Faculty of Engineering & Technology Electrical & Computer Engineering Department

ENEE2103

CIRCUITS AND ELECTRONICS LABORATORY

Prelab III

Name and ID : **Raghad Afaghani - 1192423**

Section : **2**

Instructor : **Dr. Mohammad Al Ju'beh**

Teacher Assistant : **Eng. Bilal Ismail**

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Part 1: Diode Characteristics

The figure below shows the diode Circuit in PSPICE, where the resistor R1 is assigned a value of 100 Ω, and the DC voltage source spans the range of [0, 3].

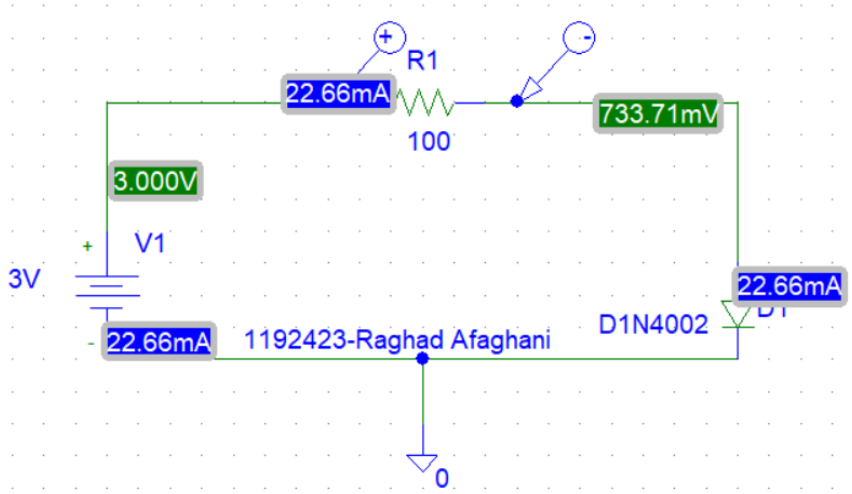


Figure 1.1: RD series circuit implementation

The table presented below records the voltages across the circuit components (VR, VD) and the current on the diode ID with voltage range [0, 3] .

Table1: Diode Circuit Data

VS	VR	VD	ID
0	0	0	0
0.2	68.415uV	199.93mV	684.15nA
0.4	3.23mV	396.77mV	32.27uA
0.6	56.46mV	543.54mV	564.59uA
0.8	193.3mV	606.72mV	1.933mA
1	361.16mV	638.84mV	3.612mA
1.5	819mV	681mV	8.19mA
2	1.295V	704.68mV	12.95mA
2.5	1.779V	721.12mV	17.79mA
3	2.66V	733.71mV	22.66mA

▪ When reverse the diode:

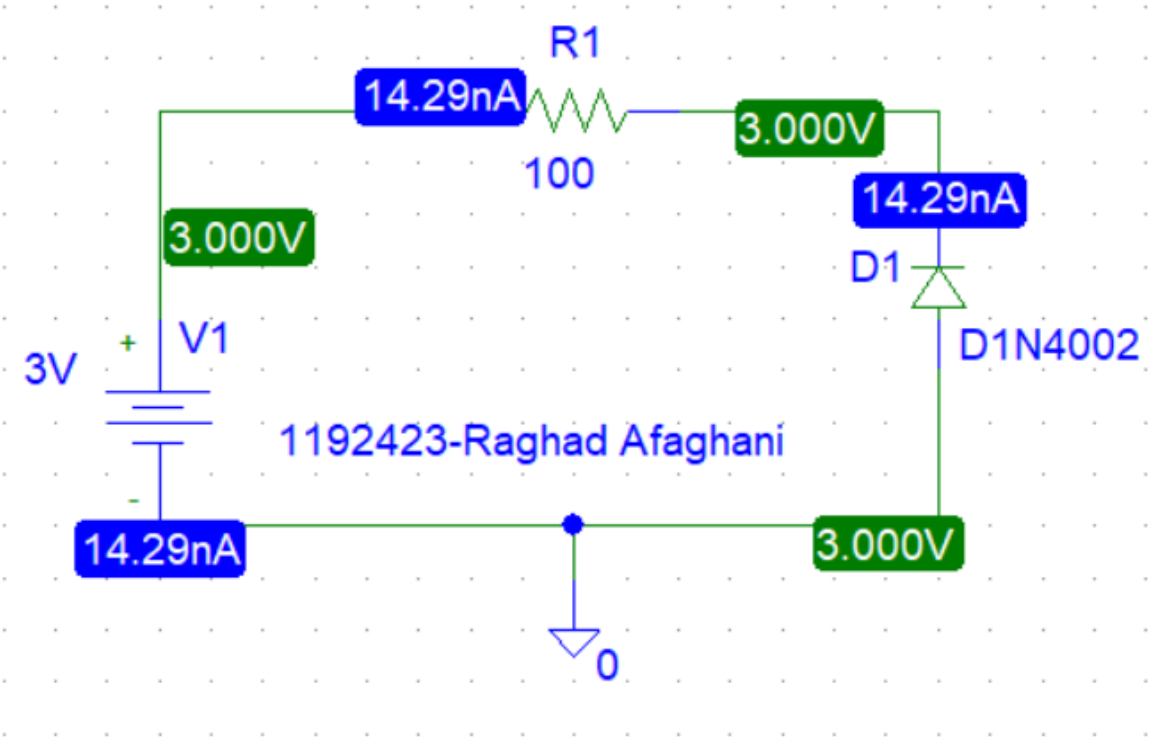


Figure 1.2: Reverse diode circuit in PSPICE

Based on the previous two circuits, it is evident that a diode with two terminals (anode and cathode) only conducts current when the anode's voltage is greater than that of the cathode. When the diode is forward-biased (with the anode connected to the positive terminal of the voltage source), it behaves like a voltage source with a voltage of approximately 0.7 volts, as shown in table 1. However, when the diode is reverse-biased at any applied voltage, the current is almost zero, and the voltage across the diode remains equal to the input voltage. Therefore, the diode acts as an open circuit, and the voltage across the resistor is also almost zero, as shown in figure 1.2.

Part 2: Rectification

A. Half wave rectifier

The half wave recitation circuit in PSPICE.

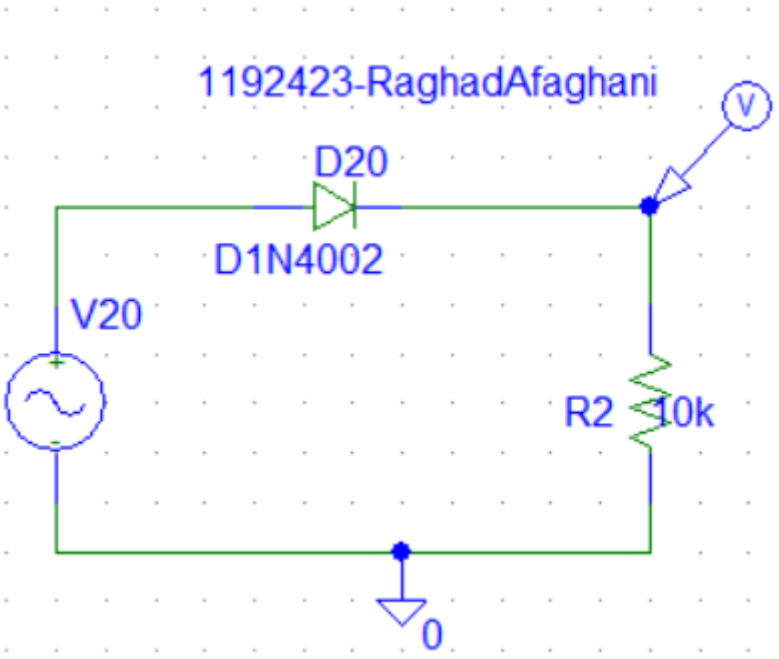
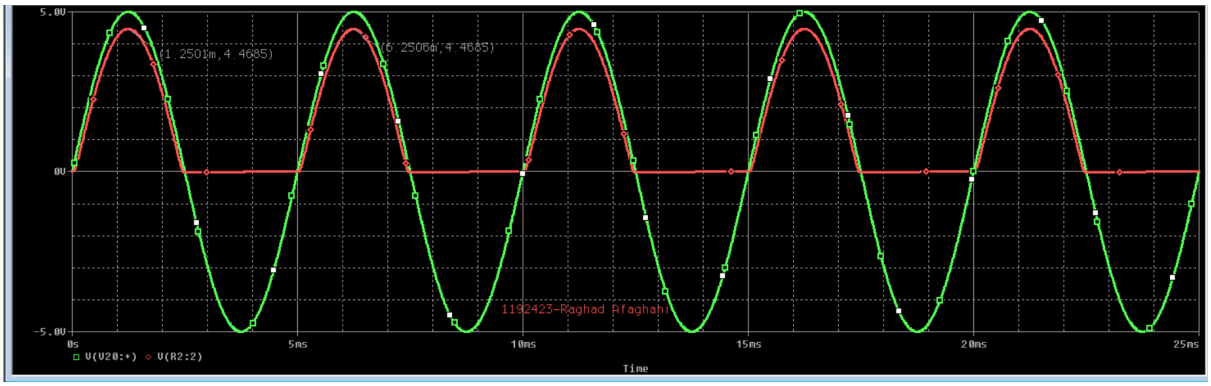


Figure 1.3: Half wave rectifier circuit forward diode

Given a frequency of 200 Hz, each wave takes 1/200 seconds, which is equivalent to 5 milliseconds. Therefore, 5 cycles of the wave, as depicted in the Vo plot below, would require 25 milliseconds.



The peak voltage value Vpk is measured to be 4.4684 volts. The time period T is calculated as 5.005 milliseconds, which is the difference between 6.2506 milliseconds and 1.2501 milliseconds.

DC value = Vpk/ π = 1.41v.
The diode is reversed as shown in Figure 1.4.

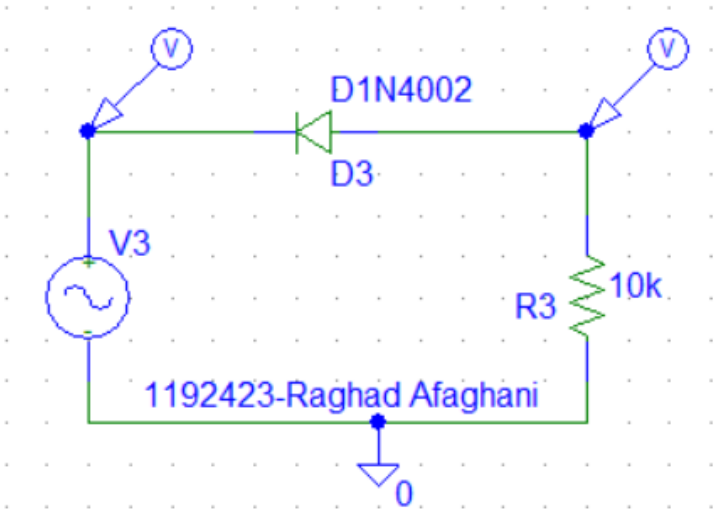
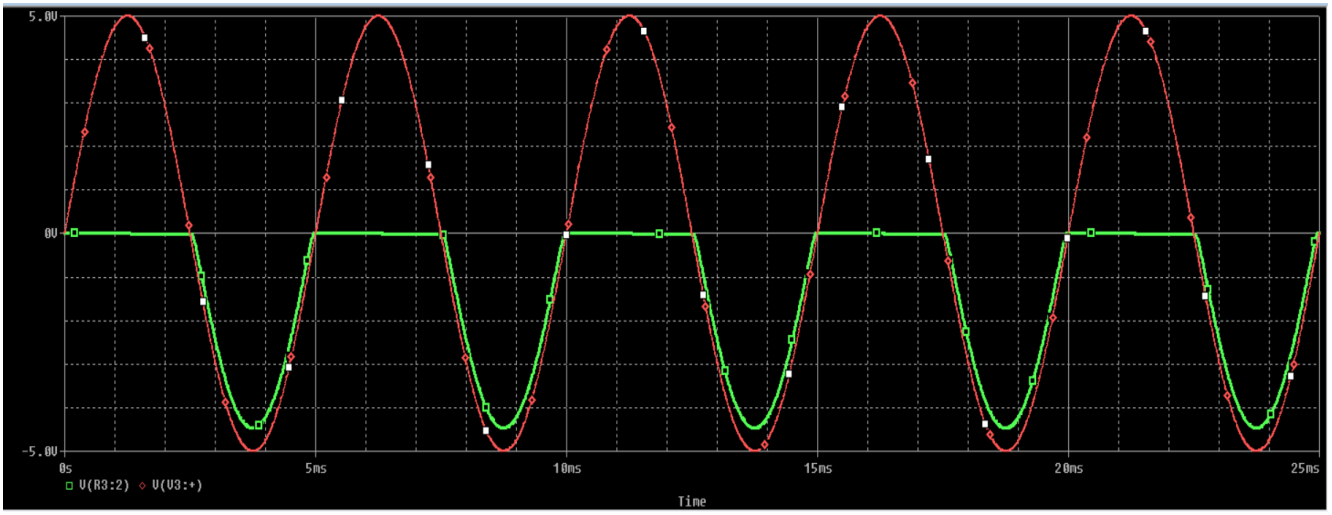


Figure 1.4: Half wave rectifier circuit reverse diode

The Output voltage is :



A capacitor with a capacitance of 2.2 uF is now introduced, as illustrated in the following figure.

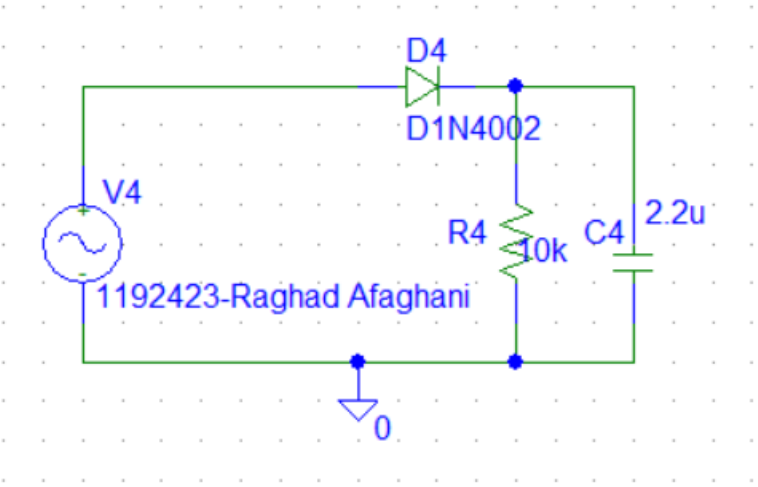
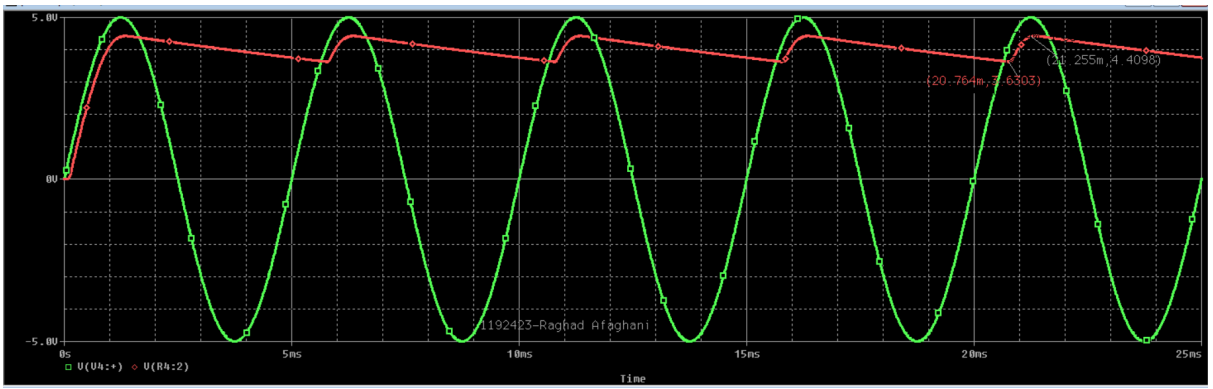
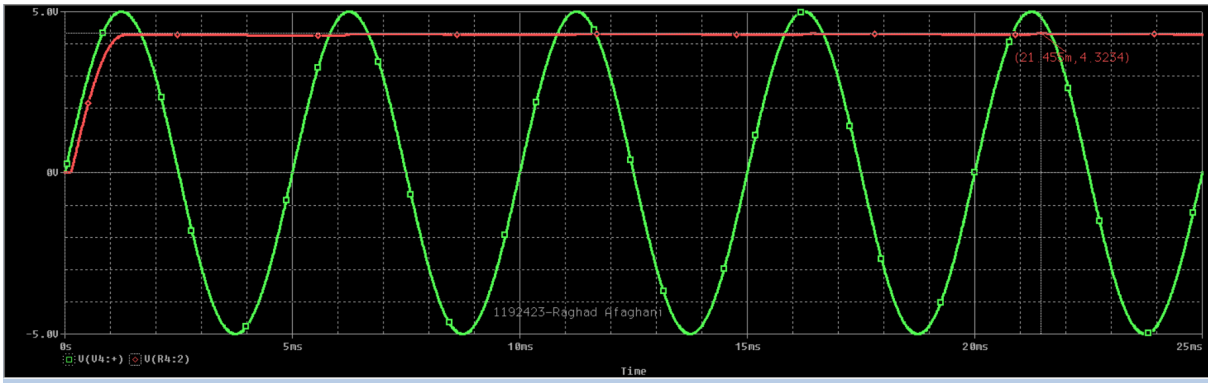


Figure 1.5: Half wave rectifier circuit with capacitor



- Peak to peak voltage = 4.4098 – 3.6303 = 0.7795v(the difference between the maximum voltage and the minimum voltage) .
- The DC voltage value =(4.4098+ 3.6308)/2 is obtained by taking the average of the maximum and minimum voltage values, which yields 4.0203 volts.

The rectifier output voltage graph after changing the capacitance to 47uF.



Vdc = 4.3234v.

B. Full wave rectifier

The full wave recitation circuit in PSPICE.

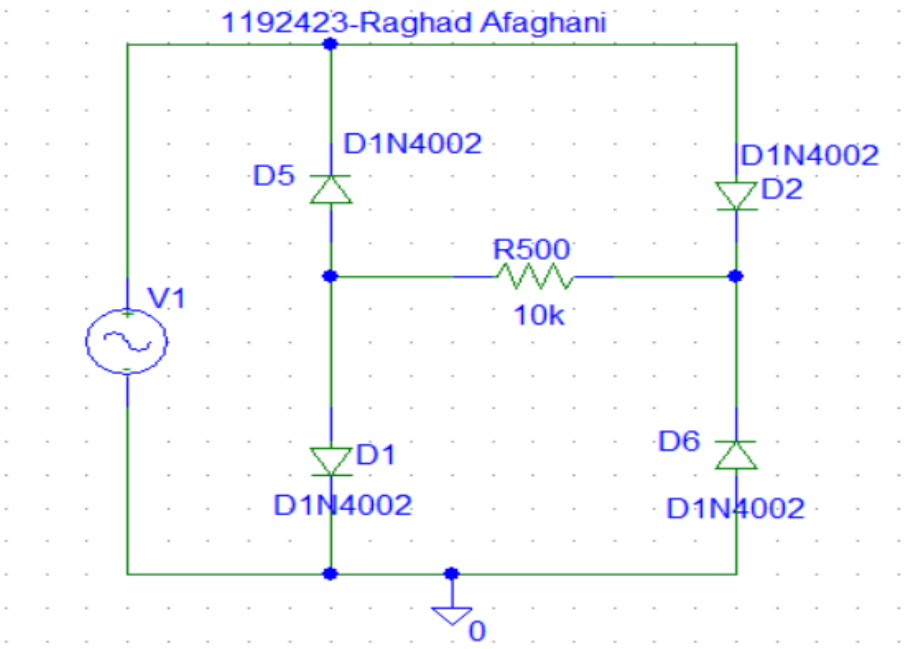
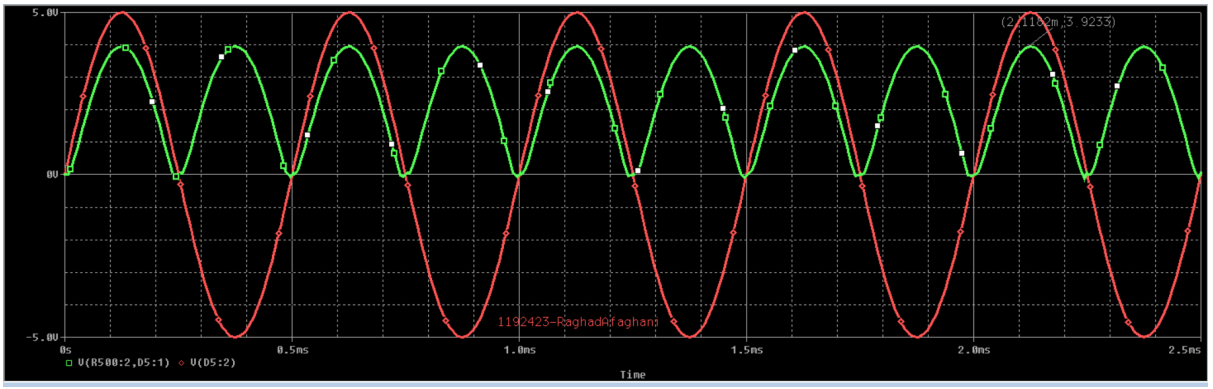


Figure 1.6: Full-wave rectifier Pspice

The graph of the output voltage is in the figure below.



T = 1 / f = 1/2000 = 0.5 ms
peak value Vpk (experimentally) = 3.9447v
dc value = Vpk/ π = 1.2562v

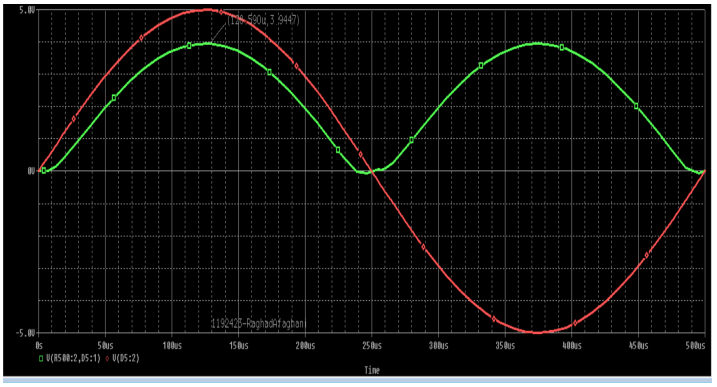


Figure 1.17 shows the full-wave circuit with a capacitor.

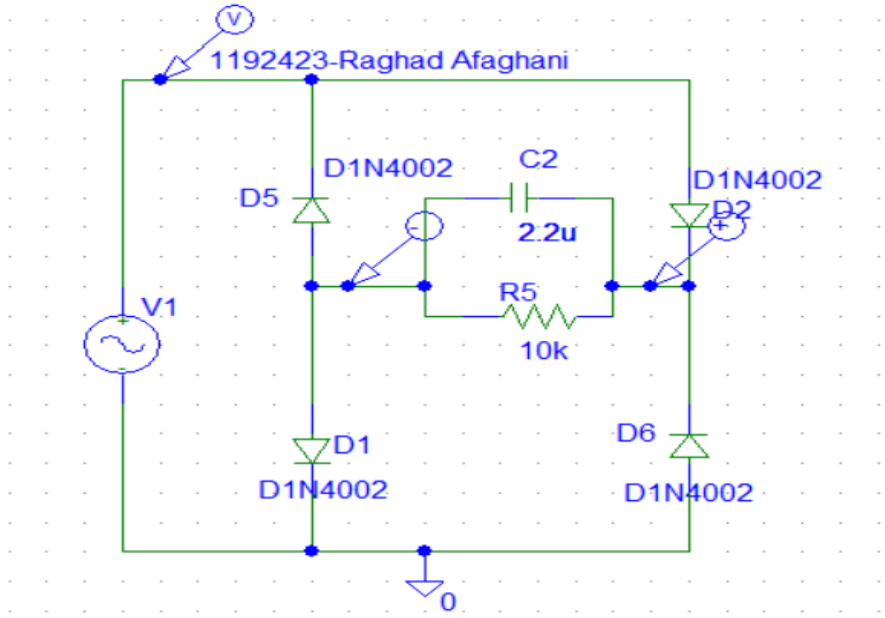
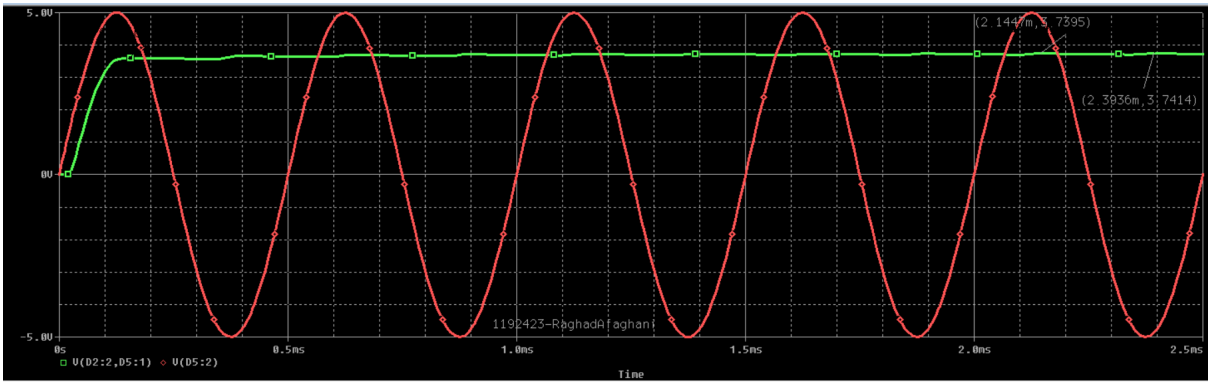


Figure 1.7:Full-Wave Rectification when adding the capacitor of 2.2 µF voltage response

The output voltage:



- Ripple peak = 3.7414 – 3.7395 = 0.0019v
- DC voltage = 3.74045

Part 3: Other Applications

A)Clipping

The clipper circuit is displayed in the figure below.

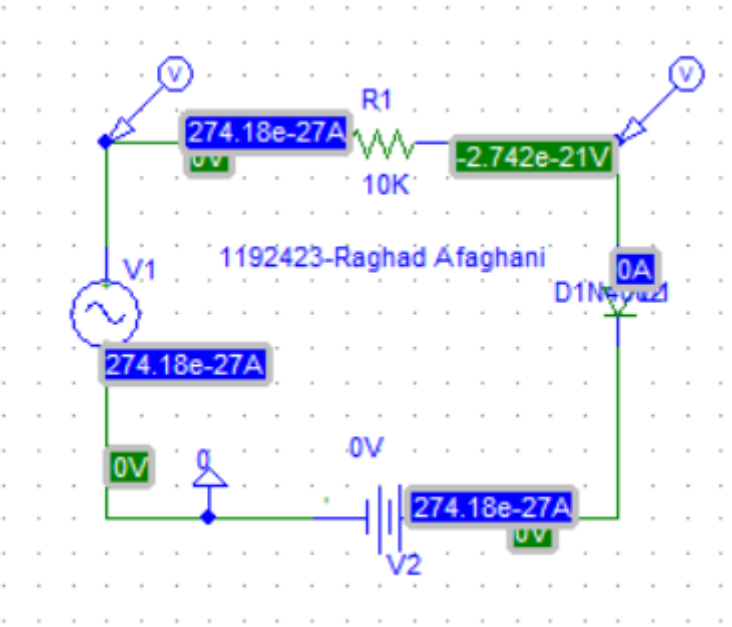
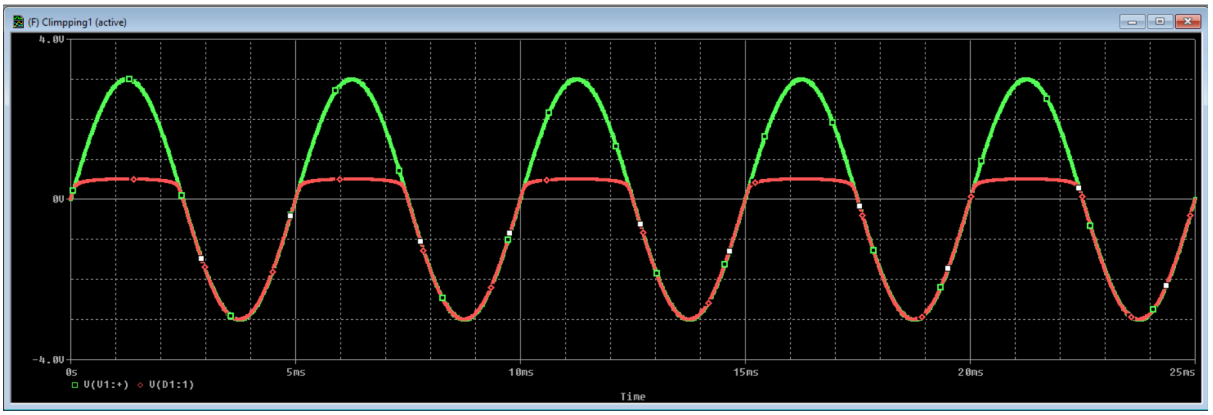
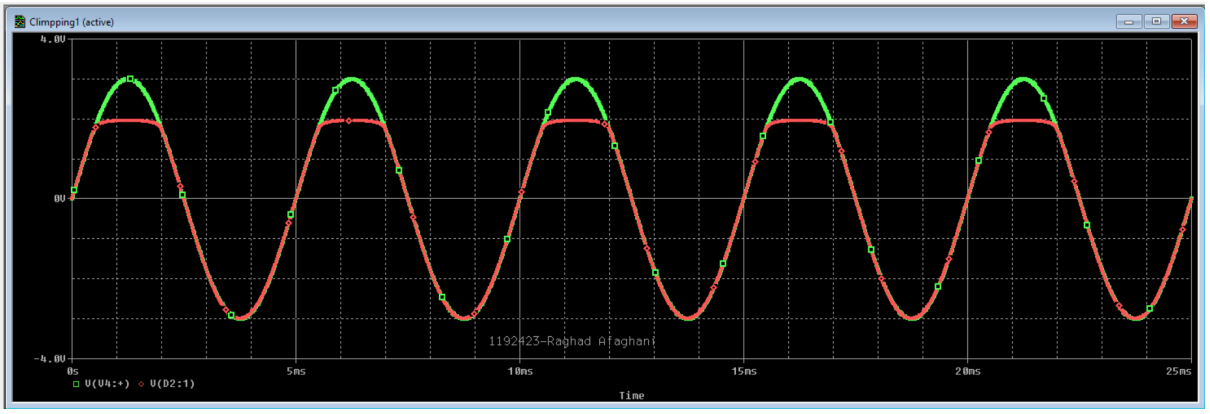
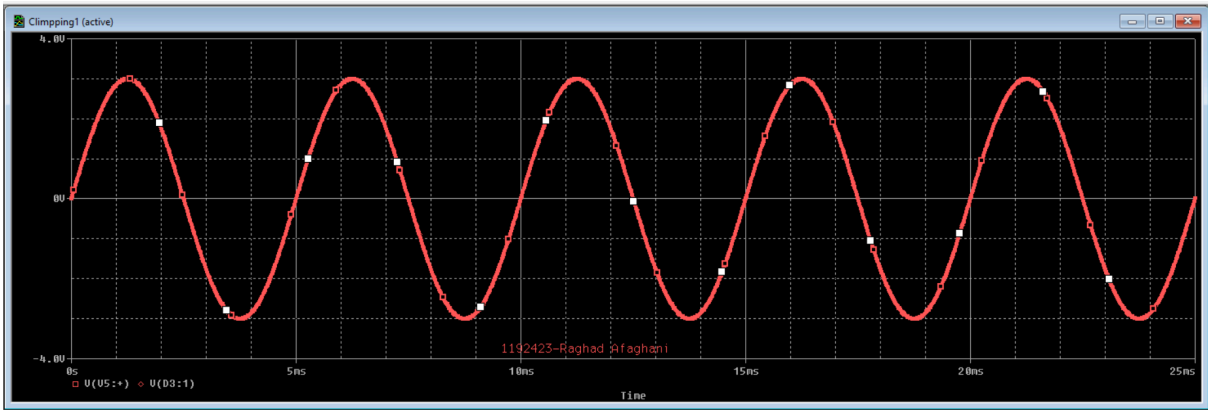


Figure 1.8:Clipping circuit implementation

The three graphs corresponding to the DC voltage values of 0 volts, 1.5 volts, and 3.5 volts are presented below in sequence.







Note that in the above simulation there are two identical graphs,This is because, given that the input voltage range is between -3 and 3 volts, it will always be lower than the DC voltage. As a result, the diode will behave as an open circuit, and the output voltage will be equal to the input voltage.

B)Clamping

The clamping circuit is displayed in the figure below.

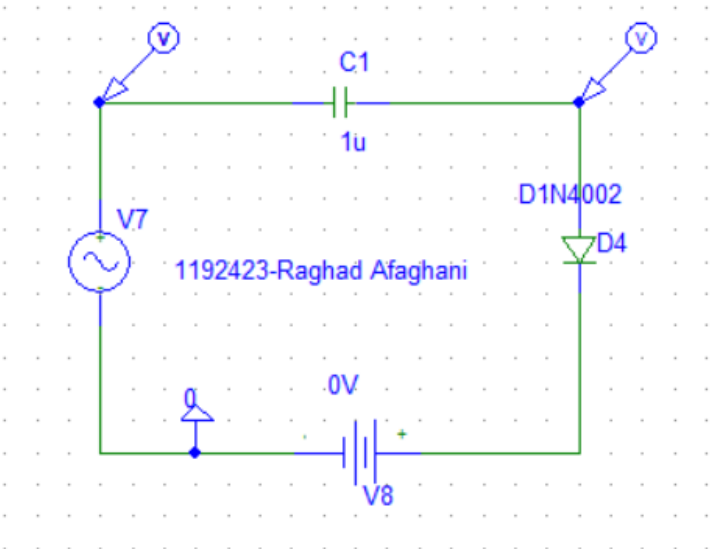
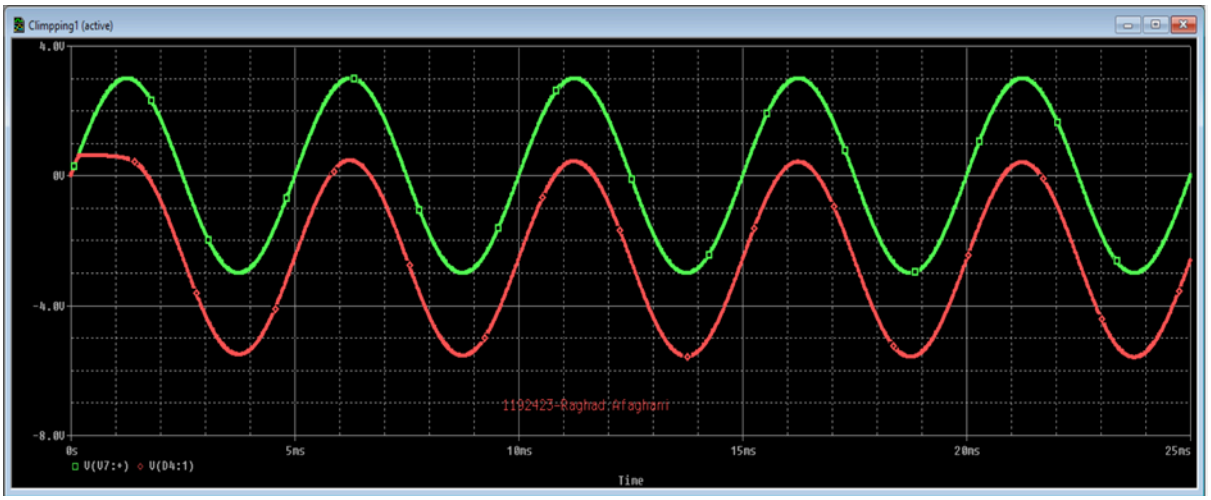
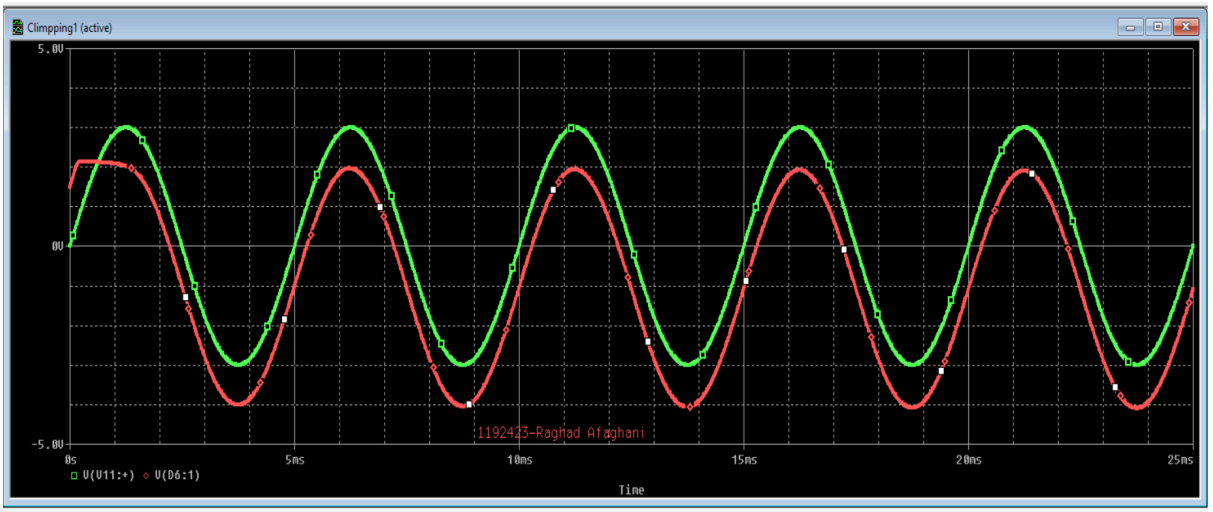
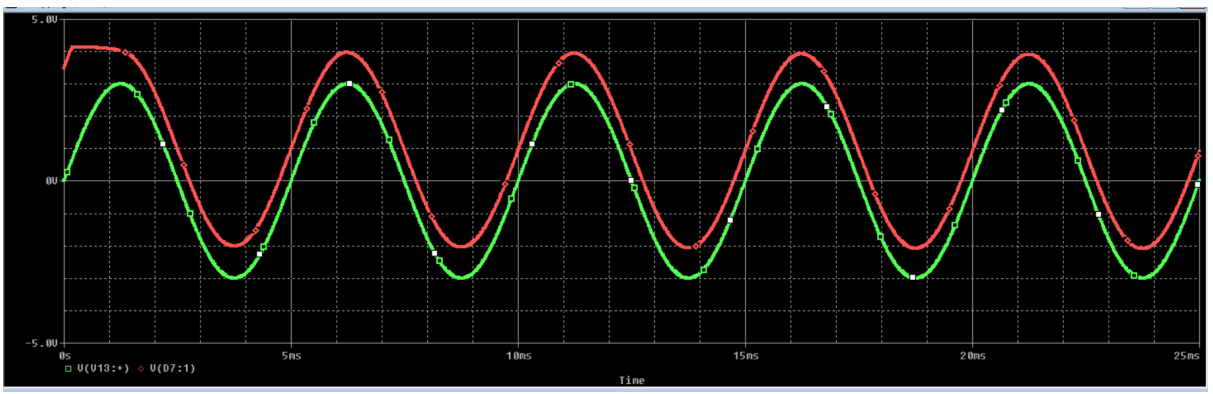


Figure 1.12:Clamping circuit implementation-with 0v

The three graphs corresponding to the DC voltage values of 0 volts, 1.5 volts, and 3.5 volts are presented below in sequence.

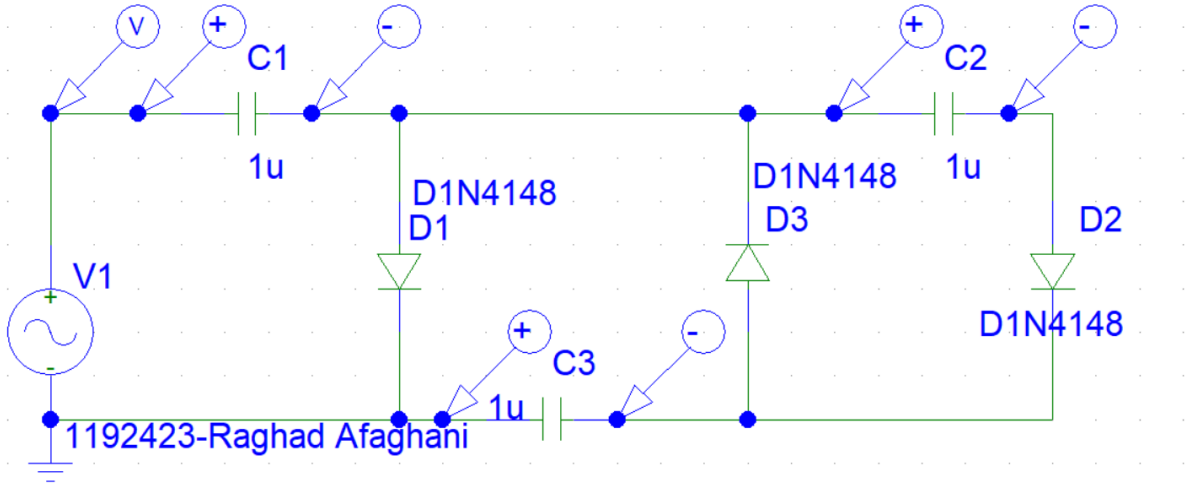




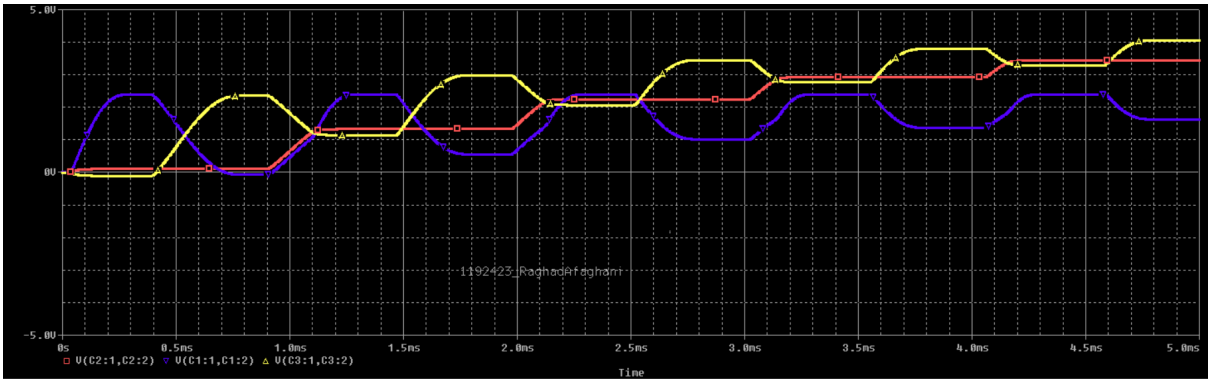


C)Voltage Multiplication Circuit

The figure shows the voltage multiplication circuit.



The figure below shows the plot of all the voltages of the capacitors.



The figure below shows the voltage of C1 + C2.