LAB 1

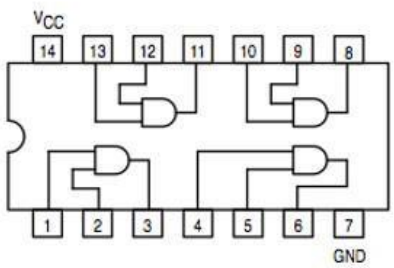
Object:-

To study operations of Basic Gates; i.e AND, OR, NOT.

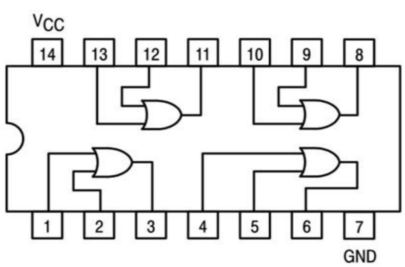
Apparatus:-

ICs (74LS08, 74LS32, 74LS04), copper wires, breadboard, DC power supply, ground and LED bulb.

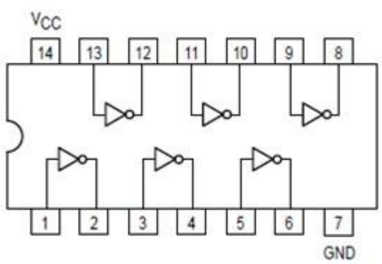
Pin Diagram:-



74LS08

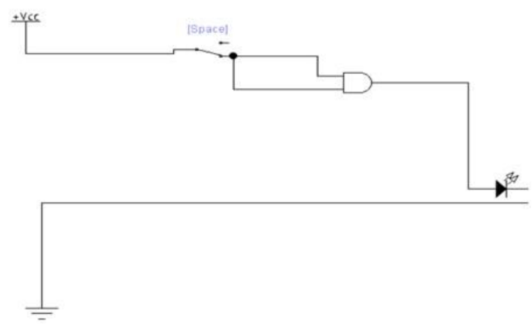


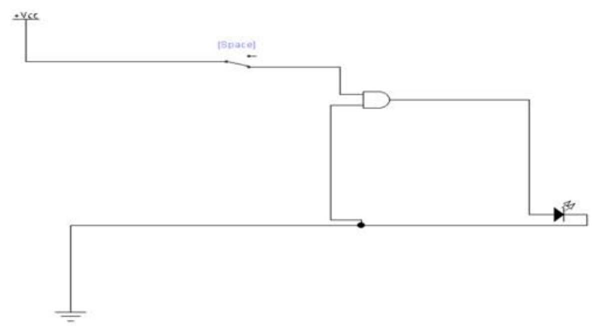
74LS32



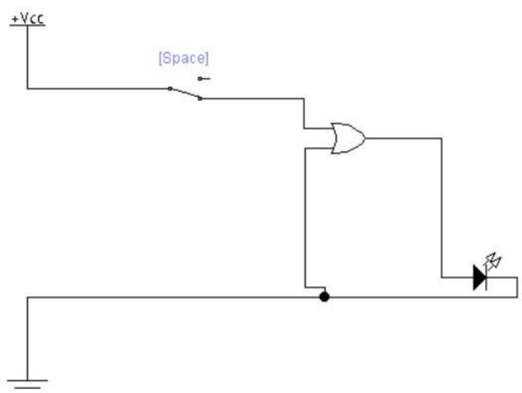
74LS04

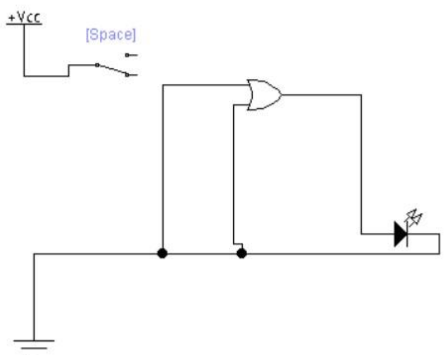
Circuit Diagrams:-



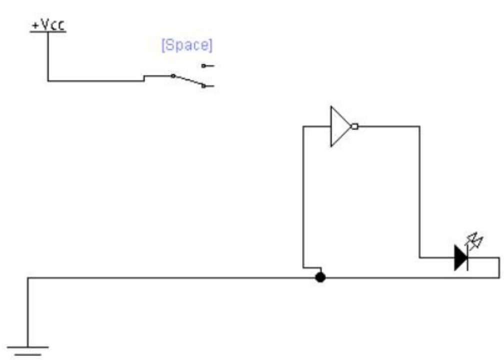


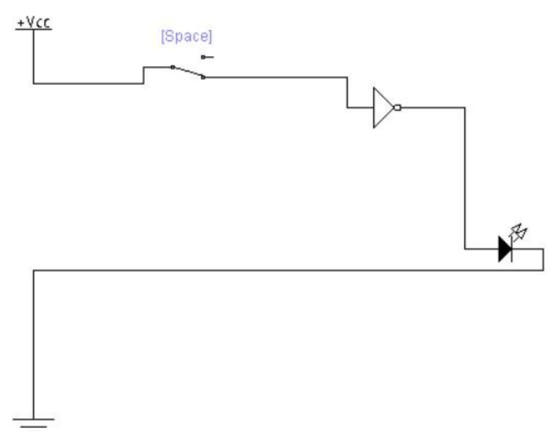
AND Gate





OR Gate





NOT Gate

Truth Table:-

NOT

x	x'
0	1
1	0

AND

x	y	xy
0	0	0
0	1	0
1	0	0
1	1	1

OR

x	y	x+y
0	0	0
0	1	1
1	0	1
1	1	1

CONCLUSION

- When n both inputs are 1/+ Vcc then **AND gate** is producing +ve to the LED bulb and LED is on.
- When at least one input of OR gate is 1/+ Vcc then **OR gate** is producing +ve to the LED bulb and LED is on.
- When the only input of NOT gate is 0/ connected to earth then **NOT gate** is producing +ve to the LED bulb and LED is on.

LAB 2

OBJECT:

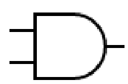
Construct the circuit for the following expression

$$X = \bar{A}B + AB$$

APPARATUS:

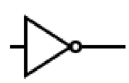
- 74LS08
- 74LS04
- 74LS32
- Bread Board
- Connecting Wires
- LED
- DC Supply

SYMBOLS:



AND GATE

OR GATE

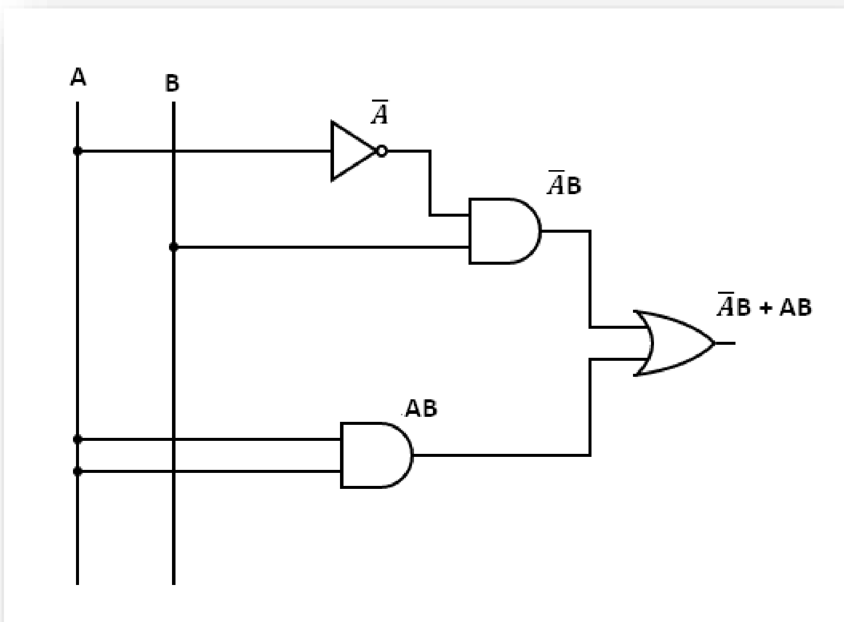


NOT GATE

METHOD:

INPUT		OUTPUT			
A	**B**	$\bar{A}$	$\bar{A}$**B**	**AB**	**X=** $\bar{A}$**B + AB**
0	**0**	1	**0**	**0**	**0**
0	1	1	1	**0**	1
1	**0**	**0**	**0**	**0**	**0**
1	1	**0**	**0**	1	1

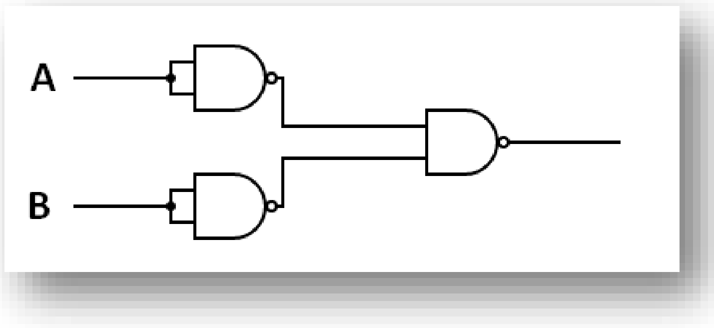
CIRCUIT DESIGN:



LAB 03

OBJECT:

Construct the circuit for the following circuit diagram



APPARATUS:

- 74LS00
- Bread Board
- Connecting Wires
- LED
- DC Supply

SIMPLIFICATION:

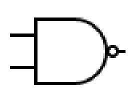
$$\overline{\overline{A.A}+\overline{B.B}}$$

$$\overline{\bar{A}.\bar{B}}$$

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

$$A+B$$

SYMBOL:

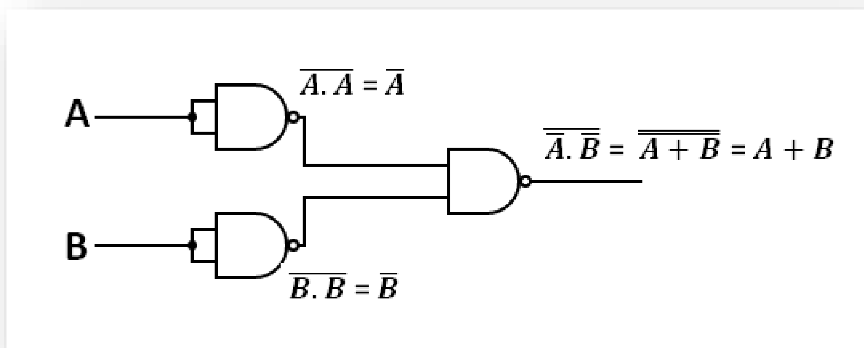


NAND GATE

METHOD:

INPUT		OUTPUT
A	B	X= A+B
0	0	0
0	1	1
1	0	1
1	1	1

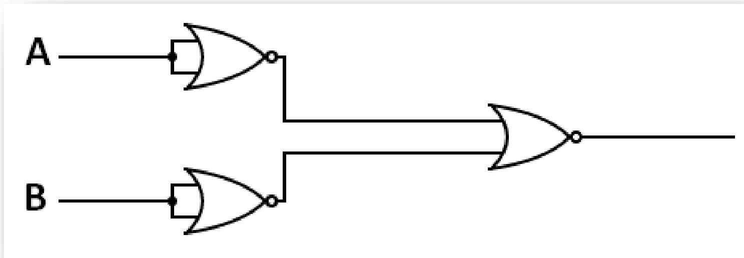
CIRCUIT DESIGN:



LAB 04

OBJECT:

Construct the circuit for the following circuit diagram



APPARATUS:

- 74LS02
- Bread Board
- Connecting Wires
- LED
- DC Supply

SIMPLIFICATION:

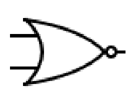
$$\overline{\overline{A+A}+\overline{B+B}}$$

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

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

$$A.B$$

SYMBOL:

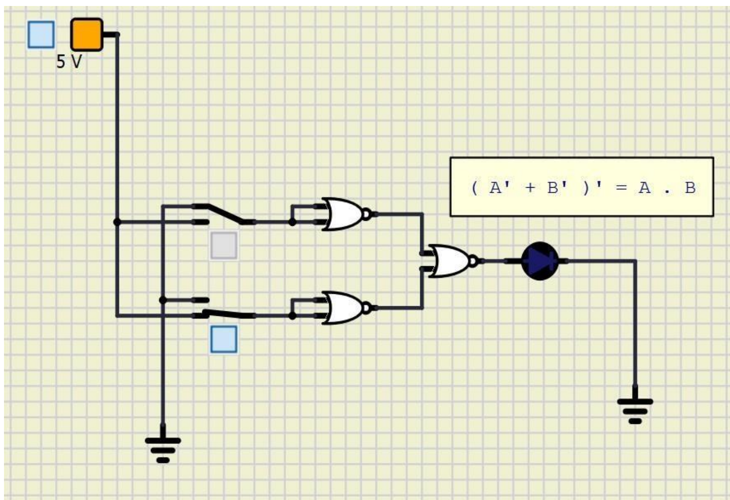


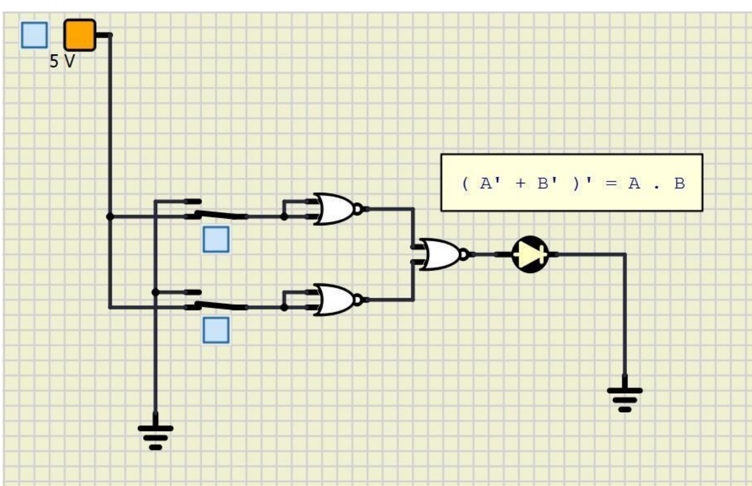
NOR GATE

METHOD:

INPUT		OUTPUT
A	**B**	**X= A.B**
0	**0**	**0**
0	1	**0**
1	**0**	**0**
1	1	1

CIRCUIT DESIGN:





LAB 05

Object:

Consider following standard sop X = A’BC+AB’C+A’B’C’+A’B’C+ABC’ minimize it by using k.map and design circuit and compare $X_{stan} = X_{simplified}$.

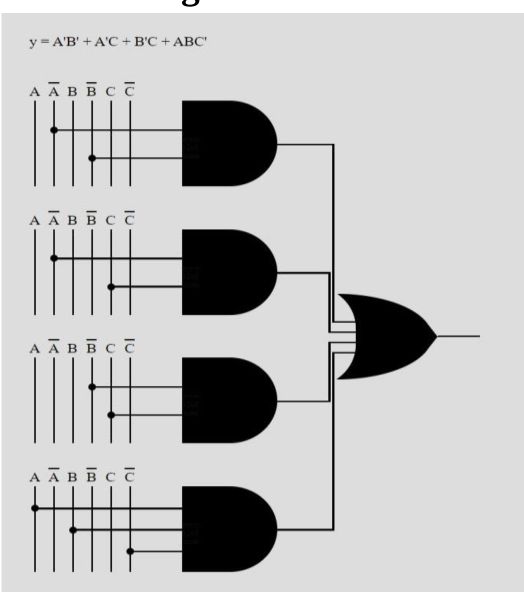
Apparatus:

74LS08 (AND Gate), 74LS32(OR Gate), Vcc source supply , ground and LED.

K-Map:

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

Circuit Diagram:



Truth Table:

Truth Table

	A	B	C	Y
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	0

Compare Xstan to Xsimplified:

$X_{stan} = A'BC + AB'C + A'B'C' + A'B'C + ABC'$

$X_{simp} = A'B + ABC' + B'C$

LAB#06

Object:

Construct the circuit from following expression using NAND gate only.

$X = \overline{A} + BC$

Truth Table:

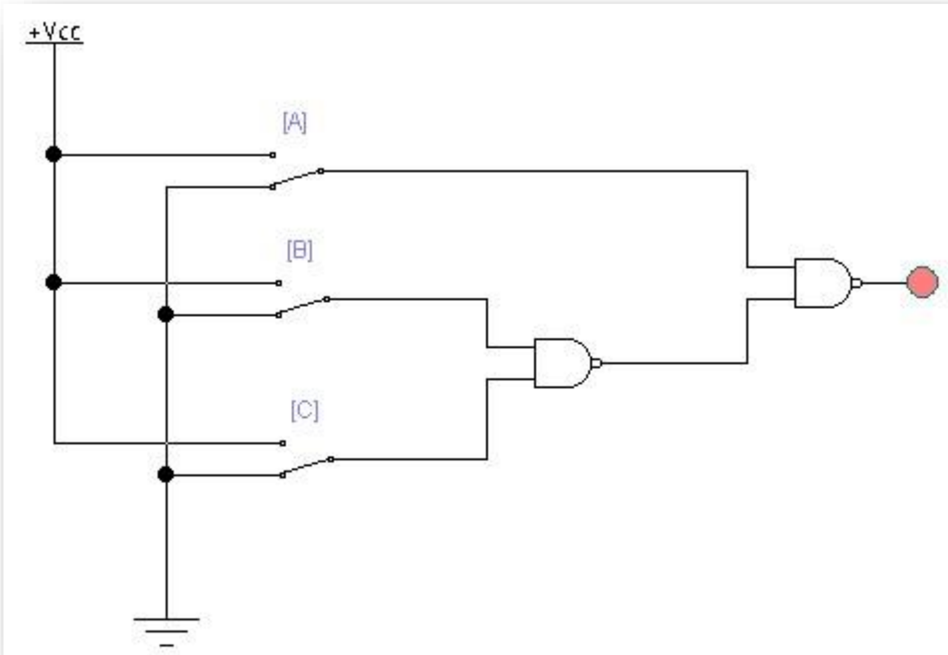
A	**B**	**C**	$\overline{\mathbf{BC}}$	$\overline{\mathbf{A}}$	$\overline{\mathbf{A}}$ **+ BC**
0	0	0	1	1	1
0	0	1	1	1	1
0	1	0	1	1	1
0	1	1	0	1	1
1	0	0	1	0	0
1	0	1	1	0	0
1	1	0	1	0	0
1	1	1	0	0	1

Circuit Diagram:

The circuit expression A'+BC made using NAND GATE where A, B and C are both initial outputs and led is connected to the last gate to visualize the output of the expression where it lights when the final result lie. A and B and C are connected to VCC and secondary ground.

According to DE Morgan's law $\overline{\overline{A}.\overline{B}} = A + B$

So after sum up the above equation = $\overline{A.\overline{(BC)}}$ = $\overline{A} + BC$



Conclusion:

The NAND of B and C gives the result $\overline{BC}$. Then it is taken input in another NAND gate with A as second input which gives result as $\overline{A.(\overline{BC})}$= $\overline{A}$ + BC our required equation. Circuit is working properly according to the truth table and logic.

LAB#07

Object:

Construct the circuit from following expression using NOR gate only.

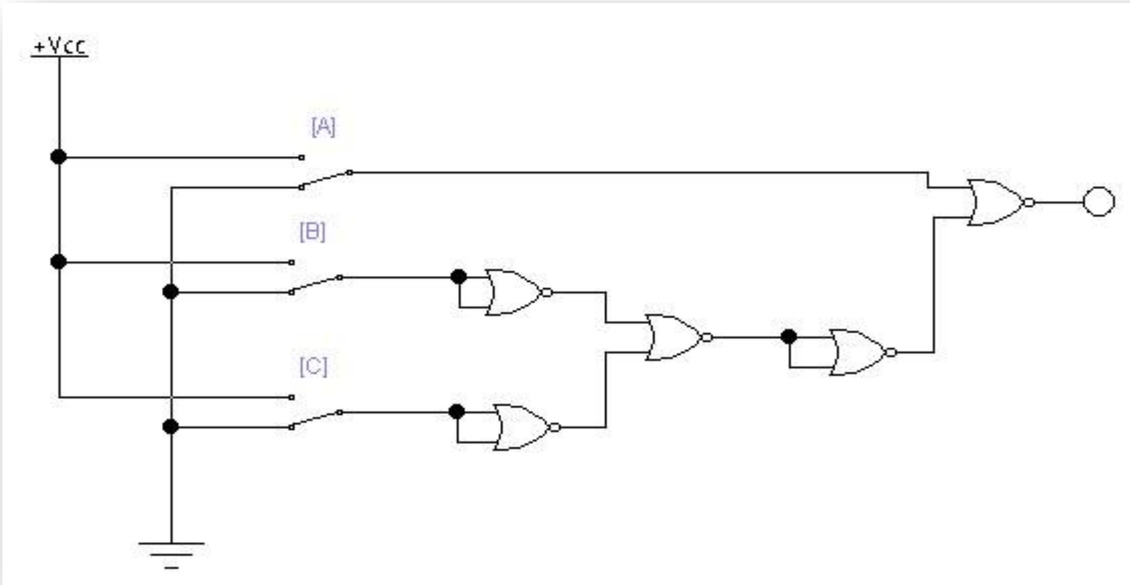
$X = \overline{A} + BC$

Truth Table:

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

Circuit Diagram:

The circuit expression A'+BC made using NOR GATE where A, B and C are both initial outputs and led is connected to the last gate to visualize the output of the expression where it lights when the final result lie. A and B and C are connected to VCC and secondary ground.



Conclusion:
The NOR of B and NOR of C gets as input to another NOR gate gives the result BC. Then NOR of A gets input in NOR with result BC which gives $\overline{A} + \overline{\overline{(BC)}}$ then it is goes in NOR gate which give us required equation $\overline{A}$ + BC. Circuit is working properly according to the truth table and logic.

LAB#08

Object:

Simulate the simplified equation **$Y = X^2$**, where X is 3-bit input variable.

Truth Table:

		Input				**Output ($Y = X^2$)**				
Decimal	A	B	C	Y_0	Y_1	Y_2	Y_3	Y_4	Y_5	Y
X =0	0	0	0	0	0	0	0	0	0	0
X =1	0	0	1	0	0	0	0	0	1	1
X =2	0	1	0	0	0	0	1	0	0	4
X =3	0	1	1	0	0	1	0	0	1	9
X =4	1	0	0	0	1	0	0	0	0	16
X =5	1	0	1	0	1	1	0	0	1	25
X =6	1	1	0	1	0	0	1	0	0	36
X =7	1	1	1	1	1	0	0	0	1	49

K- Map:

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	0
$\bar{A}$B	0	0
AB	1	1
A$\bar{B}$	0	0

Y_0

1

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	0
$\bar{A}$B	0	0
AB	0	1
A$\bar{B}$	1	1

Y

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	0
$\bar{A}$B	0	1
AB	0	0
A$\bar{B}$	0	1

Y_2

$Y_0 = AB$

$Y_1 = AC + A\bar{B}$

$Y_2 = A\ BC + A\bar{B}C$

Y_3

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	0
$\bar{A}$B	1	0
AB	1	0
A$\bar{B}$	0	0

Y_4

	$\bar{C}$	C
$\bar{A}\bar{B}$	0	0
$\bar{A}$B	0	0
AB	0	0
A$\bar{B}$	0	0

Y_5

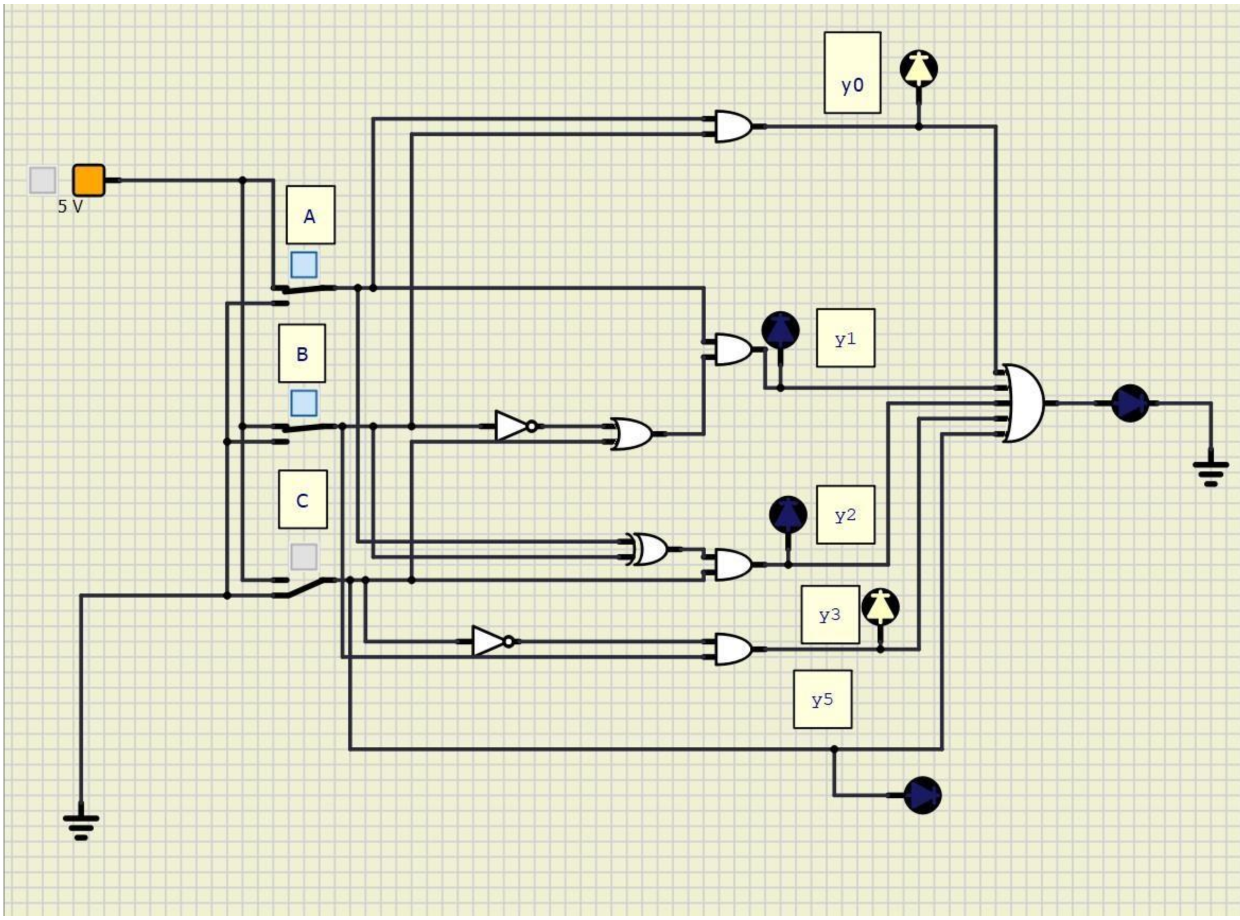
	$\bar{C}$	C
$\bar{A}\bar{B}$	0	1
$\bar{A}$B	0	1
AB	0	1
A$\bar{B}$	0	1

$Y_3 = BC$

$Y_4 = 0$

$Y_5 = C$

Circuit Diagram:



Conclusion:

The LEDs are on with respect to the truth table verifying the circuit here we consider the inputs where A = 1, B = 1 and C = 0 corresponds with the truth table and Y_0 and Y_3 are receive high.

LAB#09

Object:

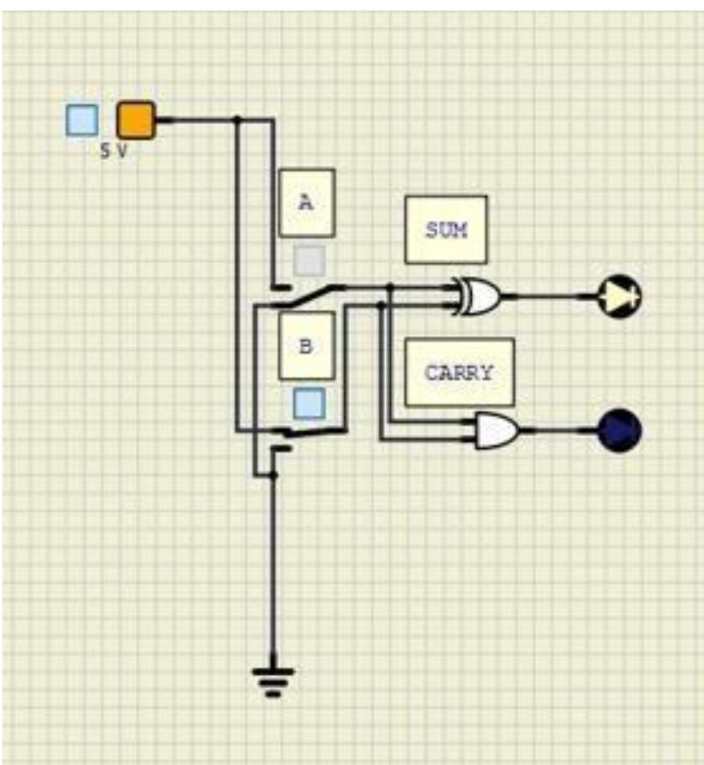
Implement the circuit of half adder.

Truth Table:

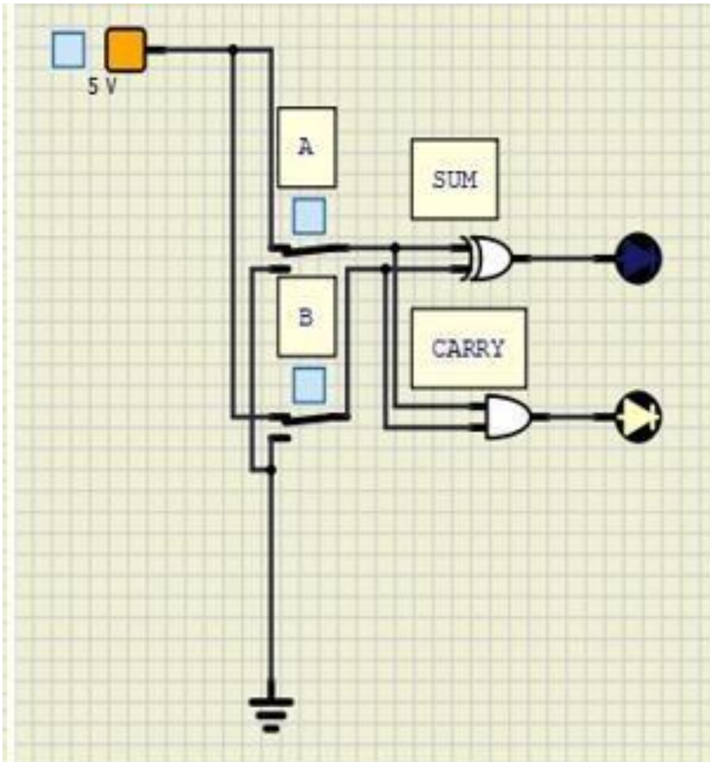
Since we consider only single bit operation, we use 2 single bits as input.

A	B	Sum = $A \oplus B$	Carry = A.B
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Circuit Diagram:



For A = 0 and B = 1



For A = 1 and B = 1

Conclusion:

The output is corresponding to that on the Truth Table which is shown in the simulator by the ‘ON’ state of the LED which represents the ‘1’ value on the truth table. E.g. In the last case of half adders all inputs are ‘1’ so the Sum is ‘OFF’ and Carry is ‘ON’.

Lab 09:

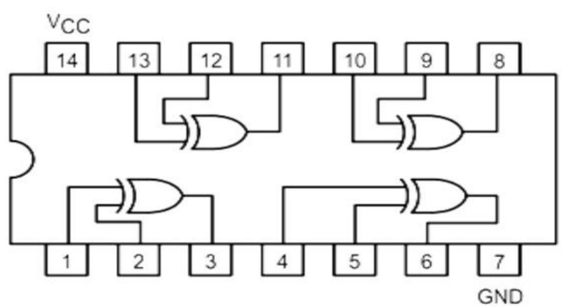
Object:

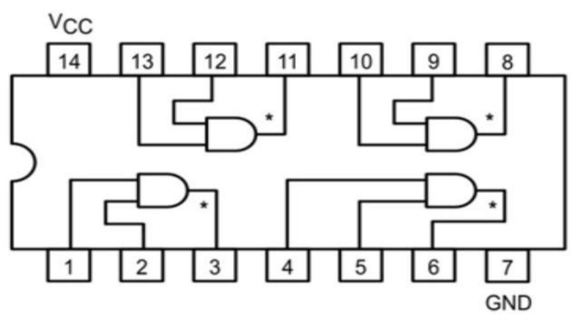
Implement the Circuit of Half Adder

Apparatus:

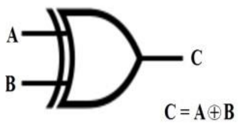
- IC________7486 , 7408
- Breadboard
- Power supply(5v DC)
- LED
- Connecting wires

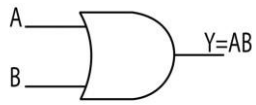
7486 XOR gate and 7408 C inner Circuit Diagram:



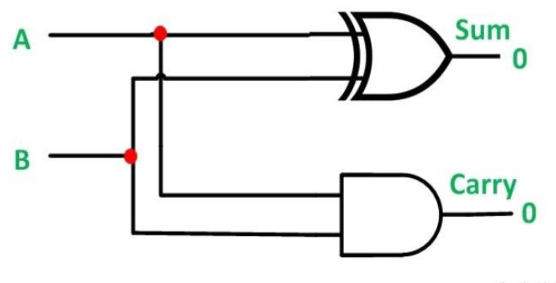


Symbol:

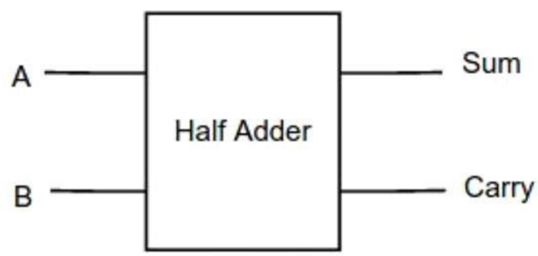




Circuit Diagram:



Logic Diagram:



Truth Table:

	B	SUM	CARRY
0	0	0	0
0	1	1	0
1	0	1	0
1	1	1	1

Conclusion:

The output is corresponding to that on the Truth Table which is shown in the simulator by the ‘ON’ state of the LED which represents the ‘1’ value on the truth table. E.g. In the last case of full-adders all inputs are ‘1’ so the Sum and C_{out} are both ‘ON’.

Lab 10:

Object:

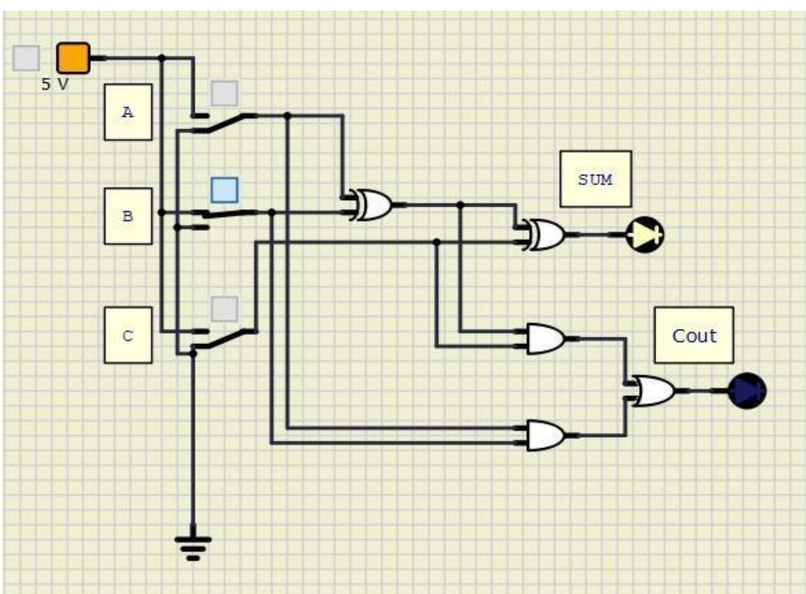
Implement the circuit of full adder.

Truth Table:

Here we take 3 single bit input.

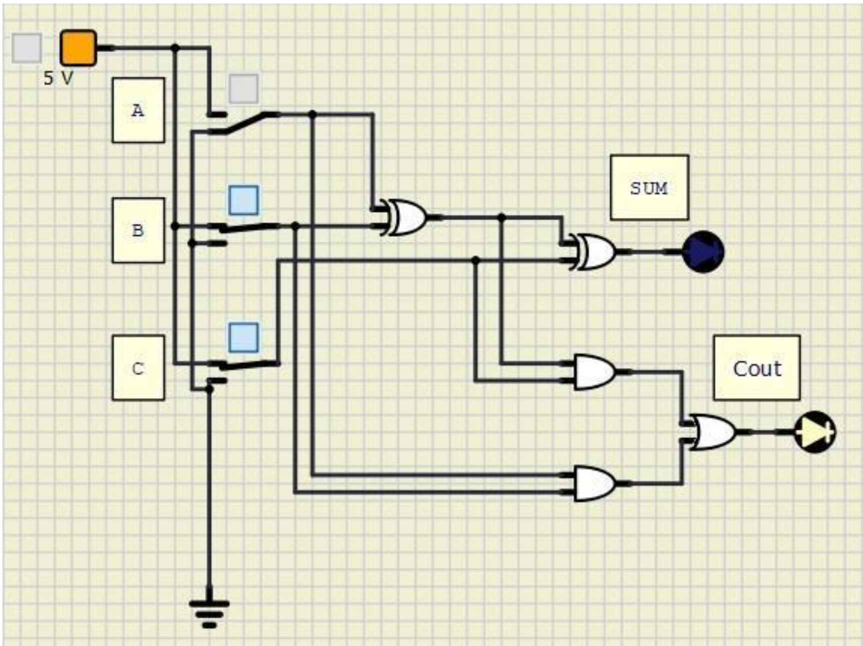
A	B	C_{in}	$\sum$	C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

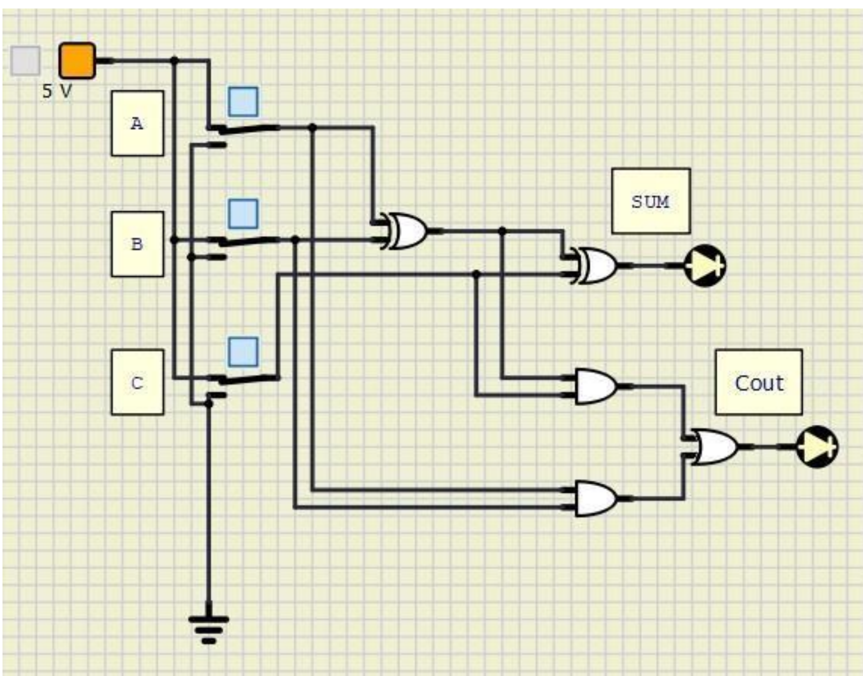
Circuit Diagram:



$\sum = (A \oplus B) \oplus C$

$C_{out} = AB + C(A \oplus B)$





Conclusion:

The output is corresponding to that on the Truth Table which is shown in the simulator by the ‘ON’ state of the LED which represents the ‘1’ value on the truth table. E.g. In the last case of full-adders all inputs are ‘1’ so the Sum and C_{out} are both ‘ON’.

LAB#11

Object:

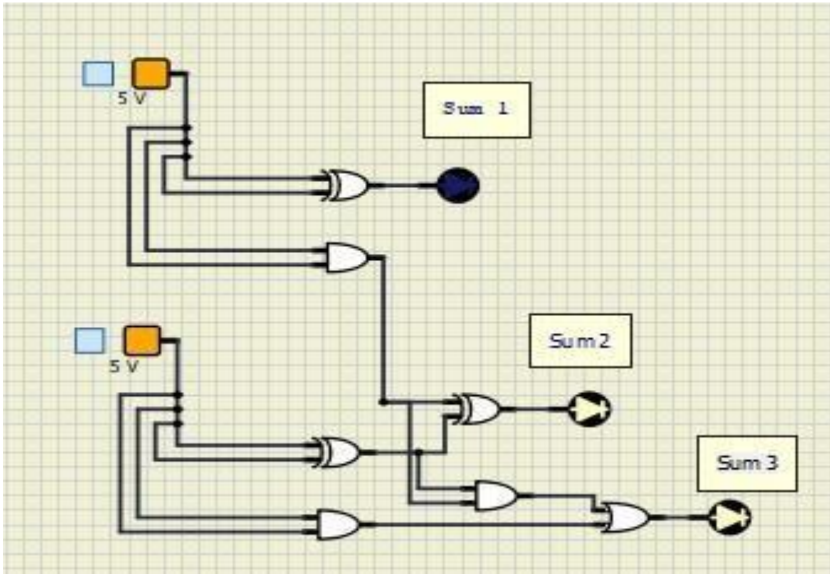
Implement two-bit parallel adders on simulator and show the result of any combination.

A_1	A_2	B_2	B_1	$\sum 1$	$\sum 2$	$\sum 3$
1	1	1	1	0	1	1

Binary Addition:

$$
\begin{array}{lllll}
 & A_2 & A_1 & \quad & 1 \quad 1 \\
 & B_2 & B_1 & \quad & 1 \quad 1 \\
\hline
\sum 3 & \sum 2 & \sum 1 & \quad & 1 \quad 1 \quad 0
\end{array}
$$

Circuit Diagram:



Conclusion:

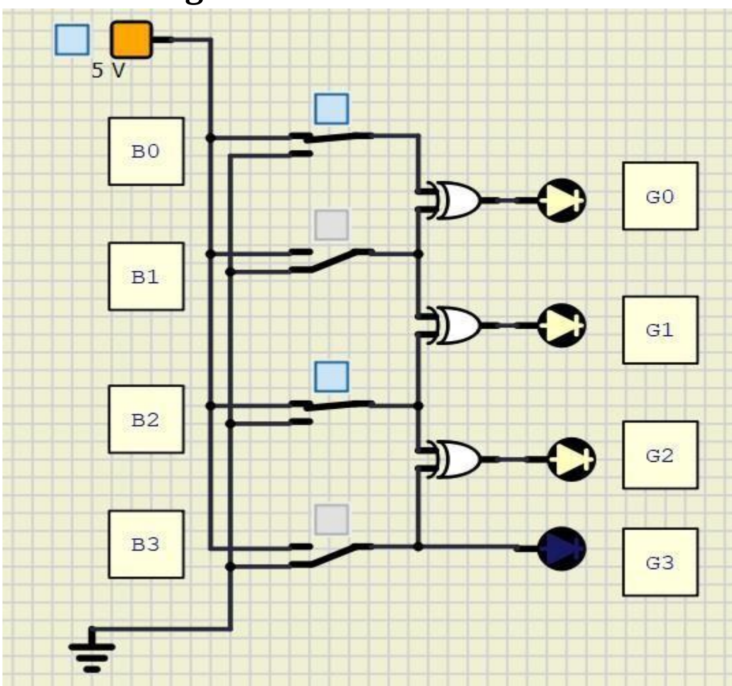
We can prove the circuit diagram above through simple binary addition, ∑1 is 0 which is indicated by the LED being off in the diagram where as the others are 1 which is indicated by the LEDs being on as shown.

LAB 12:

Object:

Implement the circuit diagram of binary to gray code conversion.

Circuit Diagram:



Binary □ 0 1 0 1

Gray □ 0 1 1 1

Conclusion:

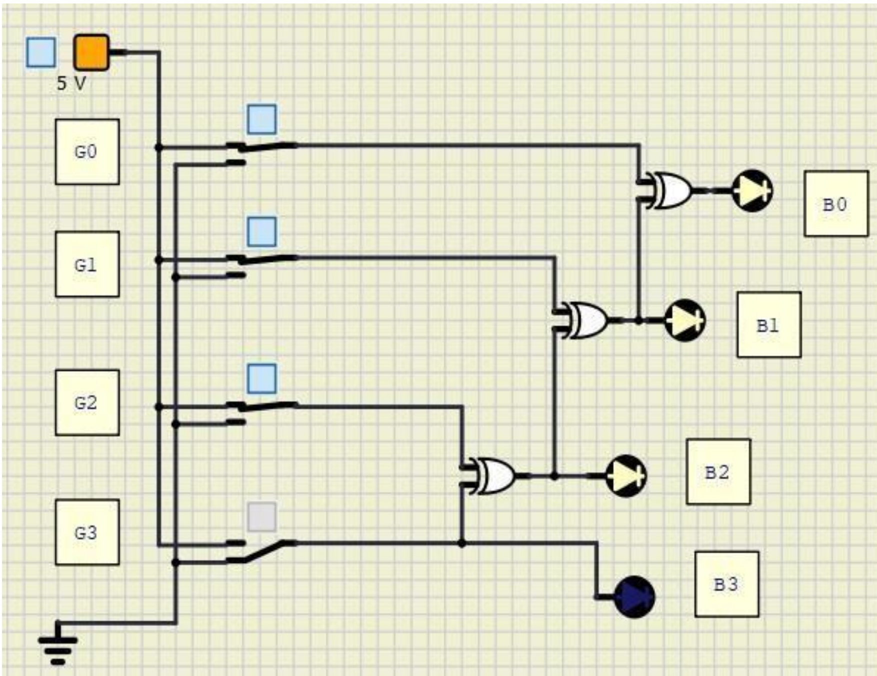
The circuit diagrams correspond to the actual conversions of Binary to Gray code as seen by the LED indications.

LAB 13:

Object:

Implement the circuit diagram of gray code to binary conversion.

Circuit Diagram:



Gray 0 1 1 1

Binary 0 1 0 1

Conclusion:

The circuit diagrams correspond to the actual conversions of Gray Code to Binary as seen by the LED indications.

LAB 14:

Object: Implement Code conversions (Binary to Excess-3) and draw its circuit diagram using simulator.

Truth Table:

A	B	C	X_3	X_2	X_1	X_0
0	0	0	0	0	1	1
0	0	1	0	1	0	0
0	1	0	0	1	0	1
0	1	1	0	1	1	0
0	0	0	0	1	1	1
0	0	1	1	0	0	0
1	1	0	1	0	0	1
1	1	1	1	0	1	0

We get these simplified equations using k-map (SOP)

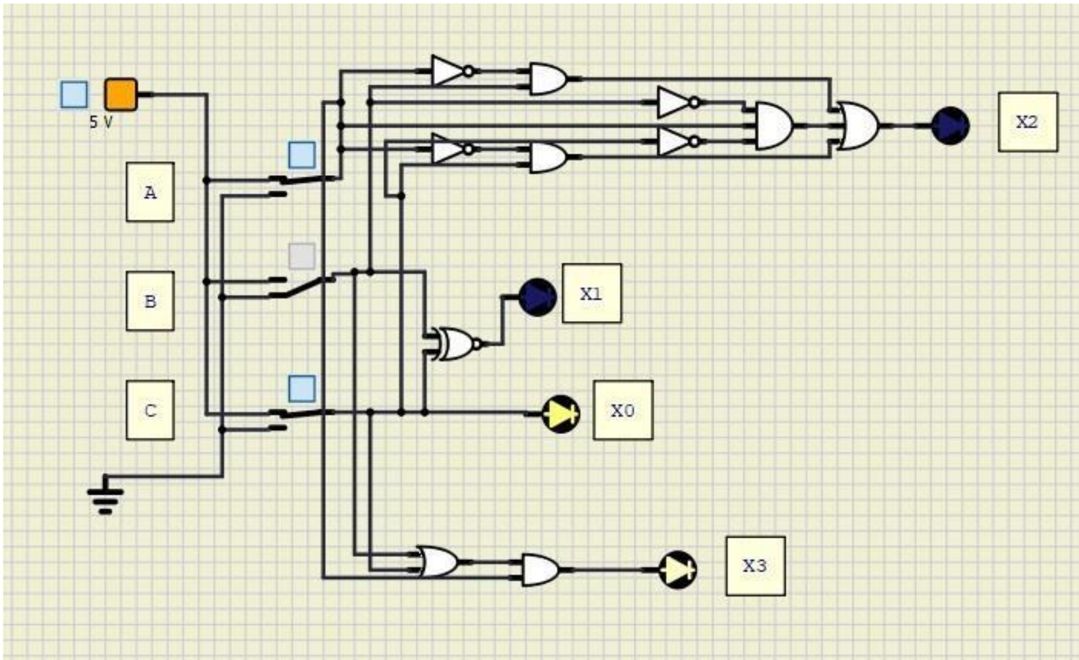
$X_0 = C$

$X_1 = \bar{B}\bar{C} + BC$ (XNOR)

$X_2 = A\bar{B}\bar{C} + A\ B + A\ C$

$X_3 = AB + A$C ‘OR’ A(B+C)

Circuit Diagram:



Conclusion:

We can see that the truth table reflects the given circuit built through the simplified equations.