The University of Azad Jammu & Kashmir, Muzaffarabad

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Roll no: 2024-SE-09

Course Title: Computer Architecture & Logic Design

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A file demonstrating all the lab tasks performed till Midterms

Department of Software Engineering

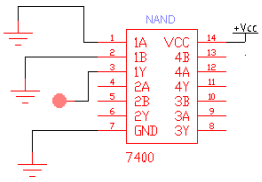
NAND Gate:

NAND Gate Simple Circuit:

Procedure:

I opened Electronics Workbench and started a new project.

1. I selected the 7400 IC, which has NAND gates in it.
2. I connected Vcc pin 14to power and GND pin 7to ground.
3. I used the first NAND gate by connecting two inputs to pin 1 and pin 2.
4. I took the output from pin 3, which gave me the NAND result.
5. Then I added switches to test the inputs and ran the circuit.
6. The output was correct for all input combinations, just like a NAND gate truth table.
7. The circuit was simple and worked perfectly.

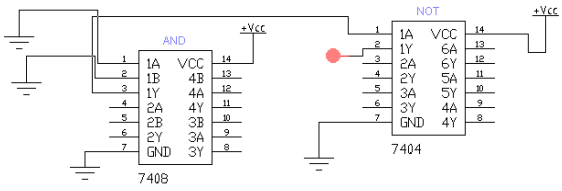


NAND Gate Complicated Circuit:

Procedure:

First, I opened Electronics Workbench and started a new file.

1. I picked the 7408 IC for the AND gate and the 7404 IC for the NOT gate from the component library.
2. Then, I connected Vcc and GND to both ICs (pin 14 to power and pin 7 to ground).
3. I connected two inputs to the AND gate at pins 1A and 1B of the 7408.
4. The output from the AND gate pin 3 was connected to the input of the NOT gate pin 1.
5. I took the final output from pin 2. This gave me the NAND output.
6. After wiring, I tested the circuit by giving different inputs and checked if the output was correct.
7. It worked like a NAND gate, so the circuit was successful.



Hardware circuit

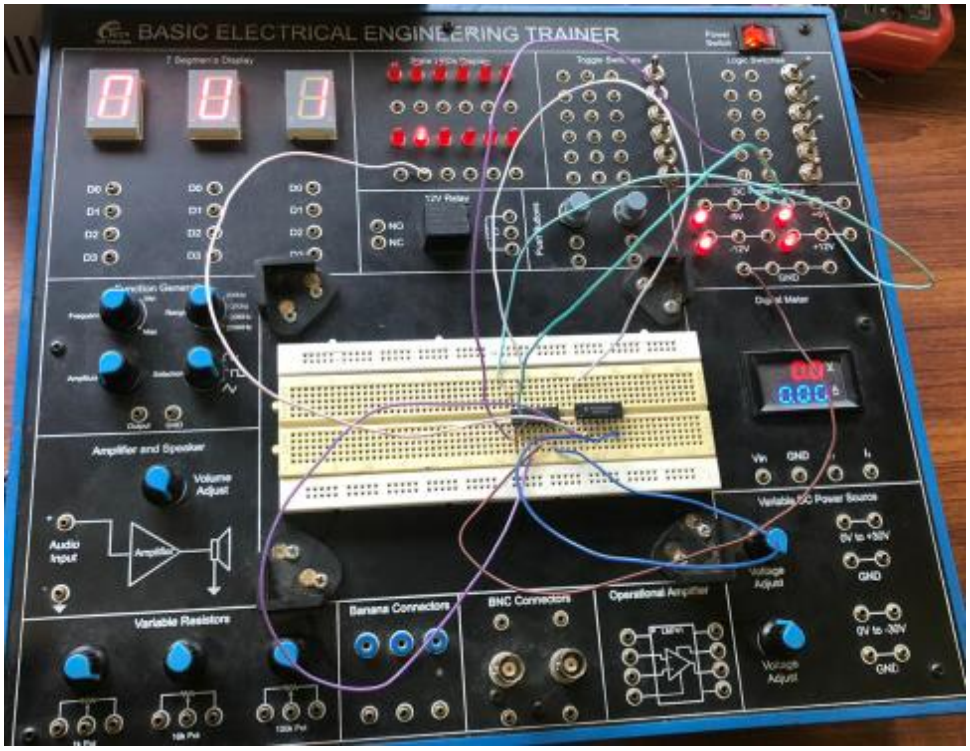


Table:

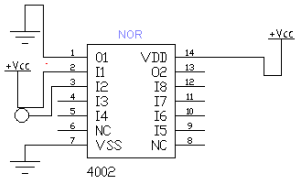
A	B	A.B	(A.B)’
1	1	1	0
1	0	0	1
0	1	0	1
0	0	0	1

NOR Gate:

NOR Gate Simple Circuit:

Procedure :

1. I opened Electronics Workbench and started a new project.
2. I selected the 7402 IC, which has NOR gates in it.
3. I connected Vcc pin 14 to power and GND pin 7 to ground.
4. I used the first NOR gate by connecting two inputs to pin 1 and pin 2.
5. I took the output from pin 3, which gave me the NOR result.
6. Then I added switches to test the inputs and ran the circuit.
7. The output was correct for all input combinations, just like a NOR gate truth table.
8. The circuit was simple and worked perfectly.



NOR Gate Complicated Circuit:

Procedure:

I opened Electronics Workbench and created a new project.

1. I selected a basic OR gate and a NOT gate from the components list.
2. I connected two input switches to the inputs of the OR gate.
3. I connected the output of the OR gate directly to the input of the NOT gate.
4. The output of the NOT gate became the final NOR output.
5. I added an LED to the output of the NOT gate to see the result.
6. Then I connected power and ground to all components as needed.

8.The output matched the NOR gate truth table exactly.

9.The circuit worked perfectly and showed how to build a NOR gate from simpler gates.

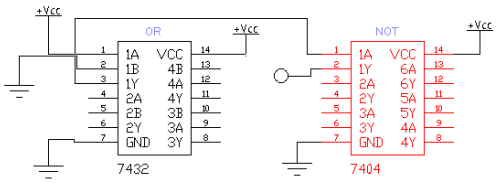


Table:

A	B	A+B	(A+B)’
1	1	1	0
1	0	1	0
0	1	1	0
0	0	0	1

De-Morgan’s Law for NAND Gate:

Procedure:

I opened Electronics Workbench and started a new project.

1. I added the 7400 IC (NAND gate), 7404 IC (NOT gate), and 7432 IC (OR gate) to the workspace.
2. I connected Vcc (pin 14) and GND (pin 7) on all three ICs.
3. For the left side of the circuit, I used a single NAND gate from the 7400:
    - I connected two switches to the inputs (pins 1 and 2).
    - The output was taken from pin 3, which showed the direct NAND result of A and B.
4. For the right side, I built the equivalent circuit using DeMorgan’s Law:

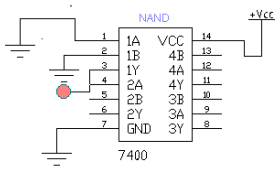
- I took the same two inputs (A and B) and connected each to a NOT gate .
- Their outputs were then connected to an OR gate .
- This way I created: A' + B' which, according to DeMorgan's Law, is equal to (A · B)'.

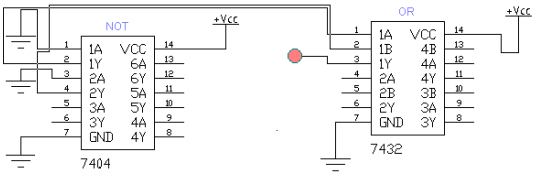
5. I connected LEDs to both outputs (NAND and OR-NOT combo) to compare them.
6. I tested all input combinations using the two switches:
   - (0,0), (0,1), (1,0), (1,1)

   which is De-Morgan's Theorem.
7. The LEDs lit up the same on both sides every time, so the proof worked perfectly.
8. This was a clean and clear way to verify DeMorgan's Law using logic gates and ICs.

Formula:

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





Hardware circuit

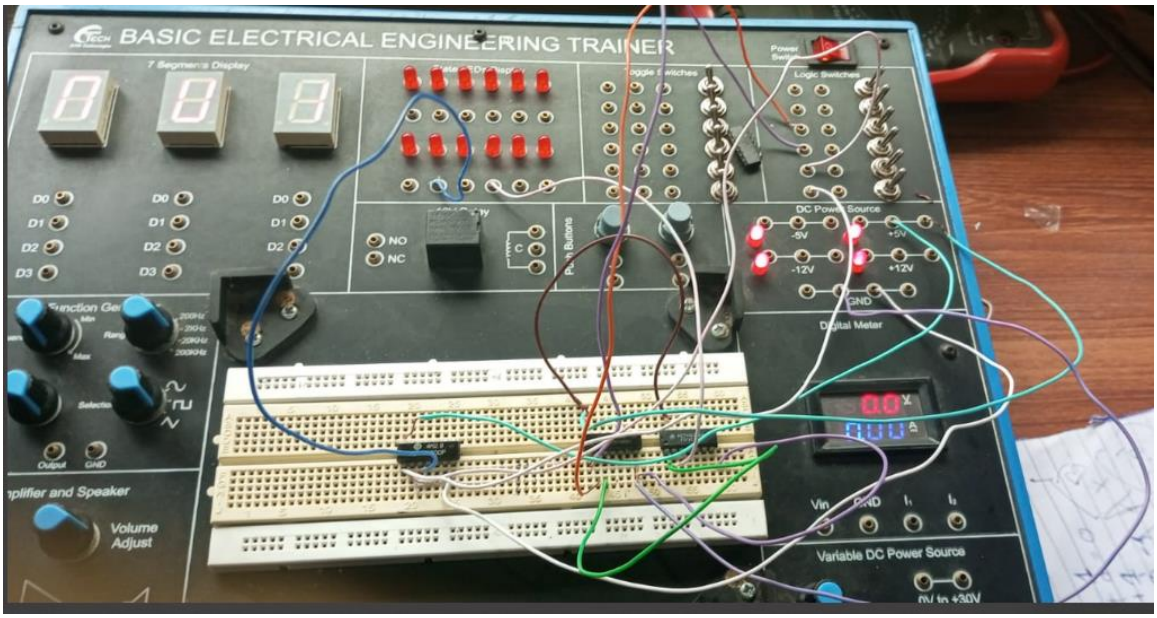


Table:

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

De-Morgan’s Law for NOR Gate:

Procedure:

I opened Electronics Workbench and started a new project.

1. I added the 7402 IC (NOR gate), 7408 IC (AND gate), and 7404 IC (NOT gate) to the workspace.
2. I connected Vcc (pin 14) and GND (pin 7) on all three ICs.
3. On the left side of the circuit, I used a single NOR gate :
    - I connected two switches as inputs to pins 1 and 2 of the IC.
    - The output from pin 3 gave me NOR(A, B) directly.

4. On the right side, I built the DeMorgan equivalent using NOT and AND gates:
    - I passed the same two inputs through two NOT gates from the 7404.
    - Then I connected those inverted outputs to an AND gate from the 7408.
    - This built: A' · B' which is the same as (A + B)’ by DeMorgan’s Law.
5. I connected LEDs to both outputs to visually compare the NOR and the AND-NOT combination.
6. I tested all input combinations using the switches:
    - (0,0), (0,1), (1,0), (1,1)
7. For every test, both outputs matched — showing the same logic level on both LEDs.
8. The circuit worked exactly how it should — both sides gave the same output for all input cases.

Formula:

(A+B)’=A’.B’

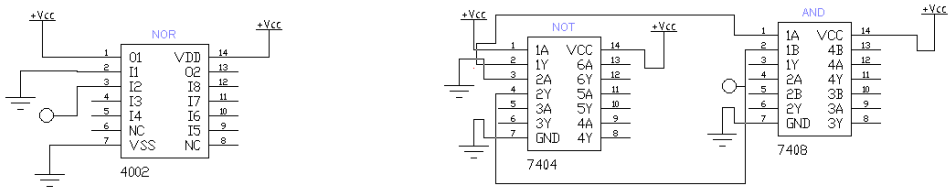


Table:

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

Half Adder

Half Adder simple circuit

Procedure: How I Created a Simple Half Adder Circuit

1. **Objective:**
   I wanted to make a half adder that adds two 1-bit inputs (A and B) and gives me the sum and carry outputs using a simple circuit.

2. **Understanding the Half Adder:**
   I know the half adder takes inputs A and B and produces:

- Sum = A XOR B
- Carry = A AND B

Since this is a simple circuit, I directly used XOR and AND gates for these outputs.

3. **Building the Circuit**:

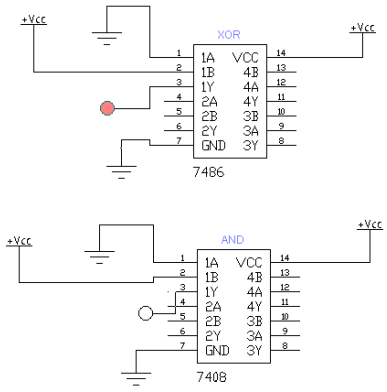
- I connected inputs A and B directly to an XOR gate to get the Sum output.
- Then I connected inputs A and B to an AND gate to get the Carry output.

4. **Testing the Circuit:**
   I tested all possible inputs:

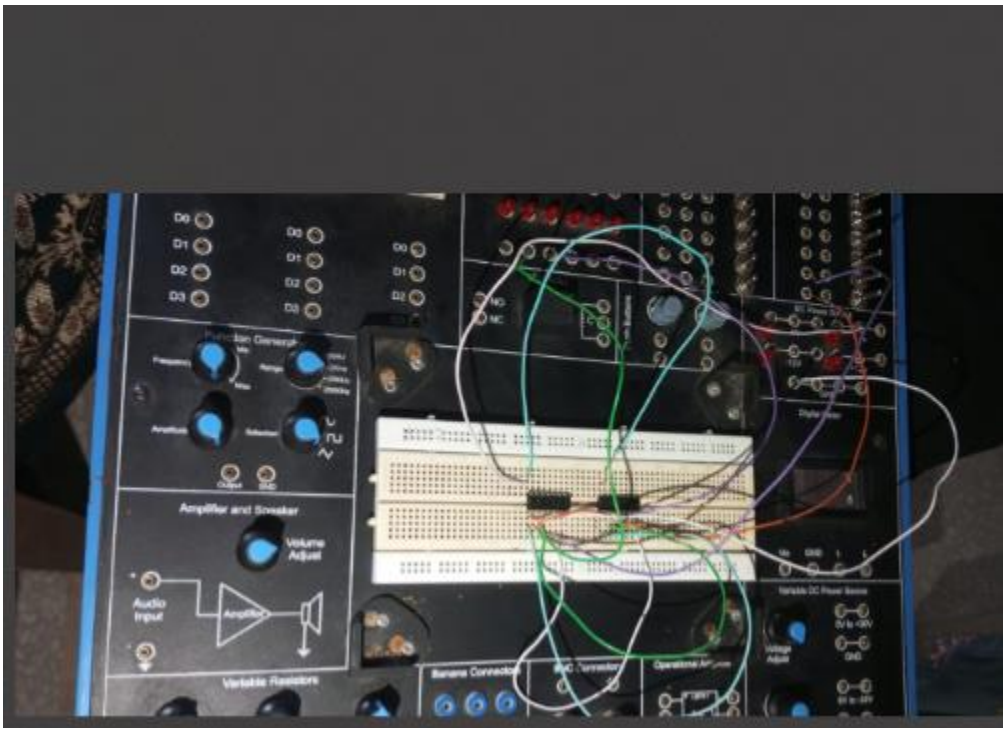
- A=0, B=0 → Sum=0, Carry=0
- A=0, B=1 → Sum=1, Carry=0
- A=1, B=0 → Sum=1, Carry=0
- A=1, B=1 → Sum=0, Carry=1

The outputs were exactly what I expected.

5. **Conclusion:**
   By using the XOR and AND gates directly, I built a simple and efficient half adder. This helped me understand how these basic gates work together to perform addition.



Hardware circuit:



Half Adder Complicated Circuit

Procedure: How I Created a Half Adder Using NOT, AND, and OR Gates

1. Objective:

I wanted to build a half adder that adds two inputs and outputs sum and carry, but only using NOT, AND, and OR gates because XOR gate wasn't allowed.

2. Understanding the Logic:

I know a half adder has two inputs (A and B) and two outputs:

- Sum = A XOR B
- Carry = A AND B

Since I can't use XOR directly, I needed to express XOR using only NOT, AND, and OR gates.

3. Building the Circuit:

- I connected input A to a NOT gate to get A', and input B to AND gate.
- Then I connected input A with AND gate and input B with NOT gate.
- Then I ANDed A' with B, and A with B'.
- I ORed the results of those two AND gates to produce the sum output.
- For carry, I simply ANDed A and B directly.

4. Testing the Circuit :

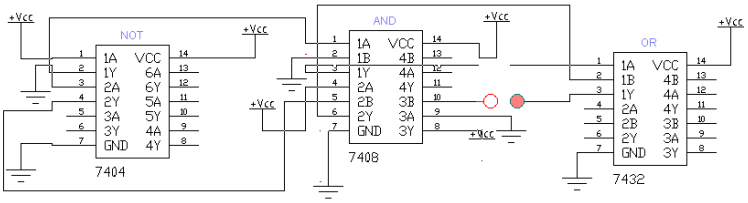
I tested the circuit for all possible inputs:

- For A=0, B=0 → Sum=0, Carry=0
- For A=0, B=1 → Sum=1, Carry=0
- For A=1, B=0 → Sum=1, Carry=0
- For A=1, B=1 → Sum=0, Carry=1

Everything worked exactly as expected.

5.Conclusion:

By building the half adder using NOT, AND, and OR gates, I learned how to create XOR functionality from basic gates. This helped me understand how complex logic circuits are made from simple parts.



Hardware circuit:

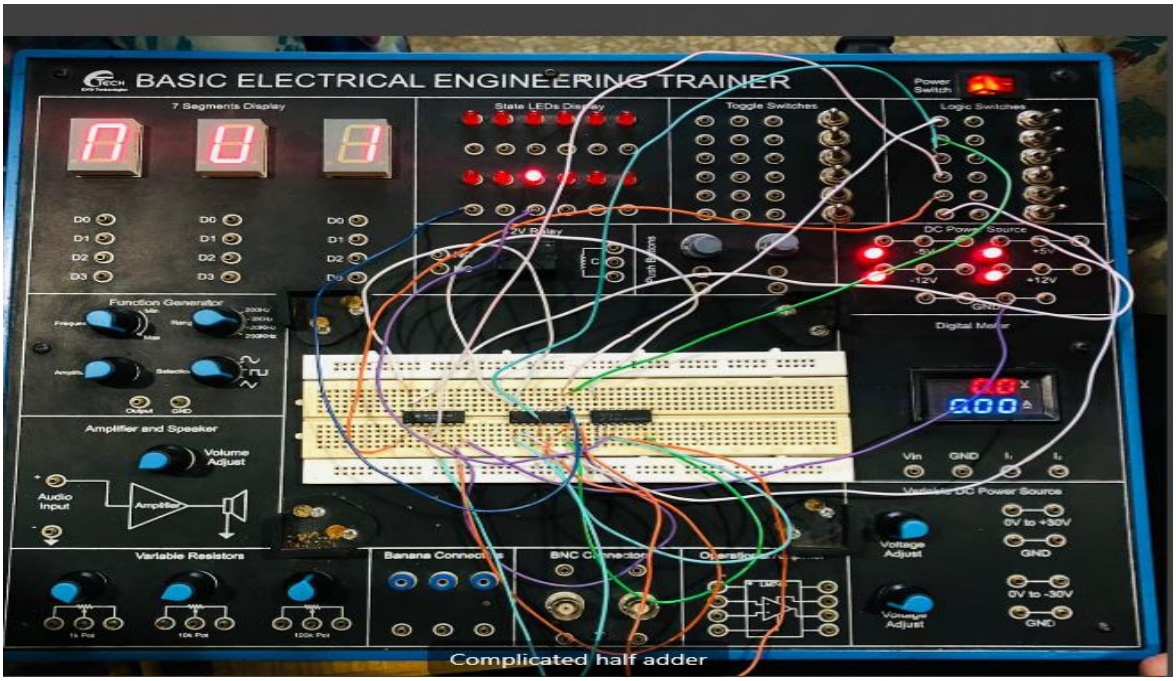


Table:

A	B	A’	B’	A’.B	A.B’	A’.B+A.B’(Sum)	A.B(carry)
1	1	0	0	0	0	0	1
1	0	0	1	0	1	1	0
0	1	1	0	1	0	1	0
0	0	1	1	0	0	0	0