

Date:

EXPERIMENT NO. 2

AIM: Simplify given Boolean expressions using Boolean algebra, realize circuits for optimized Boolean expressions, implement them using i. Basic gates only ii. NAND gates only iii. NOR gates only and verify their operations.

Boolean Expressions:

i. $F1 = ABC + A'B'C + A'BC + ABC' + A'B'C'$

ii. $F2 = \sum m(2,3,6,7,8,10,11,13,14)$

APPARATUS: connection wires, power supply, power project board, resistors, LED, ICs

Sr.No.	Component	Specification	Quantity
1	AND Gate	IC 7408	2
2	OR Gate	IC 7432	2
3	NOT Gate	IC 7404	2
4	Two input NAND Gate	IC7400	3
5	Three input NAND Gate	IC7410	2
6	NOR Gate	IC7402	3

SIMULATION WEBSITE: <https://www.tinkercad.com/>

THEORY:

Boolean algebra is a system of mathematical logic, which uses capital or small letters of the English alphabet to represent variables or a function of the variables. In Boolean algebra, there is no subtraction and division. Only logical addition and logical Multiplication are performed. There are no fractions or negative numbers in Boolean algebra.

Boolean Postulates: Consider the binary numbers 0 and 1, Boolean variable x and its complement x'. Either the Boolean variable or complement of it is known as literal. The four possible logical OR operations among these literals and binary numbers are shown below.

$$x + 0 = x$$

$$x + 1 = 1$$

$$x + x = x$$

$$x + x' = 1$$

Similarly, the four possible logical AND operations among those literals and binary numbers are shown below.

$$x.1 = x$$

$$x.0 = 0$$

$$x.x = x$$

$$x.x' = 0$$

These are the simple Boolean postulates. We can verify these postulates easily, by substituting the Boolean variable with '0' or '1'.

Note– The complement of complement of any Boolean variable is equal to the variable itself. i.e., $x'' = x$.

Boolean Laws and Theorems:

ASSOCIATIVE LAW: $A + (B+C) = (A + B) + C$; $(A.B) C = A (B.C)$

DISTRIBUTIVE LAW: $A (B + C) = AB + AC$; $A + AC = (A + C) (A + B)$

IDEMPOTANCE LAW: $A.A = A$; $A + A = A$

NEGATION LAW: $A.A' = 0$; $A + A' = 1$

DOUBLE NEGATION LAW: $(A')' = A$

IDENTITY LAW: $A.1 = A$; $A + 1 = 1$

NULL LAWS: $A.0 = 0$; $A + 0 = A$

ABSORPTION LAWS: $A + AB = A$; $A (A + B) = A$

CONSENSUS LAW: $AB + A'C + BC = AB + A'C$

TRANSPOSITION THEOREM: $AB + A'C = (A + C) (A' + B)$

DE MORGAN's THEOREM : $(A + B)' = A' B'$; $(A.B)' = A' + B'$

PROCEDURE:

- i) Optimize Boolean expressions using Boolean Algebra.
- ii) Design circuit for optimized Boolean expression using (A). Basic gates (B) NAND gates only and (C) NOR gates only and simulate them on software
- iii) Verify operation of the circuits using truth table

OBSERVATION:

CONCLUSION:

Obtained Marks:

Faculty Sign:

Date:

ASSIGNMENT:

1. List out all Boolean theorems and postulates.
2. Simplify following Boolean expression and realize circuit of optimized expression using i. Basic gates only ii. NAND gates only and iii. NOR gates only :
 - a. $F1 = (A+B+C) (A+C+D') (A+C'+D) (A+B')$
 - b. $F2 = AC' + ACE + ACE' + ACE' + A'CD' + A'D'E'$