LOGIC GATES

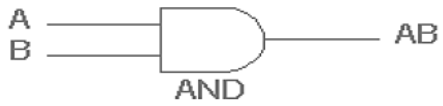
A Logic Gate is assigned as an elementary building block of digital circuits. Logic gate is considered as a device which has the ability to produce one output level with the combinations of input levels. There are seven basic types of logic gates:

- AND Gate
- OR Gate
- NOT Gate
- NAND Gate
- NOR Gate
- EXCLUSIVE-OR GATE (X-OR) Gate
- EXCLUSIVE-NOR (X-NOR) Gate

Inputs and outputs of logic gates are in two levels termed as HIGH and LOW, or TRUE and FALSE, or ON and OFF, or simply 1 and 0. A table which list out the combination of input variables and the corresponding output variables is termed as "TRUTH TABLE". It explains how the logic circuit output responds to various combinations of logic levels at the inputs. Here we are following level logic, in which the voltage levels are represented as logic 1 and logic 0. Level logic is of two types such as positive logic or negative logic. In the positive logic system, higher of the two voltage levels are represented as 1 and lower of the two voltage levels are represented as 0. But in the negative logic system, higher of the two voltage levels are represented as 0 and lower of the two voltage levels are represented as 1.

AND GATE

The AND gate is a digital logic gate with 'n' inputs one output, which perform logical conjunction based on the combinations of its inputs. The output of this gate is true only when all the inputs are true. When one or more inputs of the AND gate's inputs are false, then only the output of the AND gate is false. The symbol and truth table of an AND gate with two inputs is shown below.



Symbol

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

Truth Table

OR Gate

The OR gate is a digital logic gate with 'n' i/ps and one o/p, that performs a logical conjunction based on the combinations of its inputs. The output of the OR gate is true only when one or more inputs are true. If all the i/ps of the gate are false, then only the output of the OR gate is false. The symbol and truth table of an OR gate with two inputs is shown below.

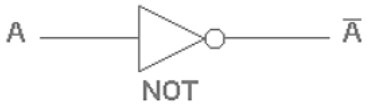
Symbol

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

Truth Table

NOT Gate

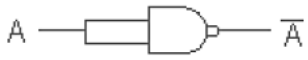
The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an inverter. If the input variable is A, the inverted output is known as NOT A. This is also shown as A', or A with a bar over the top, as shown at the outputs. The diagrams below show two ways that the NAND logic gate can be configured to produce a NOT gate. It can also be done using NOR logic gates in the same way.

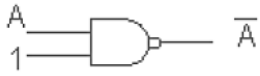


Symbol

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

Truth Table

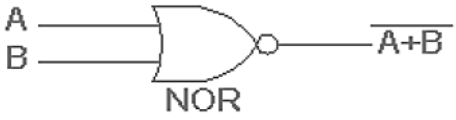




Operation

NOR Gate

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.



Symbol

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

Truth Table

EXOR gate

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.

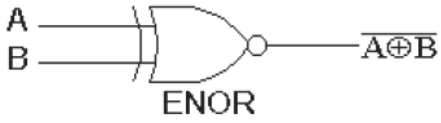
Symbol

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

Truth Table

EXNOR gate

The 'Exclusive-NOR' gate circuit does the opposite to the EOR gate. It will give a low output if either, but not both, of its two inputs are high. The symbol is an EXOR gate with a small circle on the output. The small circle represents inversion.



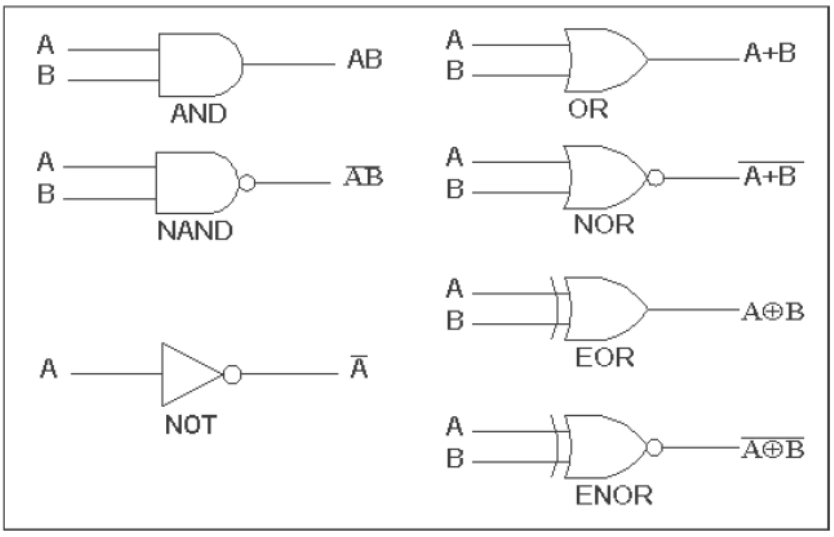
Symbol

2 Input EXNOR gate		
A	B	$\overline{A⊕B}$
0	0	1
0	1	0
1	0	0
1	1	1

Truth Table

The **NAND and NOR gates are called universal functions** since with either one the AND and OR functions and NOT can be generated.

- A function in sum of products form can be implemented using NAND gates by replacing all AND and OR gates by NAND gates.
- A function in product of sums form can be implemented using NOR gates by replacing all AND and OR gates by NOR gates.



Logic Gate Symbols