Practical No 1
Study of Logic gates and their ICs and universal gates (NOT, AND, OR, NAND, NOR, EX-OR, and EX-NOR).

Aim:

a) Study of AND, OR, NOT, XOR, XNOR, NAND and NOR gates
b) Study of IC 7400, 7402, 7404, 7408, 7432, 7486, 74266
c) Implement AND, OR, NOT, XOR, XNOR using NAND gates.
d) Implement AND, OR, NOT, XOR, XNOR using NOR gates.

Theory:

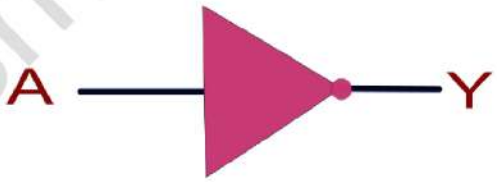
The logic gate is the most basic building block of any digital system, including computers. Each one of the basic logic gates is a piece of hardware or an electronic circuit that can be used to implement some basic logic expression. While laws of Boolean algebra could be used to do manipulation with binary variables and simplify logic expressions, these are actually implemented in a digital system with the help of electronic circuits called logic gates. The three basic logic gates are the NOT, AND, OR gate.

a) Study of AND, OR, NOT, XOR, XNOR, NAND and NOR gates

1) NOT gate:

a) **Definition:** It is a logic gate with one input and one output, the output is always the complement of the input

b) Symbol:



c) Boolean expression:

$$Y = \overline{A}$$

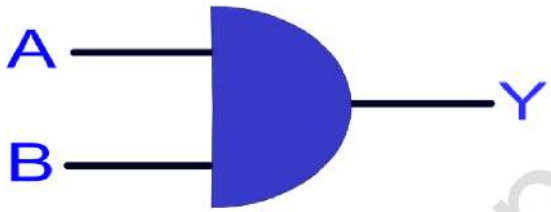
d) Truth table:

A	Y
0	1
1	0

2) AND gate:

a) **Definition:** It is a logic gate with more than one inputs but a single output, the output of AND gate is HIGH if and only if all the inputs are HIGH

b) Symbol:



c) Boolean expression:

$$Y = A \cdot B$$

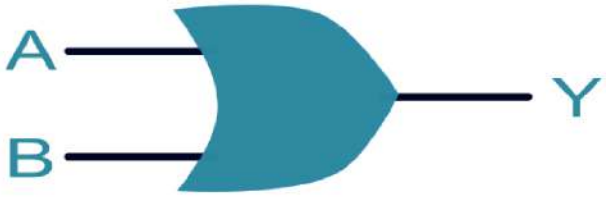
d) Truth table:

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

3) OR gate:

a) **Definition:** It is a logic gate with more than one inputs but a single output, the output the output of OR gate is LOW if and only if all the inputs are LOW

b) Symbol:



c) Boolean expression:

$$Y = A + B$$

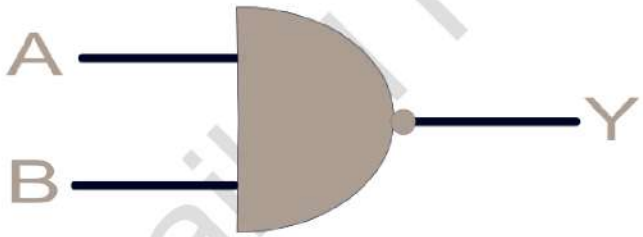
d) **Truth table:**

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

4) NAND gate:

a) **Definition:** It is a logic gate with more than one inputs but a single output, the output of NAND gate is LOW if and only if all the inputs are HIGH

b) **Symbol:**



c) **Boolean expression:**

$$Y = \overline{A \cdot B}$$

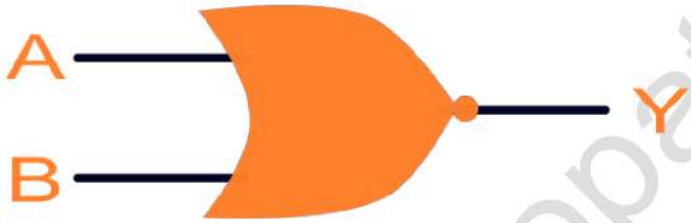
d) **Truth table:**

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

5) NOR gate:

a) **Definition:** It is a logic gate with more than one inputs but a single output, the output of NOR gate is HIGH if and only if all the inputs are LOW

b) Symbol:



c) Boolean expression:

$$Y = \overline{A + B}$$

d) Truth table:

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

6) EXOR gate:

a) **Definition:** It is a logic gate with more than one inputs but a single output, the output of EXOR gate is HIGH if and only if odd number of inputs are HIGH

b) Symbol:

c) **Boolean expression:**

$$Y = A \oplus B$$

d) **Truth table:**

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

7) EXNOR gate:

e) **Definition:** It is a logic gate with more than one inputs but a single output, the output of EXOR gate is HIGH if and only if even number of inputs are HIGH

f) **Symbol:**

g) **Boolean expression:**

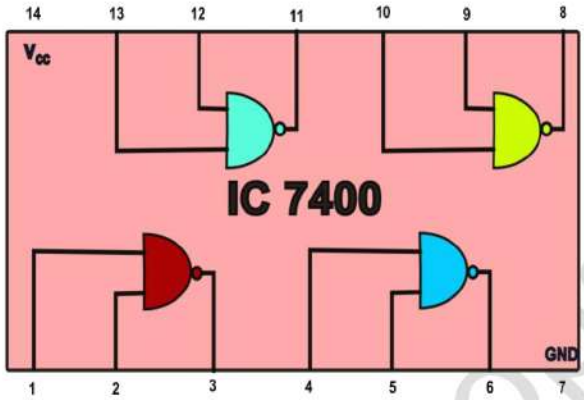
$$Y = A \odot B$$

h) **Truth table:**

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

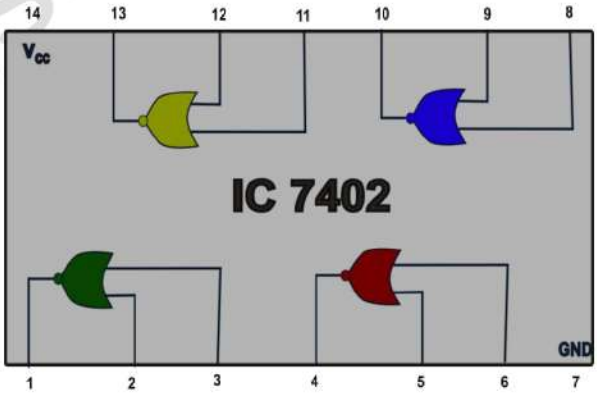
b) Study of IC 7400, 7402, 7404, 7408, 7432, 7486, 74266

i) **IC 7400:**



The IC 7400 is a quad 2-input NAND gate integrated circuit from the 74xx series, widely used in digital electronics.
Each of the four gates in the IC performs a NAND operation, which is a fundamental building block in digital logic circuits.
The 7400 IC is housed in a 14-pin dual in-line package (DIP) and operates with a power supply voltage range of 4.75 to 5.25 volts.
This IC is commonly used in various applications, including digital signal processing, combinational logic circuits, and as a building block for more complex digital circuits like multiplexers, decoders, and arithmetic logic units (ALUs).

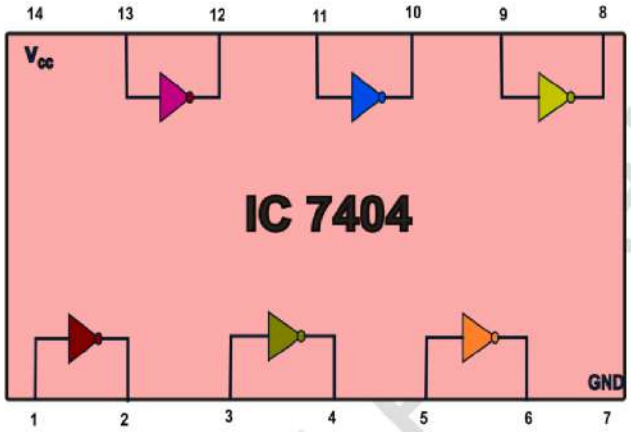
ii) **IC 7402:**



The IC 7402 is quad 2-input NOR gate integrated circuit from the 74xx series, commonly used in digital electronics. It consists of four independent NOR gates, each with two inputs, all housed in a 14-pin dual in-line package (DIP).

IC 7402 is use in various digital circuits, including combinational and sequential logic circuits, as well as in applications such as signal processing and control system

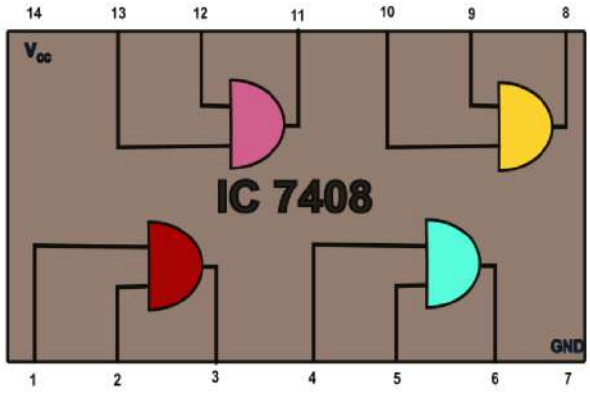
iii) IC 7404:



The IC 7404 is a hex inverter integrated circuit from the 74xx series, commonly used in digital electronics. It contains six independent NOT gates (inverters), housed in a 14-pin dual in-line package (DIP), and operates within a power supply voltage range of 4.75 to 5.25 volts.

The 7404 IC is used in various applications where signal inversion is required, such as inverting buffers, logic level shifters, and timing circuits. It can also be used in combination with other logic gates to implement complex digital circuits.

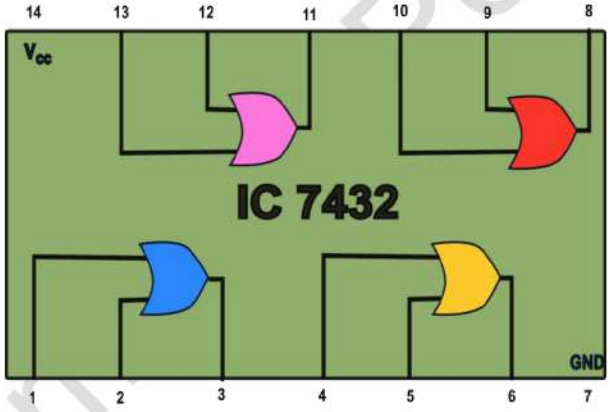
iv) IC 7408:



The IC 7408 is a quad 2-input AND gate integrated circuit from the 74xx series, commonly used in digital electronics. It consists of four independent AND gates, each with two inputs, all housed in a 14-pin dual in-line package (DIP). The IC operates within a power supply voltage range of 4.75 to 5.25 volts.

The 7408 IC is used in a variety of applications, including digital signal processing, combinational logic circuits, and control systems. It can be employed in creating logic functions, building complex digital systems, and performing logical operations in different digital devices.

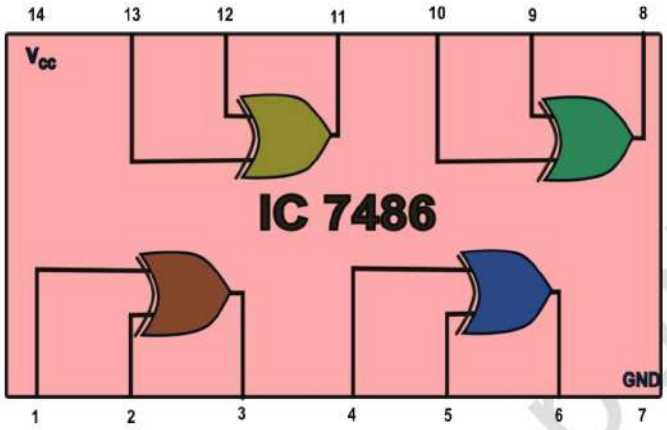
v) IC 7432:



The IC 7432 is a quad 2-input OR gate integrated circuit from the 74xx series, widely used in digital electronics. It comprises four independent OR gates, each with two inputs, all housed in a 14-pin dual in-line package (DIP). The IC operates within a power supply voltage range of 4.75 to 5.25 volts.

The 7432 IC is commonly used in various applications, including digital signal processing, combinational logic circuits, and control systems. It serves as a fundamental building block for creating more complex logic functions and is essential for implementing logical operations in numerous digital devices.

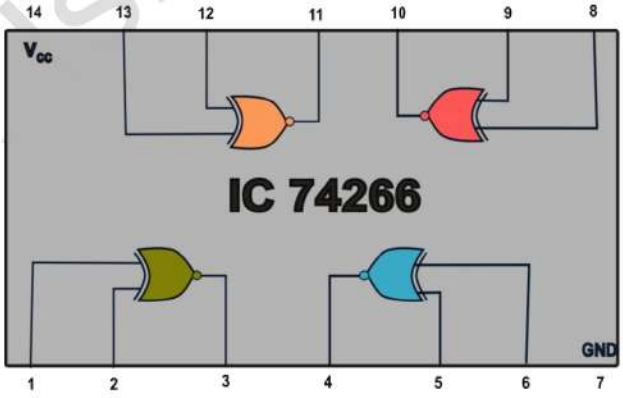
vi) IC 7486:



The IC 7486 is a quad 2-input XOR gate integrated circuit from the 74xx series, commonly used in digital electronics. It contains four independent XOR gates, each with two inputs, all housed in a 14-pin dual in-line package (DIP). The IC operates within a power supply voltage range of 4.75 to 5.25 volts.

The 7486 IC is used in various applications, including digital signal processing, arithmetic operations, error detection and correction, and cryptographic systems. The XOR gate is particularly useful in circuits where bit comparison or conditional logic operations are require

vii) IC 74266:



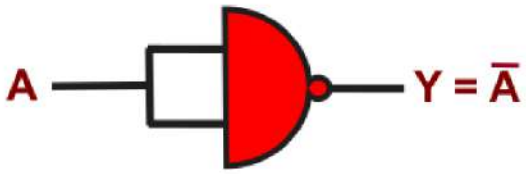
IC 74266 is a quad 2-input EX-NOR gate integrated circuit. It contains four independent EX-NOR gates, each with two inputs, and is housed in a 14-pin dual in-line package (DIP). The IC operates within a power supply voltage range of 4.75 to 5.25 volts.

This IC is useful in various digital logic applications, including equality checking, digital signal processing, and in implementing more complex logic functions.

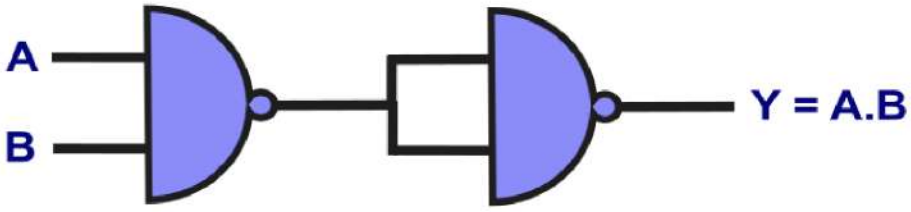
viii) Implement AND, OR, NOT, XOR, XNOR using NAND gates.

NAND gate is called as a Universal gate because by using only NAND gates any other gate can be realized

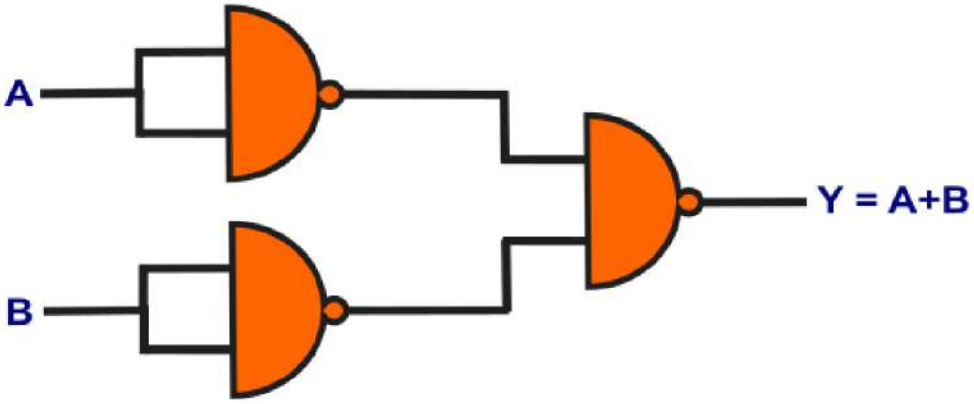
a) NAND as NOT



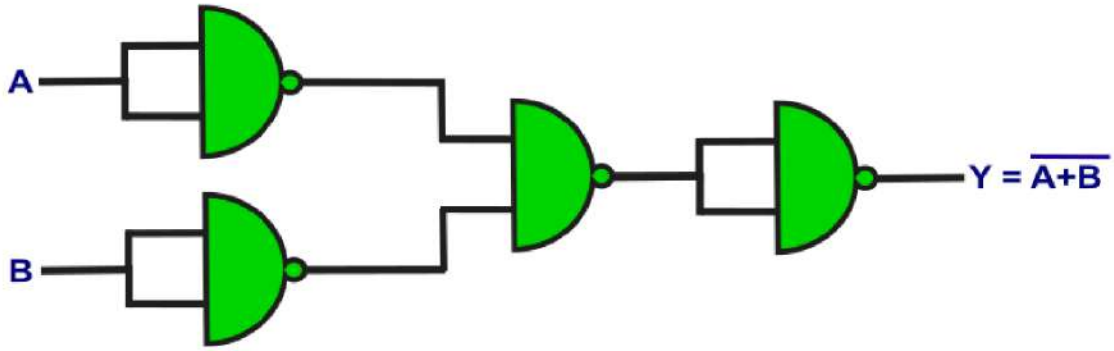
b) NAND as AND



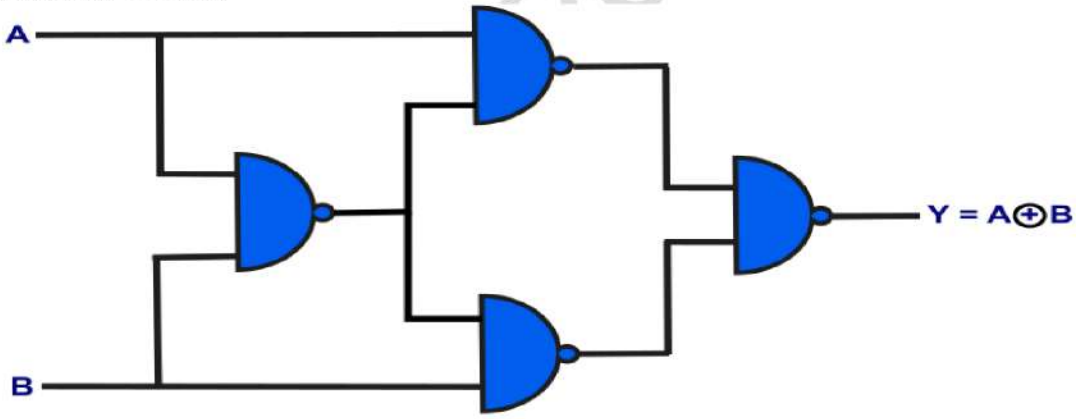
c) NAND as OR



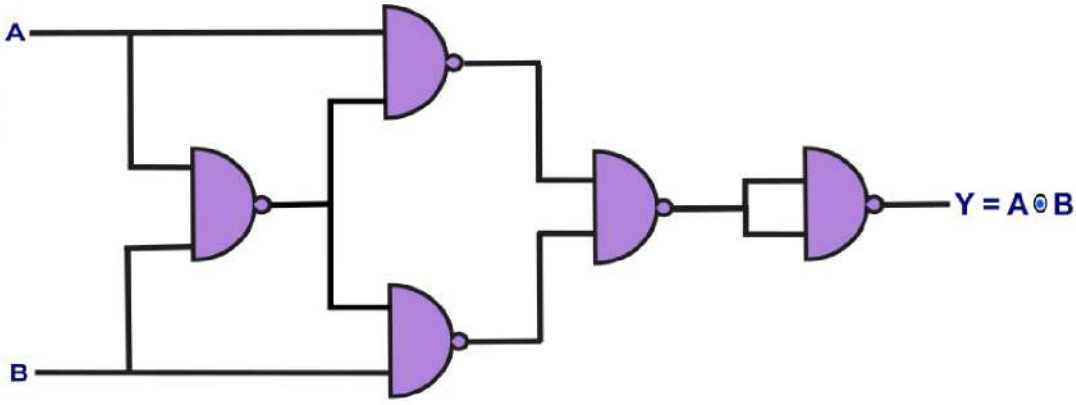
d) NAND as NOR



e) NAND as EX-OR



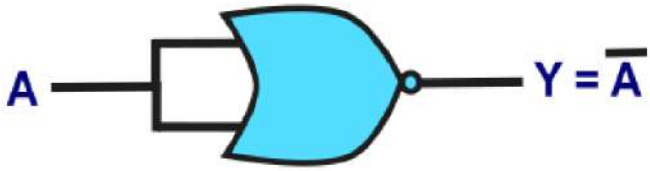
f) NAND as EX-NOR



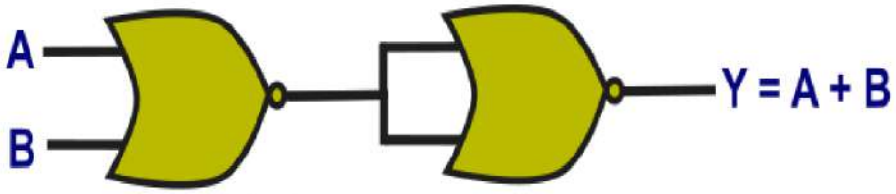
ix) Implement AND, OR, NOT, XOR, XNOR using NOR gates.

NOR gate is called as a Universal gate because by using only NOR gates any other gate can be realized

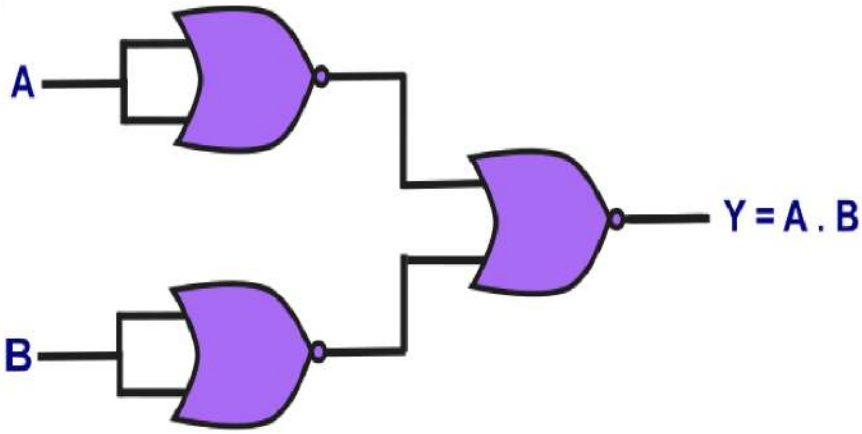
a) NOR as NOT



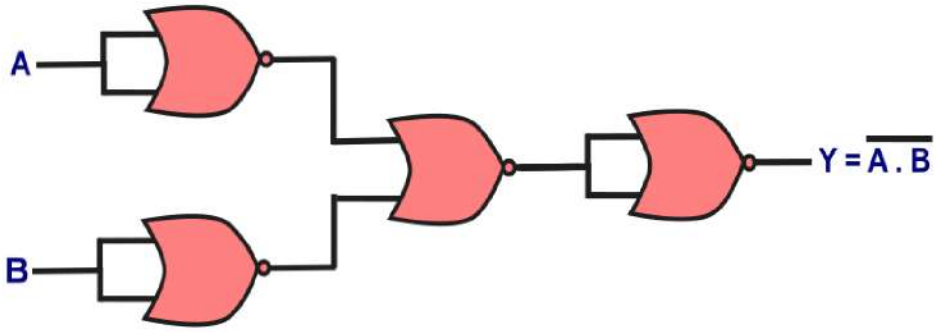
b) NOR as OR



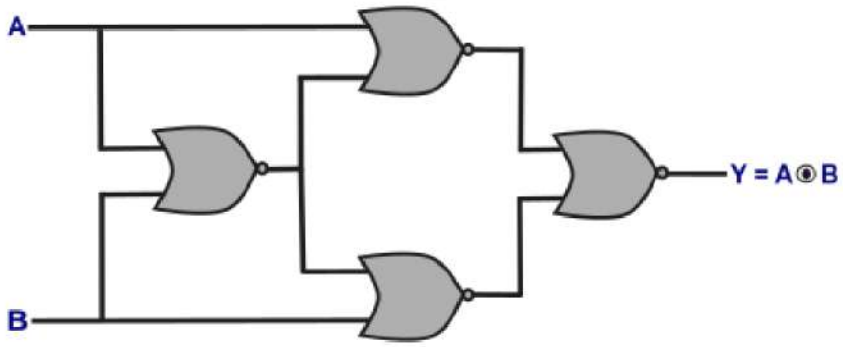
c) NOR as AND



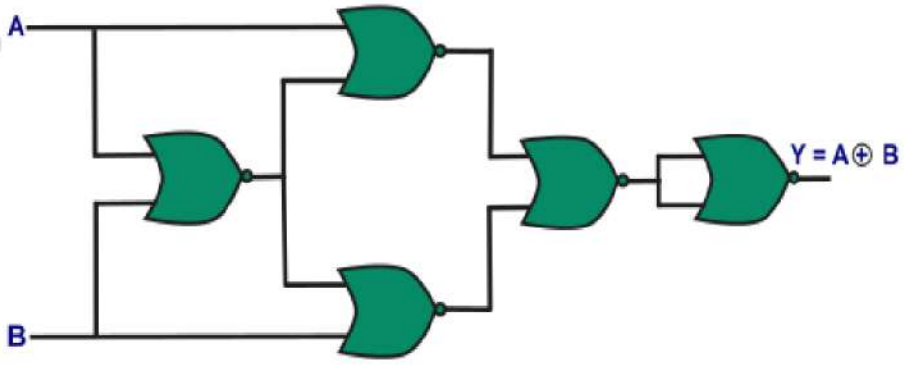
d) NOR as NAND



e) NOR as EX-NOR



f) NOR as EX-OR



Result: Hence the working of the logic gates and their respective ICs have been studied and the use of NAND and NOR as universal gate has also been verified using the Simulator.

For video demonstration of the given practical click on the link below or scan the QR-code

https://youtu.be/tElOxGHCvBg