EE 236: Experiment No. 0
NgSpice Introduction

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1 Overview of the experiment

1.1 Aim of the experiment

The experiment aimed at providing the students with an introduction to the circuit simulation software **NgSpice** through hands-on implementation and simulation of certain circuits. The experiment entailed the students to go through the given solved examples in a shared PPT and solve 2 given exercises:

1. Switching polarities of the (a) diode and (b) 2V battery in a shunt clipper and observing the output voltage waveform and the V_{out} vs V_{in} characteristics for a 1 kHz sinusoidal input voltage.
2. Designing a diode-based Bridge Rectifier and simulating it for a 12V 50Hz input voltage, hence obtaining the V_{out} vs V_{in} characteristics.

1.2 Methods

The method for both the parts included making the circuit diagram, writing the netlist for the circuit in a CIR file, writing the analysis command (`.tran`) and running it to obtain the plots asked for in the exercise. The first part involved constructing a shunt clipper, whose diagram was given in the handout. The netlist was based on that. The second part required us to construct a bridge rectifier on our own.

2 Design

2.1 Shunt Clipper

The NgSpice code was based on the diagram given in the handout, provided below. The netlist included the 1N914 diode, a 2V battery, a 1 kΩ resistor and input voltage (10V in this case). To obtain the V_{out} vs V_{in} characteristics, one could have done DC analysis but I chose to go for Transient analysis to obtain the output waveform V_{out} as well. The shunt clipper produces an output voltage which is a clipped version of the input voltage (clipped at 2+0.7 volts).

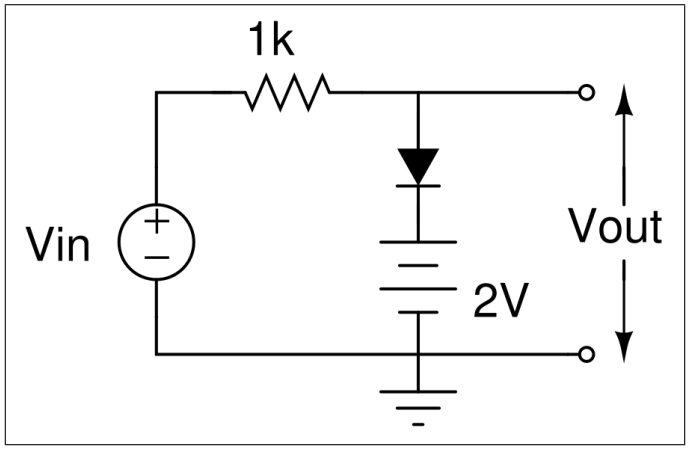
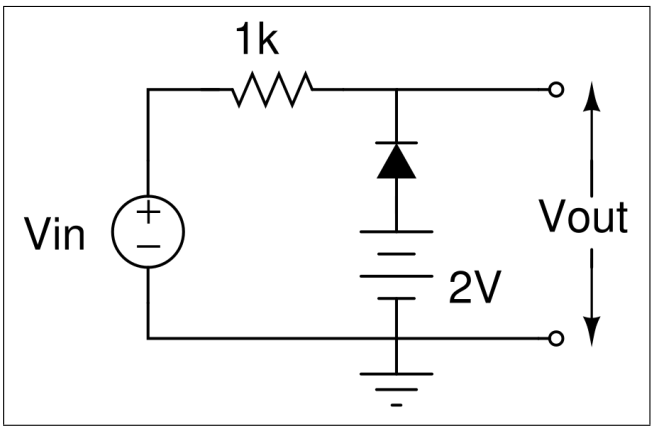
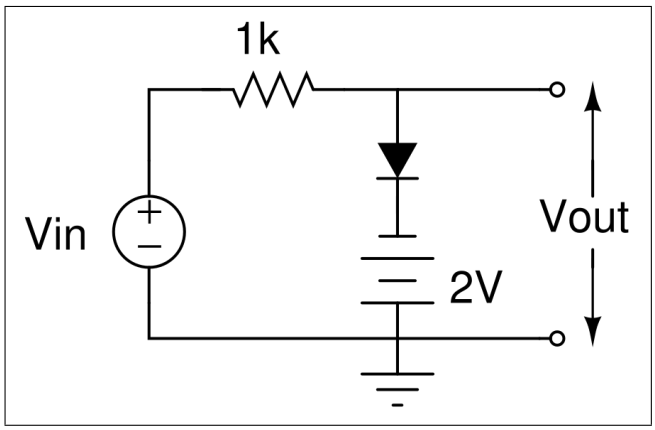


Figure 1: Shunt Clipper

In the first part, we reverse the diode polarity. The circuit clips at 2-0.7 volts. In the second part, we reverse the battery polarity. The circuit clips at -2-0.7 volts.



(a) Shunt Clipper with diode polarity reversed



(b) Shunt Clipper with battery polarity reversed

2.2 Bridge Rectifier

A bridge rectifier is used to obtain positive waves by converting the negative parts of the input wave to positive. The netlist included a resistor, input voltage (12V, 50Hz) and 4 diodes. Transient analysis was performed to obtain the V_{out} and V_{out} vs V_{in} waveforms.

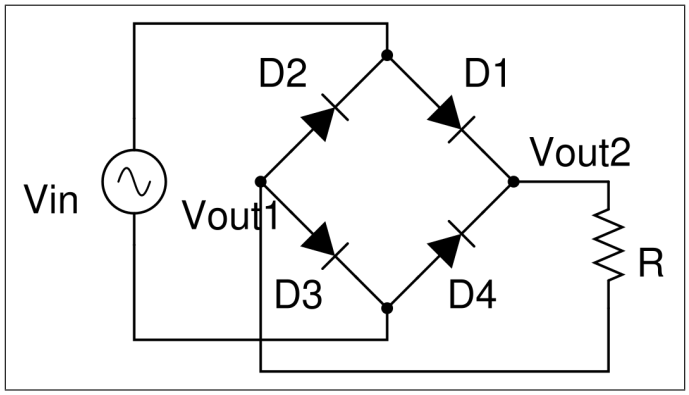


Figure 3: Bridge Rectifier

3 Simulation results

3.1 Code snippet

3.1.1 Shunt Clipper

```
Vinamra Baghel 190010070 Shunt Clipper
.include Diode_1N914.txt
Netlist
r1 in out 1k
D b out 1N914
Vb b gnd 2
Vin in gnd sin(0 10 1k 0 0 0)
Analysis
.tran 1u 6m
Control
.control
run
plot V(out) vs V(in)
.endc
.end
```

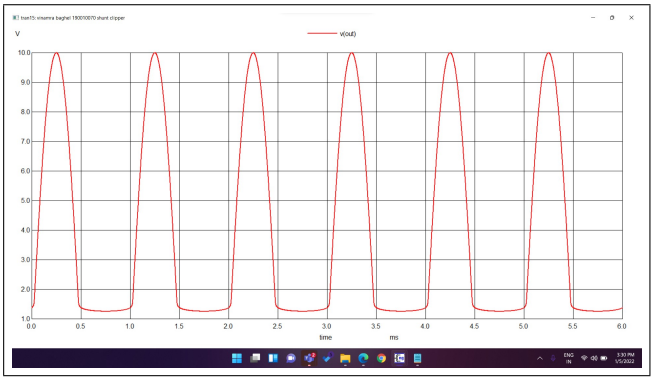
3.1.2 Bridge Rectifier

```
Vinamra Baghel 190010070 Bridge Rectifier
.include Diode_1N914.txt
Netlist
rl out1 out2 1k
D1 in out2 1N914
D2 out1 in 1N914
D3 out1 gnd 1N914
D4 gnd out2 1N914
Vin in gnd sin(0 12 50 0 0 0)
Analysis
.tran 1u 60m
Control
.control
run
plot V(out2) - V(out1) vs V(in)
.endc
.end
```

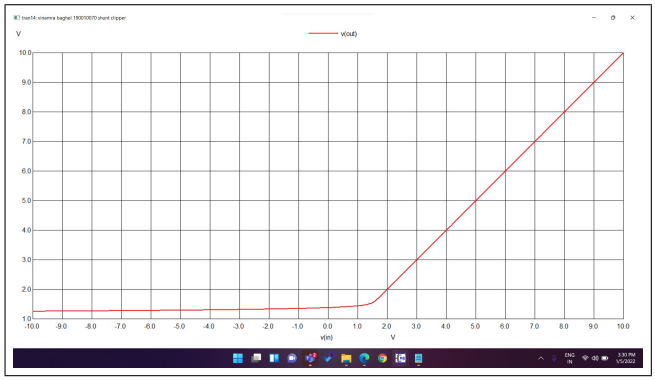
3.2 Simulation results

3.2.1 Shunt Clipper

The first part required us to reverse the diode polarity while the second part required us to reverse the battery polarity. The plots obtained are as follow.

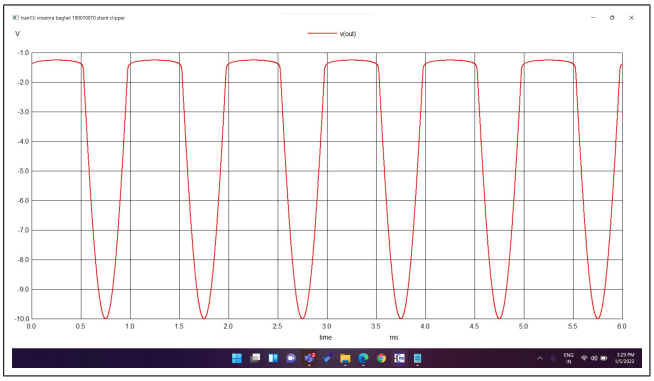


(a) V_{out} vs t

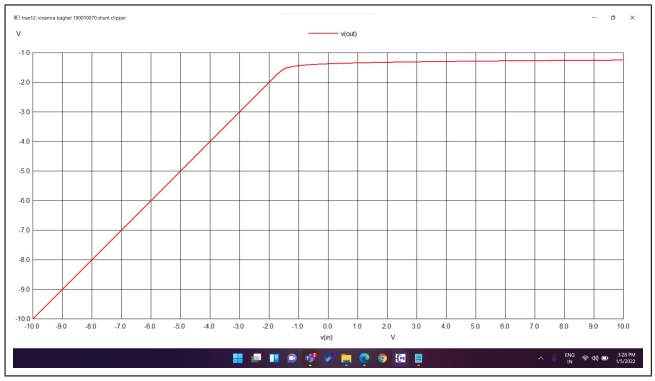


(b) V_{out} vs V_{in}

Figure 4: Shunt Clipper with diode polarity reversed



(a) V_{out} vs t

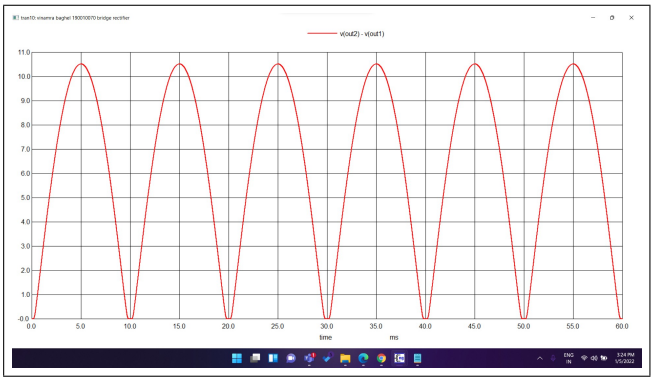


(b) V_{out} vs V_{in}

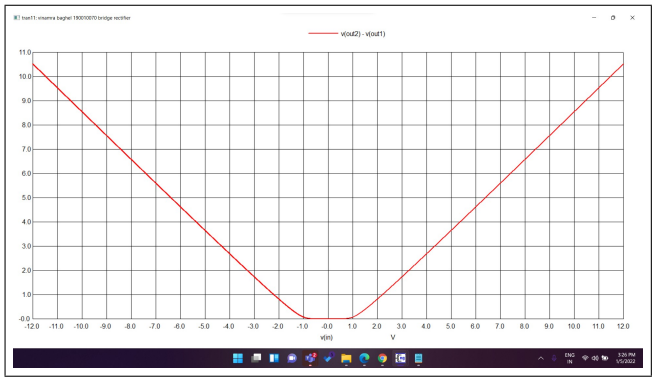
Figure 5: Shunt Clipper with battery polarity reversed

3.2.2 Bridge Rectifier

We were required to plot and simulate a diode-based bridge rectifier. The plots are as follow.



(a) V_{out} vs t



(b) V_{out} vs V_{in}

Figure 6: Bridge Rectifier

4 Experiment completion status

I could complete both the exercises given in the lab. There was no hardware involvement as it was all simulation based. The results were shown to the TA and then submitted.