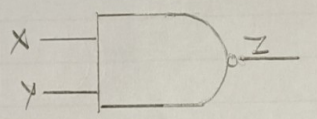
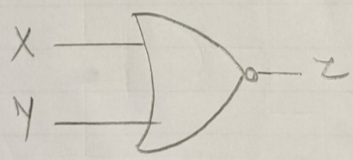


$Z = \overline{X \cdot Y}$

NAND Gate



$Z = \overline{X + Y}$

NOR Gate

Date _____

Expt. No. 1 Page No. _____

Realization of Gates using Universal Gates

Aim: To verify all gates using NAND and NOR gates.

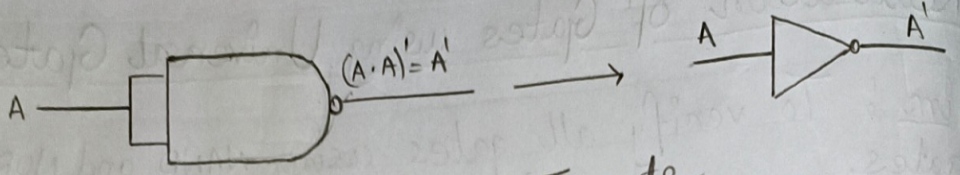
Apparatus: Breadboard, IC 7400 (NAND), IC 7402 (NOR), LEDs, +-5V power supply, Connecting wires

Theory: NAND Gate: The NAND gate represents the complement of the AND operation. Its name is an abbreviation of NOT AND. The graphic symbol for the NAND gates consist of an AND symbol with a bubble on the output, denoting that a complement operation is performed on the output of the AND gate as shown in Fig 7.1

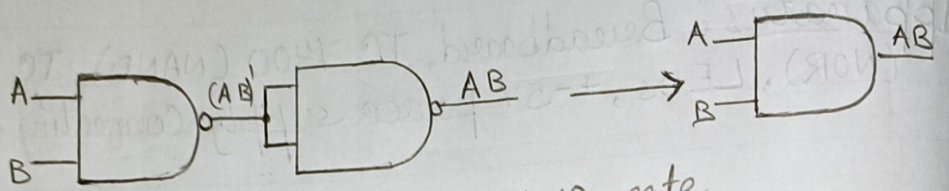
NOR Gate: The NOR gate represents the complement of the OR operation. Its name is an abbreviation of NOT OR. The graphic symbol for the NOR gate consists of an OR symbol with a bubble on the output, denoting that a complement operation is performed on the output of the OR gate. The truth table and the graphic symbol of NOR gate is shown in fig 7.2.

Teacher's Signature _____

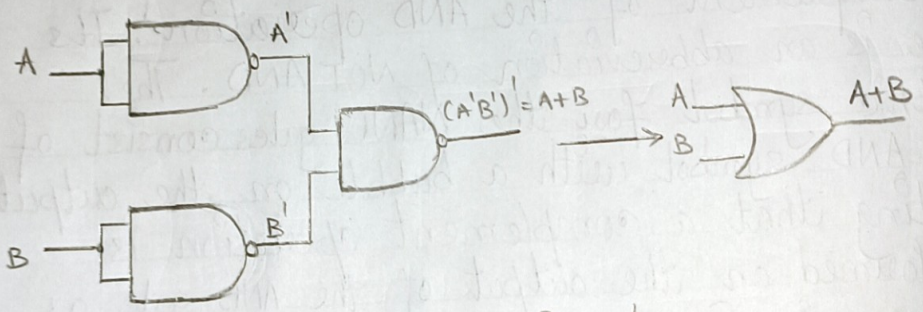
NAND gate as universal gate:



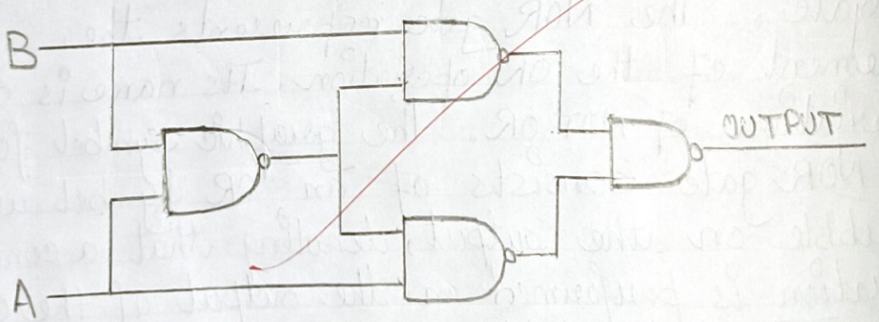
NAND as NOT gate



NAND as AND gate



NAND as OR gate



NAND as XOR gate

Expt. No. _____ Page No. _____

NAND and NOR Gates are called universal gates as all other gates can be Implemented using these two gates.

Precautions:

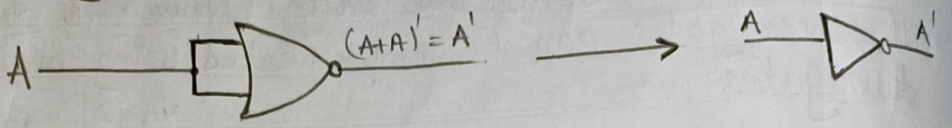
1. All ICs should be checked before starting the experiment.
2. All the connections should be tight.
3. Always connected ground first then the supply.
4. Switch off the power supply after completion of the experiment.

Result:

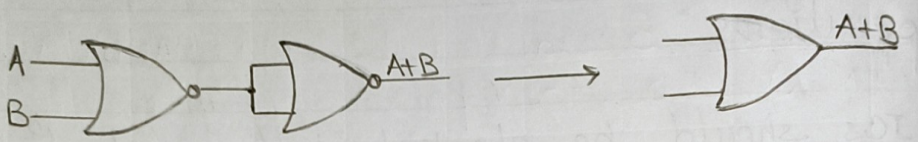
NAND and NOR gates have been studied as universal gates.

Teacher's Signature _____

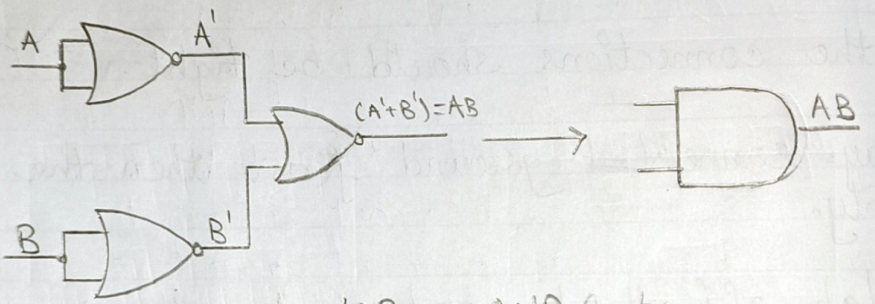
NOR gate as universal gate:



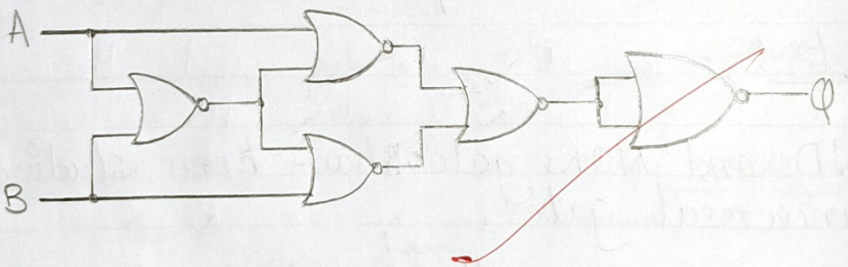
NOR as NOT gate



NOR as OR Gate



NOR as AND Gate



NOR as XOR Gate

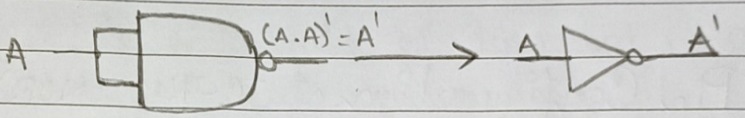
Date _____

Expt. No. _____ Page No. _____

Viva - Voce Questions

1. Why NAND & NOR gates are called universal gates?

Ans- NAND & NOR gates are called universal gates as all other gates can be implemented using these two gates.
For example:



NAND as NOR

2. Give the truth table for Ex-NOR and why it is called Extended OR?

Inputs		Outputs
A	B	EX-NOR ($Y = \overline{A \oplus B}$)
0	0	1
0	1	0
1	0	0
1	1	1

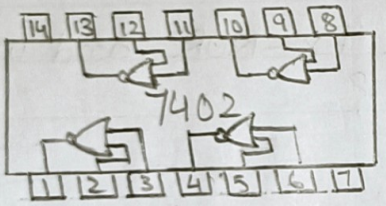
$\overline{A \oplus B} = \bar{A}\bar{B} + AB$

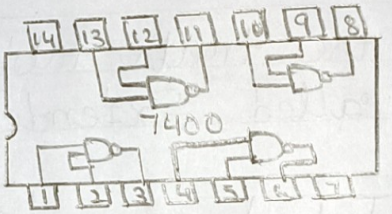
Teacher's Signature _____

Truth table of all the gates

INPUTS		OUTPUTS					
A	B	AND	NAND	OR	NOR	EXOR	EXNOR
0	0	0	1	0	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	0	1	0	0	1

Pin Configuration of IC-7402(NOR), IC-7400(NAN



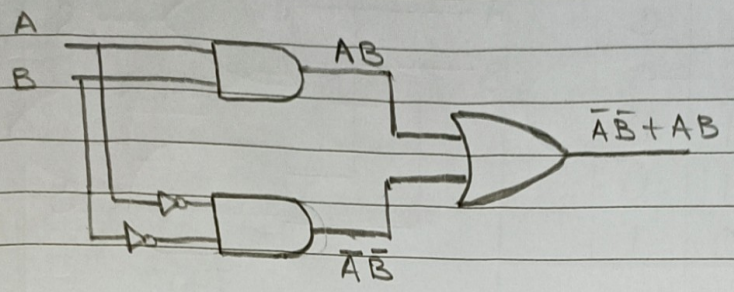


Pin Configuration of IC used

Date _____

Expt. No. _____ Page No. _____

So if we draw equivalent circuit of EX-NOR



As its output is a result of two not, two and and one OR gate therefore it is called Extended OR.

3. What is difference between logical and Asithmetic operation?

Ans- Arithmetic operators perform their actions on numbers. Assignment operators assign values to variables. Logical operators compare two values and, based on whether the comparison is true (or false), return either a "true" or "false".

4. What are Basic Gates?

Ans- Basic gates are those gates which performs basic operations & logic functions There are three basic logic gates called the AND gate, the OR gate, and the NOT gate.

Teacher's Signature _____

A \ B	0	1
0	0	1
1	1	0

$S = \bar{A}B + A\bar{B} = A \oplus B$

A \ B	0	1
0	0	0
1	0	1

$C = AB$

INPUTS		OUTPUTS	
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

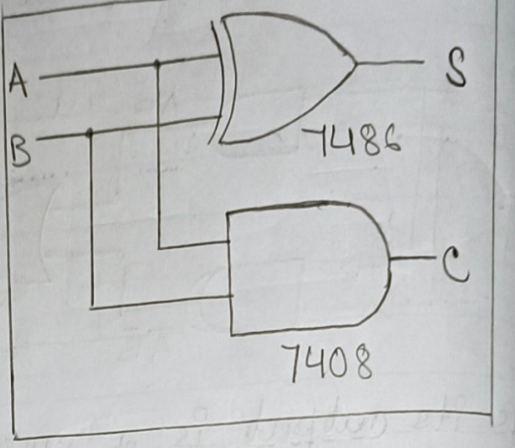
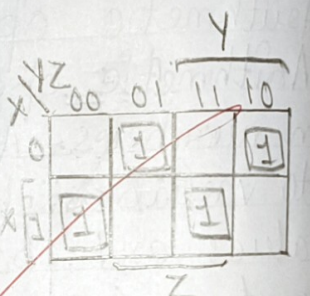


Fig-2.1 HA Circuit diagram and Truth table

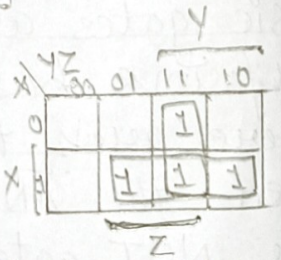
INPUTS			OUTPUTS	
A	B	C_{in}	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

FA Truth Table



$S = \bar{X}\bar{Y}Z + \bar{X}Y\bar{Z} + XY$

$= X \oplus Y \oplus Z$



$C = XY + XZ + YZ$

$= XY + Z(X\bar{Y} + \bar{X}Y)$

$= XY + Z(X \oplus Y)$

Date

Expt. No. 2

Page No.

Realization of Half Adder and Full Adder

Aim :-

To realize Half Adder and Full Adder using basic gates.

Apparatus :-

Breadboard, IC 7486 (XOR), IC 7408 (AND) IC 7432 (OR), LEDs, 5V power supply, connecting wires.

Theory :-

HALF ADDER - A combinational logic circuit that performs the addition of two data bits, A & B, is called a half-adder. Addition will result into two output bits; one of which is the sum bit, S, and the other is the carry bit, C as shown in TT. The Boolean functions describing the half-adder are:

$$S = A \oplus B$$
$$C = A.B$$

Full Adder - The half-adder does not take the carry bit from its previous stage into account. This carry bit from its previous stage is

Teacher's Signature

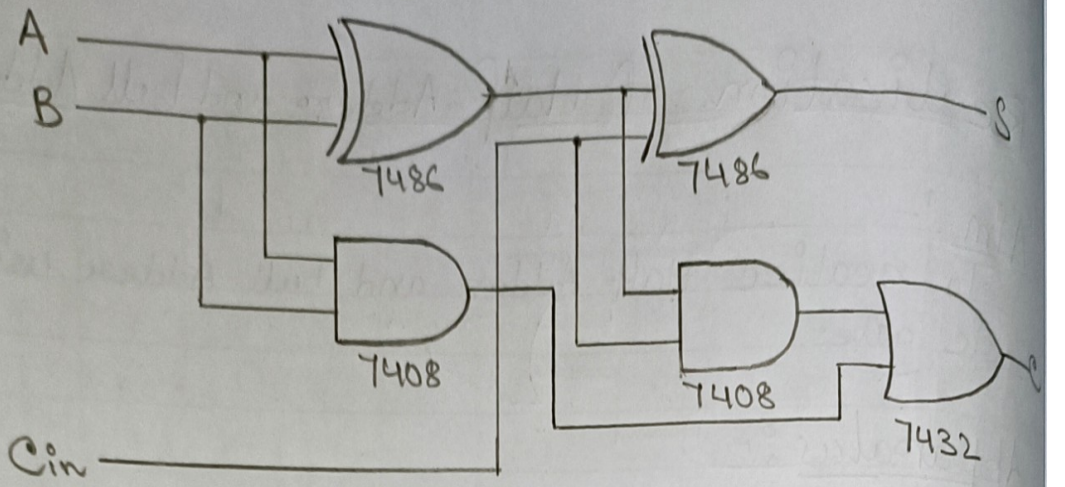
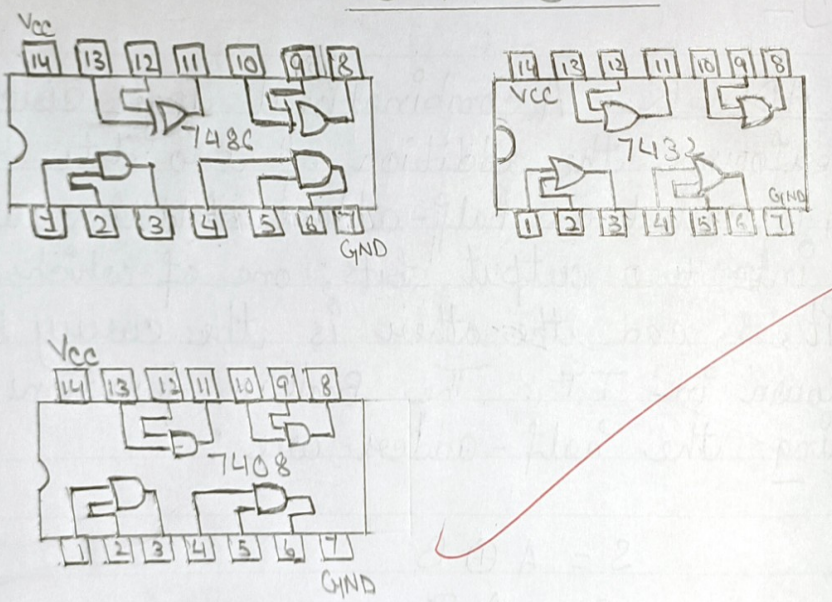


Fig 2.2 FA Circuit implementation

Pin Configuration of IC-7486(XOR), IC-7432(OR), IC-7408(AND):



Pin Configuration of IC used

Date _____

Expt. No. _____ Page No. _____

called carry-in bit. A combinational logic circuit that adds two data bits, A and B, and a carry in bit, Cin, is called a full-adder.

$$C = xy + C_{in}(x \oplus y)$$

~~Procedure:~~

Precautions:

1. All ICs should be checked before starting the experiment.
2. All the connection should be tight.
3. Always connect ground first and then the supply.
4. Switch off the power supply after completion of the experiment.

Result:

Half Adder and Full Adder have been realized using basic gates and their truth table has been verified.

Teacher's Signature _____

Date

Expt. No. Page No.

Viva-Voce Questions

1. Prove that Sum of a full adder is a XOR gate between its input.

Ans- Truth table of full adder

Inputs			Output	
A	B	Cin	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$S = (A \oplus B) \oplus Cin$

Truth table of XOR

Input			Output
A	B	Cin	Y
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

Teacher's Signature

Date _____

Expt. No. _____ Page No. _____

$Y = (A \oplus B) + C_{in}$

Hence Proved,

Since Sum from full adder truth table and Y from XOR truth table are same

2. State the difference between Half Adder and Full adder.

Ans- Half Adder is combinational logic circuit which adds two 1-bit digits. The half adder produces a sum of the two inputs.

Whereas,

Full Adder is combinational logical circuit which performs an addition operation on three one-bit binary digits. In full adder there are three input bits.

3. Can we design a full adder using two half adders?

Ans- We can design a full adder using two half adders and a OR gate.

4. What are combinational circuits?

Ans- Combinational circuit is a circuit in which we combine the different gates in the circuit.

Kaur 20/7/21

Teacher's Signature _____