Experiment 1: Introduction to Gates

A logic gate is a building block of a digital circuit. Most logic gates have two inputs and one output and are based on Boolean algebra. At any given moment, every terminal is in one of the two binary conditions *false* (high) or *true* (low).

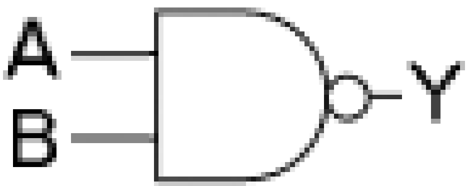
There are three types of Gates:-

1).Universal Logic Gates : Universal logic gates are the logic gates that are capable of implementing any Boolean function without requiring any other type of gate.

There are two different Universal Gates:

- ***NAND Gate*:** The output of NAND Gate is at logic high, when atleast one of the input is at logic low. The output of NAND Gate is at logic low, when all the inputs are at logic high.

  Boolean Expression: $X = \overline{A \cdot B}$



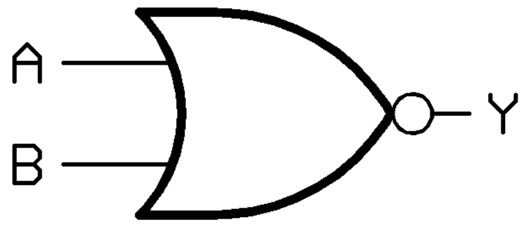
Two Input NAND Gate

A(I/P)	B(I/P)	Y(O/P)
0	0	1
0	1	1
1	0	1
1	1	0

Truth Table for two input NOR Gate

- ***NOR Gate:*** The output of NOR Gate is at logic low, if any of the input is at logic high. The output of NOR Gate is at logic high, when all the inputs are at logic low.

  Boolean Expression: $X = \overline{A+B}$



Two Input NOR Gate

A(I/P)	B(I/P)	Y(O/P)
0	0	1
0	1	0
1	0	0
1	1	0

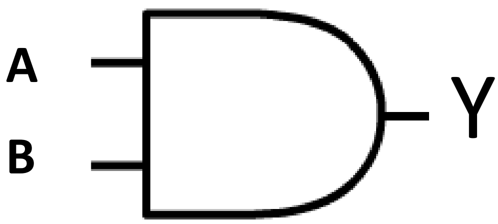
Truth Table for two input NOR Gate

2).Basic Logic Gates: Basic Logic Gates are the fundamental logic gates using which universal logic gates and other logic gates are constructed.

There are three different Basic Gates:

- ***AND Gate: :*** The output of AND Gate is at logic low, when atleast one of the input is at logic low. The output of AND Gate is at logic high, when all the inputs are at logic high.

  Boolean Expression: $X = A \cdot B$



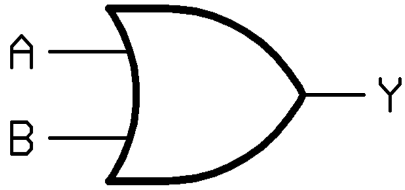
Two input AND Gate

A(I/P)	B(I/P)	Y(O/P)
0	0	0
0	1	0
1	0	0
1	1	1

Truth Table for two input AND Gate

- ***OR Gate:*** The output of OR Gate is at logic high, if any of the input is at logic high. The output of OR Gate is at logic low, when all the inputs are at logic low.

  Boolean Expression: Y=A+B



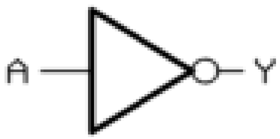
Two input OR Gate

A(I/P)	B(I/P)	Y(O/P)
0	0	0
0	1	1
1	0	1
1	1	1

Truth Table for two input OR Gate

- ***NOT Gate:*** The output of NOT Gate is at logic high when the input is at logic low, and the output is at logic low if the input is at logic high.

  Boolean Expression: $Y=\overline{A}$



NOT Gate

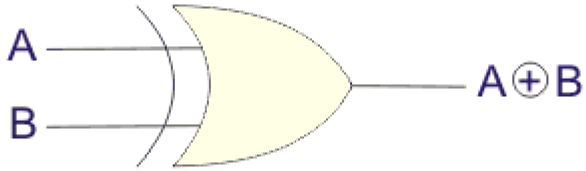
A(I/P)	Y(O/P)
0	1
1	0

Truth table for NOT Gate

3).Other Logic Gates: These two “hybrid” logic gates are called the Exclusive-OR (Ex-OR) Gate and its complement the Exclusive-NOR (Ex-NOR) Gate.

- ***X-OR Gate:*** The Exclusive OR Gate is abbreviated as the X-OR Gate. This is a compound gate made up of AND, OR and NOT gates. The output signal is obtained by comparing different input bits through this gate. The output is at logic high when there are an odd number of logic high’s in the inputs, Otherwise it is at logic low.

Boolean Expression: Y= $A \oplus B = A\overline{B} + \overline{A}B$



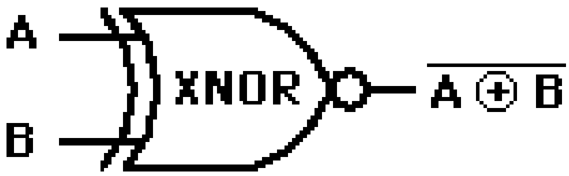
Two input X-OR Gate

A(I/P)	B(I/P)	$\overline{A}$	$\overline{B}$	$A\overline{B}$	$\overline{A}B$	Y= $A \oplus B$
0	0	1	1	0	0	0
0	1	1	0	0	1	1
1	0	0	1	1	0	1
1	1	0	0	0	0	

Truth Table for two input X-OR Gate

- ***X-NOR Gate :*** The Exclusive NOR Gate is abbreviated as the X-NOR Gate. It is combination of the Exclusive-OR gate and the NOT gate connected together in series that is also the reverse or complementary of the Exclusive-OR gate. This is a compound gate made up of AND, OR and NOT gates. An even number of logic high's on its inputs gives a logic high at the output, otherwise is at logic low.

Boolean Expression: Y= $\overline{A \oplus B}$



Two input X-NOR Gate

A(I/P)	B(I/P)	Y(O/P)= $\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

Truth Table for two input X-NOR Gate