Experiment # 2

Universal Gates and Applications of Boolean algebra

Objective:
■   To investigate the rules of Boolean algebra.
■   To gain experience working with practical circuits
■   To simplify a complex function using Boolean algebra

Required Components and Equipments

1.   AT-700 Portable Analog/Digital Laboratory
2.   7400×1

Mandatory Readings:

BOOLEAN THEOREMS

1. $x.0=0$
2. $x.1=x$
3. $x.x=x$
4. $x.\overline{x}=0$
5. $x+0=x$
6. $x+1=1$
7. $x+x=x$
8. $x+\overline{x}=1$
9. $x+y=y+x$ (Commutative laws)
10. $x.y=y.x$ (Commutative laws)
11. $x+(y+z)=(x+y)+z=x+y+z$ (Associative laws)
12. $x(yz)=(xy)z=xyx$ (Associative laws)
13. $(w+x)(y+z)=wy+xy+wz+xz$
14. $x+xy=x$
15. $x+\overline{x}y=x+y$
16. $\overline{x}+xy=\overline{x}+y$
17.   (DeMorgan's Theorem)

$$\overline{x+y}=\overline{x}.\overline{y}$$

18.   (DeMorgan's Theorem)

$$\overline{x.y}=\overline{x}+\overline{y}$$

Diagram of Circuit:

Building Basic Gates using Universal [NAND] Gates:

NOT Gate

OR Gate

AND Gate
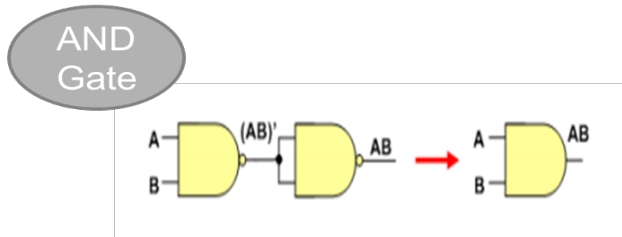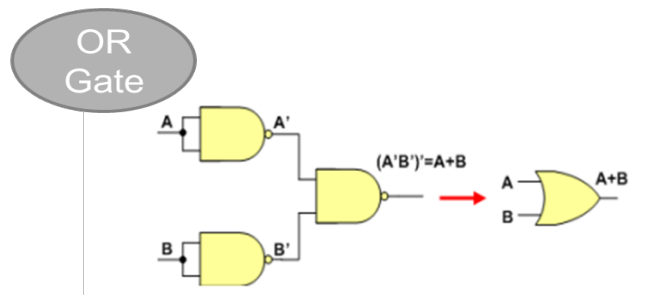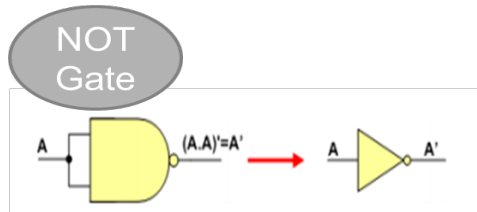
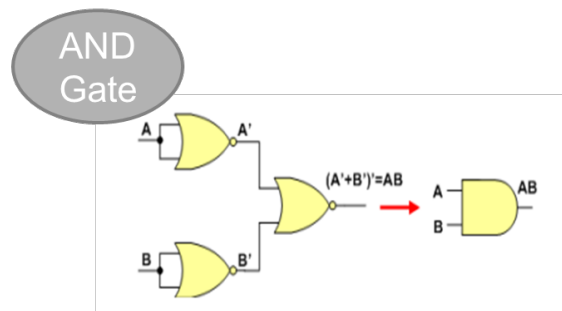**Building Basic Gates using Universal [NOR] Gates:**

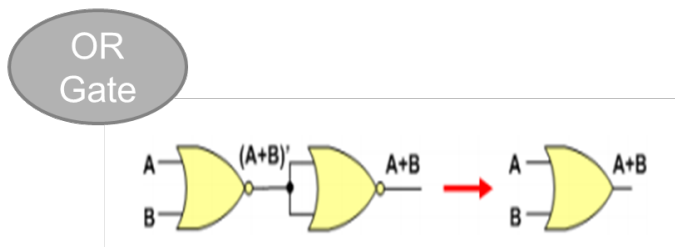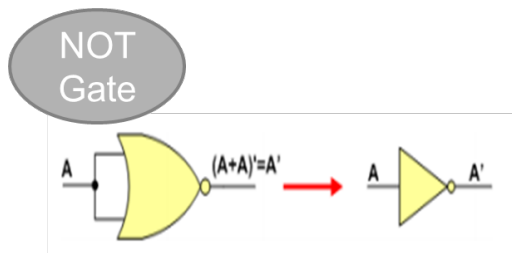NOT Gate

OR Gate

AND Gate

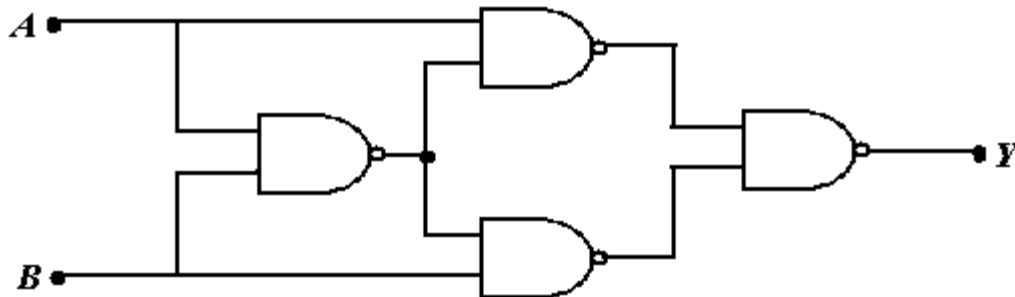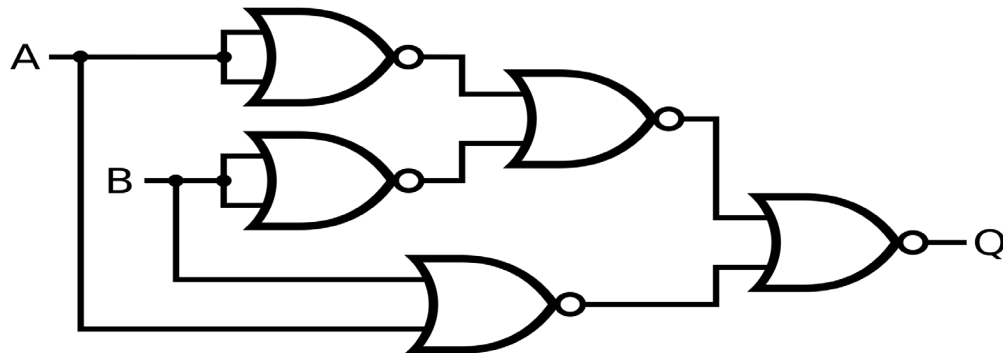**Diagram 1: Building Circuit using Universal Gates [NAND]:**

Diagram 2: Building Circuit using Universal Gates [NOR]:

Procedure:

■   Construct the Circuit of Figure 1, on the breadboard of AT-700.
■   Remember each IC's pin 14 connected to "+5V" position of DC Power Supply of AT-700, and pin 7 connected to "GND" position.
■   Connect the inputs to Data switches and outputs to any position of LED Display.
■   Find out the outputs for all possible combinations of input states.
■   Write down the input-output in tabular form.

Report:
The report should cover the followings

1.   Name of the Experiment
2.   Objective
3.   Required Components and Equipments
4.   Experimental Setup (Draw diagram 1 and 2)

5.   Results (Truth Table) and Discussions .The discussions part must include the answers of the following questions:

●   What is the Boolean Equation for the output (for both diagrams)?
●   Simplify the Boolean equations (for both diagrams).
●   The circuits' functions are identical to two single gates. Write down the name of those gates.
●   Implement the following function using NAND gate only: $(A(AB+CD))'$. Do not simplify the function. Draw the diagram only.