Title: Verify De Morgan's and Distributive Laws Using Logic Gates

➢ *Objective*:

The objective of this experiment is to verify the De Morgan's Laws and the Distributive Laws in Boolean algebra by implementing logic gates. Specifically, we will demonstrate the equivalence of given expressions using logic gates to prove these fundamental laws.

➢ *Equipment*:

- Logic gates (AND, OR, NOT, NAND, NOR)
- Breadboard
- Power supply
- Connecting wires

De – Morgan's Law

Q1

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

Truth Table: ***Logic Diagram***:

L.H.S: $\overline{(A+B)}$

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

R.H.S: $\overline{A}.\overline{B}$

A	B	$\overline{A}$	$\overline{B}$	$\overline{A}.\overline{B}$
0	0	1	1	1
0	1	1	0	0
1	0	0	1	0
1	1	0	0	0

De – Morgan's Law

Q2

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

Truth Table: ***Logic Diagram***:

L.H.S: $\overline{(A.B)}$

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

R.H.S: $\overline{A}+\overline{B}$

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

Distributive Law

Q1

$$A(B + C) = AB + AC$$

Truth Table: ***Logic Diagram***:

L.H.S: $A(B + C)$

A	B	C	$B + C$	$A(B + C)$
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

***Truth Table*:** ***Logic Diagram*:**

***R.H.S*: $AB + AC$**

A	B	C	$A.B$	$A.C$	$AB + AC$
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	0	0	0
1	0	1	0	1	1
1	1	0	1	0	1
1	1	1	1	1	1

Distributive Law

Q2

$(A + B)(C + D) = AC + AD + BC + BD$

***Truth Table*:**

***L.H.S*: $(A + B)(C + D)$**

A	B	C	D	$A + B$	$C + D$	$(A + B).(C + D)$
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	1	1	1
0	1	1	0	1	1	1
0	1	1	1	1	1	1
1	0	0	0	1	0	0
1	0	0	1	1	1	1
1	0	1	0	1	1	1
1	0	1	1	1	1	1
1	1	0	0	1	0	0
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

Logic Diagram:

Truth Table:

***R.H.S*: $AC + AD + BC + BD$**

A	B	C	D	$A.C$	$A.D$	$B.C$	$B.D$	$AC + AD + BC + BD$
0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	1	0	1	0	0	0	1	1
0	1	1	0	0	0	1	0	1
0	1	1	1	0	0	1	1	1
1	0	0	0	0	0	0	0	0
1	0	0	1	0	1	0	0	1
1	0	1	0	1	0	0	0	1
1	0	1	1	1	1	0	0	1
1	1	0	0	0	0	0	0	0
1	1	0	1	0	1	0	1	1
1	1	1	0	1	0	1	0	1
1	1	1	1	1	1	1	1	1

Logic Diagram:

- ***Conclusion***:

In this experiment, we successfully verified De Morgan's laws and the Distributive Laws using logic gates. We observed that the logic diagrams constructed for these theorems produced the same output as the expected truth tables, confirming the equivalence of the given Boolean expressions. This experiment illustrates the practical application of these fundamental laws in digital logic design and provides hands-on experience with logic gates.

THE END