Experiment - 1

AIM: Verification and interpretation of truth table for AND, OR, NOT, NAND, XOR & XNOR gates.

APPARATUS: Bread board, logic gates / IC's, wires

THEORY: Logic gates are electronic components which perform logic functions one or more input to produce a single. There are 7 gates. A truth table is a combination of various input along with its output.

1) **AND Gate:** This gate produces output as 1 when all inputs are 1 otherwise the output is 0. It has minimum of 2 inputs.

2) **OR GATE:** This gate produces 1 as output when any of the input is 1 otherwise it is 0. It minimum ~~input~~ of 2 inputs.

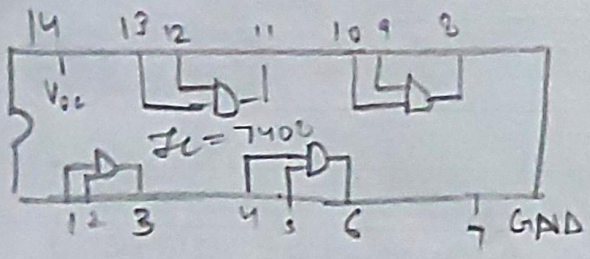
3) **NOT Gate:** This gate produces complement of its input. This gate is also called inverter. It has one output & 1 input.

4) **NAND Gate:** It is a series of ~~OR~~ AND gates followed by a NOT gate. It is a universal gate.

5) **NOR GATE:** It is a series of OR gate followed by NOT gate. It is a universal gate.

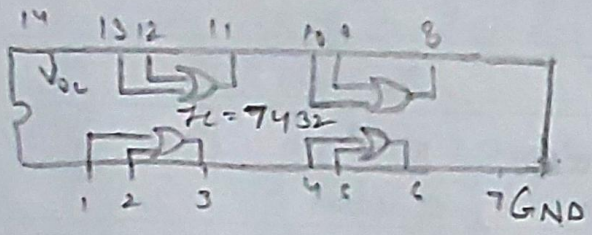
6) **Exclusive-OR (XOR):** It gives 1 when number 1s as input is odd.

AND Gate



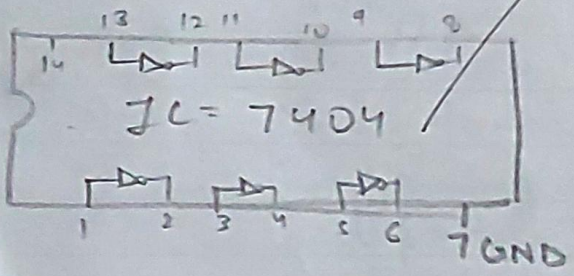
A	B	A·B
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate



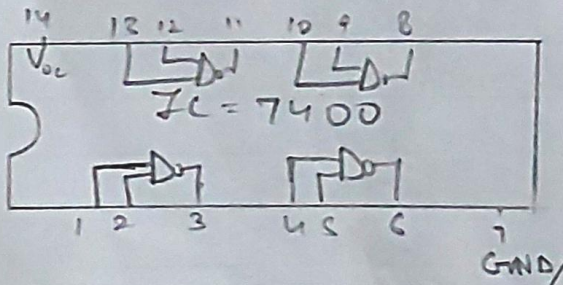
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate



A	$\bar{A}$
0	1
1	0

NAND Gate



NAND Gate

A	B	$\overline{A\,B}$
0	0	1
0	1	1
1	0	1
1	1	0

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7) Exclusive-NOR (XNOR): This gate gives 1 as output when 1s at all its input is odd otherwise is 0. It has two inputs and 1 output

Procedure:

1) Connect the bread board to DC supply
2) Connect the input of any one logic gate to logic source and its output to logic indicators.
3) Apply various inputs combinations & observe output for each.
4) Verify truth table for input/output combination.
5) Repeat the process of all logic gates.
6) Switch off the DC supply.

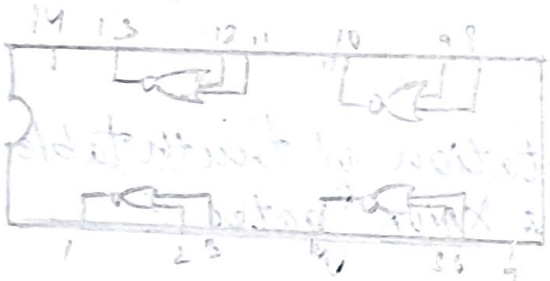
Basic Laws of Boolean Algebra

1) $A+B = B+A$ (Commutative Law)
   $AB = BA$
2) $(A+B)+C = A+(B+C)$ (Associative law)
   $(AB)C = A(BC)$
3) $A.(B+C) = AB+BC$ (Distributive law)
4) $A+AB = A$
5) $\overline{A+B} = \overline{A}.\overline{B}$ (De-Morgan's Law)
   $\overline{A.B} = \overline{A}+\overline{B}$

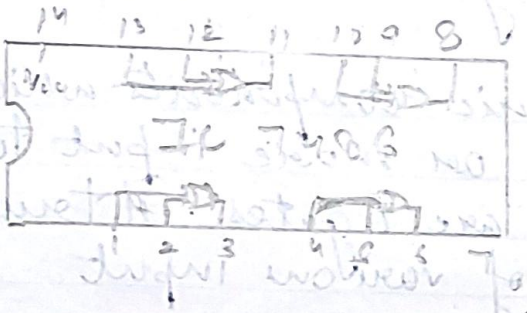
Result: Truth table & various results are verified.

25/10/24

NOR Gate

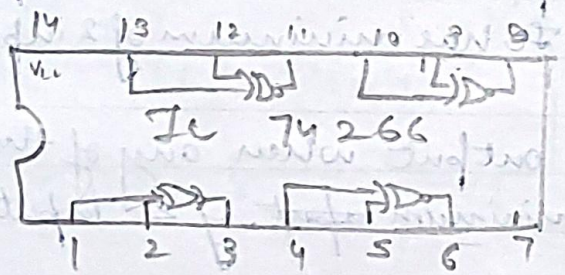


XOR



A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

XNOR Gate



A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

Experiment-2

Aim: Realization of logic functions of NAND gates.

Apparatus: Bread board, NAND gates, wires.

Theory: NAND gate is actually a combination of 2 logic gates AND and NOT gate. Its output is complement of AND gate. This gate can have minimum 2 input and output is always 1 by using only NAND gate. We can realize all logic functions AND, OR, NOT, XOR and XNOR. That's why this gate is known as Universal gate.

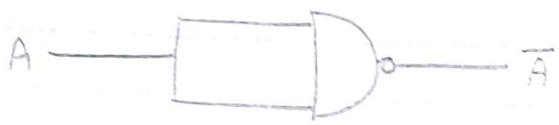
* **NAND as NOT gates:** NOT gate represents complement of the input. It can have only one input and NAND input together. Now, it will work as NOT gate.

$$Y = (AA')$$
$$Y = A'$$

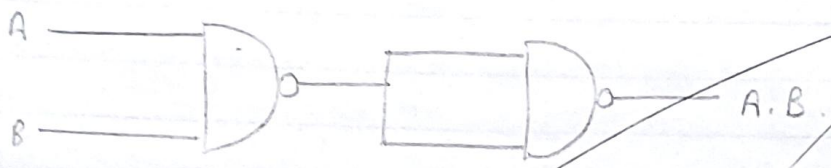
* **NAND as AND gates:** NAND produce complement of AND gate so if the product of a NAND is inverted overall; output will be AND gate.

$$Y = ((A.B'))'$$
$$Y = A$$

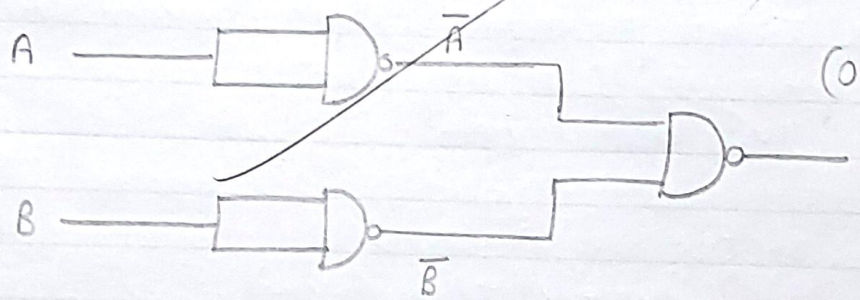
Experiment -2



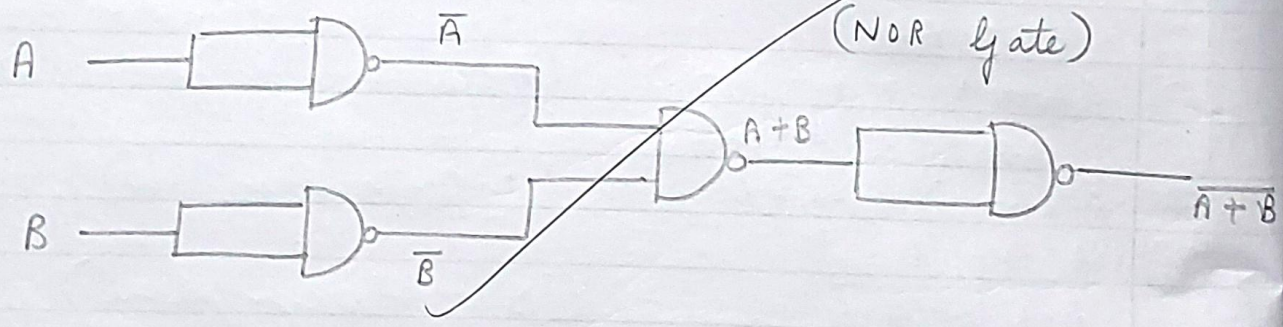
(NOT gate)



(AND gate)



(OR gate)



(NOR gate)

* NAND as OR gates ⇒ From De Morgon's Theorem —

$$(A+B) = A'+B'$$
$$(A'.B') = A''+B''$$
$$= A+B$$

So, give the inverted input to a NAND gate to obtain OR gate as ~~input~~ output.

* NAND as XOR gates: Output of a input XOR gate is shown by —

$$Y = AB' + A'B$$

This can be achieved with logic diagrams are—

Gate No.	Input	Output
1	A, B	$(A,B)'$
2	$A, (A,B)'$	$A((A,B)')'$
3	$((A,B)'), B$	$(B(A,B)')'$
4	$(A(A,B)')(B(A.B)')'A'B+AB$	

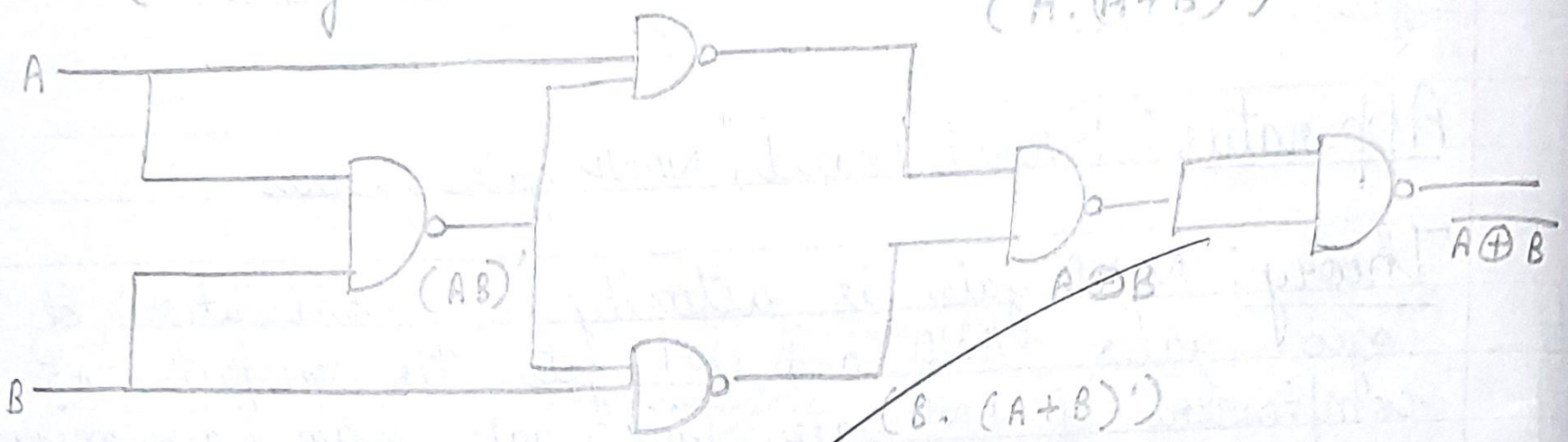
Now, the output from gate 4 is overall output.

$$Y = ((A(A.B)').(B(A.B)')')'$$
$$(A(A.B)')'' + (B(A.B)')''$$
$$= A.A' + A.B' + B.A' + B.B'$$

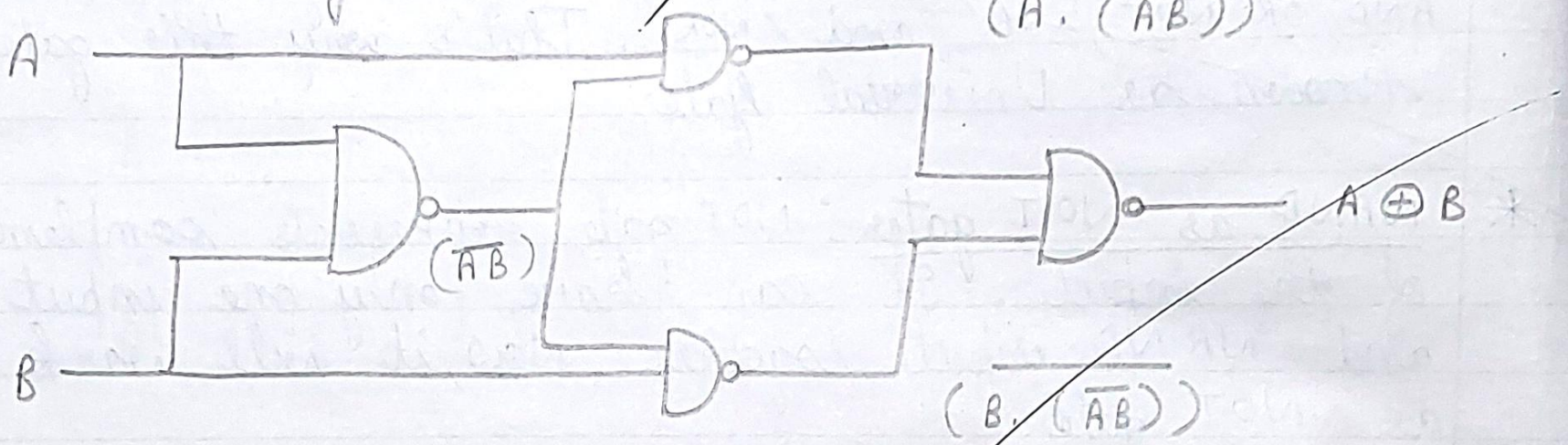
Procedure:

1) Connect the Kit to the AC Power supply.
2) Connect the NAND gate for any of the logic gates.
3) Connect the input of first stage to give source and output to the last gate to logic indicator.
4) Apply various input combination and observe output.

(X-NOR gate)



(X-OR gate)



5.) Verify the truth table for each input / output.
6.) Repeat the process for all logic functions.
7.) Switch OFF the AC power supply.

Result: We implement and verified logic gates NOT, AND, OR, XOR, XNOR gate using universal NAND gate.

6

25/10/21

Experiment-3

Aim: Realization of all basic gates using NOR gate.

Apparatus: Bread board, NOR gates, wires

Theory: A NOR gate is formed by an OR gate followed by a NOT gate. The output of OR is fed as input to NOT gate. This gate has minimum of 2 inputs, outputs is always 1. We can realise all basic gate using NOR gates

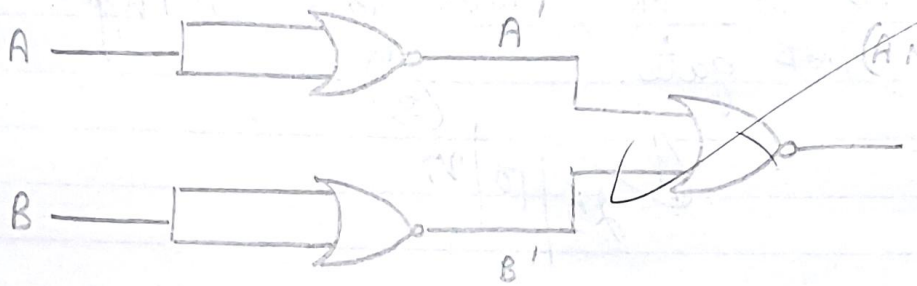
* NOT gate — $Y = (\overline{A+A}) = \overline{A}$
* OR gate — $Y = (\overline{A+B}) = A+B$
* AND gate — $Y = [(\overline{A+B})] = \overline{A}.\overline{B} = A.B$
* XOR gate — $Y = A \oplus B$
* X NOR gate — $Y = AB + B'A'$ or $\overline{A \oplus B}$
* NAND gate — $Y = \overline{A.B}$

Procedure

1.) Comment the trainer kit to power supply.
2.) Connect the NOR gate for any of the logic equation to be satisfied.
3.) Connect the input of first stage to logic source and output of the last stage as gate to logic indicator.
4.) Apply various input combination and observe output for each type
5.) Verify the truth table for each input - output

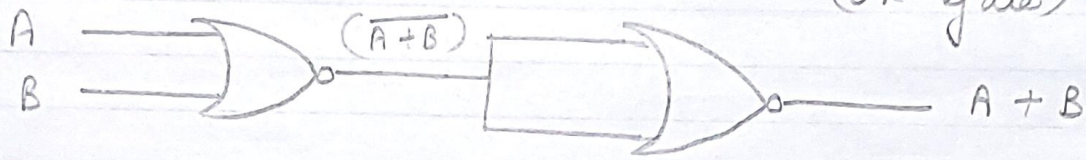
Experiment - 3

(NOT gate)

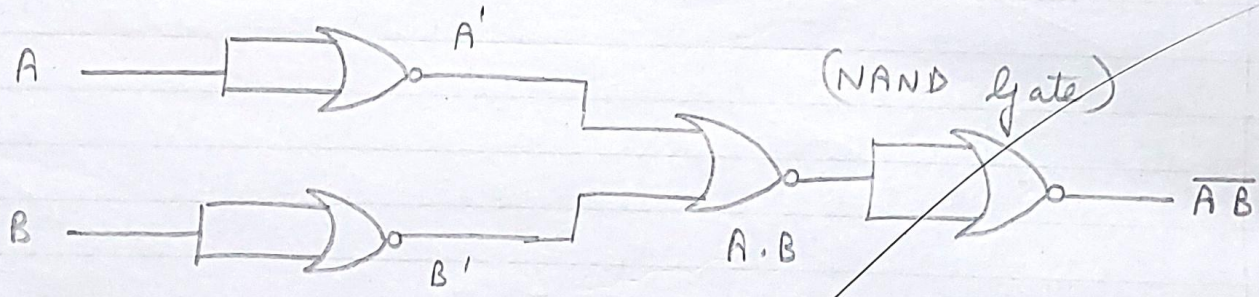


(AND gate)

(OR gate)



(NAND gate)



combination.

6.) Repeat the process for all logic functions.

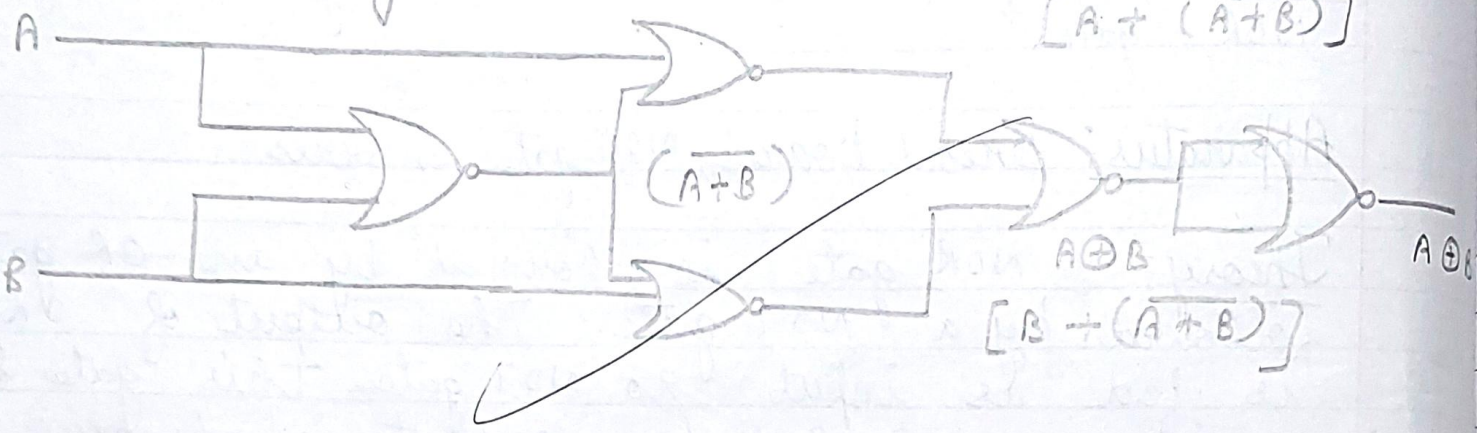
7.) Switch OFF the AC supply.

Result: We implemented and verified logic gates NOT, AND, OR, NAND, XOR, XNOR using NOR gates.

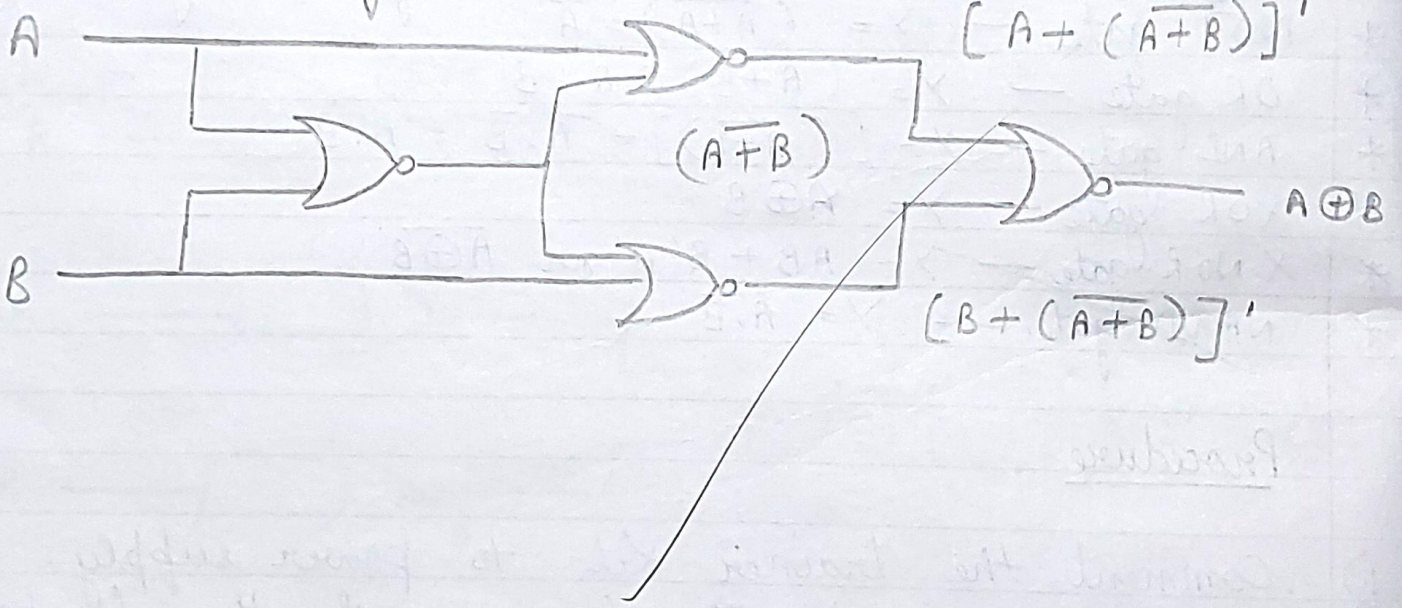
Discussion: The boolean NOR function provides a single yet vital component of logic circuits, whether used as control gives logic, DCB miniaturization.

26/10/24

(X-OR gate)



(X-NOR gate)



Experiment -4

Aim → To realize to gray code convertor

Apparatus → Breadboard, connecting wires, IC supply, display board.

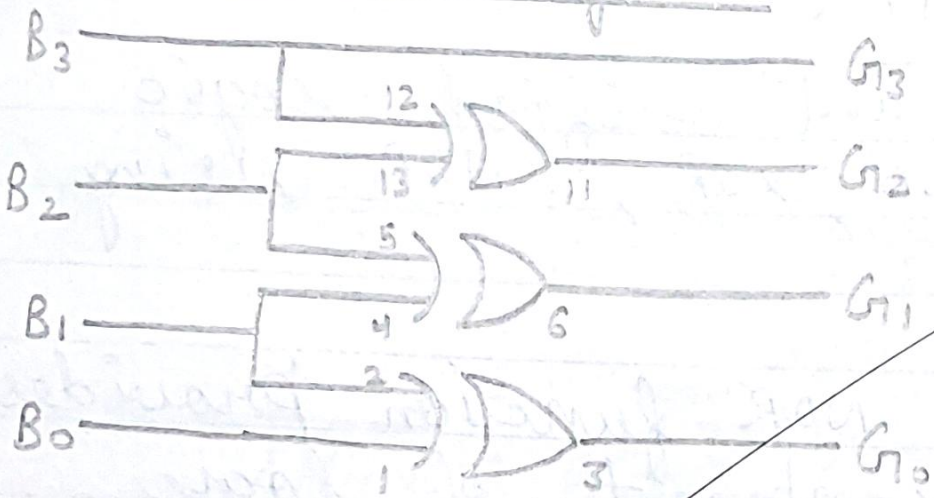
Theory → ① The most significant bit [MSB] of the gray code is always equal to the MSB of the given binary code.
② Other bits of the output gray code can be obtained by Ex-oring binary code bit at that index and previous index.
There are four inputs and four outputs. The input variable are defined as G_3, G_2, G_1, G_0 from the truth table, combinational circuit is designed.
The logical expression are defined as:-

$$B_3 = G_3$$
$$B_2 \oplus B_3 = G_2$$
$$B_1 \oplus B_2 = G_1$$
$$B_0 \oplus B_1 = G_0$$

Procedure → ① Construct the circuit as per the given circuit diagram.
② Insert IC on bread board.
③ Given VCC and ground to all IC's.
④ Specify the output of binary and gray convertor
⑤ Verify the output by truth table.

Experiment-4

Circuit diagram



⑥ The experiment has been done.

Result → Binary code has been converted to gray code

Precautions

① Make neat and tight connections.
② Insert all the IC's without damaging bread-board.
③ Do not give more power supply for more time.

Discussion

Gray codes are unidistant codes which are very essential for designing and digital system, hence forth their study is critical for digital analysis.

6

25/10/24

Truth Table

Input				Output			
B_3	B_2	B_1	B_0	G_3	G_2	G_1	G_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

Experiment → 5

Aim → To realize gray to binary code convertor.

Apparatus → Bread board, connecting wires, IC, power supply.

Theory → ① The most significant bit [MSB] of the binary code is equal to the MSB of the given binary number.

② Other bits of output binary code can be obtained by checking gray code bit at that index. If current gray code bit is 0, then copy previous binary code bit, else copy invert of previous code bit.

There are four inputs and outputs, The input variables are defined as G_3, G_2, G_1, G_0 and output variables are difined as B_3, B_2, B_1, B_0. from the Truth-table, combinational circuit is designed, the logical expression are defined as:-

$$G_0 \oplus G_1 \oplus G_2 \oplus G_3 = B_0$$

$$G_1 \oplus G_2 \oplus G_3 = B_1$$

$$G_2 \oplus G_3 = B_2$$

$$G_3 = B_3$$

Procedure →

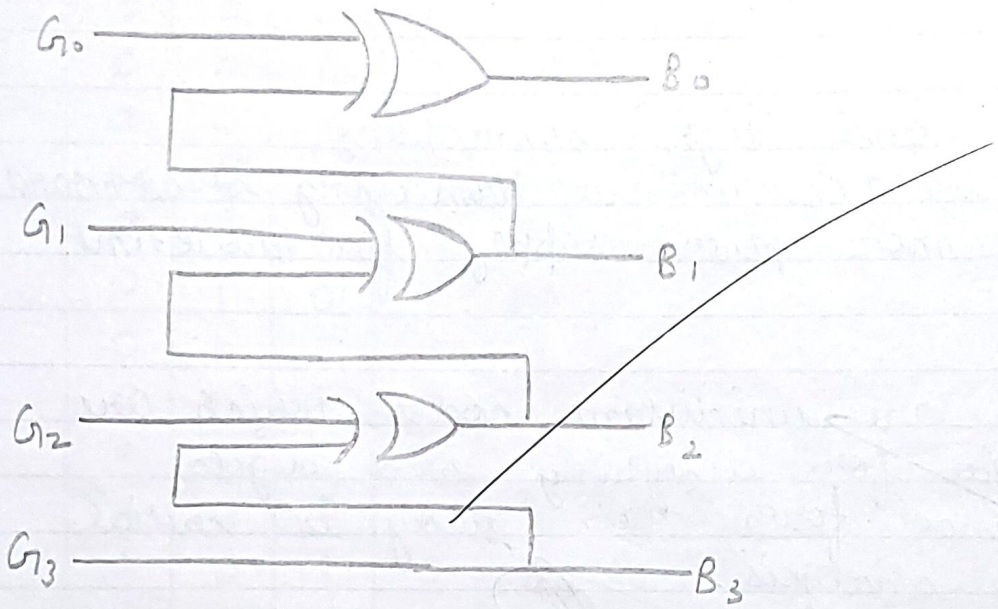
① Convert breadboard to power supply.

② Construct circuit as per diagram.

③ Given VCC and ground to IC.

Experiment - 5

Circuit Diagram



④ Specify the output of gray code to ~~bin~~ binary code.
⑤ Verify the output with truth tables.

<u>Result</u> → Gray code has been converted to binary code.

<u>Precautions</u>

① Ensure the connections are tight.
② Insert all IC without dragging the pins.
③ Do not give more power supply for more time.

6

25/10/24

Truth Table

Input				Output			
G_3	G_2	G_1	G_0	B_3	B_2	B_1	B_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	1
1	0	0	0	1	1	1	1
1	0	0	1	1	1	1	0
1	0	1	0	1	1	0	0
1	0	1	1	1	1	0	1
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	1
1	1	1	0	1	0	1	1
1	1	1	1	1	0	1	0

Experiment-6

Aim: To verify the operation of Half Adder.

Apparatus: Breadboard, connecting wires, power supply IC-7908, IC-7988, LED display board.

Theory: Half adder can add 2 bits (bit by bit) individually output of the Half order has some bit (sum) and carry bit.

1. For Sum – Sum is High when (01 + 10) combination exists. Sum = $\bar{A}B + A\bar{B}$
Boolean expression for sum bits is equal to $\bar{A}B + A\bar{B}$

$$Sum = A \oplus B$$

2. For Carry – Carry is High only when (11) combination exists.

$$(Output) = A.B$$

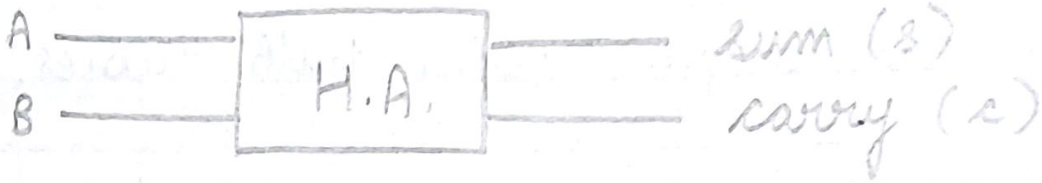
Half adder has output = Sum + Cost

$$= A \oplus B + A.B$$

Procedure

1. Construct circuits as per diagram.
2. Input or insert ICs on breadboard.
3. Live VCC and ground to all ICs
4. Verify the Truth Table.

Experiment-6



Truth Table

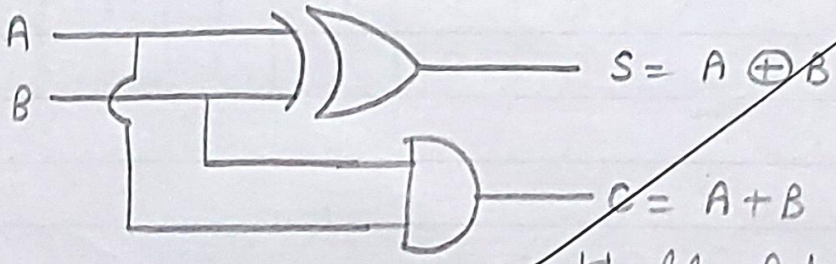
A	B	sum	carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

A \ B	0	1
0	0 (0)	1 (1)
1	1 (2)	0 (3)

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

A \ B	0	1
0	0	0
1	0	1

$C = A + B$



Half Adder

Result: Operation on the Half Adder has been verified.

Precautions

1. Insert ICs carefully in breadboard without damaging.
2. Switch off board when not in use.

25/10/24

Aim: To study the operation of a Half Subtractor

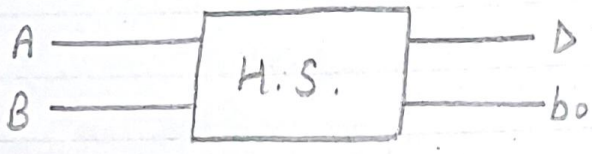
Apparatus Used: Breadboard, connecting wires, power supply, IC-7408, IC-7486, IC-7404, LED display board.

Theory: Half Subtracter is a combinational circuit which is used to perform the subtraction of 2 bits. It has inputs X and Y and two outputs "D" difference and "Bo" output borrow output. From Truth Table difference output is 0, if $x=4$ and 1 ~~is~~ $x=y$, borrow out is 1 whenever $x<1$.

Procedure

1. Connect IC's or breadboard.
2. Give +5V to pin no. 14 and pin no. 7 to ground.
3. Connect input pin A and B of IC from bindry switch as shown.
4. Connect output pins D and borrow output from LED.
5. Switch on power supply and change combinations of A and B & observe output on LED.
6. Verify the Truth Table.

Experiment - 7



output

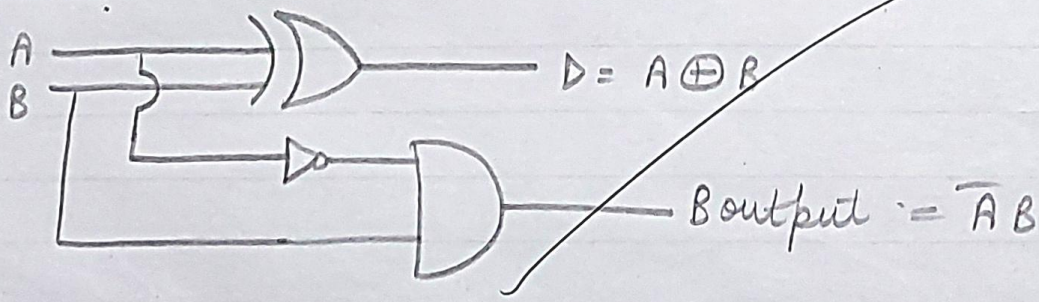
A	B	D	Bout
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

A \ B	0	1
0		1
1	1	

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

A \ B	0	1
0		1
1		

Borrow Output $= \bar{A}B$



Result: The Truth Table of Half Subtracter is verified.

Precautions

1.) Insert and detach IC carefully in 1 from breadboard without damaging to pins.
2.) Take care while supplying voltage to IC.
3.) Connections should be strictly according to diagram.

8

25/10/24

Aim: To verify the operation of Full Adder.

Apparatus Required: Breadboard, connecting wires, power supply, IC-7408, IC-7432, IC-7486.

Theory: It is a logic circuit that accepts 3 binary digit as its I/Ps and generators two output i.e. sum & carry. It adds their 1 bit no. and carry input from previous stage.

Full adder had output = Sum + Carry

$$= A \oplus B \oplus C + (AB + BC + CA)$$

Procedure

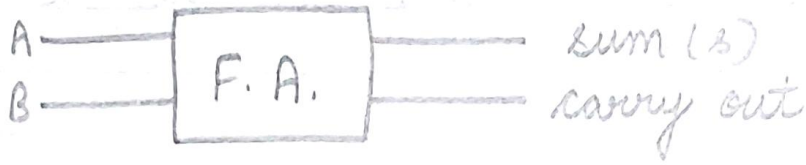
1.) Construct circuit as per diagram.
2.) Input has the IC's on breadboard.
3.) Give VCC and ground to all IC's.
4.) Verify the Truth Table.

Result: Operation of Full Adder has been verified.

Precautions

1.) Insert IC's carefully in breadboard without damaging.
2.) Switch off the breadboard when not in use.

Experiment - 8



A	B	Cin	sum (s)	carry (out)
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

A \ BC in	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$$Sum\ (s) = \bar{A}\bar{B}\,Lin + \bar{A}B\bar{C}\,in + A\bar{B}\bar{C}\,in + ABC\,in$$
$$= Lin\,(\overline{A \oplus B}) + \bar{L}in\,(A \oplus B)$$

Let $A \oplus B = x$

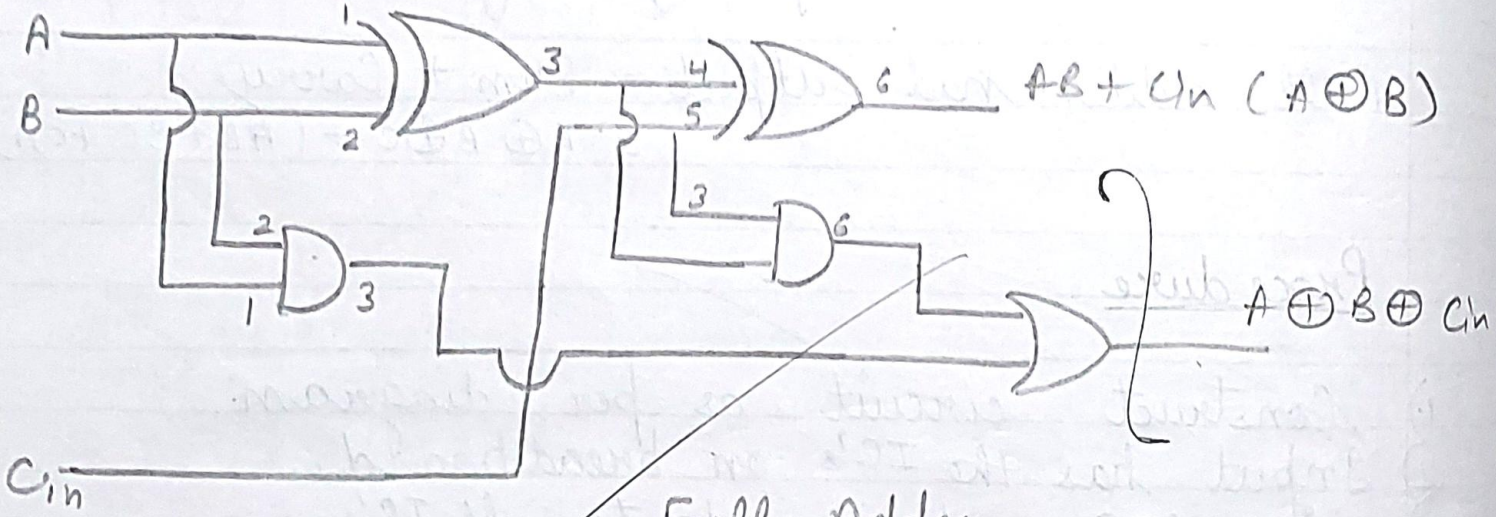
$$S = (Cin\,(\bar{x}) + \bar{C}in\,(x))$$
$$= A \oplus B \oplus Lin$$

BC in	00	01	10	11
0	0	0	1	0
1	0	1	1	0

With Poring $\longrightarrow$ $L_{out} = AB + C_{in}B + AC_{in}$

Without Poring $\longrightarrow$ $L_{out} = A\bar{B}C_{in} + \bar{A}BC_{in} + ABC_{in} + AB\bar{C}_{in}$

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



Full Adder

8

25/10/24

Experiment - 9

Object: To study the operation of a Full Subtracter.

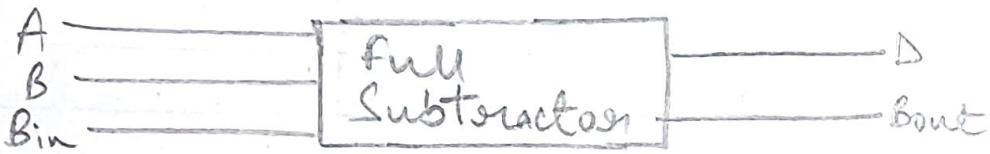
Apparatus Required: Breadboard, Connecting wires, power supply, IC-7408, IC-7432, IC-7486, IC-7464

Theory: A Full subtracter is a combinational circuit that performs the subtraction involving three bits. It has three inputs A, B & B in (borrow) & two output difference (D) and borrow out (B).

Procedure

1.) Connect the IC on bread board.
2.) Give +5V to pin no. 14 & pin no. 7 to GND.
3.) Connect input pin A, B & pin of IC from Binary switches.
4.) Switch on Power supply & change the input combination.
5.) Verify the Truth Table.

Result: The Truth Table for a Full subtractor is verified.



A	B	Bin	D	Bout
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

A \ BC	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$$D = \bar{A}\bar{B}b_{in} + AB b_{in} + A\bar{B}\bar{b}_{in} + \bar{A}B\bar{b}_{in}$$

$$= A \oplus B \oplus b_{in}$$

A \ BC	00	01	11	10
0	0	1	1	1
1	0	0	1	0

$$b_{out} = \bar{A}\bar{B}b_{in} + ABb_{in} + \bar{A}B\bar{b}_{in} + \bar{A}Bb_{in}$$

$$= \bar{A}B + b_{in}(\overline{A \oplus B})$$

Precautions:

1) Insert the IC carefully in breadboard without damaging pins.
2) Take care while supplying Voltage to IC.

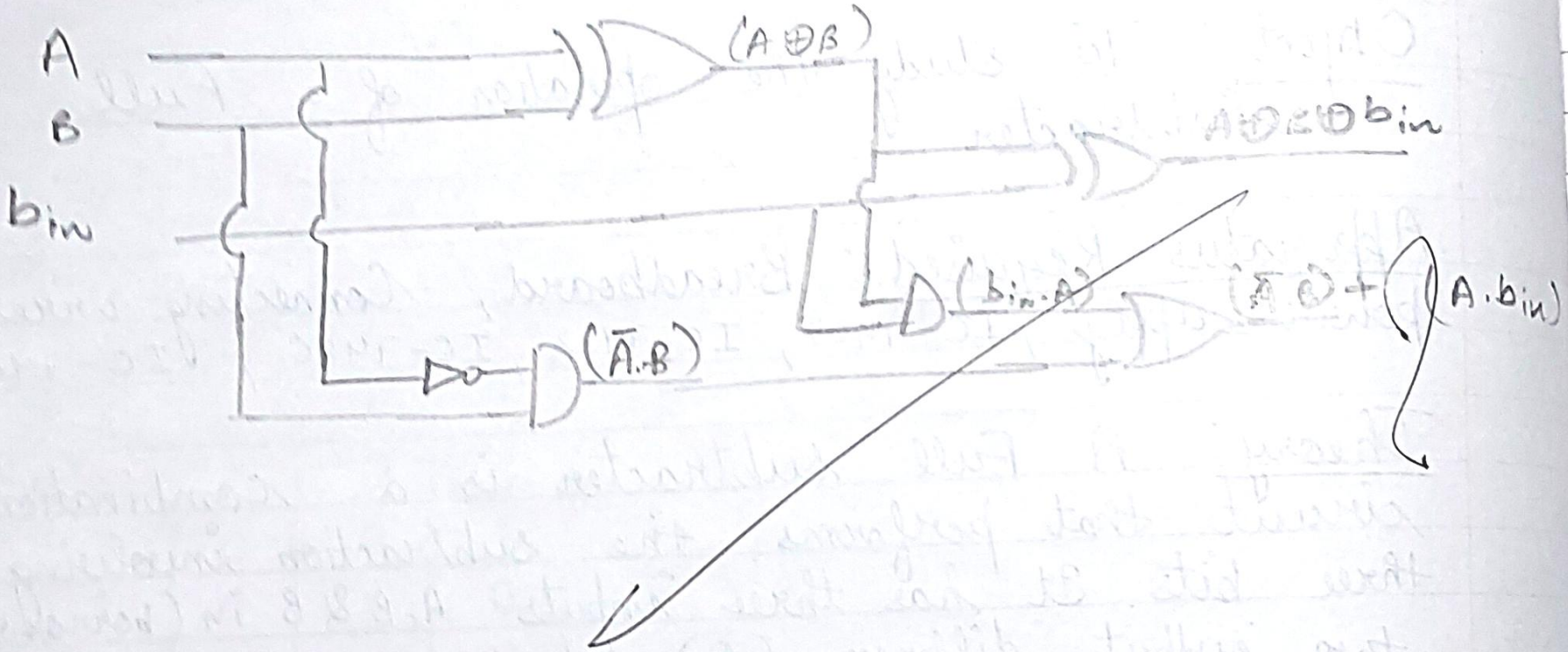
Discussion: Full subtracter is the combinational circuit that perform subtraction involving 3 bits.

Full subtractor are used in —

* Processor to complete table address, etc.
* Used in For DSPR networking board system.

6

25/10/24


A
B
bin
(A⊕B)
A⊕B⊕bin
(bin.A)
(Ā.B)
(Ā.B)+(A.bin)

Experiment - 10

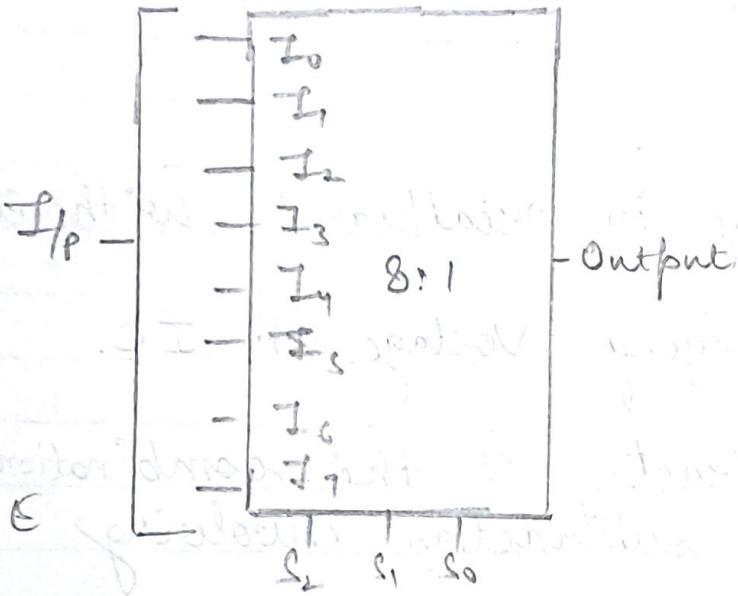
Aim: To verify the operation of Multiplexer.

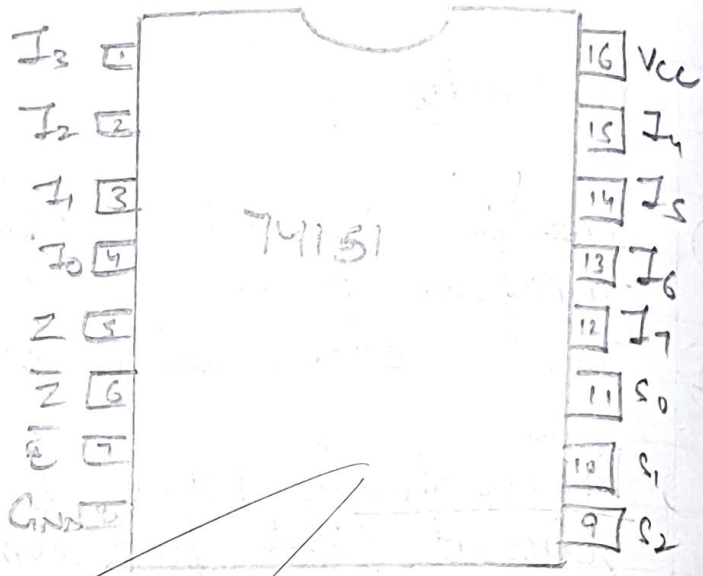
Apparatus: Bread board, connecting wires, power supply, IC-74151, 74138, LED display board, etc.

Theory: The Multiplexer is a logic circuit that gates one out of several inputs to a single output. The input selected is controlled by a set of select lines.
Demultiplexer is a logic circuit that gates one data input and distributes it over several outputs.

Procedure

1) Insert IC-74151 on the IC base of the experimental board.
2) Give +5 to pin no. 16 and ground to pin no. 8
3) Pin 7 of the 74151 is crip enable pin, which is active low i.e. the IC, will function only if pin 7 is low.
4) Pin 4, 3, 2, 1, 15, 14, 13, 12 are input to the Multiplexer pin no. 5 is the output of the multiplexer while pin no. 6 is the inverted output of pin 5. Pins 11, 10, 9 are select lines S_0, S_1, S_2 respectively.
5) Give inputs to the Multiplexer using binary data switches.





Truth Table

SELECT LINES			
MSB		LSB	OUTPUT
S_2	S_1	S_0	(u)
0	0	0	I_0
0	0	1	I_1
0	1	0	I_2
0	1	1	I_3
1	0	0	I_4
1	0	1	I_5
1	1	0	I_6
1	1	1	I_7

6.) Vary the data on the select signals on pins S_0, S_1 & S_2.

7.) Closure the output on pin 5 & note down in Truth Table.

Result: The operation of Multiplexer is verified.

25/10/24

Experiment – 11

AIM: To verify the operation of the Demultiplexer

Apparatus: Bread Board, Connecting wires, power supply (+5 volt) 74188 IC, LED display board etc.

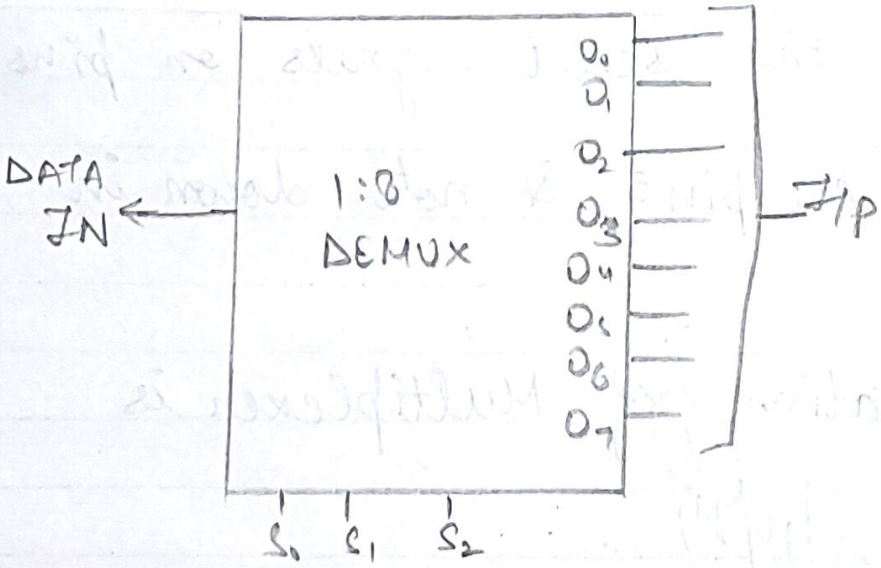
Theory: The Demultiplexer performs the reverse operation of a multiplexer. It accepts one input and steer it to one of the several outputs by means of the select lines like MUX we 1:2, 1:4, 1:8, 1:16 DEMUX. Demultiplexers are commonly called decoders eg: 1:4 ~~mux~~ mux is also called 2 line to 4 line decoders, a 1:16 Demux is called a 4 line to 16 line decoders

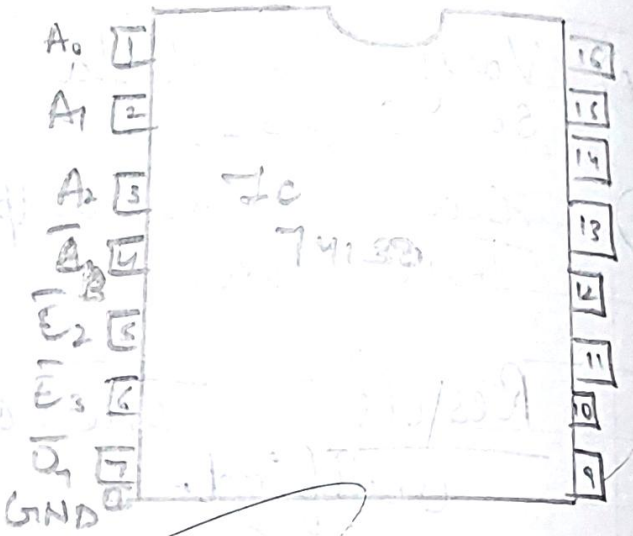
Procedure: 1) Insert IC74138 on the IC base of the experiment board.
2) Give +5V to pin no. 16 and GND to pin no. 8
3) IC has multiple enable pins (4, 5, 6). If $\overline{B_1}$ = high or E_2 = high or E_3 = low, all outputs will be high. For normal operation $E_1 = E_2$ = low and E_3 = high
4) Give inputs to Demux on pins (1, 2, 3) (A_0, A_1 (A_2)) depending upon the values of inputs, out of the 8 outputs lines are pin (15, 14, 13, 12, 11, 10, 9, 7) will be active low
5) Vary the data on select signal on pins 1, 2, 3
6) Observe the outputs on pins and note down in Truth Table.

Result: The operation of demultiplexer is verified.

9

26/9/24





Truth Table

INPUT	SELECT LINES			Output							
	MSB		LSB	O_0	O_1	O_2	O_3	O_4	O_5	O_6	O_7
	n_2	n_1	n_0								
D	0	0	0	D	1	1	1	1	1	1	1
D	0	0	1	1	D	1	1	1	1	1	1
D	0	1	0	1	1	D	1	1	1	1	1
D	0	1	1	1	1	1	D	1	1	1	1
D	1	0	0	1	1	1	1	D	1	1	1
D	1	0	1	1	1	1	1	1	D	1	1
D	1	1	0	1	1	1	1	1	1	D	1
D	1	1	1	1	1	1	1	1	1	1	D

Experiment-12

AIM: To Setup ~~rest a~~ 7 Segment static display system to display no 0 to 9

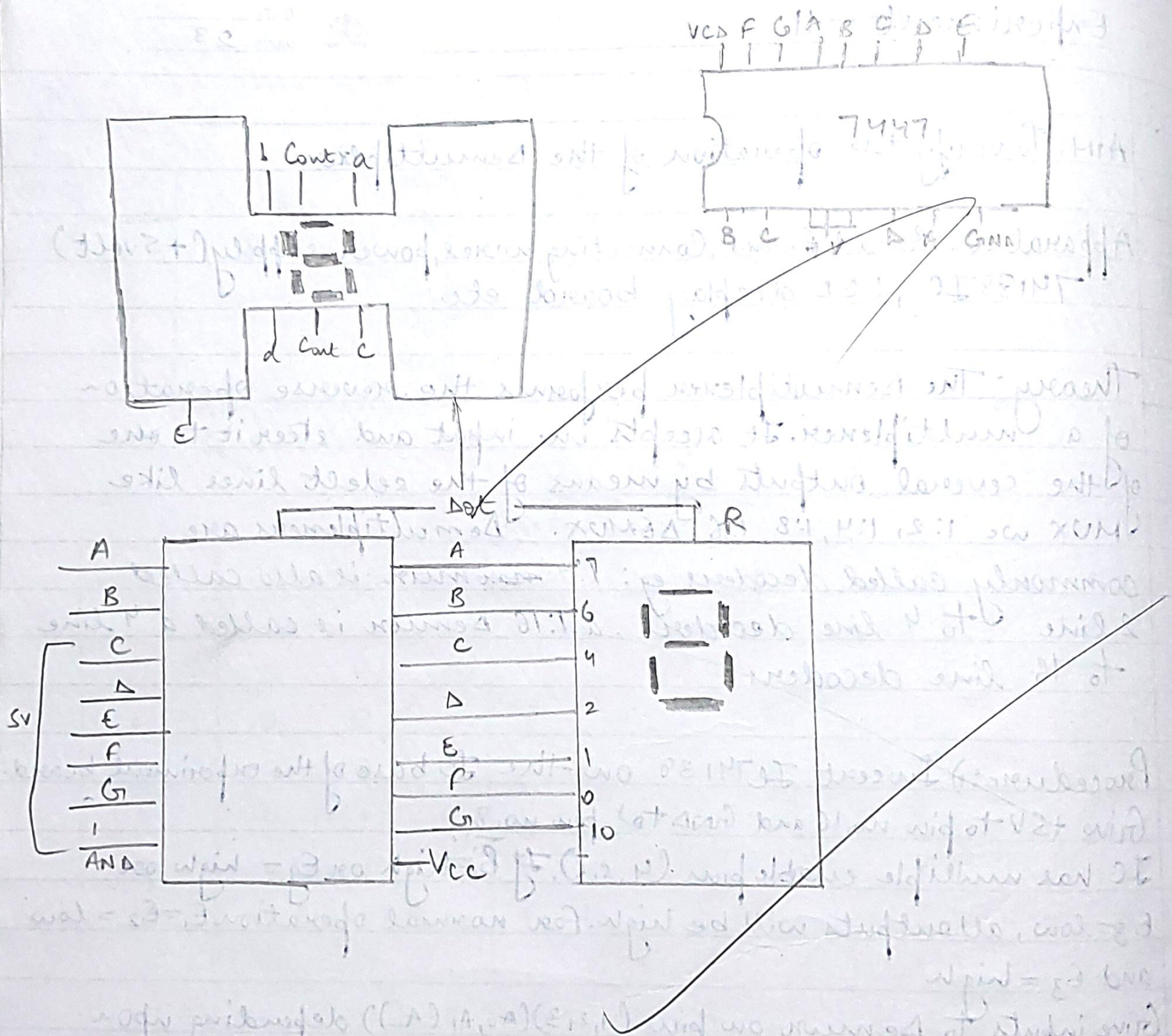
Apparatus: IC 7447, 7 Segment display (common anode) patch chards, resistors and bread board.

Theory: LEDs finds its place in many applications in these modern electronic field. One of them is seven segment display. It contains the arrangement of LEDs in eight passion and a (.) with common electrode lead (Anode and Cathode). The purpose of arranging it in that we can make any no. out of that by switching ON and OFF that particular LEDs.

Procedure: 1) Check all the components for their working.
2) Insert appropriate IC in IC base
3) Make connections as per the circuit diagram.
4) Verify the truth table.

Precautions: → Make sure the connections are tight
→ Observe the readings carefully.

25/10/23


VCD F G A B C D E
7447
B C GND
Cont a
d Cont c
E
DOC
R
A
B
C
D
E
F
G
I
5V
AND
Vcc
7
6
4
2
1
0
10

Experiment - 13

AIM: To study and verify truth table of SR flip-flop

Apparatus: Bread board, connecting wires, power supply, IC 7400

Theory: The basic NAND gate SR flip-flop circuit is used to store the data and thus provides feedback from both of its outputs again back to its inputs. The SR flip flops actually has 3 inputs, SET, RESET and clock pulse.

Procedure: 1) Connect breadboard to AC power supply
2) Construct the SR flip-flop as per logic diagram.
3) For different combination of SR, verify the truth table

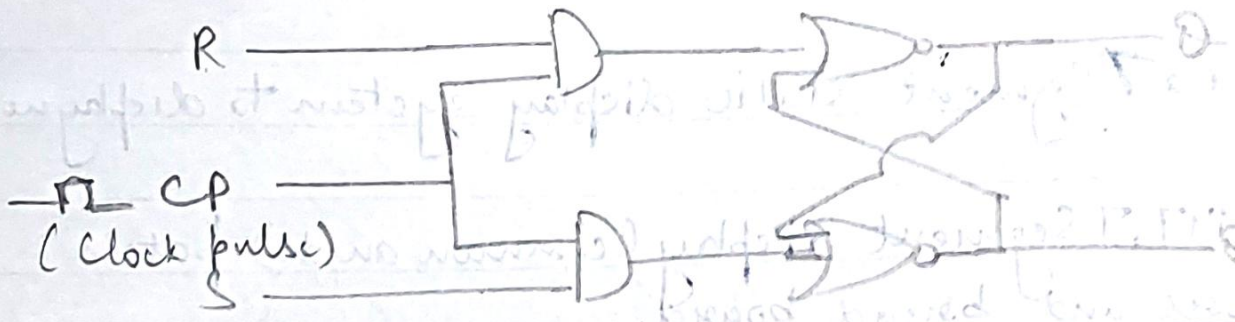
Result: The truth table of SR flip-flop has been verified.

Precaution: 1) Be careful while supplying voltage
2) Insert ICs ~~and~~ carefully without damaging pins
3) Make all connections ~~clean & tight~~

Discussion: SR flip-flop is essential for storing data in digital systems.

10

25/10/24



Ipu	Inputs		Output	State
CLK	S	R	Q	
X	0	0	No change	Previous
↑	0	1	0	Reset
↑	1	0	1	Set (·)
↑	1	1		Forbidden

AIM: To study and verify the truth table of D-flip flop.

Apparatus: Bread board, connecting wires, power supply, IC 7400, IC 7404.

Theory: A D-flip-flop has a single data input. This type of flip flop obtained from the SR flip flop by connecting the R input through an inverter and the S input is connected directly to data input. The modified clocked SR flip-flop is known as D-flip-flop and is shown. From the truth table of SR flip flop we see that the ~~the~~ output of the SR flip flop is in unpredictable state when inputs are same and high. In many practical applications, these inputs condition are not required. These input conditions can be avoided by making them component of each other.

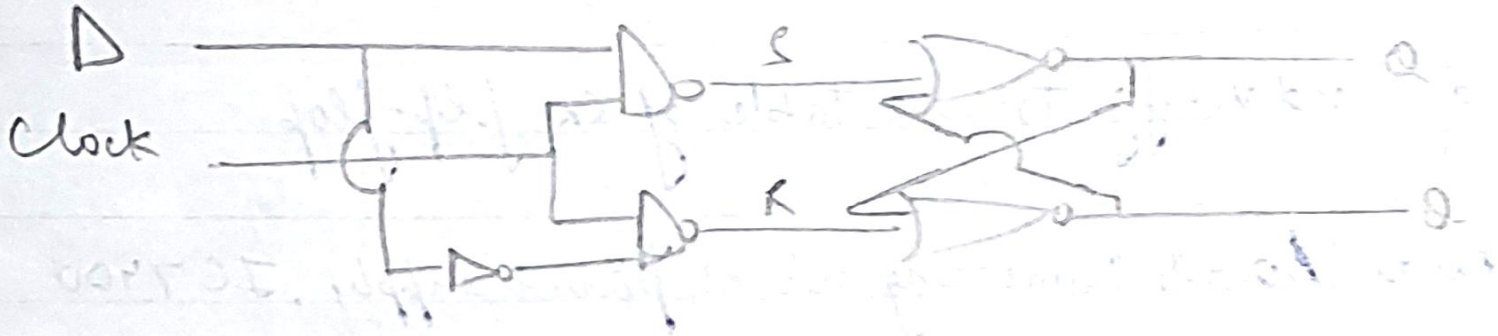
Procedure: 1) Connect bread board to AC power supply.
2) Construct D-flip flop as per logic diagram.
3) For different values of D, verify the truth table

Results: The truth table of D-flip-flop has been verified.

Precautions:
1) Be careful while supplying voltages
2) Insert ICs carefully without damaging pins.
3) Make all connection clean and tight.

10

25/10/24



Input			Output	
D	reset	clock	Q	Q'
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	0	1

Experiment - 15

AIM: To study and verify the truth table of JK flip-flop

APPARATUS: Breadboard, display board, connecting wires, power supply, basic gates etc.

THEORY: In a RS flip-flop the input R=S=1 leads to indeterminate output. The RS flip-flop circuit may be refined if both inputs are 1 than about the outputs are complement each other as shown in characteristic table.

PROCEDURE:
1) Insert ICs & give input & output to various pins
2) Give good power supply and switch on power supply.
3) Take output and verify them with truth table.

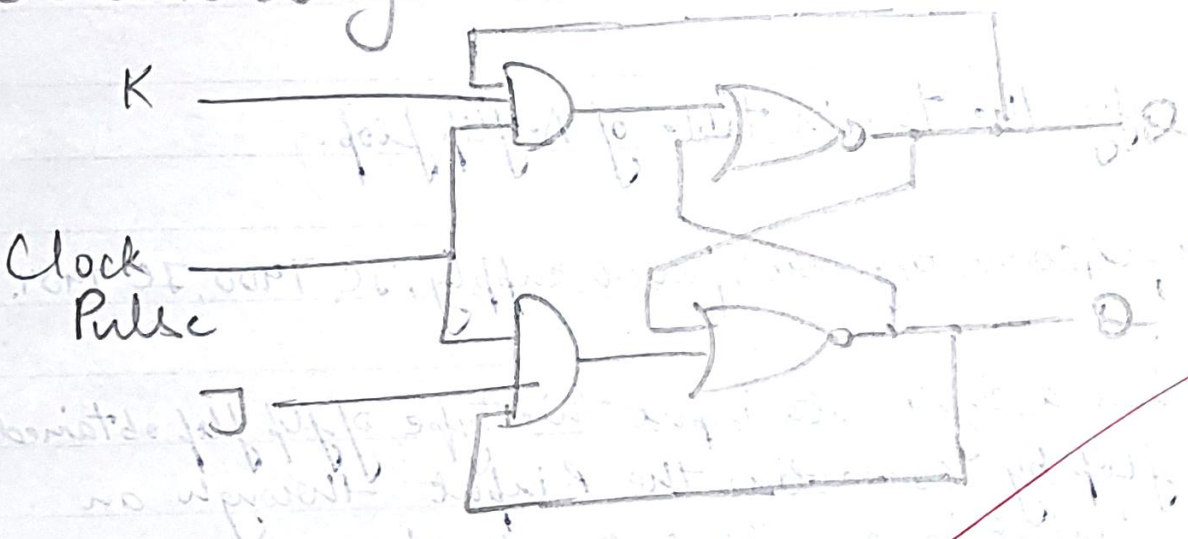
RESULT: The truth table of JK flip-flop has been verified

PRECAUTIONS: 1) Make all connections clean & tight
2) Insert ICs carefully without damaging pins

DISCUSSION: The JK flip-flop is used in place of SR flip-flop to avoid the illogical condition present in the latter flip flop.

08/11

Circuit diagram



Characteristic Table

Trigger CLK	Inputs J	Inputs K	Output: Present state Q	Output: Present state Q'	Output: Next state Q	Output: Next state Q'	Inference
↓	X	X	—		—		Latched
↑	0	0	0	1	0	1	No change
↑			1	0	1	0	
↑	0	1	0	1	0	1	Reset
↑			1	0	0	1	
↑	1	0	0	1	1	0	Set
↑			1	0	1	0	
↑	1	1	0	1	1	0	Toggles
↑			1	0	0	1	

Experiment - 16

AIM: To study and verify the truth table of T-flip-flop

APPARATUS: Breadboard, display board, connecting wires, power supply, basic gates, ICs.

THEORY: T-flip-flop is known as toggle flip-flop. The T-flipflop is modification of JK flip flop. Both JK inputs of the JK flip-flops are held at logic 1 and the clock signal continues to change as shown in table.

PROCEDURE:
1) Insert ICs ~~and in their~~ respective positions and give inputs output connections to various pins.
2) Give ground and power supply. Switch ON the power supply.
3) Take output and verify the truth table.

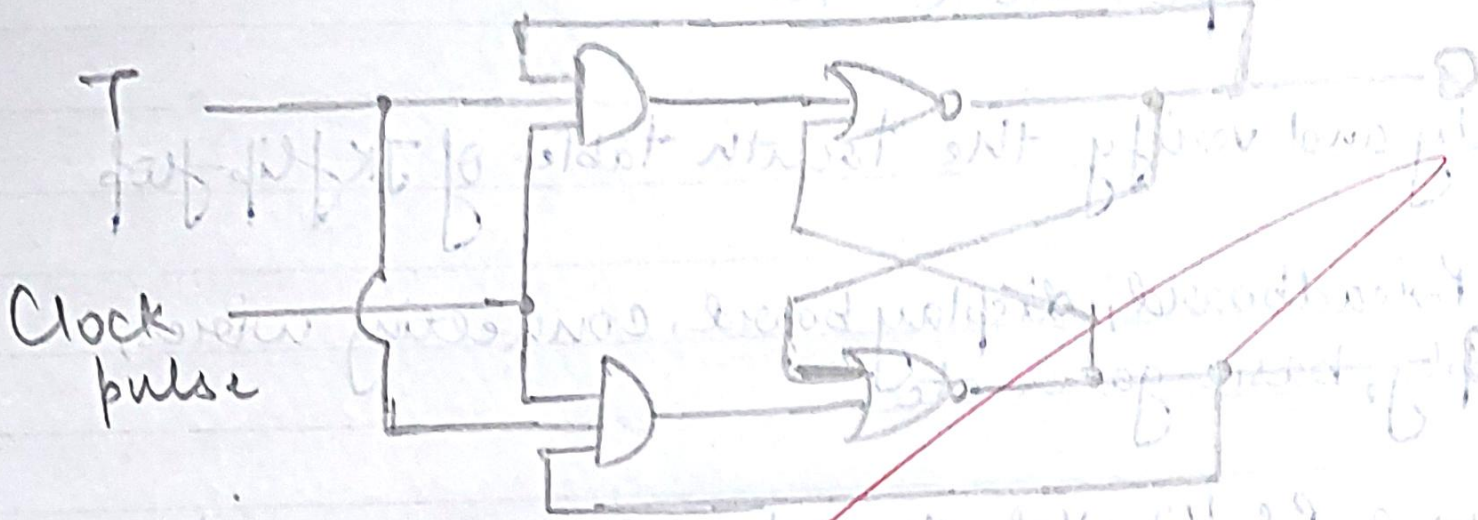
RESULT: The truth table of T-flip-flop has been verified.

PRECAUTIONS: ~~The truth~~
1) Make all connections tight and clean
2) Insert the carefully in breadboard without damaging the pins
3) Be careful while supplying voltage.

DISCUSSION: T-flip-flop is used for toggling operations in famile state machines.

08/11/24

Circuit Diagram



Characteristic Table

T	Clock	Q	Q'
0	↑	Q	Q'
1	↑	Q'	Q
X	↓	Q	Q'