EXPERIMENT 2

LOGIC GATES AND BOOLEAN ALGEBRA

OBJEJTIVE

Gain experience in truth table and Boolean algebra.

THEORY

THE *AND* GATE

The ***AND*** gate implements the Boolean ***AND*** function where the output only is logical 1 when all inputs are logical 1. The standard symbol and the truth table for an ***AND*** gate with two inputs is given below.

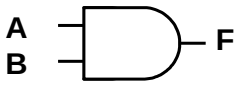

Figure 1 ***AND*** Gate symbol

A	B	F
0	0	0
0	1	0
1	0	0
1	1	1

Table 1 Truth table of ***AND*** Gate

The Boolean expression for the ***AND*** gate is F = A.B

THE *OR* GATE

The ***OR*** gate implements the Boolean ***OR*** function where the output is logical 1 when just input is logical 1. The standard symbol and the truth table for an ***OR*** gate with two inputs is given below.

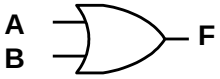

Figure 2 ***OR*** Gate

A	B	F
0	0	0
0	1	1
1	0	1
1	1	1

Table 2 Truth table of ***OR*** Gate

The Boolean expression for the ***OR*** gate is $F = A + B$.

THE *NOT* GATE

The ***NOT*** gate implements the Boolean ***NOT*** function where the output is the inverse of the input. The standard symbol and the truth table for the ***NOT*** gate is given below.

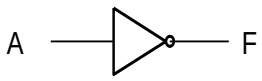

Figure 3 ***NOT*** Gate

A	F
0	1
1	0

Table 3 Truth table of ***NOT*** Gate

The Boolean expression for the ***NOT*** gate is $F = \bar{A}$

From these three basic logical gates it's to possible implement any Boolean expression into hardware.

THE *NAND* GATE

The ***NAND*** gate is an ***AND*** gate followed by a ***NOT*** gate. The output is logical 1 when one of the inputs is logical 0. The standard symbol and the truth table for the ***NAND*** gate is given below.

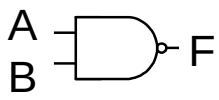

Figure 4 ***NAND*** Gate

A	B	F
0	0	1
0	1	1
1	0	1
1	1	0

Table 4 Truth table of ***NAND*** Gate

The Boolean expression for the ***NAND*** gate is $F = \overline{A \cdot B}$.

THE *NOR* GATE

The ***NOR*** is a combination of an ***OR*** followed by a ***NOT*** gate. The output is logical 1 when none of the inputs are logical 0.The standard symbol and the truth table for the ***NOR*** gate is given below.

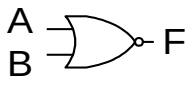

Figure 5 ***NAND*** Gate

A	B	F
0	0	1
0	1	0
1	0	0
1	1	0

Table 5 Truth table of ***NAND*** Gate

The Boolean expression for the ***NOR*** gate is $R = \overline{A + B}$.

TRUTH TABLE

A truth table is a list of all the possible inputs and the corresponding outputs for a given system. The amount of possible inputs is determined by the amount of input variables. This value can be obtained by the formula 2^n.

Example: Determine the truth table for: Y= A'B'C + ABC.

Truth Table			
A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Table 6 Truth Table

BUILDING A CIRCUIT

In order to build a circuit from a truth table, we must first determine the Boolean expression for that particular truth table. Then the circuit can be constructed from multiple ***AND*** gates who's outputs all tie into one multiple input ***OR*** gate.

Looking at the truth table, we must first determine the Boolean expression. From the two instances where the output is high we obtain the following Boolean expression.

F = A'B'C + ABC

To build this circuit we need two 3-input AND gates, two Inverters, and a 2-input OR gate. The completed circuit is shown below:

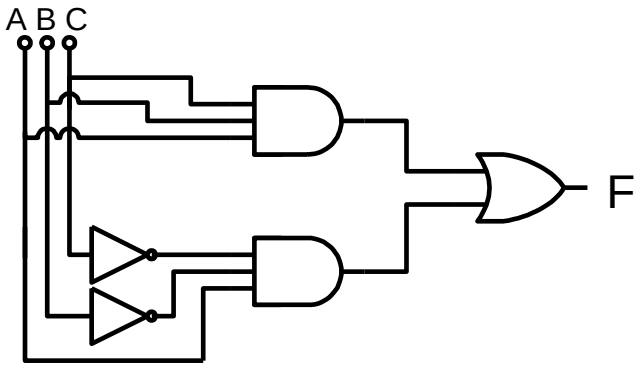

Figure 6 Logic Circuit

EXPERIMENTAL PROCEDURE

Equation F = (A+B)C'

1) Complete the Truth Table of the equation.
2) Implement equation by NAND gates.

Equipment List:

1) 74LS00 ***NAND*** GATE
2) Standard set equipments