ECEN 248 - Lab Report

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Lab Number: 1

Lab Title: Digital Logic Gates

Section Number: 510

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Objectives:

The overall objective of this lab is to familiarize ourselves with the behavior of logic gates, logic interpretation, and fundamental circuit writing techniques. This experiment involves constructing truth tables using high and low electronic signals to observe the behavior of different logic gates. By conducting these tests of various logic gates , we will analyze their outputs and determine the expected logical operations.

Design:

To begin this lab we will start by setting up the DC power supply and multimeter. First, we must ensure that both devices are turned off. This is just a safety precaution. We then connect the red lead of the power supply to the red lead of the multimeter and do the same for the black leads. After making these connections we turn on both power supplies and multimeter to verify if the multimeter is accurately measuring the power supply output. This additional step ensures that the breadboard functions correctly and the power supply outputs are accurate . Once verified, we turn off the power supply and start setting up our breadboard.

To begin setting up the breadboard, we place the 74ALS04 (NOT Gate) vertically, ensuring that none of its pins are pre-connected. Next we connect the red lead of the power supply to the power rail and the black lead to the ground rail . Using jumper wires, we connect the power rail to the VCC pin on the chip and another wire to connect the ground rail to the GND pin on the chip.

To properly test the NOT gate, we take a wire and connect it towards the chip's input pin of the chip to the power supply , representing a high input. Then we connect the red lead of the multimeter to the corresponding output pin of the chip and the black lead of the multimeter to ground. When we turn on the power supply, the multimeter will measure the output of the NOT gate with the high input. To test the NOT gate with the low input we simply move the wire connected to the input pin from power to ground.

We then conduct the same procedures on the other logic gates which are, NAND , NOR , AND , OR, and XOER. Unlike the NOT gate, which has a single input pin and requires only two tests , these gates have two input connections and require four tests for high and low inputs. The same procedure applies by ensuring proper power and ground connections, applying inputs, and measuring outputs with the multimeter to verify the expected behavior of each logic gate.

Results :

I will discuss my findings in this section and why the outputs are high and low towards each gate observed in this lab .

Table 2: Truth Table for Inverter (NOT Gate)

A (High/Low)	Y (Volts)	Y (High/Low)
Low	4.012v	H
High	0.046057v	L

The NOT gate follows the Boolean equation Y = A' , This means the input will be inverted when outputted. During the lab when input was set to LOW , the output is HIGH , which corresponds to the measured (4.012 V). When the input was set to HIGH , the output was LOW (Y = 0) , which corresponds to the measured (0.0461 V).

Table 3: Truth Table for AND & OR Gates

A (H/L)	B (H/L)	AND2 (V)	AND2 (H/L)	OR2 (V)	OR2 (H/L)
L	L	0.0917v	L	0.0601v	L
L	H	0.09174v	L	3.983v	H
H	L	0.09175v	L	3.983v	H
H	H	4.911v	H	3.981v	H

The AND gate follows the Boolean equation Y = A * B . The gate truth table only produces a true when both inputs A and B are both true.The Lab outputs confirmed this by producing a

HIGH output when both inputs are HIGH. In this case it is confirmed by the measured (4.41 V) in the last row. In all the other cases, at least one input is low , which results in an output of LOW (0.0917 V).

The OR gate follows the Boolean equation Y = A+ B. According to its truth table , if either A or B is true , the output is also true . The measurements obtained in the lab confirmed this behavior. When either input was HIGH , the output measured (3.98 V) indicating HIGH. Conversely , when both inputs were LOW, the outputs remained LOW, measuring around (0.006 V).

Table 4: Truth Table for NAND, NOR, & XOR Gates

A (H/L)	B (H/L)	NAND2 (V)	NAND2 (H/L)	NOR2 (V)	NOR2 (H/L)	XOR2 (V)	XOR2 (H/L)
L	L	3.988v	H	4.004v	H	0.157v	L
L	H	3.908v	H	0.0669v	L	4.148v	H
H	L	3.918v	H	0.0668v	L	4.148v	H
H	H	0.0617v	L	0.0665v	L	0.168v	L

The NAND gate follows the Boolean equation Y = A' * B '. The truth table shows that the output is only false when both inputs are true. In other words , the circuit produces a LOW output only when both inputs HIGH. In the lab, we confirmed this behavior , as demonstrated by the last row showing (0.0617 V). in all other cases, the output remains HIGH (3.9 V), which aligns with the truth table.

The NOR gate follows the Boolean equation Y = A' + B' . The truth table shows that the output is only true if both inputs are false. In the lab, we observed the output HIGH (4.004 V) only when both inputs are LOW. if either input is HIGH , the output drops to LOW (0.065- 0.69 V), aligning with theoretical expectations.

The XOR gate follows the Boolean equation Y = A $\oplus$ B , meaning it produces a HIGH output when the inputs differ. This is confirmed in the outputs that we observed in the lab when both A

or B differ from each other outputting a HIGH of 4.148 V. While the output remains LOW (0.168 V -0.157 V) when both are the same.

Conclusion:

Through the lab it was observed that different gates produced varying voltages. This is due to the fact that the gates were put into the same pattern of A and B. However each gate demonstrated a different range of numbers that represented high and low. This could be due to the composition and the different placements of both A and B found on each gate that could give these different values. Which overall made an observation on the voltages and observed the different outputs on each gate.

Post-lab Deliverables:

I overall really enjoyed this lab because it had me working on different gates and different materials that I never had the chance to experiment with. I didn't particularly dislike this lab. The instructions were clear and the lab manual helped my understanding towards how to properly do the lab