Practical No.4: Construct Exclusive 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. Construct Ex-OR, EX- NOR 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

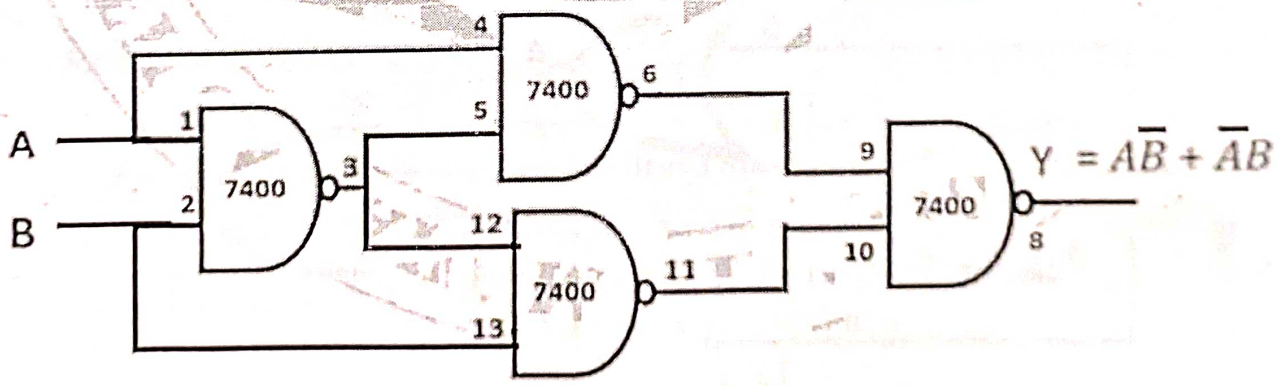


Fig 4.1: Circuit Diagram : EX-OR gate using NAND gate

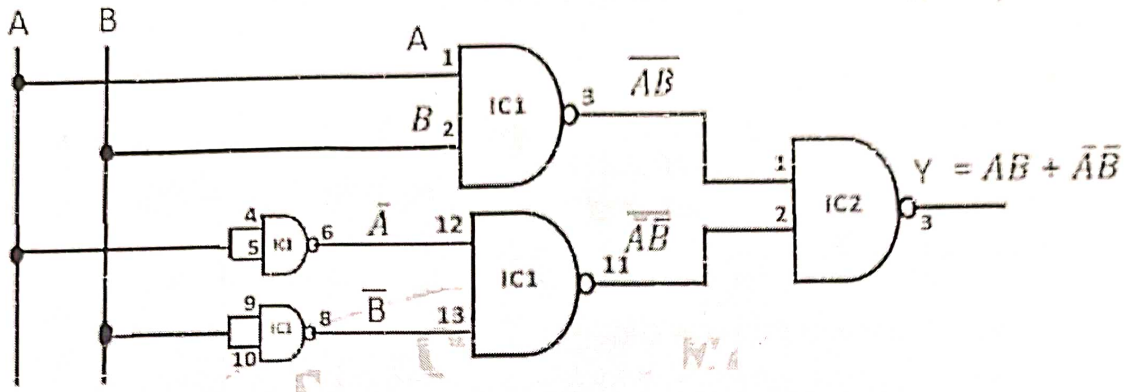


Fig 4.2: Circuit Diagram: EX-NOR gate using NAND gate

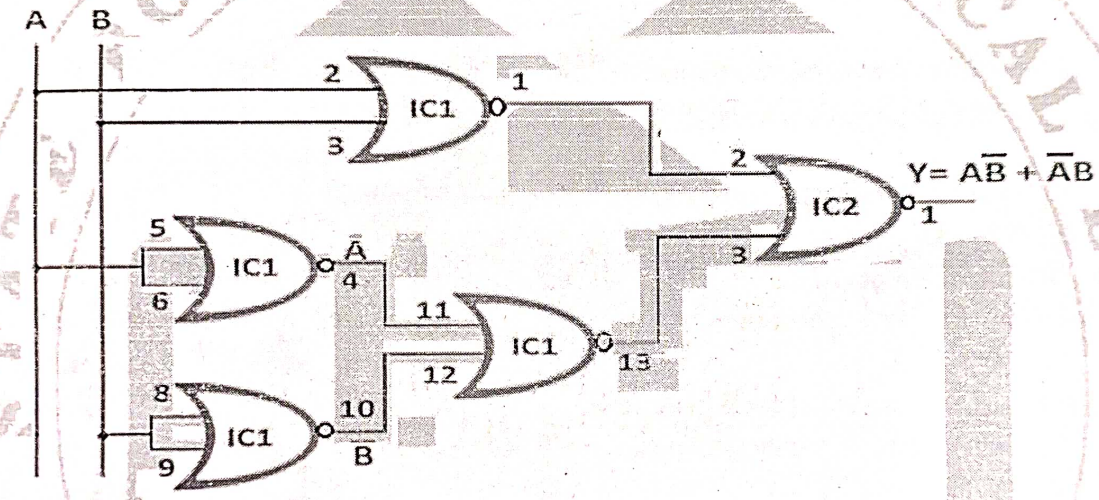


Fig 4.3: Circuit Diagram : EX-OR gate using NOR gate

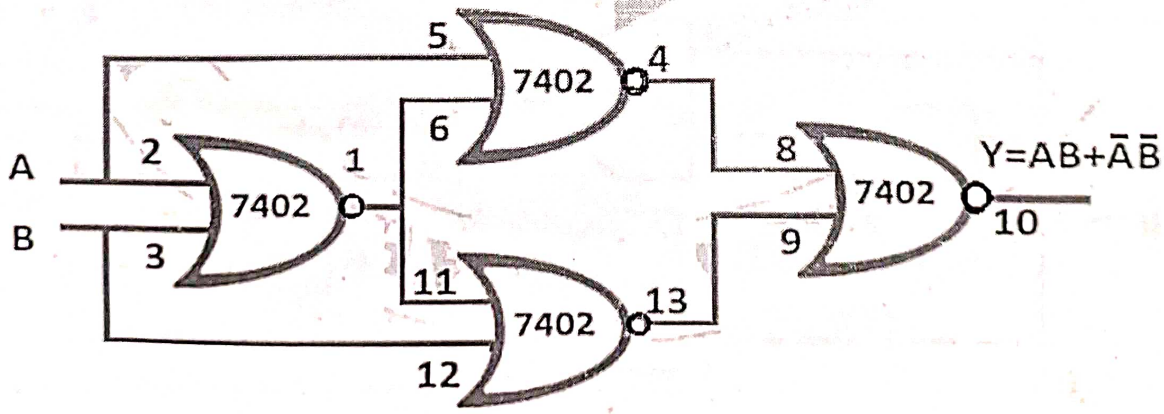
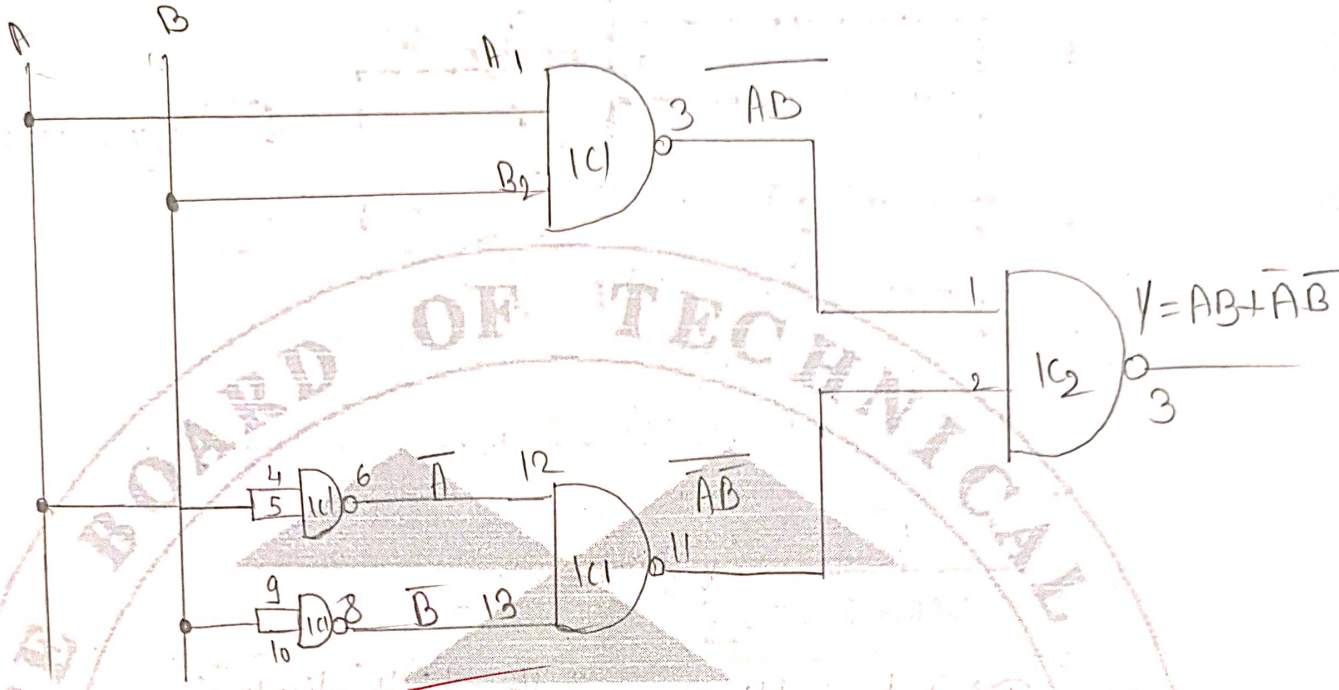


Fig 4.4: Circuit Diagram: EX-NOR gate using NOR gate

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	2 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 , IC7402 and test with digital IC Tester.
2. Make the connection as shown in figure 4.1-4.2 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 4.3-4.4.

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital multimeter	3 1/2 digit display	1
2	DC Power Supply	+5V fixed Power Supply	1
3	Bread board	5.5cm x 17 cm	1
4	IC	7400, 7402	1

XII Actual Procedure

1] Identify pin configuration of logic gate IC 7400, IC 7402 & test with digital IC tester

2] Connect the +5V to +Vcc pin of IC & GND pin to ground

XIII Observation:

Table 4.1: Observation Table For EX-OR & EX-NOR gate using NAND gate

Inputs		EX-OR			EX-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	4.5	OFF	0	0 V
0(0V)	1(5V)	OFF	0	0	ON	1	4.5 V
1(5V)	0(0V)	OFF	0	0	ON	1	4.5 V
1(5V)	1(5V)	ON	1	4.5	OFF	0	0 V

Table 4.2: Observation Table For EX-OR & EX-NOR gate using NOR gate

Inputs		EX-OR			EX-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)						
0(0V)	1(5V)						
1(5V)	0(0V)						
1(5V)	1(5V)						

XIV Result(s)

In this practical we learn to construct exclusive gates

XV Interpretation of results

In this practical we learn to construct exclusive gates

XVI Conclusion and recommendation

Hence we learn to construct Exclusive 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. Write truth table for three input EX-OR & three input EX-NOR gates.
2. Refer diagram 4.1 & measure the voltage of pin 3,6,11.
3. Refer diagram 4.4 & measure the voltage of pin 1,4,13.

[Space for Answers]

1 → truth table for 3 input Ex-OR

A	B	C	A⊕B⊕C
0	0	0	0
0	0	1	1
0	1	0	1

0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Truth table for XNOR gate 3-input

A	B	C	A⊙B⊙C
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

2] ⟶

To measure the Voltage at Pins 3, 6 and 11 of the NAND gates in the circuit

Pin 3 : This is the output of the first NAND gate (IC 7400) with inputs A & B. The nand gate will output a 1 both A & B are 1 in which case it will output 0

Pin 6 : This is the output of 2nd nand gate. this nand gate is taking the output from pin 3 and the input A. the output will be 1 unless both the input from pin 3 & A are 1.

Pin 11 : This is the output of the 3rd nand gate it takes input from pin 13 (B) & pin 6. the output will be 1 unless both inputs (B & Pin 6) are 1.

A	B	Pin 3 (A NAND B)	Pin 6 (Pin 3 NAND A)	Pin 11 (Pin 6 NAND B)
0	0	1	1	1
0	1	1	1	0
1	0	1	0	1
1	1	0	1	1

3] ⟶

The given circuit diagram is an implementation of a two-input XNOR gate using NOR gate (IC7402)

Pin 1:
This is the output of the 1st Nor gate IC7402. The Nor gate output 1 only when both inputs are 0.

Pin 4:
This is the output of the 2nd NOR gate, which takes the output from pin 1 and the input from pin 6 which comes from A or B. It will output 1 only with both inputs are 0.

pin 13:
This is the output of the third nor gate, which takes inputs from pin 12 & the input from pin 11 which comes from A or the output of the first NOR gate. it will output 1 only when both inputs are 0

logical table :

A	B	Pin (A NOR B)	Pin 4 (Pin 1 NOR A)	Pin 13 (Pin 12 NOR 11)
0	0	1	0	0
0	1	0	1	0
1	0	0	1	0
1	1	0	0	1

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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

XVIII 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	