

**Practical No.1: Test the functionality of AND, OR, NOT, EX-OR and EX-NOR logic Gates using equivalent 74 series or CMOS Devices (CD) series.**

**I Practical Significance**

Logic gates are commonly referred to as the fundamental building blocks of digital circuits. Digital gates are used in all digital circuits such as switches, memories, microprocessors, and embedded systems. Knowledge of functions of logic gates will help the students to build the digital circuits.

**II Industry/Employer Expected Outcome(s)**

Students will be able to test the functionality of the digital circuits/system.

**III Course Level Learning Outcome(s)**

Apply Boolean laws to minimize complex Boolean function.

**IV Laboratory Learning Outcome(s):**

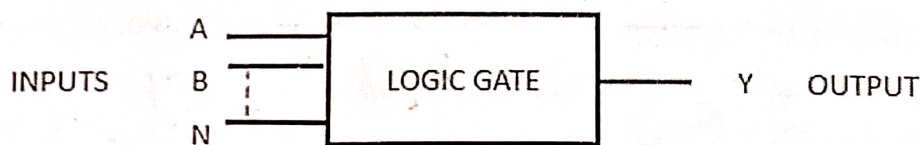
1. Test the functionality of basic gates.
2. Test the functionality of special purpose gates.

**V Relevant Affective Domain related outcome(s)**

Identify PIN configuration of IC.  
Handle the components and equipment carefully.  
Follow all safety precautions.

**VI Relevant Theoretical Background**

A logic gate is an electronic circuit which makes logical decisions. A logic gate is basically an electronic circuit designed by using components like diodes, transistors, resistors, capacitors, etc. and capable of performing logical operations. It has only one output and one or many inputs.



**Fig. 1.1 Block diagram of logic gate**

The output of a logic gate depends on the combination of inputs and the logical operation that the logic gate performs. Logic gates are the basic building blocks of all digital systems. These gates are AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR gates. In digital logic design only two voltage levels or states are applied as input, and these states are generally referred to as Logic "1" and Logic "0", High and Low, or True and False. These two states are represented in truth tables as binary digits "1" and "0" respectively.

### Classification of Logic Gates:

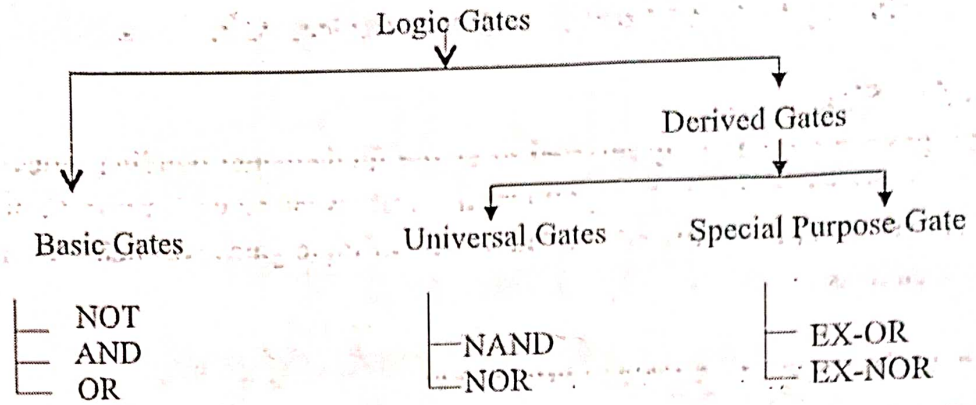


Fig 1.2 Classification of logic gates

### VII Circuit diagram a) Sample circuit

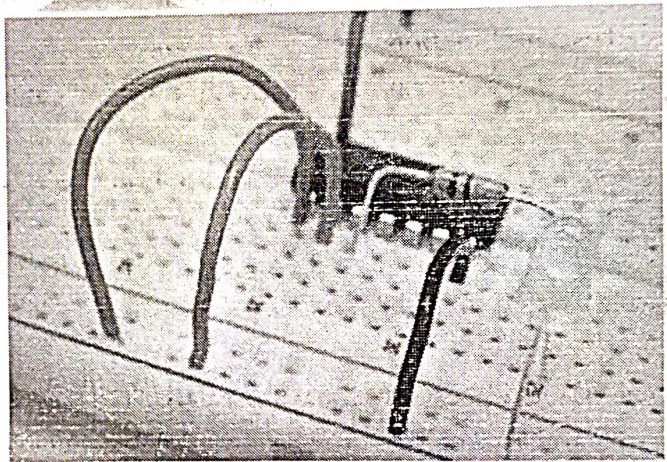
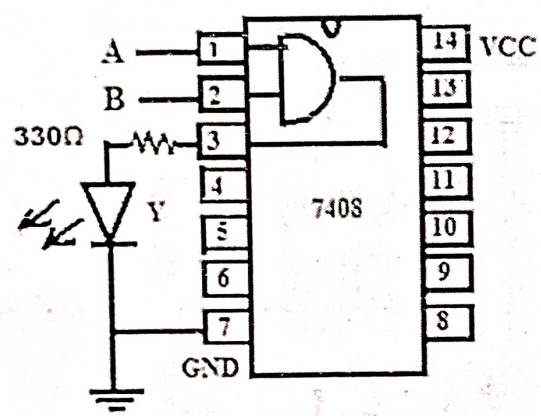


Fig 1.3: Circuit Diagram

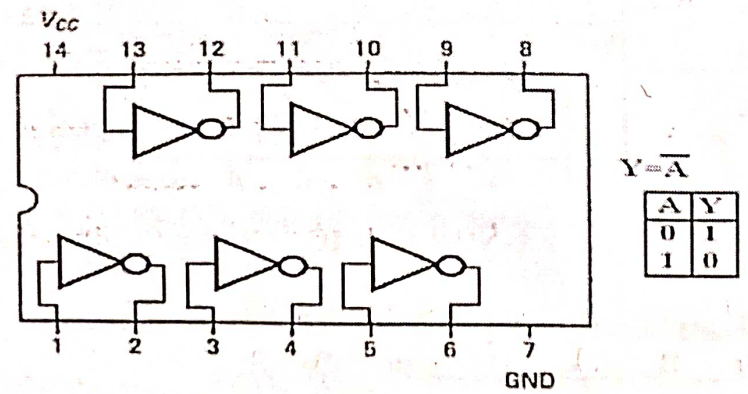


Fig. 1.4 NOT Gate IC 7404 and truth table

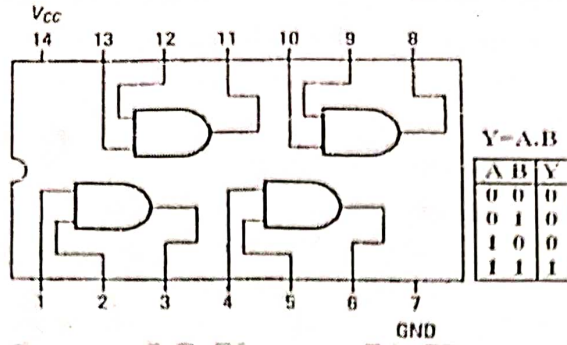


Fig. 1.5 AND gate IC 7408 and truth table

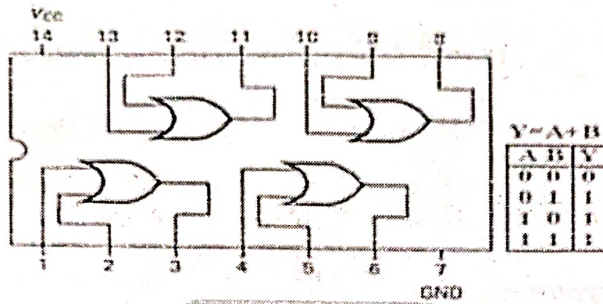


Fig. 1.6 OR Gate IC 7432 and truth table

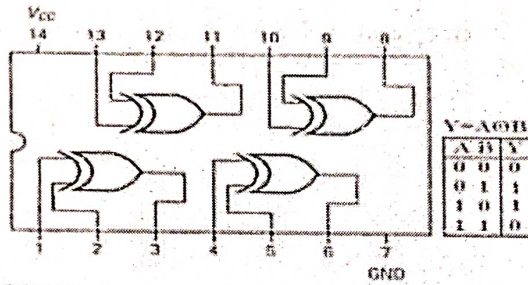


Fig. 1.7 EX-OR Gate IC 7486 and truth table

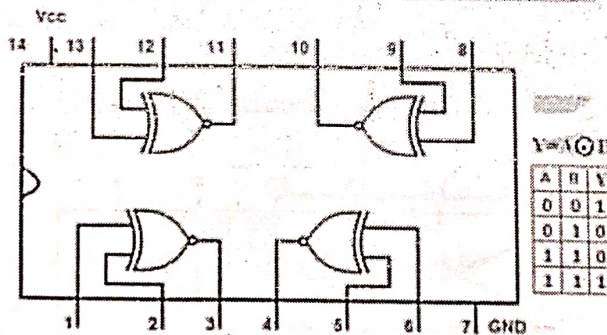
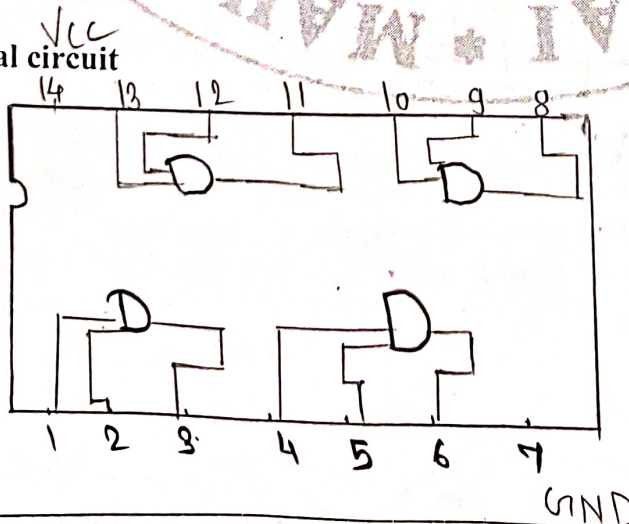


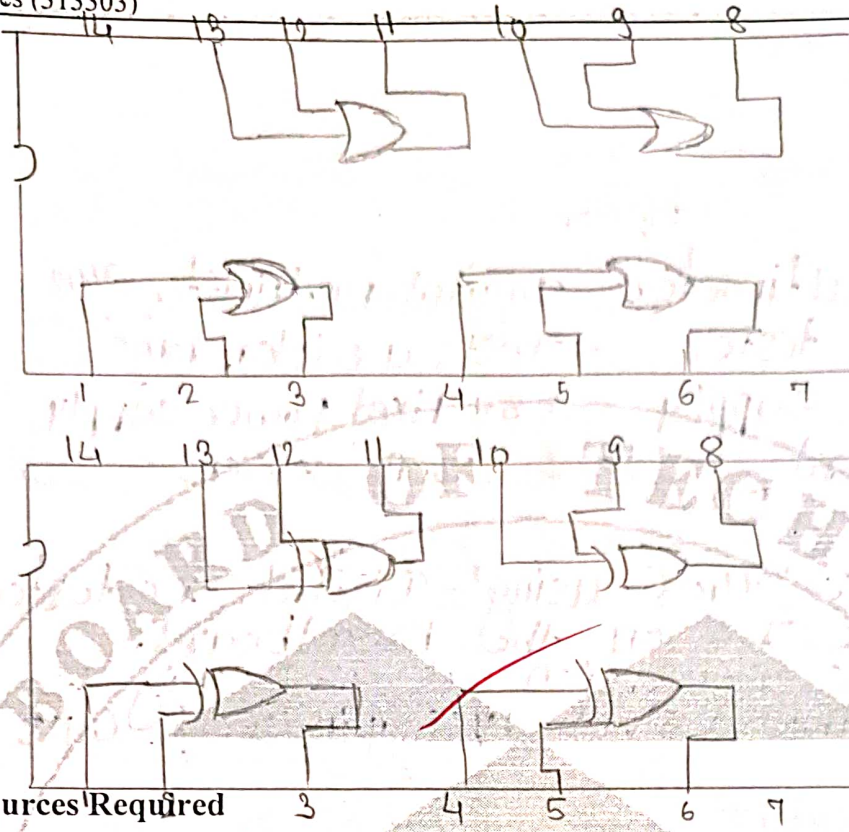
Fig. 1.8 EX-NOR Gate IC 74266 and truth table

b) Actual circuit



$Y = A \cdot B$

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



### VIII Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Multimeter	Digital Multimeter: 3 ½ digit display.	1
2	Digital IC Tester	Tests a wide range of Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	1
3	DC power supply	+5 V Fixed power supply	1
4	Breadboard	5.5cm X 17 cm	1
5	IC	7404, 7432, 7408, 7486, 74266 or (CMOS IC's 4049, 4081, 4071, 4070, 4077)	1 each
6	LED	Red /Yellow color 5 mm	1
7	Connecting wires	Single strand 0.6 mm Teflon coating	As required
8	Resistor	1.1 K $\Omega$ or 330 $\Omega$	As required

### IX Precautions to be followed

- 1) Check IC before use.
- 2) Set power supply to 5V (Variable DC Power Supply) before connecting.
- 3) Check all the connections as per circuit diagram.

### X Procedure

1. Test the IC 7408 using Digital IC tester
2. Mount the IC on the breadboard
3. Make the connection as per fig 1.3.
4. Connect the +5V to +V<sub>cc</sub> pin of IC and GND pin to ground
5. Observe the LED (on or off) for each combination of input as per truth table
6. Verify the truth table.
7. Repeat the process for IC 7404, 7432, 7486, 74266.

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital multimeter	Digital multimeter : 3 1/2	1
2	Digital IC tester	Tests a wider range of digital ICs.	1
3	DC power supply	+5V fixed power supply	1
4	Breadboard	5.5cm x 17cm	1

XII Actual Procedure

- i. Test the IC 7408 using Digital IC tester
- ii. mount the IC on the breadboard.
- iii. make the connection as per Fig 1.3
- iv. Connect the +5V to VCC pin IC & GND pin to ground

XIII Observation:

Table 1.1: Observation Table for NOT gate

Input A	7404 (NOT)		
	LED Status (ON/OFF)	Logic Level (1/0)	Output voltage (v)
0 (0V)	off	0	0V
1 (5V)	ON	1	5V

Table 1.2: Observation Table for AND, OR, EX-OR, EX-NOR gate

Inputs		7408 (AND)			7432 (OR)			7486 (EX-OR)			74266 (EX-NOR)		
A	B	LED Status (ON/OFF)	Logic Level (1/0)	Output voltage (v)	LED Status (ON/OFF)	Logic Level (1/0)	Output voltage (V)	LED Status (ON/OFF)	Logic Level (1/0)	Output voltage (V)	LED Status (ON/OFF)	Logic Level (1/0)	Output voltage (V)
0(0V)	0(0V)	off	0	0V	off	0	0V	off	0	0V	ON	1	4.9V
0(0V)	1(5V)	off	0	0V	ON	1	4.8V	ON	1	4.9V	off	0	0V
1(5V)	0(0V)	off	0	0V	ON	1	4.8V	ON	1	4.9V	off	0	0V
1(5V)	1(5V)	ON	1	4.9V	ON	1	4.8V	off	0	0V	ON	1	4.9V

①

3] →

Pin 14 (VCC) is intended to supply power to the IC so connecting it to ground instead of a positive voltage means the IC is not powered correctly.

Pin 7 (GND) is intended to be to VCC reverses the polarity of the power supply.

4] →

The IC 7432 is a Quad 2-Input OR gate chip which means it contains four OR gates in a single integrated circuit package. Each OR gate has two inputs and one output.

5] →

The resistor connected in series with the LED is needed to limit the current flowing through the LED & protect it from damage. The value of the resistor is chosen based on the LED's forward voltage & the desired current to ensure the LED operates within its safe operating limits.

6] →

LS in IC number 74LS00 stands for low-power Schottky. The significance of LS in 74LS00 indicates that the IC is part of the low-power Schottky series, which is known for its lower power consumption compared to standard TTL.

## XIV Result(s)

In this practical we learn about basic and universal gate concepts and also check/realise output of the gate are dependence on input logic.

## XV Interpretation of results

In this practical we observe about operation about and or gate, NOR gate, XNOR gate, EX-OR gate.

## XVI Conclusion and recommendation

Hence we have studied about test the functionality of AND, OR, NOT, EX-OR logic gates using equivalent 74 series or CMOS devices (CD) series.

## XVII Practical related questions

Note: Below given are a few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Write down voltage at logic level 0 and 1 for positive logic.
2. List the function of pin 7, 14 of IC 7404.
3. State the effect if pin number 14 is connected to ground and pin number 7 is connected to VCC?
4. List number of OR gates are available in IC 7432.
5. State the need for the resistor connected in series with LED. Write down the value of resistor.
6. State the significance of LS of IC number 74LS00.

[Space for Answers]

1) →

In positive logic:

- logical level 0 corresponds to a low voltage (usually close to 0V).
- logical level 1 corresponds to a high voltage (typically 3.3V, 5V or another positive voltage depending on the system).

2) →

- For the 7404 IC (a hex inverter)
- pin 7: Ground (GND); This pin is connected



to the ground of the power supply.

Pin 14: VCC This pin is connected to the positive supply voltage.

**XVIII References/Suggestions for further reading**

1. <https://de-iitr.vlabs.ac.in/exp/truth-table-gates/theory.html>
2. <https://www.futurlec.com/74/iC7404.shtml>
3. <https://www.electroschematics.com/wp-content/uploads/2013/07/7408-datasheet.pdf>
4. [https://www.ti.com/lit/ds/symlink/sn5432.pdf?ts=1720330546912&ref\\_url=https%253A%252F%252Fwww.google.com%252F](https://www.ti.com/lit/ds/symlink/sn5432.pdf?ts=1720330546912&ref_url=https%253A%252F%252Fwww.google.com%252F)
5. <https://www.ntchip.com/electronics-news/ic-7486-chip>
6. <https://www.jameco.com/Jameco/Products/ProdDS/47360.pdf>

**XIX Assessment Scheme**

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total ( 25 Marks)		100 %

Marks Obtained			Dated signature of Teacher
Process related (15)	Product related (10)	Total (25)	
13	10	23	