Report Submission Guidelines

1. Attach the signed Data Sheet (if any)
2. Attach the captured images (if any)
3. Answer the questions in the "Test Your Understanding" section
4. Add a brief Discussion regarding the experiment. For the Discussion part of the lab report, you should include the answers of the following questions in your own words:
   - What did you learn from this experiment?
   - What challenges did you face and how did you overcome the challenges? (if any)
   - What mistakes did you make and how did you correct the mistakes? (if any)
   - How will this experiment help you in future experiments of this course?

Test Your Understanding

Answer the following questions:

1. $R = 1k\Omega$ was used in the experiment. If we use $R = 2.2k\Omega$, will there be any problem in observing the I-V characteristics plot? Explain briefly.

   Answer:

   using R = 2.2 k instead of 1k will not cause any major issues in observing the I-V characteristics plot, but it will affect the current through the circuit and the shape of the plot. If I increase R, the I will decrease, for the same voltage applied, a higher resistance will result a lower current. The I-V curve will represent a smaller current as $I = \frac{V}{R}$, The diode will behave in the same way, but the ~~current~~ value will be smaller go through it. So, we will see lower current values on the y-axis.

2. From the I-V characteristics of a diode that you obtained, which devices can be used to model the diode?

   Answer:

   (-1) Based on the I-V characteristics I observe, the most appropriate model to describe the diode's behavior would be Series Resistance model. ?? The 0.7 V threshold that I observe in characteristic of the CVD model+R ~~where~~, after the threshold voltage, the current increases exponentially with voltage, which suggests that the diode's behavior is being captured more accurately than by a simple constant voltage drop. so CVD+R model accounts for the slight increase in voltage due to dynamic resistance of the diode.

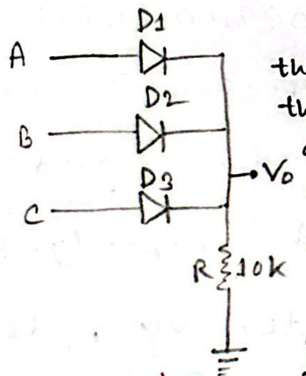
3. Compare the ideal diode model, CVD model and CVD + r model. Which model is better and why?

Answer:

Ideal diode model: Perfect conductor when forward-biased, perfect insulator when reverse-biased. Ignore voltage drop, reverse leakage current. CVD model: diode has constant voltage drop when forward-biased. Ignore dynamic resistance and voltage rise with current. CVD+r model: Includes dynamic resistance in series with the diode more complex but provides real-world accuracy. CVD+r model is best as it most accurately models the real-world diode behavior, including voltage increase with current.

4. Design a 3-input OR gate using diodes and explain why a pull-down resistor is necessary. What happens if the resistor value is too large or too small?

Answer:



The pull-down resistor is necessary to ensure that the output is low when all inputs are low. without this resistor, the output would float when no diode are conducting, leading undefinded or erratic voltage at the output. When resistor is too large, it will not be able to pull the output low quickly enough, this result in a weak pull to ground and output might be susceptible to noise or might not fully low. When too small, excessive current draw, wasting power and damage the components too.

CA??

5. Implement a 2-input AND gate using diodes. If the input high level is 5V and low level is 0V, calculate the actual output levels considering 0.7V diode drops.

Answer:

-1

when, A=0V, B=0V. the two diode will be on. So, there will be two 0.7 V ~~diode~~ voltage source. $(0.7+0.7)=1.4$v

∴ output = 1.4 v.

when, A=0V, B=5V. / A=5V, B=0V: one of the diode will be on; output = 0.7 v.

when, A=5V, B=5V. two diode will be off and output = 5V.

Discussion:- In this lab, I learned about the fundemental principals of diodes including their I-V charabcteristics, the CVD model. and how to implement logic gates using diodes. I explored the behavior of diodes in a circuit and how their voltage-current relationship can be modeled using different theoritical models. The experiment also provided hands-on experience with building circuits, using an oscilloscope for measurement and verifying theoritical models againt experimental results.

One challagnges I faced during the experiment was setting up the oscilloscope. correctly to view the I-V. Initially the settings were unclear, and the data did not appear as expected. I overcame this by carefully following the procedure and ensure the oscilloscope channels were connected properly and making necessary adjustments in the XY mode for a clearer display of the data. ~~Another~~

A mistake I made initially was misunderstanding the orientation of the diodes in the circuit. This led to inaccurate readings of the voltage drops and current ~~me~~ measurements. After reviewing the circuit diagrams and reassembling the components, I ensured the diodes were placed in the correct direction

This experiment has helped me understand how to model the behavior of real components like diode which is essential for designing and analyzing more complex electronic circuits. Moreover, the CVD model and the use of logic gates with diodes will be directly applicable to future digital electronic works. Enhanced my understanding of semiconductor device.

(d) Change the scaling and position of the plot using the **Scale** knob and **Position** knob of both channels, respectively if you need.

You will see a small screen showing the I-V characteristics graph using the XY mode of the oscilloscope. The XY mode plots the voltage data of CH1 and CH2 in the x-axis and y-axis respectively. So, the x-axis represents V_D. As, $I_D = I_R \propto V_R$, the y-axis represents I_D.

(e) Observe the I-V graph and capture it with a camera.

Task-02: Verification of CVD model

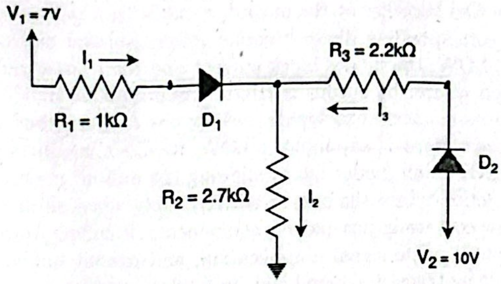


Figure 8: ***Circuit-2***

Procedure

1. Use the Digital Multimeter to measure the resistances R_1, R_2, and R_3, as well as the forward voltage drops V_{Do_1} and V_{Do_2} of diodes D_1 and D_2, respectively. Fill in the tables below with the measured values.
2. Construct the ***Circuit-2*** given above.
3. Use the DC Power Supply to set $V_1 = 7V$ and $V_2 = 10V$ with 0.5A current limit
4. Now, measure the voltages across the resistances and fill out the tables.
5. For theoretical analysis, assume the diode follows the Constant Voltage Drop (CVD) model with a forward voltage drop of V_{D0}. Use the experimental values for both V_{D0} and the resistor in calculations to minimize error.

	V_{Do_1} (V)	V_{Do_2} (V)	R_1 (kΩ)	R_2 (kΩ)	R_3 (kΩ)	V_{R1} (V)	V_{R2} (V)	V_{R3} (V)	$I_1 = \frac{V_{R1}}{R_1}$ (mA)	$I_2 = \frac{V_{R2}}{R_2}$ (mA)	$I_3 = \frac{V_{R3}}{R_3}$ (mA)	D_1 (on/off)	D_2 (on/off)
Experimental	0.578	0.585	1	2.709	2.152	0.56	5.95	3.513	0.56	2.196	1.63	On	On
Theoretical			1	2.70	2.152	1.232	5.19	4.225	1.232	1.92	1.96	on	on

Percentage of error $= \left\lvert \frac{\text{Experimental} - \text{Theoretical}}{\text{Theoretical}} \right\rvert \times 100\%$	For I_1	For I_2	For I_3
	54.54%	14.37%	16.84%