Experiment # 8   **Date:**
Verification of Logic gates using ICs

Aim:

To verify and interpret the truth tables for AND, OR, NOT, NAND, NOR Exclusive OR (EX-OR), Exclusive NOR (EX-NOR) Gates.

Apparatus required:

Sl. No.	Components Name	Range		Quantity
1	Logic gates / ICs	IC7400, IC7404, IC7432,	IC7402, IC7408, IC7486	1 Nos. each
2	Resistors	-		1 No.
3	LED	-		1 No.
4	RPS	-		1 No.
5	Connecting Wires	-		Few
6	Bread Board	-		1 No.

Theory:

Logic gates are electronic circuits that perform logical functions on one or more inputs to produce one output. There are seven logic gates. When all the input combinations of a logic gate are written in a series and their corresponding outputs are written along them, then this input/ output combination is called Truth Table. Various gates and their working are explained here.

1) AND Gate

When all its inputs are 1, the AND gate produces an output of 1. Otherwise, the output is 0. This gate can have a minimum of 2 inputs but there is always only one output. Its output is 0 when any input is 0.
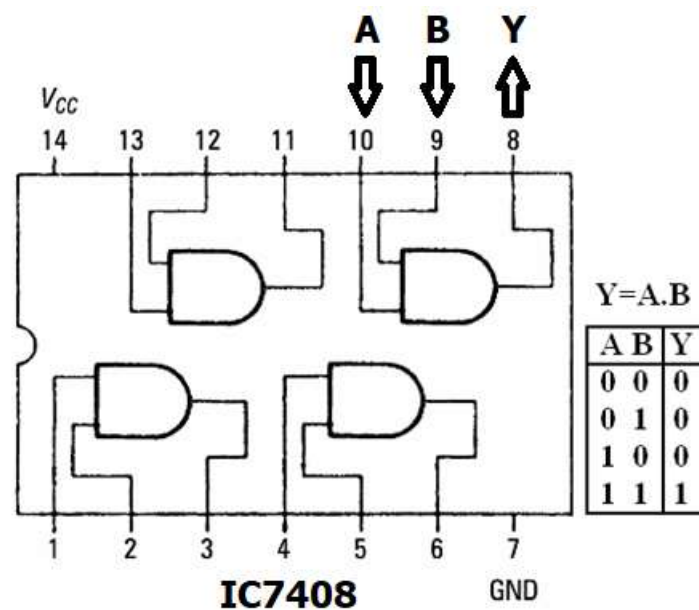

Fig.1

2) OR Gate

When any or all its inputs are 1, the OR gate produces an output of 1. Otherwise, the output is 0. This gate can have a minimum of 2 inputs but there is always only one output. Its output is 0 when all inputs are 0.
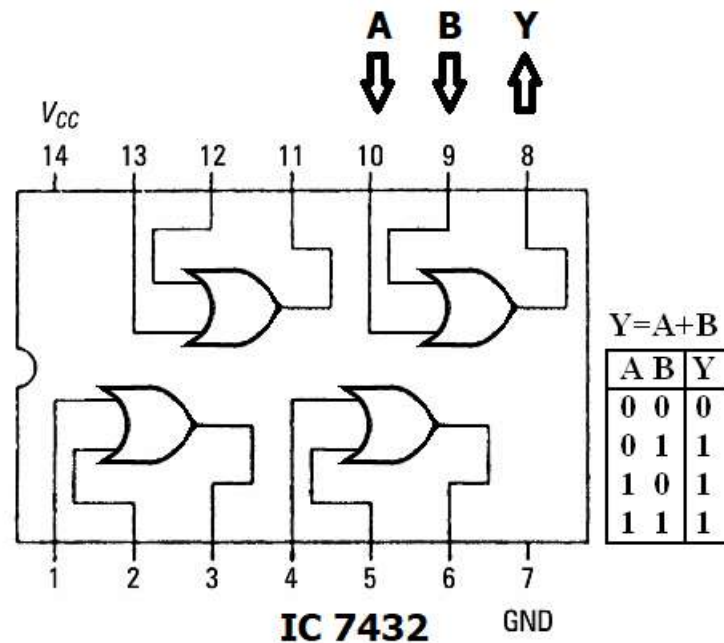

Fig.2

Y=A+B

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

3) NOT Gate

NOT gate produces the complement of its input. This gate is also called an INVERTER. It always has one input and one output. Its output is 0 when the input is 1 and its output is 1 when the input is 0.
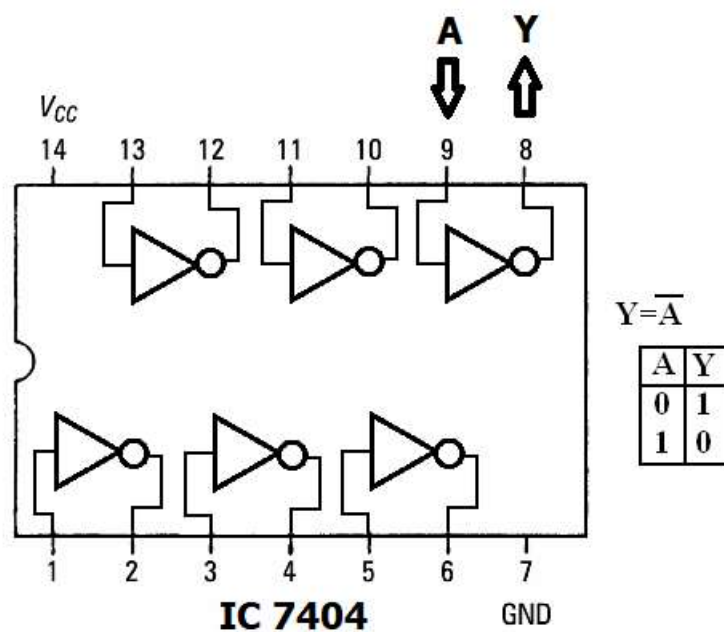

Fig.3

$Y=\overline{A}$

A	Y
0	1
1	0

4) NAND Gate

NAND gate is a series connection of AND gate with NOT gate. When the output of an AND gate is given as the input to a NOT gate, this combination will work as NOT-AND or NAND gate. Its output is 1 when any or all inputs are 0. Otherwise, the output is 0.
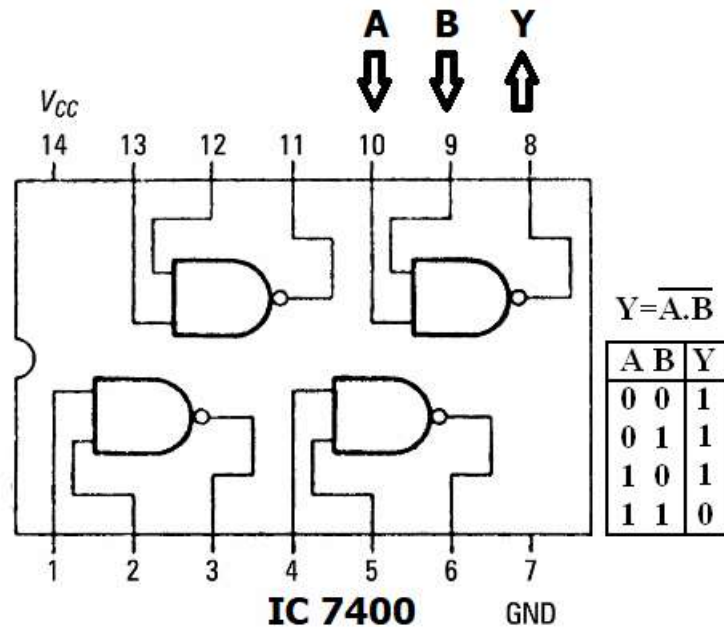

$Y = \overline{A.B}$

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

IC 7400

Fig.4

5) NOR Gate

NOR gate is a series connection of OR gate with NOT gate. When the output of an OR gate is given as the input to a NOT gate, this combination will work as NOT-OR or NOR gate. Its output is 0 when any or all inputs are 1. Otherwise, the output is 1.
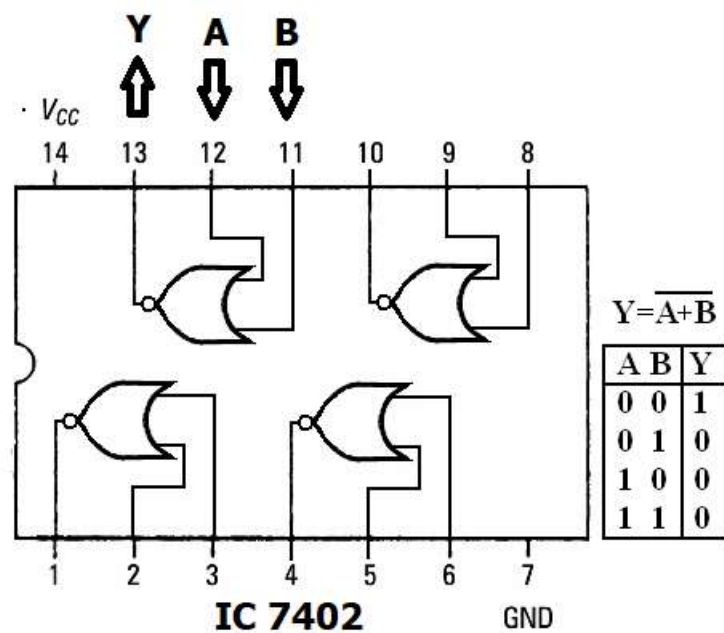

$Y = \overline{A+B}$

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

IC 7402

Fig.5

6) Exclusive OR (X-OR) Gate

X-OR gate produces an output as 1, when number of 1's at its inputs is odd. Otherwise, the output is 0. It has two inputs and one output.
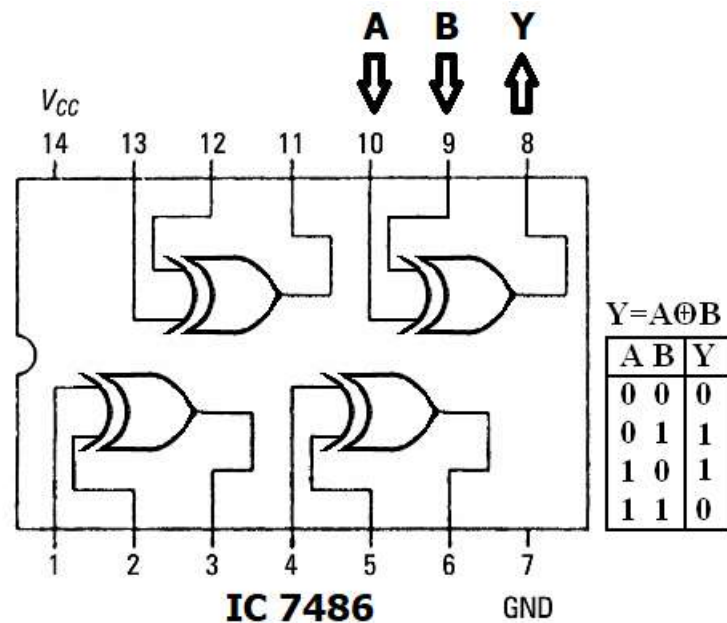

$Y=A\oplus B$

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

Fig.6

7) Exclusive NOR (X-NOR) Gate

X-NOR gate is a series connection of X-OR gate with NOT gate. It produces an output as 1, when number of 1's at its inputs is not odd. Otherwise, the output is 0. It has two inputs and one output.
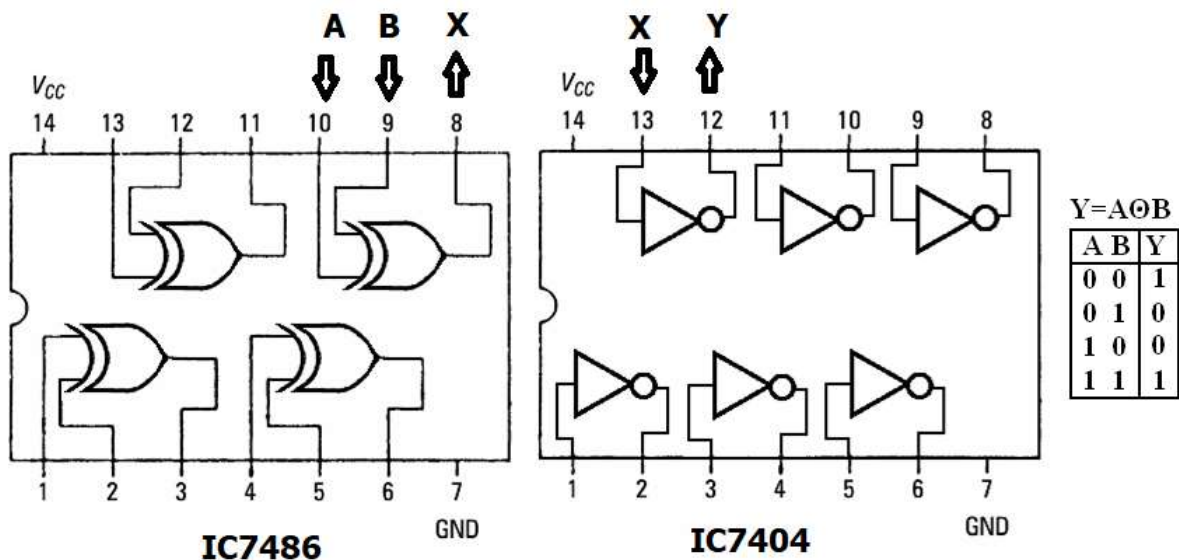

$Y=A\odot B$

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

Fig.7

Procedure:

- Connect the breadboard setup to the power supply.

- Connect the inputs of any one logic gate to the logic sources (+V and ground) and its output to the logic indicator (LED).
- Apply various input combinations and observe the output for each one. If the output is 1, the LED will glow.
- Verify the truth table for each input/ output combination.
- Repeat the process for all other logic gates.
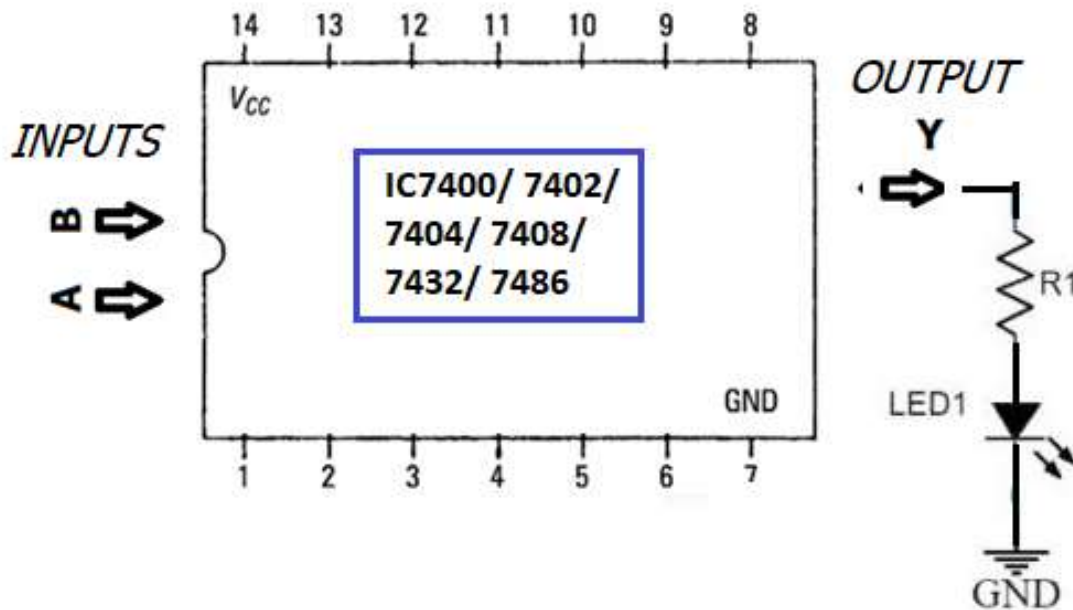- Switch off the power supply.

Circuit Diagram:

Fig.8

Observation Table:

Inputs		OR	AND	NOT	NAND	NOR	X-OR	X-NOR
A	B	$Y = A + B$	$Y = A * B$	$Y = \bar{A}$	$Y = \overline{A * B}$	$Y = \overline{A + B}$	$Y = A \oplus B$	$Y = \overline{A \oplus B}$
0	0							
0	1							
1	0							
1	1							

Result :

Thus, the truth tables for AND, OR, NOT, NAND, NOR, Exclusive OR (EX-OR), Exclusive NOR (EX-NOR) Gates were verified.