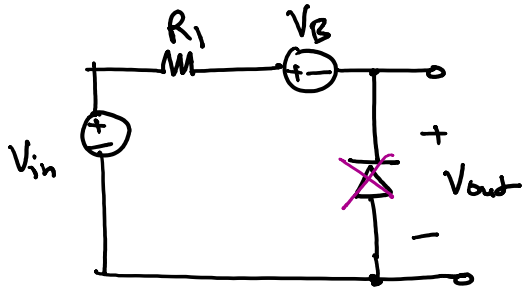
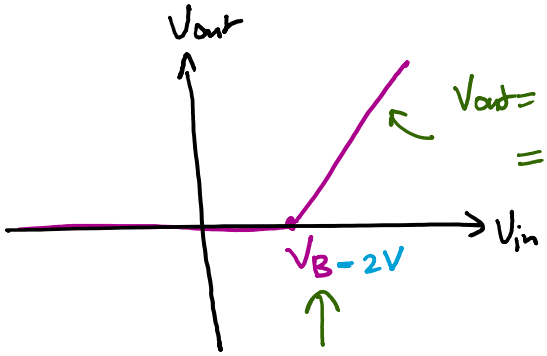
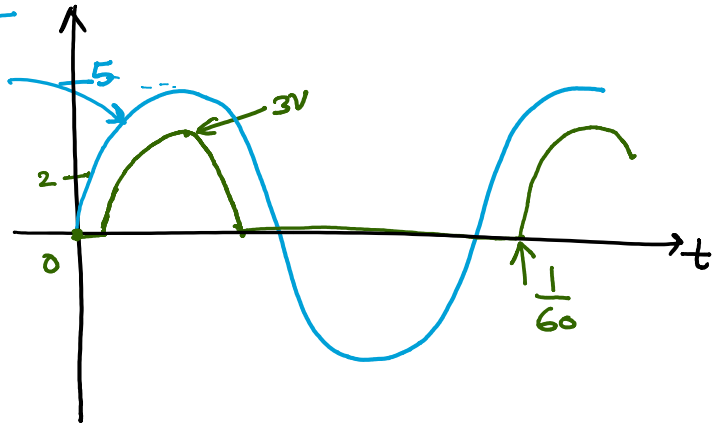
ECE 310 - Lecture 12

Wednesday, February 7, 2018 10:27 AM



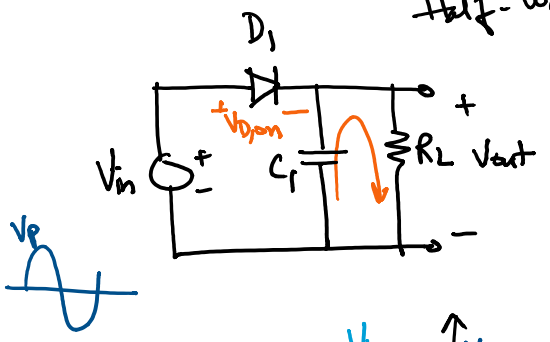


c) Ideal Diode

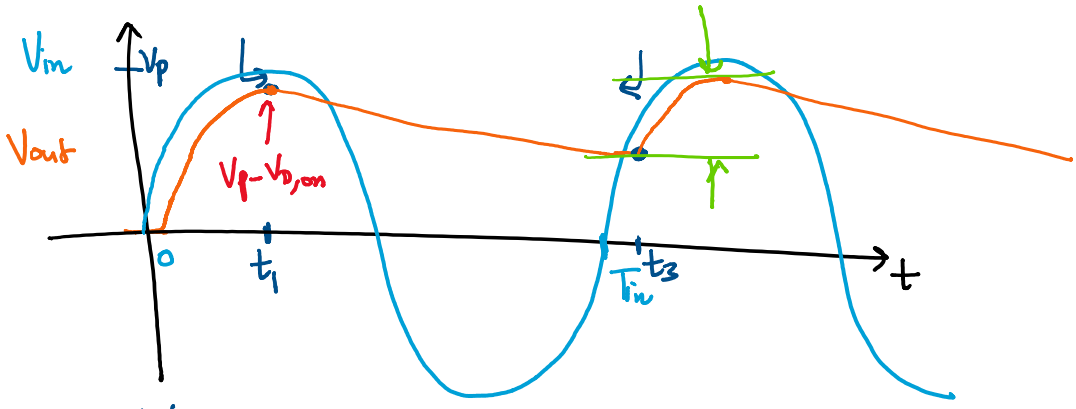


EXAM I is on Feb 12 Monday.

Half-Wave Rectifier



Ripple Voltage, V_R



$$V_{out}(t) = (V_p - V_{D,on})\, e^{-t/R_L C_1}$$

$\tau = R_L C_1$ time constant

To ensure small ripple

$\Rightarrow \tau \gg t_3 - t_1$

$\Rightarrow R_L C_1 \gg t_3 - t_1$

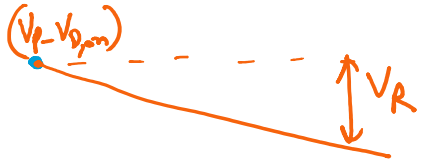
Taylor Expansion

$$e^{-t/R_L C_1} \simeq 1 - \frac{t}{R_L C_1}$$

$t \ll R_L C_1$

$$\rightarrow V_{out}(t) \simeq (V_p - V_{D,on})\left(1 - t/R_L C_1\right)$$

$$= \underbrace{(V_p - V_{D,on})}_{\text{initial condition}} - \underbrace{\frac{(V_p - V_{D,on})}{R_L C_1} \cdot t}_{\text{droop}}$$



$$V_R = \frac{V_p - V_{D,on}}{R_L} \cdot \frac{T_{in} - \Delta T}{C_1}$$

ΔT is the time when D_1 is ON, and charging the capacitor

for small ripple, $\Delta T \ll T_{in}$

$$V_o \simeq \frac{V_p - V_{D,on}}{} \cdot \frac{T_{in}}{}$$

$$V_R \simeq \frac{V_p - V_{D,on}}{R_L} \cdot \frac{T_{in}}{C_1}$$

$$\boxed{V_R = \frac{V_p - V_{D,on}}{R_L C_1 \cdot f_{in}}}$$

f_{in} ← input frequency

$$I_L = \frac{V_p - V_{D,on}}{R_L} \in \text{max load current}$$

$$\boxed{V_R \simeq \frac{I_L}{C_1 f_{in}}}$$

$$PIV \simeq 2V_p$$

For Bridge Rectifier:

$$\boxed{V_R \simeq \frac{1}{2} \cdot \frac{V_p - 2V_{D,on}}{R_L C_1 f_{in}}}$$

⇒ FW has half the ripple than half wave rectifier

Max reverse bias voltage across a diode $= V_p$

$PIV \simeq V_p$ (NOT $2V_p$!)