

Experiment # 2: Universal Gates, 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:

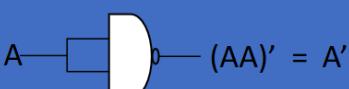
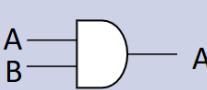
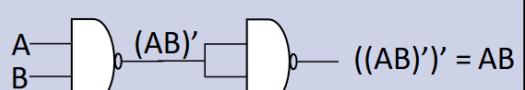
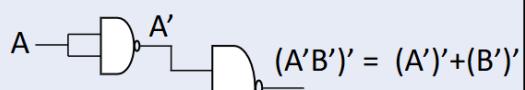
1. IC 7400 $\times 1$
2. IC 7402 $\times 2$

Boolean Postulates & Theorems:

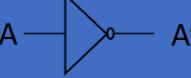
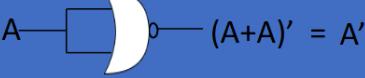
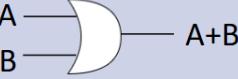
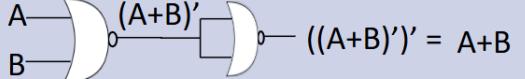
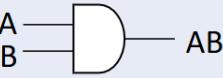
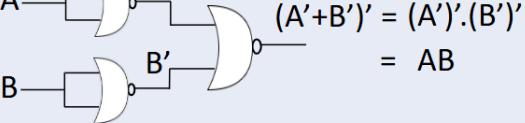
Postulate 2:	(a) $x + 0 = x$	(b) $x \cdot 1 = x$
Postulate 3: Commutative	(a) $x + y = y + x$	(b) $x \cdot y = y \cdot x$
Postulate 4: Distributive	(a) $x(y+z) = xy + xz$	(b) $x + yz = (x+y).(x+z)$
Postulate 5:	(a) $x + x' = 1$	(b) $x \cdot x' = 0$
Theorem 1:	(a) $x + x = x$	(b) $x \cdot x = x$
Theorem 2:	(a) $x + 1 = 1$	(b) $x \cdot 0 = 0$
Theorem 3: Involution	$(x')' = x$	
Theorem 4: Associative	(a) $x+(y+z) = (x+y) + z$	(b) $x \cdot (y \cdot z) = (x \cdot y) \cdot z$
Theorem 5: DeMorgan	(a) $(x + y)' = x' \cdot y'$	(b) $(xy)' = x' + y'$
Theorem 6: Absorption	(a) $x + xy = x$	(b) $x \cdot (x + y) = x$

Diagrams:

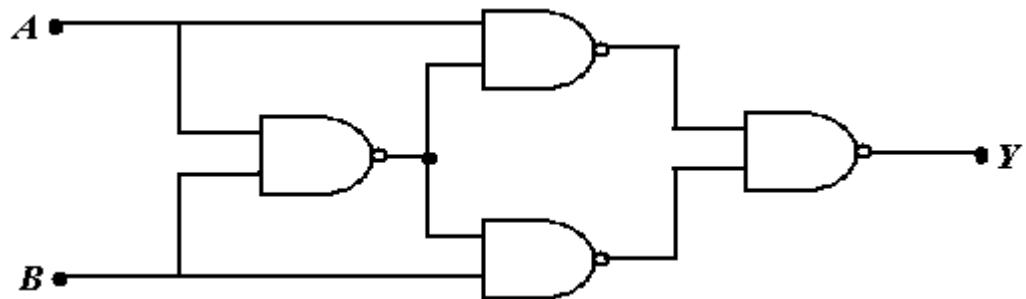
Building basic gates using Universal (NAND) Gate(s):

Not		
And		
Or		

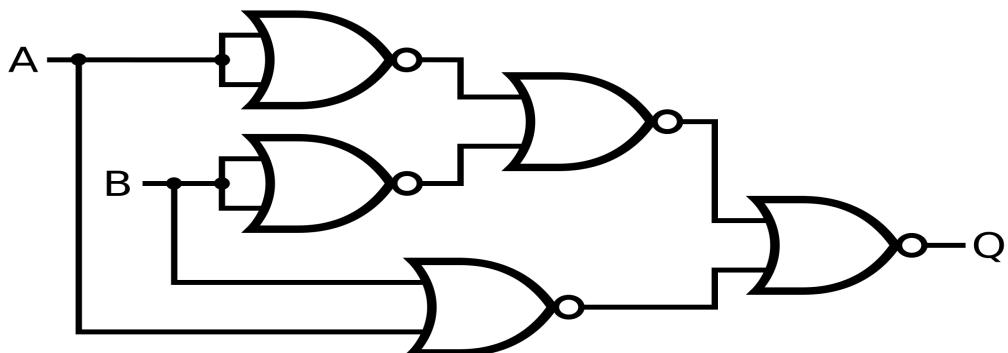
Building basic gates using Universal (NOR) Gate(s):

Not		 $(A+A)' = A'$
Or		 $((A+B)')' = A+B$
And		 $(A'+B')' = (A') \cdot (B')' = AB$

Circuit Diagram - 1:



Circuit Diagram - 2:



Procedure:

- Construct the Circuit Diagram - 1 on the breadboard.
- Remember to connect each IC's VCC pin to the "+5V" position of the DC Power Supply of the trainer board, and the GND or 0V pin to the "GND" position of the trainer board.
- Connect the inputs to the Data switches and outputs to any position of the LED Display.
- Find out the outputs for all possible combinations of input states.
- Write down the input-output in tabular form.

Report:

Your report must have the following segments:

1. Name of the Experiment.
2. Objective.
3. Required Components.
4. Experimental Setup - Draw the Circuit Diagram 1 and 2.
5. Results - Detailed Truth Table of both circuit diagrams.
6. Discussions - Answer the following questions:
 - a) What is the Boolean Equation for the output (for both circuit diagrams)?
 - b) Simplify the Boolean equations using Boolean algebra (for both diagrams).
 - c) The circuits' functions are identical to two single gates. Write down the name of those gates.
 - d) Implement the following function using NAND gate only: $(A + (AB + CD))'$.
Do not simplify the function. Draw the circuit diagram only.