EXPT NO.3 :
STUDY OF DE-MORGAN'S THEOREM

Objective :

To study and verify de-morgan's theorem.

Equipments :

Logic Circuit Simulator Pro.

Theory :

A mathematician named DeMorgan developed a pair of rules regarding group complementation in Boolean algebra. By group complementation, represented by a long bar over more than one variable.

Inverting all inputs to a gate reverses that gate's essential function from AND to OR, or vice versa, and also inverts the output. So, an OR gate with all inputs inverted (a Negative-OR gate) behaves the same as a NAND gate and an AND gate with all inputs inverted (a Negative-AND gate) behaves the same as a NOR gate. This theorems states the same equivalence in "backward" from: that inverting the output of any gate results in the same function as the opposite type of gate (AND vs OR) with inverted inputs :

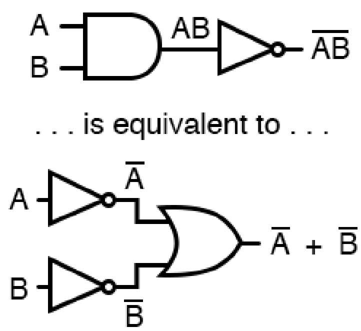
A long bar extending over the term AB acts as a grouping symbol, and as such is entirely different from the product of A and B independently inverted. In other words, (AB)' is not equal to A'B'. Because the "prime" symbol (') cannot be stretched over two variables like a bar can, we are forced to use parentheses to make it apply to the whole term AB in the previous sentence. A bar, however, acts as its own grouping symbol when stretched over more than one variable. This has a profound impact on how Boolean expressions are evaluated and reduced, as we shall see.

De Morgan's theorem may be thought of in terms of breaking a long bar symbol. When a long bar is broken, the operation directly underneath the break changes from addition to multiplication, or vice versa, and the broken bar pieces remain over the individual variables

Procedure :

THEOREM 1 : $\overline{AB} = \overline{A} + \overline{B}$

1. Do the connection as shown in the figure.
2. Connect A & B terminals to the logic inputs from input switches.
3. Connect both the outputs to led indicators in the Output section.
4. Provide different combinations of inputs A &B and observe the output on LEDs to verify the theorem.



$$\overline{AB} = \overline{A} + \overline{B}$$

Truth Table

A	B	$\overline{AB}$	$\overline{A}$	$\overline{B}$	$\overline{A}+\overline{B}$
0	0	1	1	1	1
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	0	0	0

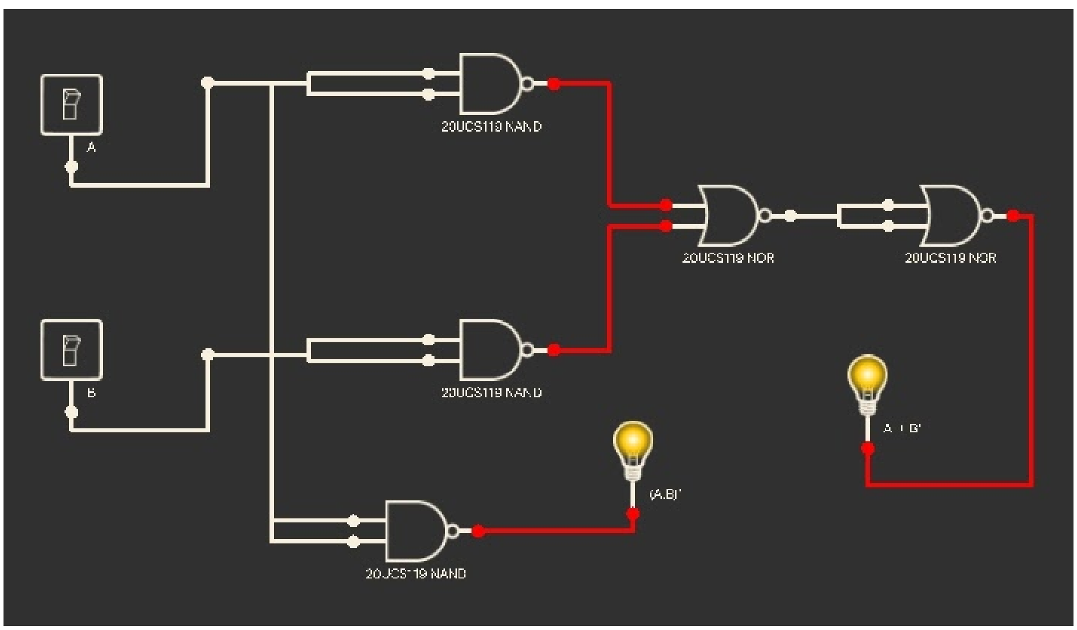


Figure : $\overline{AB} = \overline{A} + \overline{B}$

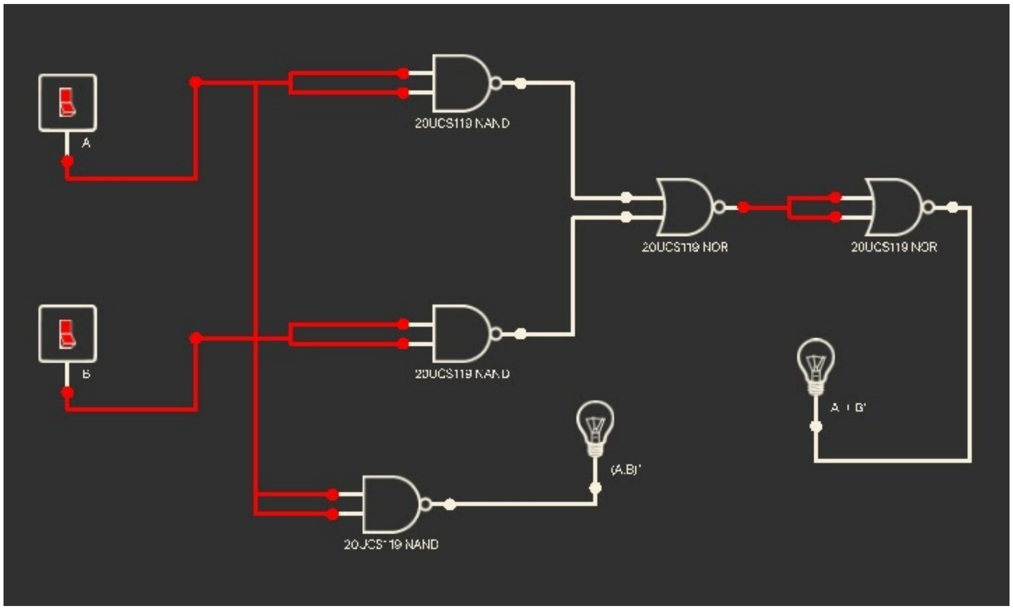


Figure : $\overline{AB} = \overline{A} + \overline{B}$

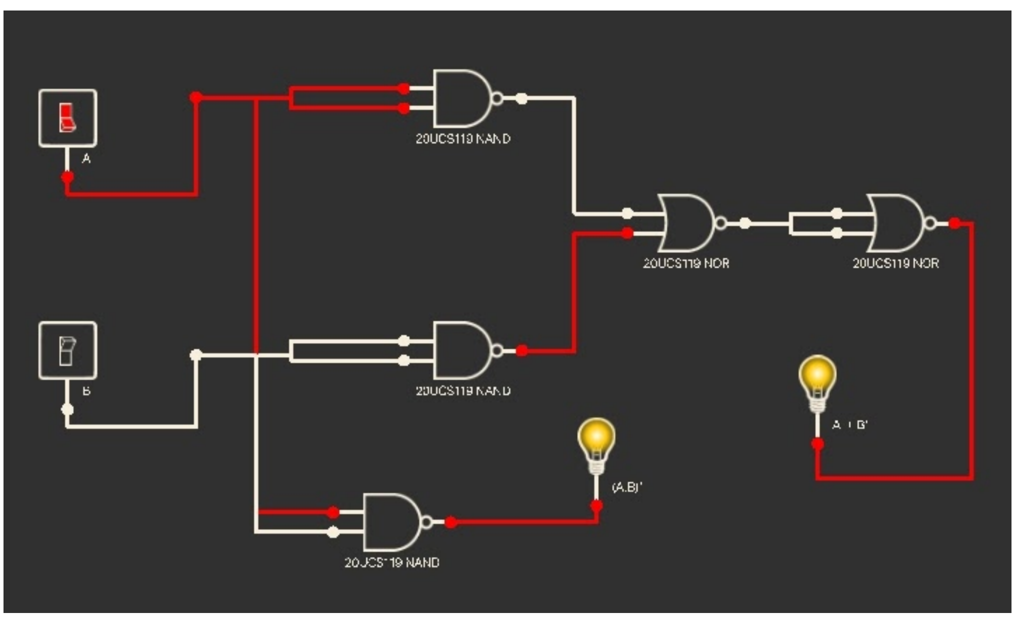
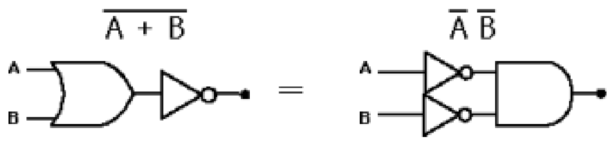


Figure : $\overline{AB} = \overline{A} + \overline{B}$

THEOREM 2 : $\overline{A+B} = \overline{A}.\overline{B}$

1. Do the connection as shown in the figure.
2. Connect A & B terminals to the logic inputs from input switches.
3. Connect both the outputs to led indicators in the Output section.
4. Provide different combinations of inputs A &B and observe the output on LEDs to verify the theorem.



Truth Table						
A	B	$\overline{A}$	$\overline{B}$	A+B	$\overline{A+B}$	$\overline{A}.\overline{B}$
0	0	1	1	0	1	1
0	1	1	0	1	0	0
1	0	0	1	1	0	0
1	1	0	0	1	0	0

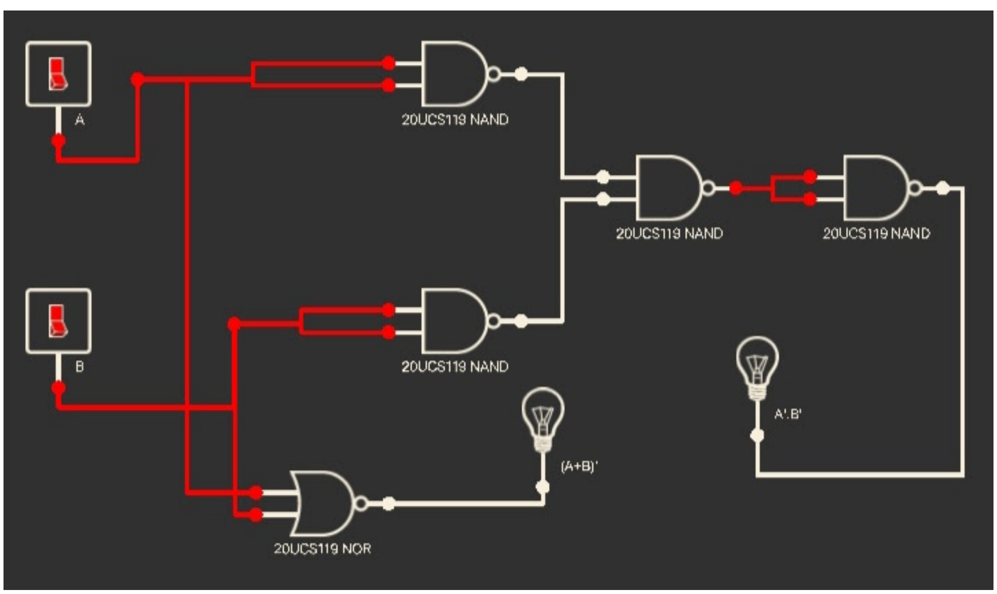


Figure : $\overline{A+B} = \overline{A}.\overline{B}$

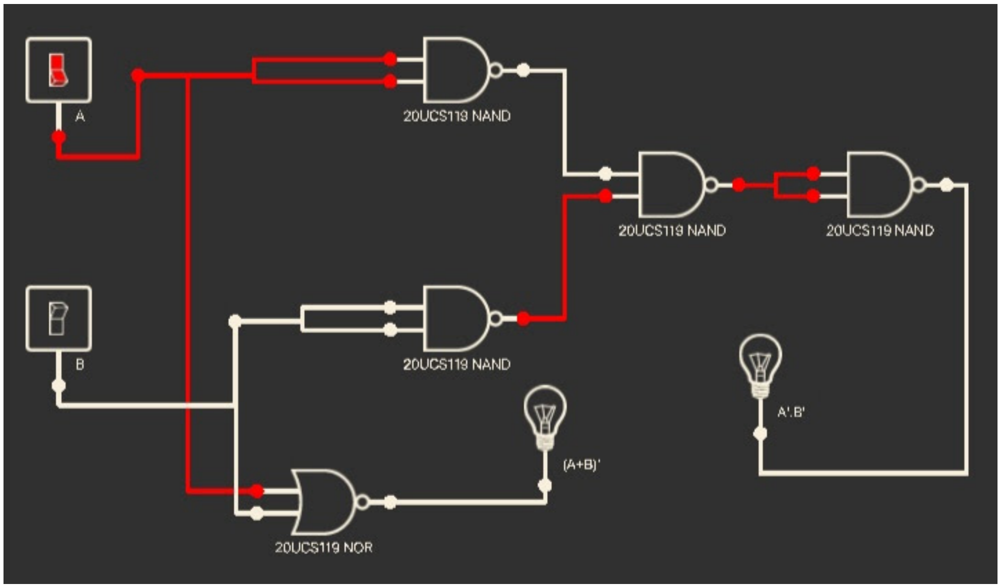


Figure : $\overline{A+B} = \bar{A}\,.\,\bar{B}$

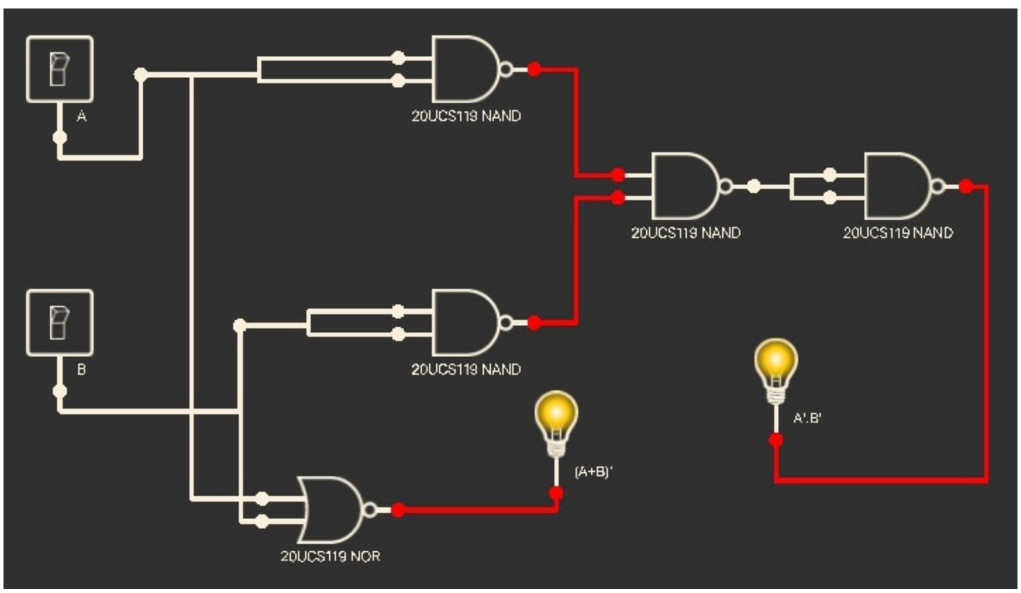


Figure : $\overline{A+B} = \bar{A}\,.\,\bar{B}$

Conclusion :

Hence, De-Morgan's theorem is verified.