

CPE 316: Electrical Circuits and Electronic Design Laboratory.

Lab 04

Implement the Digital to Analog Converter Using Op-Amp.

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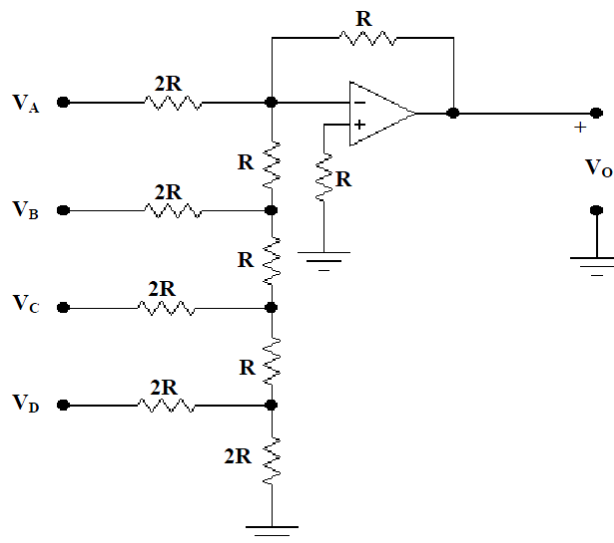
Date of Experiment: 09/18/22.

INTRODUCTION:

The purpose of this laboratory was to understand how op-amps and binary resistive ladder networks can be combined to construct Digital-to-Analog converters. The first step was to digitally design, and binary resistive ladder connected to an op-amp, and then re-enact the same design using physical components in the lab.

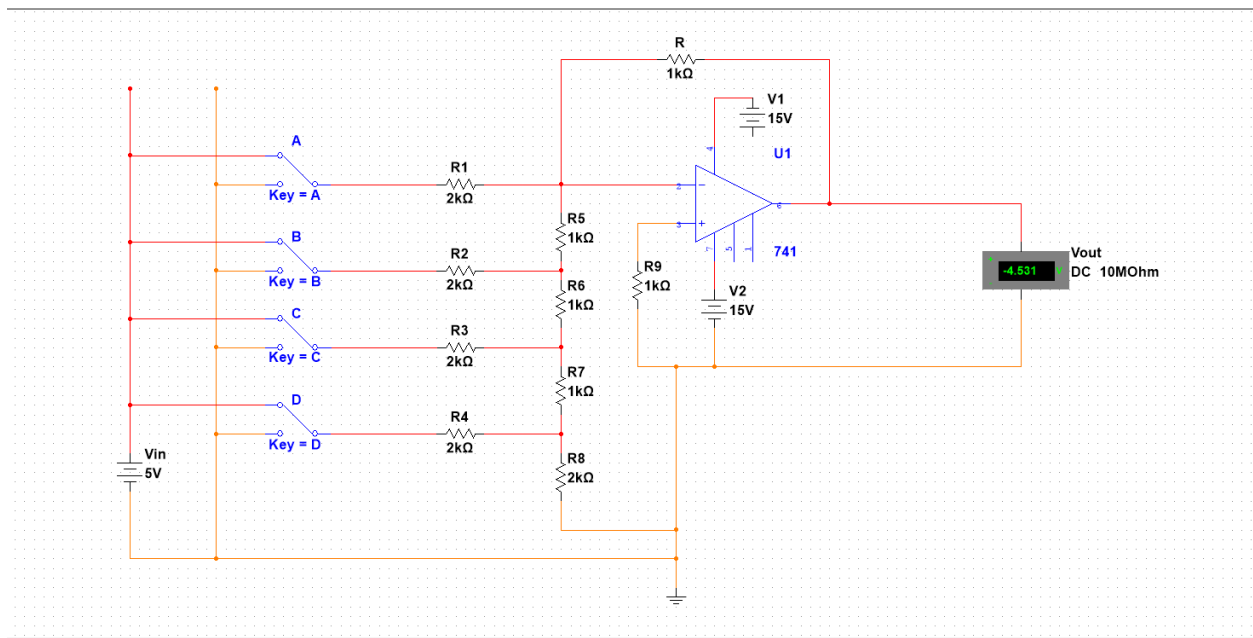
PART A:

This lab only contained one part, which would be to use set up digital and laboratory designs of the binary resistive circuit below:

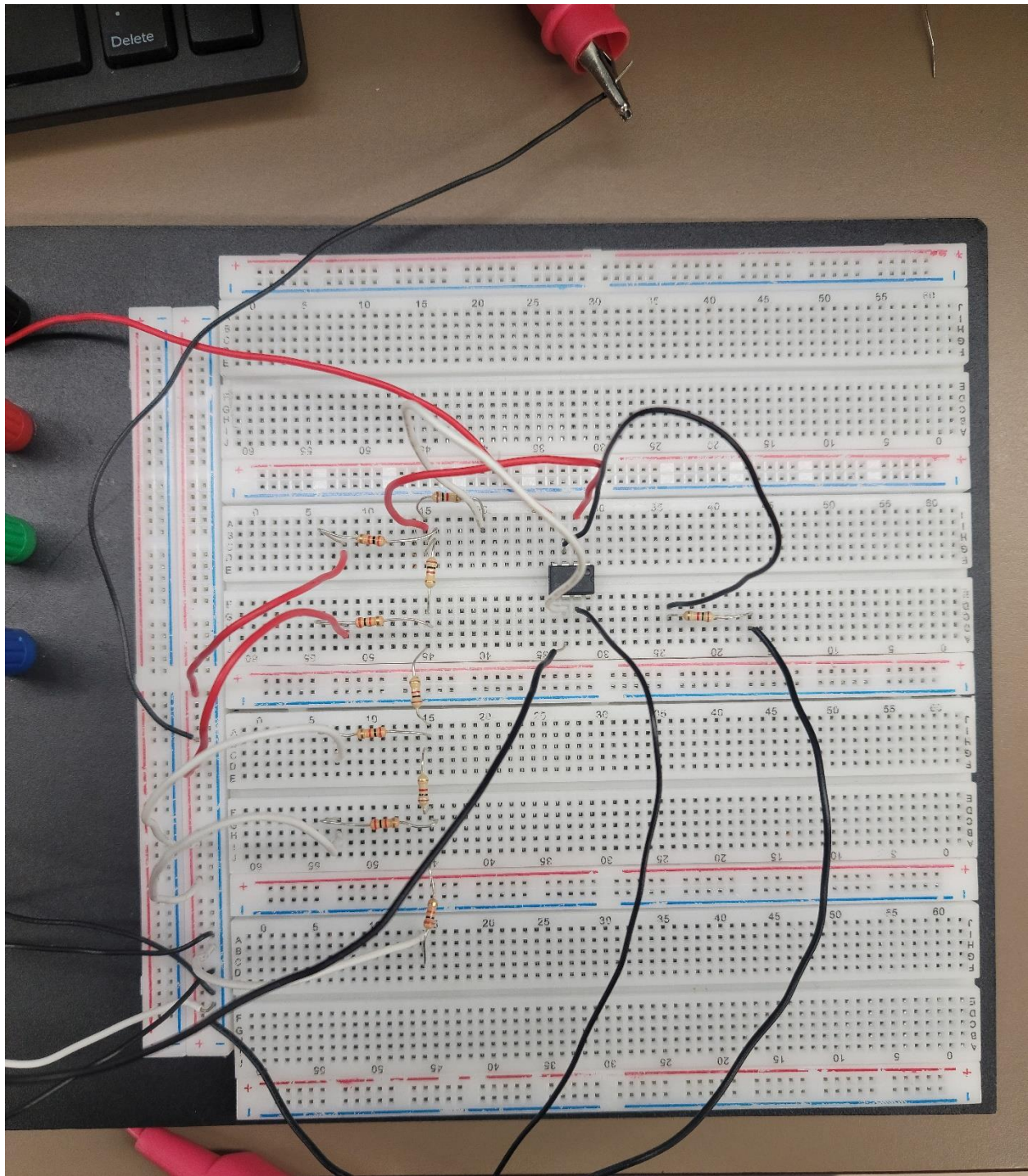


Input voltage V_{in} is set to 5V, multiple 1k and 2k resistors and batteries. By changing the switch values, we can define 1 as logic "ON" and 0 as logic "OFF".

The design was completed as shown below:



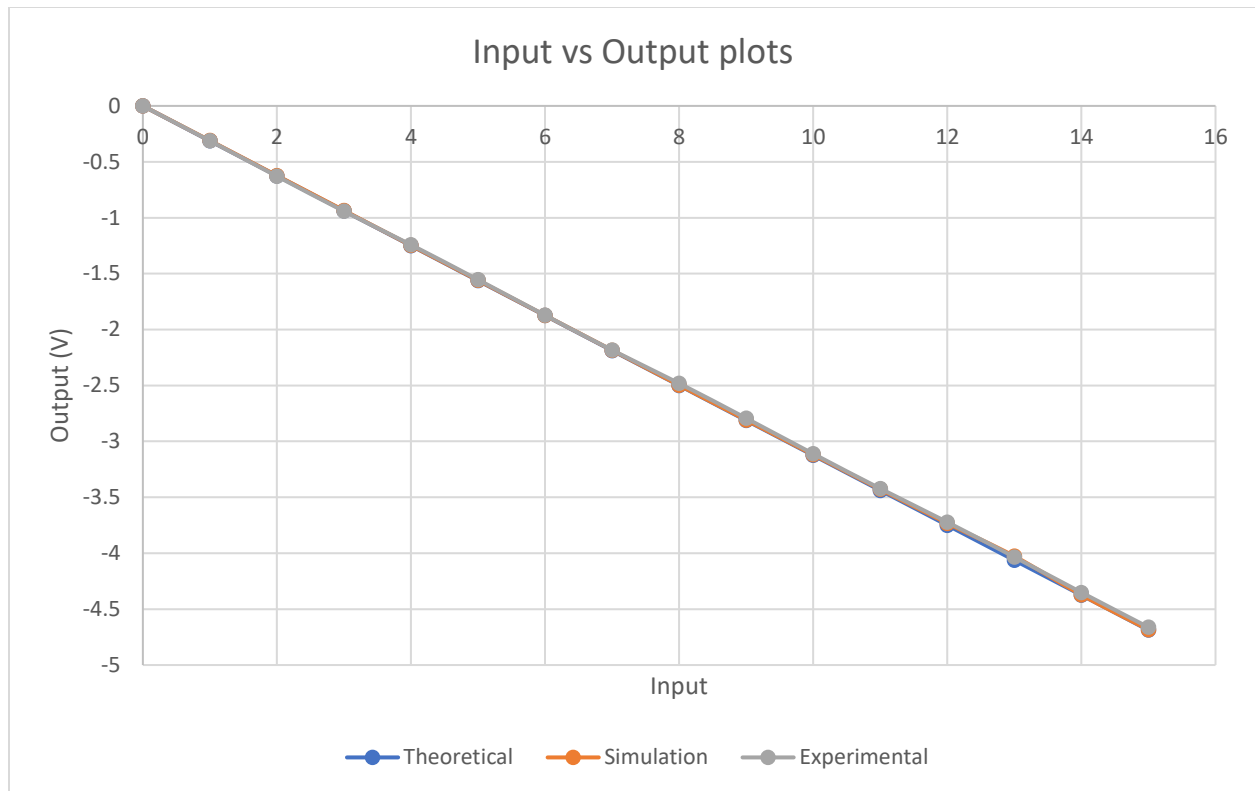
Laboratory circuit design:



The simulation, theoretical and experimental results are all recorded in the table below:

Input State					Theoretical	Simulation	Experimental
	V _A	V _B	V _C	V _D	V _O (V)	V _O (V)	V _O (V)
0	0	0	0	0	0	0	0
1	0	0	0	1	-0.313	-0.31	-0.312
2	0	0	1	0	-0.625	-0.623	-0.629
3	0	0	1	1	-0.938	-0.935	-0.942
4	0	1	0	0	-1.250	-1.248	-1.242
5	0	1	0	1	-1.563	-1.56	-1.554
6	0	1	1	0	-1.875	-1.873	-1.872
7	0	1	1	1	-2.188	-2.185	-2.184
8	1	0	0	0	-2.5	-2.498	-2.481
9	1	0	0	1	-2.813	-2.809	-2.793
10	1	0	1	0	-3.125	-3.12	-3.111
11	1	0	1	1	-3.438	-3.429	-3.422
12	1	1	0	0	-3.750	-3.733	-3.722
13	1	1	0	1	-4.063	-4.027	-4.034
14	1	1	1	0	-4.375	-4.373	-4.351
15	1	1	1	1	-4.688	-4.685	-4.662

Input vs. Output plots:



In conclusion, the output values for both the digital and in-lab designs both almost matched the theoretical values, albeit with small margins of error.