Basic Electronic Circuits (IEC-103)

Lecture-09

DC Power Supplies

Power Supply

- All electronic circuits need a power source to work.
- For electronic circuits made up of transistors and / or ICs, this power source must be a DC voltage of a specific value.
- A battery is a common DC voltage source for some types of electronic equipment especially portables like cell phones and iPods.
- Most non-portable equipment uses power supplies that operate from the AC power line but produce one or more DC outputs.

Power Supplies

Bench Power Supply

Power Supplies

Bench Power Supply

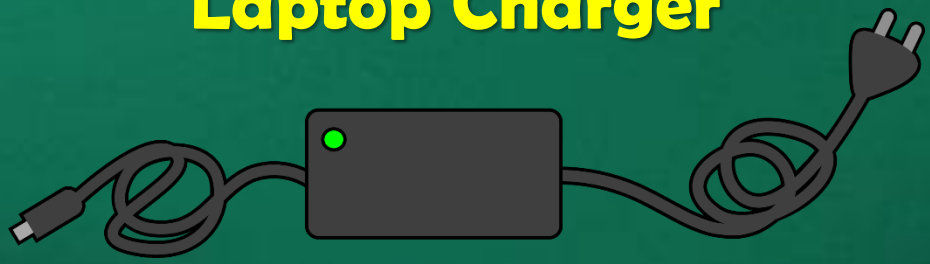
Switch Mode Power Supply

Power Supplies

Bench Power Supply

Switch Mode Power Supply

Laptop Charger



Power Supply System

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- The power supply system has output which is used to power an electronic circuit.

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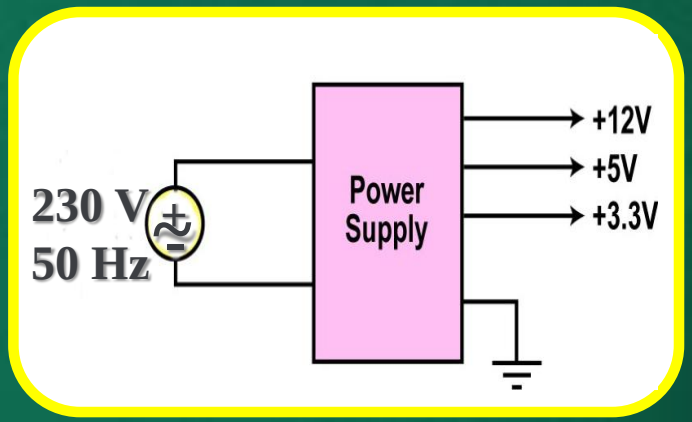
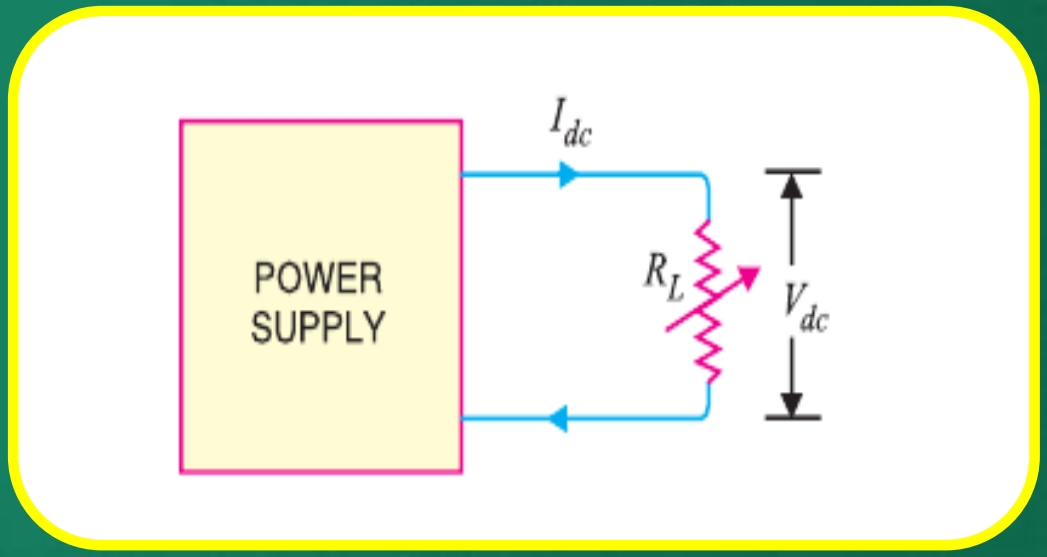
- The input is 230 V 50 Hz mains supply.

Power Supply Characteristics

- **The input is the** 230 V 50 Hz AC **power line.**
- **The power supply converts the** AC **into** DC **and provides one or more** DC **output voltages.**
- **Common voltages are** 48, 24, 15, 12, 9, 5, 3.3, 2.5, 1.8, 1.5, 1.2 **and** 1 V**.**
- **A good example of a modern power supply is the one inside a** PC **that furnishes** 12, 5, 3.3 **and** 1.2 V**.**



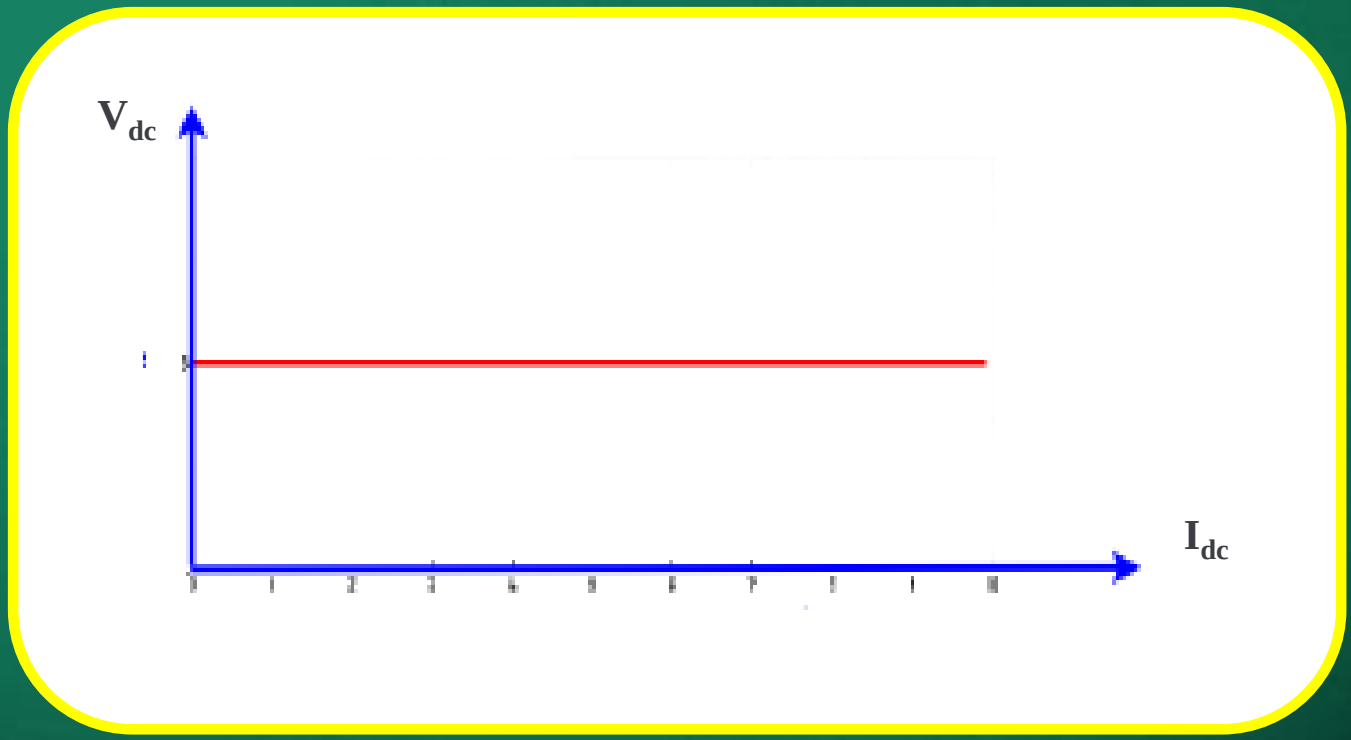
Power Supply Characteristics



Note: In spite of variations in the load or variations in the input voltage, the output voltage should be maintained constant.

Power Supply Characteristics

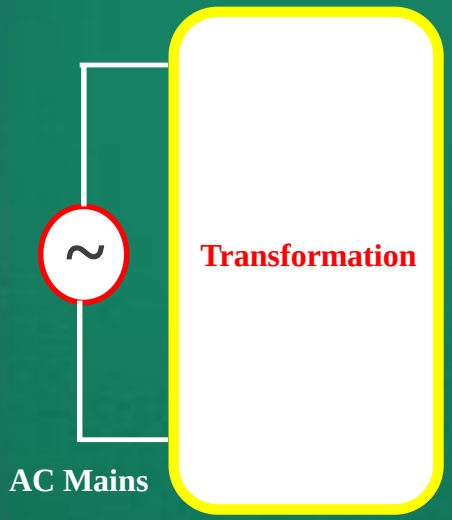
VI characteristics of an ideal regulated power supply



Different Stages of a Power Supply

AC Mains

Different Stages of a Power Supply



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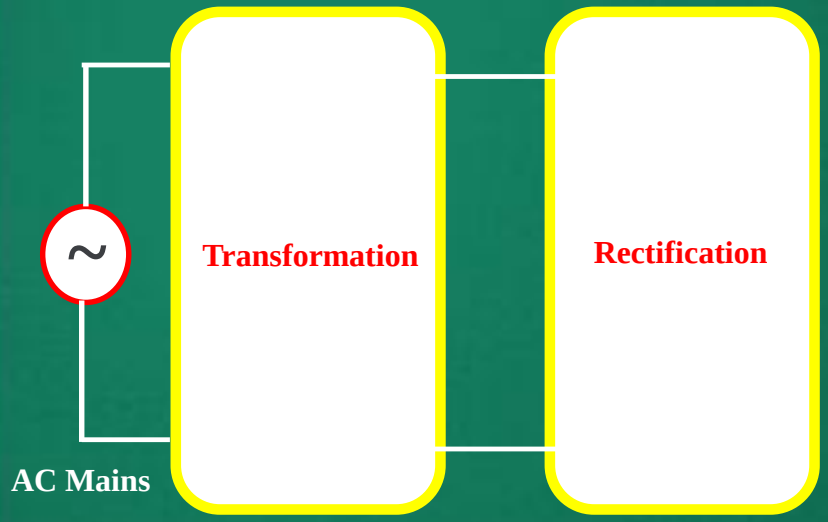

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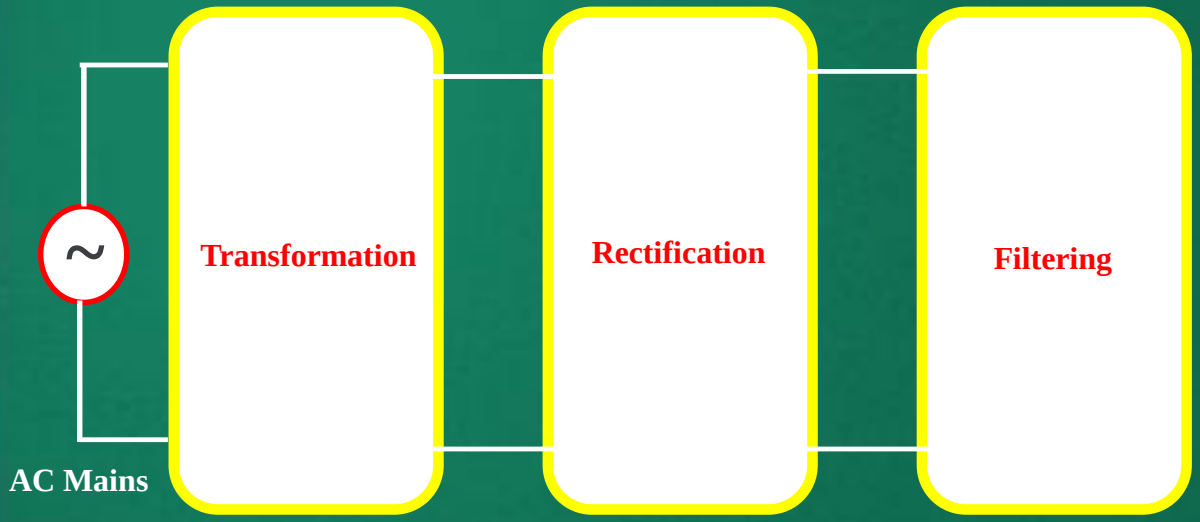

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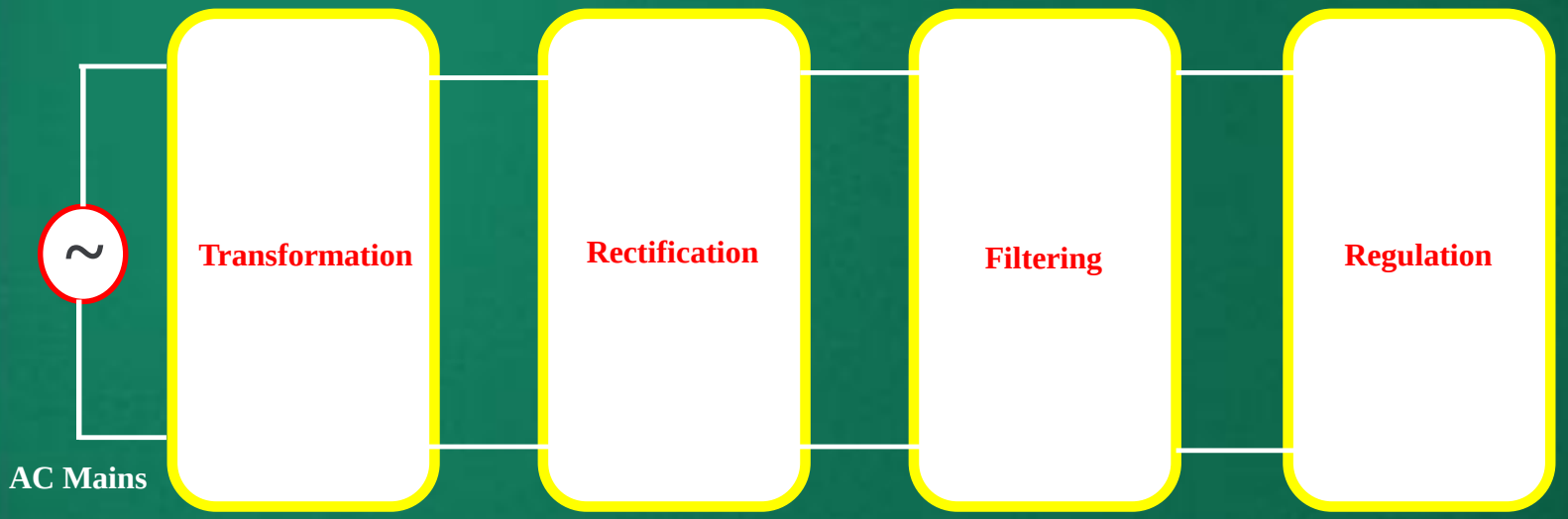

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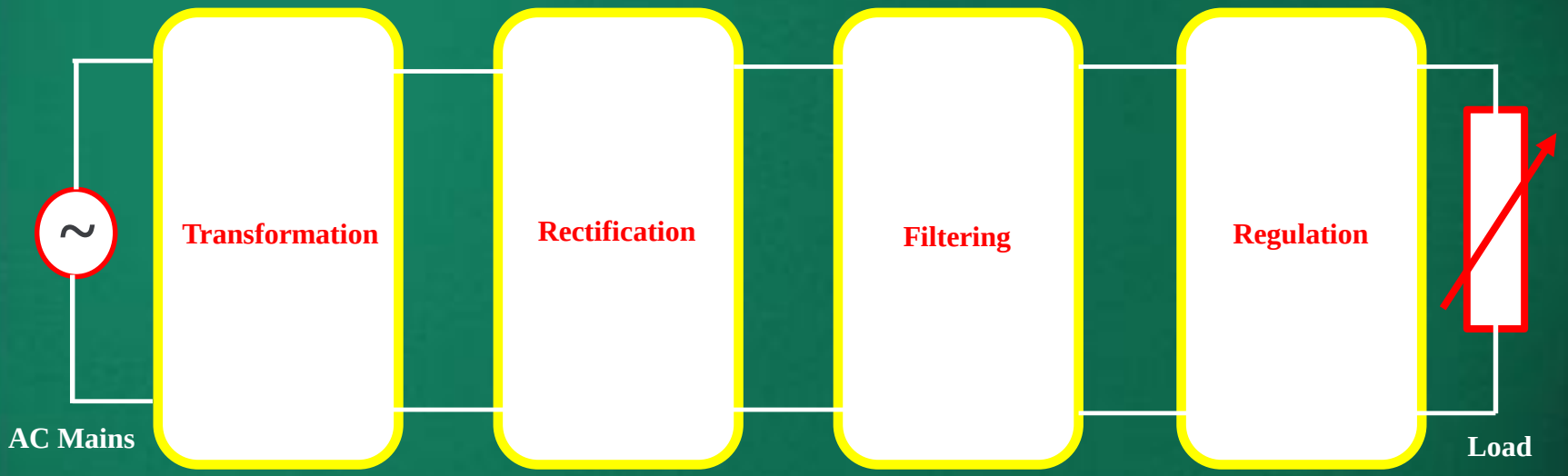

Realization of each Stage

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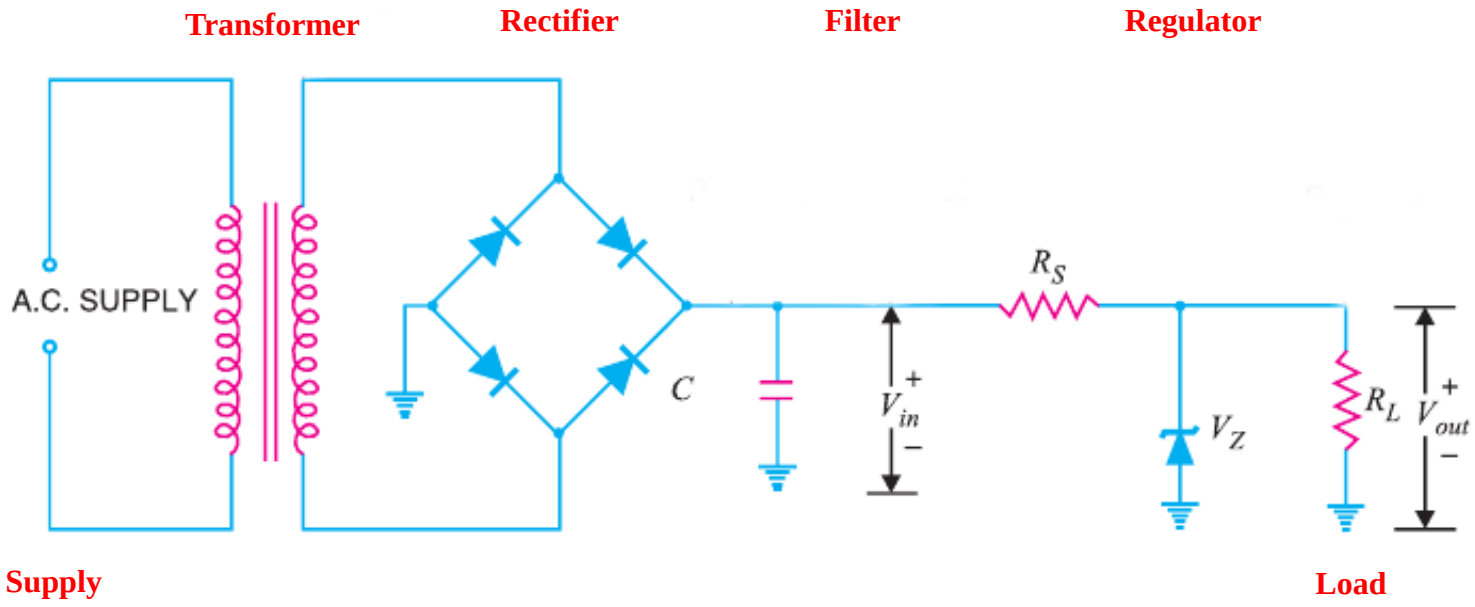
Circuit Diagram of a Simple Regulated Power Supply



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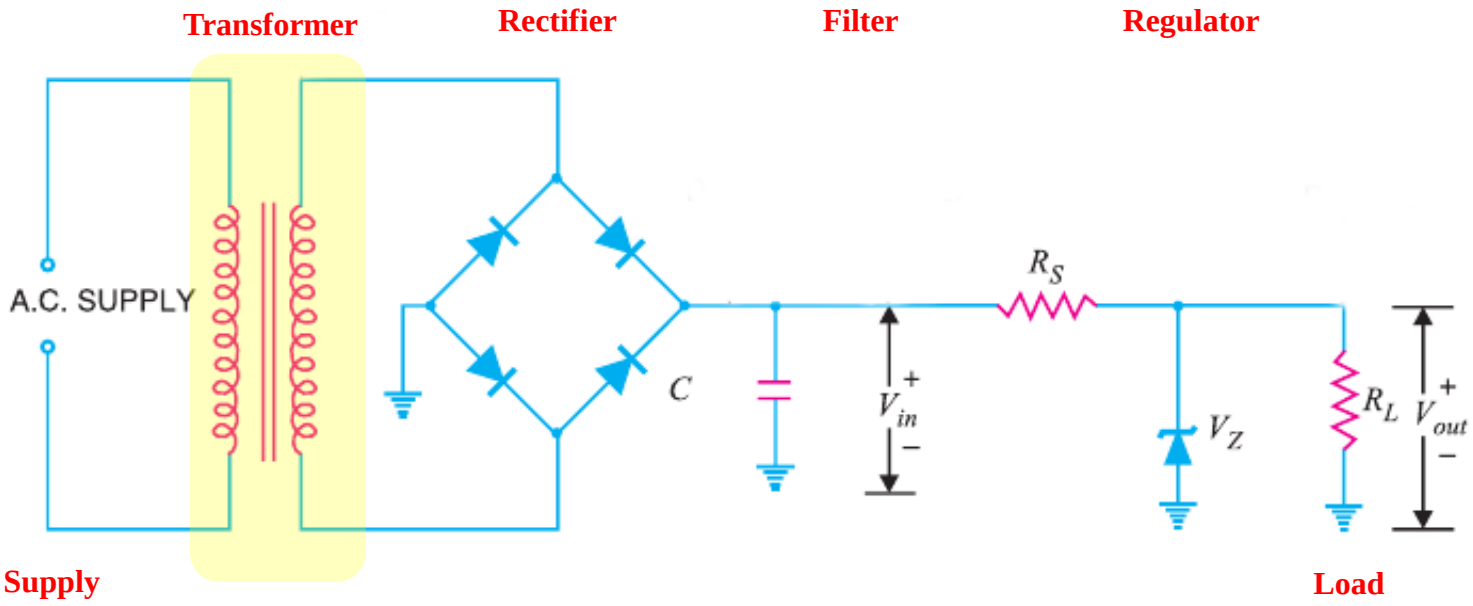

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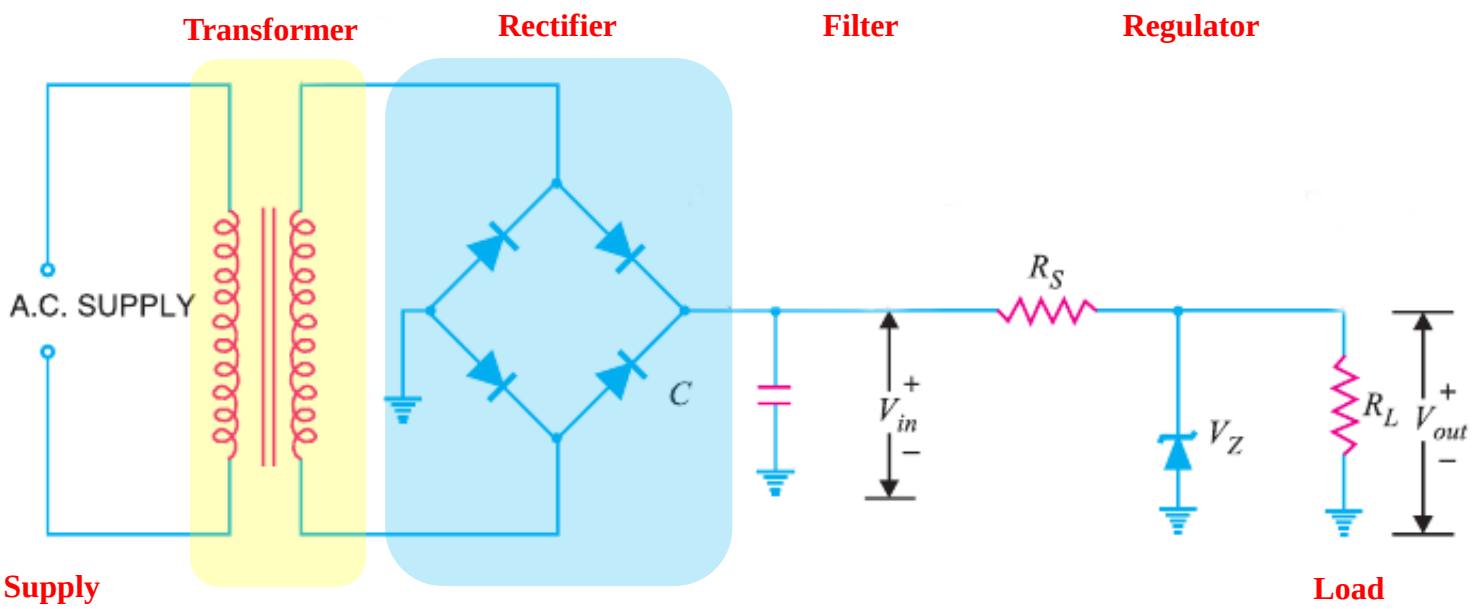

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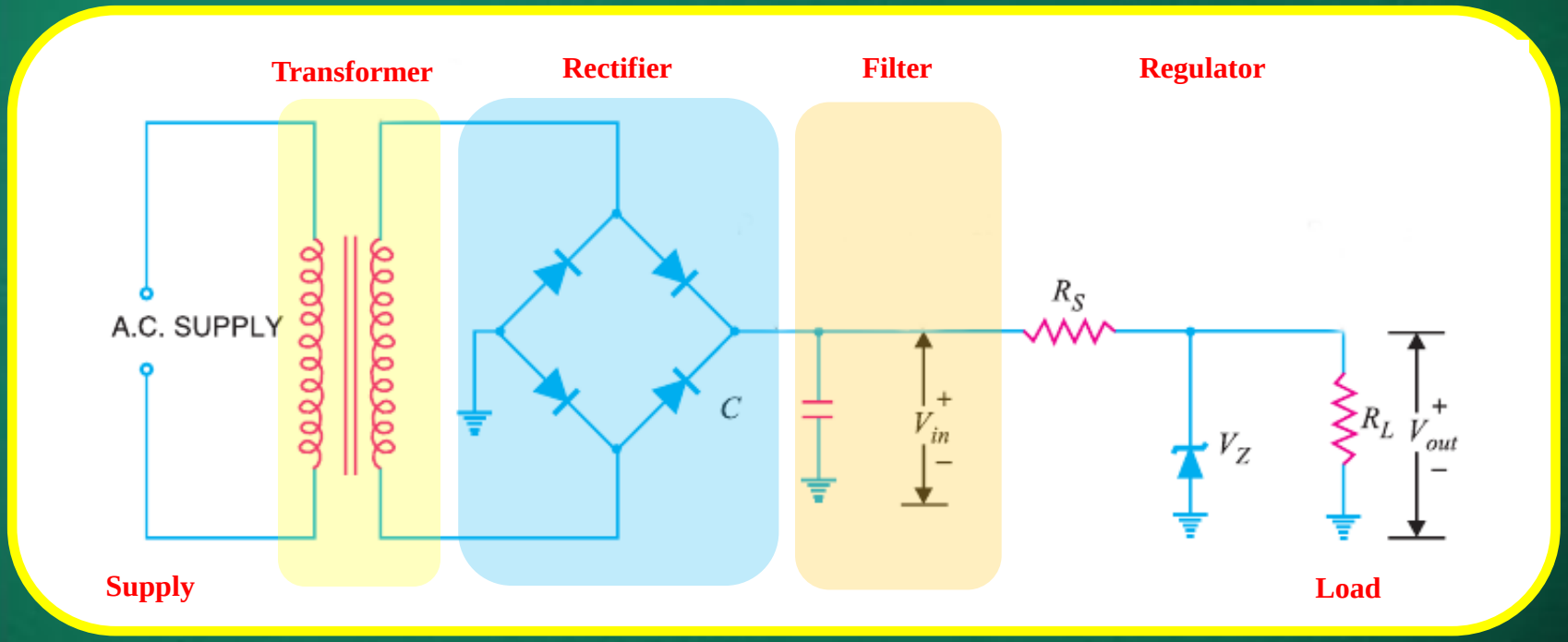

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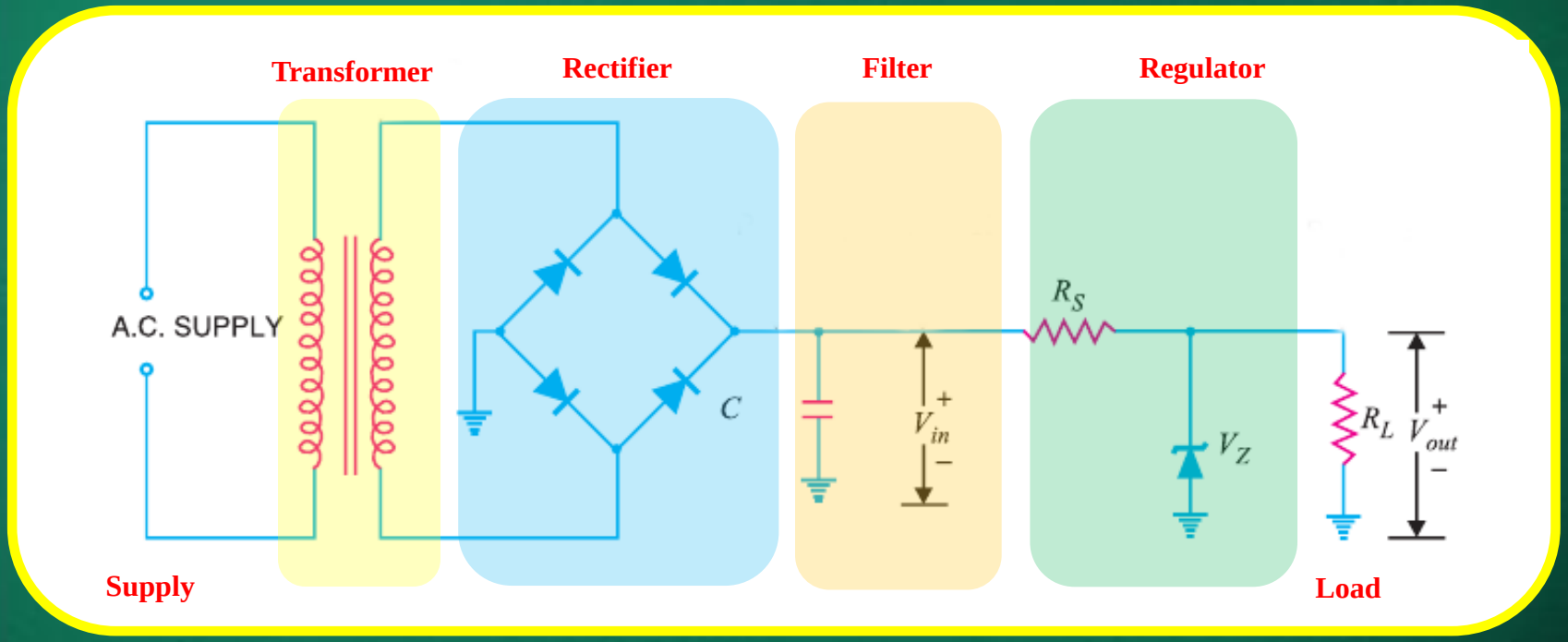
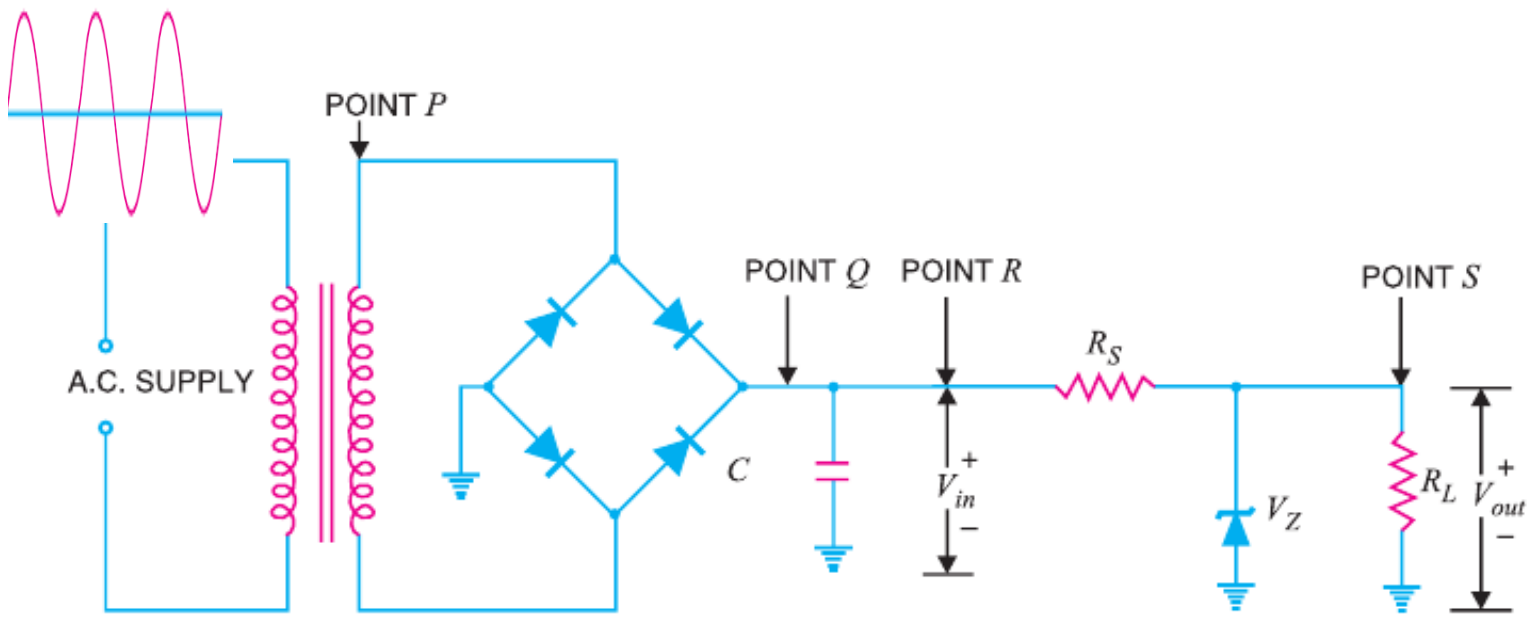


Output Waveform after each Stage



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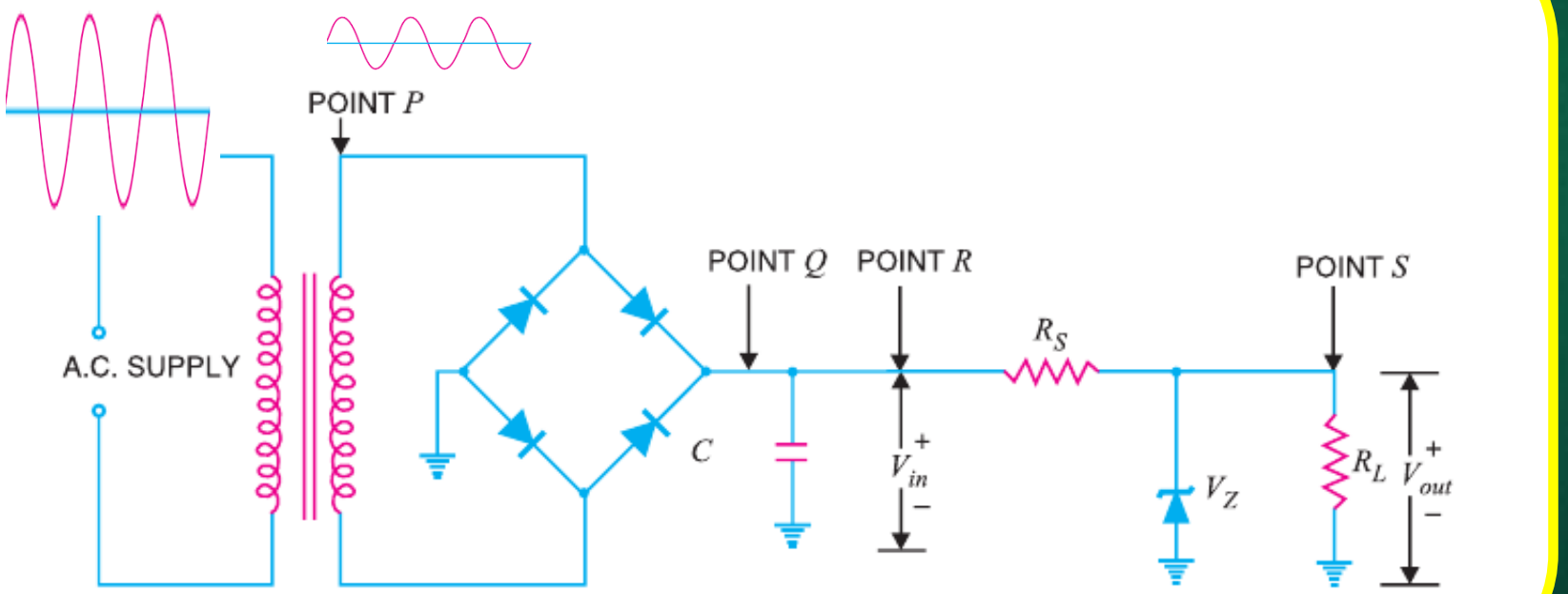

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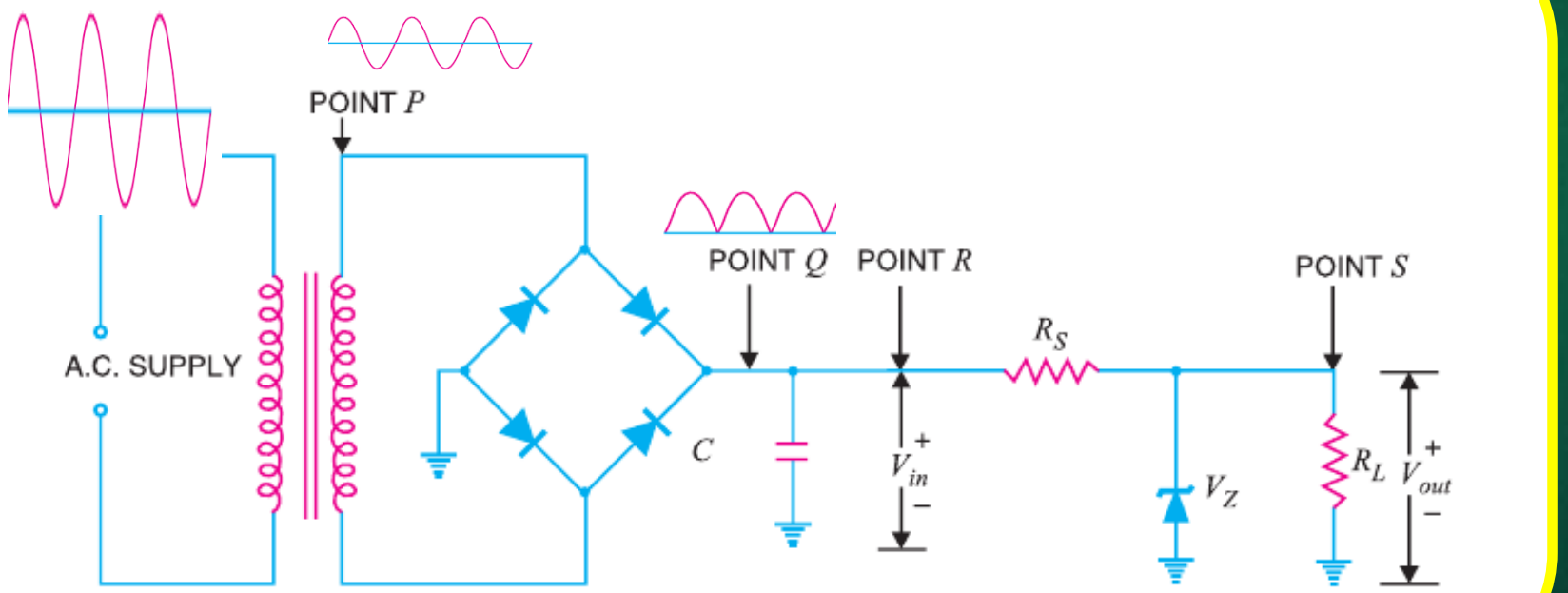

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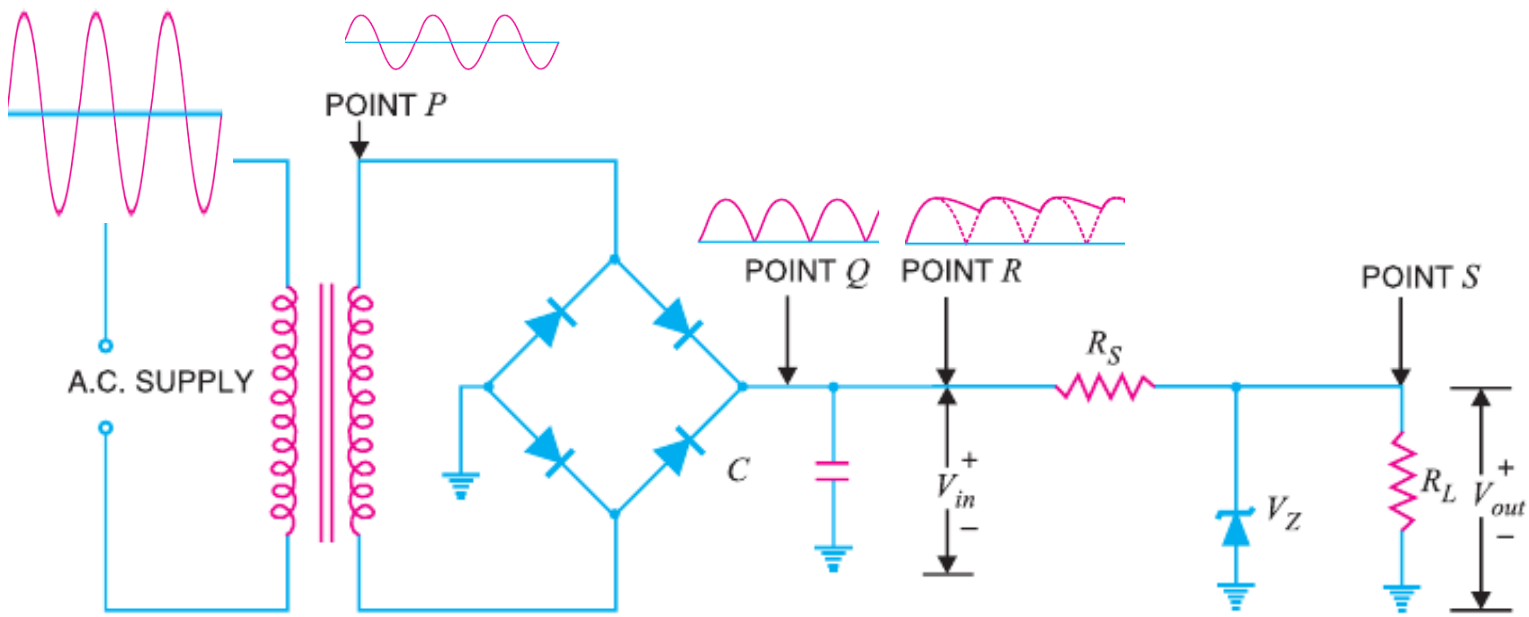

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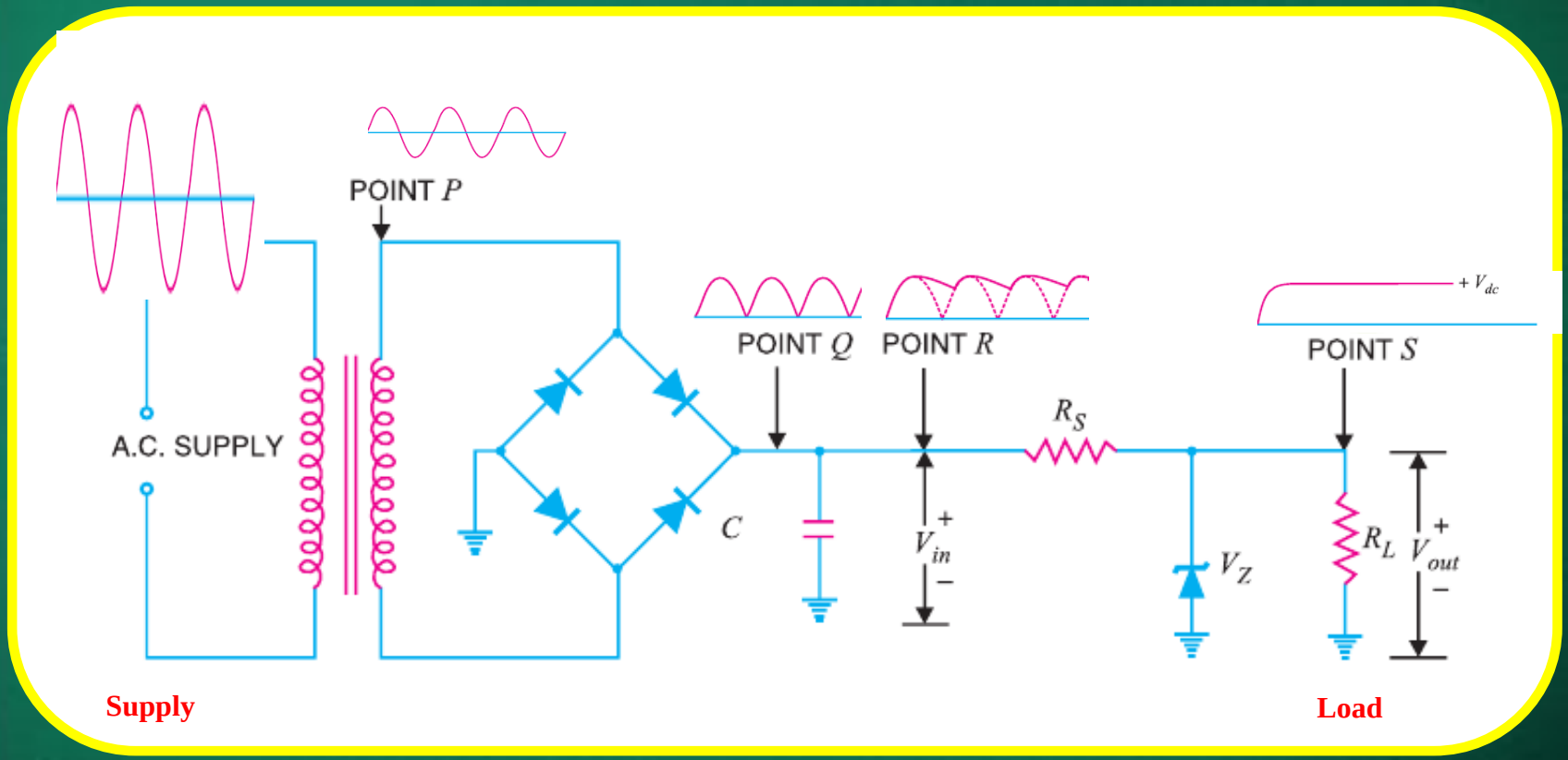

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$$\%LR = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$$

Transformers

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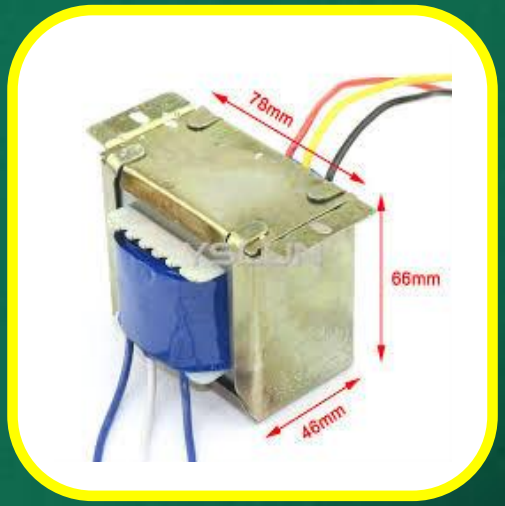
Without Centre Tap



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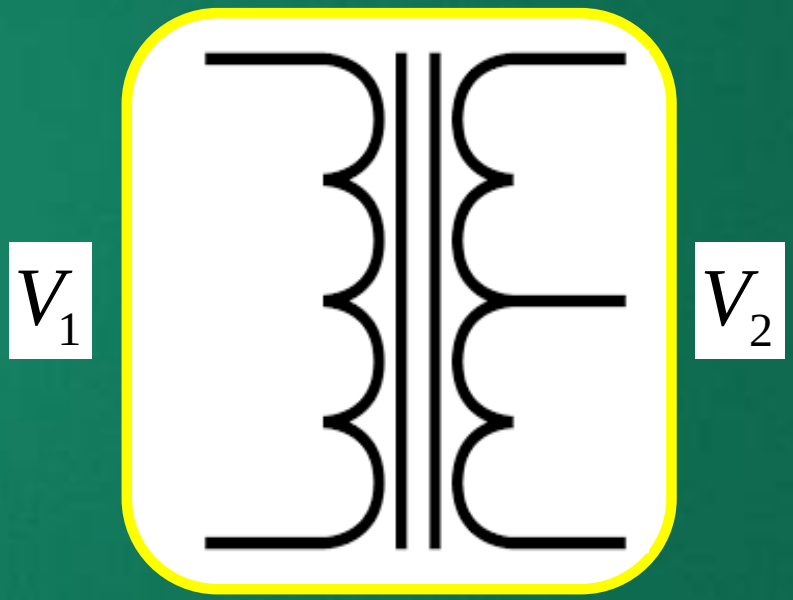

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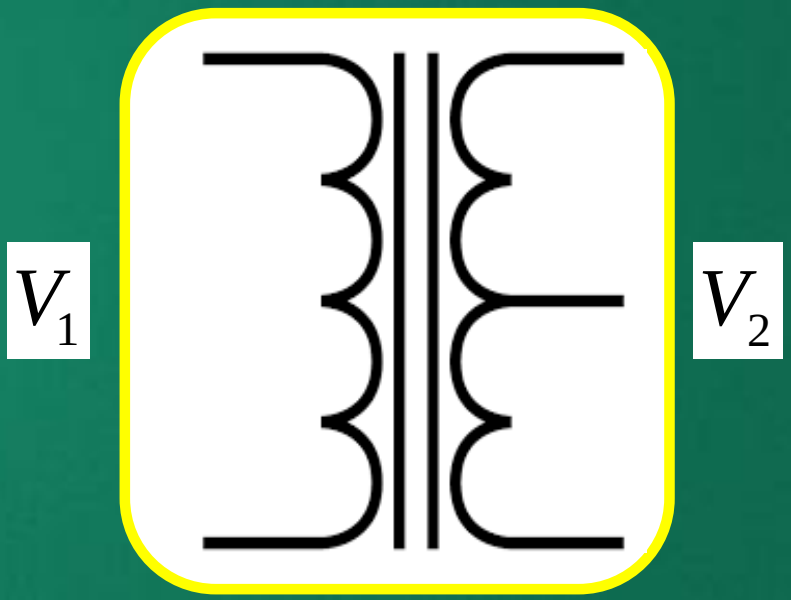

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}$$

Rectifiers

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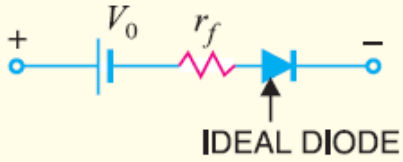
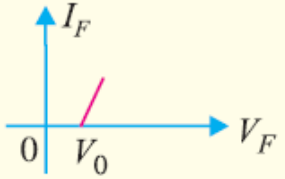
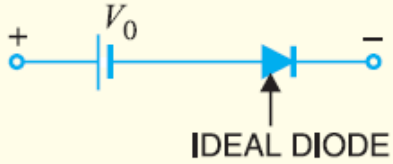
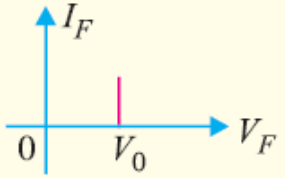
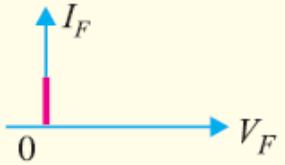
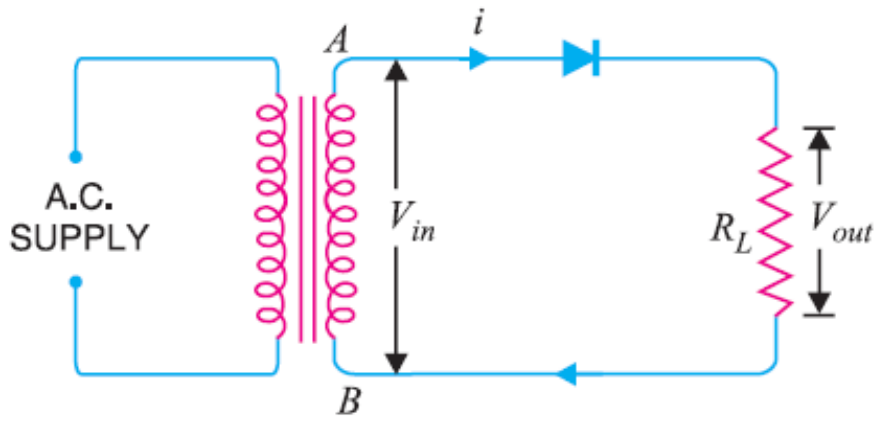
- Can be classified into two types
  - Half wave rectifiers
  - Full wave rectifiers

Diode Equivalent Circuits

S.No.	Type	Model	Characteristic
1.	Approximate model		
2.	Simplified model		
3.	Ideal Model		

Half Wave Rectifier



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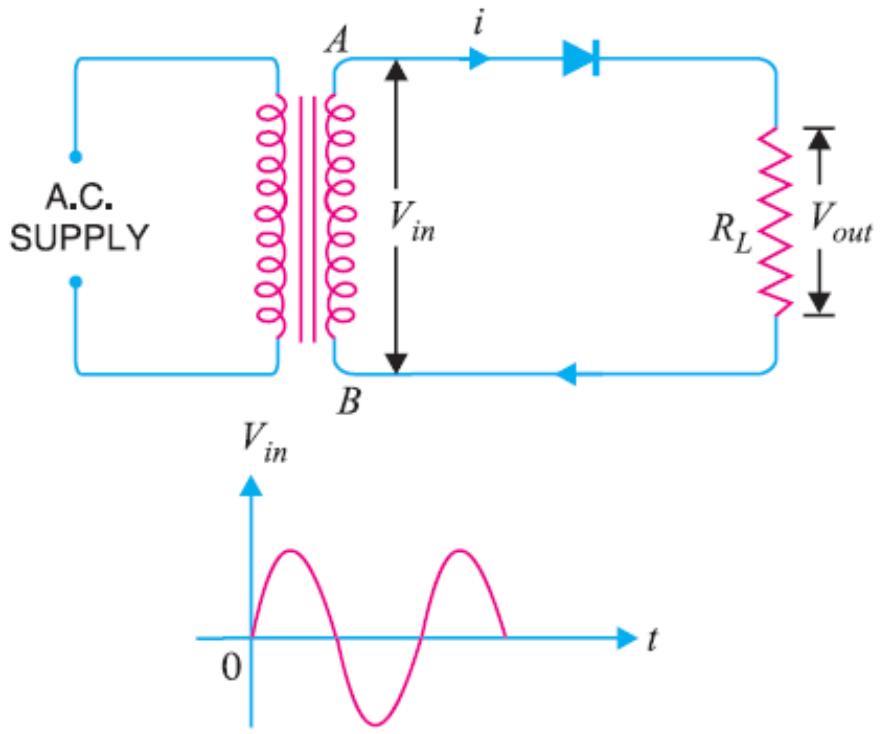

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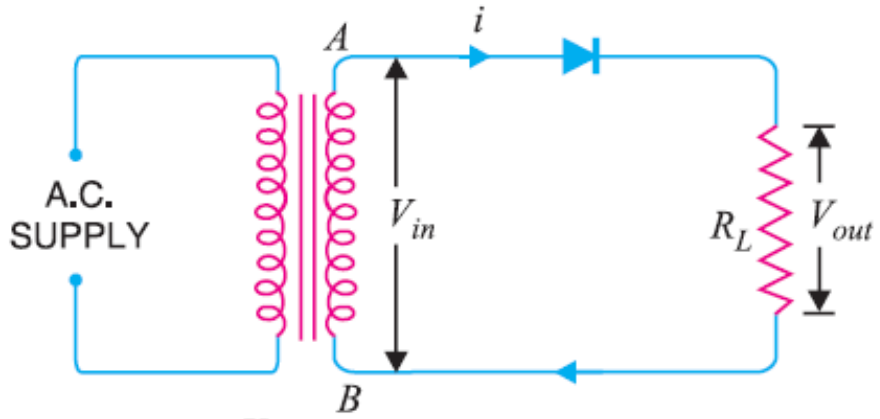

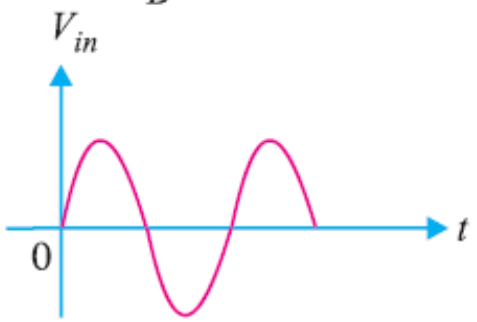

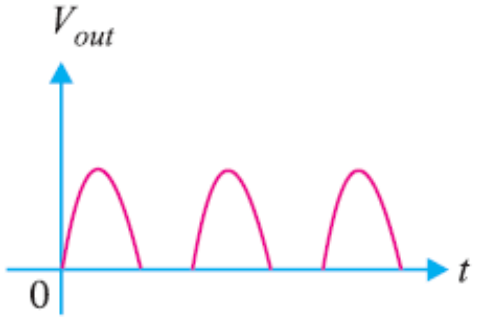

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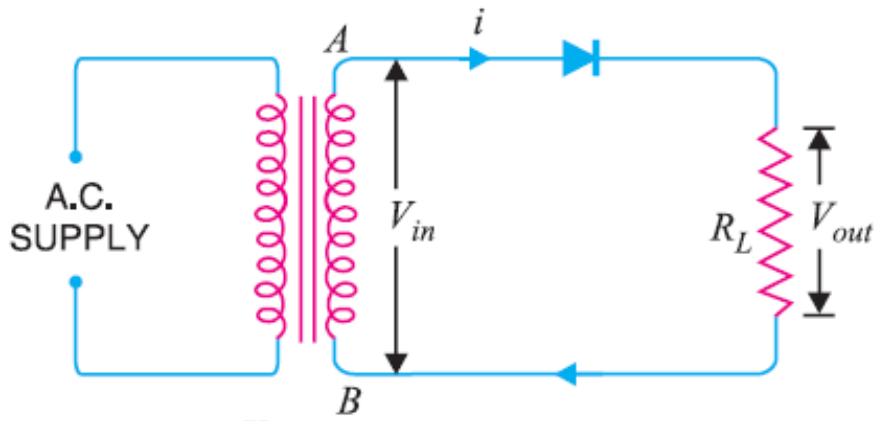

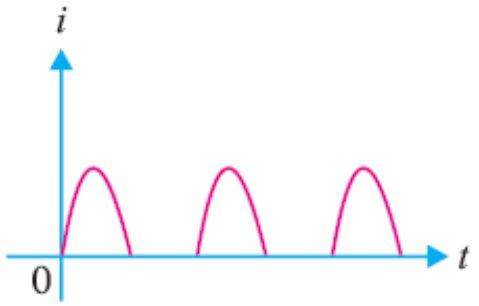

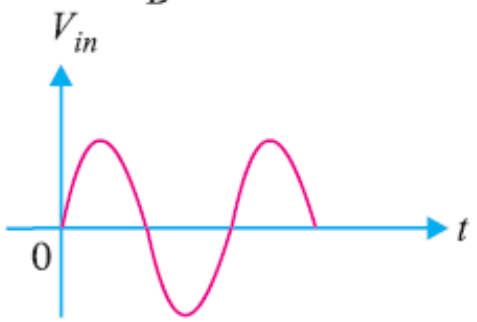

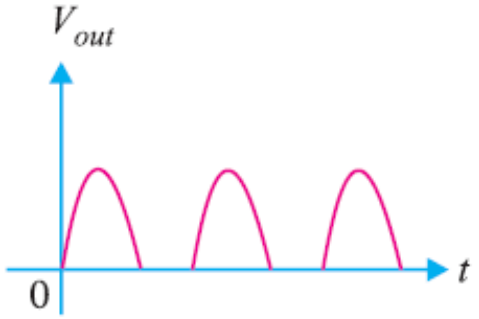

Half Wave Rectifier

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- Ripple Factor

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- **Ripple Factor**

$$\gamma = \frac{V_{ac}}{V_{dc}} = \frac{\sqrt{V_{rms}^{\ 2} - V_{dc}^{\ 2}}}{V_{dc}} = \frac{1}{2}\sqrt{\pi^2 - 4} = 1.21$$

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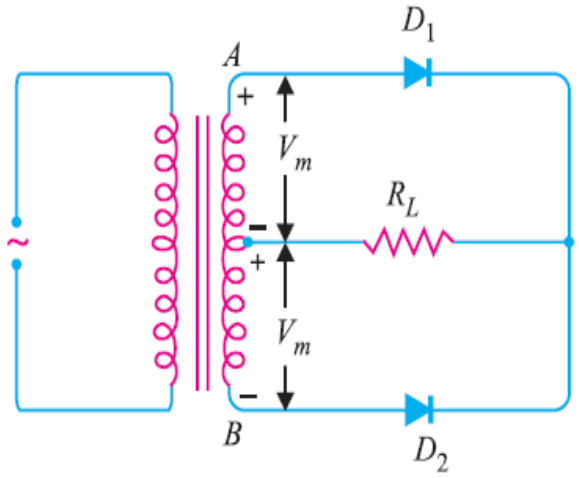
- **It delivers power only half the time, therefore output is low.**

Full Wave Rectifiers

- Full Wave Rectifiers
  - Centre-Tap Full Wave Rectifier



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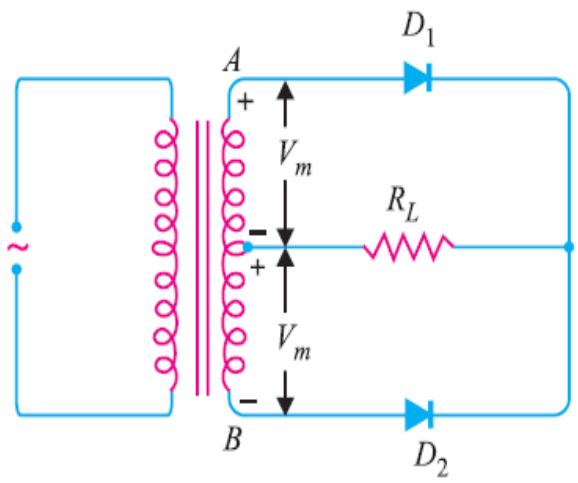
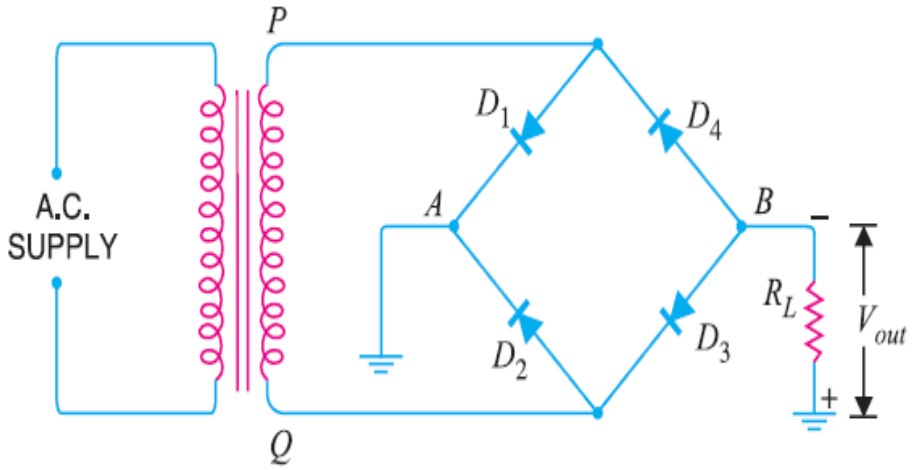
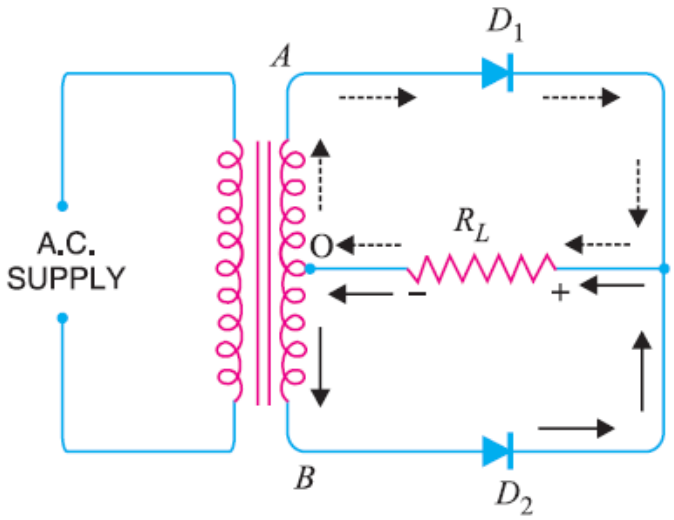




Centre-Tap Full Wave Rectifier



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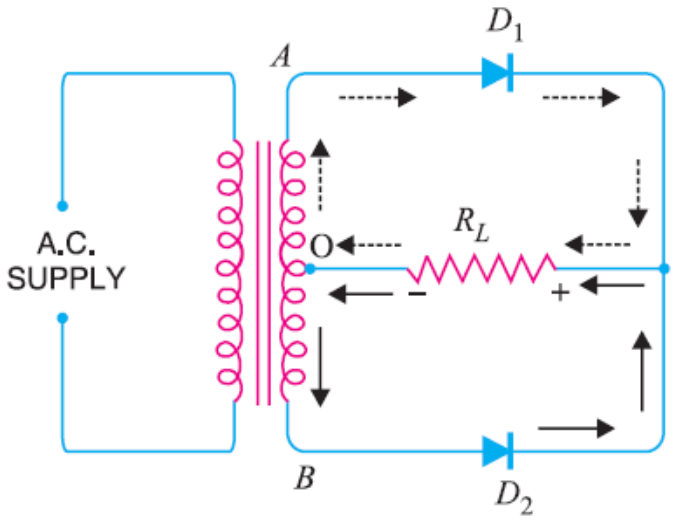

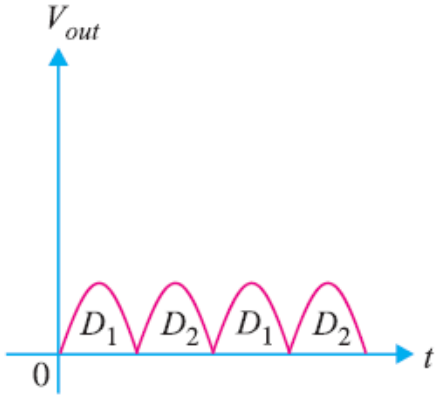

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Centre-Tap Full Wave Rectifier

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$$\gamma = \frac{V_{ac}}{V_{dc}} = \frac{\sqrt{V_{rms}^{\ 2} - V_{dc}^{\ 2}}}{V_{dc}} = \frac{\sqrt{\pi^2 - 8}}{2\sqrt{2}} = 0.48$$

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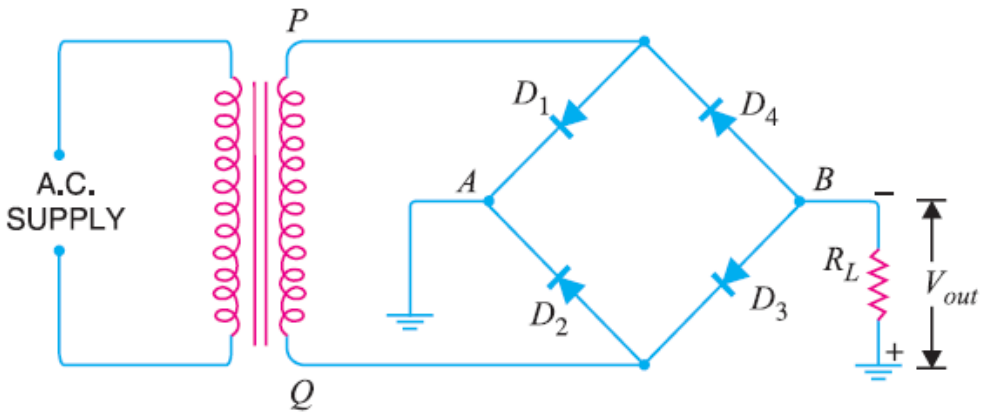
- **The diodes must have high** PIV ($2V_m$)**.**
- **The** DC **output is small because each diode utilizes only one half of the transformer's secondary voltage**

Full Wave Bridge Rectifier



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- **It requires 4 diodes.**

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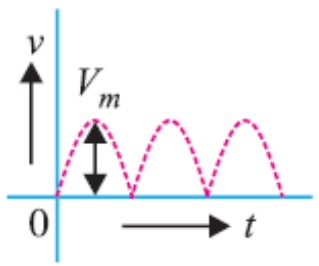
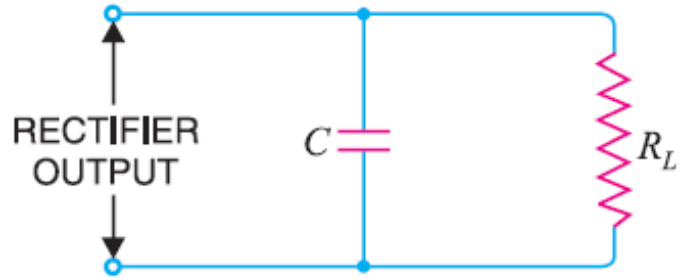
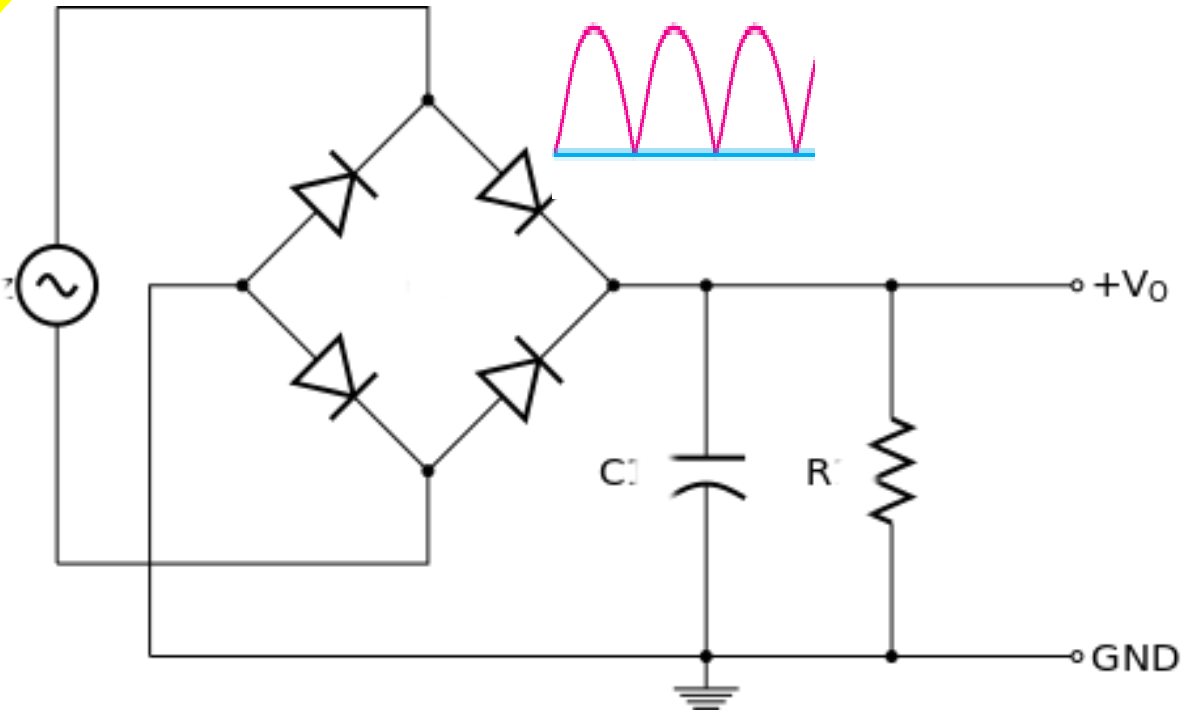




Capacitor Filter



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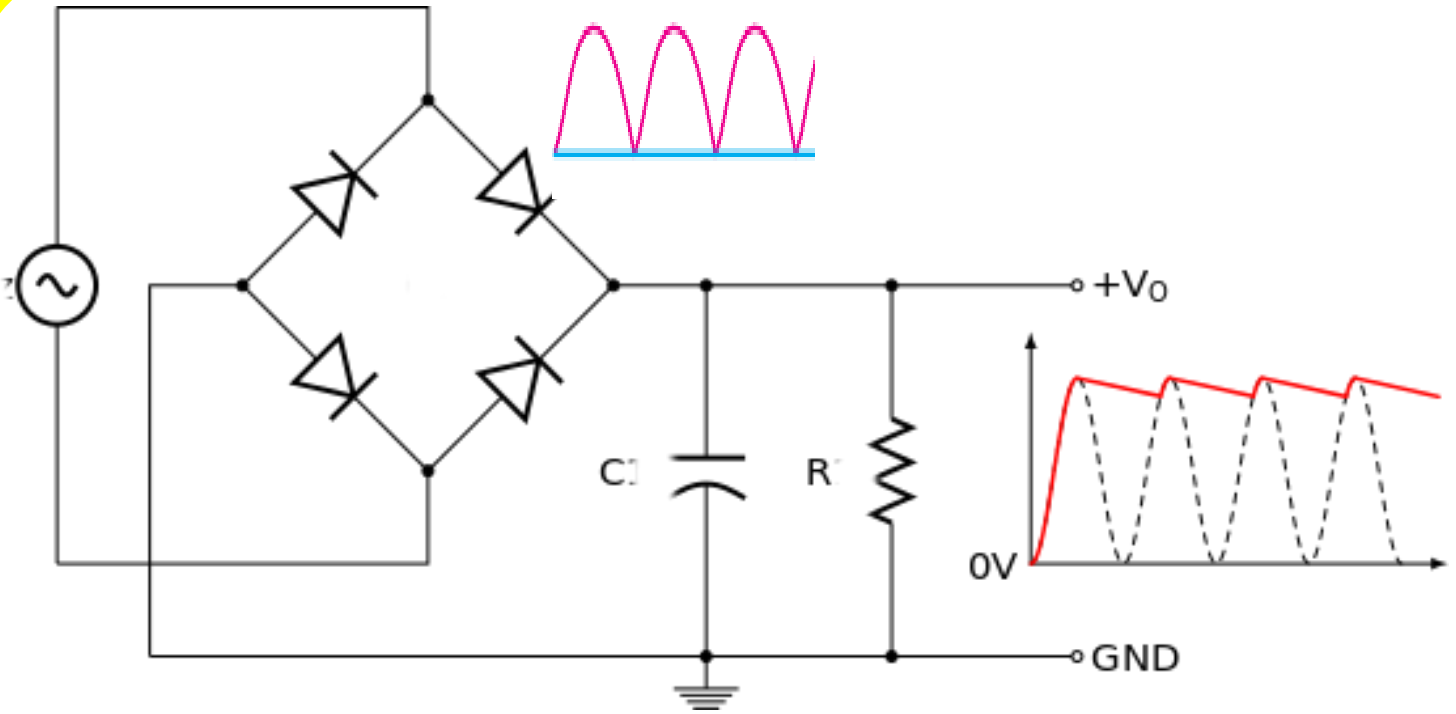

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- **Larger the value of capacitor, lesser will be the ripple.**
- **If the load is connected across the filter, the power supply is termed as unregulated power supply.**