I. OBJECTIVE:

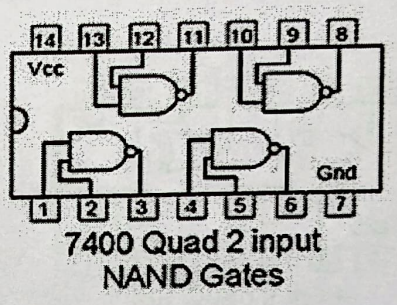
1. Investigation of the logic behaviour of various gates:
   a) 7400 quadruple two-input NAND gates
   b) 7402 quadruple two-input NOR gates
   c) 7404 hex inverters
   d) 7408 quadruple two-input AND gates
   e) 7432 quadruple two-input OR gates
   f) 7486 quadruple two-input XOR gates

2. Using a single 7400 IC, connect a circuit that produces
   a) An inverter.
   b) A two-input AND.
   c) A two-input OR.
   d) A two-input XOR.

II. PRE-LAB

1. Quad 2-input NAND gate

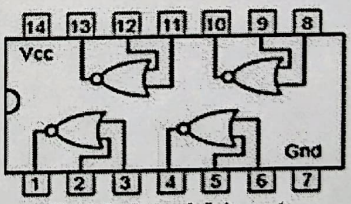
A	B	F= $\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0



7400 Quad 2 input NAND Gates

2. Quad 2-input NOR gate

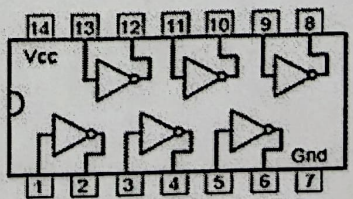
A	B	F= $\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0



7402 Quad 2 input NOR Gates

3. Hex Inverter

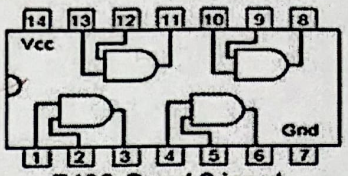
A	F= $\overline{A}$
0	1
1	0



7404 Hex NOT Gates (Inverters)

4. Quad 2-input AND gate

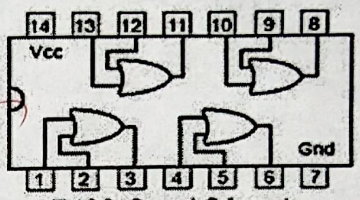
A	B	F= A·B
0	0	0
0	1	0
1	0	0
1	1	1



7408 Quad 2 input AND Gates

5. Quad 2-input OR gate

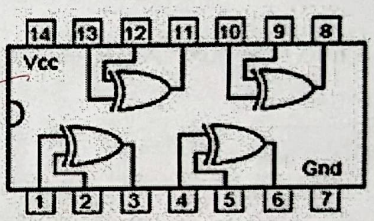
A	B	F= A+B
0	0	0
0	1	1
1	0	1
1	1	1



7432 Quad 2 input OR Gates

6. Quad 2-input EX-OR gate

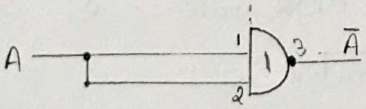
A	B	F= $\bar{A}\cdot B + A\cdot\bar{B}$
0	0	0
0	1	1
1	0	1
1	1	0



7486 Quad 2 input XOR Gates

7. Draw the circuit diagram & obtain truth tables for obj. 2

a) An inverter →

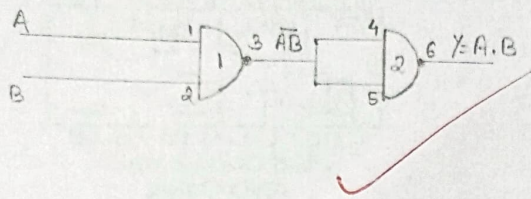


Diagram

Truth Tables →

Inputs		Outputs
A	A=B	F=(AB)' = A'
0	0	1
1	1	0

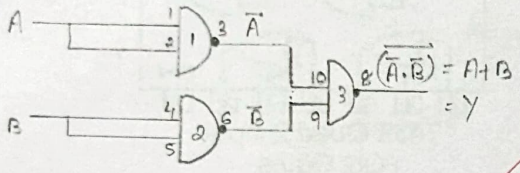
b) A two-input AND →



Truth tables →

Inputs		Outputs		
A	B	$A \cdot B$	$\overline{A \cdot B}$	$Y = \overline{\overline{A \cdot B}} = A \cdot B$
0	0	0	1	0
0	1	0	1	0
1	0	0	1	0
1	1	1	0	1

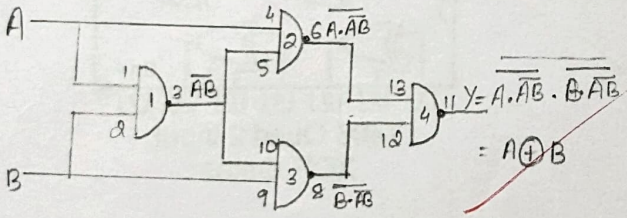
c) A two-input OR →



Truth tables →

Inputs		Outputs			
A	B	$\overline{A}$	$\overline{B}$	$\overline{A} \cdot \overline{B}$	$\overline{\overline{A} \cdot \overline{B}} = A + Y = Y$
0	0	1	1	1	0
0	1	1	0	0	1
1	0	0	1	0	1
1	1	0	0	0	1

d) A two-input XOR →



Truth Tables →

Inputs		Outputs			
A	B	$\overline{AB}$	$A \cdot \overline{AB}$	$B \cdot \overline{AB}$	$Y = \overline{\overline{A \cdot \overline{AB}} \cdot \overline{B \cdot \overline{AB}}}$
0	0	1	1	1	0
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	1	1	0

III > LAB →

Components Required →

Sl. No.	Name of the Component	Specification	Quantity
1	7400 IC	Quad 2 input NAND Gate	1
2	7402 IC	Quad 2 input NOR Gate	1
3	7404 IC	Hex Inverters	1
4	7408 IC	Quad 2 input AND Gate	1
5	7432 IC	Quad 2 input OR Gate	1
6	7486 IC	Quad 2 input XOR gate	1
7	Universal Trainer Kit	—	1
8	Connecting Wires	23 swg	As required

Observation →

Objective-1 →

IC No.	Gate No.	Input Pins	Output Pins	Remark
7402 (NOR)	1	2,3	1	Working
	2	5,6	4	Working
	3	8,9	10	Working
	4	11,12	13	Working
7400 (NAND)	1	1,2	3	Working
	2	4,5	6	Working
	3	10,9	8	Working
	4	13,12	11	Working
7404 Hex NOT	1	1	2	Working
	2	3	4	Working
	3	5	6	Working
	4	9	8	Working
7408 AND	1	1,2	3	Working
	2	4,5	6	Working
	3	9,10	8	Working
	4	13,12	11	Working
7432 OR	1	1,2	3	Working
	2	4,5	6	Working
	3	9,10	8	Working
	4	13,12	11	Working
7486 XOR	1	1,2	3	Working
	2	4,5	6	Working
	3	9,10	8	Working
	4	13,12	11	Working

Objective - II

IC No.	Gate No.	Input Pins	Output Pins	Remark
Inverter using 7400 IC	1	2	3	Working
	2	5	6	Working
	3	9	10	Working
	4	12	13	Working
A two input AND using 7400 IC	1	1, 2	6	Working
	2	8, 9	13	Working
A two input OR using 7400 IC	1	1, 4	8	Working
A two input XOR using 7400 IC	1	1, 2	11	Working

III. LAB:

Components Required:

S. No	Name of the Component	Specification	Quantity
-			

Observation:

Conclusion:

1) In Obj. 1, we verified the functioning of various logic gates.

2) In Obj. 2, we conclude that NAND gate is a universal gate because we are able to connect & implement an Inverter, AND, OR and XOR gate with single 7400 IC Gate.

IV. POST LAB to connect & implement an Inverter, AND, OR and XOR gate with single

1. What is the voltage range for operation of digital circuits?
2. What is the significance of ground and V_{cc} connection?
3. Which gates are known as universal gates & why?
4. What is the minimum number of NAND gates used to realize an EX-OR gate?

Ans→ 1) Acceptable input signal voltages range from 0 V to 0.8 V for a low logic state, & 2 volt to 5 V for a high logic ~~gates~~ state.

2) VCC (Voltage Common Collector) is the higher voltage with respect to GND (ground). VCC is the power input of a device. It may be +ve or -ve with respect to GND. When the only +ve power supply is used then VSS means ground or Zero.

3) A universal gate is a gate which can implement any Boolean function without need to use any other gates. The NAND or NOR gates are universal gates.

4) An XOR gate circuit can be made from 4 NAND gates.