EXPERIMENT 4

NAME OF EXPERIMENT

To Verify the Universal Gates (NAND and NOR Gates)

APPRATUS REQUIRED

1. Logic Gates Kit.
2. Connecting Probes (Leads).
3. Power Supply

THEORY

1. NAND GATE

The NAND or "Not AND" function is a combination of the two separate logical functions, the AND function and the NOT function connected together in series. The logic NAND function can be expressed by the Boolean expression of, $(A.B)'$

"If both A and B are true, then Y is false"

$$Y = (A.B)'$$

2. NOR GATE

The NOR or "Not OR" function is a combination of the two separate logical functions, the OR function and the NOT function connected together in series. The logic NOR function can be expressed by the Boolean expression of, $(A + B)'$

"If either A or B is true, then Y is false"

$$Y = (A + B)'$$

UNIVERSAL GATES

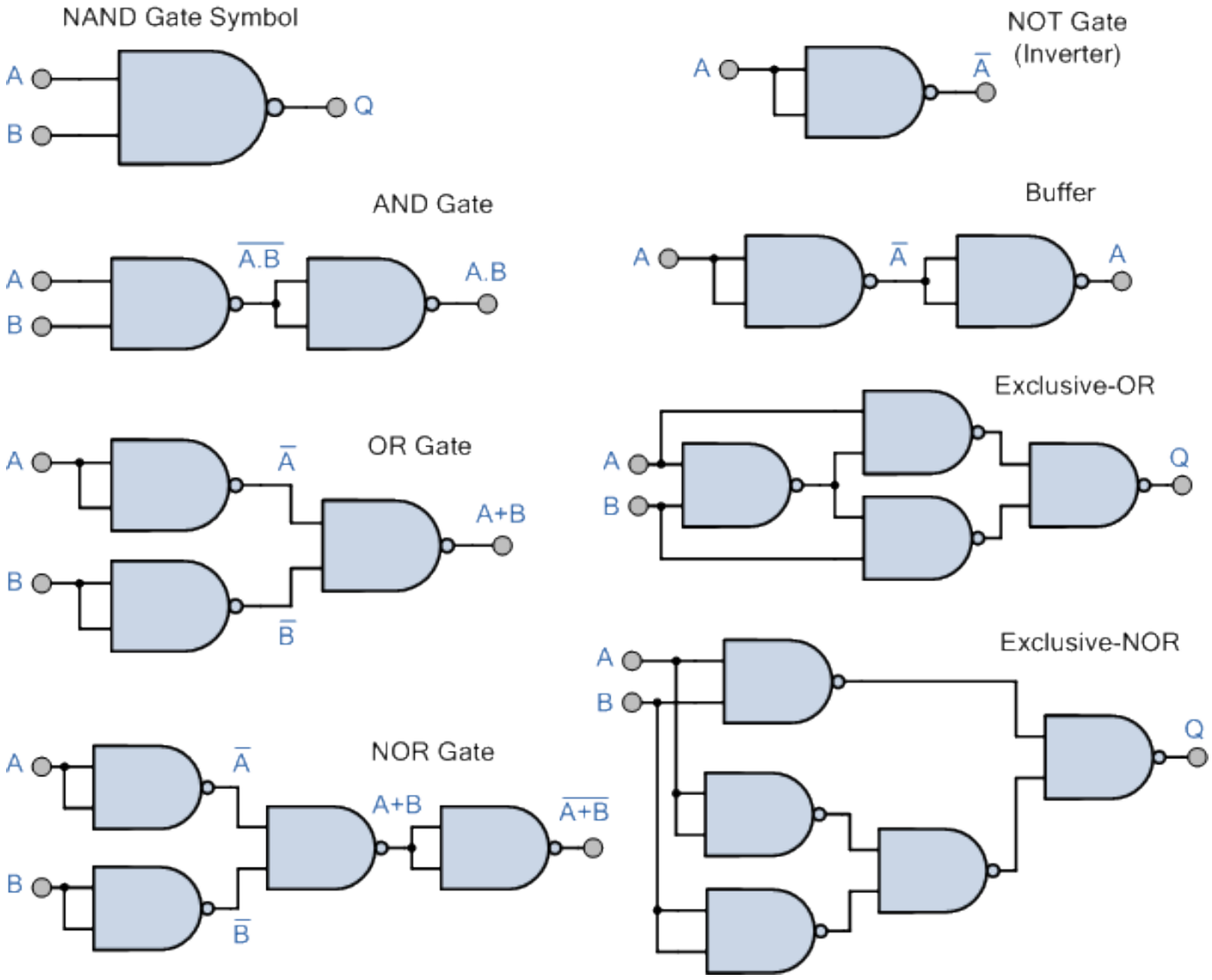
A universal gate is a gate which can implement any Boolean function without need to use any other gate type. The NAND and NOR gates are universal gates. In practice, this is advantageous since NAND and NOR gates are economical and easier to fabricate and are the basic gates used in all IC digital logic families. In fact, an AND gate is typically implemented as a NAND gate followed by an inverter not the other way around!! Likewise, an OR gate is typically implemented as a NOR gate followed by an inverter not the other way around.

NAND and NOR gates are also known as the universal gates because with these gates all gates can be design as given in the circuit diagram below.

NAND Gate as universal gate

To prove that any Boolean function can be implemented using only NAND gates, we will show that the AND, OR, and NOT operations can be performed using only these gates.

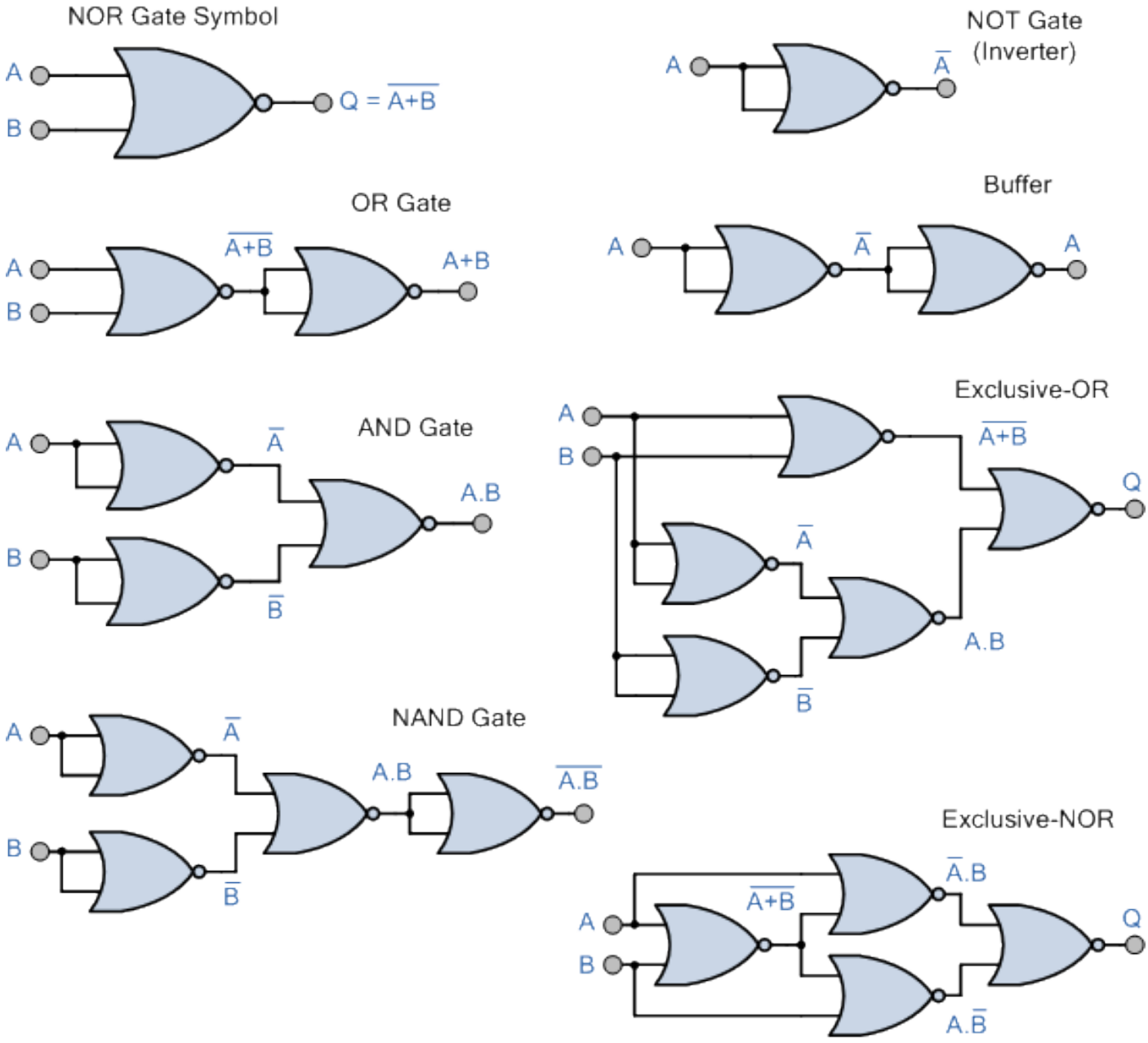
CIRCUIT DIAGRAM



NOR Gate as universal gate

To prove that any Boolean function can be implemented using only NOR gates, we will show that the AND, OR, and NOT operations can be performed using only these gates.

CIRCUIT DIAGRAM



PROCEDURE

Make connections on the Logic Gates Kit as the circuit diagram and verify the truth table for Each logic gate.

RESULT

Successfully constructed basic logic gates using universal gates. Verified NAND and NOR Gates as the universal gates.

DISCUSSION

Concept of the digital logic gates is cleared after performing this experiment.