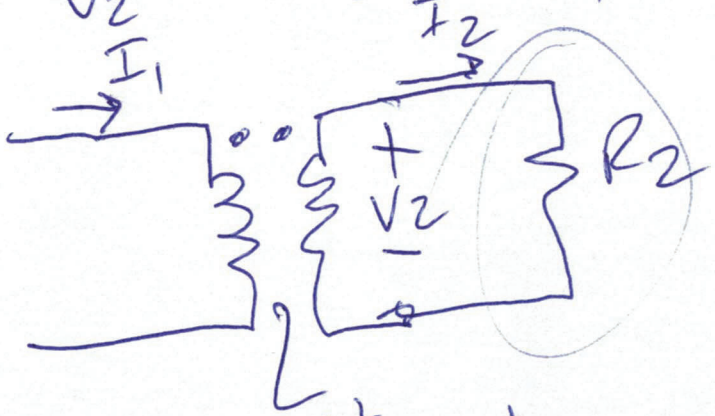
EE 442/ECG 642
Sept. 28, 2022
Lecture 9 Power Electronics

$$I_2 = V_1 \cdot \frac{N_2}{N_1} \leftarrow \frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1} \rightarrow V_1 I_1 = V_2 \cdot I_2$$

$$R_2 = \frac{V_2}{I_2} \rightarrow I_2 = \frac{V_2}{R_2}$$



Not including magnetizing inductance

$$V_1 I_1 = V_2 \cdot \frac{V_2}{R_2}$$

$$V_1 I_1 = V_1^2 \cdot \left(\frac{N_1}{N_2}\right)^2 \cdot \frac{1}{R_2}$$

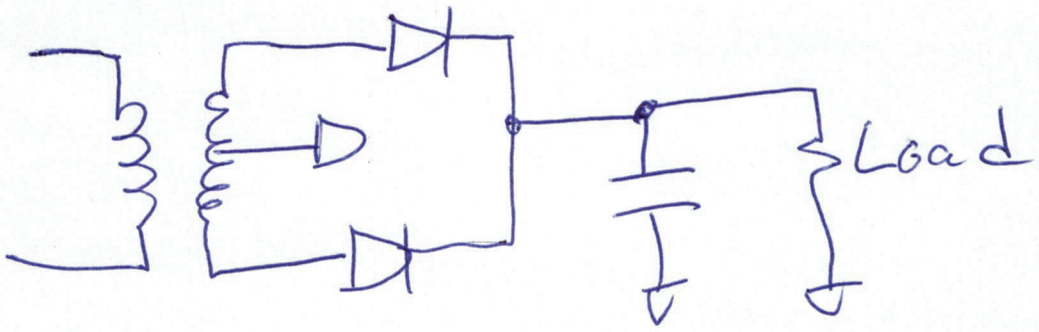
Resistor transform $= R_1 = \frac{V_1}{I_1} = R_2 \left(\frac{N_2}{N_1}\right)^2 = R_2 \cdot \frac{L_2}{L_1}$

Practice Test 1 – EE 442 and ECG 642 Power Electronics
Fall 2022 – University of Nevada, Las Vegas

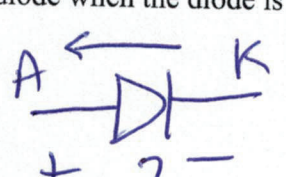
NAME: Lecture 9

Closed book and notes.
Show your work for credit and put a box around your answers.

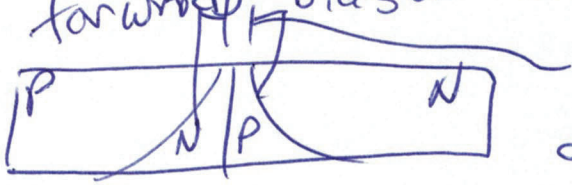
1. Sketch a full-wave rectifier using two diodes and a center-tapped transformer. (5 points)



2. Explain, in your own words, how a significant current can flow from the cathode to the anode of a diode when the diode is forward biased. (5 points)



Removing the stored junction charge in the forward biased diode.



storage or diffusion CAPACITANCE

3. What happens to the depletion region width of a diode as it's reverse biased? What happens to the corresponding junction capacitance? (5 points)

depletion width ↗ as |Vreverse| ↗

CAPACITANCE goes down

$C = \frac{\epsilon \cdot A}{t}$

A = Area of plates two plates
t = thickness between

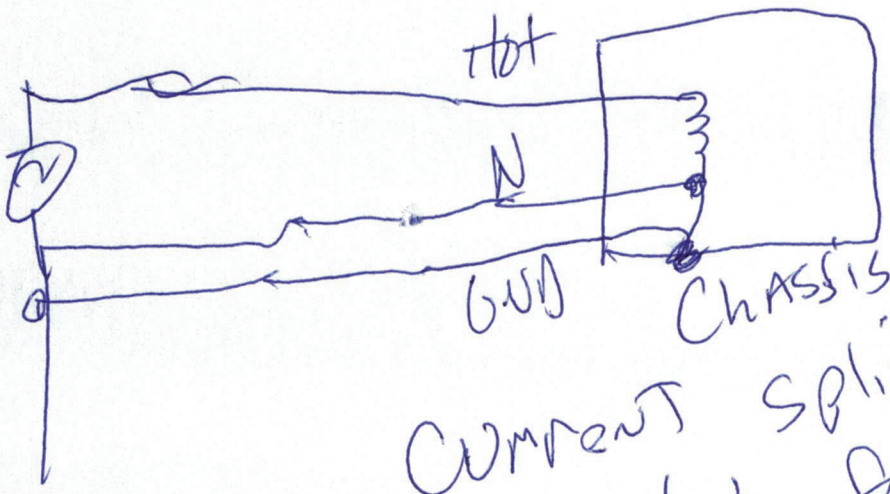
2)

4. What is the magnetizing inductance in a transformer? Ideally, how much magnetizing current flows in this magnetizing inductance? Why? (5 points)

Inductance of primary with nothing connected to secondary. Zero, only current flows "ideally" in ~~neutral~~ reflected inductance from load.

5. What would happen to the current flowing on the hot (aka phase or line) voltage in your home if you shorted the neutral to the ground in an air conditioner? Where is the ground connected in the air conditioner? Why? (5 points)

Ground connected to metal frame

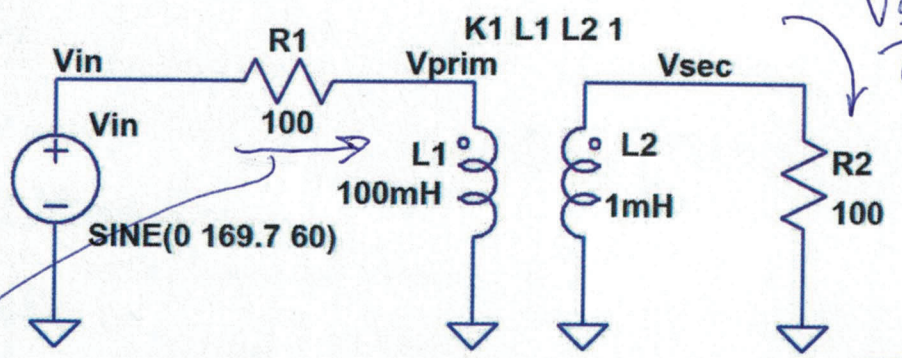


Current splits and half from Hot flows back on N and half flows back on ground

3)

$$\frac{V_{prim}}{V_{sec}} = \sqrt{\frac{L_1}{L_2}} = \frac{I_{sec}}{I_{prim}}$$

6. Determine the currents (sinusoidal time domain equations that show phase shift) flowing in the following circuit. (25 points)



$\frac{V_{sec}}{100}$

$62.5\text{mA} \angle 69.35^\circ$

100

$169.7 \angle 0$

$j \cdot 2\pi \cdot 60 \cdot 0.1$

$V_{sec} = V_{prim} \cdot \sqrt{\frac{L_2}{L_1}}$

$V_{prim} = 169.7 \angle 0 \cdot \frac{j2\pi 6}{j2\pi 6 + 100}$

$i_{sec} = 62.5\text{mA} \cos(2\pi 60 t + 69.35^\circ)$

$\frac{169.7 \angle 0 \cdot 37.7 \angle 90}{\sqrt{100^2 + (2\pi 6)^2} \angle \tan^{-1} \frac{2\pi 6}{100}}$

$\frac{V_{in} - V_{prim}}{100}$

$102.2 \angle 20.65^\circ$

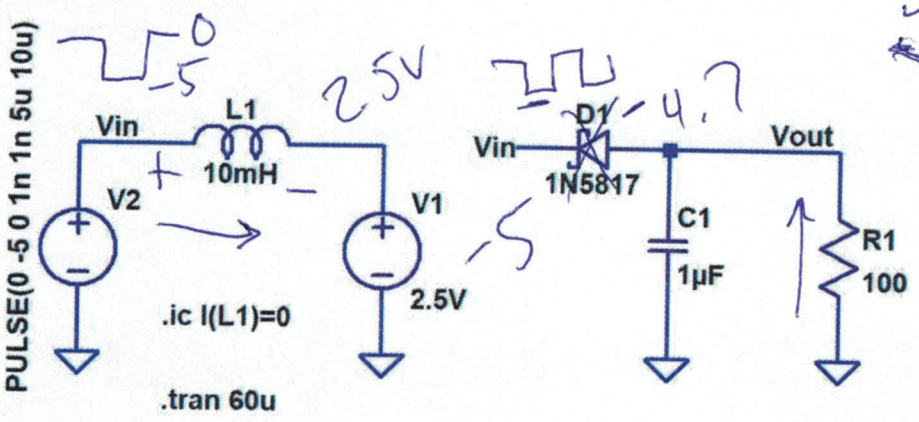
$V_{prim} = 62.6 \angle 69.35^\circ$

$V_{sec} = V_{prim} \sqrt{\frac{1}{100}}$

$= 6.25 \angle 69.35^\circ$

4)

7. Determine the currents flowing in L1 and R1 in the following circuits. (25 points)



$$V = L\frac{di}{dt} = -5 - 2.5 = 10mH \cdot \frac{\Delta i}{5\mu}$$

$$\Delta i = \frac{-7.5 \cdot 5\mu}{10mH}$$

$$\Delta i = 3.75mA$$

$$V = L\frac{di}{dt} = 0 - 2.5 = 10mH \cdot \frac{\Delta i}{5\mu}$$

$$\Delta i = \frac{-2.5 \cdot 5\mu}{10m} = 1.25mA$$

$$\frac{\frac{4.7}{100}}{1\mu} = \frac{\Delta V}{5\mu}$$

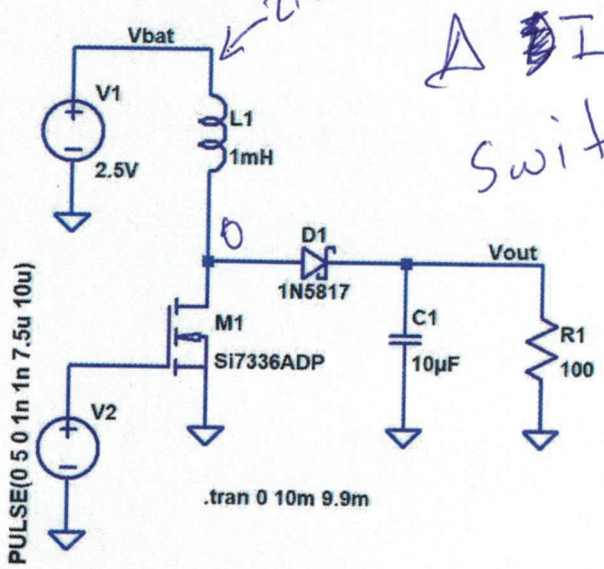
$$\Delta V = \frac{4.7 \cdot 5}{100} = \frac{4.7}{20} = .235V$$

$$\frac{I}{C} = \frac{dV}{dt}$$

$$\frac{\frac{4.7}{100}}{1\mu} = \frac{\Delta V}{5\mu}$$

5)

8. For the following circuit, determine the current in the inductor, the average output voltage, and the ripple in the output voltage. As always, show your hand calculations for credit. (25 points)



$\Delta I = C\frac{dV}{dt} = 10\mu\frac{\Delta V}{7.5\mu} = \frac{V_{OUT}}{100}$

Switch is on

ΔV

$V = L\cdot\frac{\Delta i}{\Delta t}$

$2.5 = 1mH = \frac{\Delta i}{7.5\mu}$

$V_{OUT} = \frac{V_{bAT}}{1-D}$

$= 10V$

$I = \frac{V_{OUT}}{100}$

Assume const

$\Delta V = \frac{\Delta t}{C}\cdot\frac{V_{OUT}}{100}$

6)