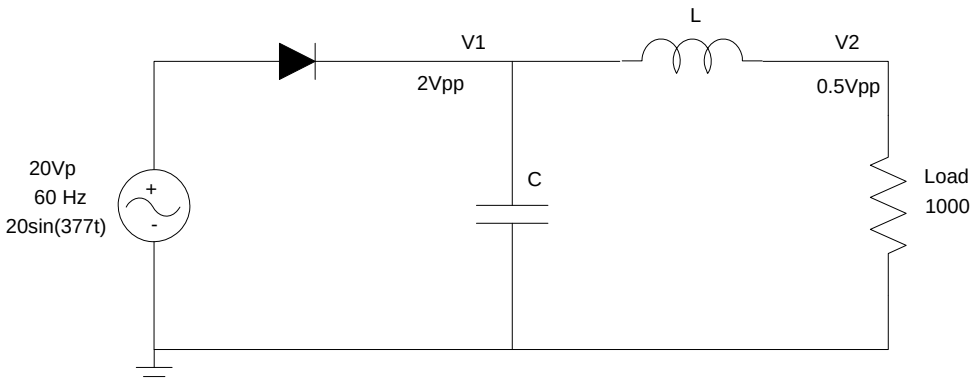
ECE 320 - Homework #5

AC to DC Converters, DC to DC Converters. Due Monday February 13th, 2017

AC to DC Converter.



1) Find L and C so that

- V1 has a ripple of 2Vpp and
- V2 has a ripple of 0.5Vpp
- For this value of L and C, what is the DC voltage at V2?

First, find C so that V1 has a 2Vpp ripple:

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

$$\left(\frac{19.3V}{1000\Omega}\right) = C\frac{2V}{1/60s}$$

$$C = 160\mu F$$

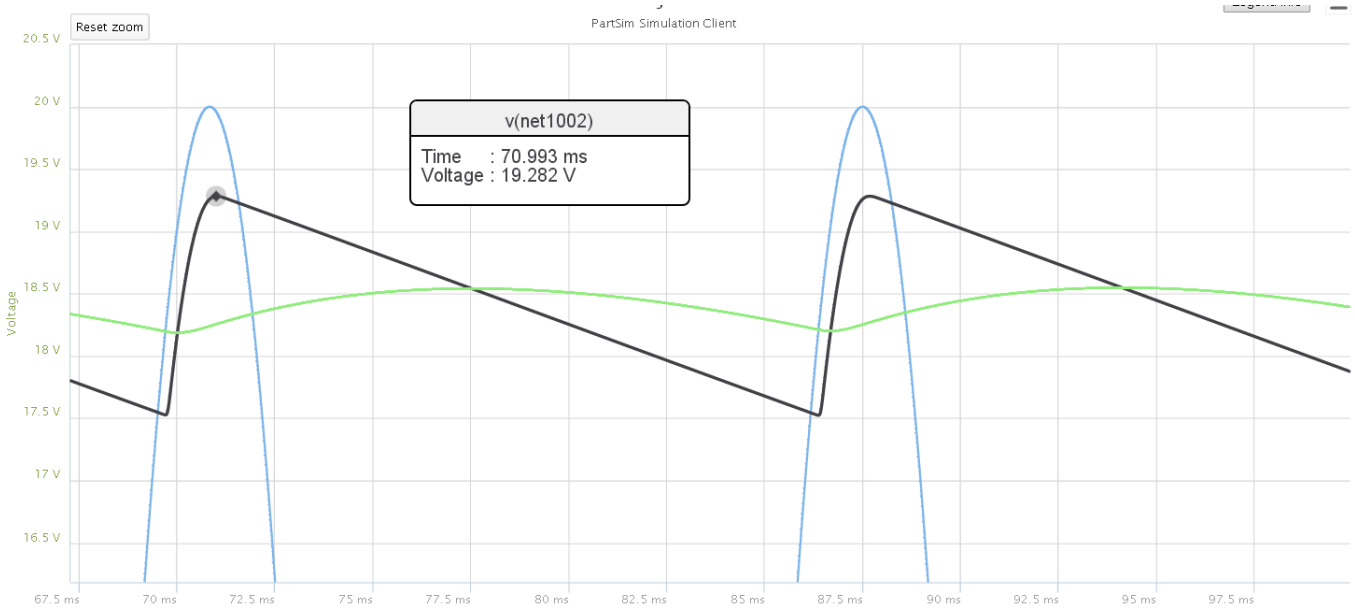
Next, find L so that V2 has a 0.5Vpp ripple. The ripple at V2 is 1/4th of the ripple at V1. This means that

$$j\omega L = 4 \cdot R$$

$$j\omega L = j4000$$

$$L = 10.6H$$

2) Simulate this circuit in PartSim to check your analysis.



Ripple at Vc (black) and R (green)

From the simulation:

The peak voltage is 19.292V (vs. 19.3V computed)

The peak-to-peak voltage at V1 (black line) is 1.758 Vpp (vs. 2.00 Vpp computed)

The peak-to-peak votlage at V2 (green line) is 0.337 Vpp (vs. 0.500 Vpp computed)

The resulting design meets the specs - but is slightly conservative (the ripple is slightly less than what was comptued)

3) Lab: Build this circuit in lab with L=0. Check the DC voltage and the peak-to-peak voltage at V1 and compare to your analysis. Note: The 20Vp sine wave source is a wall plug in room 237 and 211 which is capable of 500mA.

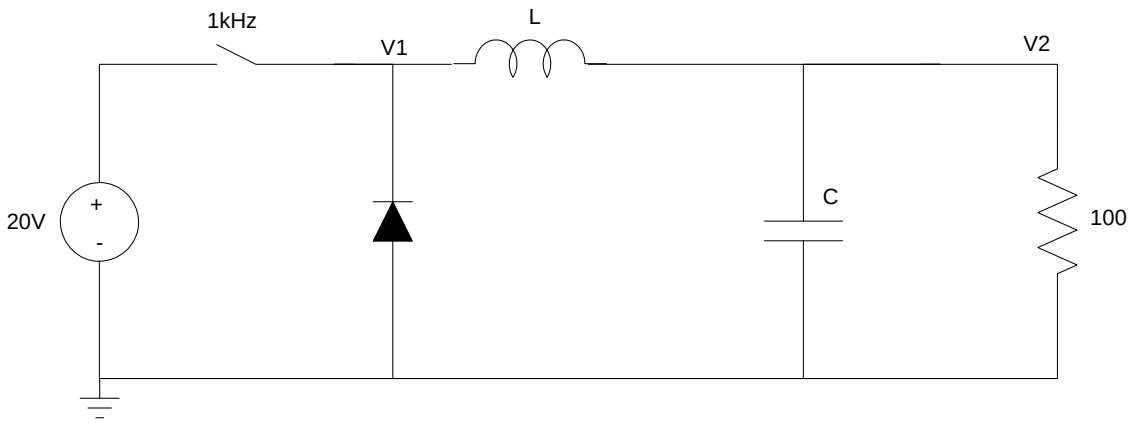
L = 0

L = 10H	Calculations problem 1	Simulation Results problem 2	Lab Results Problem 3
Vmax (DC)	19.3 V	19.292 V	21.2 V
Vpp (AC)	2 Vpp	1.78Vpp	2.2 Vpp

L = 10H

L = 10H	Calculations problem 1	Simulation Results problem 2	Lab Results Problem 3
Vmax (DC)	19.3 V	19.292 V	21.2 V
Vpp (AC)	500 mVpp	337 mVpp	280 mVpp

DC to DC Converter



4) Find the duty-cycle of the switch so that the voltage at V2 is 5V DC.

Duty Cycle = $\left(\frac{5.7V}{20.7V}\right) = 0.2754$

5) Assume C = 0. Determine L so that V2 has a 2Vpp ripple

Assume the ripple at V1 is 20.7Vpp

The ripple is reduced by a factor of

$$\left(\frac{20.7V_{pp}}{2V_{pp}}\right) = 10.35$$

Pick L so that it is 10.35 times bigger than R

$$j\omega L = j \cdot 10.35 \cdot 100\Omega$$

$$L = \frac{1035}{2\pi \cdot 1000Hz} = 164mH$$

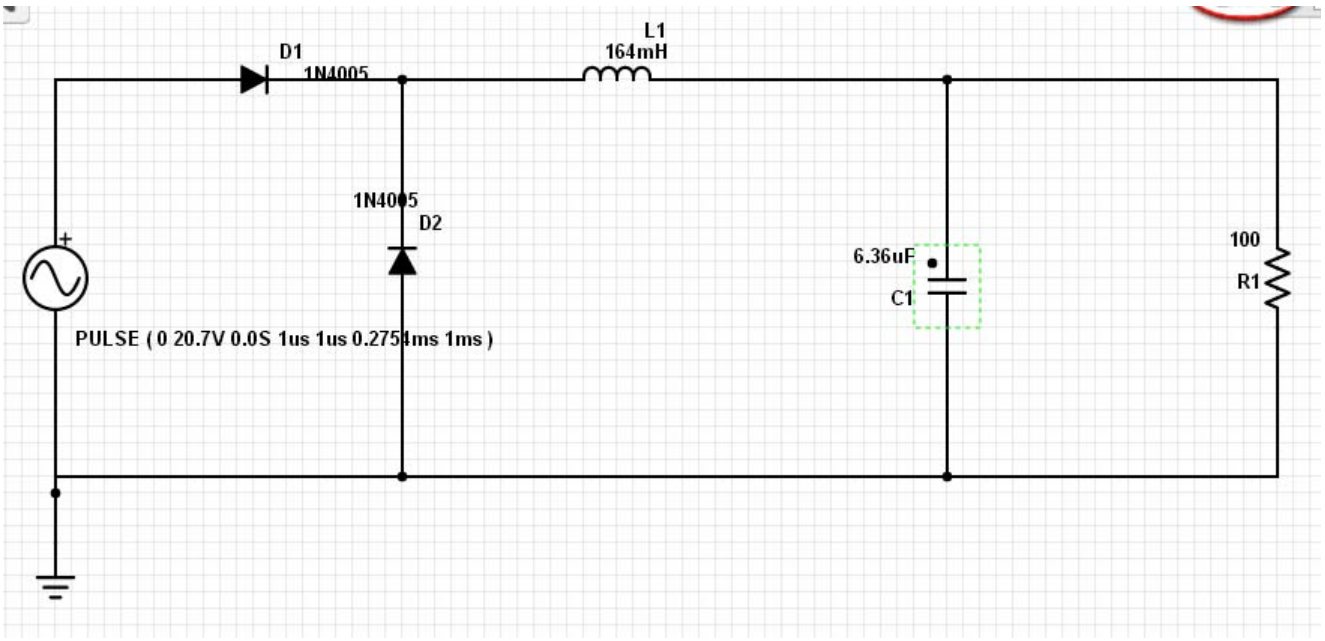
6) Add C so that the ripple at V2 becomes 500mVpp.

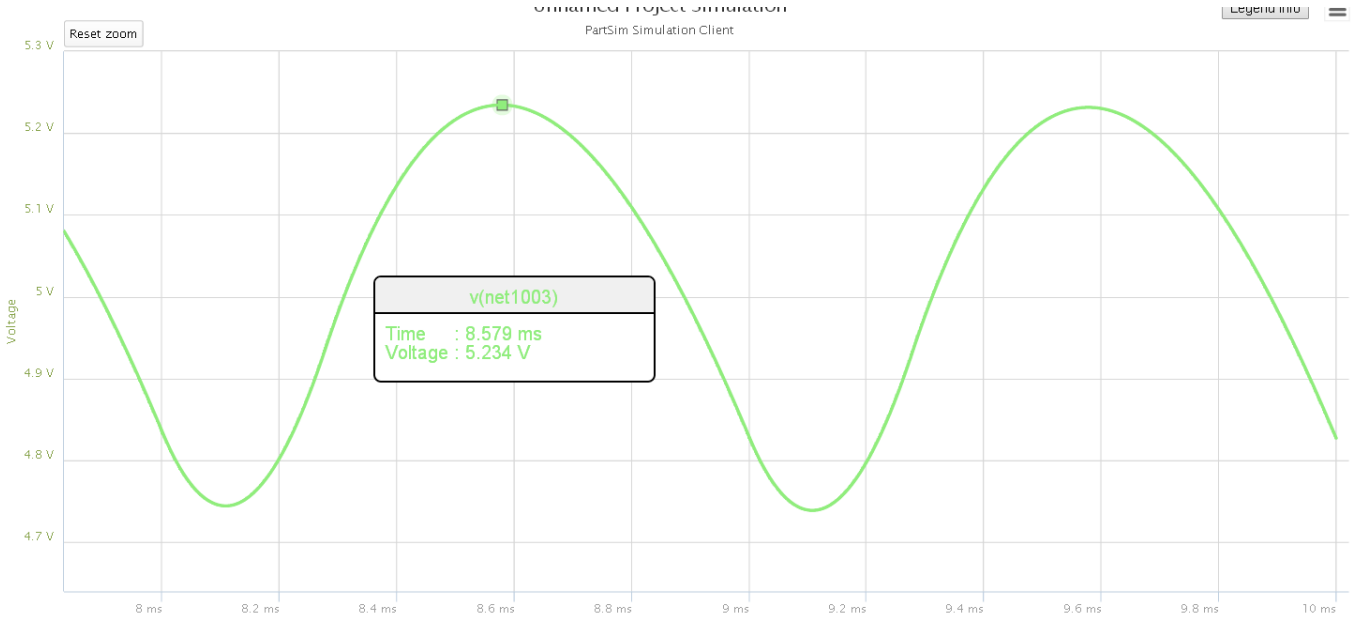
For the ripple to be reduced by another factor of 4x, let

$$\frac{1}{j\omega C} = -j \cdot \frac{1}{4}R = -j25\Omega$$

$$C = \frac{1}{25 \cdot 2\pi \cdot 1000Hz} = 6.36\mu F$$

7) Check your design in PartSim.





	Calculations problem 4-6	Simulation Results problem 7	Lab Results n/a
Vavg (DC)	5.00 V	4.99 V	-
Vpp (AC)	500 mVpp	490 mVpp	-