University of British Columbia
Electrical and Computer Engineering
Digital Design and Microcomputers
CPEN312

Lab 1 - Logic Gates

In this laboratory you will implement a simple digital system using logic gate integrated circuits.

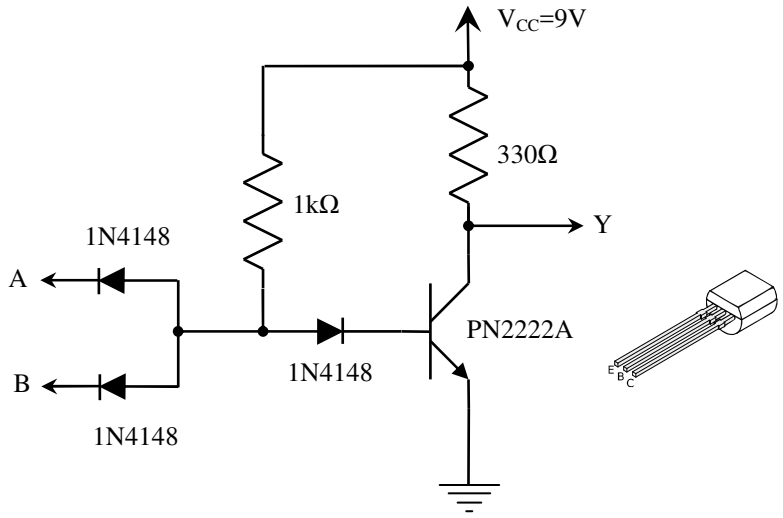
Tools and Parts Needed

1. Wire stripper, pliers, wire, and breadboard which are available in the lab. If you don't own these tools, you can use the ones available in the lab.
2. 1 x PN2222A NPN transistor, 3 x 1N4148 diodes, 1 x 330 Ω resistor, 2 x CD4093/CD4011 4-NAND gate ICs, 10 x 1k resistors, 9V battery clip, 2 x push-buttons, as well as the common anode 7-segment display LSHD-F101. These parts will be provided either at lecture time or in the lab.

Activities

1) Find the pin out of the CD4093/CD4011, integrated circuit (IC) and the LSHD-F101 display. Draw the top view of the ICs and display on a piece of paper showing all the gates and power supply connections.

2) Assemble and test the NAND gate built with discrete components as show in the diagram below. The inputs are labeled 'A' and 'B'. The output is labeled 'Y'. Measure the voltages at the inputs and output using the lab multimeter in order to assess their logic state. Show this circuit and the test results together with the results of point 4) below to one of the teaching assistants on duty.



3) Add the last two digits of your student number. From the result pick the four digits from the table below.

Sum	Display
0	0523
1	2038
2	5261
3	4386
4	4826
5	1268
6	7480
7	3274
8	6321
9	1625

Sum	Display
10	3946
11	2386
12	7951
13	5379
14	2508
15	2159
16	3527
17	9630
18	8316

Design and simulate with Multisim a 2-bit decoder that displays the digits that correspond to your student number using a 7-segment display as indicated in the table below. Remember that the LED segments are turned on with logic 0. Use ONLY 2-input NAND gates[1].

Inputs		
B	**A**	Digits (left to right)
0	0	Digit 1
0	1	Digit 2
1	0	Digit 3
1	1	Digit 4

For example, if the last two digits of your student number add up to decimal 14, then you have to display "2508" with the 7-segment display. When the binary input is 00 display number 2, when the binary input is 01 display 5, when the binary input is 10 display 0, and when the binary input is 11 display 8.

4) The logic gate integrated circuits we have for this lab need a 3V to 18V DC power supply to operate. You can use a 9V battery (not provided) together with the battery clip provided in the kit to provide power to the ICs. Insert the CD4093/CD4011 ICs into the breadboard and wire both the power and ground pins of both ICs. Assemble and test the circuit you designed and simulated in point 3 above. Use the push-buttons provided in the kit for the two login inputs. Remember to limit the maximum current per segment by adding a 1k resistor in series as it was shown in the lecture. Demonstrate your results to the teaching assistant on duty in order to get a grade for your work. Be prepared to provide details about your design as well as run simulations upon the teaching assistant request. Also, the teaching assistant may ask you to disassemble your circuit before assigning you a grade. You must also submit a picture of your circuit and Multisim simulation file to Canvas.

[1] It should take 8 2-input NAND gates or less to solve this problem.