

## Practical 4: To Study and Verify the Truth Table of Logic Gates

Logic gates are the basic building blocks of digital circuits. They take one or more input signals and produce an output based on a specific logical operation. In this practical, we study common logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and verify their truth tables.

### Types of Basic Logic Gates and Their Working

Logic gates follow **Boolean algebra** rules and help computers perform decision-making operations.

#### (A) AND Gate

##### Symbol:

A dot ( $\cdot$ ) is used for AND operation.

##### Working:

- Output is 1 *only when both inputs are 1.*
- Otherwise, output is 0.

##### Truth Table:

A	B	Output (A·B)
0	0	0
0	1	0

1	0	0
1	1	1

### (B) OR Gate

#### Symbol:

A plus (+) sign.

#### Working:

- Output is 1 if any one input is 1.
- Output is 0 only when both inputs are 0.

#### Truth Table:

A	B	Output (A+B)
0	0	0
0	1	1
1	0	1
1	1	1

## (C) NOT Gate

### Symbol:

An input followed by a triangle with a bubble.

### Working:

- **Inverts the input** (opposite output).
- If input = 1 → output = 0
- If input = 0 → output = 1

### Truth Table:

A	Output ( $\neg A$ )
0	1
1	0

## Universal Logic Gates

### (D) NAND Gate

(NOT + AND)

### Working:

- Output is **0 only when both inputs are 1**.
- Otherwise, output is 1.

### Truth Table:

A	B	Output ( $\neg(A \cdot B)$ )
0	0	1
0	1	1
1	0	1
1	1	0

### (E) NOR Gate

(NOT + OR)

#### Working:

- Output is 1 only when both inputs are 0.
- Otherwise, output is 0.

#### Truth Table:

A	B	Output ( $\neg(A+B)$ )
0	0	1
0	1	0

1	0	0
1	1	0

## Exclusive Logic Gates

### (F) XOR Gate (Exclusive OR)

#### Working:

- Output is 1 when inputs are different.
- Output is 0 when inputs are same.

#### Truth Table:

A	B	Output ( $A \oplus B$ )
0	0	0
0	1	1
1	0	1
1	1	0

### (G) XNOR Gate (Exclusive NOR)

#### Working:

- Output is **1** when inputs are same.
- Output is **0** when inputs are different.

**Truth Table:**

A	B	Output ( $\neg(A \oplus B)$ )
0	0	1
0	1	0
1	0	0
1	1	1

### Verification of Truth Table (How It Is Done in Lab)

To verify logic gate truth tables, the following steps are performed:

#### Step 1:

Connect the logic gate IC to the breadboard.

#### Step 2:

Provide power supply:

- V<sub>cc</sub> → +5V
- GND → ground

**Step 3:**

Give input combinations (0 or 1) using switches or wires.

**Step 4:**

Observe output using an LED or logic probe.

**Step 5:**

Compare observed output with the theoretical truth table.

If both match → **truth table verified successfully**