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Experiment No : 01

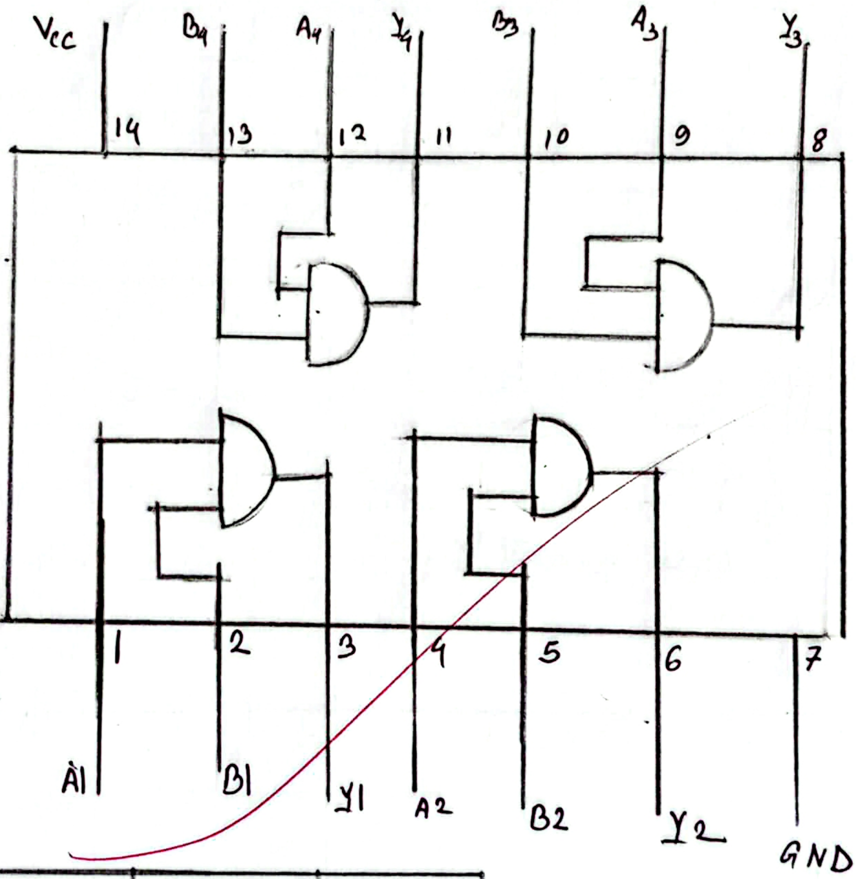
Experiment Name : Experiment the fundamental logic gate (AND, OR, NOT).

Objective : Introduction to digital electronics lab study of digital IC nomencaltune, specifications, data sheets, Vcc and ground concepts and verification of logic gate truth tables.

Equipments Required : AND Gate (7408), OR Gate (7432). NOT Gate (7404), connecting wires, ternary board,

Theory : A logic gate is a device that performs a boolean function, a logical operation performed on one or more binary inputs that produces a single binary output.
All digital systems can be constructed by only three basic logic gates. These basic gates are called AND gate, OR gate and NOT gate.

1. AND gate: The AND gate is a basic digital logic gate that implements logical conjunction from mathematical logic. AND gate behaves according to the truth table. A high output results only if all the inputs to the AND gate are High. If not all of the inputs to the AND gate are high, a low output results.



A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

2. OR Gate: The OR gate is a digital logic gate that implements logical disjunction. The OR gate outputs true if any of its inputs is true. othewise it outputs false. The input and output states are normally represented by different voltage levels.

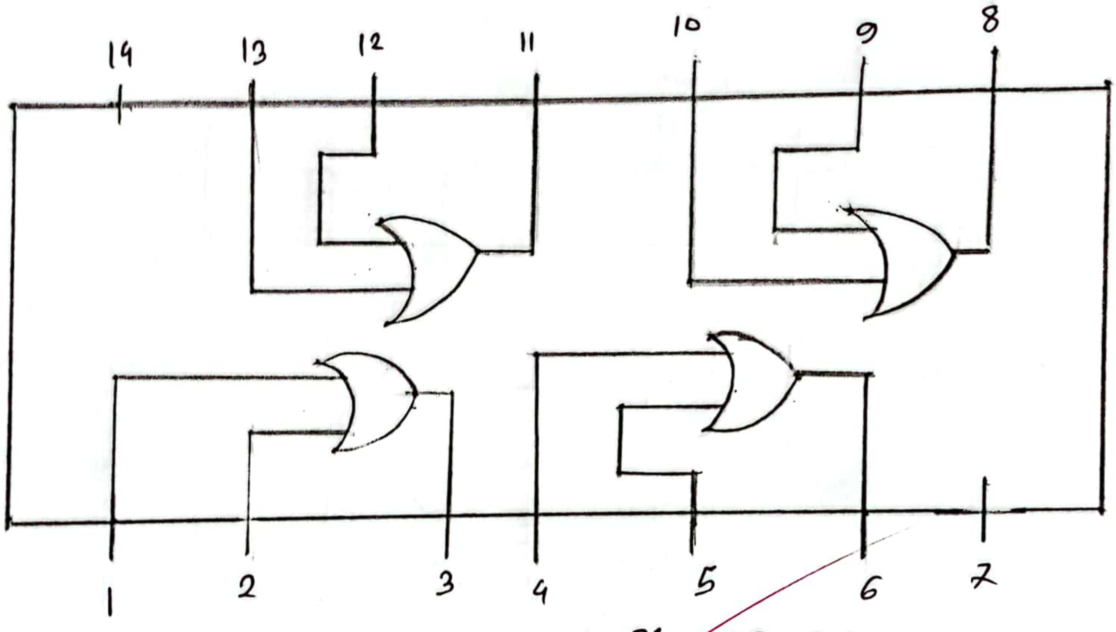


Fig: OR Gate.

Truth Table:

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1

3. NOT gate: A NOT gate performs logical negation on its input. If this input is true then the output will be false. Similarly a false input results in a true output.

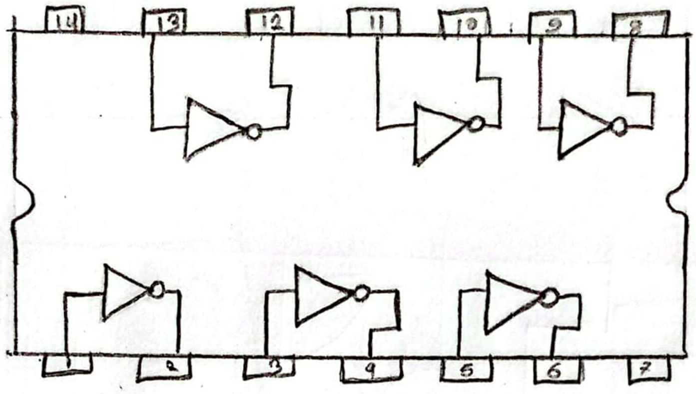


Fig: NOT gate.

<u>Truth table:</u>

A	$\bar{A}$
0	1
1	0

<u>Conclusion:</u> In this experiment, we succesfully verified the functionality of the fundamental logic gates AND, OR, NOT using truth tables. Through the use of these gates, we observed how binary inputs are processed to produce specific outputs. This experiment reinforced the basic principles of digital logic and their importance in constructing more complex circuit.

Experiment No: 02

Experiment Name: Investigate the logic gates NAND and NOR.

Objective: Introduction to digital electronics lab study of digital IC nomencalture, specifications, data sheets, Vcc and ground concepts and verification of logic gate truth tables.

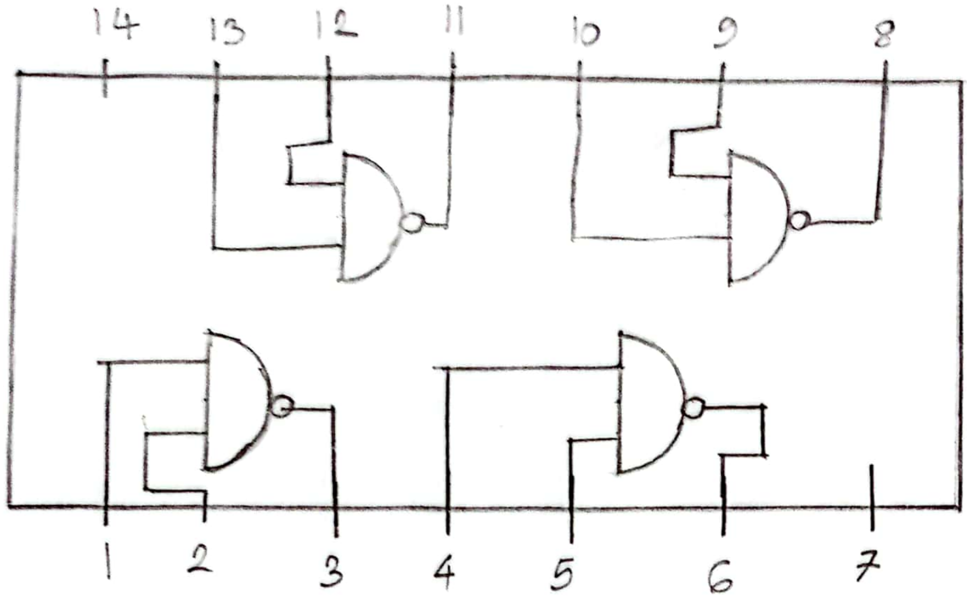
Equipments Required: NAND Gate (7400), NOR Gate (7402). Connecting wires, ternary board.

<u>Theory:</u> A logic gate is a device that performs a boolean function, a logical operation performed on one or more binary inputs that produces a single binary output. All digital systems can be constructed only by three logic gates. They are AND, OR or NOT gates. A universal gate is a gate which can implement any

boolean function without need to use any other gate type

1. NAND gate: NAND gate is an abbreviation for "NOT AND". A two-input NAND gate is a digital combination logic circuit that performs the logical inverse of an AND gate. While an AND gate outputs a logical "1" only if both inputs are logical '1'., a NAND gate outputs a logical 0 for this same combination of inputs.

2. NOR gate: A NOR gate is a digital logic gate that gives an output of 0 when any of its inputs are 1, otherwise 1. NOR is the result of the negation of the OR operator.



Truthtable of NAND gate:

A	B	Output
1	1	0
0	0	1
0	1	1
1	0	1

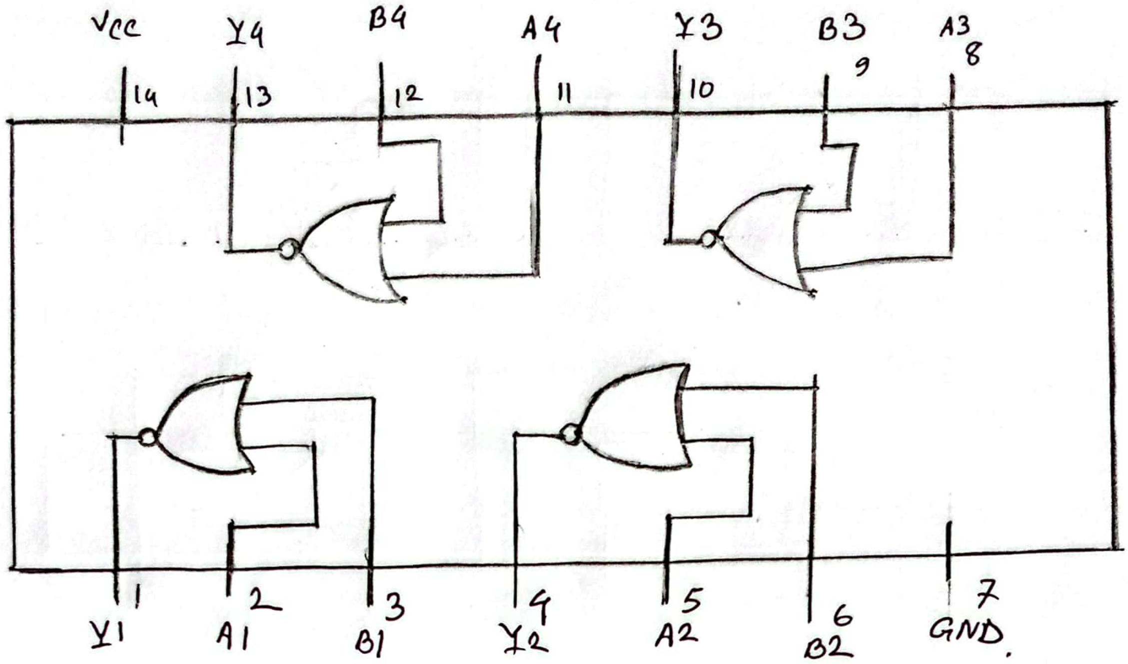


Fig: IC 7402

Truth table of NOR gate:

A	B	Output
1	1	0
1	0	0
0	1	0
0	0	1

Procedure:

1. Place the breadboard gently on the observation table.
2. To avoid the shortage of voltage fix the IC.
3. Connect the wire to the main voltage source. whose other end is connected to last pin of the IC (14 place from the notch).
4. Connect the ground of IC (7th place from notch) to the ground terminal provided on the digital lab kit.
5. Give the input at any one of the gate of the ICs i.e. 1st, 2nd, 3rd, 4th gate by using connecting wires.
6. Connect output pins to the led on digital lab kit.
7. Switch on the power supply.
8. If LED glows red output is true, if it doesn't output is false.

Result: All gates are verified. Observed output matches theoritical concepts.

Discussion: In this experiment, we successfully investigated the behavior of NAND and NOR gates, verifying their truth tables and understanding their significance as universal gates. By configuring multiple NAND and NOR gates, we were able to replicate the function of other basic gates, highlighting their flexibility in digital logic design.

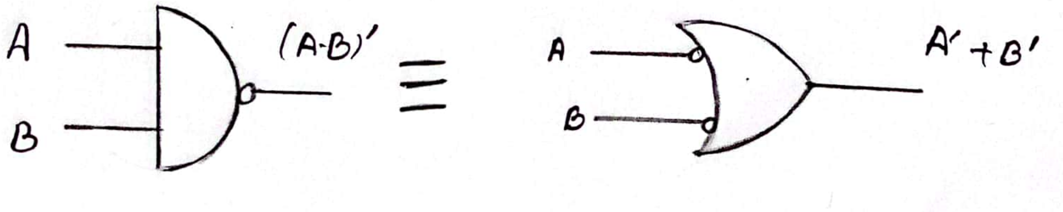
Experiment No: 03

Experiment Name: Design a circuit to verify De Morgan's law for two variables

Objective: To verify De Morgan's Theorem.

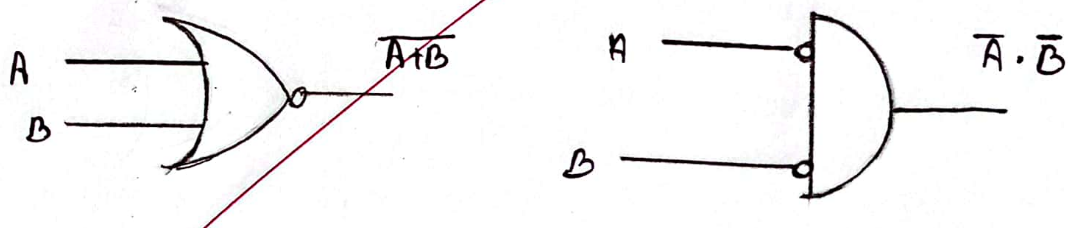
Equipment Required: Breadboard, Patch cords, IC - 7404 (NOT), 7408 - AND, 7432 - OR.

Theory: De Morgan's first theorem states that the opposite of multiplying two variable is the same as adding the opposite of those variables. In other words, if we AND two variables and then take the complement, it is the same as doing OR the complements of the individual variables. $(A \cdot B)' = A' + B'$



De Morgan's second theorem says that the complement of adding two variables is the same as multiplying the complement of each variable. In simpler terms, if we OR two variables and then take the complement, it's the same as to do AND operation the complements of the individual variables.

$$(A+B)' = A' \cdot B'$$



Truth Table:

De Morgan's First Theorem:

$$(A \cdot B)' = A' + B'$$

L.H.S (A·B)'			R.H.S (A'+B').		
A	B	Y	A	B	Y
0	0	1	0	0	1
0	1	1	0	1	1
1	0	1	1	0	1
1	1	0	1	1	0

Procedure:

1. Plug the IC chip into the breadboard
2. Connect the supply voltage and ground lines to the chips, pin 7 = Ground, PIN 14 = +5V.
3. Make the connection between the ICs.
4. Connect the inputs of the gate to the input switches of the LED.

5. Connect the output of the gate to the output LED.

6. Once all connection have been done, turn on the power switch of the breadboard.

7. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is off. We need to apply various combination of input according to the truth table and observe the condition of Output LEDs.

Result: Verification of De Morgan's theorem is successfully done.

Discussion: From the experiment above we have learned the applications of De Morgan's law by which we can optimize our circuits by reducing logic gates. Simplyfying the boolean expressions using these laws has both theoretical and practical significance in improving circuit efficiency. This experiment confirmed the value of De Morgan's laws for optimizing logic circuits through successful expression simplification and verification using truth tables and logic gates.