CME 2203 Lab 4 Pre-lab

Name-Surname : Çağrı AYDIN

Student Number: 2021510010

Section : 2

Subject : Diodes

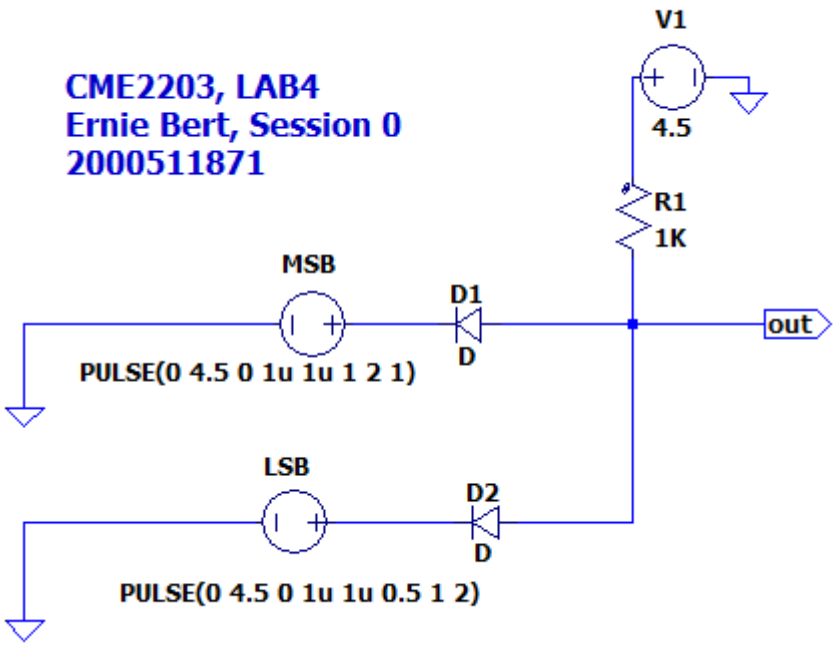
☞ Please read this document from start to finish carefully before starting your work.

☞ Prepare as a **PDF** including screenshot and simulation graph.

☞ Prelab must be prepared INDIVIDUALLY and uploaded to Sakai course page.

Draw the following circuit on LTSpice Schematics and save to a folder of your choice. Note that the screenshot we want is more than just the circuit; we want simulation graphs as well.

1. For your screenshot, top of the window should contain the graph plot panes, and the bottom of the window should contain:
    a. The circuit diagram



    b. The text label
2. Create the circuit schematic shown above. Note that we use **square pulses** to create all combinations of MSB and LSB. You can see the parameter values below the logic input voltage sources MSB and LSB. You can make both MSB and LSB provide **pulses for 4 cycles**.

3. Adjust the component values as follows:
    a. For V1 we can just assign a DC value of +4.5V.
    b. We want MSB and LSB to act as a switch we open and close periodically, so we want it to produce a square wave voltage pattern.
    c. To achieve this, right click on LSB and click Advanced. Select PULSE. Enter the parameters as follows (letter **u** works for microsecond):

        i. $V_{initial}$(V) : 0
        ii. V_{on}(V) : 4.5
        iii. T_{delay}(s) : 0
        iv. T_{rise}(μs) : 1u
        v. T_{fall}(μs) : 1u
        vi. T_{on}(s) :0.5
        vii. T_{period}(s) : 1
        viii. N_{cycles} :2

This setting creates a square wave with a period of 1s, and because it's on(+4.5V) at only 0.5s, so its DUTY CYCLE is 50%. It lasts for 2 cycles, so for (cycle no)x(period T) = 2x1 = 2 seconds.

    d. Now, right click on MSB and click Advanced. Select PULSE. Enter the parameters as follows (letter **u** works for microsecond):

        i. $V_{initial}$(V) : 0
        ii. V_{on}(V) : 4.5
        iii. T_{delay}(s) : 0
        iv. T_{rise}(μs) : 1u
        v. T_{fall}(μs) : 1u
        vi. T_{on}(s) : 1
        vii. T_{period}(s) : 2
        viii. N_{cycles} : 1

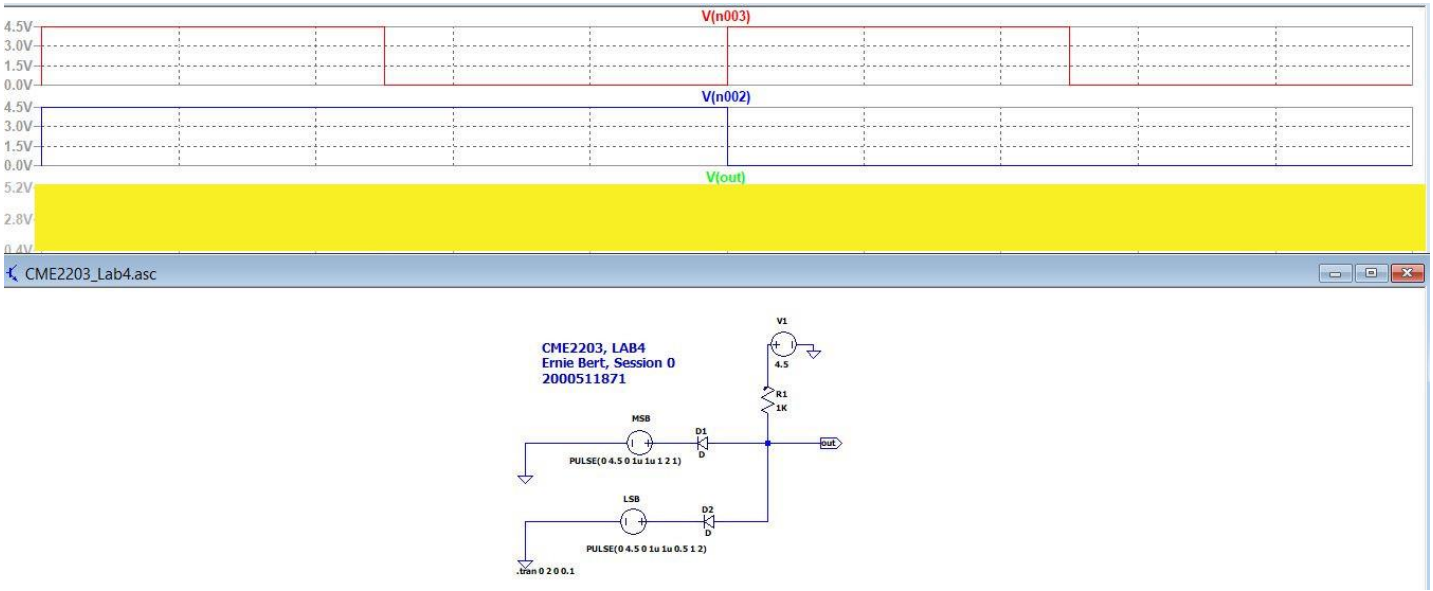
This setting creates a square wave with a period of 2s. It lasts for only one cycle, so 1x2 = 2 s.

4. Now, we are ready to run the simulation! Click on the running human  and edit the simulation command (Remember, you can also change this command later by going to Simulate\Edit Simulation Command):
    a. Under the Transient tab, select the following parameters:
        i. Stop Time : 2
        ii. Time to Start Saving Data : 0
        iii. Maximum Time Step : 0.1 and click OK.

This means you run the simulation from 0 to 2s. with time intervals of 100ms. Click the running human again. You should see an empty graph on top of the window now. Let's fill it with graphs!

b. Now, move the cursor to the graph, right click and select `Add Plot Pane`. Now you should have a total of three voltage plot panes. If not you should add more.
c. Click on the top graph pane, then click the red probe appearing on the circuit to the wire connecting to positive side of LSB, to the left of diode. This is our first logic input.
d. Click on the middle graph pane, then click the red probe appearing on the circuit to the wire connecting to positive side of MSB, to the left of diode. This is our second logic input.
e. Click on the bottom graph pane, then click on the wire that connects to **Out** port. This is the logic output.

So your final screenshot should be like this (**Out** voltage is not shown)



Congratulations! You are all set! Add screenshots of your circuit design and simulation graph and answer following questions.

1 - How does this circuit work? Explain in detail.
2 - What are some possible disadvantages of using diodes as gates?

My Answers:

1 - How does this circuit work? Explain in detail.

This circuit is a basic representation of an AND gate which only uses diodes and power supplies. Let me explain all the possibilities step by step.

*Possibility no1.

MSB and LSB are both closed so only power supply of the circuit is V1 which is 4.5 volts. Electricity wants to go to the most potential difference area and in this case, it is ground. So, our currents pass the diodes and meets the ground. This is why we read 0V on the output.

*Possibility no2.

MSB or LSB is open. If we open one of the other voltage sources (let's talk about LSB) the current will encounter the diode in front of the power source. Our voltage is high enough to break the diode, but it will lose some voltage while trying to break the diode. And this is why we have a resistor in front of the V1. Resistors also lowers the current and, in this circuit, it will make the same current as LSB. If you notice the power source LSB and MSB are faces opposite of the V1 and the currents met on the cable our voltage will be 0V. This is why we read 0V on the output when we open one of the SB's.

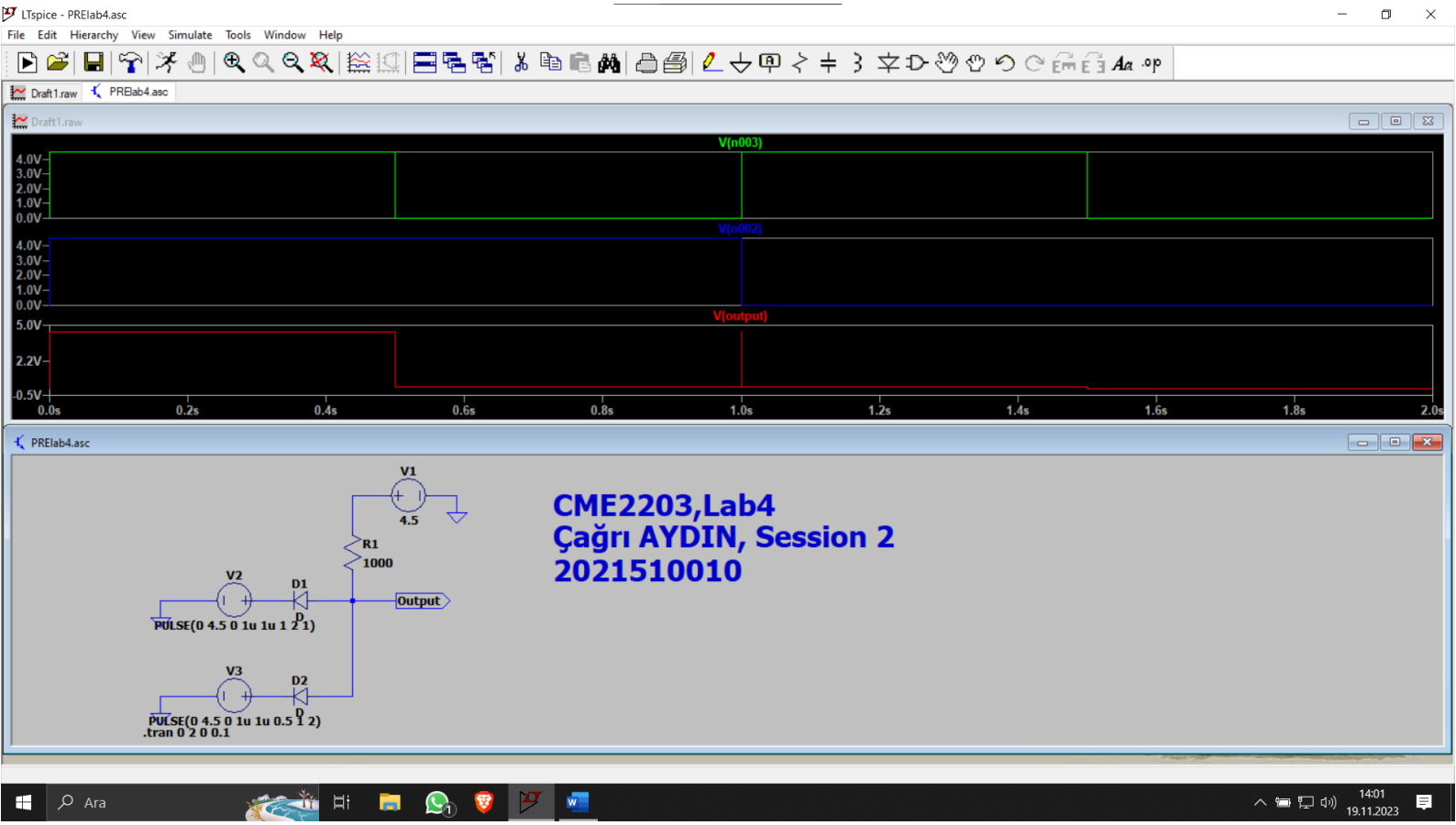
*Possibility no3.

MSB and LSB both open. If we open both SB power sources one of the sources will exterminate the V1 source and the other SB will see on the output.

As I explained on the above our output only seen open when both SB's are open and this circuit basically acts like an logic AND gate.

2 - What are some possible disadvantages of using diodes as gates?

Whenever when we use diodes depending on the material it is made of we will see a voltage drop so in each stage will reduce the voltage level, so after a few stages, the level drops so much that it becomes unusable. Another disadvantage of using diodes is when we force so much current towards the side where the diode has no permeability it broke down and our circuit wont do its job.


LTspice - PRElab4.asc
File Edit Hierarchy View Simulate Tools Window Help
Draft1.raw
PRElab4.asc
V(n003)
V(n002)
V(output)
4.0V
3.0V
2.0V
1.0V
0.0V
5.0V
2.2V
-0.5V
0.0s
0.2s
0.4s
0.6s
0.8s
1.0s
1.2s
1.4s
1.6s
1.8s
2.0s

PRElab4.asc
V1
4.5
R1
1000
V2
D1
Output
PULSE(0 4.5 0 1u 1u 1 2 1)
V3
D2
PULSE(0 4.5 0 1u 1u 0.5 1 2)
.tran 0 2 0 0.1
CME2203,Lab4
Çağrı AYDIN, Session 2
2021510010

Ara
14:01
19.11.2023