EE230: Lab 3.
Precision Rectifiers

Rohan Rajesh Kalbag, 20D170033

January 29, 2022

1 Overview of the experiment

1.1 Aim of the experiment

To simulate half-wave and full-wave precision rectifiers using NGSPICE and plot the output waveforms for sinusoidal input signals and comparison of the simulated outputs and experimental outputs

1.2 Methods

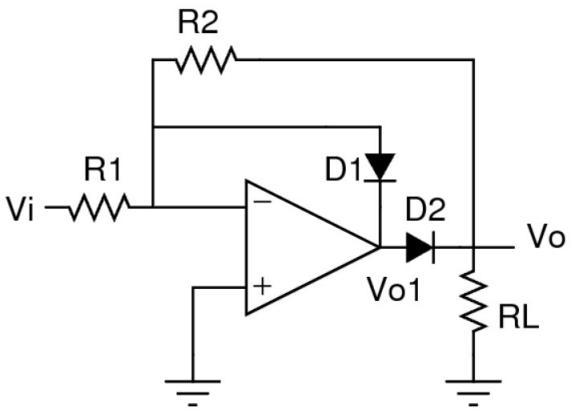
The netlists for half wave precision rectifier-A, half wave precision rectifier-B and full wave precision rectifier were made in NGSPICE.

Subcircuits for 1N914 diode and UA741 operational amplifier were directly used in the netlists. The half wave precision rectifier-B subcircuit was used to make the full precision rectifier.

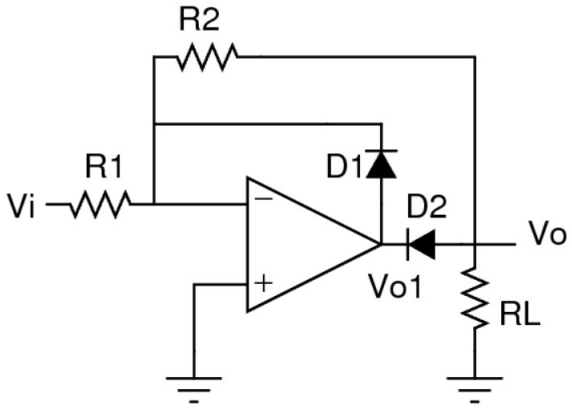
Plots for various waveforms were made as per the handout. Then these plots were compared with the experimental plots that were provided along with the handout

2 Design

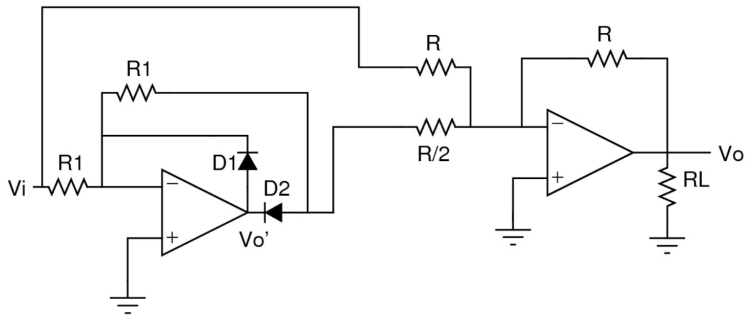
2.1 Circuit Diagrams



Half Wave Precision Rectifier - A



Half Wave Precision Rectifier - B



Full Wave Precision Rectifier

3 Simulation results

3.1 Code snippets

3.1.1 Half Wave Precision Rectifier - A

```
Half Wave Precision Rectifier-A
*Rohan Rajesh Kalbag - 20D170033

.include ua741.txt
.include Diode_1N914.txt

v1 2 0 dc 15
v2 3 0 dc -15
x1 0 1 2 3 4 ua741
d1 1 4 1N914
d2 4 6 1N914
vi 5 0 sin(0 5 1k 0 0 0)
r1 5 1 10k
r2 1 6 10k
rl 6 0 1k

.tran 1ms 10ms
.control
run
plot v(6) v(4) v(5)
.endc
.end
```

3.1.2 Half Wave Precision Rectifier - B

```
Half Wave Precision Rectifier-B
*Rohan Rajesh Kalbag - 20D170033

.include ua741.txt
.include Diode_1N914.txt

v1 2 0 dc 15
v2 3 0 dc -15
x1 0 1 2 3 4 ua741
d1 4 1 1N914
d2 6 4 1N914
vi 5 0 sin(0 5 1k 0 0 0)
r1 5 1 10k
r2 1 6 10k
rl 6 0 1k

.tran 1ms 10ms
.control
run
plot v(6) v(4) v(5)
.endc
.end
```

3.1.3 Full Wave Precision Rectifier

```
Full Wave Precision Rectifier
*Rohan Rajesh Kalbag - 20D170033

.include ua741.txt
.include Diode_1N914.txt

v1 2 0 dc 15
v2 3 0 dc -15
vi 5 0 sin(0 5 1k 0 0 0)

*half-wave-precision-rectifier

.subckt HWPR 1 2 3 4 5 6 7
x1 1 2 3 4 5 ua741
d1 5 2 1N914
d2 7 5 1N914
r1 6 2 10k
r2 2 7 10k
.include ua741.txt
.include Diode_1N914.txt
.ends

*inverting summer
x3 0 1 2 3 4 5 6 HWPR
r3 5 8 10k
r4 6 8 5k
x2 0 8 2 3 9 ua741
r5 8 9 10k
rl 9 0 1k

.tran 1ms 10ms
.control
run
plot v(9) v(5)
.endc
.end
```

3.2 Simulation Results

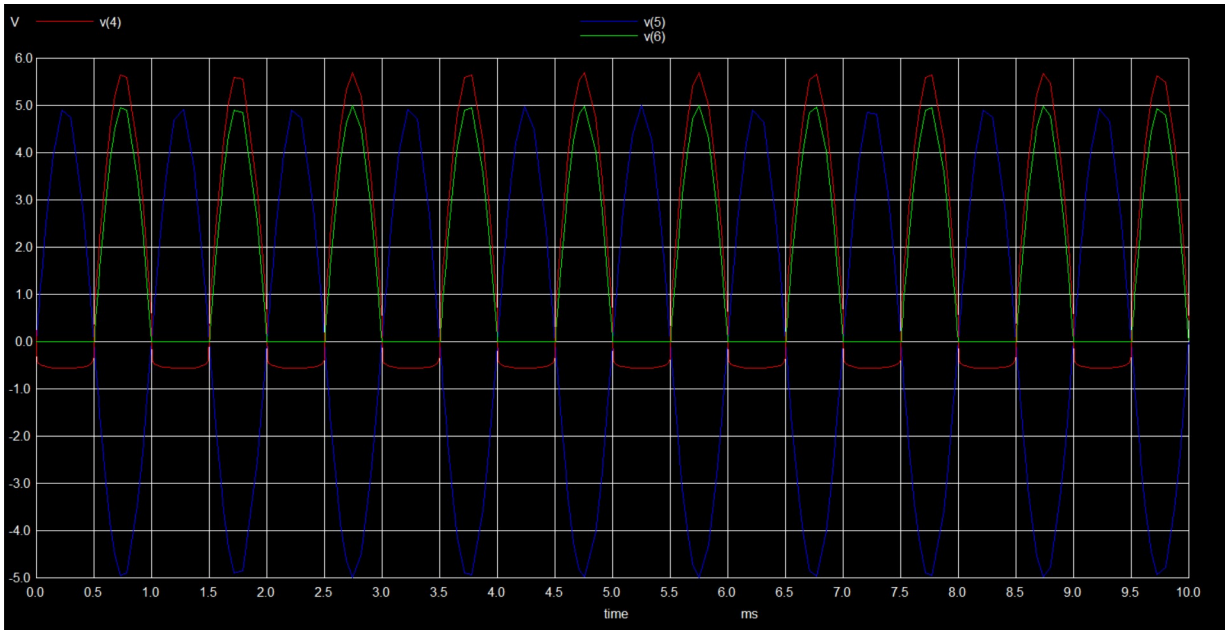


Fig 1.1
Output and Input waveform for Half Wave Precision Rectifier-A
v(4): V_{o1}, v(6): Output Voltage V_o, v(5): Input Voltage V_i

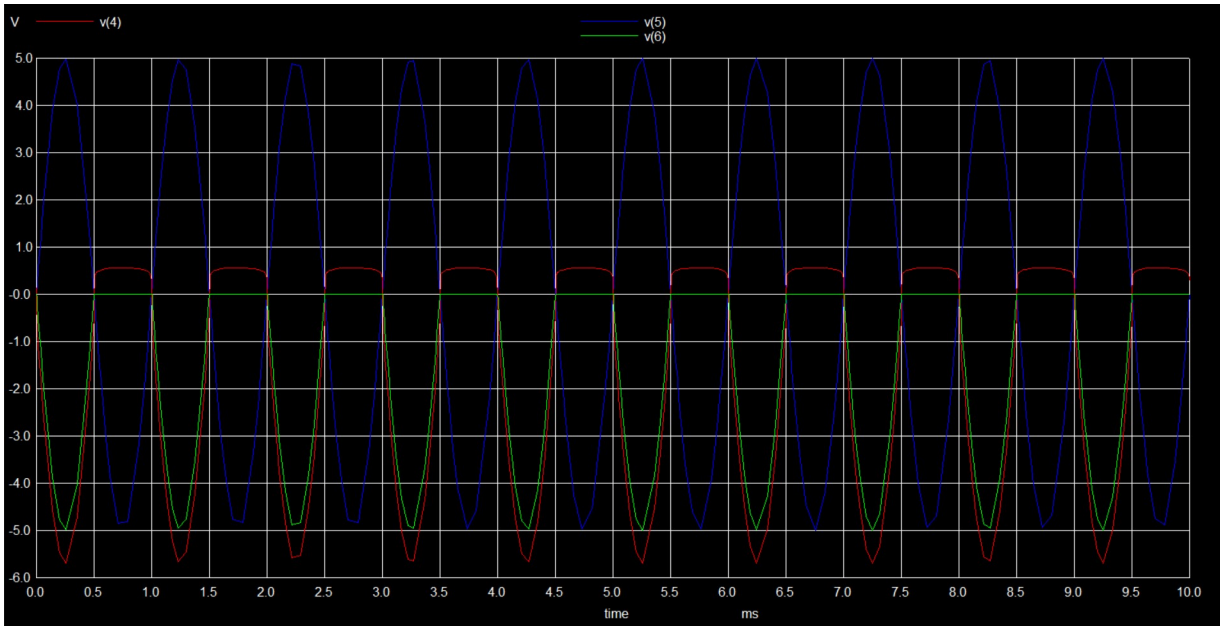


Fig 1.2
Output and Input waveform for Half Wave Precision Rectifier-B
v(4): V_{o1}, v(6): Output Voltage V_o, v(5): Input Voltage V_i

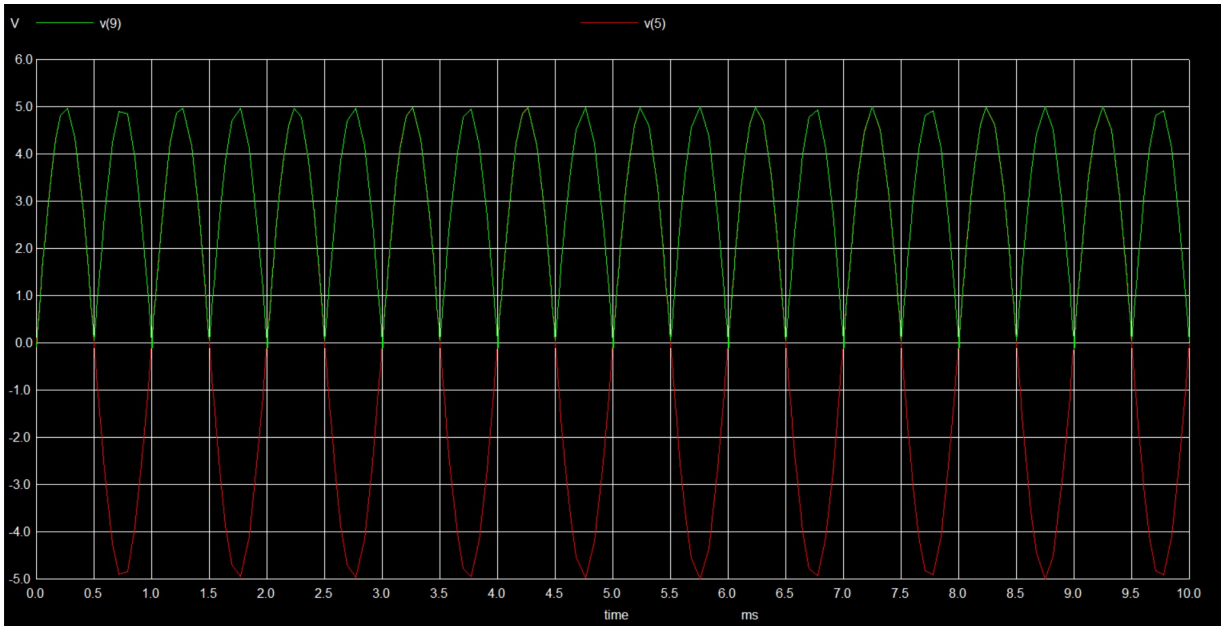


Fig 1.3
Output and Input waveform for Full Wave Precision Rectifier
v(9): Output Voltage V_o, v(5): Input Voltage V_i

4 Experimental results

The plots of the output waveform V_{out} obtained from the simulation of the two half wave rectifiers and the full wave rectifier match the experimental plots that were shared in the handout.

A half rectified wave of the positive cycle is obtained for the A configuration and the output waveform is zero for the negative cycle.

A half rectified wave of the negative cycle is obtained for the B configuration and the output waveform is zero for the positive cycle.

A completely rectified wave is obtained for the full wave rectifier which is periodic with frequency two times the original frequency.