EE236: Experiment No. 0
NGSPICE - Usage and Examples

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1 Overview of the experiment

1.1 Aim of the experiment

Aim of this experiment is to get familiar with NGSpice for simulation purposes and XCircuit for design purposes.
To simulate basic electrical circuits like a Shunt Clipper and Diode-based Bridge Rectifier and plot the transient response as well as the transfer characteristics.

1.2 Methods

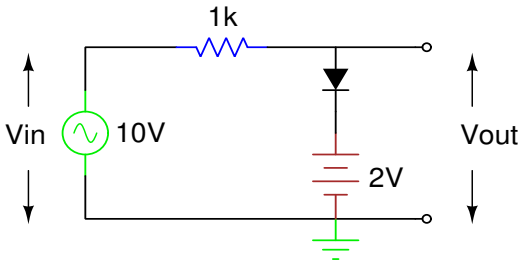
First, I simulated all 3 examples given in the lab sheet with their code snippets to get adjusted with NGSpice. Then for the exercises, I analysed both the Shunt Clipper and Bridge Rectifier circuits and how they will behave in the given cases. Then, I wrote the netlists for all the given cases. For Shunt Clipper, I applied 10V, 1kHz sin wave as input and did transient analysis for 10msec. For Bridge Rectifier, I ran the transient analysis for 100msec.

2 Design

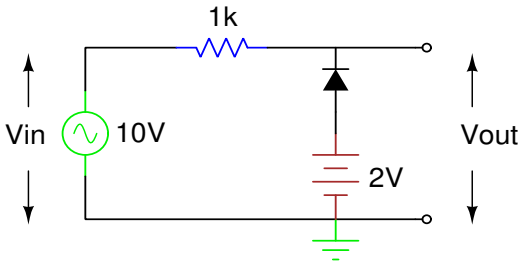
1) Shunt Clipper
In this circuit, we have to alter the terminals of a) Diode and b) 2V Battery. So, it will make 4 combinations.
A) Both have original polarities.

B) Diode has reverse polarity.
C) Battery has reverse polarity.
D) Both have reverse polarities.

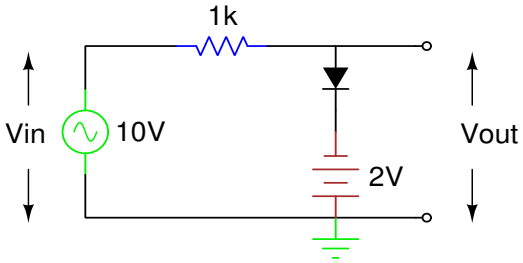
Case A)



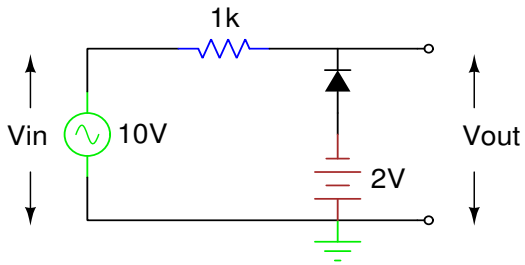
Case B)



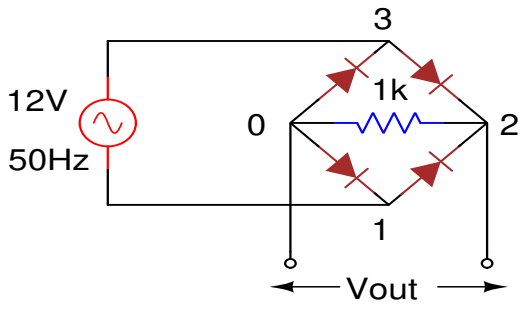
Case C)



Case D)



2) Diode-based Bridge Rectifier



3 Simulation results

3.1 Code snippet

1) Shunt Clipper

```
Mayur Ware | 19D070070
*EE236 | Lab 0 | Exercise 1 (d)
*Shunt Clipper DC analysis with reversed polarities
*Including Diode model file
.include Diode_1N914.txt
R1 1 2 1k
*Specifying a default diode p n
D1 3 2 1N914
*Independent DC source of 2V
Vdc 0 3 dc 2
*Independent DC source whose voltage is to be varied
```

```
Vin 1 0 sin(0 10v 1k 0 0)
*Transient Analysis
.tran 0.02ms 10ms
.control
run
set color0 = white
set color1 = black
set color2 = blue
set color3 = red
set xbrushwidth = 2
*Vin vs Vout plot
plot V(2) vs V(1)
*Vin and Vout plot
plot V(2) V(1)
.endc
.end
```

2) Diode-based Bridge Rectifier

```
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*EE236 | Lab 0 | Exercise 2
*Bridge Rectifier analysis
*Including Diode model file
.include Diode_1N914.txt
*Bridge Rectifier
D1 1 2 1N914
D2 0 1 1N914
D3 3 2 1N914
D4 0 3 1N914
*Load Resistor
R1 2 0 1k
*Input Voltages
Vin 1 3 sin(0 12 50 0 0)
*Transient Analysis
.tran 10u 100m
*Control Commands
.control
run
set color0 = white
set color1 = black
```
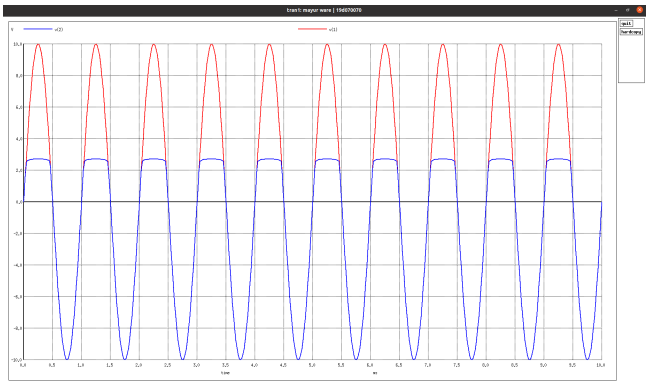
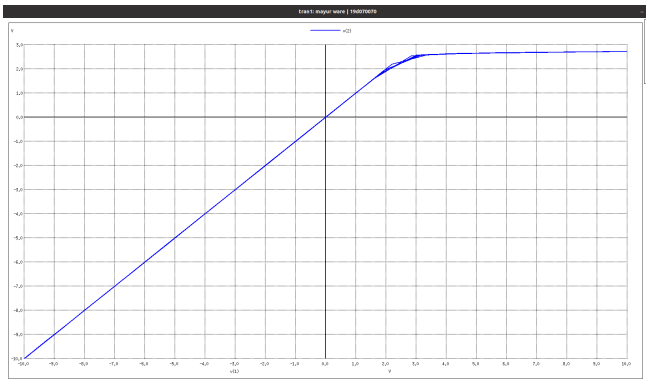

```
set color2 = blue
set color3 = red
set xbrushwidth = 2
let V_input = V(1) - V(3)
plot V(2) V_input
plot V(2) vs V_input
.endc
.end
```

3.2 Simulation results

1) Shunt Clipper
Case A)



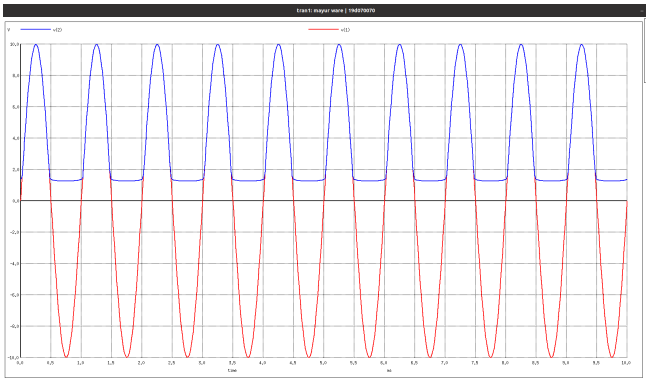
Transient Response



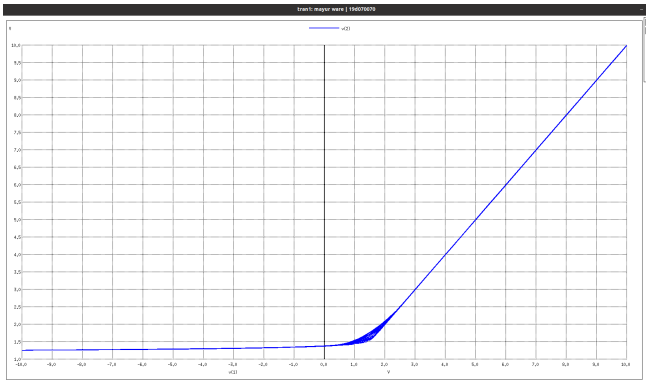
Transfer Characteristics

In Case A, when the polarities of battery as well as diode are unchanged, we can notice from the graphs that, the diode is becoming forward biased at +2.7V (2V + barrier potential) and hence the waveforms are clipping at +2.7V.

Case B)



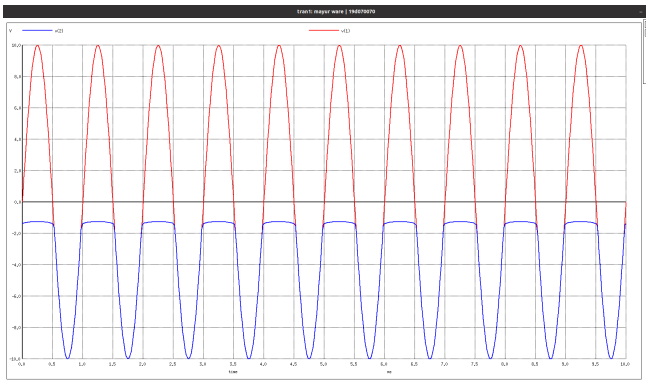
Transient Response



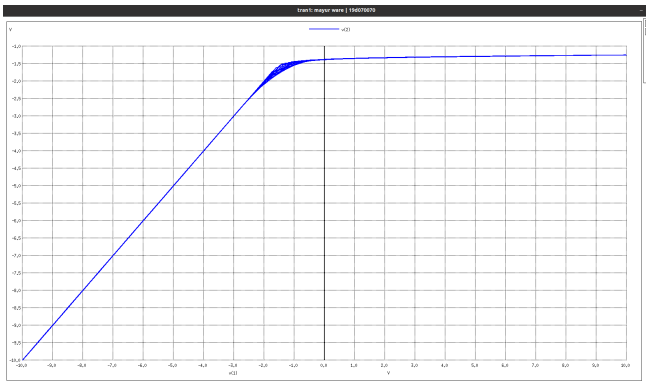
Transfer Characteristics

In Case B, when the polarity of diode is reversed, the circuit is clipping at +1.3V (2V - barrier potential) because the diode will become reverse biased at voltages above +1.3V.

Case C)



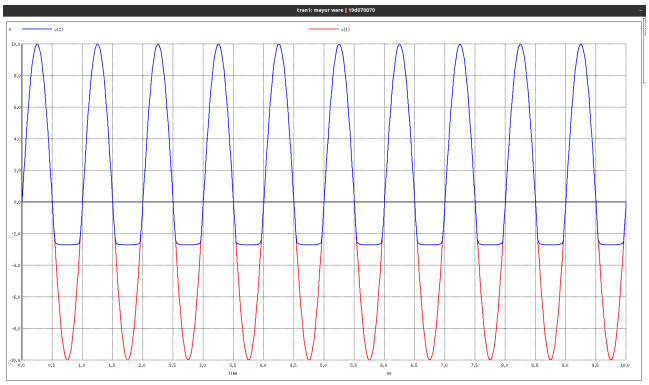
Transient Response



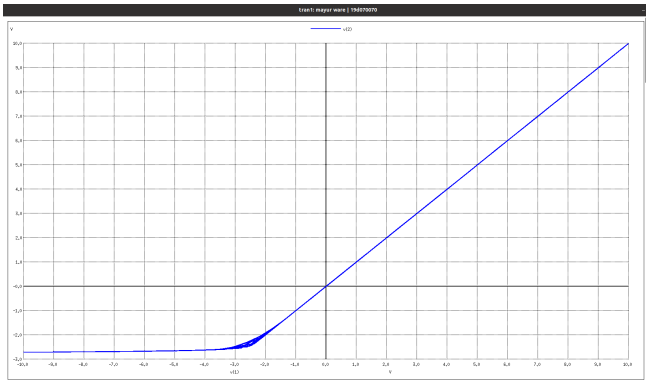
Transfer Characteristics

In Case C, the polarity of battery is reversed. The circuit is clipping at -1.3V (-2V + barrier potential) because diode is becoming forward biased at voltages above -1.3V.

Case D)



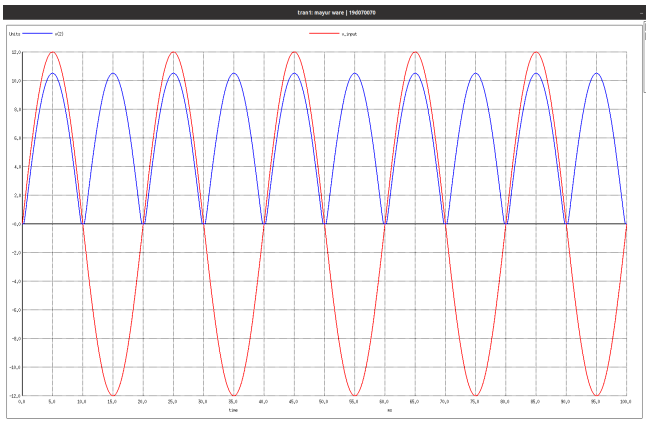
Transient Response



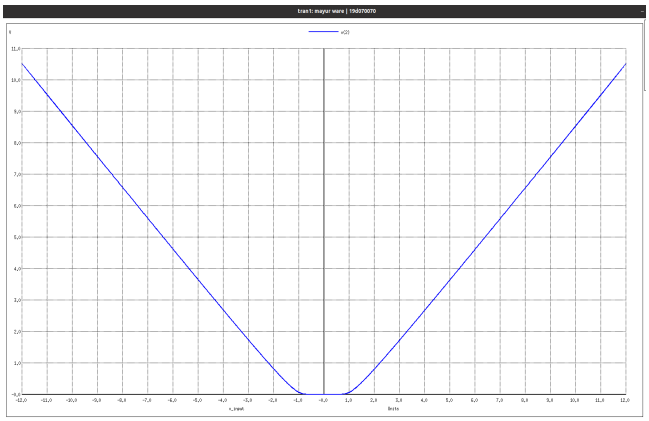
Transfer Characteristics

In Case D, polarities of both are altered. The circuit is clipping at -2.7V (-2V + barrier potential) because diode will become forward bias for voltages below -2.7V.

2) Diode-based Bridge Rectifier



Transient Response



Transfer Characteristics

For the positive half cycle, the current will flow from 3>2>0>1. Whereas, for the negative half cycle, the current will flow from 1>2>0>3.
Difference between input and output peaks is due to the diode non-idealities.

4 Experimental results

This section is not applicable for this experiment.

5 Experiment completion status

I have completed all sections as well as exercises in this lab.

6 Questions for reflection

This section is not applicable for this experiment.