Practical No.3: Construct Basic Gates using Universal Gates.

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 the constructed Basic gates using universal 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 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.

VII Circuit diagram

a) Sample circuit

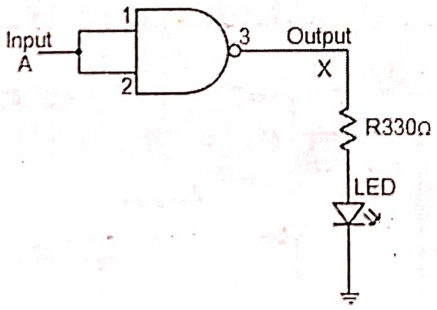


Figure (a)

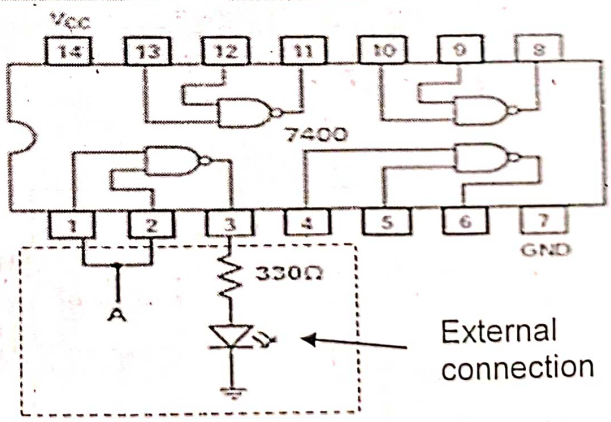


Figure (b)

Fig. 3.1 NOT gate using NAND gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

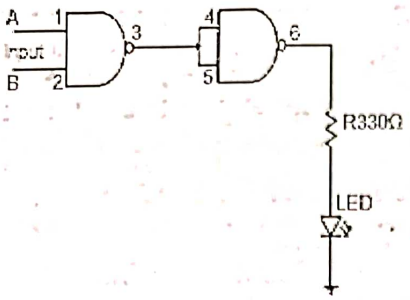


Figure (a)

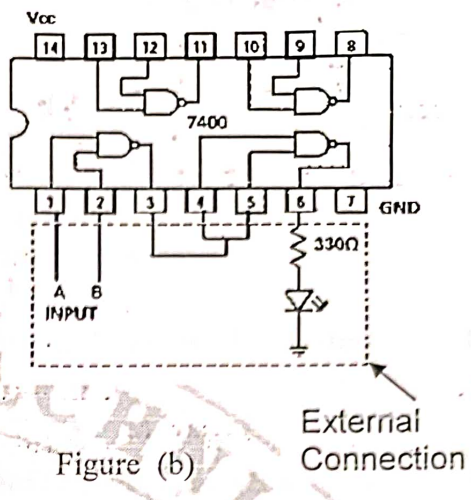


Figure (b)

Fig. 3.2 AND gate using NAND gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

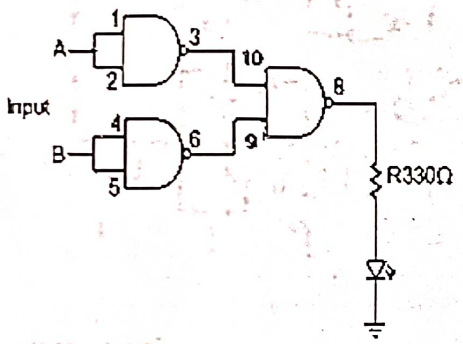


Figure (a)

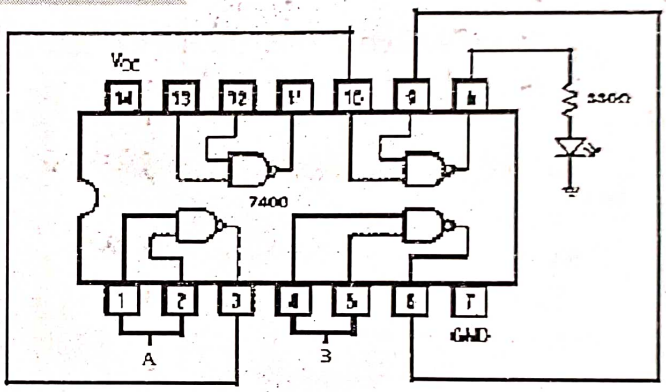


Figure (b)

Fig. 3.3 OR gate using NAND gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

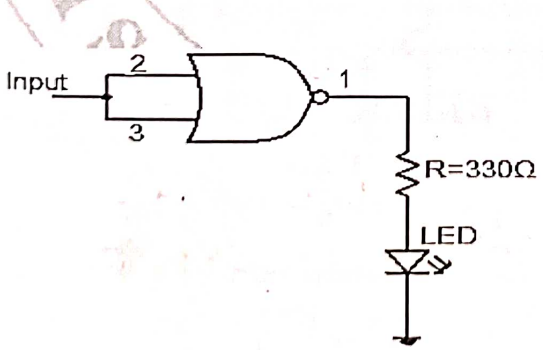


Figure (a)

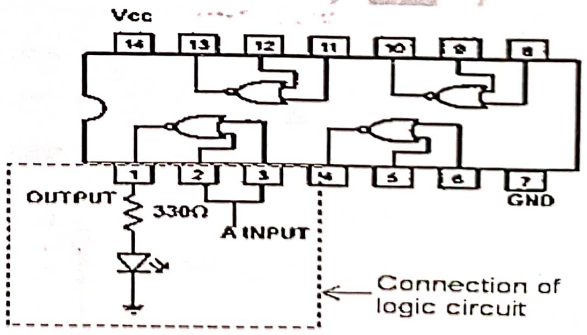


Figure (b)

Fig. 3.4 NOT gate using NOR gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

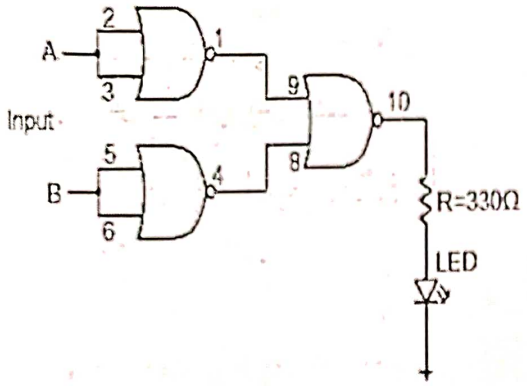


Figure (a)

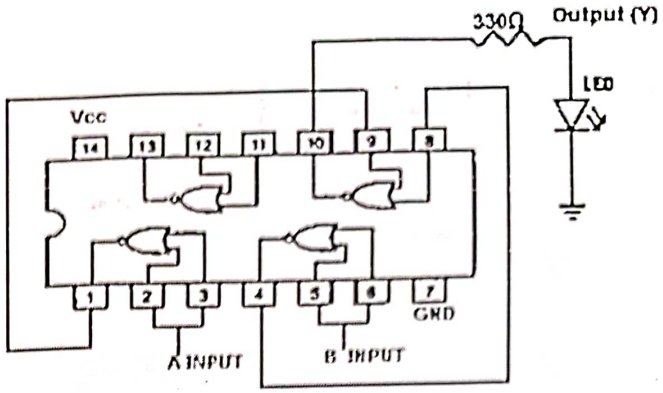


Figure (b)

Fig.3.5 AND gate using NOR gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

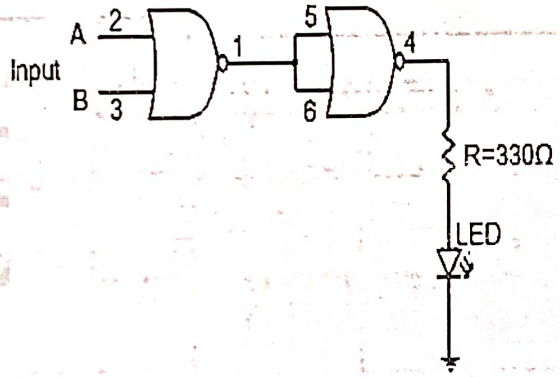


Figure (a)

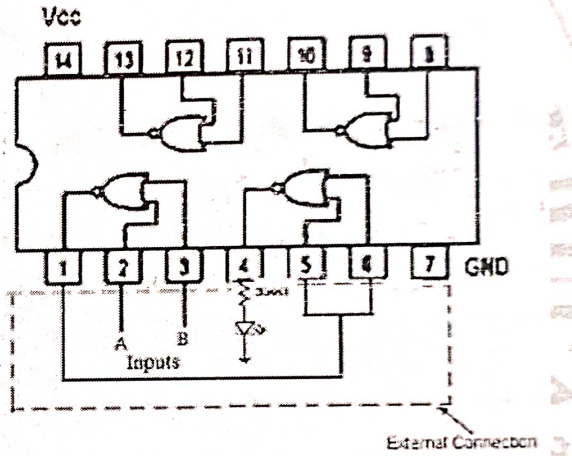
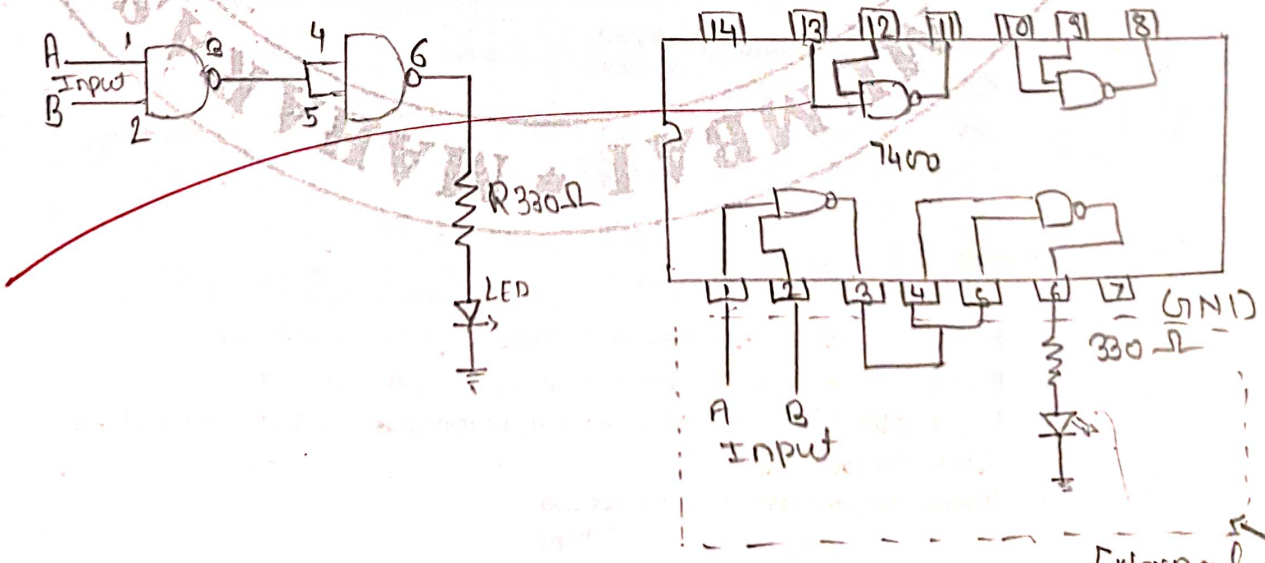
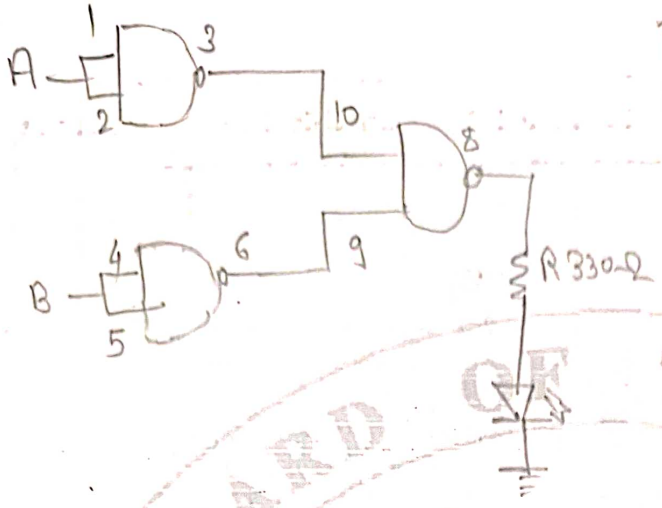


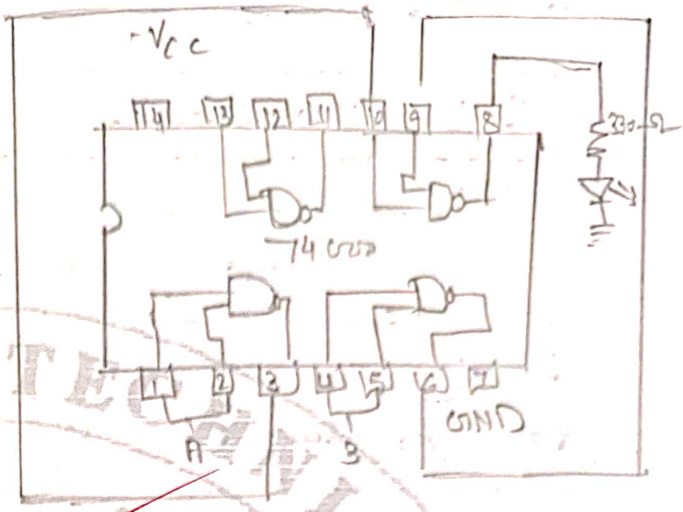
Figure (b)

Fig. 3.6 OR gate using NOR gate a) Logic diagram b) IC Circuit diagram
(Use the appropriate value of the resistor . Diagram shows sample values)

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	Breadboard	5.5cm X 17 cm	1
5	IC	7400, 7402	1 Each
6	LED	Red /Yellow color 5 mm	1
7	Connecting wires	Single strand 0.6 mm Teflon coating	As required
8	Resistor	1KΩ/330Ω	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. Identify pin configuration of logic gate IC 7400 and test with digital IC Tester.
2. Make the connection as shown in figure 3.1-3.3 on breadboard
3. Connect the +5V to Vcc pin of IC and GND pin to ground
4. Observe the LED (on or off) for each combination of input as per truth table
5. Verify the truth table
6. Repeat the process for figure 3.4-3.6.

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital multimeter	3 1/2 digit display	2
2	Breadboard	5.5cm x 17cm	1
3	I C	7400, 7402	1
4	LED	Red/yellow color 5mm	1

XII Actual Procedure

1] Check IC before use
2] Set Power supply to 5V before connecting
3] check all the connections as per circuit diagram

XIII Observation:

Table 3.1 a: Observation Table For NOT gate using NAND gate

Inputs	NOT		
A	LED Status (ON/OFF)	Logic Level (0/1)	Output voltage (V)
0(0V)	OFF	0	0.4 V
1(5V)	ON	1	4.5 V

Table 3.1 b: Observation Table For AND, OR gate using NAND gate

Inputs		AND			OR		
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)	OFF	0	0 V	OFF	0	0 V
0(0V)	1(5V)	OFF	0	0.1 V	ON	1	4.5V
1(5V)	0(0V)	OFF	0	0V	ON	1	4.5V
1(5V)	1(5V)	ON	1	4.5V	ON	1	4.5V

Table 3.2 a: Observation Table For NOT gate using NOR gate

Inputs	NOT		
A	LED Status (ON/OFF)	Logic Level (0/1)	Output voltage (V)
0(0V)	ON	1	4 V
1(5V)	OFF	0	0 V

Table 3.2 b: Observation Table For AND, OR gate using NOR gate

Inputs		AND			OR		
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)	OFF	0	0 V	OFF	0	0 V
0(0V)	1(5V)	OFF	0	0 V	ON	1	4.8 V
1(5V)	0(0V)	OFF	0	0 V	ON	1	4.2 V
1(5V)	1(5V)	ON	1	4.5 V	ON	1	4 V

XIV Result(s)

In this practical we learn about how to Constructs basic Gates using universal gates

XV Interpretation of results

In this practical we observe about operation that are perform using the basic gates that are universal gates

XVI Conclusion and recommendation

Hence, we learnt how to perform the practical using constructs basic gates using universal gates

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. Design 3 input NOR gate using 2 input NOR gate IC 7402.
2. Draw EX-NOR gate using NAND Gates.
3. Write name of manufacturers of Digital IC 7400, 7402 used in your lab.
4. What is the significance of L, LS and H in the following IC 74L00, 74LS00, and 74H00?

→

The letters 'L', 'LS' and 'H' in the IC numbers 74L00, 74LS00 and 74H00 signify different logic families and their characteristics.

- 74L00 : Low-power TTL (transistor-transistor logic) family - low power consumption (typically 1-2 mA per gate) - low speed typically 10-20 propagation delay)

- 74LS00 : Low-power Schottky TTL family - lower power consumption typically 0.5 - 1.5 mA per gate than 74L00 - Faster speed typically 5 - 10 ns propagation delay than 74200 improved noise immunity

- 74H00 : High-speed TTL family - Higher speed typically 2-5 ns propagation delay than 74L00 and 74LS00 - Higher power consumption typically 10 - 20 mA per gate than 74L00 and 74LS00.

[Space for Answers]

1] ⟶

To design a 3-input NOR GATE using 2 input NOR GATE IC T402 you can use the following Configuration

1. Connect inputs A & B to one 2-input NOR GATE (IC1)
2. Connect input C to one input of another 2-input NOR GATE (IC2)
3. Connect the output of IC1 to the other input or to
4. The output or IC2 is the output of 3 input NOR GATE.

- Heres the schematic

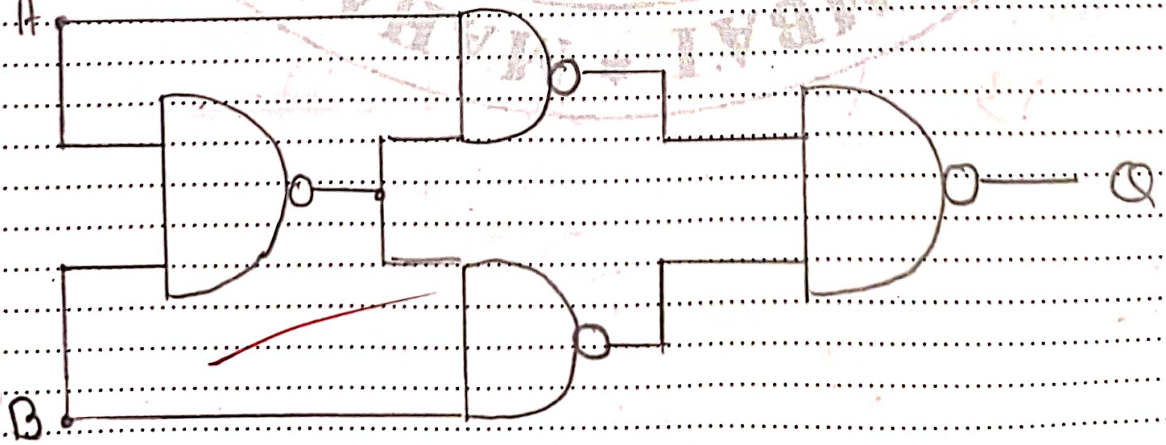
IC1 (2-input NOR Gate
- Input 1 : A
- Input 2 : B
- Output : IC1out

IC2 (-2input NOR GATE)
- Input 1 : C
- Input 2 : IC1out
- Output IC2L3 : input NORGate

- Truth Table

A	B	C	Q
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

2] ⟶



Name two same manufacturer of digital ICs
Two and Four

1. Texas Instruments (TI)
2. Fairchild Semiconductors
3. Intel Corporation
4. Kelim Semiconductor
5. Omnivelectronics

XVIII References/Suggestions for further reading

1. https://de-iitr.vlabs.ac.in/exp/realization-of-logic-functions/simulation.html
2. https://www.futurlec.com/74/IC7400.shtml
3. https://www.futurlec.com/74/IC7402.shtml

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	