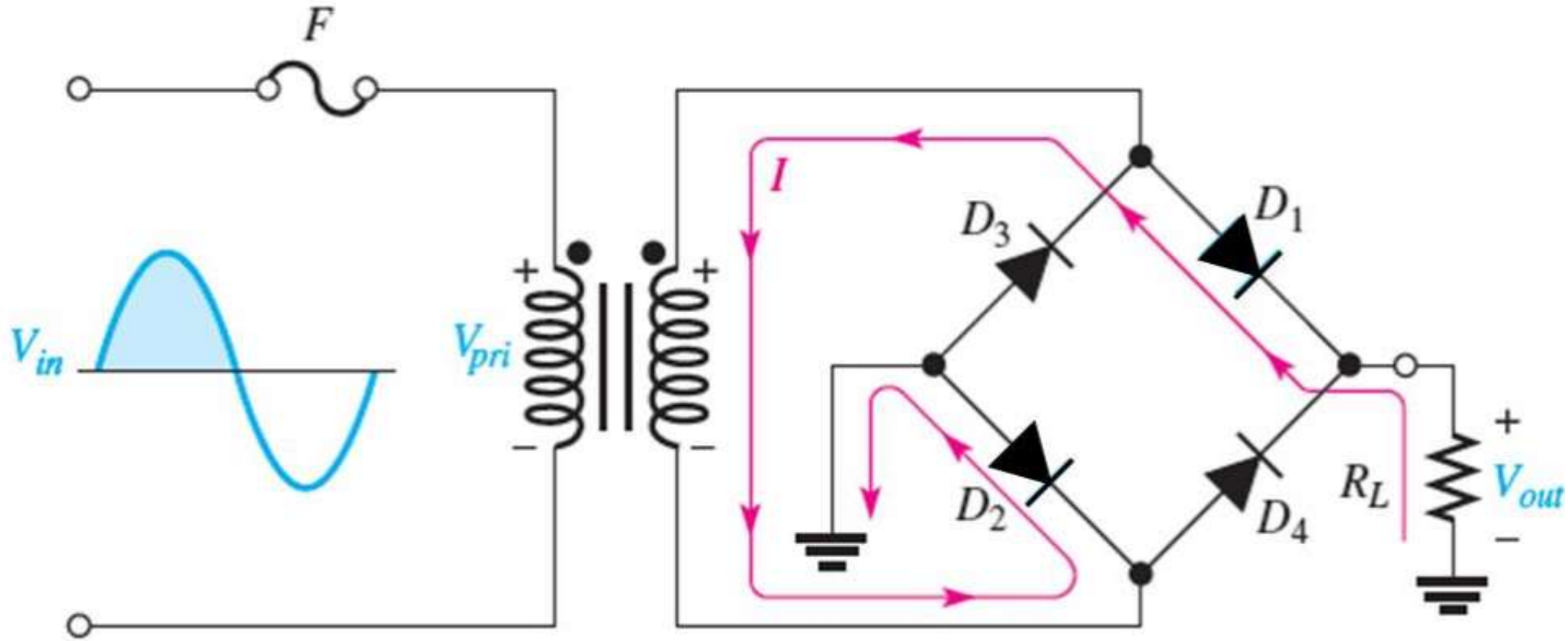
Allows unidirectional current to the load during the entire input cycle.



Center-Tapped Full-Wave Rectifier



Full-Wave Bridge Rectifier



Center-Tapped Full-Wave Rectifier

- The center-tapped (CT) full-wave rectifier uses two diodes connected to the secondary of a center-tapped transformer.
- The input signal is coupled through the transformer to the secondary.
- Half of the secondary voltage appears between the center tap and each end of the secondary winding.

Positive half-cycle

For a positive half-cycle of the input voltage, the polarities of the secondary voltages are shown in Figure below.

a) Forward-biases the upper diode D1.

b) Reverse-biases the lower diode D2.

The current path is through D1 and the load resistor RL, as indicated.

Negative half-cycle

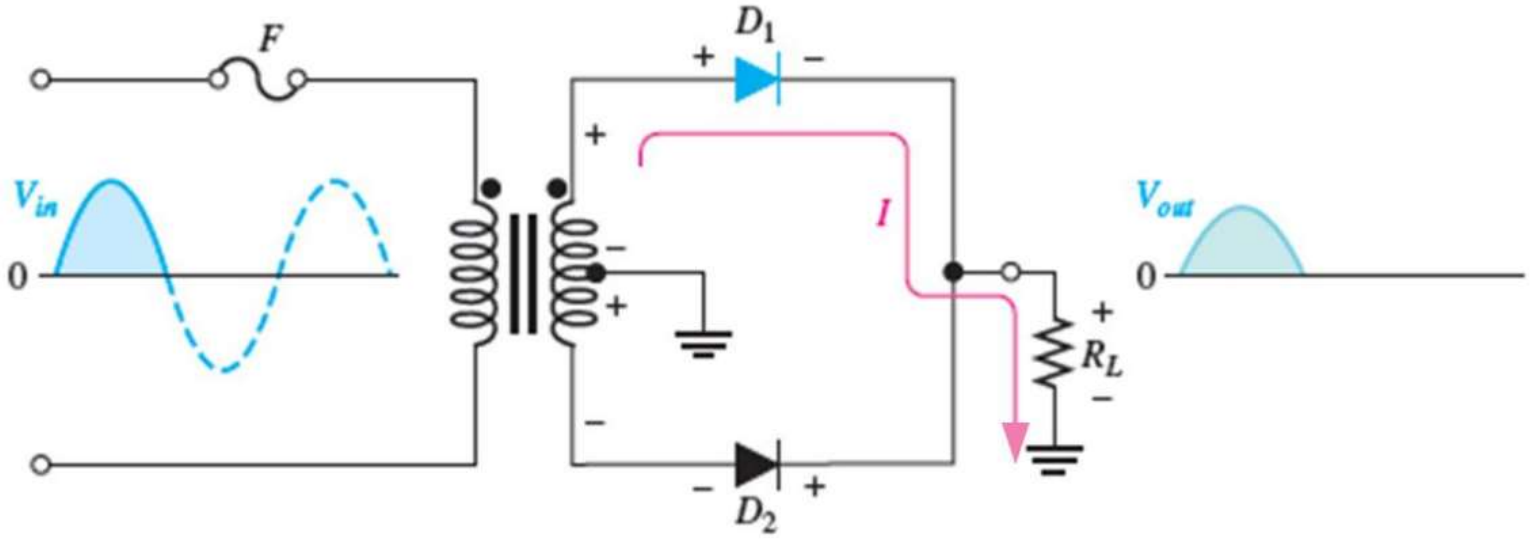
For a negative half-cycle of the input voltage, the polarities of the secondary voltages are shown in Figure below.

a) Forward-biases the upper diode D2.

b) Reverse-biases the lower diode D1.

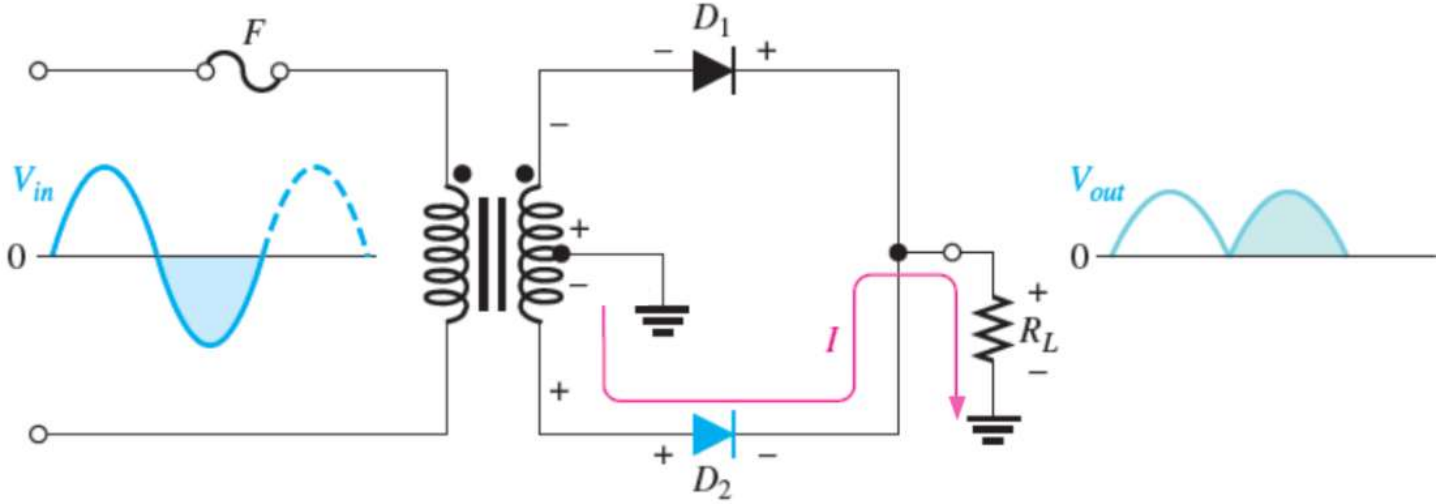
The current path is through D2 and the load resistor RL, as indicated.

Positive – Negative cycle



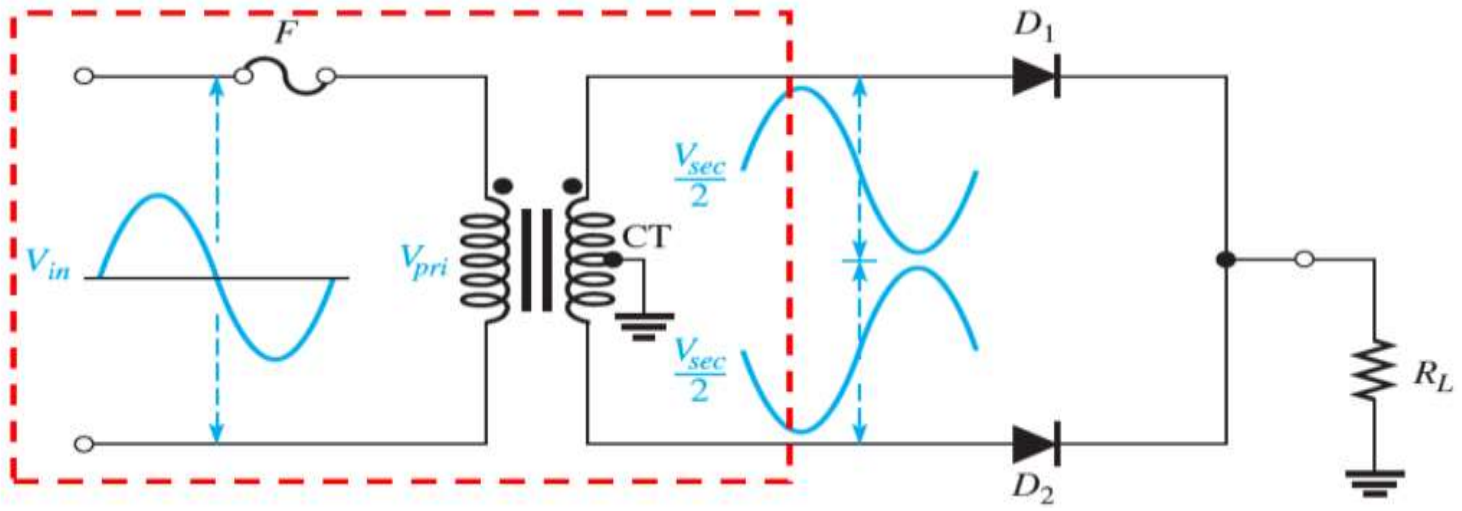
Positive half-cycle

Negative half-cycle



Effect of the Turns Ratio n

- The output voltage is determined by the turns ratio, n, of the transformer.
- The peak output voltage is one-half the peak secondary voltage.
- The primary voltage Vpri is the same as the input voltage Vin.



Example

To obtain an output voltage V$\boldsymbol{p(out)}$ with a peak value approximately equal to the input peak $\boldsymbol{Vp(in)}$, what would be the turn ratio n of a transformer?

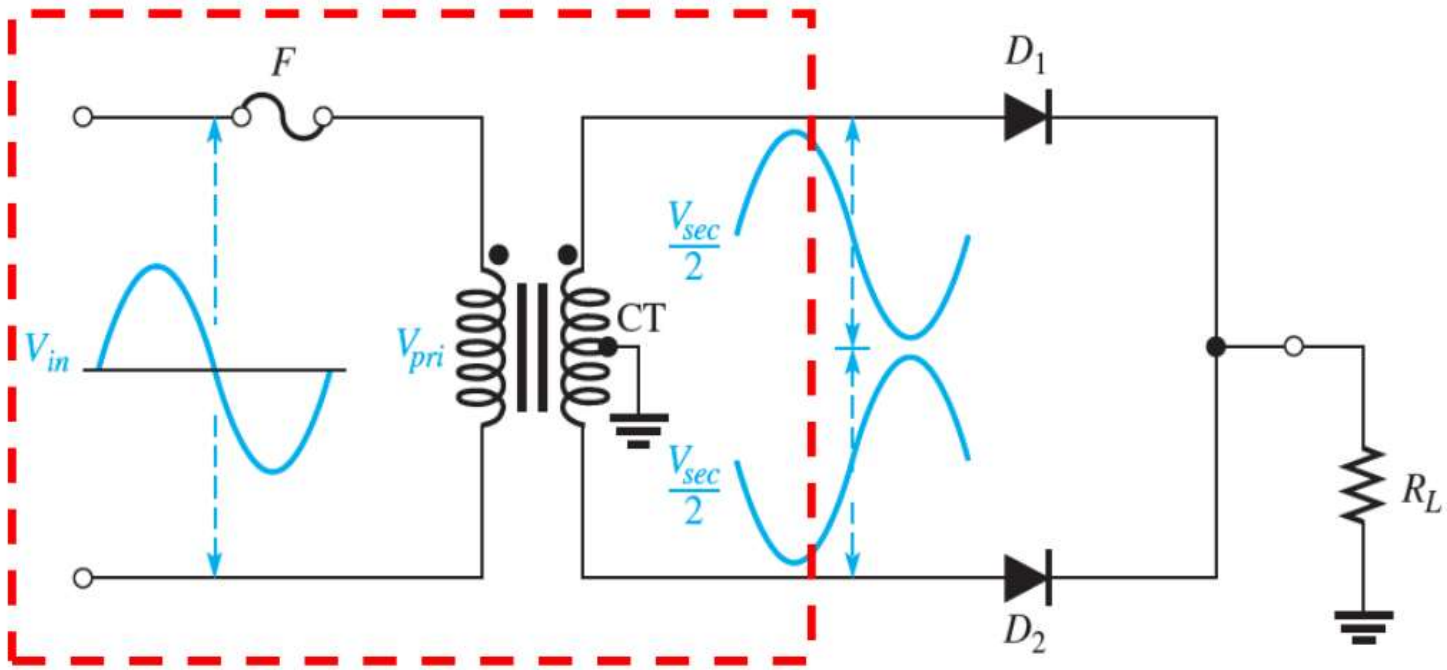
Sol:

$$\mathbf{V}_{\boldsymbol{p(out)}} = \frac{\boldsymbol{nV_{p(in)}}}{\mathbf{2}}$$

$$\boldsymbol{n} = \frac{\mathbf{2V}_{\boldsymbol{p(out)}}}{\boldsymbol{V_{p(in)}}}$$

Since, $\mathbf{V}_{\boldsymbol{p(out)}}$ equal $\boldsymbol{V_{p(in)}}$

$$\boldsymbol{n = 2}$$



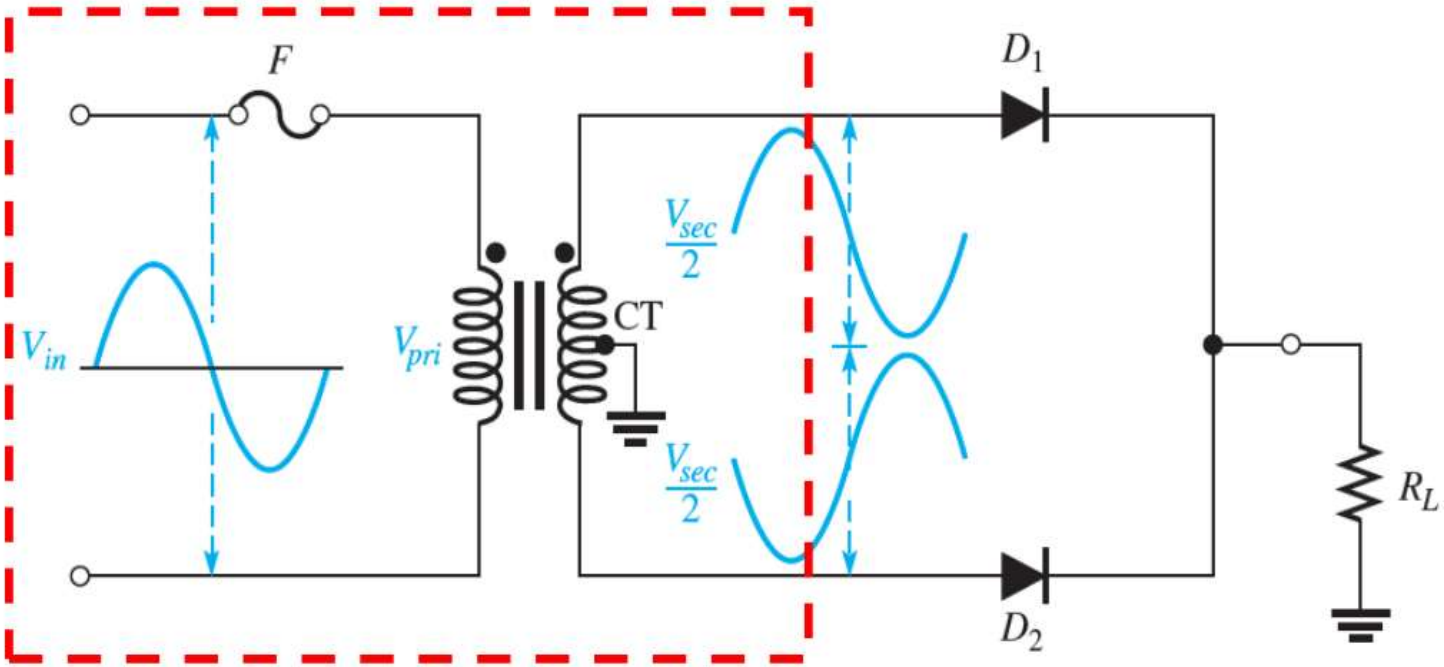
Example

Specify the turns ratio of a transformer required for a center-tapped full wave rectifier if the input voltage is 311 V and the required output is 12 V peak?

Sol:

$$n = \frac{2V_{p(out)}}{V_{p(in)}}$$

$$n = \frac{2\times12}{311} = 0.0771$$



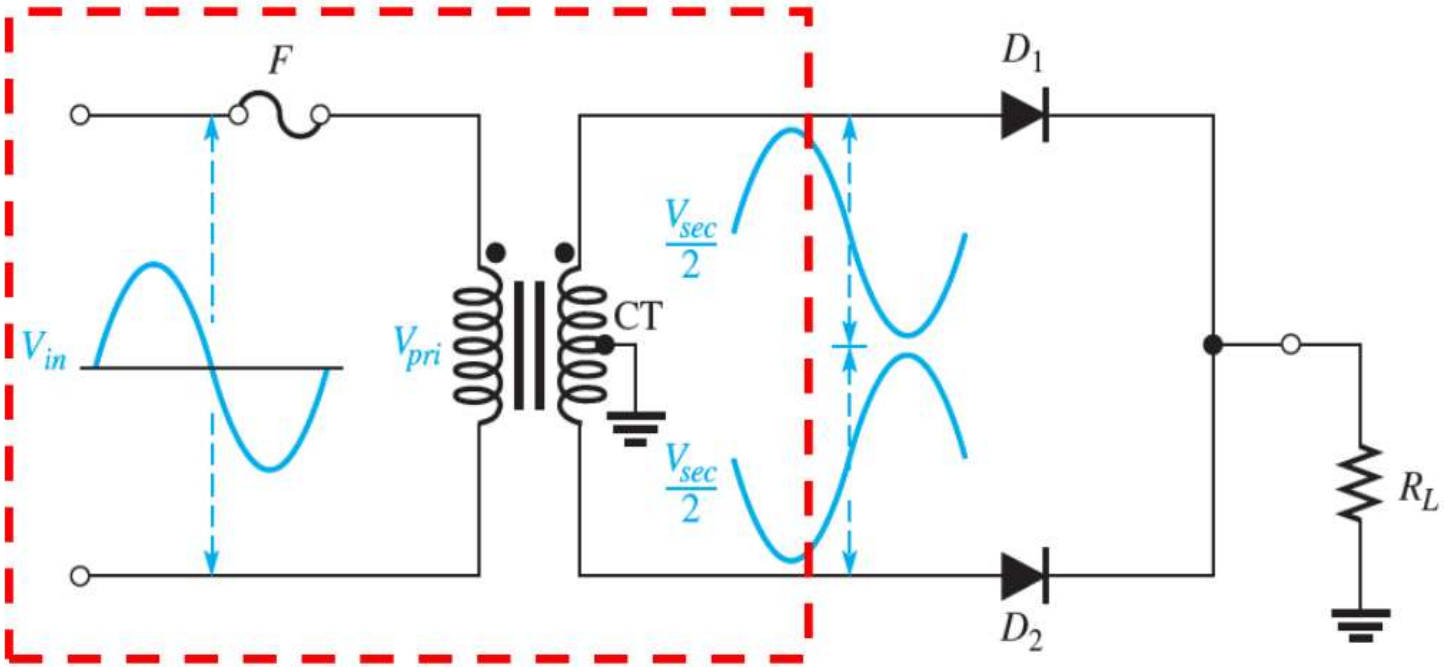
Example

For a center-tapped full-wave rectifier if the input voltage is 311 V, What is the peak output if the turns ratio is 0.15?

Sol:

$$V_{p(out)} = \frac{nV_{p(in)}}{2}$$

$$V_{p(out)} = \frac{0.15 \times 311}{2} = 23.3\,V$$



Peak Inverse Voltage (PIV)

- Each diode in the FWR is alternately forward-biased and then reverse-biased.
- The maximum reverse voltage VR that each diode must withstand is the peak value of the total secondary voltage Vp(sec).