0. Review
1. Quiz
2. Full Wave Rectifier
3. Bridge Rectifier

- HW 1 due today
- Quiz
- PreLab 1 due at beginning of lab session
- Lab 1 report due Fri (see course website for template)
0. Review

1. Flyback Diode

Inductive Kick → without diode

Diode ON

Switch open

Diode OFF

Switch closed

Clamped at $V_{cc} + 0.7$

with diode
Ideal Diode:

- \( V_D = V_a - V_c \)
- \( V_D \) (ON)

Real Diode:

- \( I_D \)
- \( V_D \) (reverse bias)
- \( I_{\text{MAX}} \) (forward bias)

Breakdown
1. Quiz

1 problem for 20 pts
(10-15 min)
Intro to Power Supplies e.g. 12V

- Many electronic devices require a DC voltage.
- Wall outlet provides AC voltage (120Vrms, 60Hz)
- Most DC power supplies have the following:

![Diagram of power supply components: AC input, transformer, rectifier, filter, regulator, DC output]
Power Transformer

Line voltage (120V\text{rms}, 60 \text{Hz}) is usually much larger than desired DC output.

**Example**

- **Line voltage is specified as rms**: 120V 60 Hz
- **Peak voltage**: $V_{\text{peak}} = \sqrt{2} \cdot V_{\text{rms}} = \sqrt{2} \times 120 = 169.7 \text{V}_p$

![Diagram of transformer showing primary and secondary voltages, with peak voltage calculations.]
2. Full-Wave Rectifier

Recall that a half-wave rectifier "wastes" half of the input signal.

Q: How to use all of the input AC signal?

A: **Full-wave rectifier** uses **TWO diodes**

**NOTE:** Secondary winding has grounded center tap.
1) One diode is ON for (+) half cycle

2) Other diode is ON for (-) half cycle
NOTE 1: \[ V_L = \frac{1}{2} V_{sec} - 0.7 \]

Ex:

120V rms
60 Hz

Average

\[ \frac{1}{\pi} V_p \]

NOTE 2: DC value of rectified voltage

HOT  WAVE

\[ \frac{1}{\pi} V_p \]

DC

VS.

FULL WAVE

\[ \frac{2}{\pi} V_p \]

DC

Peak secondary voltage

\[ = (\sqrt{2} \times 120) \times \frac{1}{10} \times \frac{1}{\sqrt{2}} = 8.5 \text{ } V_p \]
Filtering

Need capacitors to smooth the rectified voltage?

Half-Wave

\[ V_{\text{peak}} \rightarrow V_{\text{ripple}} \rightarrow \frac{1}{f} \]

\[ V_{\text{ripple}} = \left[ \frac{\text{Discharge Rate}}{\text{Interval}} \right] \times \frac{V_{\text{peak}}}{R_C} \times \frac{1}{f} \]

Full Wave

\[ \frac{1}{2f} \]

\[ V_{\text{ripple}} = \frac{V_{\text{peak}}}{R_C} \times \frac{1}{2f} \]
• Positive power supply

120 \text{V}_{\text{rms}}

60 \text{Hz}

\[ T = \frac{1}{60 \text{Hz}} \times \frac{1}{2} \]

\[ \frac{V}{V_{\text{ripple}}} \]

• Negative Supply

120 \text{V}_{\text{rms}}

60 \text{Hz}
Dual supply output:

▲ "split"

☆ 4 diodes form two full-wave rectifiers!

**Positive output**

**Negative output**
3. Bridge Rectifier

- 4 diodes used in a bridge
→ Two diodes for (t) cycle

1  3

→ Two diodes for (t) cycle

2  4
• Positive supply

- Diagram of the circuit

  \[ V_{\text{PEAK}} = V_{\text{SEC.P}} - 1.4 \text{ V} \]

• Negative Supply

- Diagram of the circuit

  \[ V_{\text{PEAK}} = -(V_{\text{SEC.P}} - 1.4 \text{ V}) \]