ECE231-2021 Lab 2

Lab Report: Diode Circuits

PRA Section: 0101

Date: 02/09/2021

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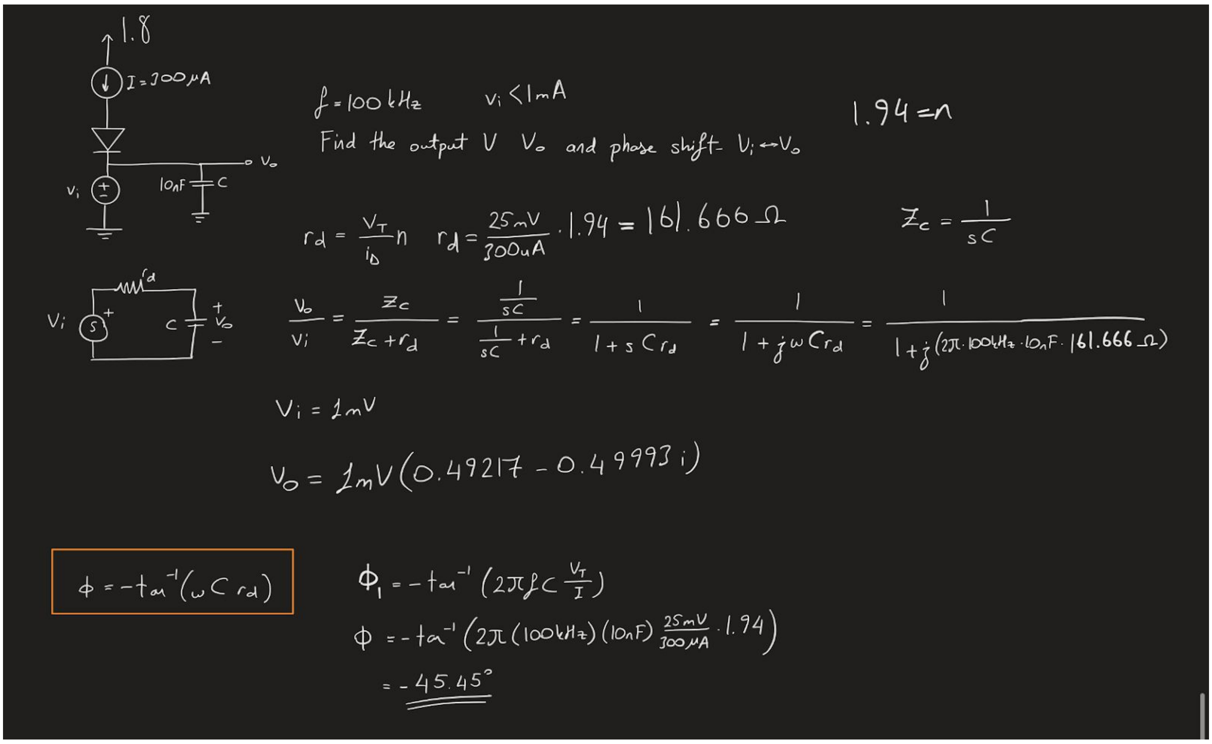
STEP 2: Submit your PDF in Quercus with the file name:

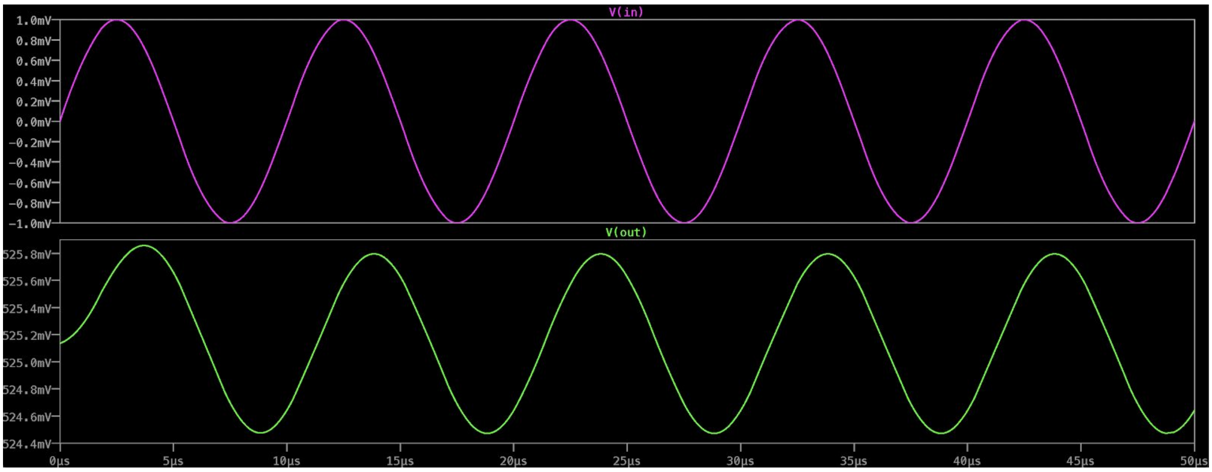
ECE231_Lab2_PRA0101_You_Uzun.pdf

S.4.1

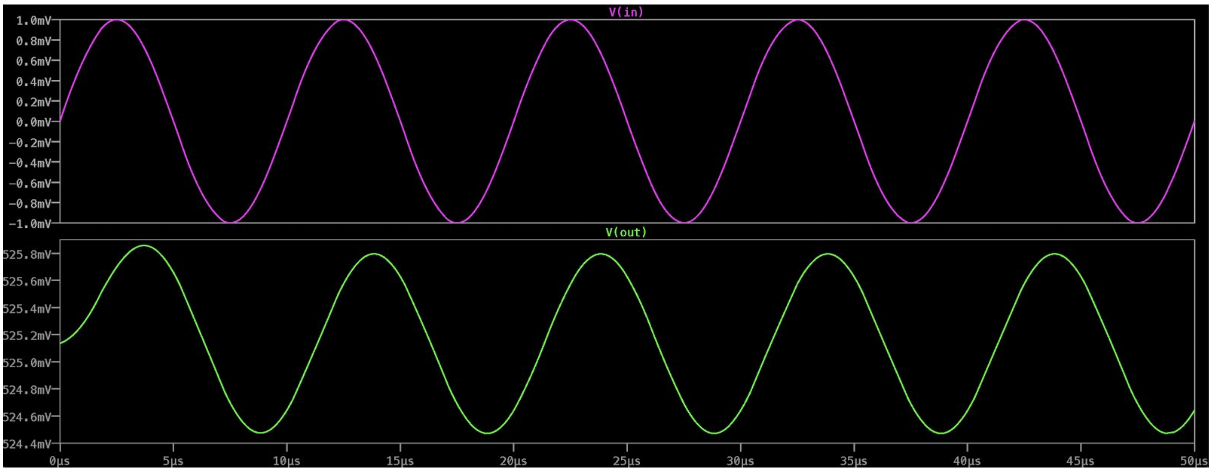
a) Sketch the small-signal equivalent circuit and analytically find the output voltage and the phase shift between Vi and Vo.



b) Plot of the transient waveform for the given value of the current source of the output and verification of calculations.

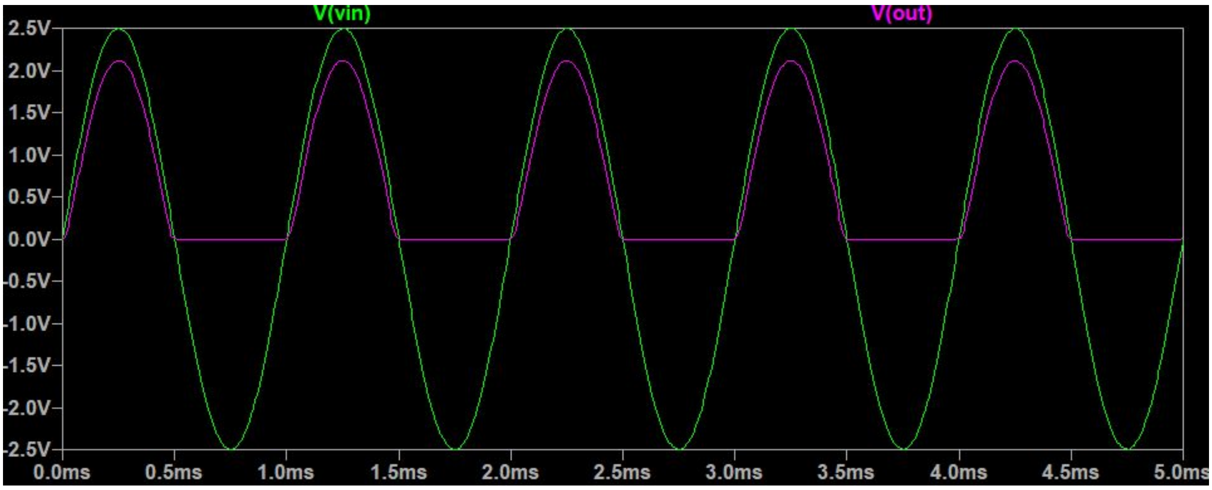


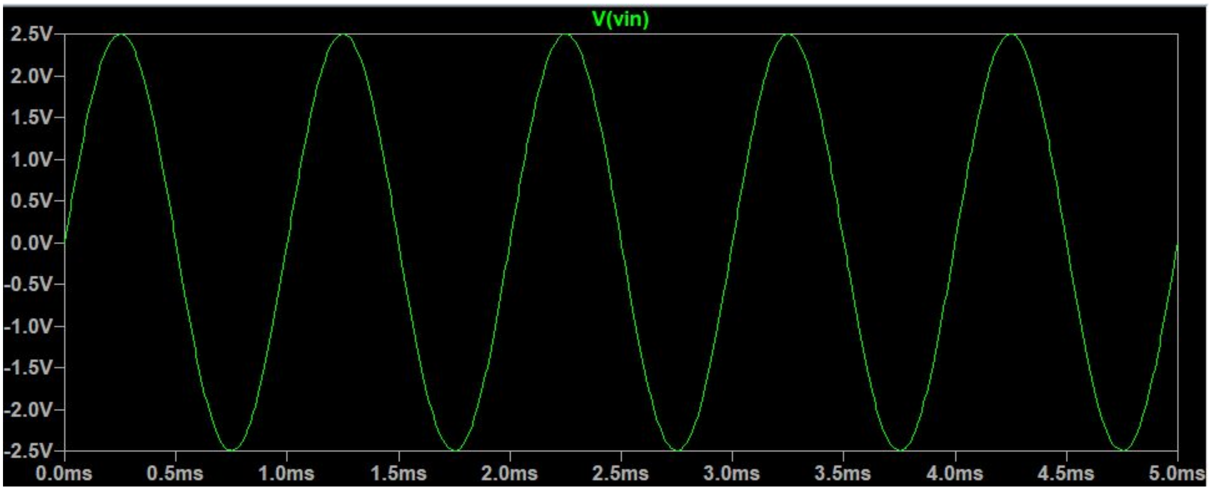
c) Plot of the transient waveform for the designed value of the current source and verification of the design.

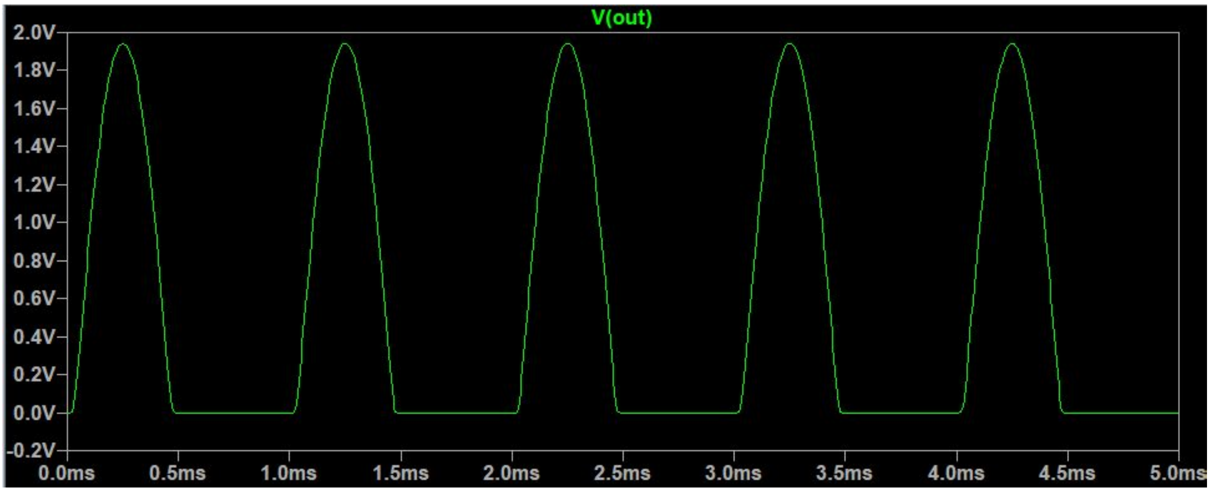


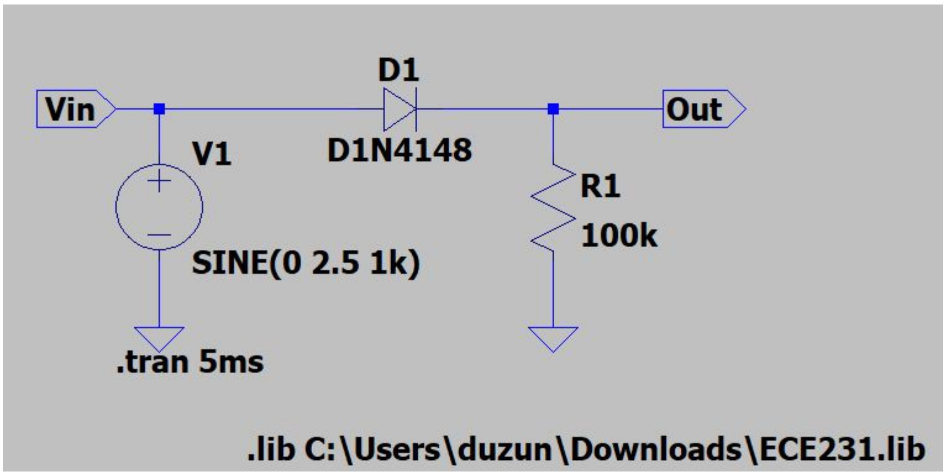
S.4.2

a) Plot of the input and output transient waveforms for the half-wave rectifier.

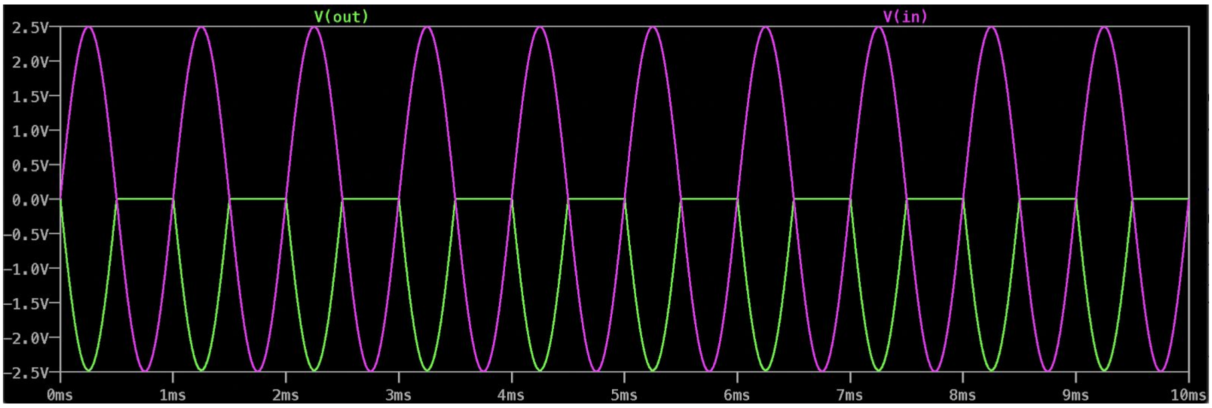


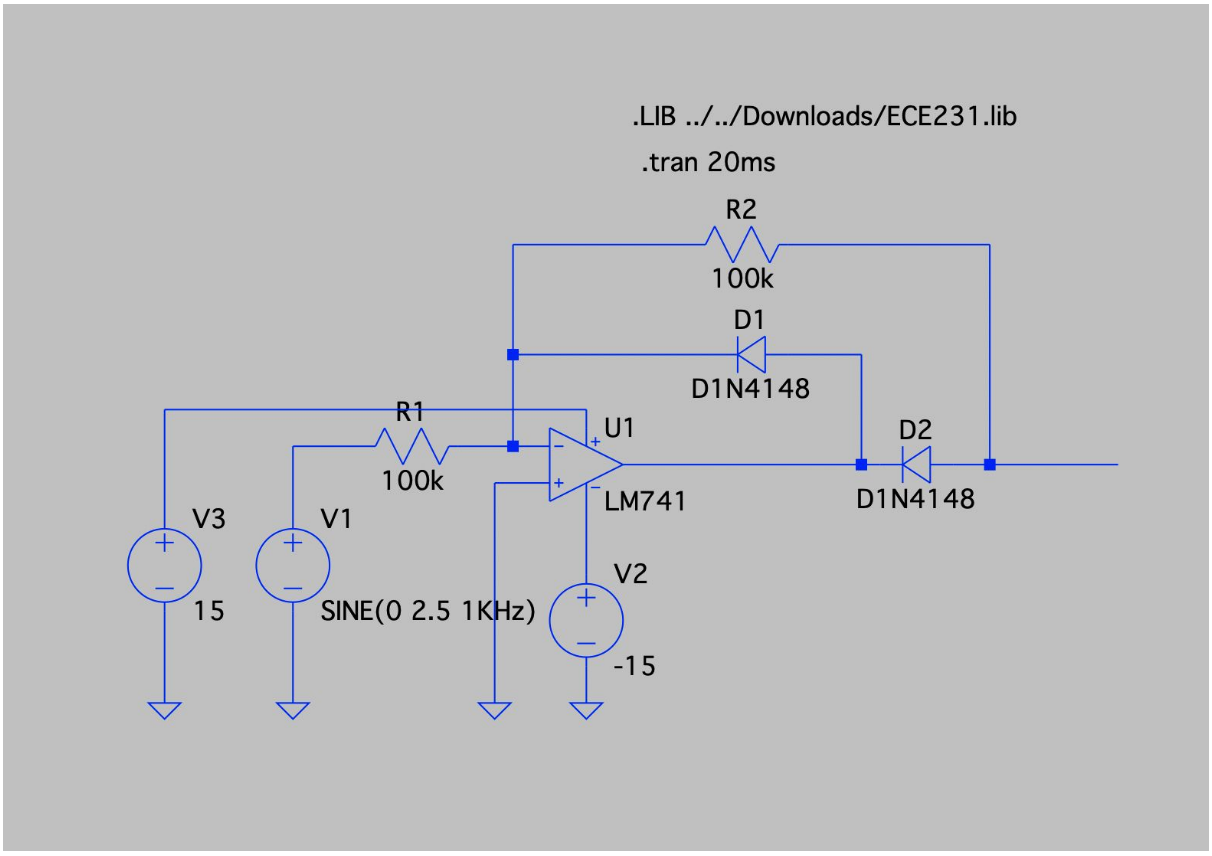

V(vin)
2.5V
2.0V
1.5V
1.0V
0.5V
0.0V
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
0.0ms
0.5ms
1.0ms
1.5ms
2.0ms
2.5ms
3.0ms
3.5ms
4.0ms
4.5ms
5.0ms


V(out)
2.0V
1.8V
1.6V
1.4V
1.2V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
-0.2V
0.0ms
0.5ms
1.0ms
1.5ms
2.0ms
2.5ms
3.0ms
3.5ms
4.0ms
4.5ms
5.0ms


D1
Vin
Out
V1
D1N4148
R1
100k
SINE(0 2.5 1k)
.tran 5ms
.lib C:\Users\duzun\Downloads\ECE231.lib

b) Plot of the input and output transient waveforms for the precision half-wave rectifier.



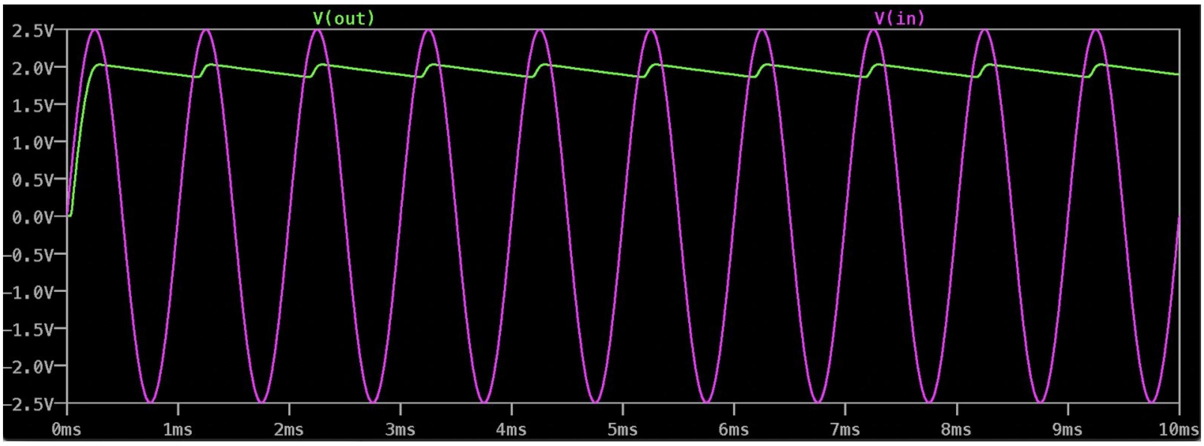


c) Reporting the peak output voltages in (a) and (b) and mentioning and explaining the differences.

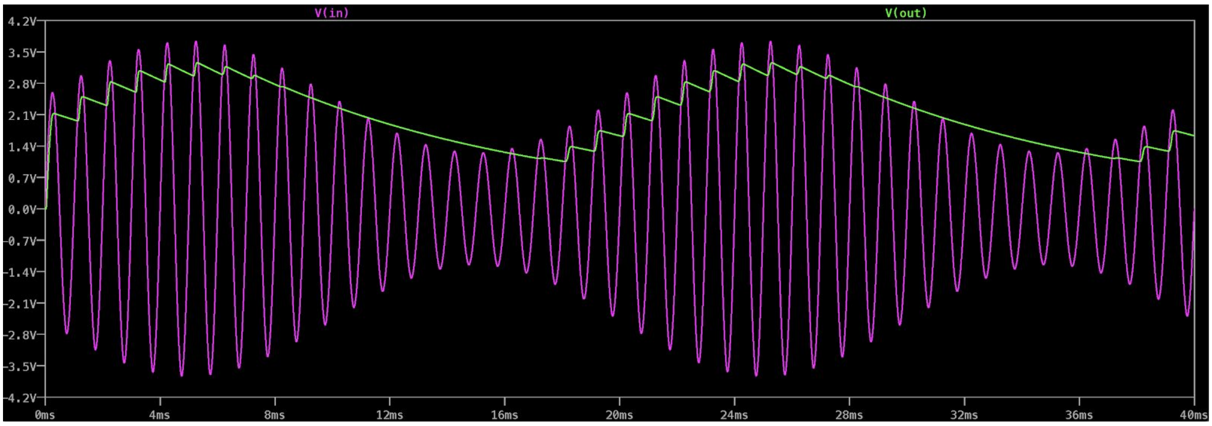
In a) only the positive value portion of the voltage was allowed to pass through to V(out), whereas in b), only the negative portion of the input voltage was allowed to pass through to V(out). Additionally, the peak output voltage in b) maintains the amplitude of the input voltage (2.5V) whereas a) loses some of the amplitude (max amplitude is ~2.1V, loses ~0.4V). The voltage drop occurs in part a as the diode is forward biased. In part b there is no voltage drop as we used an op amp.

S.4.3

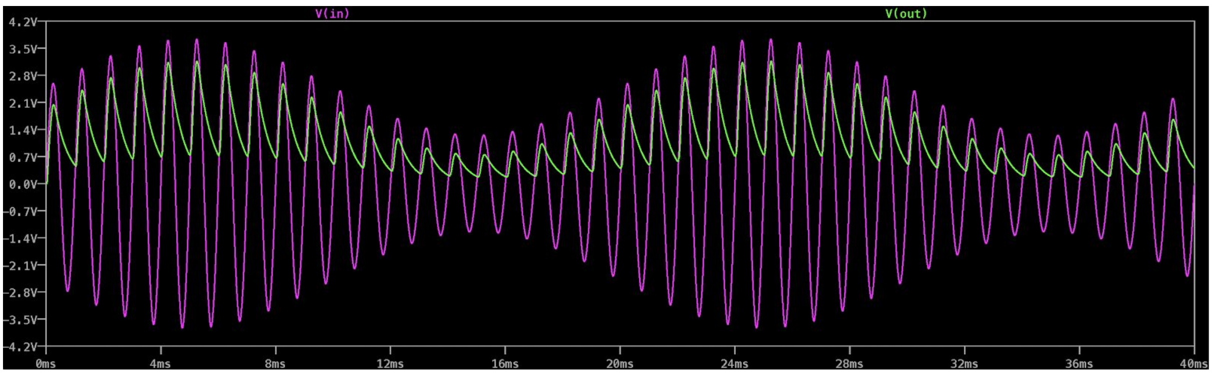
a) Plot of the input and output transient waveforms of the peak detector with a sine wave input.



b) Plot of the input and output transient waveforms of the peak detector with an AM input.



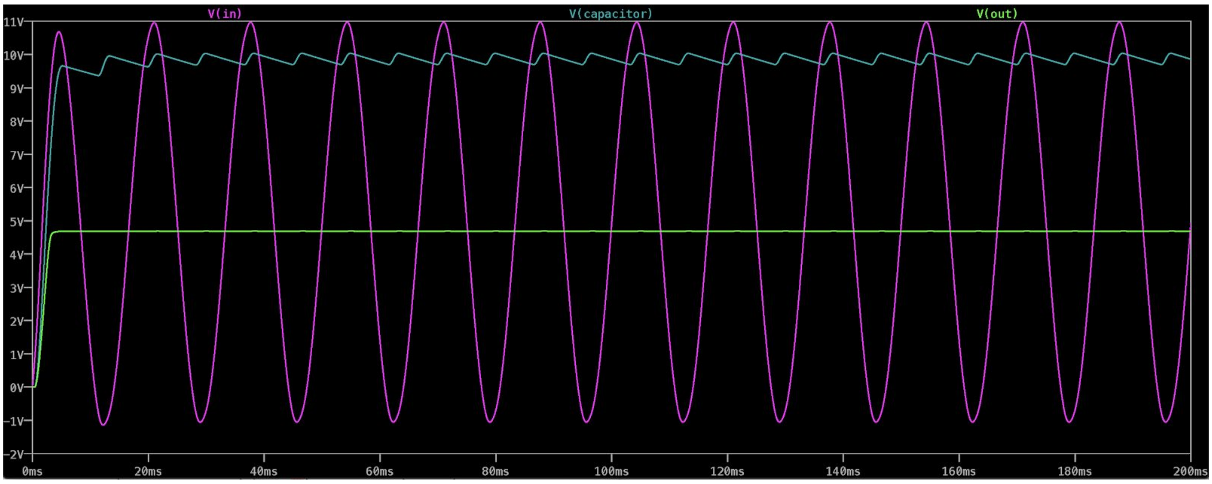
c) Plot of the input and output transient waveforms with the additional resistor and explanation of any changes compared to (b).



In part b the peak detector is more accurate as the signal passes closer to the peaks. When we add a parallel resistor to the circuit, the RC time constant decreases as the R eq decreases. Thus, in part c, as the RC time constant decreases, the capacitor discharges more quickly which causes more ripples (and lower peak detection accuracy) in the signal.

S.4.4

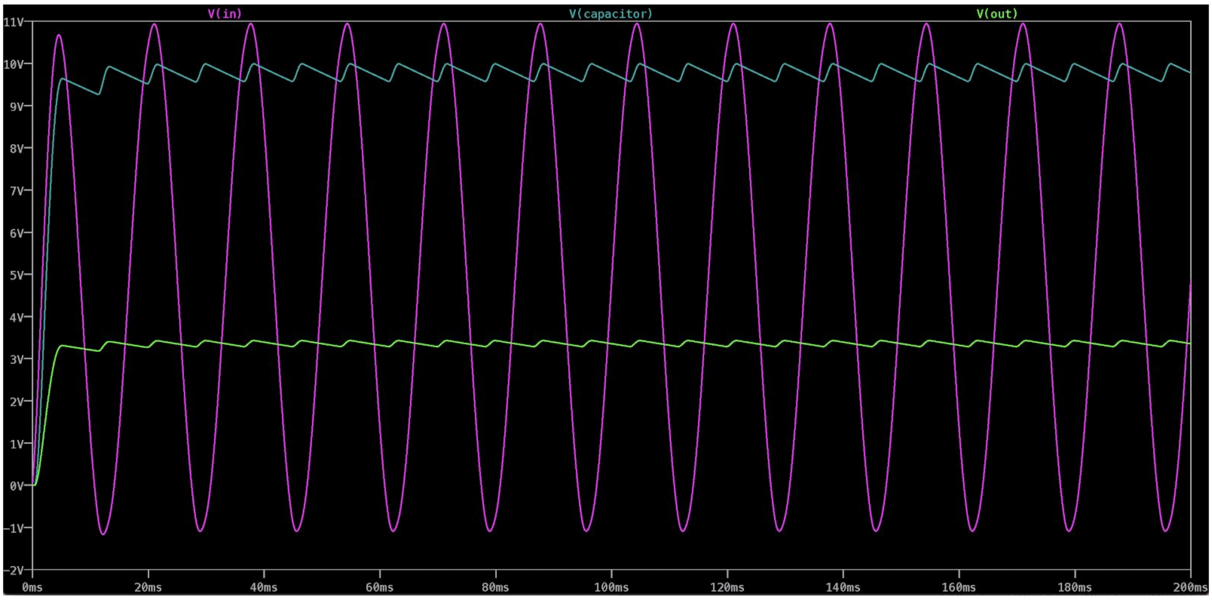
a) Plot of the transient waveforms of the input and the voltages across the capacitor and the load resistor.



b) Reporting of the DC level of the output and its peak-to-peak ripple.

4.678V, peak-to-peak difference is 6mV.

c) Same as (a) and (b) but for a load resistor and explaining why the output voltage deviates from the desired value.

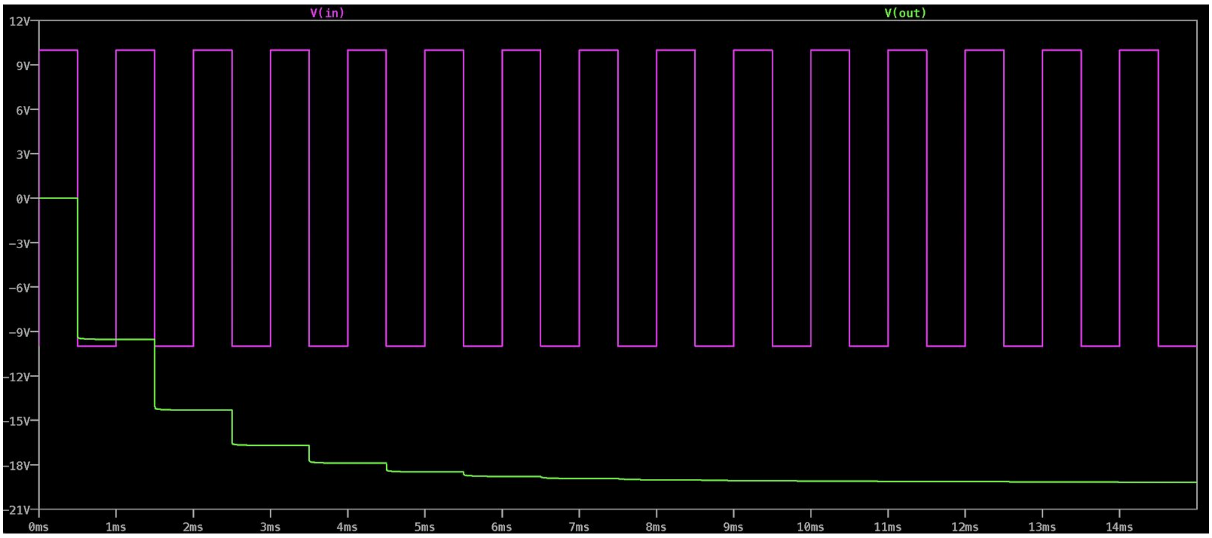


3.38V, peak-to-peak difference is 144mV

Zener Diodes can be used to produce a stabilised voltage output with low ripple under varying load current conditions. The zener diode in our circuit has a maximum voltage cap at 4.7V. In part b, the voltage exceeds 4.7V, thus we see the zener diode flattening out the waveform to cap it at 4.7V. In part c, the voltage does not reach that level, thus it is not flattened out and we see a larger peak-to-peak difference.

S.4.5

· Plot of the input and output transient waveforms. How does the output relate to the input?



The output starts at 0v and the voltage decreases by a step every period. After a while output voltage stabilizes around -19.2V which is close to the double of our input voltage amplitude 10V. This is consistent with the behavior we would expect from a voltage doubler.

C1 and D1 within the circuit act as a negative clamping circuit, which vertically translates the waveform so that all parts are less than 0V. C2 and D2 within the circuit act as a negative peak detector, which checks for and retains the negative peak of the square wave. As the capacitors charge, the output voltage stabilizes to -19.2V (negative peak of the square wave + vertical shift).

V(out) = max(V(in) + V(capacitor peak))