



# ***Green University of Bangladesh***

Department of Computer Science and Engineering

## **Lab report-04**

Course Title: Digital Logic Design Lab

Course code: CSE-204

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Submitted to:	Submitted by :
Name : Md.Atikuzzaman	Name : Jakirul Islam
Designation : Lecturer	ID : 193002101
Department : CSE	Department : CSE
Green university of Bangladesh	Green university of Bangladesh

**Title:** Draw the circuit diagram and verify the De-Morgan laws

**Objective:** To construct a circuit, draw the circuit diagram and verify the De-Morgan laws.

**Apparatus Required:**

COMPONENTS: IC 7408, 7432 and 7404.

EQUIPMENT: Power supply, Bread board, Logisim software, Tinkercad online stimulation.

Theory:

Boolean functions are commonly expressed using the following forms:

Canonical forms:

- Sum of minterms
- Product of maxterms

Standard forms:

- Sum of products (SOP)
- Product of sums (POS)

Represented as a sum of minterms only :  $f = \Sigma(\text{minterms})$

Represented as a product of maxterms only :  $f = \Pi(\text{maxterms})$

- A minterm is a product of all variables taken either in their direct or complemented form
- A maxterm is a sum of all variables taken either in their direct or complemented form

$$y = f(x_{n-1}, \dots, x_0) = \sum_{i=0}^{2^n-1} y_i \cdot m_i$$

Boolean function can be specified using a sum (logical OR) of minterms.

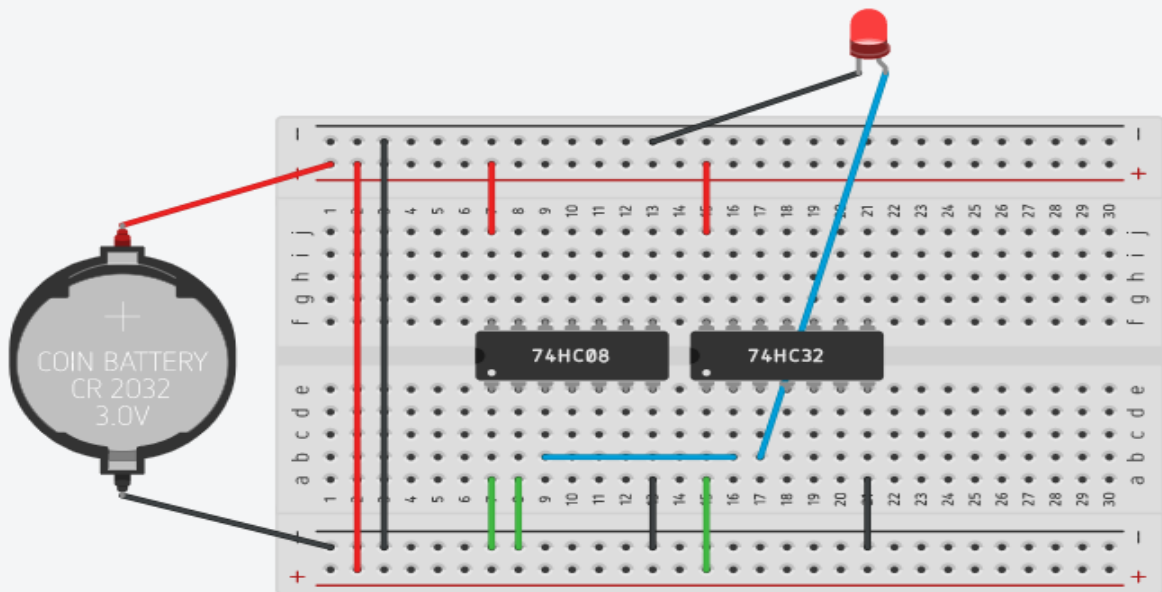
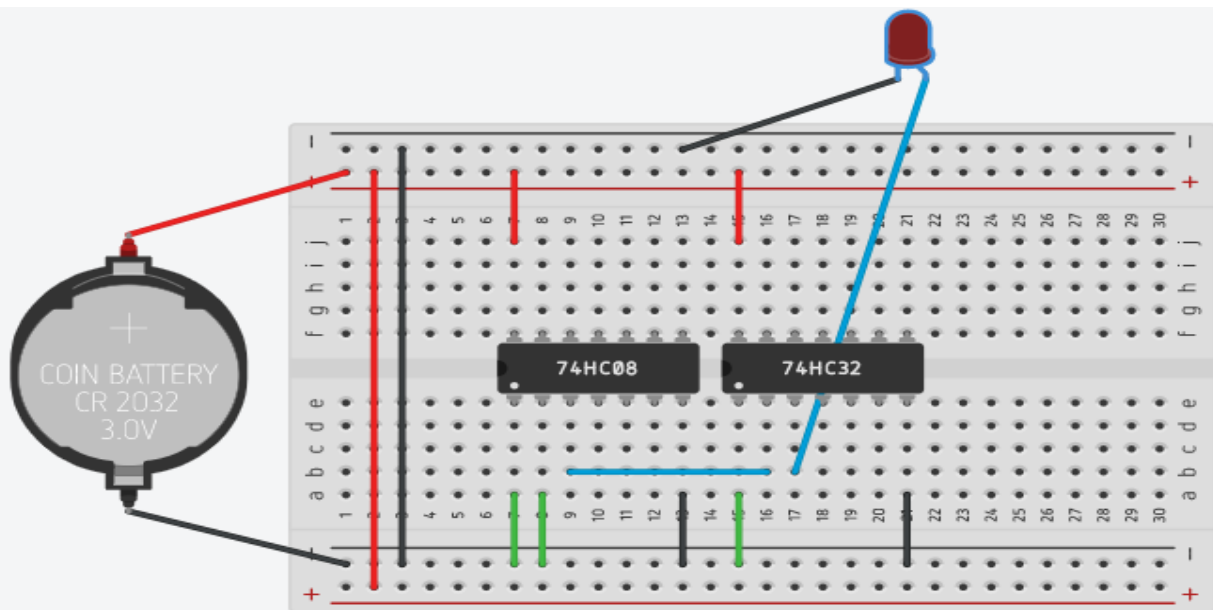
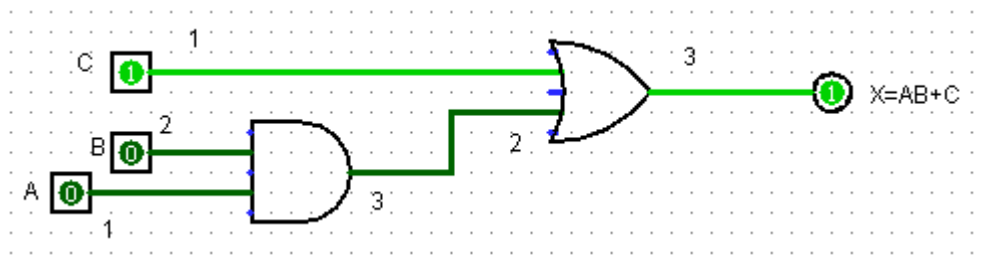
$X = AB+C$  the equivalent canonical form is  $ABC+A'BC+AB'C+A'B'C+ABC'$ .

Algebraically it can be shown that these two are equivalent as follows:

$$\begin{aligned} ABC+A'BC+AB'C+A'B'C+ABC' &= BC(A+A') + B'C(A+A') + ABC' \\ &= BC1 + B'C1 + ABC' \\ &= C(B+B') + ABC' \\ &= C + ABC' \end{aligned}$$

$$= C + AB$$

Realization of Boolean Expression:  $X=AB+C$



Substitute a one in the truth table for each entry below.

Creating a Truth Table from Minterms Step One

Finally put zeros in all the entries that you did not fill with ones in the first step above:

Minterms for 3 Input Variables

C	B	A	Minterm
0	0	0	$A'B'C'$
0	0	1	$AB'C'$
0	1	0	$A'BC'$
0	1	1	$ABC'$
1	0	0	$A'B'C$
1	0	1	$AB'C$
1	1	0	$A'BC$
1	1	1	$ABC$

Y	C	B	A	Minterm	$m_j$
0	0	0	0		
1	0	0	1		
2	0	1	0		
3	0	1	1	1	$m_3$
4	1	0	0	1	$m_4$
5	1	0	1	1	$m_5$
6	1	1	0	1	$m_6$
7	1	1	1	1	$m_7$

C	B	A	Minterm
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$$y = 0 \cdot m_0 + 0 \cdot m_1 + 0 \cdot m_2 + 1 \cdot m_3 + 1 \cdot m_4 + 1 \cdot m_5 + 1 \cdot m_6 + 1 \cdot m_7$$

$$= m_3 + m_4 + m_5 + m_6 + m_7$$

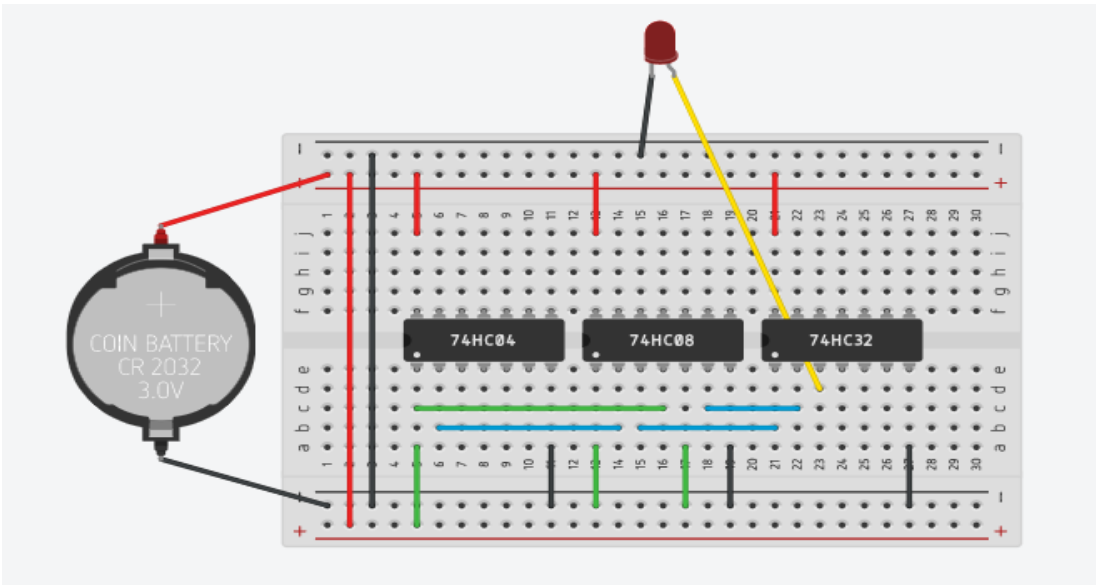
$$Q = A'B'C + A'BC + ABC' + ABC$$

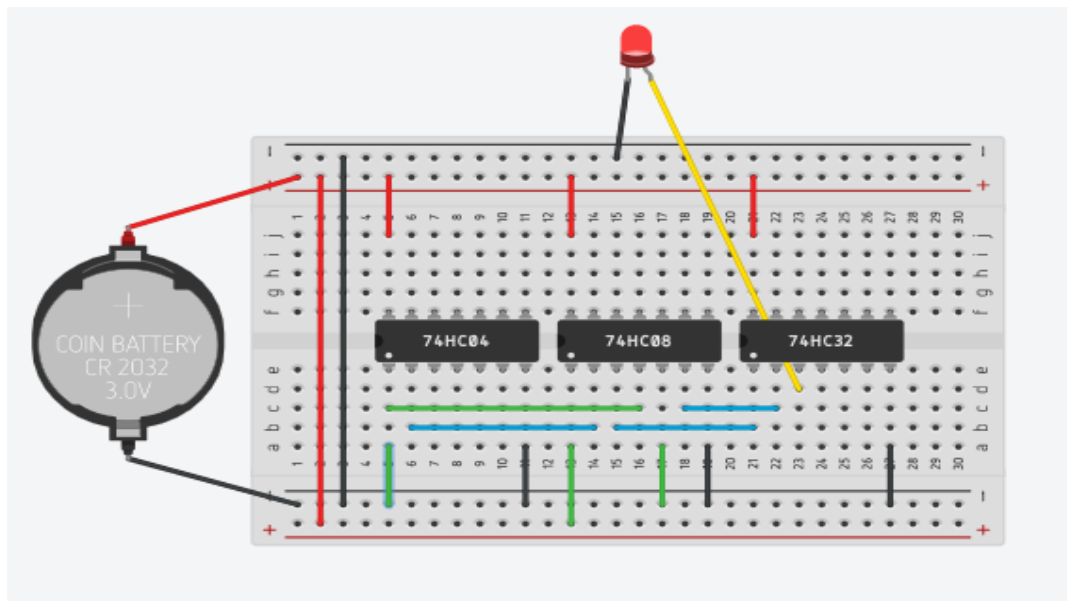
$$Q = A'C(B'+B) + AB(C'+C)$$

$$Q = A'C + AB$$

For this we need to design a circuit in logisim software in which the output will be

$$\underline{A'C+AB}$$

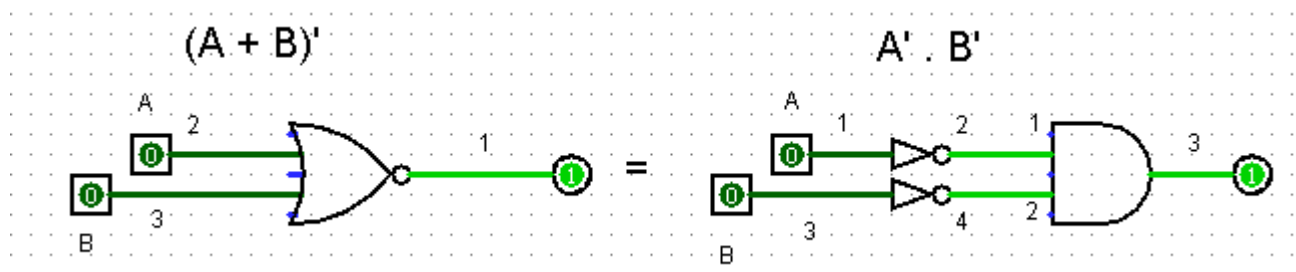




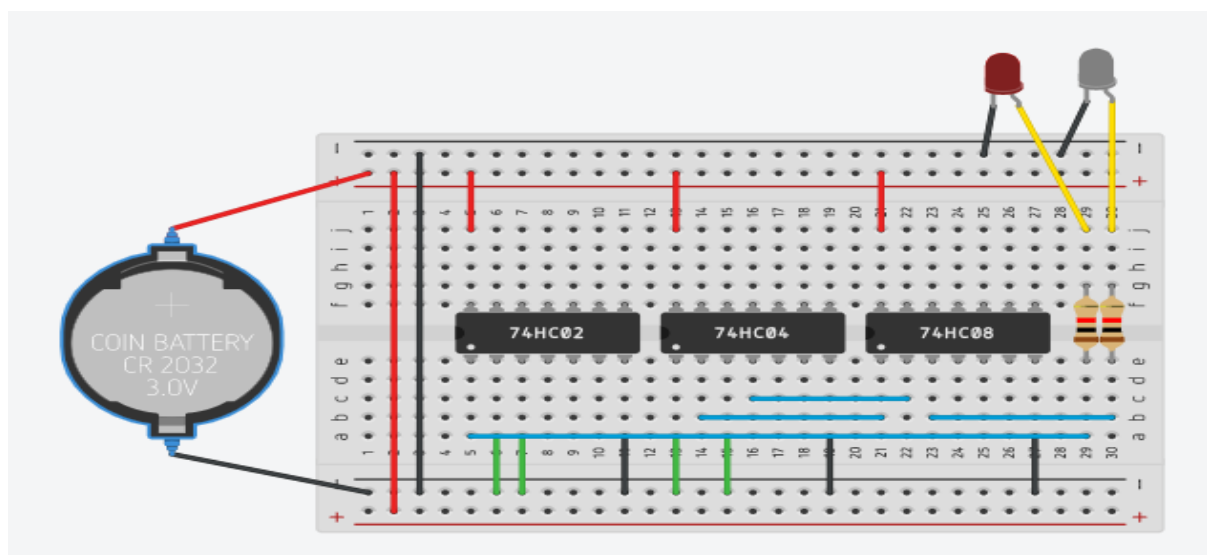
## De Morgan's Law

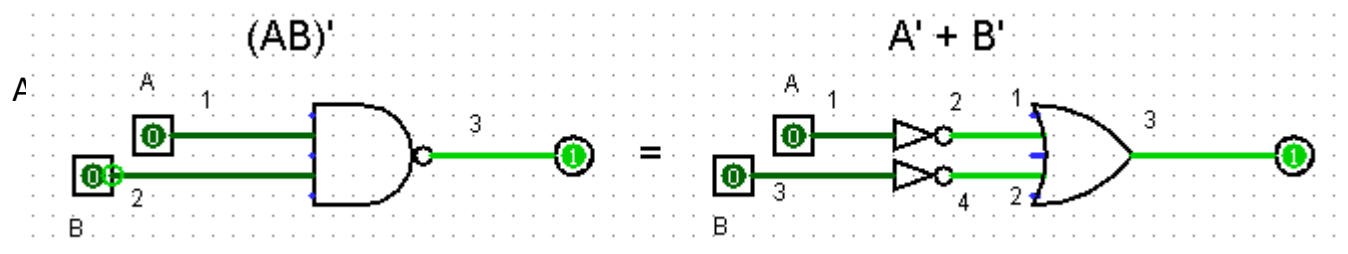
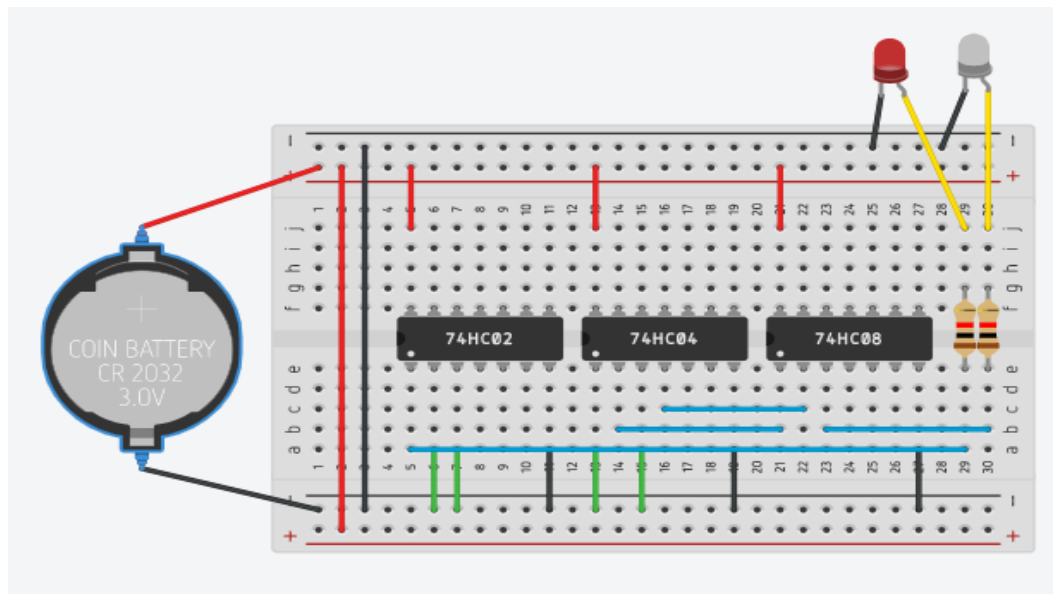
1)  $(A + B)' = A' \cdot B'$

2)  $(A \cdot B)' = A' + B'$

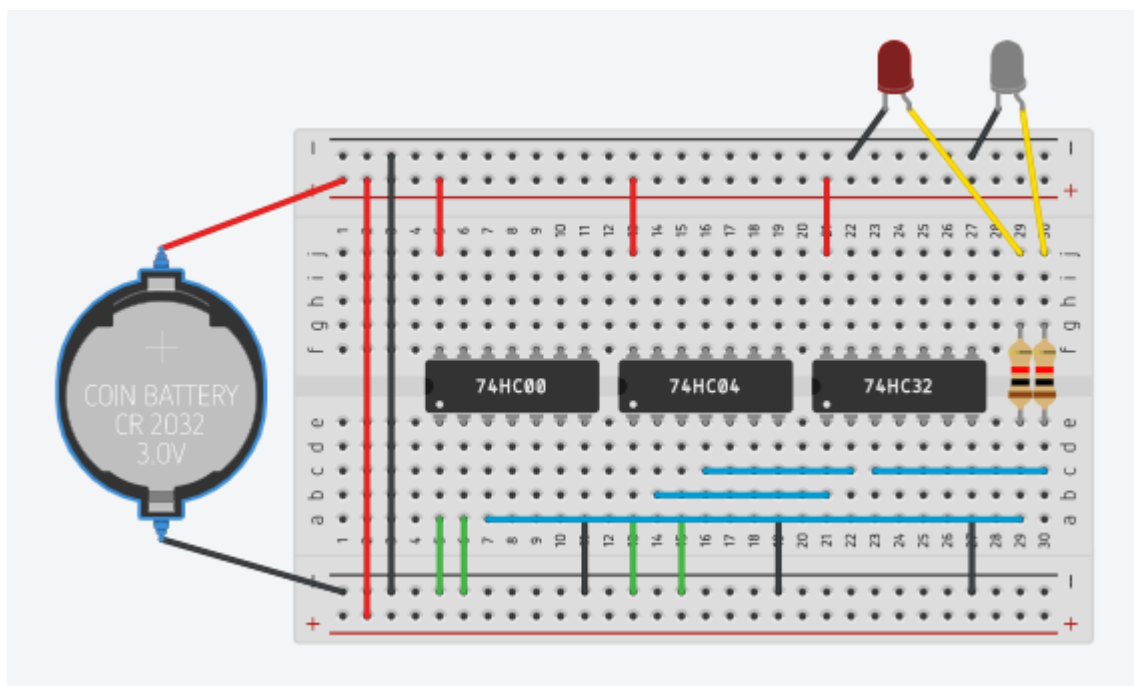


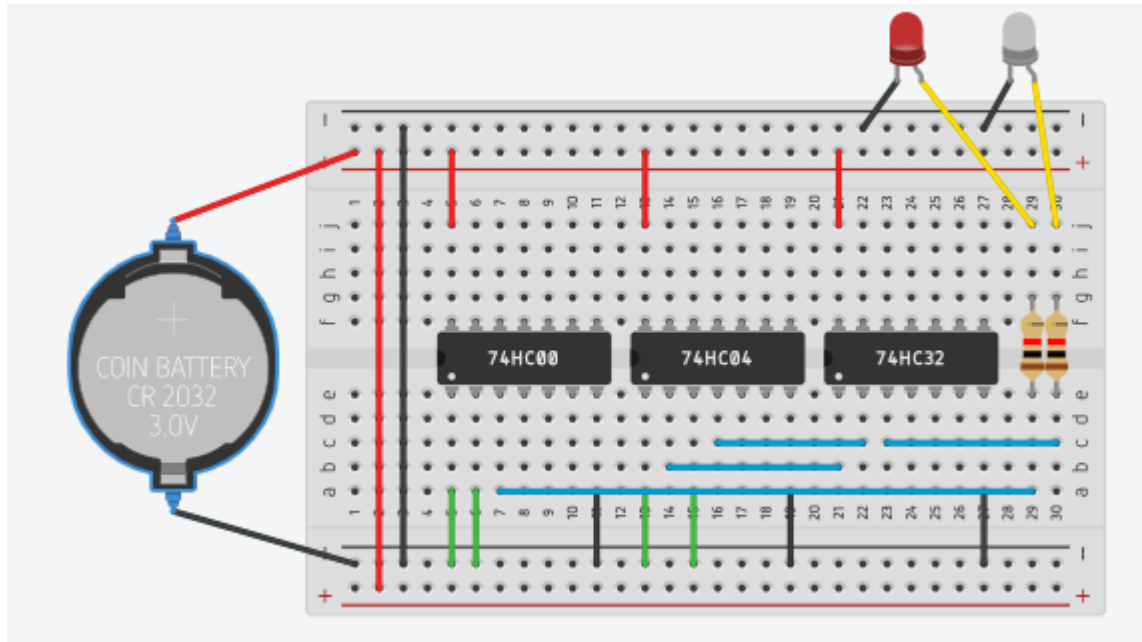
A NOR gate is equivalent to an inversion followed by an AND





NAND gate is equivalent to an inversion followed by an OR





## Dicussion:

Here this an experiment which was done by us from our home using some online tools such as logisim software and tinkercad online platform and this experiment can be done by maintaining some self-safety issues like we don't need to touch the IC's when then power is on, we had to apply proper grounding for IC's.

Although this lab on the online platform by using Logisim software and Tinkercad online stimulation. By using online stimulation we can stimulate the lab in home. In the lab we have learn how to use bread bord and IC's. We have learn how all IC's work.

After doing all procedures smoothly, we can learn about the operations of basic logic gates practically & verify the required truth tables for each of them. It's a successful & effective experiment indeed.