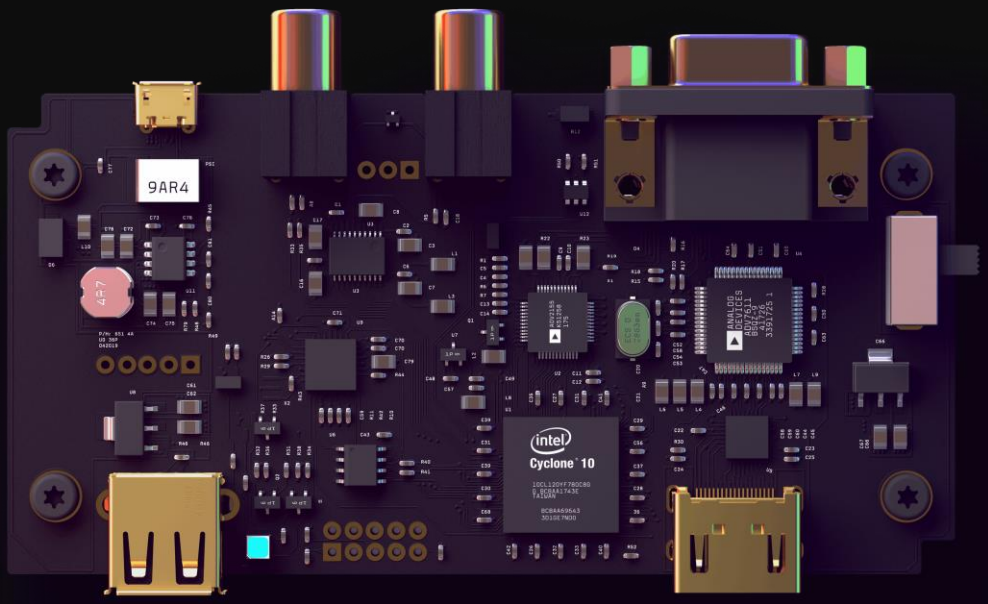
EC205

Analog Electronics Lab

Lab – 3



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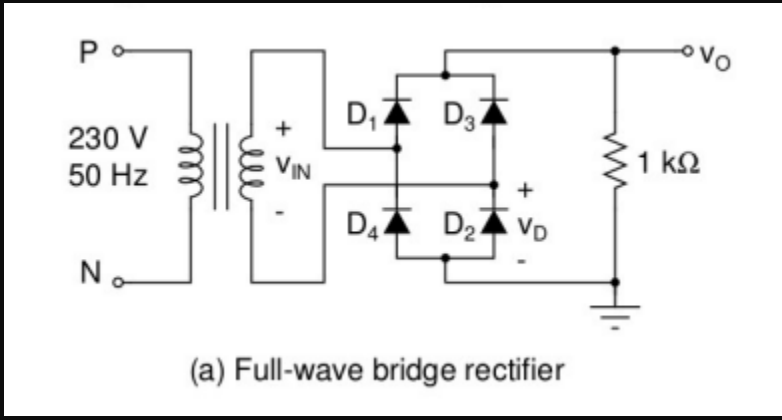
Experiment 3: Full-wave Rectifier, Unregulated and Regulated Power supply

Aim:

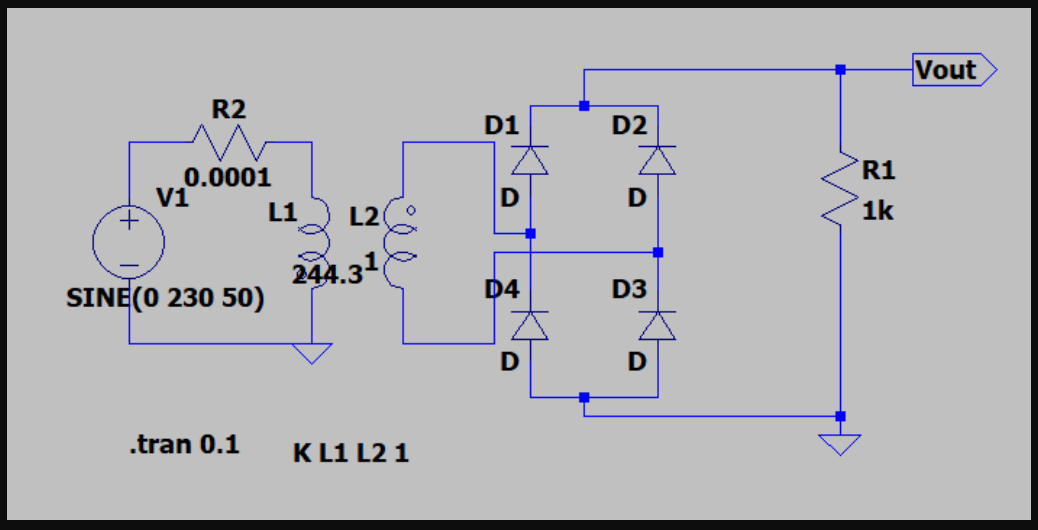
- To design a full-wave bridge rectifier for an average output voltage of 8 V to feed 1kQ load.
- To design an unregulated power supply for an output voltage of approximately 10 V and current 0.1 A.
- To design a regulated power supply for an output voltage of 5 V and current of 0.1 A using voltage regulator chip /iA7805.

Experiment (a)

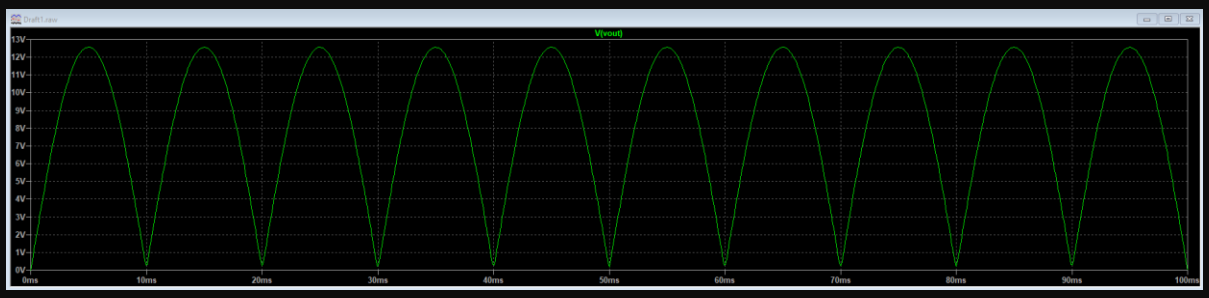


(a) Full-wave bridge rectifier

Circuit in LTspice:

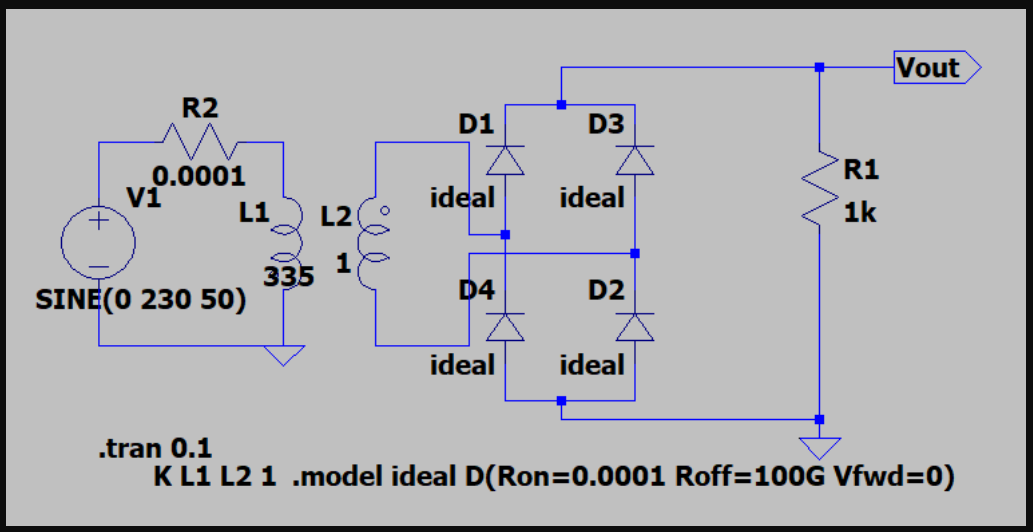


Output Waveform

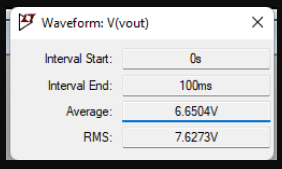


a) $V_{Out(avg)}$ =8V

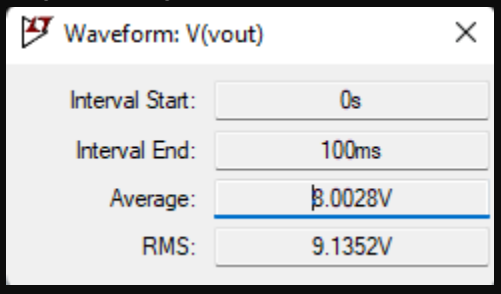
$V_{transformer}$ = $V_{Out(peak)}$ = $\frac{VOut(avg)x\pi}{2}$ = $\frac{8x\pi}{2}$ = 12.566370V



b) we can expect a drop in our final average output voltage.
Here with standard diode without changing secondary voltage of transformer in ltspice from ideal diode, New $V_{Out(avg)}$ will be 6.6504V instead of 8V.



c) V_{DC} = 8V V_{AC} = 9.1352V for standard diode

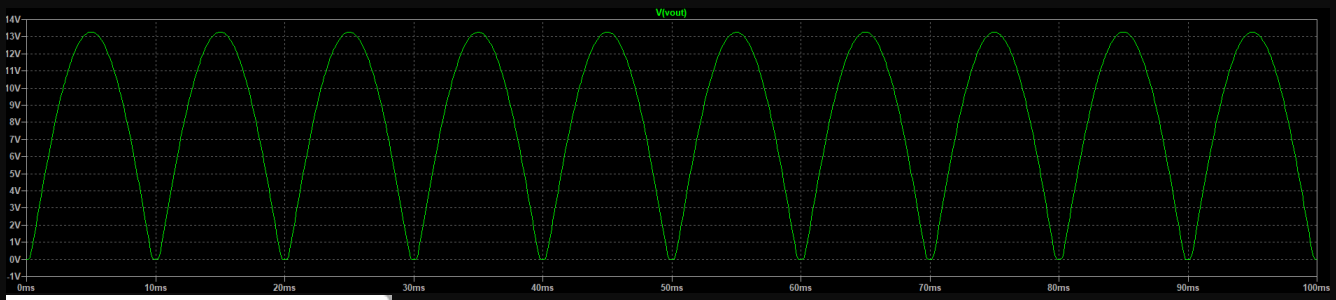


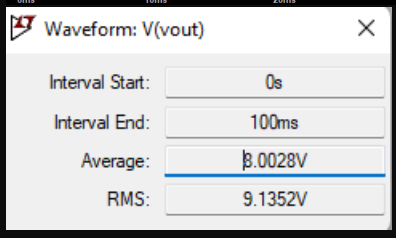
d) $\gamma = \sqrt{(V_{ac}/V_{dc})^2 - 1}$

$= \sqrt{\left(\frac{9.1352}{8}\right)^2 - 1}$

= 0.5513

e)

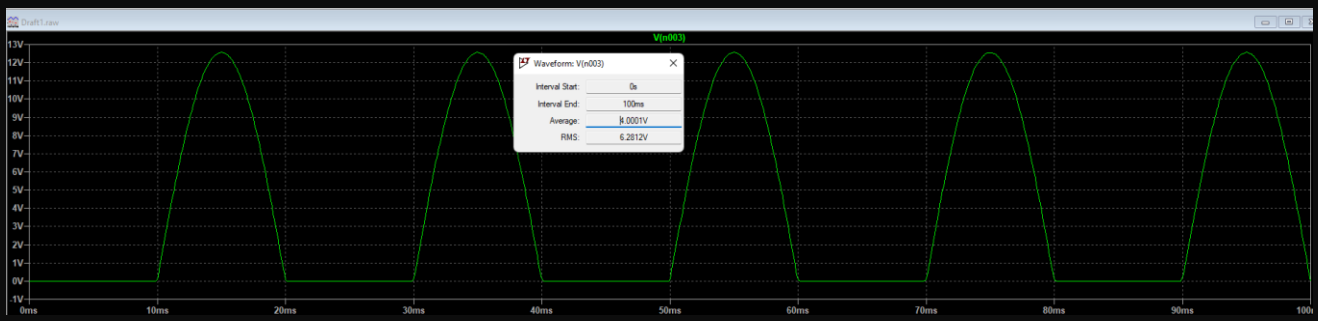




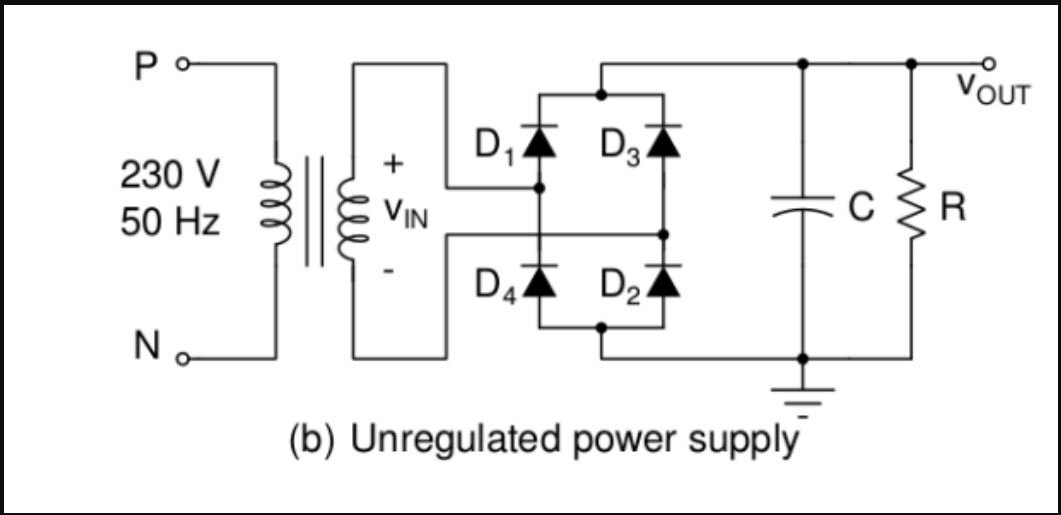
f) Voltage waveform across D2

g) peak inverse voltage with Ideal diode will be 0V.
while -0.7V with standard diode

h) V_{rms} = 4V

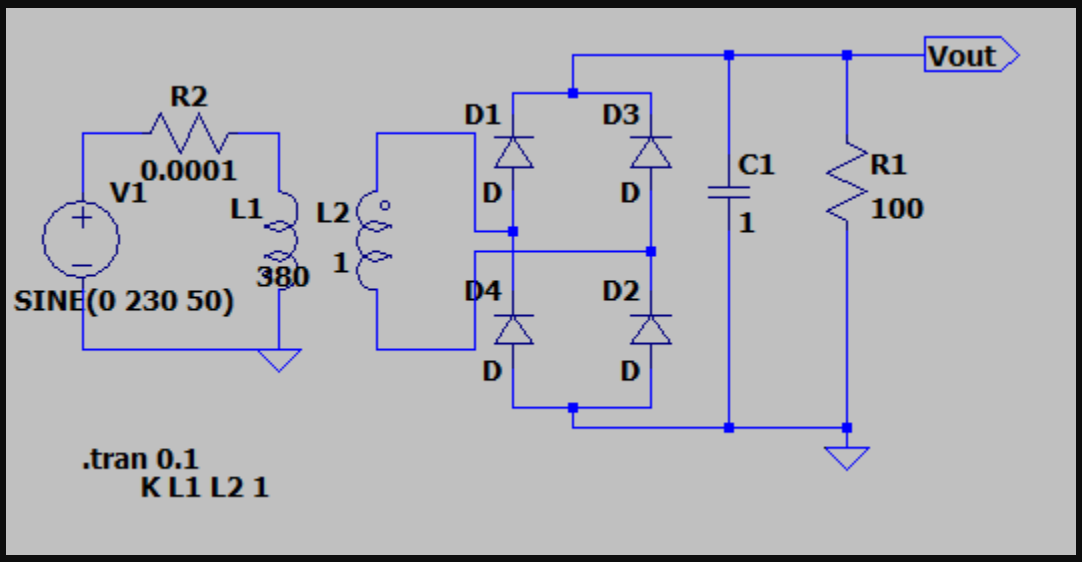


Experiment (b)

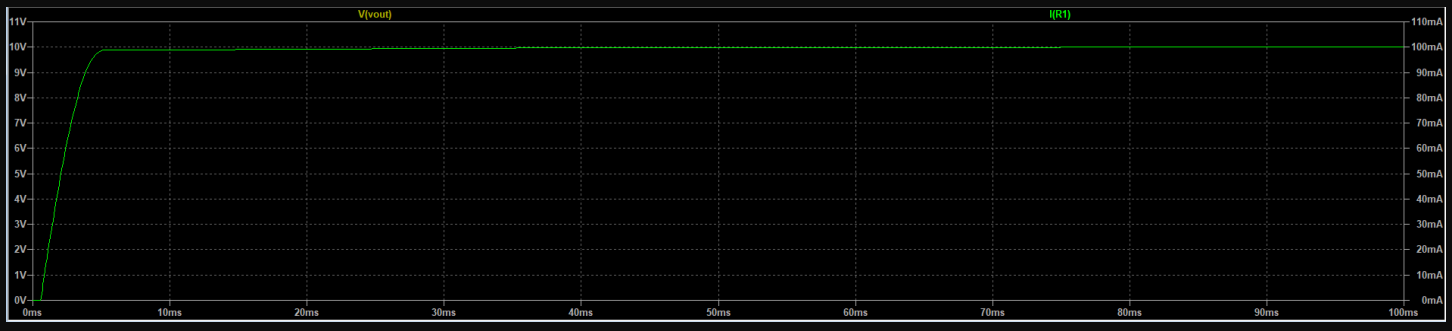


(b) Unregulated power supply

Circuit in LTspice:



Waveform:



Values Observed in LTspice:

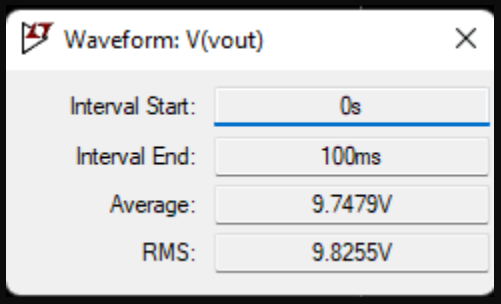
V_{DC} = 9.7479V

V_{AC} = 9.8255V

$$\gamma = \sqrt{(V_{ac}/V_{dc})^2 - 1}$$

$$= \sqrt{\left(\frac{9.8255}{9.7479}\right)^2 - 1}$$

= 0.1264



Theoretical Values considering unfilitered output:

$V_{DC} = \frac{VOutx2}{\pi} = \frac{10x2}{\pi}$ = 6.366V

$V_{AC} = \frac{VOutx2}{\sqrt{2}} = \frac{10}{\sqrt{2}}$ = 7.0710V

$$\gamma = \sqrt{(V_{ac}/V_{dc})^2 - 1}$$

$$= \sqrt{\left(\frac{7.0710}{6.366}\right)^2 - 1}$$

= 0.4834

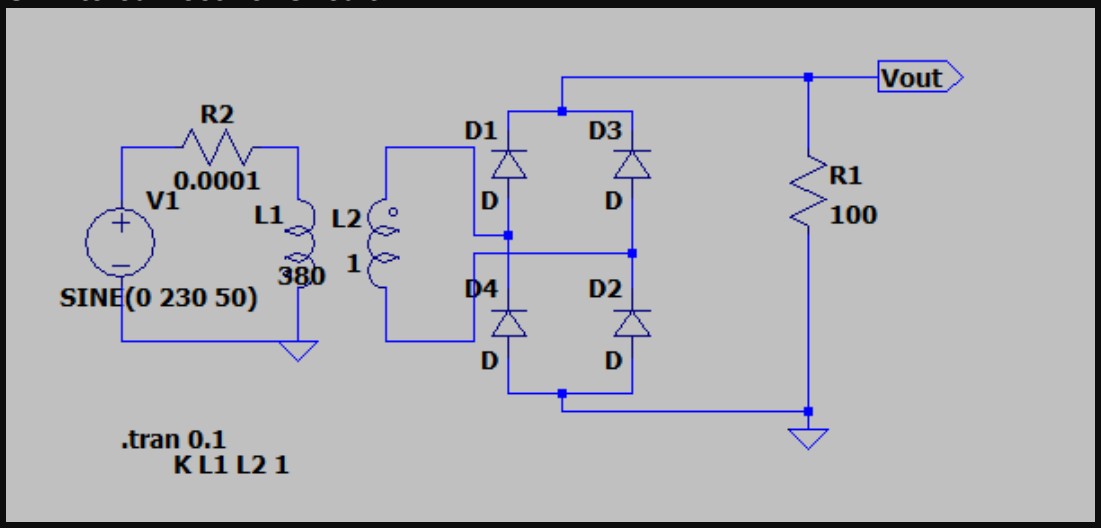
Theortical values considering Filtered output:

$V_{AC} = V_{Out} = V_{DC}$ = 10V

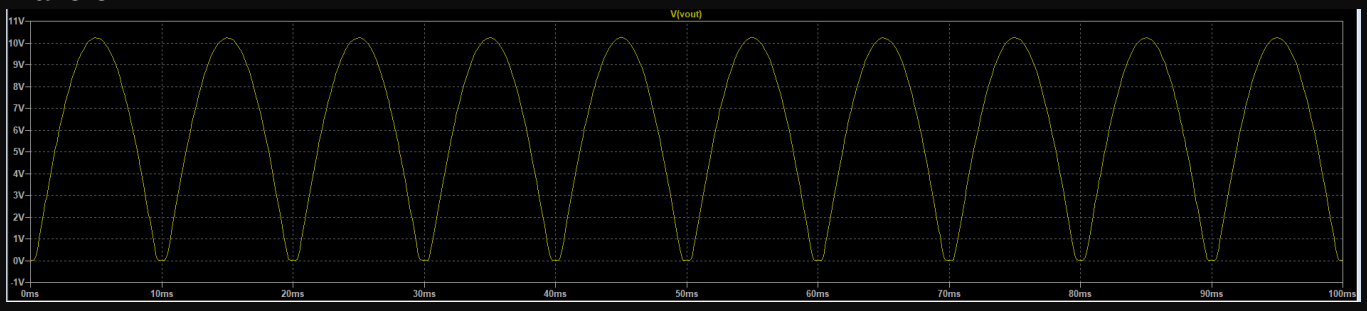
$$\gamma = 0$$

We can see that the experimented voltages are bit lower than the theoretical values considering filtered output.

Unfilitered Rectifier Circuit:

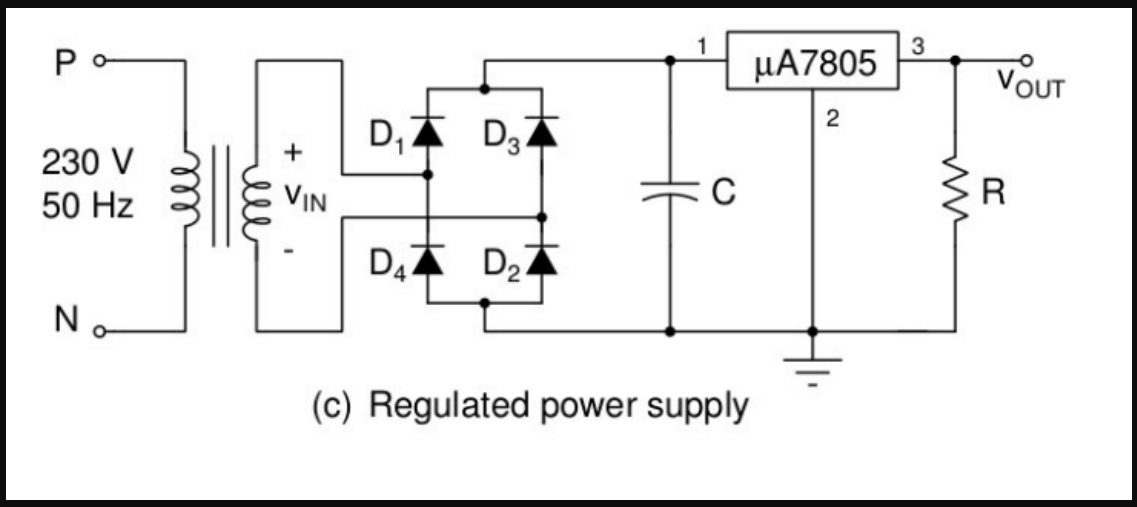


Waveform:

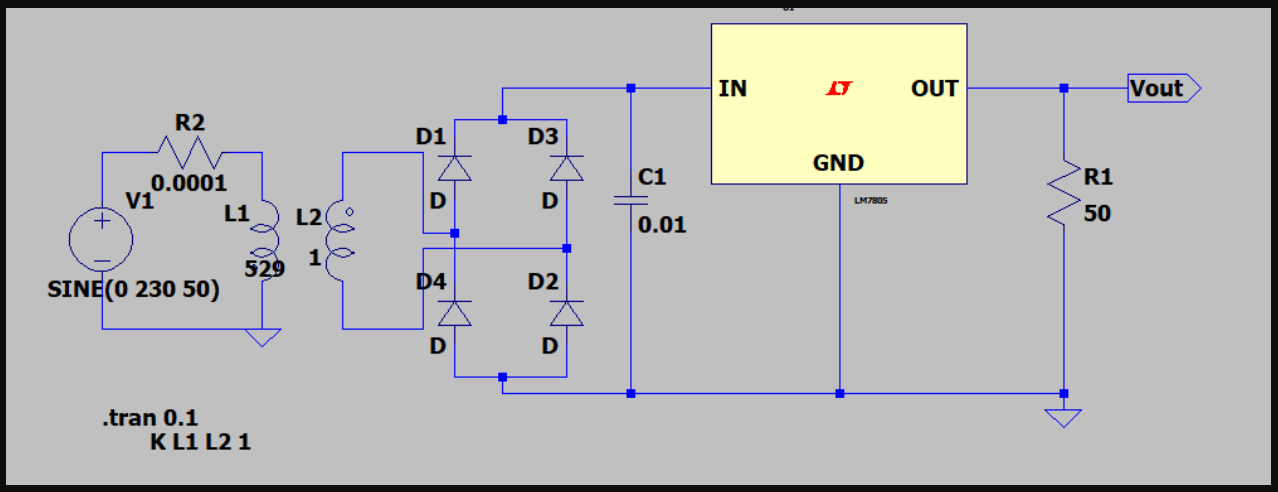


V_{AC} = 6.9848V
V_{Out} = 10V
V_{DC} = 6.0576V
The Unfiltered rectifier output ac and dc voltage values are lower than the filtered rectifier output as expected.

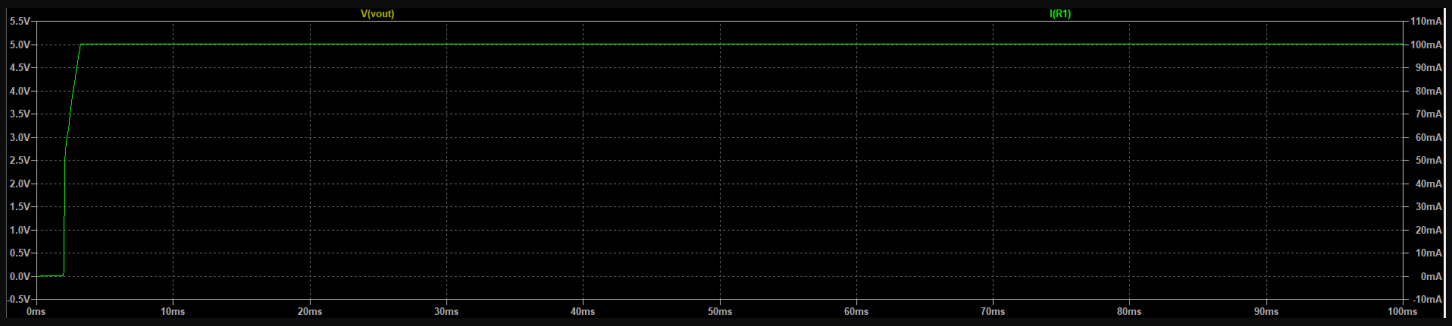
Experiment (c)

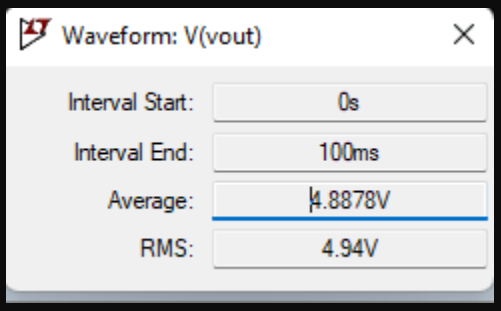


Circuit in LTspice:



Waveform:





V_{DC} = 4.8878V

Answer the following (Not more than two sentences for each question)

1. **Why electrolytic capacitors are used in the filter circuit?**
   Electrolytic capacitors are preferred because they have polarity and are available in values from 1μF to thousands of μF and are also cheap.

2. **How to identify the polarity of the capacitor?**
   The stripe on the electrolytic capacitor indicates the negative end.

3. **Discuss the limitations of the electrolytic capacitor.**
   large leakage currents: They have large current leakage, value tolerances: they have high tolerance compared to some alternatives, equivalent series resistance and a limited lifetime.

4. **What is a rectifier diode?**
   Rectifier Diode is a semiconductor device used to convert alternating current to direct current. It has obvious unidirectional conductivity, and can be made of materials such as semiconductor germanium or silicon.

5. **What is the repetitive peak current of the diode?**
   The repetitive peak forward surge current is the maximum current surge the diode can handle as repetitive pulses without damaging itself.