UNIVERSITY OF ASIA PACIFIC

Department of Computer Science & Engineering

Course Title – Digital Logic & System Design Lab

Course Code – CSE 210

Experiment No. – 02

Experiment name – Simplification of logic expression & logic circuit designing.

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PROBLEM STATEMENT :

a) Simplify the given logic expression and verify the truth table.
b) Design a logic circuit from a given truth table.

OBJECTIVE : The objective of the experiment is to draw truth table from a given expression and verify it using logic circuit. Again write down a logic expression from a truth table, simplify it and finally draw logic circuit of simplified expression.

APPARATUS :

- IC-7408(AND Gate)
- IC-7432(OR Gate)
- IC-7402(NOR Gate)
- IC-7486(XOR Gate)
- Logic display
- Logic switch

INTRODUCTION: Logic gates are symbols that can directly replace an expression in "Boolean Arithmetic". Simplification means, one Boolean expression which is minimized into an equivalent expression by applying Boolean identities. Boolean algebra is used to simplify Boolean expression which represents combinational logic circuit. It reduces the original expression to an equivalent expression that has fewer terms which means that less logic gates are needed to implement the combinational logic circuit.

Boolean Algebra:

1. $x \cdot 0 = 0$
2. $x \cdot 1 = 1$
3. $x \cdot x = x$
4. $x \cdot \bar{x} = 0$
5. $x + 0 = x$
6. $x + 1 = 1$
7. $x + x = x$
8. $x + \bar{x} = 1$
9. $x + y = y + x$
10. $x \cdot y = y \cdot x$
11. $x+(y+z) = (x+y)+z = x+y+z$
12. $x.(y.z) = (x.y).z = x.y.z$
13. $x.(y+z) = x.y + x.z$
14. $x + x.y = x$
15. $x + \bar{x} .y = x + y$
16. $\overline{x + y} = \bar{x} . \bar{y}$
17. $\overline{x . y} = \bar{x} + \bar{y}$

❖ SIMPLIFY THE FOLLOWING LOGIC EXPRESSION AND VERIFY THE TRUTH TABLE

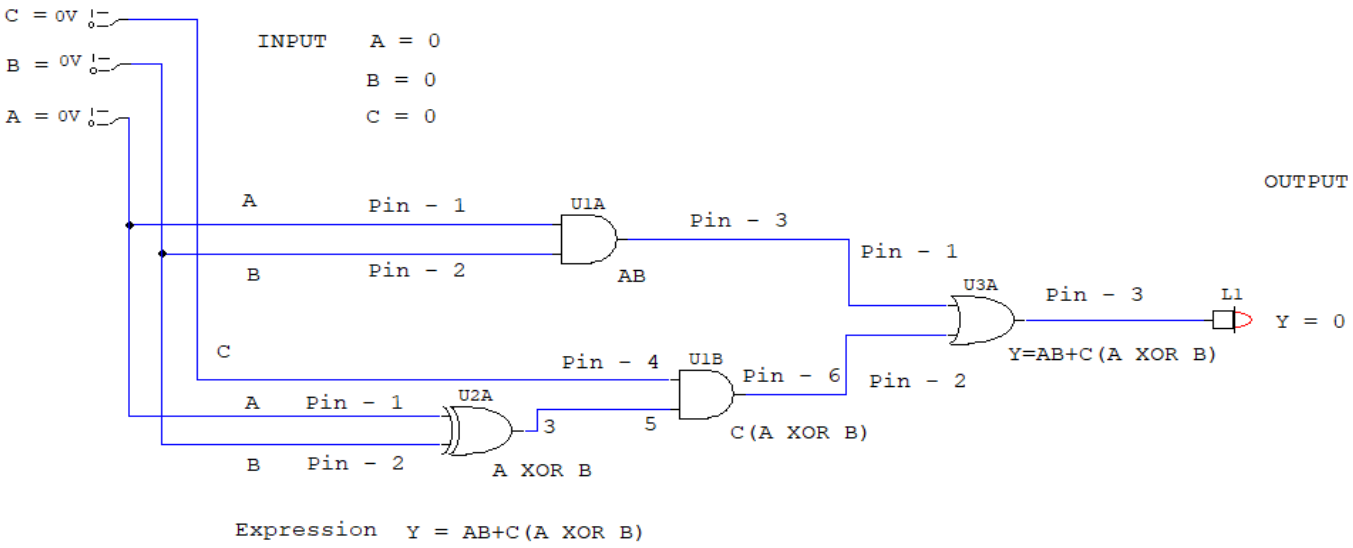
Given Expression: $Y = AB + C(A \oplus B)$

TRUTH TABLE:

INPUT						**OUTPUT**
A	B	C	$A \oplus B$	A.B	$C(A \oplus B)$	Y
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	1	0	0	0
0	1	1	1	0	1	1
1	0	0	1	0	0	0
1	0	1	1	0	1	1
1	1	0	0	1	0	1
1	1	1	0	1	0	1

For the following expression first we have to do **A and B** (A.B) then **A XOR B** ($A \oplus B$) and then AND operation with **C AND** $\mathbf{A \oplus B}$. Finally OR operation between **A.B OR** $\mathbf{C(A \oplus B)}$. So finally the expression will be $\mathbf{AB + C(A \oplus B)}$.

CIRCUIT DIAGRAM

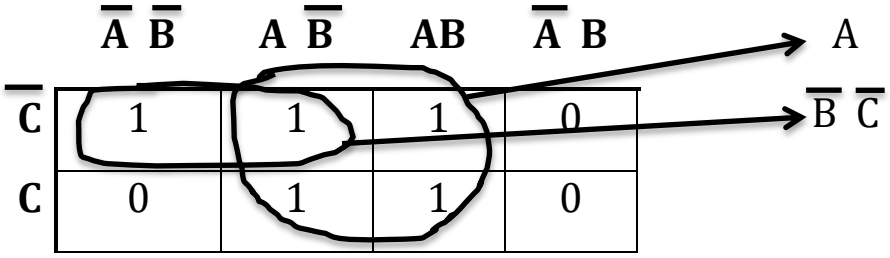


❖ DESIGN A LOGIC CIRCUIT FROM A GIVEN TRUTH TABLE

A	B	C	Y	EXPRESSION
0	0	0	1	$\bar{A}\,\bar{B}\,\bar{C}$
0	0	1	0	--
0	1	0	0	--
0	1	1	0	--
1	0	0	1	A$\bar{B}\bar{C}$
1	0	1	1	A$\bar{B}$C
1	1	0	1	AB$\bar{C}$
1	1	1	1	ABC

$Y = \overline{A}\,\overline{B}\,\overline{C} + A\,\overline{B}\,\overline{C} + A\,\overline{B}\,C + A\,B\,\overline{C} + ABC$

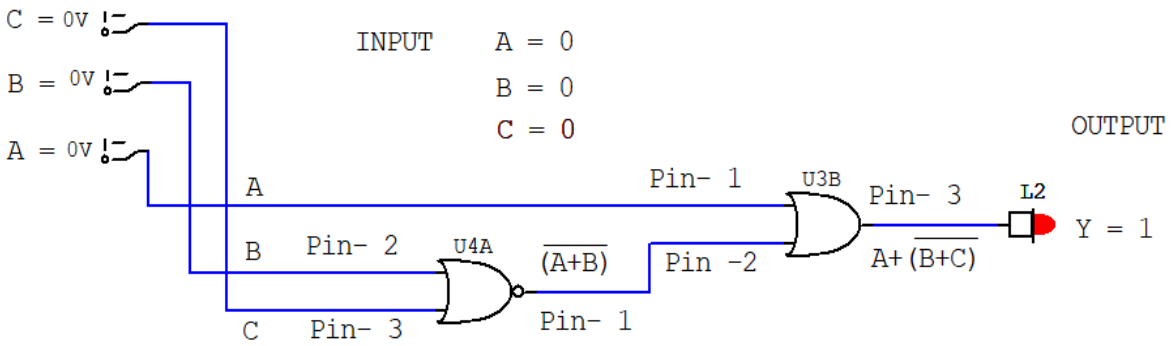
***Using K-map :**



$Y = A + \overline{B}\,\overline{C}$

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

CIRCUIT DIAGRAM



EXPRESSION : $Y=A+\overline{(B+C)}$

DISCUSSION : In this experiment we learned about simplification of a equations. Drawing truth table from a logic expression and it's logic circuit. Then we learned how to write logic expression from a truth table and draw logic circuit of it. We have to simplify logic expression as much as we can. So that we will need less number of logic gates to express the logic expression. It is better to use K-map to simplify logic expression. K-map gives most possible simplified expression. So we will try to simplify logic expression using K-map.