Name of the experiment:

Universal Gates and Applications of Boolean algebra

Objective:

- To investigate the rules of Boolean algebra.
- To gain experience working with practical circuits.
- To gain simplify a complex function using Boolean algebra.

Required Components and Equipments:

1. AT-700 Portable Analog / Digital Lab laboratory
2. 7400 X1

Experimental Setup :

Diagram – 1

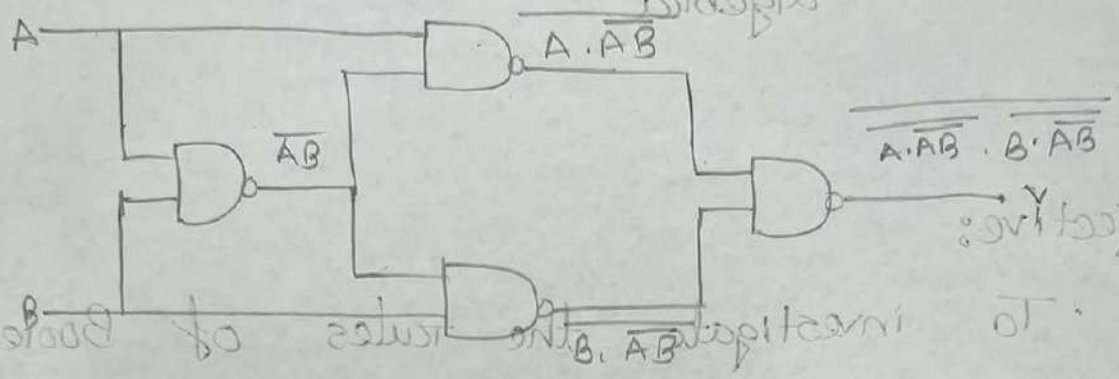
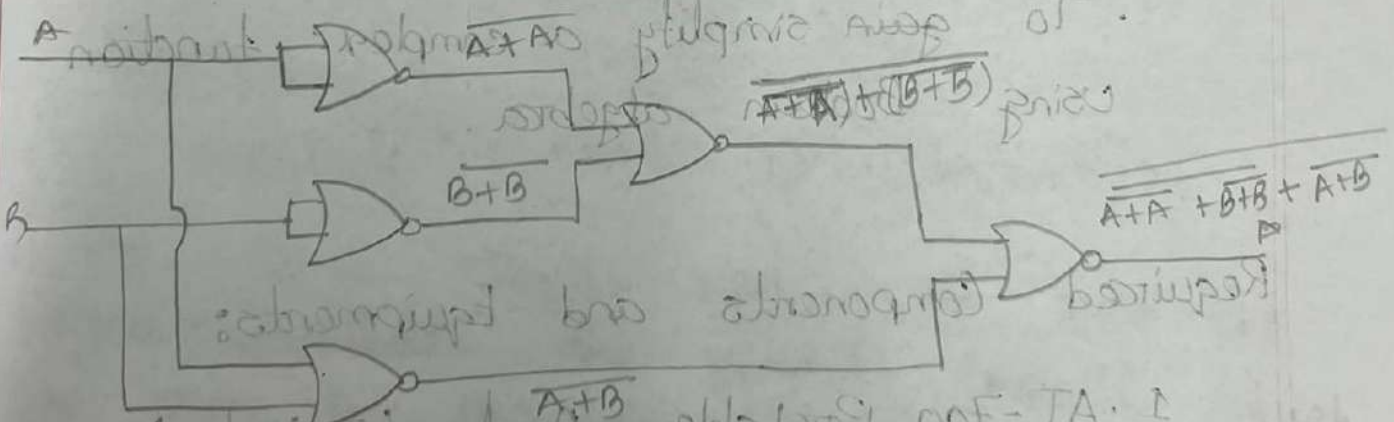


Diagram – 2



Results (Truth Table) and Discussions:

A	B	AB	$\overline{AB}$	$A.(\overline{AB})$	$B(\overline{AB})$	$A(\overline{AB}).B(\overline{AB})$
0	0	0	1	1	0	0
0	1	0	1	1	1	1
1	0	0	1	0	1	1
1	1	1	0	1	0	0

Truth Table of Diagram-1

A	B	$\overline{A+A}$	$\overline{B+B}$	$\overline{A+A}+\overline{B+B}$	$\overline{A+B}$	$(\overline{A+A}+\overline{B+B})+\overline{A+B}$
0	0	1	1	0	1	0
0	1	1	0	0	0	0
1	0	0	1	0	0	0
1	1	0	0	1	0	0

Truth Table of Diagram-2

The above truth tables of both the circuits indicates the output. Result which is when the LED light will be turned on when the inputs are given. Diagram-1 shows the building of a circuit using NAND gate. Diagram-2 shows the building of a circuit using NOR gate.

The boolean equation for the output for Diagram-1 -

$\overline{(\overline{A \cdot (A \cdot B)}) \cdot (\overline{B \cdot (\overline{A \cdot B})})}$

Simplification — $\overline{(\overline{A \cdot (A \cdot B)}) \cdot (\overline{B \cdot (\overline{A \cdot B})})}$

$= \overline{A \cdot (AB)} + \overline{B \cdot (\overline{AB})}$

$= A \cdot \overline{AB} + B \cdot \overline{AB} = A(\overline{A}+\overline{B}) + B(\overline{A}+\overline{B})$

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

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

The boolean equation of the output for Diagram-2

$\overline{(\overline{A+A} + \overline{B+B}) + \overline{A+B}}$

Simplification,

$\overline{(\overline{A+A} + \overline{B+B}) + \overline{A+B}}$

$= \overline{(\overline{A+A} + \overline{B+B})} \cdot \overline{(\overline{A+B})}$

$= (A+A + \overline{B+B}) \cdot (A+B)$

$= (\overline{A \cdot A} + \overline{B} \cdot \overline{B})(A+B)$

$= (\overline{A}+\overline{B})(A+B) = A\overline{A} + A\overline{B} + B\overline{A} + B\overline{B}$

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

The circuits functions are identical to two single gates. For the first circuit if all the inputs are on (1) or off (0), then the light turn off (which means the output shows 0 in the truth table). Otherwise, the light will be turned on (1 in truth table). So the circuits

function is identical to XOR gate. The function of the 2nd circuit is also similar which indicates that the function of the 2nd circuit is also identical to XOR gate.

Implementing the function $(A(AB + CD))'$ using NAND gate only: