De-Morgon's Theorem

LAB #03

Fall 2025

CSE202L Digital Logic Design Laboratory

Class Section: **A**

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De-Morgan's Theorem:

Objective:

By the end of this experiment, you should be able to:

- Demonstrate De-Morgan's theorems through practical implementation using two input variables.

Required Components:

- 7432 – Quad 2-input OR gate IC
- 7404 – Hex Inverter IC
- LED (Light Emitting Diode)
- 7430 – Quad 2-input AND gate IC
- DIP Switch
- Three resistors (1 kΩ each)

DE-MORGAN'S THEOREM:

- $(X + Y)' = X' \cdot Y'$ .... (a)
- $(X \cdot Y)' = X' + Y'$ .... (b)

Procedure:

- Assemble the circuit corresponding to the left-hand side of Equation (a), as illustrated in Figure 3.1. Observe how the LED responds to different input combinations.
- Next, construct the circuit shown in Figure 3.2, representing the right-hand side of Equation (a). Test all possible input combinations using the switches and fill in the truth table (Table 3.1) accordingly.
- Compare the output columns from both circuits to determine if Equation (a) is validated.
- Repeat the same steps for the circuits shown in Figures 3.3 and 3.4 to verify Equation (b) as per De-Morgan's Theorem.

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LOGIC CIRCUIT DIAGRAM

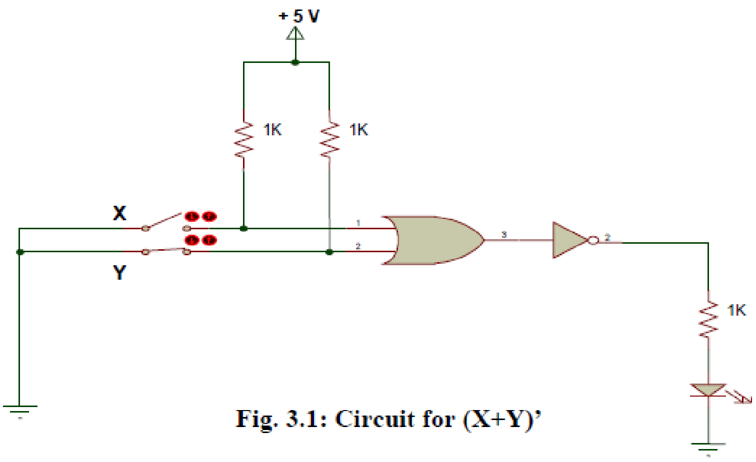


Fig. 3.1: Circuit for (X+Y)'

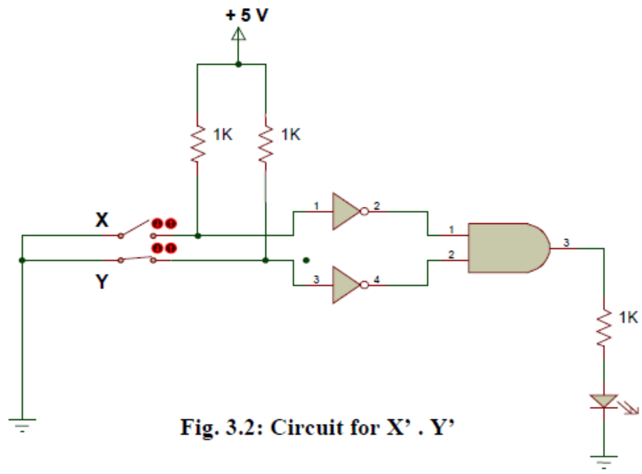
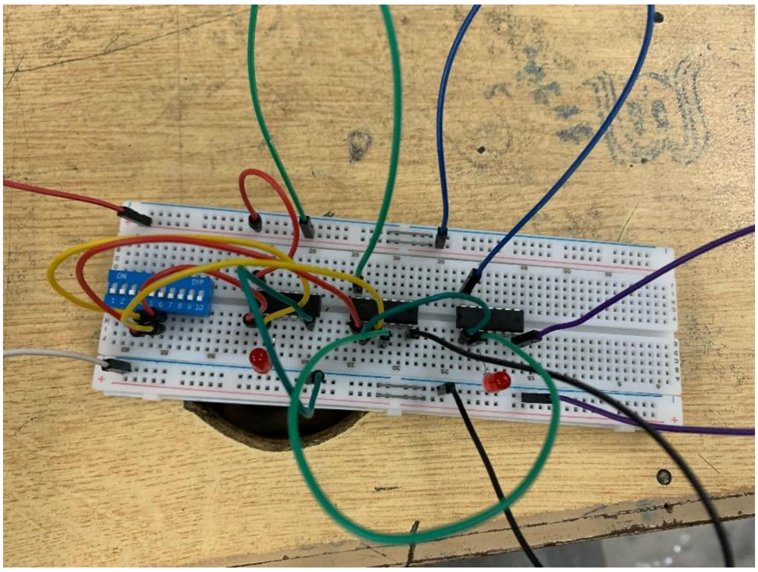


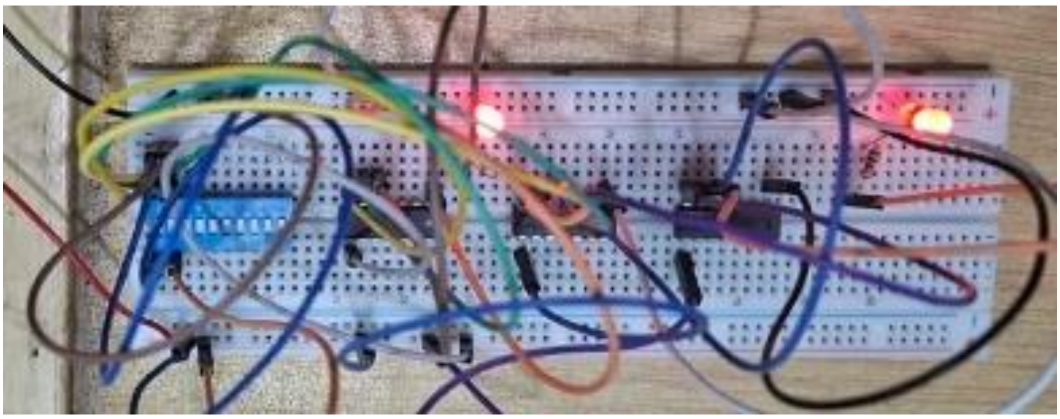
Fig. 3.2: Circuit for X' . Y'

Truth Table 3.1:

X	Y	(X . Y)'	(X' + Y')
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

Circuit Picture:





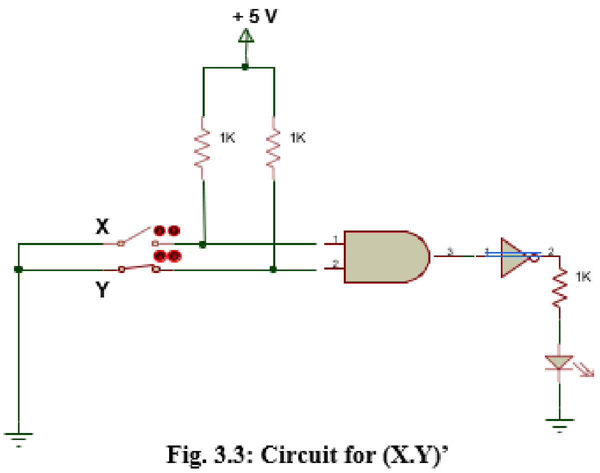


Fig. 3.3: Circuit for (X.Y)'

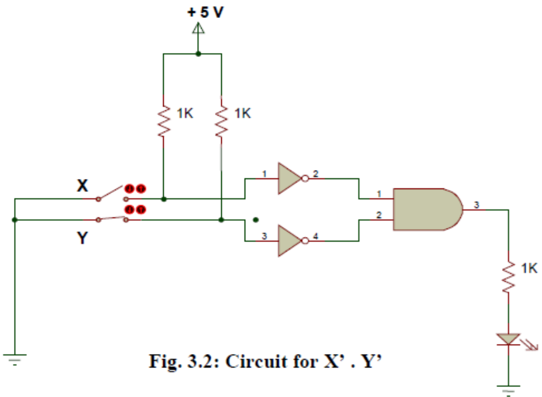


Fig. 3.2: Circuit for X' . Y'

Truth Table 3.2:

X	Y	(X . Y)'	(X' + Y')
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

REVIEW QUESTIONS:

▪ Simplify the expression using De-Morgan's theorems and verify the two expressions experimentally.

F= ((A . B)' + A)'

ANSWER:

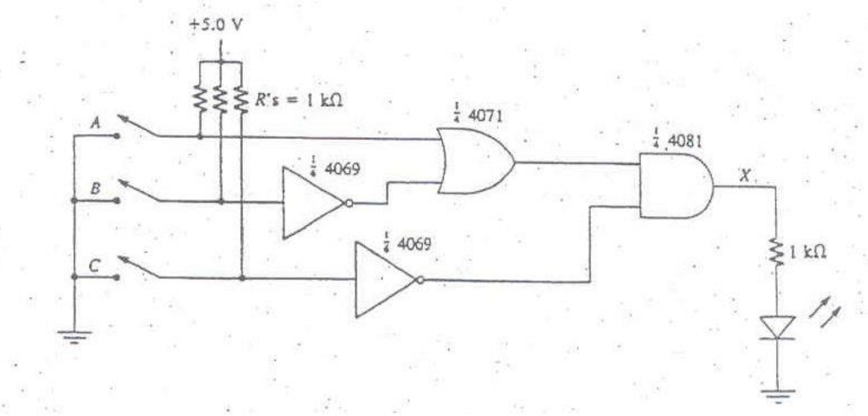
(TASK 1) :

$$F = ((A \cdot B)' + A)'$$
$$= ((A' + B') + A)'$$
$$= (\underbrace{A' + A}_{1} + B')'$$
$$= (1 + B')'$$
$$= (1)'$$
$$= 0$$

Truth Table:

A	B	$A \cdot B$	$(A \cdot B)'$	$(A \cdot B)' + A$	$((A \cdot B)' + A)'$
0	0	0	1	1	0
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	0	1	0

- Determine experimentally whether the given circuits are equivalent. Then use De-Morgan's theorem to prove your answer algebraically.

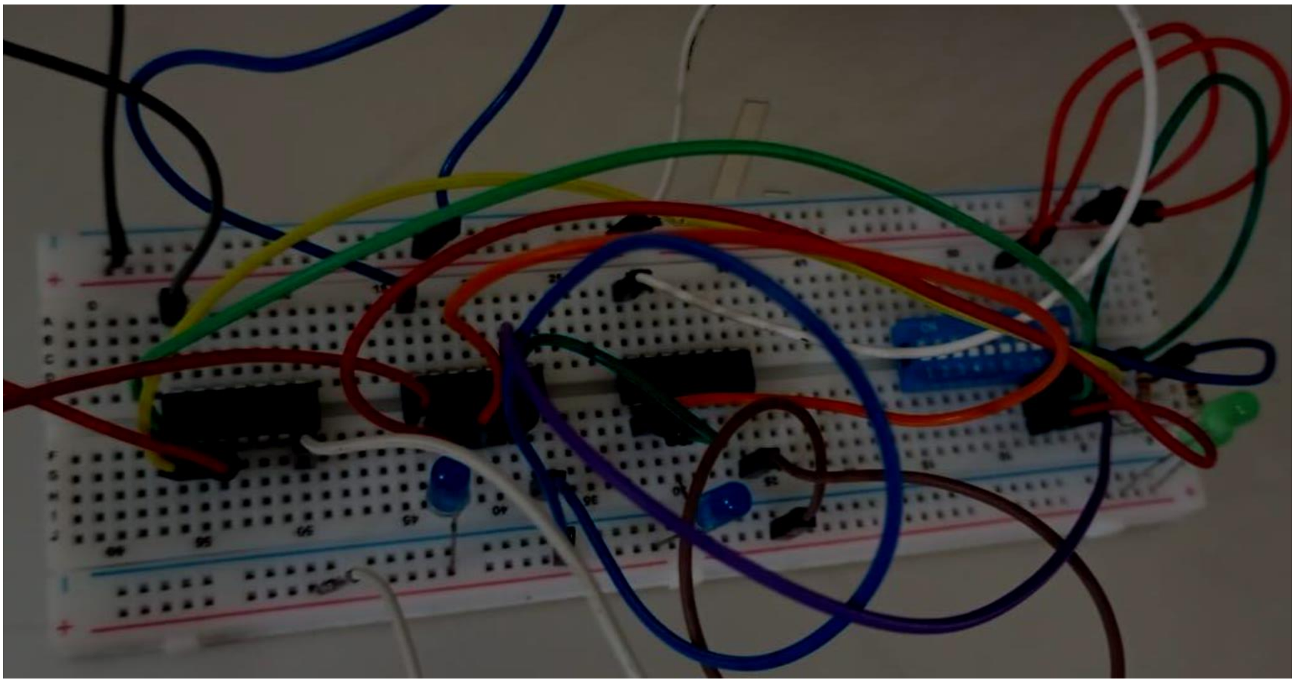


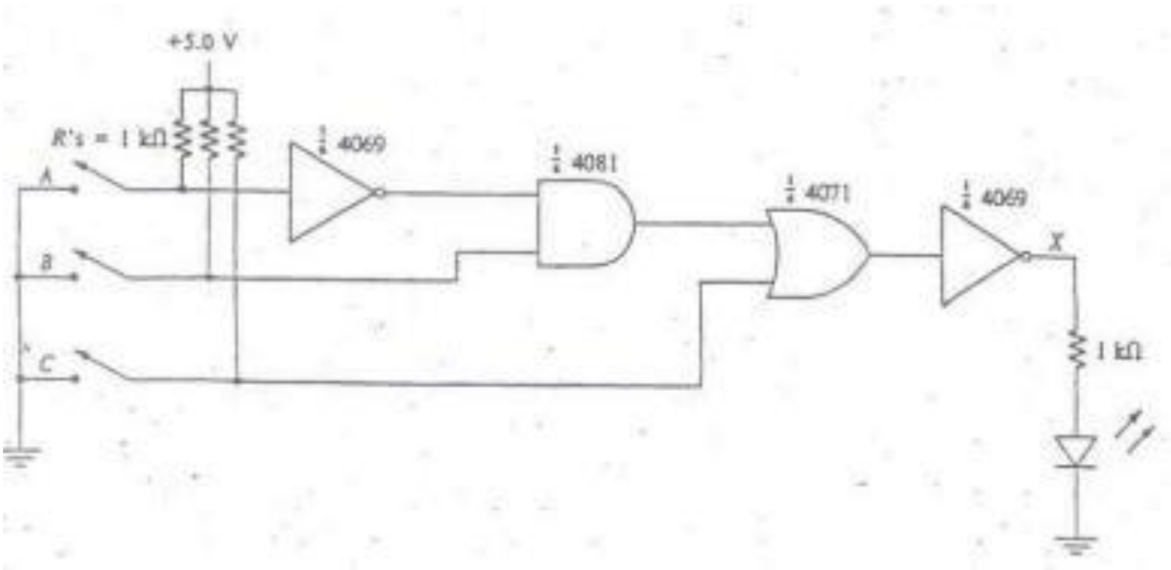
Answer:

$$F_1 = (A+B')\cdot C'$$
$$= A\cdot C' + B'\cdot C' \rightarrow (a)$$

$$F_2 = ((A'\cdot B)+C)'$$
$$= (A'\cdot B)'\cdot C'$$
$$= (A+B')\cdot C'$$
$$= A\cdot C' + B'\cdot C' \rightarrow (b)$$

Hence (a) = (b) Proved





Experimental Diagram: