EXPERIMENT NO. 1

AIM: To Verify the Behaviour of Logic Gates using Truth Table.

APPARATUS:

- Digital Trainer kit
- Digital ICs: 7404 :Hex Inverter
  7408: Quad 2 input AND
  7432: Quad 2 input OR
  7400: Quad 2 input NAND
  7402: Quad 2 input NOR
  7486: Quad 2 input EXOR
- Patch cords

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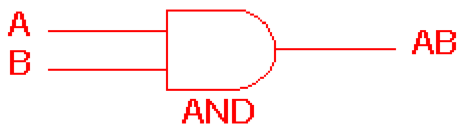
LEARNING OBJECTIVES:

- Students will get familiar with the usage of the available lab equipments.
- Student will get familiar with Digital Trainer Kit.
- Student will able to describe and verify the operation for the AND, OR, NOT, NAND, NOR, XOR, XNOR gates.
- Student will able to do representation of functions by truth tables, logic diagrams
  and Boolean algebra
- Student will get basic knowledge in integrated circuit devices operation
- Student will practice how to build a simple digital circuit using ICs and other digital
  Components.
- Student will learn how to Wire a circuit.

THEORY AND ANALYSIS:

A Digital Logic Gate is an electronic device that makes logical decisions based on the different combinations of digital signals present on its inputs. Logic gates are the building blocks of digital circuits. Combinations of logic gates form circuits designed with specific tasks in mind. They are fundamental to the design of computers. Digital logic using transistors is often referred as Transistor-Transistor Logic or TTL gates. These gates are the AND, OR, NOT, NAND, NOR, EXOR and EXNOR gates

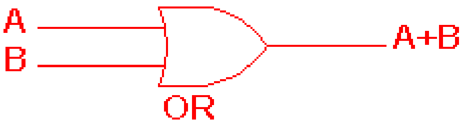
AND Gate: A multi-input circuit in which the output is 1 only if all inputs are 1.The symbolic representation of the AND gate is:



2 Input AND gate		
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

The AND gate is an electronic circuit that gives a high output (1) only if all its inputs are high. A dot (.) is used to show the AND operation i.e. A.B.

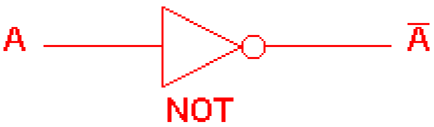
OR gate: A multi-input circuit in which the output is 1 when any input is 1.The symbolic representation of the OR gate is shown:



2 Input OR gate		
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

The OR gate is an electronic circuit that gives a high output (1) if one or more of its inputs are high. A plus (+) is used to show the OR operation.

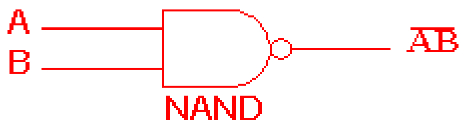
NOT gate: The output is 0 when the input is 1, and the output is 1 when the Input is 0. The symbolic representation of an inverter is :



NOT gate	
A	$\overline{A}$
0	1
1	0

The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an inverter. If the input variable is A, the inverted output is known as NOT A. This is also shown as A', or A with a bar over the top, as shown at the outputs.

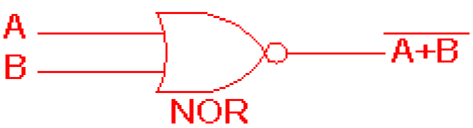
NAND gate: AND followed by INVERT. It is also known as universal gate.Thesymbolic representation of the NAND gate is:



2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

This is a NOT-AND gate which is equal to an AND gate followed by a NOT gate.The outputs of all NAND gates are high if any of the inputs are low. The symbol is an AND gate with a small circle on the output. The small circle represents inversion.

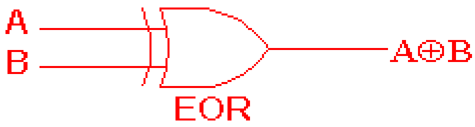
NOR gate: OR followed by inverter. It is also known as universal gate. The symbolic representation is:



2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

This is a NOT-OR gate which is equal to an OR gate followed by a NOT gate.The outputs of all NOR gates are low if any of the inputs are high. The symbol is an OR gate with a small circle on the output. The small circle represents inversion.

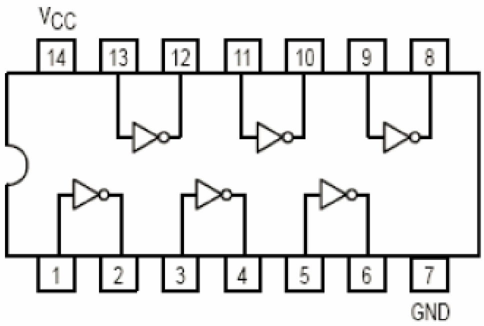
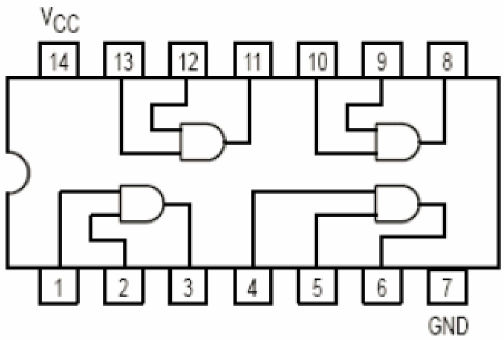
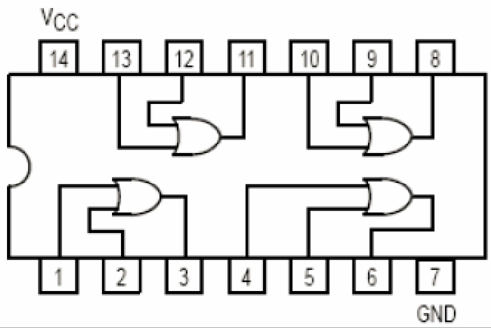
EXOR gate: The output of the Exclusive –OR gate, is 0 when it’s two inputs are the same and it’s output is 1 when its two inputs are different. It is also known as Anti-coincidence gate.

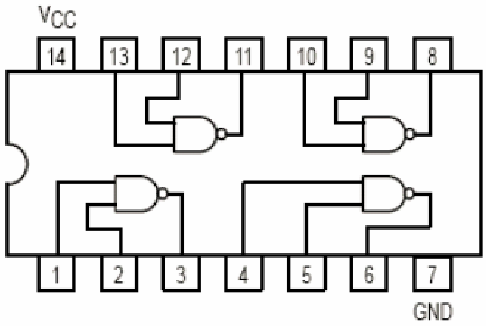
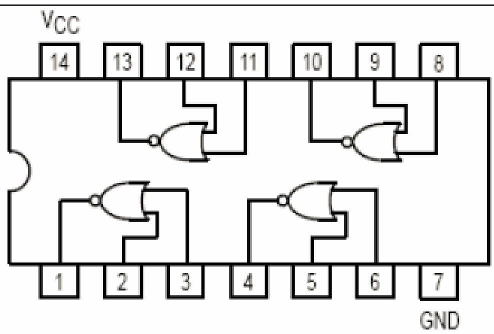
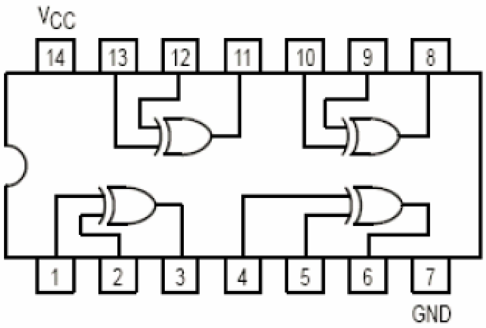


2 Input EXOR gate		
A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

The 'Exclusive-OR' gate is a circuit which will give a high output if either, but not both, of its two inputs are high.An encircled plus sign (⊕) is used to show the EOR operation.

PIN DIAGRAM:

	**Not Gate: IC 7404(HEX Inverter)** **14 Pin** **Supply voltage :5V**
	**AND Gate: IC 7408** **14 Pin** **Quad 2 input AND Gate** **Supply voltage :5V**
	**OR Gate: IC 7432** **14 Pin** **Quad 2 input OR Gate** **Supply voltage :5V**
	NAND Gate: IC 7400 **14 Pin** **Quad 2 input NAND Gate** **Supply voltage :5V**

	
	**NOR Gate: IC 7402** **14 Pin** **Quad 2 input NOR Gate** **Supply voltage :5V**
	**EXOR Gate: IC 7486** **14 Pin** **Quad 2 input EXOR Gate** **Supply voltage :5V**

PROCEDURE:

1. Collect the components necessary to accomplish this experiment.
2. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5V.
3. According to the pin diagram of each IC mentioned above, wire only one gate to verify its truth table.
4. Connect the inputs of the gate to the input switches of the LED.
5. Connect the output of the gate to the output LEDs.
6. Once all connections have been done, turn on the power switch.
7. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if LED is OFF apply the various combinations of inputs according to the truth table and observe the condition of Output LEDs.
8. Repeat the above steps 1 to 5 for all the ICs.

Results and Analysis:

NOT Gate: When logic 1 is applied to one of NOT gate of 7404 IC, then Output becomes zero. When input LED is ON (RED), the output LED become OFF (Green) vice versa.

OR Gate: The output of an OR gate is a 1 if one or the other or both of the inputs are 1, but a 0 if both inputs are 0. When One or the other or Both of the input LEDS are ON (RED Light), then output LED is ON(RED) otherwise Output LED is OFF(Green Light)

AND Gate: The output of an AND gate is only 1 if both its inputs are 1. For all other possible inputs the output is 0.When both the LEDS are On, then output LED is ON (RED Light) otherwise Output LED is OFF.

NOR Gate: The output of the NOR gate is a 1 if both inputs are 0 but a 0 if one or the other or both the inputs are 1.

NAND Gate: The output of the NAND gate is a 0 if both inputs are 1 but a 1 if one or the other or both the inputs are 0.

EXOR gate: The output of the XOR gate is a 1 if either but not both inputs are 1 and a 0 if the inputs are both 0 or both 1.

Observation Table: LED ON: Logic 1

LED OFF: Logic 0
Input variables: A,B
Output variable: Y

S.No	Input(A) LED	Input(B) LED	Output (NOT) $Y = \overline{A}$	Output (AND) Y=AB	Output (OR) Y=A+B
1					
2					
3					
4					

CONCLUSION:

Any Boolean expression can be realized using NOT, AND, OR, NAND,NOR, EXOR gates.