Logical Operations

Apart from the arithmetic operations that we frequently perform, there are some **logical operations** as well. These operations are usually performed on the **binary digits(0s and 1s)**

Logic gates are the fundamental building blocks of a digital system. A logic gate is an **idealized or physical** device used to perform a **logical operation(**implement a **Boolean function)**.

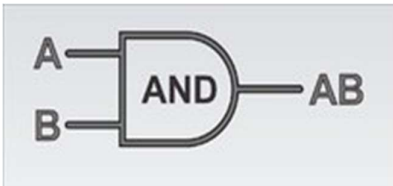
A **truth table** lists all possible combinations of inputs and the corresponding output, depending on the operation performed.

Logic gates belong to several families and involve a little complicacy. However, in this course, we will focus on basic logical operations.

AND Gate (IC no. 7408)

The **AND** gate is used to perform logical **'AND'** operation. It gives an output 1 when all its inputs are 1, else its output is 0.

SYMBOL



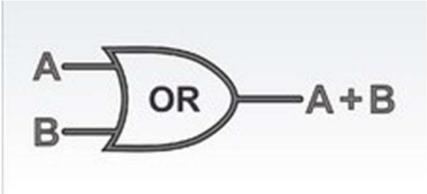
Truth Table

A	B	Y=A.B
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate (IC no. 7432)

The **OR** gate is used to perform a logical **'OR'** operation. It gives an output 0 when all its inputs are 0, else its output is 1.

SYMBOL



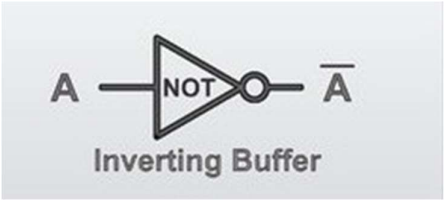
Truth Table

A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate (IC no. 7404)

The **NOT** gate is used to perform a logical **'NOT'** operation. The output of a NOT gate is the complement of its input. It gives an output 1 when the input is 0 and vice-versa. It has a single input and a single output.

SYMBOL



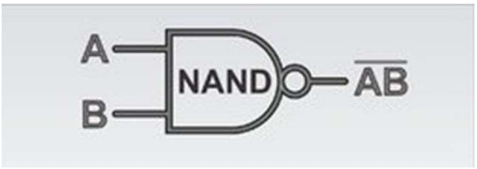
Truth Table:-

A	A'
0	1
1	0

NAND Gate (IC no. 7400)

The **NAND** gate performs the logical **'NAND'** operation. It is the combination of **AND** and **NOT** operation. It gives an output 1 when any of the input is 0, else the output is 0.

SYMBOL



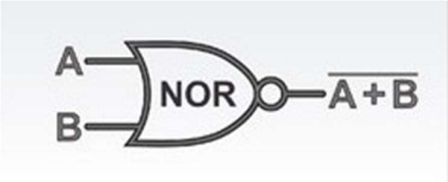
Truth Table

A	B	Y=A'.B'
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate (IC no. 7402)

The **NOR** gate performs the logical **'NOR'** operation. It is the combination of **OR** and **NOT** operation. It gives an output 0 when any of the input is 1, else the output is 1.

SYMBOL



Truth Table

A	B	Y=A'+B'
0	0	1
0	1	0
1	0	0
1	1	0

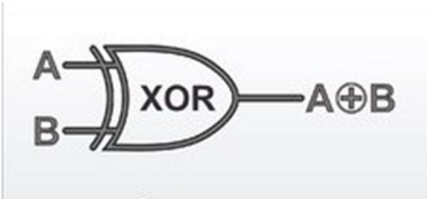
EX-OR/X-OR Gate (IC no. 7486)

The **EXCLUSIVE-OR/EX-OR** gate performs the logical **'EX-OR'** operation. Its output is determined by the following expression:

Y=A'B+AB'

The output of an EX-OR gate is 0 when all its inputs are at the same logic state(0/1), else the output is 1.

SYMBOL



Truth Table

A	B	Y=A'B+AB'
0	0	0
0	1	1
1	0	1
1	1	0

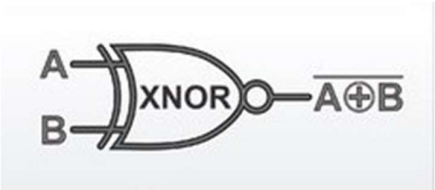
EX-NOR/X-NOR Gate (IC no. 74266)

The **EXCLUSIVE-NOR/EX-NOR** gate performs the logical **'EX-NOR'** operation. It is the combination of **EX-OR** and **NOT** operation. Its output is determined by the following expression:

Y=AB+A'B'

The output of an EX-NOR gate is 1 when all its inputs are at the same logic state(0/1), else the output is 0.

SYMBOL



Truth Table

A	**B**	**Y=AΘ B**
0	0	1
0	1	0
1	0	0
1	1	1

Those were some of the logical operations that are performed frequently. You can go through various tutorials available on the internet for a more detailed study of logical operations and logic gates.

By the end of this module, you should be familiar with **Number Systems** and **Logical Operations**. With this, our prerequisite module comes to an end.

Keep Exploring!

References

'Digital Design With an Introduction to the Verilog HDL, VHDL, and System Verilog', 6th Edition By M. Morris Mano and Michael D. Ciletti, Pearson Education