Lab Report 2

Name: Vishak Kashyap K
Roll Number: 2023113012
Group: 9

Experiment 2 (Part A) - Logic Levels

Objective:

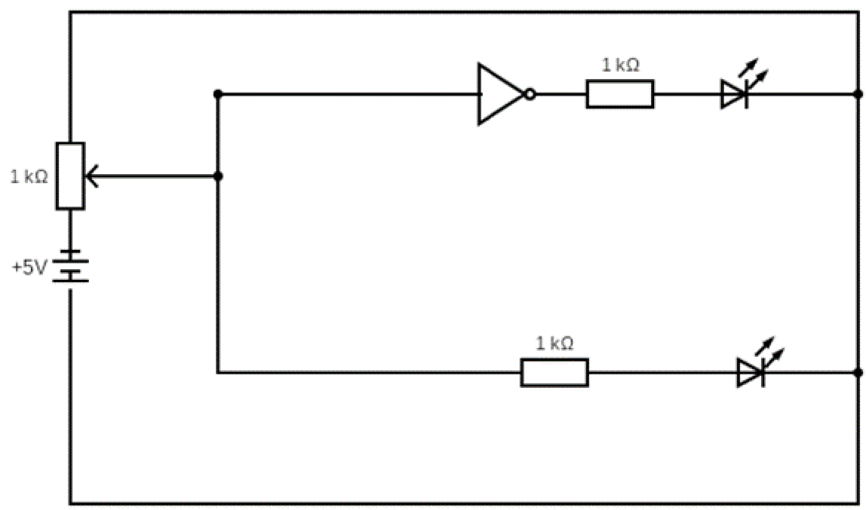
Identify the voltages of binary logic levels.

Electronic Components Required:

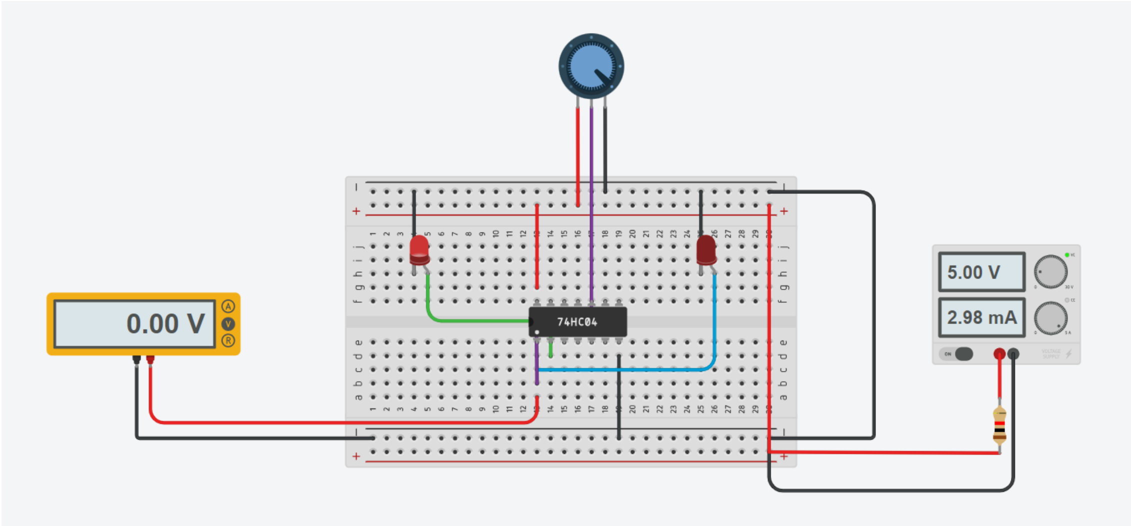
1. Multimeter
2. Potentiometer
3. 7404 IC (Hex Inverter)
4. Normal Connecting Wires
5. Power Supply (VCC & GND)
6. Digital Test Kit

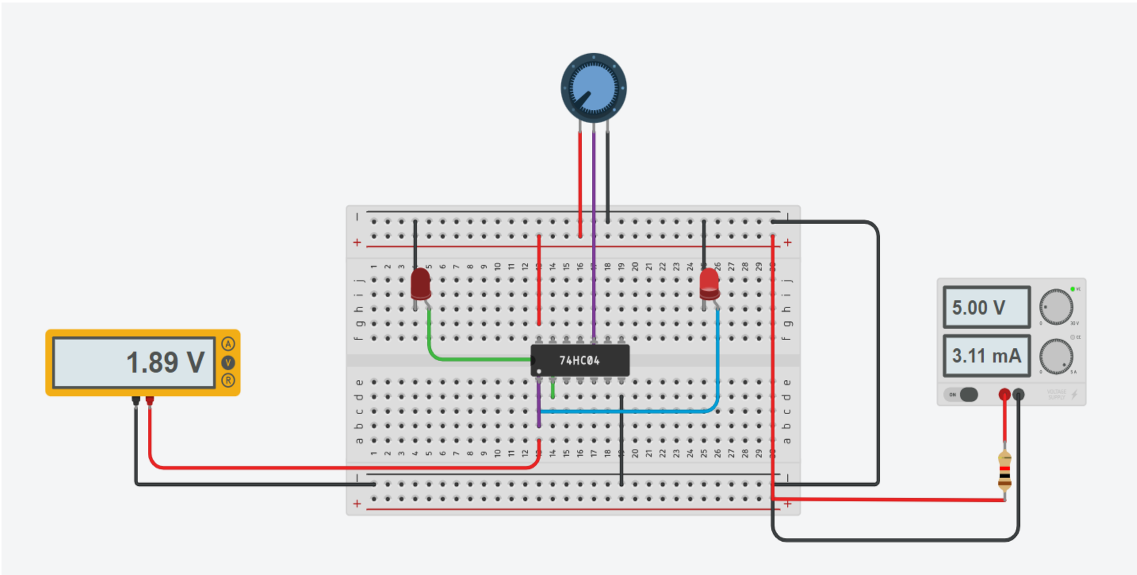
Reference Circuit:

1. Circuit Diagram



2. Tinkercad Screenshot



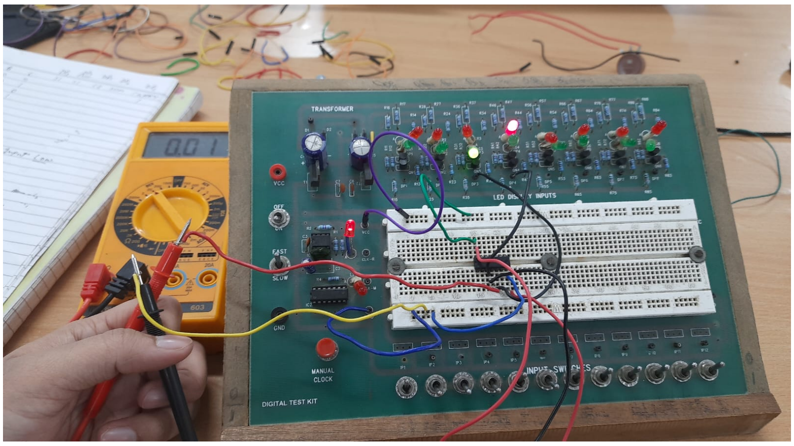


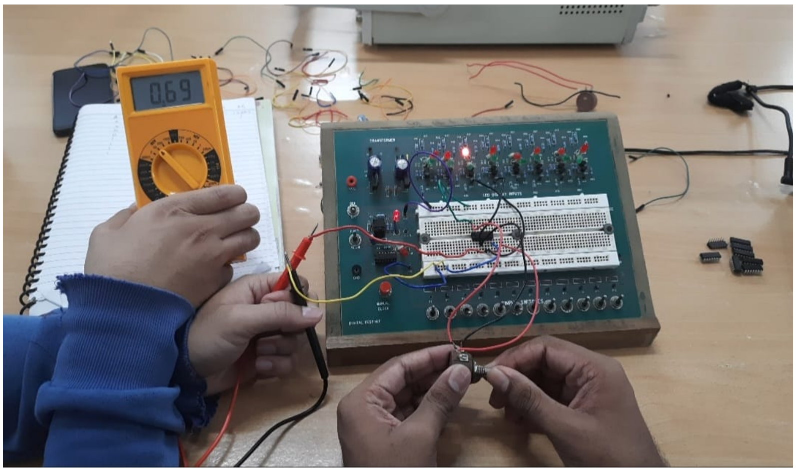
Procedure:

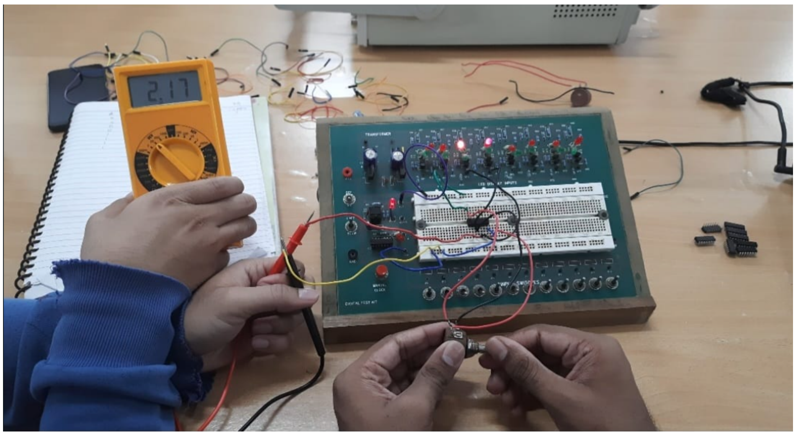
1. Set up the circuit using the reference circuit given in the above diagram.
2. Then turn the potentiometer shaft such that multimeter equals 0v and leds start glowing
3. Now turn the shaft of potentiometer slowly and note the voltages at which lr1 and lg3 start glowing

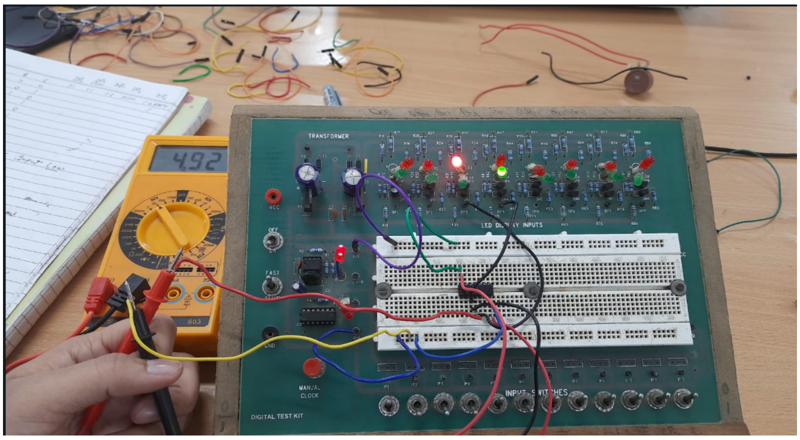
4. Finally compare the villages noted with the specific binary logic levels for voltage range of 0V to 5V.

Observations:









We notice that initially lg1 and lr2 glows but as we gradually change the voltage, lr1 and lg2 start glowing at different voltage levels

Conclusions:

The voltages observed correlate with the specifications for binary logic levels for a 0-5V range.

Voltage	OUTPUT
0.0-0.8	IL
0.8-1.8	IH
1.9-2.7	OL
2.8-5.0	OH

Link for Tinkercad Simulation:

https://www.tinkercad.com/things/i0GJy9DOgB3-logic-levels/editel?sharecode=vUkzrZAKDbAY_O59UhKuqW4Q61SWIlwTxsohFVd9gVc

Experiment 2 (Part B) - Gate Identification

Objective:

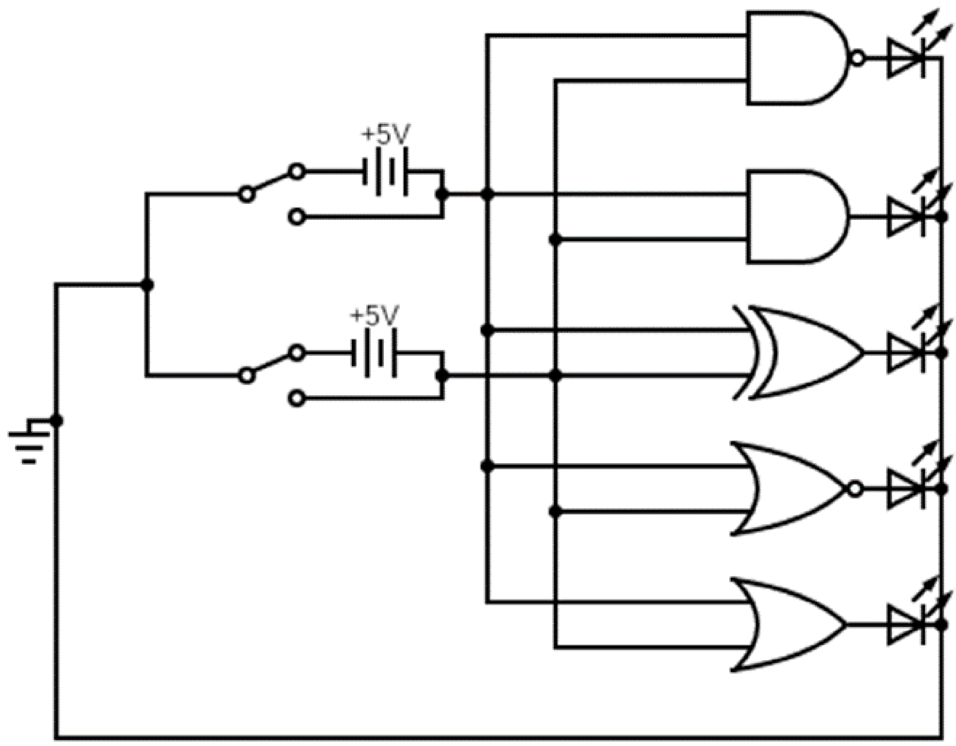
To identify the basic logic gates using truth tables in integrated circuits.

Electronic Components Required:

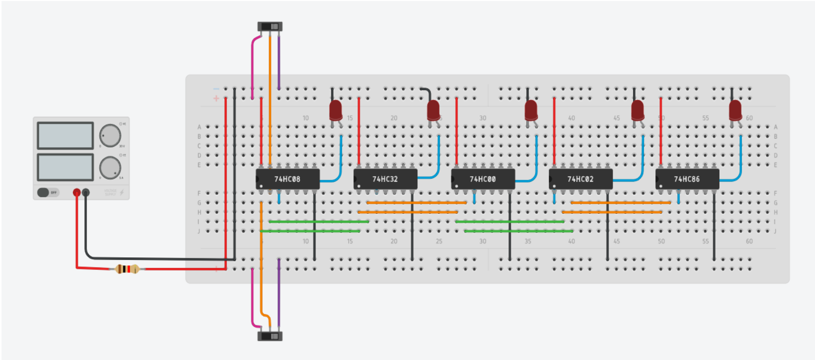
1. Logic Gates (7404, 7408, 7400, 7432, 7486, 7402)
2. LEDs
3. Switches
4. Normal Connecting Wires
5. Digital Test Kit
6. Voltage Supply

Reference Circuit:

1. Circuit Diagram



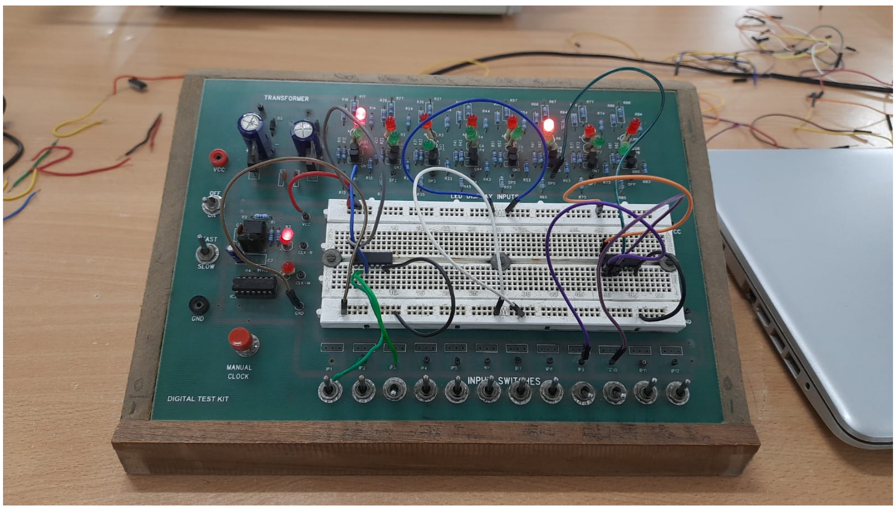
2. Tinkercad Screenshot



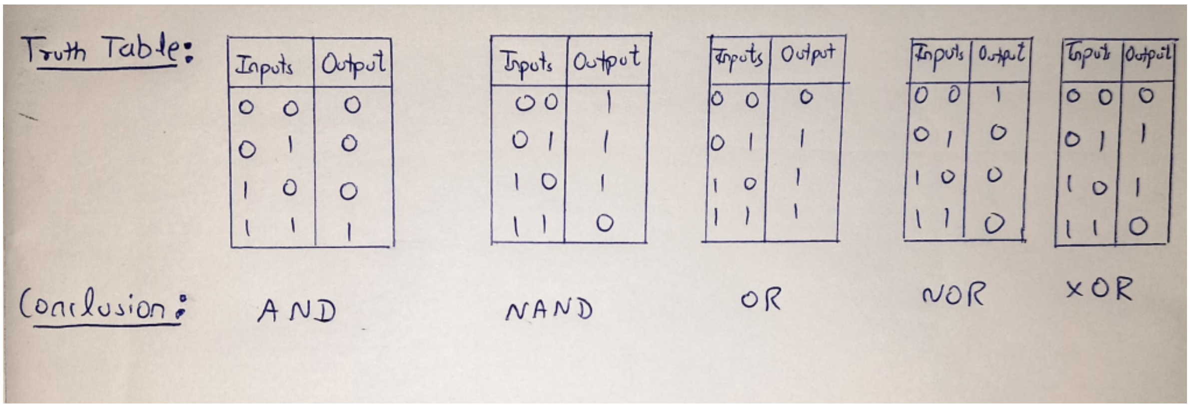
Procedure:

1. Connect VCC and GND of power supply to the power and ground inputs of the logic gate
2. Connect the input 1 and input 2 of the logic gate to two different switches and connect the output of the logic gate to the display point led of the display kit.
3. Now check all the possible possibilities with switches and tabulate the results as observed on display point leds
4. Using the truth table we can decipher the logic gate.

Observations:



We noted switch on as 1 and off as 0, and used the same notation for the LED- light on as 1 and off as 0. Here are the following truth tables we observed.


Truth Table:

Inputs		Output
0	0	0
0	1	0
1	0	0
1	1	1

Inputs		Output
0	0	1
0	1	1
1	0	1
1	1	0

Inputs		Output
0	0	0
0	1	1
1	0	1
1	1	1

Inputs		Output
0	0	1
0	1	0
1	0	0
1	1	0

Inputs		Output
0	0	0
0	1	1
1	0	1
1	1	0

Conclusion: AND NAND OR NOR XOR

Conclusions:

This experiment helped me understand how IC gates take in inputs and output them in real life.

IC 7408 - AND Gate

IC 7432 - OR Gate

IC 7400 - NAND Gate

IC 7402 - NOR Gate

IC 7486 - XOR Gate

Link for Tinkercad Simulation:

https://www.tinkercad.com/things/dqscYmTLK3y-gate-identification/editel?sharecode=eWwTfLOjhZMgwJ-EsEOPpd9bKYVuq6DnK1UEJDjUafc

Experiment 2 (Part C) - De Morgan's Theorems

Objective:

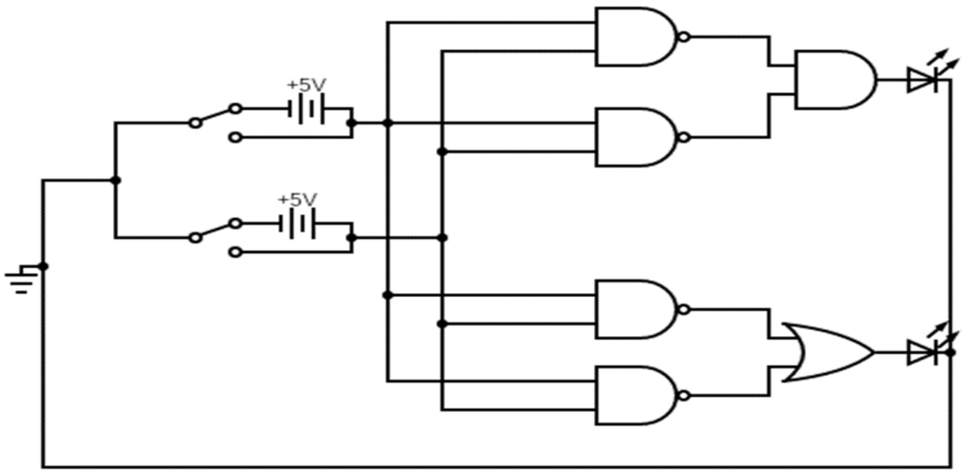
To verify and prove De Morgan's Theorems using circuits and truth tables (A . B)' = A' + B' and (A+B)' = A'.B'. Using different input A and B to get the same outputs into two different LEDs.

Electronic Components Required:

1. Digital Test Kit
2. Power supply
3. Normal Connecting wires
4. 7400(NAND) & 7432(OR) IC
5. 7402(NOR) & 7408(AND) IC
6. Resistor
7. LED
8. Switches

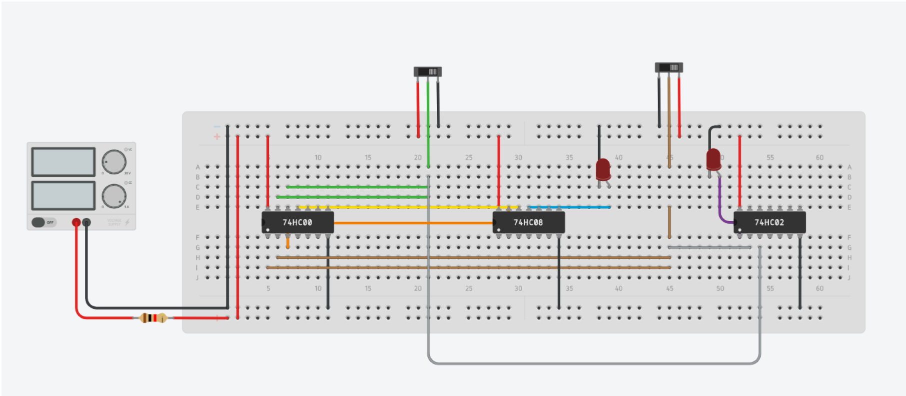
Reference Circuit:

1. Circuit Diagram
   (A+B)' = A'.B' and (A.B)' = A'+B'

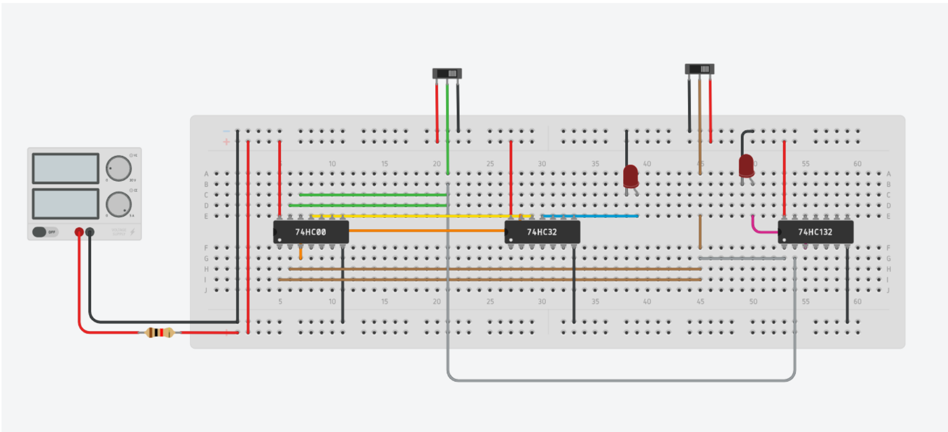


2. Tinkercad Screenshot

For (A+B)’ = A’.B’



For (A.B)’ = A’+B’

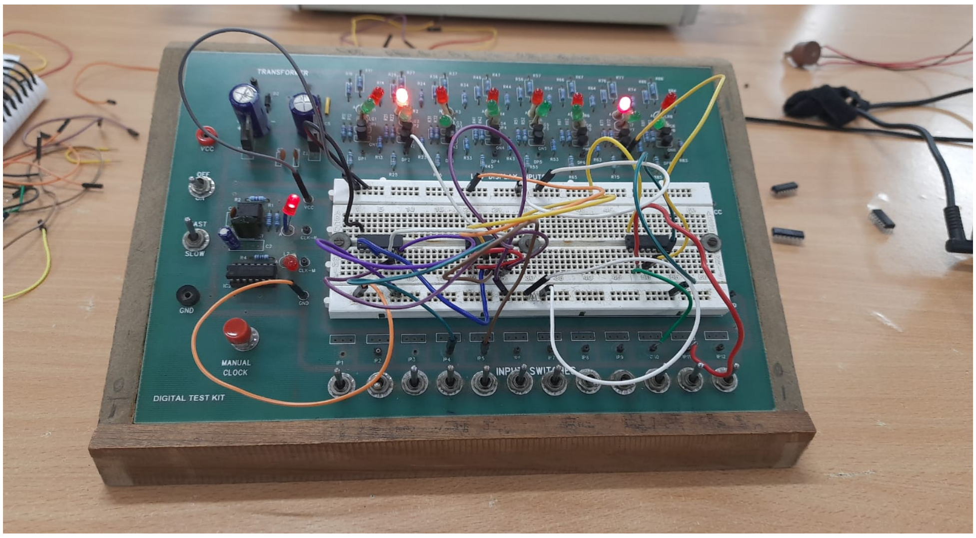


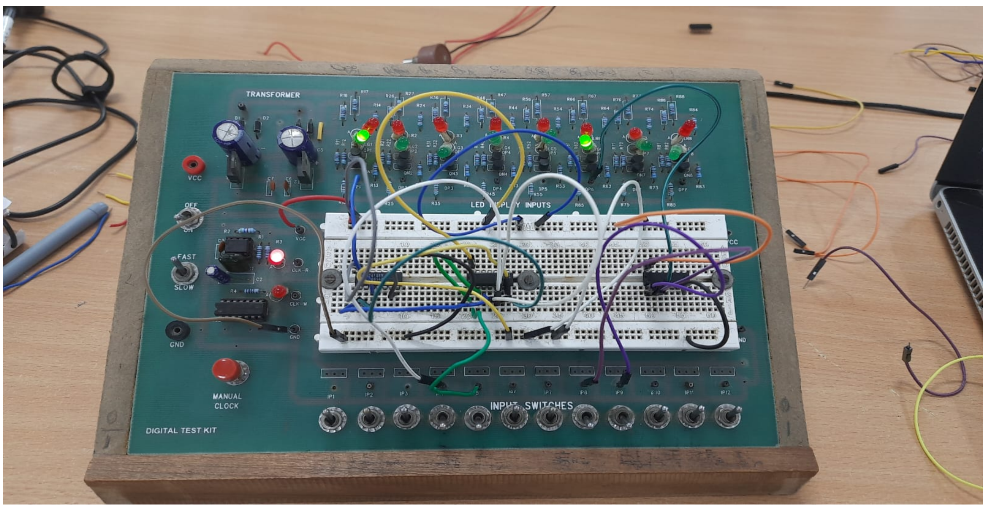
Procedure:

1. We connected the power supply using VCC and GND.
2. We tested the LED lights to confirm that they functioned correctly.
3. We then added the 7400 and 7432 IC gates into our experiment.
4. We then connected the VCC and GND of the power supply to the breadboard and then connected it to the respective terminals of the IC gates, LEDs and switches.

5. Then we took the inputs from the switches and connected input A and B to the NAND gate to get (A•B)’.
6. We connected this output to an LED
7. We then took the input of A and B twice into the NAND to get the output A’ and B’ not respectively.
8. Then we took both these inputs into an OR gate to get the output as (A’ + B’)
9. Finally we connected this output to an LED also.
10. Similarly, we did this to prove (A + B)’ = A’ • B’.

Observations:





When we turned on and off the switches, the LEDs both lit up and off at the same time, meaning that we correctly proved De Morgan's Law.

Conclusions:

This experiment helped me understand how De Morgan's Law works practically, connecting different inputs and outputs to get the desired result.

A	B	A'.B'	(A+B)'	A'+B'	(A.B)'
0	0	1	1	1	1
0	1	0	0	1	1
1	0	0	0	1	1
1	1	0	0	0	0

Link for Tinkercad Simulation:

1. (A+B)' = A'.B'

https://www.tinkercad.com/things/1Tf3PaM6Sws-de-morgans-theorems-1/editel?sharecode=nkcPQJEv7Rm1pyyUunlxQpt_66WMSd6XBtrZU-gbmnc

2. (A.B)' = A'+B'

https://www.tinkercad.com/things/k6UgyhQPROE-de-morgans-theorems-2/editel?sharecode=-5FGNqmzhhe20iC5_geEuV0_Yb0Dq1cXo7mSJuTslSU

Experiment 2 (Part D) - Binary Full Adder

Objective:

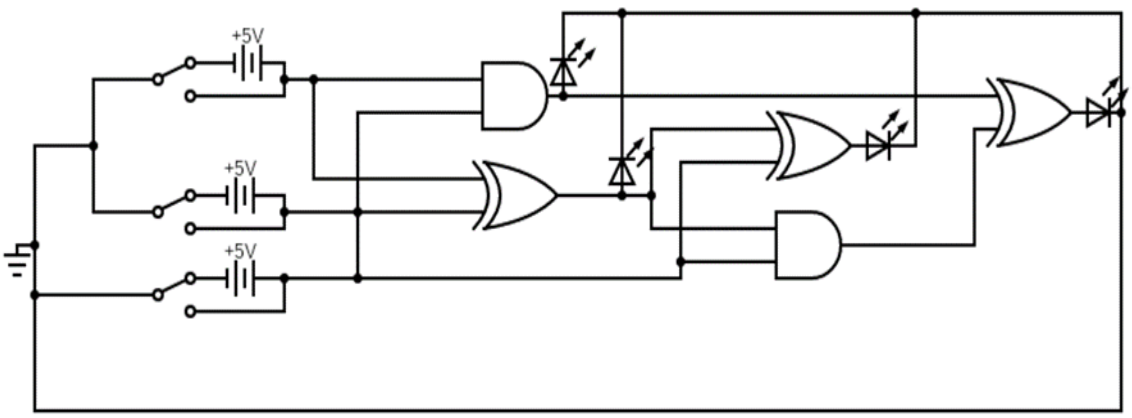
In this experiment, our goal was to be able to use only 2 IC gates in the lab to show how the binary full adder works. Using different inputs A and B to get further outputs to use as inputs.

Electronic Components Required:

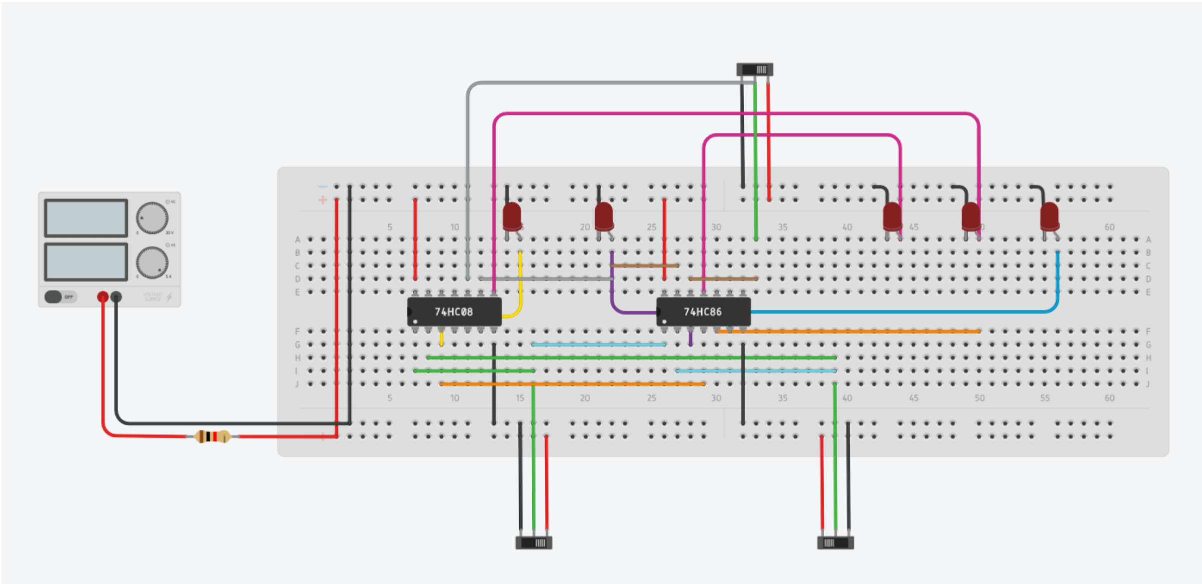
1. Digital Test Kit
2. Power supply
3. Connector wires
4. 7408(AND) & 7486(XOR) IC
5. Resistors
6. LEDs
7. Switches

Reference Circuit:

1. Circuit Diagram



2. Tinkercad Screenshot



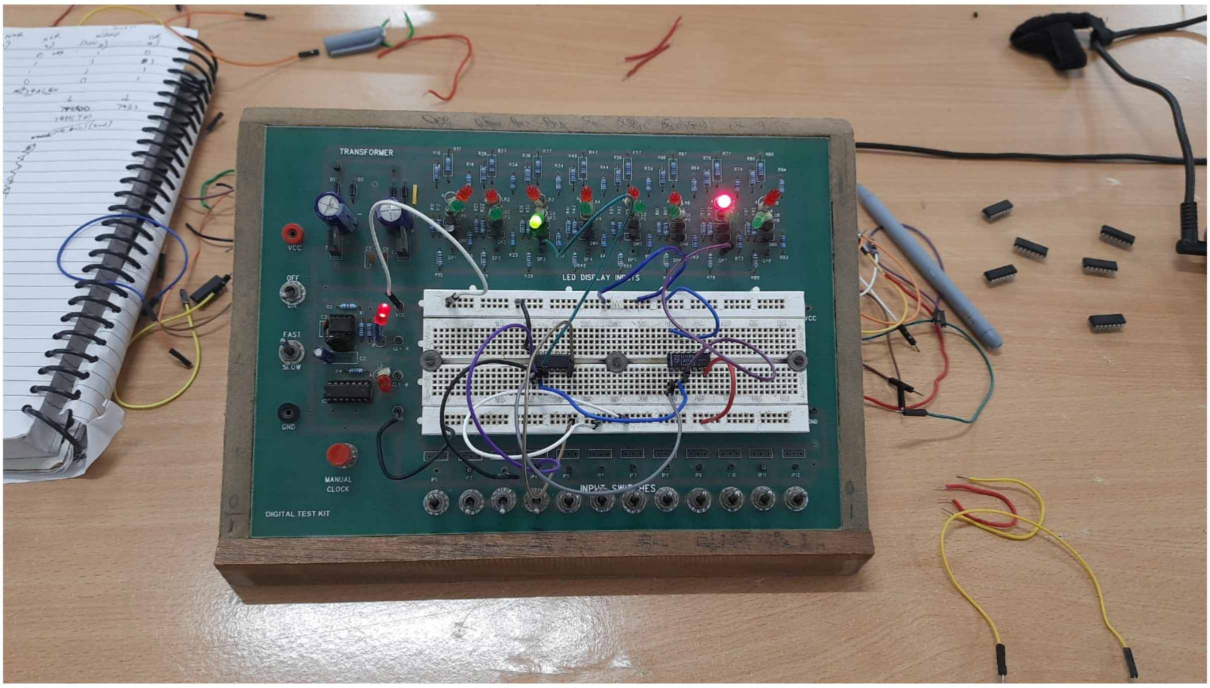
Procedure:

1. First, we make the half adder using AND and XOR gates.
2. Connect the inputs from A switch and B switch into inputs of AND gate, this gives us C1
3. Then connect the inputs from A and B into inputs of XOR gate, this gives us S1.Connect C1 and S1 to display point leds respectively. Half adder is done.
4. Now connect S1 as input into one of the input XOR gate and connect C switch as input into the input of XOR gate, the output gives us SUM, connect SUM to one of the display point LEDS.
5. Connect S1 as input into the input of AND gate, and C into the other input of AND gate, the output of this gives us C2, connect C2 to one of the display pins.
6. Now take C1 AND C2 and connect them as inputs to inputs of an OR gate, the output of this gate gives CARRY.

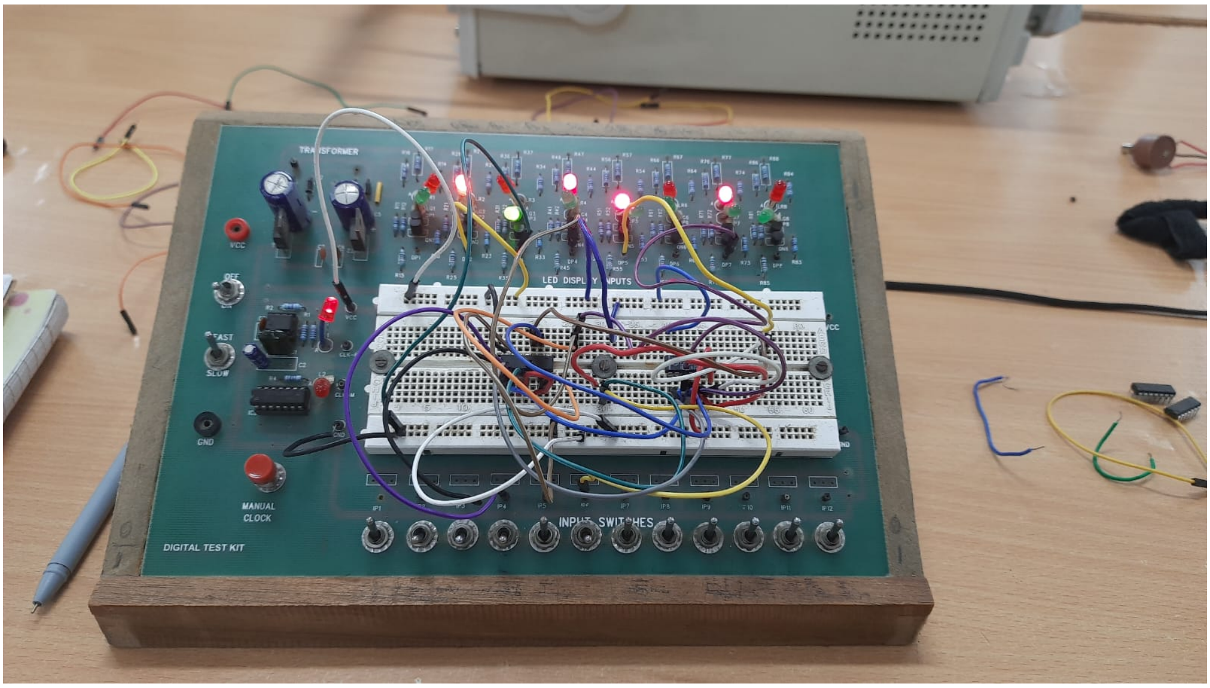
7. We finally get the truth table of S1, C1, C2, SUM, CARRY, using the above circuit.

Observation:

Half Adder



Full Adder



We noted switch on as 1 and off as 0, and used the same notation for the LED on as 1 and off as 0. Here is the truth table we observed:

Input A	Input B	Input C	S1	C1	C2	SUM	CARRY
0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0
0	1	0	1	0	0	1	0
0	1	1	1	0	1	0	1
1	0	0	1	0	0	1	0
1	0	1	1	0	1	0	1
1	1	0	0	1	0	0	1
1	1	1	0	1	0	1	1

Conclusion:

1. The half adder circuit successfully and accurately adds the inputs A and B. The sum is represented by S1 and the carry is C1.
2. The full adder successfully adds the inputs from A, B and C, the sum of these inputs is represented by SUM and the final carry is represented by CARRY.

Link for Tinkercad Simulation:
https://www.tinkercad.com/things/bccht6Wok7Q-binary-full-adder/editel?sharecode=Cp4hnqI19C6Wm8uZNeYWuF9gNA9uV6YCOfl6ZqB7rFQ