

Digital Logic Design (EL-227) LABORATORY MANUAL SPRING - 2021



LAB 02 Primary Gates

STUDENT NAME

ROLL NO

SEC

INSTRUCTOR SIGNATURE & DATE

Lab Session 02

OBJECTIVES:

The objective of this lab is:

- Verification and interpretation of truth tables for AND, OR, NOT, XOR, NAND & NOR gates.

APPARATUS:

- Logic trainer
- Breadboard, logic gates / ICs,
- Wires

What are logic gates?

Logic gates are electronic circuits which perform logical functions on one or more inputs to produce one output. There are seven logic gates. When all the input combinations of a logic gate are written in a series and their corresponding outputs written along them, then this input/ output combination is called **Truth Table**.

What is Truth Table?

The **table** used to represent the boolean expression of a logic gate function is commonly called a **Truth Table**. A logic gate **truth table** shows each possible input combination to the gate or circuit with the resultant output depending upon the combination of these input(s).

AND GATE

AND gate produces an output as 1, when all its inputs are 1; otherwise, the output is 0. This gate can have minimum 2 inputs but output is always one. Its output is 0 when any input is 0.

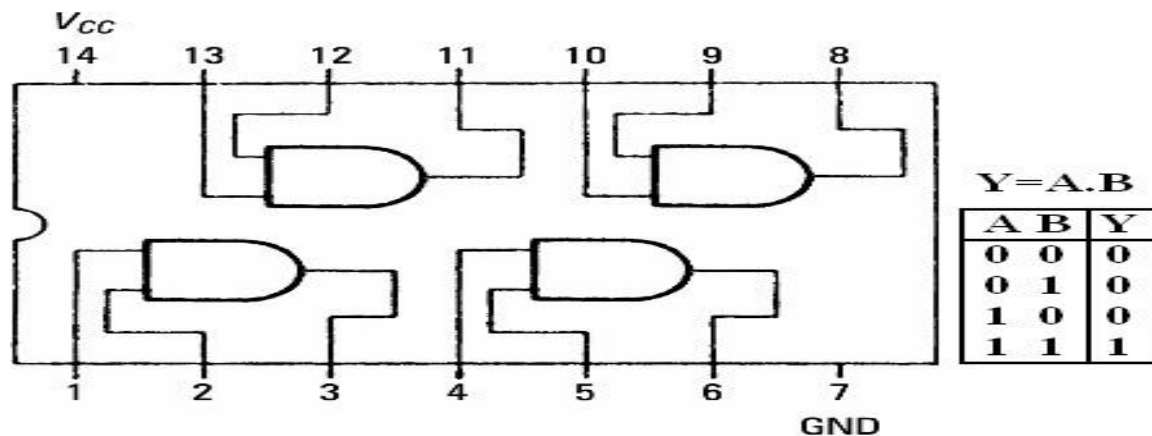
IC Number of And gate:

The number to identify that the given IC is AND gate so on the top of IC a serial number 7408 will be written.

Diagrammatic Representation:



IC Representation and Truth Table:



OR GATE

OR gate produces an output as 1, when any or all its inputs are 1; otherwise the output is 0. This gate can have minimum 2 inputs but output is always one. Its output is 0 when all input are 0.

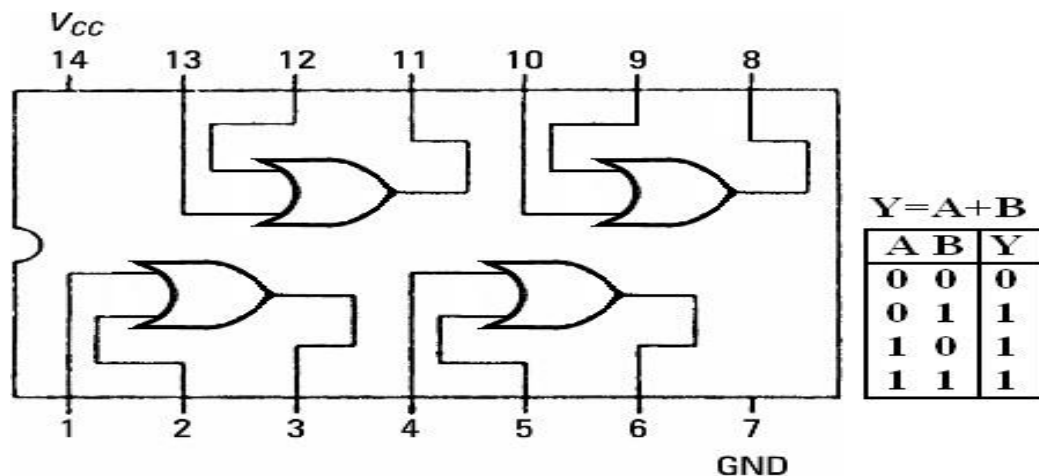
IC Number of OR gate:

The number to identify that the given IC is OR gate so on the top of IC a serial number 7432 will be written.

Diagrammatic Representation:



IC Representation and Truth Table:



NOT GATE

NOT gate produces the complement of its input. This gate is also called an INVERTER. It always has one input and one output. Its output is 0 when input is 1 and output is 1 when input is 0.

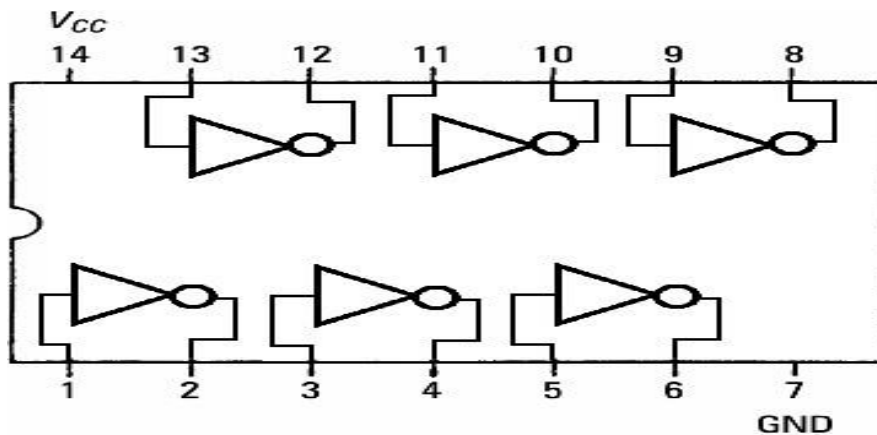
IC Number of NOT gate:

The number to identify that the given IC is NOT gate so on the top of IC a serial number 7404 will be written.

Diagrammatic Representation:



IC Representation and Truth Table:



$$Y = \overline{A}$$

A	Y
0	1
1	0

BASIC CIRCUIT CONNECTION PROCEDURE:

The components used to build digital circuits are very delicate and can easily be damaged if not handled properly. Following are the steps to build a digital circuit:

- Turn power switch OFF.
- Place diode / transistor / IC chip on the breadboard. Make sure their pins are not short circuited.
- Connect the GND pins of all IC chips to ground.
- Connect the VCC pins of all chips to +5V on your trainer.
- Connect all other input and output signals
- Turn power ON

PRECAUTIONS:

Be careful not to connect any circuit output to VCC or any other output.

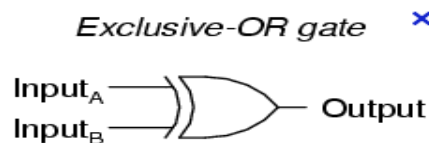
- Check IC diagram before making any connections.
- Turn power OFF before you modify the circuit.
- Handle components from their top plastic part. Avoid touching ICs

XOR GATE

XOR GATE

An Exclusive-OR (XOR) gate is a gate with two / three or more inputs and one output. The output of a two-input XOR gate assumes a HIGH state if one and only one input assumes a HIGH state. This is equivalent to saying that the output is HIGH if either input X or input Y is HIGH exclusively and LOW when both are 1 or 0 simultaneously. If A and B are two inputs, then output C can be represented mathematically as $C = A \oplus B$. Here \oplus denotes the XOR operation. $A \oplus B$ is equivalent to $A.B + A.B$. Truth table and symbol of the XOR gate is shown in the figure below:

Figure 1-4: 2-Input Exclusive-OR Gate



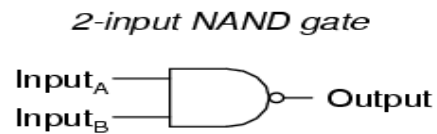
A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

NAND GATE

NAND GATE

NAND gate is a cascade of AND gate and NOT gate. It has two or more inputs and only one output. The output of NAND gate is HIGH when any one of its input is LOW (i.e. even if one input is LOW, Output will be HIGH). If A and B are two inputs, then output C can be represented mathematically as $C = \overline{A.B}$. Here dot (.) denotes the AND operation and Bar denotes inversion. Truth table and symbol of the NAND gate is shown in the figure below.

Figure 1-6: 2-Input NAND Gate



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

NOR GATE

NOR GATES

NOR gate is a cascade of OR gate and NOT gate. It has two or more inputs and only one output. The output of NOR gate is HIGH when any all its inputs are LOW (i.e. even if one input is HIGH, output will be LOW). If A and B are two inputs, then output C can be represented mathematically as $C = \overline{(A + B)}$; here plus (+) denotes the OR operation and bar denotes inversion. Truth table and symbol of the NOR gate is shown in the figure below.

Figure 1-8: 2-Input NOR Gate



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