SUBJECT: BASIC ELECTRONICS

Half-Wave Rectifier

Elementrix Classes

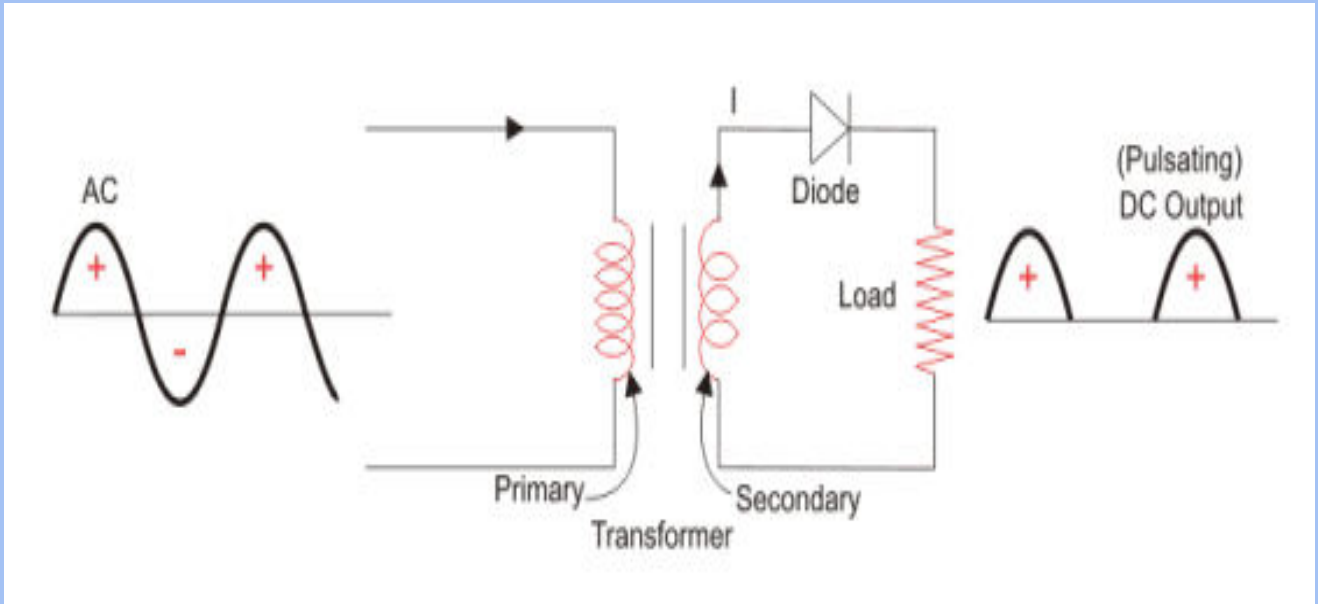
Half-wave Rectifier

- **Rectifier:** A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

- A half wave rectifier is a type of rectifier that only allows one half-cycle of an AC voltage waveform to pass, blocking the other half-cycle. Half-wave rectifiers are used to convert AC voltage to DC voltage, and only require a single diode to construct. A half wave rectifier is the simplest form of rectifier available.

Working

- Figure shows the input AC voltage waveform, the circuit diagram and the final output voltage waveform of a half wave rectifier.



- During the positive half cycle, the diode is forward biased making the current flow through the load resistor. While during the Negative half cycle the diode is reverse biased so it stops the current flow through the load resistor. Since current can not flow through the load during the negative half cycles, the output voltage is equal to zero.

Therefore, for an AC voltage the output voltage of a half wave rectifier will be (for an ideal diode)

$$V_o(t) = \begin{cases} V_m \sin(\omega t), & 0 \leq t \leq T/2 \\ 0, & T/2 \leq t \leq T \end{cases}$$

Half-Wave Rectifier Calculations

- **Average output voltage (V_{dc}):** This represents the average value of the rectified DC voltage over a full cycle. For a half-wave rectifier,

$$V_{dc} = \frac{V_m}{\pi}$$

- **Root mean square (RMS) output voltage (V_{rms}):** This refers to the effective value of the AC component remaining in the DC output. For a half-wave rectifier,

$$V_{rms} = \frac{V_m}{2}$$

- **Ripple Factor (γ):** Ripple is the unwanted AC component remaining when converting the AC voltage waveform into a DC waveform. Even though we try out best to remove all AC components,there is still some small amount left on the output side which pulsates the DC waveform. This undesirable AC component is called ripple.

  This measures the AC variation present in the DC output, indicating its smoothness. It's calculated as

$$\gamma = \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$$

- **Efficiency:** The ratio of the DC power available at the load to the applied input AC power is known as the efficiency, **η**. Mathematically it can be given as:

$$\eta = \frac{DC\,power\,output}{AC\,power\,input} = \frac{P_{dc}}{P_{ac}} = 40.53\%$$

- **Form factor:** Form factor (f.f.) is defined as the ratio between RMS load voltage and average load voltage. The form factor of the half wave rectifier is as,

$$f.f. = \frac{V_{rms}}{V_{dc}}$$

- **Peak inverse voltage (PIV):** Peak Inverse Voltage (PIV) is the maximum voltage that the diode can withstand during reverse bias condition. If a voltage is applied more than the PIV, the diode will be destroyed.Thus for a half-wave rectifier

$$PIV = V_m$$

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