Experiment (1)

Introduction to Logic Gates

3.2 Objectives:

- To get familiar with the usage of the available lab equipments.
- To describe and verify the operation for the AND, OR, NOT, NAND, NOR, XOR, XNOR gates.
- To Introduce a basic knowledge in integrated circuit devices operation.
- To practice how to build a simple digital circuit using ICs and other digital components .

3.3 Background Information :

Logic gates are the simplest component of any logic circuit. So, to understand the computer logic, you should understand and master the logic operators (gates). A gate is a digital electronic circuit having only one output but one or more inputs. The output or a signal will appear at the output of the gate only for certain input-signal combinations.

There are many types of logic gates; such as AND, OR and NOT, which are usually called the three basic gates. Other popular gates are the NAND and the NOR gates; which are simply combinations of an AND or an OR gate with a NOT gate inserted just before the output signal. Other gates include the XOR "Exclusive-OR" and the XNOR "Exclusive NOR" gates.

In this experiment, we will investigate all known logic gates and study their operations according to the truth table.

3.4 Equipment Requires :

The following equipments are needed to perform all the procedures :

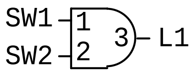
Universal Breadboard
Jumper wire kit
(1) 7400 TTL QUAD NAND GATE
(1) 7402 TTL QUAD NOR GATE
(1) 7404 TTL HEX INVERTER GATE
(1) 7408 TTL QUAD AND GATE
(1) 7432 TTL QUAD OR GATE
(1) 7486 TTL QUAD EXCLUSIVE OR GATE
(1) 74266 TTL QUAD EXCLUSIVE NOR GATE
2x Toggle Switches
1x Carbon-film Resistor (470Ω)
1x LED

3.5 Procedure:

Step I :

1. Collect the components necessary to accomplish this experiment.
2. Plug the IC chip into the breadboard.
3. Connect the supply voltage and ground lines to the chips. PIN7 = Ground and PIN14 = +5.

4. According to the pinout diagram of each IC mentioned above, wire only one gate to verify its truth table.
5. Once all connections have been done, turn on the power switch of the breadboard .
6. Operate the switches and fill in the truth table (Write "1" if LED is ON and "0" if L1 is OFF).
7. Repeat the above steps for each IC package.

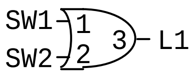


7408

AND Gate

$L1 = SW1SW2$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	

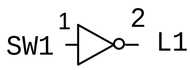


7432

OR gate

$L1 = SW1 + SW2$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	

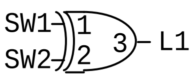


7404

NOT Gate

$L1 = \overline{SW1}$

SW1	L1
0	
1	

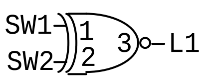


7486

XOR Gate

$L1 = SW1 \oplus SW2$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	

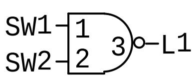


74266

XNOR Gate

$L1 = SW1 \Theta SW2$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	

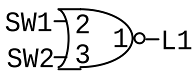


7400

NAND Gate

$L1 = \overline{SW1SW2}$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	



7402

NOR Gate

$L1 = \overline{SW1 + SW2}$

SW1	SW2	L1
0	0	
0	1	
1	0	
1	1	

Step II :

1. Consider the logic circuit shown in Figure3.1, use the required IC chips to wire this circuit and verify its function table.
2. After finishing the experiment, turn off the power switch , disconnect the wires , take out all IC chips from the trainer, put back everything you have used and clean your table.

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

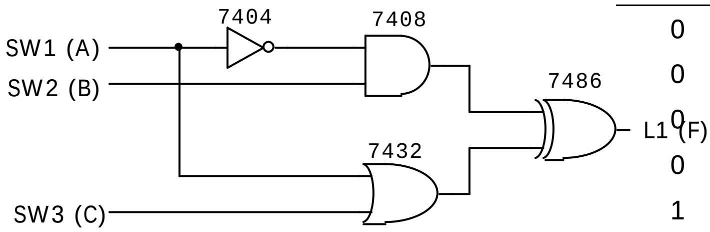


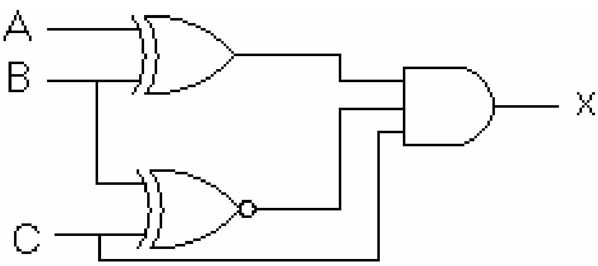
Figure3.1

Function Table

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

Questions :

1) Implement 3-input AND gate using:
   a) Some 2-input AND gates
   b) 4-input AND gate
2) Implement an inverter using NAND gate?
3) Construct 4-input AND gate using two 3-input AND gates.
4) Implement 2-input OR gate using two 2-input NOR gates?
5) Determine the input combination needed to make x = 1 in the following logic circuit :



6) Write a truth table for the following circuit. Derive Boolean expressions for all outputs.