PIONEER

Topic:

Procedure: 1) First we open the circuit maker application in our device.

2) Then we click on the device option on the upper menu-bar and then click on browse. We search digital basics option to get the desired logic gates required, i.e., here we need 2 XOR gate, 2 AND gate, 2 NOT gate and 1 OR gate.

3) For input, we browse for switches in the device option and copy as many switches we need here.

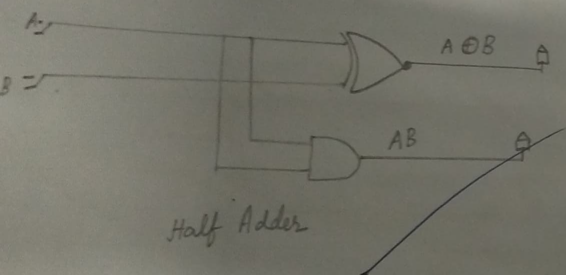
4) For output, we browse the logic display option and place the LEDs on our screen

5) Then we connect all the gates with switches and LED with the help of ⊕ button to see the circuit.

6) Lastly, we click on the run button to see the circuit running and verify our truth table.

Conclusion: This experiment includes the design and implementation of half and full subtractor and also full subtractor using half subtractors. This experiment enhanced our knowledge of circuit design and to perform arithmatic operation

19/8/23



Experiment-4

Topic: Design a half adder, full adder and also full adder using 2 half adder using circuit maker (V6).

Half Adder:

Theory: Half adder is a combinational logic circuit that is designed to add two binary digits. The half adder provides the output along with a carry (if any). The half adder circuit can be designed by connecting an XOR gate and one AND gate. It has two input terminals and two output terminals for sum (S) and carry (C).

The output of the XOR gate is the sum of two bits and the output of the AND gate is carry bit.

Truth Table:

Inputs		Outputs	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Sum = $A \oplus B$

Carry = $A.B$

Procedure: i) First we open the circuit maker application in your device.

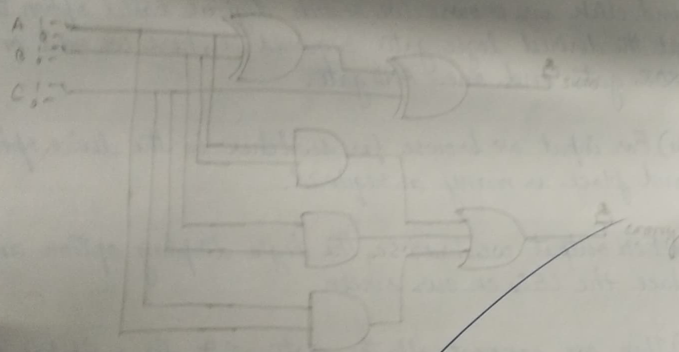
ii) Then click on the device option on the upper menu bar and click on browse. We search digital basics option to get the desired logic gates required, i.e., here we need one XOR gate and one AND gate.

iii) For input we browse for switches in the device option and place as many as required.

iv) For output we browse the logic display option and place the LEDs on our screen.

v) Then we connect all the gate with the switches and LED with the help of ⊕ button to see the complete circuit.

vi) Lastly, we click on the run button to see the circuit working and then verify the truth table.



Full Adder

Full Adder:

Theory: It is a combinational logic circuit that can add two binary digits (bits) and a carry bit and produces a sum bit and carry bit each.

The full adder consists of one XOR gate, three AND gates and one OR gate.

Truth Table

Inputs			Outputs	
A	B	C	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

Sum = $A \oplus B \oplus C$

Carry = $AB + BC + AC$

Procedure: i) First we open the circuit maker application in your device.

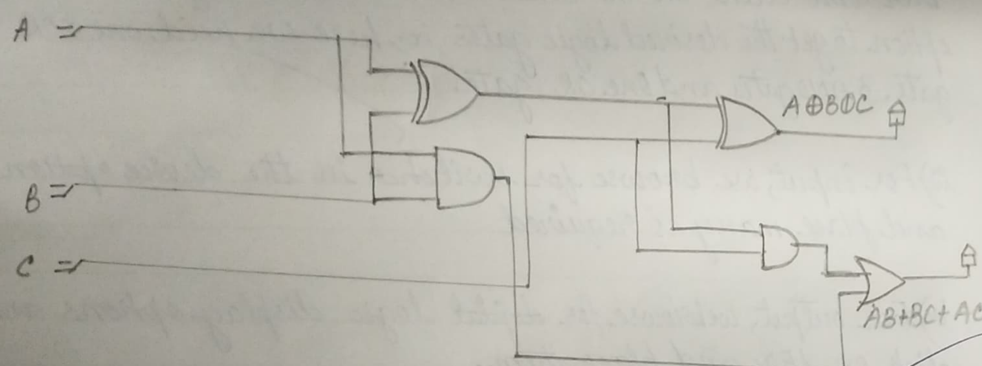
ii) Then we click on the device option on the upper menu bar and click on the browse. We search digital basics option to get the desired logic gates, i.e., here we need one XOR gate, 3 AND gates and one OR gate.

iii) For input, we browse for switches in the device option and place many as required

iv) For output, we browse for ~~digital~~ logic display options and click on LEDs and place them.

v) Then we connect all the gates with the switches and LED with the help of ⊕ button to see the complete circuit.

vi) Lastly, we click on the run button to see the circuit working and then verify the truth table.



Full Adder using 2 half Adder

Full Adder using 2 Half Adders:

Theory: To build a full adder, you need two half adders. One half adder is used to add the two inputs bits (A and B) while the other half adder combines the sum output of first half adder with the third input to produce the final sum output and Carry Output

This way we can create a full adder by cascading 2 half adders.

Using half adders to construct full adder provides not only modularity but also reusability. A half adder is a basic block that adds two input bits. By combining multiple half adders, you can construct larger adders with ease. This approach simplifies the design of the circuit.

Procedure: i) First we open the circuit maker application in our device.

ii) Then we click on the device option on the upper menu bar and click on browse, ~~&~~ search digital basics option to get the desired logic gates, i.e., here we need 2 XOR gate 2AND gate and 1OR gate.

iii) For input, we browse for switches in the device option and place as many required

iv) For output, we browse the logic display option and place the LEDs on our screen.

v) Then we connect all the gate with the switches and LED which with the help of ⊕ button is joined, to see the complete circuit.

vi) Lastly, we click on the run button to see the circuit working and then verify the truth table.

Conclusion: This experiment includes the design and imple-mentation of half adder, full adder, and also full adder using half adders.

This experiment enhanced our knowledge of circuit design and to perform arithmatic operation.

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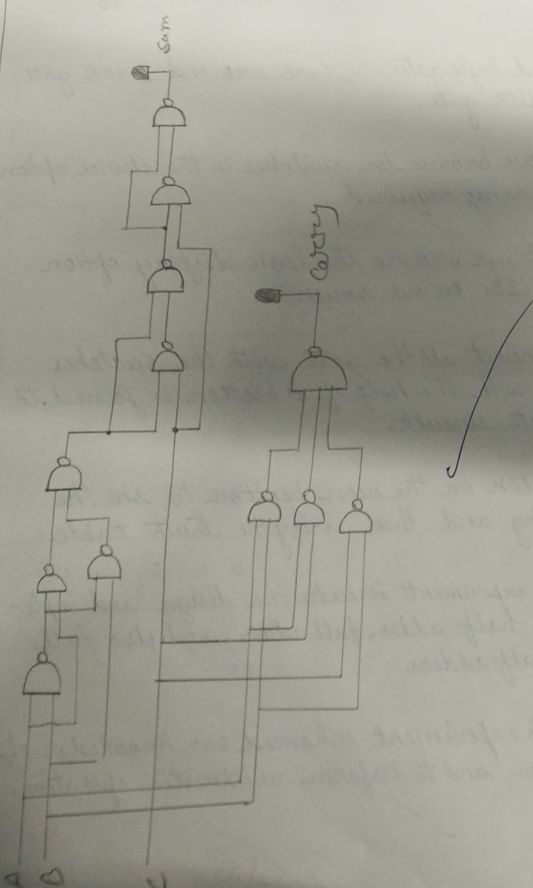


Full adder using only NAND gates

Experiment-5

Topic: Design a full adder using only NAND gates.

Theory: Full Adder is a combinational Logic Circuit which performs binary addition on three binary bits.

NAND gates are universal gates as any logic system can be implemented using these two gate. The full adder circuit can also be implemented using NAND gates and sum (S) and Carry (C) function is:

$S = (A\oplus B)\cdot\overline{(A\oplus B)C}\cdot C\cdot\overline{(A\oplus B)C}$

$C = \overline{\overline{C\cdot(A\oplus B)}\cdot\overline{AB}} = AB + (A\oplus B)C = AB + BC + AC$

Truth Table of Full Adder:

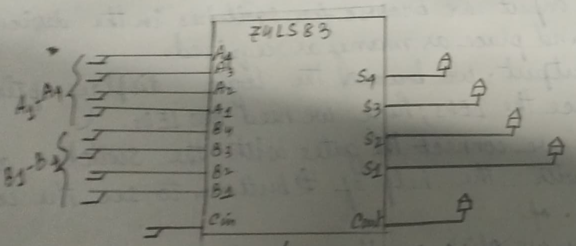
A	B	C	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Topic:

Procedure:- i) Open Circuit maker and create a new project
ii) Then click on the device option on the upper menu bar and click on browse. We search digital basics option to get the desired logic gates required, i.e., here we need only ~~nor~~ NAND gates.
iii) For input we browse for switches in the device option and place as many as required.
iv) For output, we browse the logic display option and place the LEDs; here we need two LEDs.
v) Then we connect the gates with the switches and LEDs with the help of ⊕ button to see the complete circuit.
vi) Lastly, we click on the run button to see the circuit working and then verify our truth table.

Conclusion: Here, we get to learn about the working of the full adder which is made using only NAND gates and also its repective circuit diagram.

09/09/23



4-bit parallal Adder

Experiment-6

Topic: Design a 4-bit parallel adder using circuit maker V6.

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Theory: A 4-bit parallel adder is a digital circuit that can add two 4 bit binary numbers in parallel. It consists of 4 full-adder circuits, each responsible for adding one bit of the numbers. The carry-out from one full adder is connected to the carry-in bit of the next. The common 4-bit parrallel adder IC is 74LS83 which combines full-adder circuits into a single package

Using Input: $A_4A_3A_2A_1$ = 1101 , $B_4B_3B_2B_1$ = 1011

C_{in} is always initialised 0.

Calculations

c=1 c=1 c=1

		1	1	0	1 ← (C_{in}=0)
		1	0	1	1
(C_{out}=1)	1	1	0	0	0
		S_4	S_3	S_2	S_1

Truth Table :

Input (A)	Input (B)	Output(s)	Carry
$A_4 = 1$	$B_4 = 1$	$S_4 = 1$	$C_{out} = 1$
$A_3 = 1$	$B_3 = 0$	$S_3 = 0$	$C_3 = 1$
$A_2 = 0$	$B_2 = 1$	$S_2 = 0$	$C_2 = 1$
$A_1 = 1$	$B_1 = 1$	$S_1 = 0$	$C_1 = 1$
			$C_{in} = 0$

Procedure : i) Firstly we open the circuit maker (v6) application in our device.

ii) Then we go on menu and then click on device option and then find the 4-bit parallel adder whose common ic is 74LS83 and place it on our screen

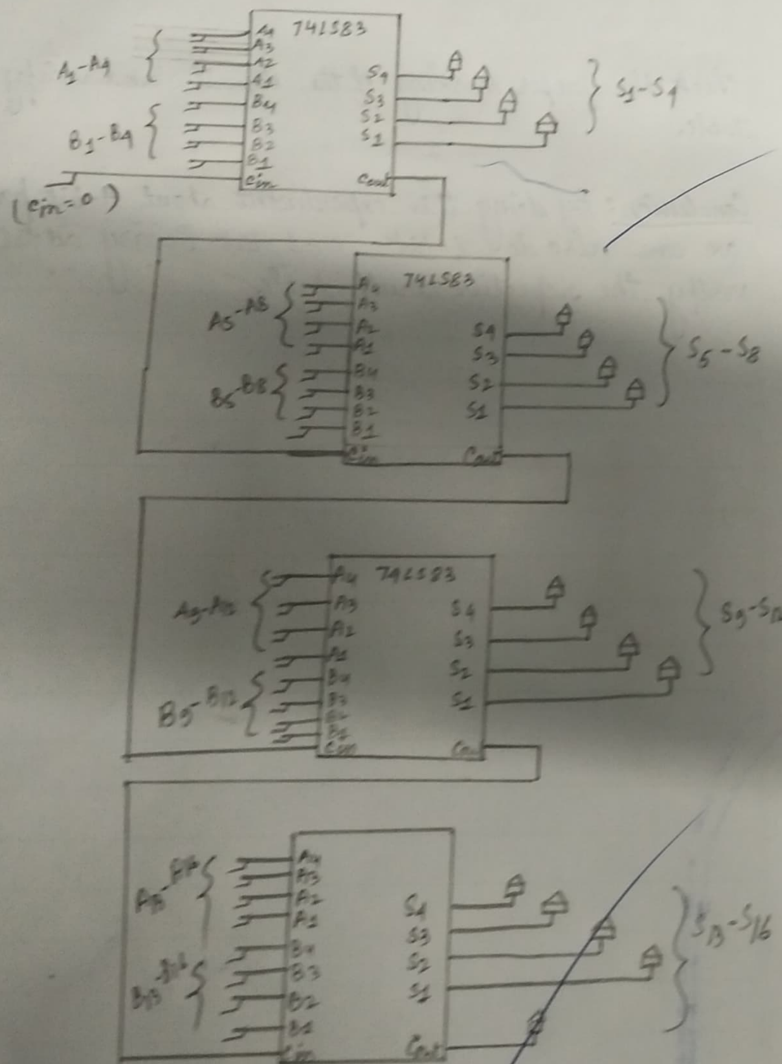
iii) For inputs, we go to browse option and then select 9 switches for input A, input B and one carry input.

iv) For outputs, we go to display logics option and then there we need 5 LEDs → 4 Sum output and 1 for Cout.

v) Then we connect all the switches and LEDs to the ic of 4-bit parallel adder and click on run to

Check the proper working of the circuit and verify the Truth Table.

Conclusion: By doing this experiment about 4-bit parallel adder we can also do 2 bit or 1 bit Binary addition and verify the respective truth table.



16 bit parallel adder using 4 4-bit parallel adder

Experiment-7

Topic: Design a 16-bit parallel adder using circuit maker (v6)

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Theory: A 16-bit parallel adder is a circuit that can add two 16-bit binary numbers together. It does this by performing binary addition on each pairs of corresponding bits and propagating any carry generated from one bit to another bit. A 16 bit parallel adder is made here using 4. 4-bit parallel adder.

Using Inputs:

A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
B_{16}	B_{15}	B_{14}	B_{13}	B_{12}	B_{11}	B_{10}	B_9	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1
1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
S_{16}	S_{15}	S_{14}	S_{13}	S_{12}	S_{11}	S_{10}	S_9	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1

Truth Table

Input (A)	Input (B)	Output (S)	Carry
$A_{16}=0$	$B_{16}=1$	$S_{16}=1$	$C_{out}=0$
$A_{15}=0$	$B_{15}=0$	$S_{15}=0$	C_{15} 0
$A_{14}=0$	$B_{14}=0$	$S_{14}=0$	$C_{14}=0$
$A_{13}=0$	$B_{13}=0$	$S_{13}=0$	$C_{13}=0$
$A_{12}=0$	$B_{12}=0$	$S_{12}=0$	$C_{12}=0$
$A_{11}=0$	$B_{11}=0$	$S_{11}=0$	$C_{11}=0$

$A_{10} = 0$	$B_{10} = 0$	$S_{10} = 0$	$C_{10} = 0$
$A_9 = 0$	$B_9 = 0$	$S_9 = 0$	$C_9 = 0$
$A_8 = 0$	$B_8 = 0$	$S_8 = 0$	$C_8 = 0$
$A_7 = 0$	$B_7 = 0$	$S_7 = 0$	$C_7 = 0$
$A_6 = 0$	$B_6 = 0$	$S_6 = 0$	$C_6 = 0$
$A_5 = 0$	$B_5 = 0$	$S_5 = 0$	$C_5 = 0$
$A_4 = 0$	$B_4 = 0$	$S_4 = 1$	$C_4 = 0$
$A_3 = 0$	$B_3 = 1$	$S_3 = 0$	$C_3 = 1$
$A_2 = 1$	$B_2 = 0$	$S_2 = 0$	$C_2 = 1$
$A_1 = 1$	$B_1 = 1$	$S_1 = 0$	$C_1 = 1$

$\boxed{C_{in} = 0}$

Procedure: i) Firstly we need to open the circuit maker (v6). on the device.

ii) For inputs, we go to the device option and then browse the switches and take 33 switches → 32 for inputs and 1 for Carry input.

iii) We take 4 4 bit parallal adders from the find option and putting the IC no. – 74LS83.

iv) For outputs, we go to the Logic display button and take 17 LEDs → 16 for Sum output and 1 for Cout.

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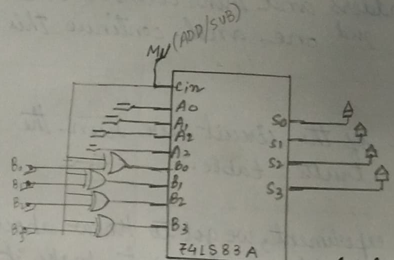
v) Then we connect all the ~~circuit~~ switches and LEDs to the 4 bit adders like → ~~8~~ 4 bit of input A and input B each to each of the 4 adders and then connect one c-out to the cin of the 2nd one and continue this chain process.

vi) After the completion of the circuit we run the circuit and check the truth table.

<u>Conclusion</u>: By doing this experiment, we got to know about the working of 16 bit-parallel adder and how to make it with the help of four 4-bit parallel adder.

16/9/23



4 bit binary
Adder Substractor

Experimental Result

INPUT										OUTPUT				
M	Cin	A_0	A_1	A_2	A_3	B_0	B_1	B_2	B_3	Cout	S_0	S_1	S_2	S_3
0	0	1	0	1	1	1	1	0	1	1	0	0	0	1
1	1	1	0	1	1	1	1	0	1	1	0	1	0	0

Experiment-8

Topic: Design an Adder Substractor Composite unit and verify addition and subbtraction.

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4-Bit Binary Adder-Substractor

Theory: In Digital Circuits, A Binary-Adder-Substractor is capable of both the addition and substraction of binary numbers in one circuit itself. The operation is performed by depending on the binary value of the controlled signal holds. It is one of the components of the ALU.

Let consider two 4-bit Binary numbers A and B as inputs to the digital circuit.

A_0 A_1 A_2 A_3 for A
B_0 B_1 B_2 B_3 for B

The circuit consists of 4-full adders. Since, we are performing operations on 4-bit numbers.
The Mode (M) input controls the operations of the circuit.

Conditions for Working:

1) When M = 0, circuit becomes an adder and operates (A+B)
2) When M = 1, circuit becomes a substractor and operates (A-B)

Topic :

Procedure:

i) Firstly, we need to open the circuit maker (v6) in our device.

ii) For inputs, we go to the device option and then browse the switches option and place it on screen

iii) Then we need the 4 bit adder substractor, i.e., IC - 74LS83. which has ~~8 8 2 bit 4 inputs and~~ A_0, A_1, A_2, A_3, B_0, B_1, B_2, B_3 as inputs and Cin is connected to node (switch).

iv) For output, we go to logic display option and take the LEDs as our display and place it on screen

v) After this we connect all the switches and LEDs and join them to the IC.

vi) Then we run our circuit and verify our desired results.

Conclusion: In this experiment, we design 4-bit adder substractor and get to know about how its works and gather knowledge. We also checked and verify our results.

Experiment - 9

Topic: Design a full Adder using Decoder (IC - 74LS139) by Circuit maker.

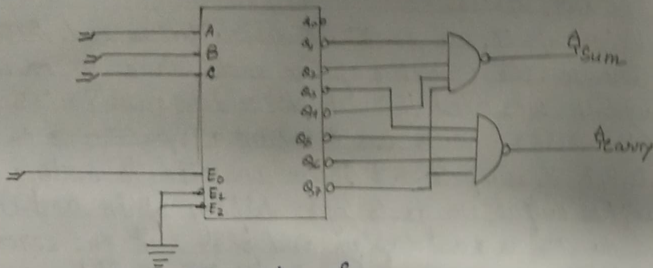
Decoder: A decoder is a combinational circuits that converts binary information from n input lines to a maximum of 2^n lines.

Truth Table:

Input			Output:							
A	B	C	Q_0	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Procedure: We can design a full adder using decoder (3:8 decoder). As 74LS139 is a active low decoder, so we need Nand gates for full adder circuits.

i) Firstly, we need to open the circuit maker(v6) on our device.



Full adder using IC-74LS138 chip

$Sum = \Sigma(1,2,4,7)$

$Carry = \Sigma(3,5,6,7)$

Truth Table of Full Adder:

INPUT			OUTPUT	
A	B	C	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

ii) For inputs, we go to the device option and then browse the switches. ~~and~~ &

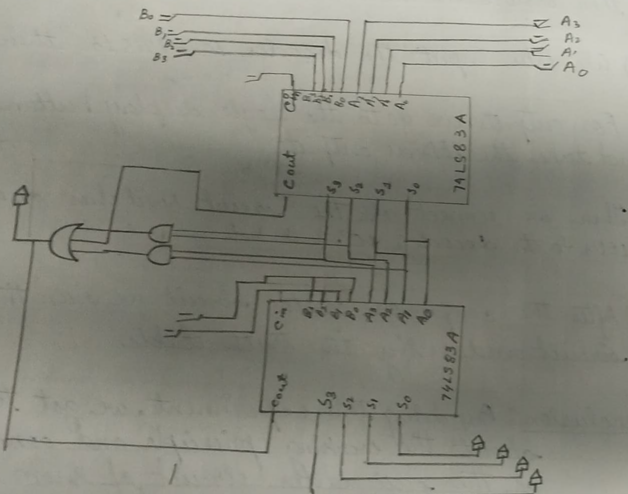
iii) We take input the decoder IC -74LS13 then

iv) For outputs, we go to the logic display button and take the LEDs as outputs

v) Then we connect all the circuit switches and LEDs to the decoder IC.

vi) After the completion of the circuit we run the circuit and verify the truth table.

Conclusion: By doing this experiment, we got to know about the working principle and connection of the full adder circuit of sum and carry.



BCD Adder

Experiment - 10
Topic: Design a BCD adder using circuit maker (V6).

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BCD Adder

BCD stands for binary coded decimal. It is used to perform the addition of BCD numbers. A BCD digit can have any of ten possible four-bit representations. Computers to Calculators which carry out the arithmetic operations directly in the decimal number system represent the numbers in BCD form.

Suppose, we have two 4-bit numbers A and B. The value of A and B can vary from 0(0000) to 9 (1001) because we are considering decimal numbers.
The output will vary from 0 to 18 if we are not considering from the previous sum. But if we are considering the carry, then the maximum value of the output will be 19(1+9+9). When we simply adding A and B, then we get the binary sum.

Example:

Input:
A = 0111 B = 1000
Output: Y = 10101

Explanation: We are adding A(7) and B(8). The value of binary sum will be 1111 (15) But the BCD sum will be 10101, where

Decimal	Binary Sum					BCD Sum				
	C'	S_3'	S_2'	S_1'	S_0'	C	S_3	S_2	S_1	S_0
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	1
2	0	0	0	1	0	0	0	0	1	0
3	0	0	0	1	1	0	0	0	1	1
4	0	0	1	0	0	0	0	1	0	0
5	0	0	1	0	1	0	0	1	0	1
6	0	0	1	1	0	0	0	1	1	0
7	0	0	1	1	1	0	0	1	1	1
8	0	1	0	0	0	0	1	0	0	0
9	0	1	0	0	1	0	1	0	0	1
10	0	1	0	1	0	1	0	0	1	0
11	0	1	0	1	1	1	0	0	1	1
12	0	1	1	0	0	1	0	1	0	0
13	0	1	1	0	1	1	0	1	0	1
14	0	1	1	1	0	1	0	1	1	0
15	0	1	1	1	1	1	0	1	1	1
16	1	0	0	0	0	1	0	0	0	0
17	1	0	0	0	1	1	0	0	0	1
18	1	0	0	1	0	1	1	0	1	0
19	1	0	0	1	1	1	1	0	1	1

Topic :

1 is 0001 and 5 is 0101 in binary respectively

Procedure:

i) Firstly, we need to open the circuit maker (v6) on the device.

ii) For inputs, we go to the device option and then browse the switches and get your desired ones.

iii) Then We take the 4-bit parallel adder from the find option and putting the IC No- 74LS83.

iv) For outputs, we go to the logic display button and take the LEDs as much as required.

v) Then we connect all the switches and LEDs ~~as~~ to the adder and continue the chain process.

vi) After completing the circuit we run it and verify our results.

~~Procedure~~ **Conclusion**: By doing this experiment, we get to know about the concept of BCD adder. If the sum of two nos is less than or equal to 9, then the value of BCD sum is same as the binary sum otherwise, they will differ by 6 (0110 in binary)