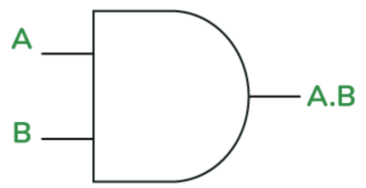
Practical 1

Aim : Logic gate and Universal Gate

AND Gate:-

AND gate is the fundamental logic gate that executes the logical multiplication of binary input. The AND operation is carried out in the same way as standard multiplications of 1s and 0s. An AND gate is a logic circuit that performs AND operations on the input of the circuit. When all the inputs are 1, the AND Gate outputs 1, otherwise it outputs 0. A dot (.) denotes the AND operation. (7408 IC Quad 2 input AND gates)

2- Input AND Gate



Truth Table

A (Input 1)	B (Input 2)	X = (A.B)
0	0	0
0	1	0
1	0	0
1	1	1

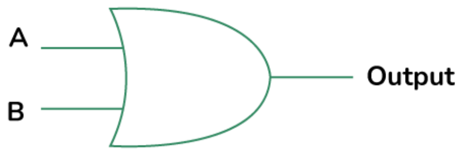
Boolean Expression :

$$Y=A.B$$

OR Gate:-

OR gate is the type of Logic Gate. Let's suppose in binary numbers 0 and 1, 0 is low and 1 is high. So when at least one of the provided inputs is high then the output is high otherwise it's low.

2-Input OR Gate



Truth Table

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	1

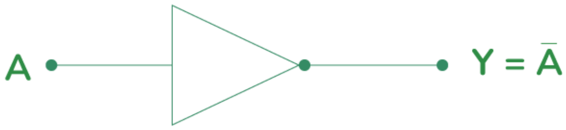
Boolean Expression :

$$Y=A+B$$

NOT Gate:-

In digital circuits, the NOT gate is a basic logic gate having only a single input and a single output. The output of the NOT gate is logic 0 when its input is logic 1 and the output is logic 1 when its input is logic 0. Thus, the NOT gate is used to perform the inversion operation in digital circuits.

NOT Gate



Truth Table

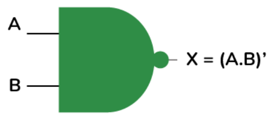
A (Input)	$Y = \bar{A}$ (Output)
0	1
1	0

Boolean Expression :

$$Y=A'$$

NAND Gate:

A NAND gate falls under the category of Universal gates because the NAND gate can implement any Boolean function without the help of basic gates and also calculate the results of logical inputs without the help of any other logic gate.



Truth Table

Input A	Input B	X = (A.B)'
0	0	1
0	1	1
1	0	1
1	1	0

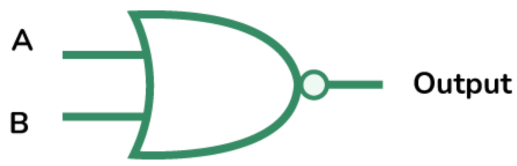
Boolean Expression :

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

NOR Gate :

NOR Gate is Universal Gate because it can be used to implement other basic logic gates like AND, OR, and NOT gate by connecting NOR gates in specific configurations.

2- Input NOR Gate



Truth Table

Input A	Input B	0 = (A + B)’
0	0	1
0	1	0
1	0	0
1	1	0

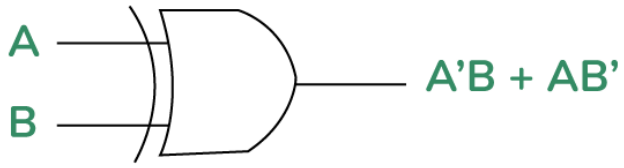
Boolean Expression :

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

XOR Gate:

The **XOR or Exclusive OR Gate** it takes two inputs and produces an output depending on the combination of the two inputs applied. This logic gate produces a high or logic 1 output when both of the inputs are dissimilar, otherwise, it produces a logic 0 output.

XOR Gate



Truth Table

A (Input 1)	B (Input 2)	X = A‘B + AB’
0	0	0
0	1	1
1	0	1
1	1	0

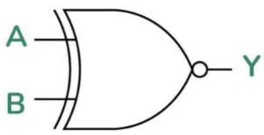
Boolean Expression :

$$Y=A'B+AB'$$

XNOR Gate:

An XNOR gate, also known as an equivalence gate or an EX-NOR gate. It produces a true output if both of its inputs are the same (either both true or both false). It is also known as the material biconditional.

What is XNOR Gate?



Truth Table

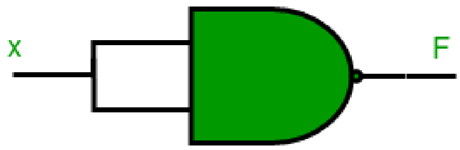
Input A	Input B	Output
0	0	1
0	1	0
1	0	0
1	1	1

Boolean Expression :

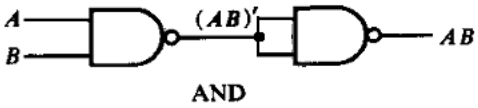
$$Y= \boldsymbol{AB + A'B'}$$

NAND Gate as Universal Gate:-

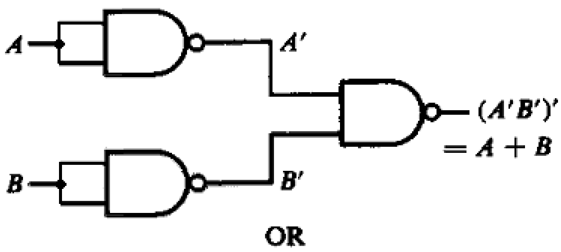
***Implementing NOT Gate using NAND Gate –**



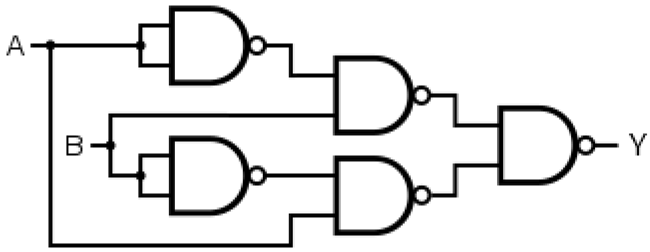
***Implementing AND Gate using NAND Gate –**



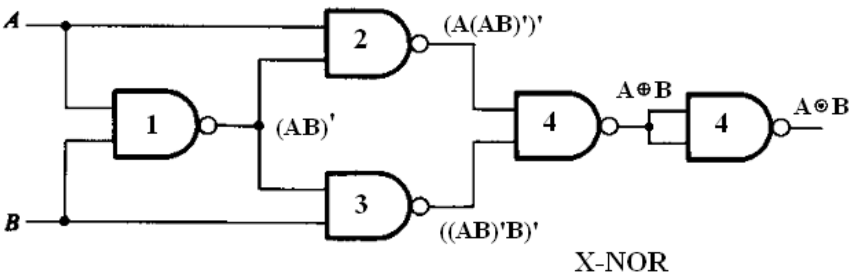
***Implementing OR Gate using NAND Gate –**



***Implementing EX-OR Gate using NAND Gate –**

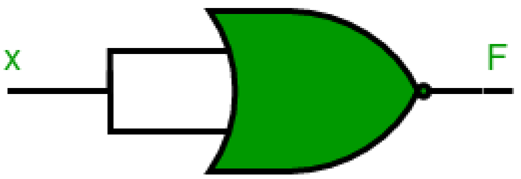


***Implementing EX-NOR Gate using NAND Gate –**

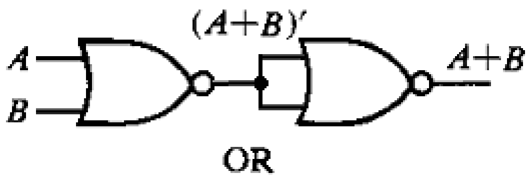


NOR Gate as Universal Gate:-

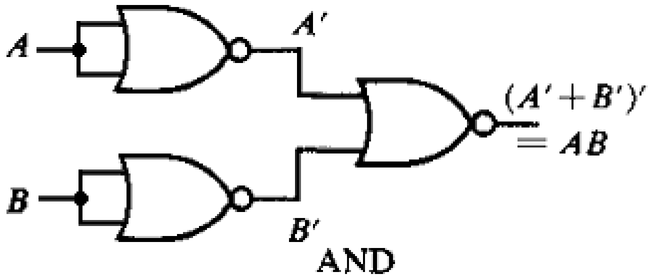
***Implementing NOT Gate using NOR Gate –**



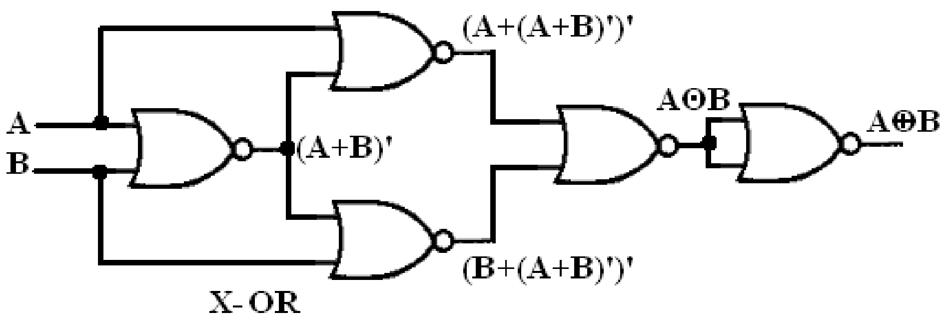
***Implementing OR Gate using NOR Gate –**



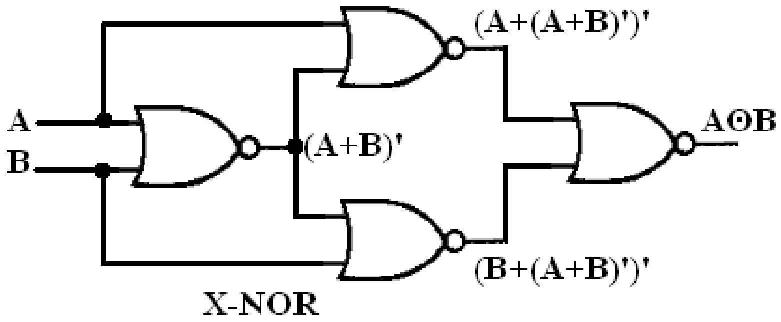
***Implementing AND Gate using NOR Gate –**



***Implementing EX-OR Gate using NOR Gate –**



***Implementing EX-NOR Gate using NOR Gate –**



- **Pin Descriptions of the 7408 IC**