

**Practical No.2: Test the functionality of the given Universal Gates using equivalent 74 series /CD series**

**I Practical Significance**

A universal gate is a gate which can implement any Boolean function without need to use any other gate type. The NAND and NOR gates are universal gates. In practice, this is advantageous since NAND and NOR gates are economical and easier to fabricate and are the basic gates used in all IC digital logic families.

**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 NAND and NOR gate using breadboard.

**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**

OR, AND and NOT gates are the three basic logic gates as they together can be used to construct the logic circuit for any given Boolean expression. The NAND and NOR gates are known as universal gates. NOR and NAND gates have the property that they individually can be used to implement logic circuits corresponding to any given Boolean expression.

**VII Circuit diagram**

a) Sample circuit

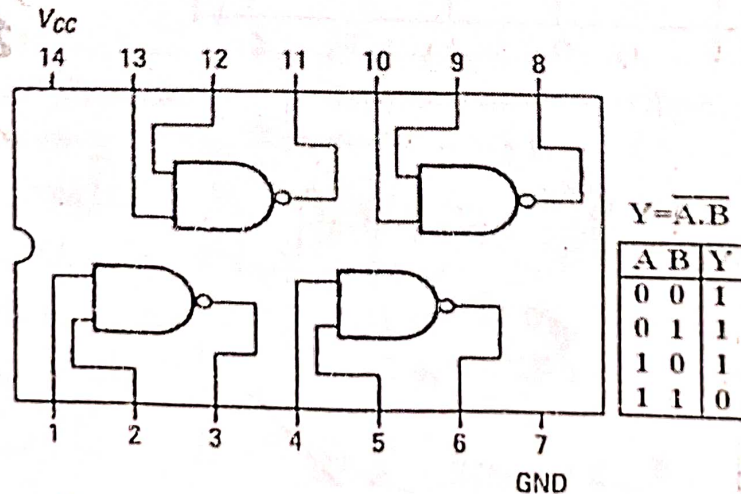


Fig. 2.1.NAND Gate IC 7400 and Truth table

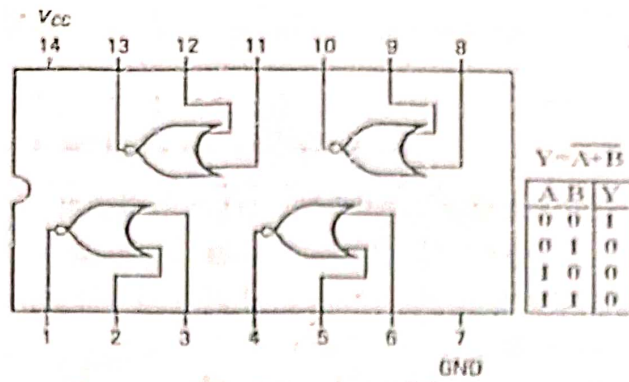


Fig. 2.2. NOR Gate IC 7402 and Truth table

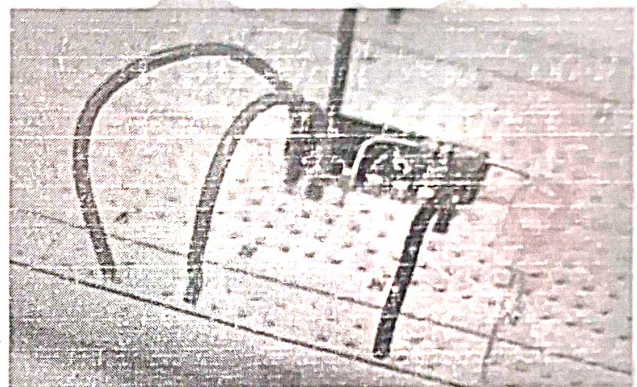
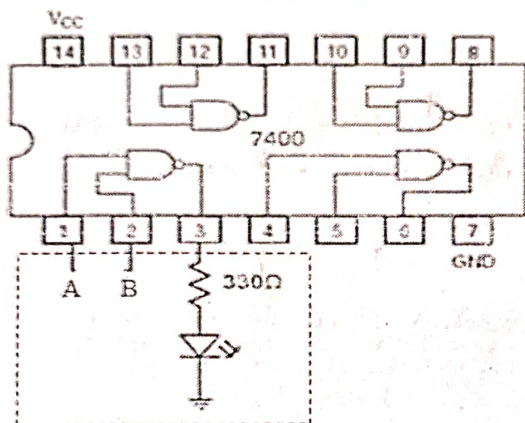
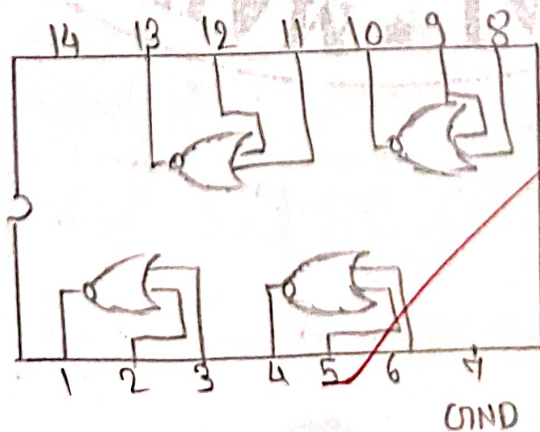
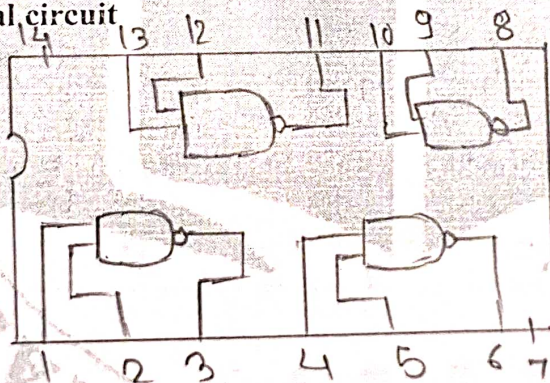


Fig 2.3: Sample Circuit Diagram

b) Actual circuit



## VIII Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	2
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	Breadboards	5.5cm X 17 cm	1
5	IC	7400, 7402, or CMOS IC's. 4011, 4001	1 Each
6	LED	Red /Yellow color 5 mm	1
7	Connecting wires	Single strand 0.6 mm Teflon coating	As required
8	Resistor	1K $\Omega$ 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 using Digital IC tester
2. Mount the IC on the breadboard
3. Make the connection as per fig 2.3.
4. Connect the +5V to +Vcc 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 7402.

## XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital multimeter	Digital multimeter: 3 1/2	2
2	Digital IC Tester	Tests a wide range of Digital IC's	1
3	Resistor	1K $\Omega$ or 330 $\Omega$	1
4	Breadboards	5.5cm x 17cm	1

## XII Actual Procedure

- 1) Test the IC using Digital IC tester
- 2) mount the IC on the breadboard

3] Connect the +5V to +VCC pin of IC and GND pin to ground.

### XIII Observation:

Table 2.1: Observation Table for NAND, NOR gate

Inputs		7400 (NAND)			7402(NOR)		
A	B	LED Status (ON/OFF)	Logic Level (0/1)	Output voltage (V)	LED Status (ON/OFF)	Logic Level (0/1)	Output voltage (V)
0(0V)	0(0V)	ON	1	4.5V	ON	1	4.5V
0(0V)	1(5V)	ON	1	4.5V	OFF	0	0V
1(5V)	0(0V)	ON	1	4.5V	OFF	0	0V
1(5V)	1(5V)	OFF	0	0V	OFF	0	0V

### XIV Result(s)

In this practical we learn about the functionality of the given universal gates using equivalent 74 Series / CD series.

### XV Interpretation of results

In this practical we observe about the functionality of the universal gate NAND OR NOR gates.

### XVI Conclusion and recommendation

Hence we studied functionality about the universal gates using equivalent 74 series / 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. List the function of pin 7 and 14 of IC 7402.
2. Write down name of manufacturer of Digital IC 7400, 7402 used in practical.
3. Suggest another IC's used as NAND, NOR Gate.
4. Write the IC no. which has three input NAND & NOR gates.

[Space for Answers]

1] →

The IC 7402 is a quad 2-input NOR gate following are the functions of pins 7 & 14.

• pin 7: Ground (GND) - This pin is connected to the ground or 0V of the power supply.

• Pin 14: VCC - This pin is connected to the positive power supply voltage (typically +5V).

These pins are standard for most 14-pin logic ICs where pin 7 is always ground & pin 14 is the power supply.

2] →

The 7400 and 7402 series of digital ICs have been manufactured by several well-known semiconductor companies over the years.

1. Texas Instruments (TI)
2. National Semiconductor
3. Signetics
4. Motorola Semiconductor
5. RCA

These manufactures have produced a wide range of 7400 series logic ICs.

3] →

NAND Gate ICs:

1. IC 4011: Quad 2-input NAND gate (CMOS version)
2. IC 7403: Quad 2-input NAND gate with open collector output
3. IC 7420: Dual 4-input NAND gate
4. IC 7410: Triple 3-input NAND gate

NOR Gate ICs:

1. IC 4001: Quad 2-input NOR gate
2. IC 7427: Triple 3-input NOR gate
3. IC 4002: Dual 4-input NOR gate

These ICs are widely used in digital electronics.

4) →

Here are the IC numbers that contain 3-input NAND & NOR gates  
 - 3-input NAND Gate: IC 7410 = This IC contains three independent 3-input NAND gates  
 - 3-input NOR Gate: IC 7427 = This IC contains three independent 3-input NOR gates

### 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/IC7400.shtml>
3. <https://www.futurlec.com/74/IC7402.shtml>
4. [https://www.youtube.com/watch?v=wn-zP-tQq5Y&list=PLUqrzxm3-gfJKoDjwuupjsFuDRm\\_5aVWW&index=5](https://www.youtube.com/watch?v=wn-zP-tQq5Y&list=PLUqrzxm3-gfJKoDjwuupjsFuDRm_5aVWW&index=5)
5. [https://www.youtube.com/watch?v=vozaQgGBetM&list=PLUqrzxm3-gfJKoDjwuupjsFuDRm\\_5aVWW&index=6](https://www.youtube.com/watch?v=vozaQgGBetM&list=PLUqrzxm3-gfJKoDjwuupjsFuDRm_5aVWW&index=6)
6. <https://de-iitr.vlabs.ac.in/exp/truth-table-gates/theory.html>

### 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	