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Exp:5 (LO(A)

Aim: Design of Adder and Subtractor

Components:- IC7408, IC 7486, IC 7404, IC 7432, Breadboard, Leds

Theory:-

1 Half Adder

A half adder has two inputs for the two bits to be added and two outputs one from the sum 'S' and other carry 'C' into the higher adder position.

Truth table:

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Kmap for sum:

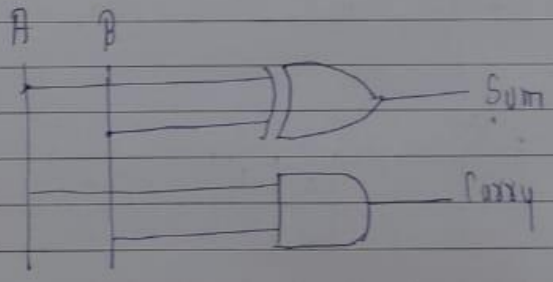
A \ B	0	1
0	0	1
1	1	0

Kmap for carry

A \ B	0	1
0	0	0
1	0	1

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

Logic Diagram:-



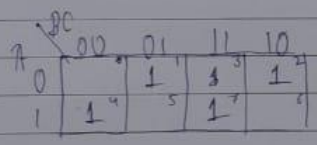
2 Full Adder

A full adder is a combinational circuit that forms the arithematic sum of input; it consists of three inputs and two outputs.

Truth Table :

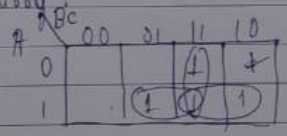
A	B	C_{in}	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Kmap for Sum :-



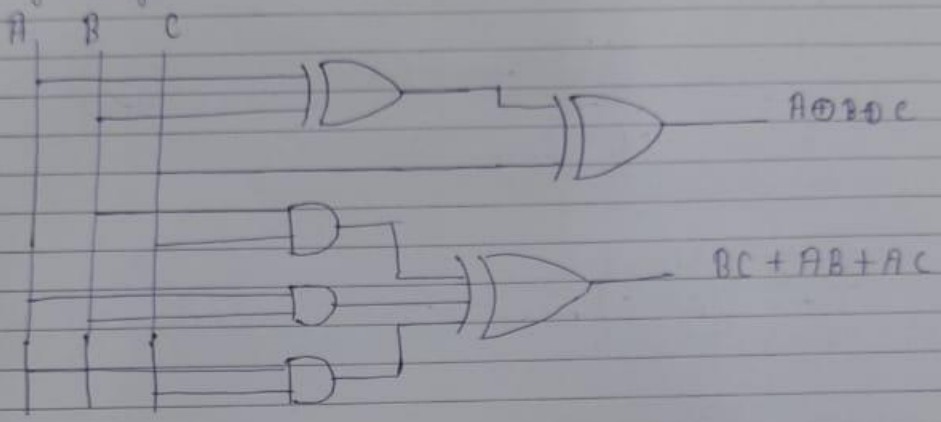
$S = A \oplus B \oplus C$

Kmap for Carry :



$C = BC + CA + AB$

Logic Diagram:



3 Half Subtractor

The half subtractor is constructed using X-OR and AND Gate.

Truth Table:

A	B	Borrow	diff
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

kmap for borrow:

A \ B	0	1
0	0	1
1	0	0

$B = \bar{A}B$

kmap for diff:

A \ B	0	1
0	0	1
1	1	0

$D = A \oplus B$

Logic Diagram:

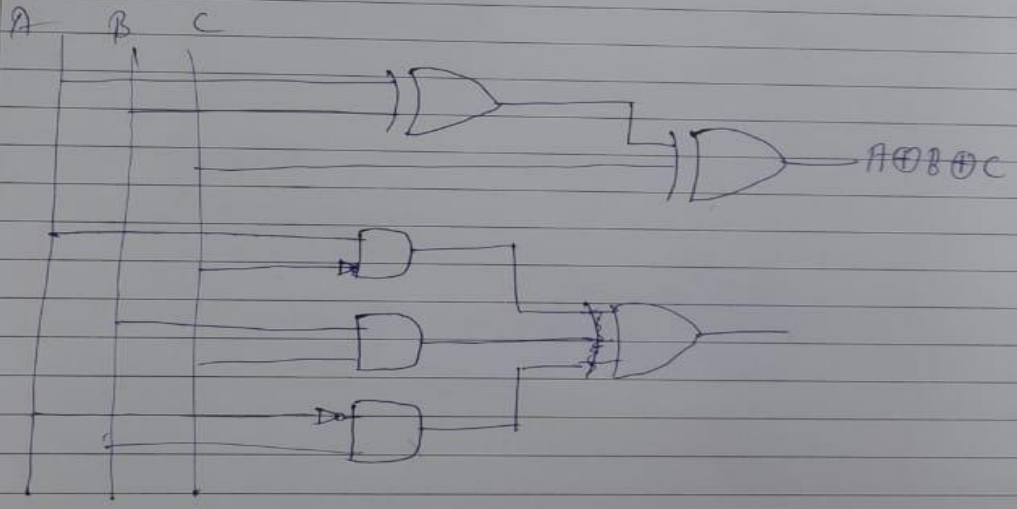
A B C

Kmap for borrow:

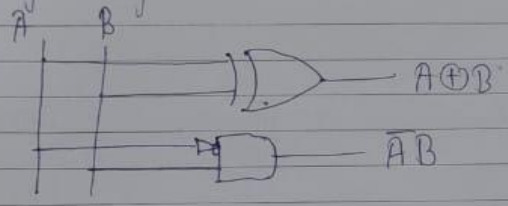
A \ BC	00	01	11	10
0		1	1	1
1			1	

$B = \overline{A}C + BC + \overline{A}B$

Logic Diagram:



Logic Diagram:



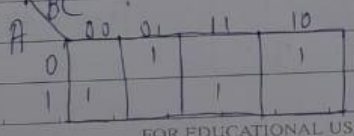
4 Full Subtractor

The full subtractor is a combination of X-OR, AND OR, NOT Gates.

Truth Table :-

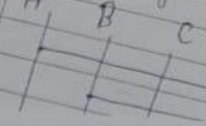
A	B	C	Diff	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Kmap for diff :

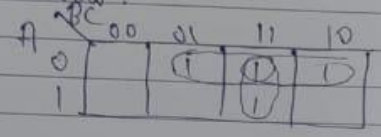


$D = A \oplus B \oplus C$

Logic Diagram:

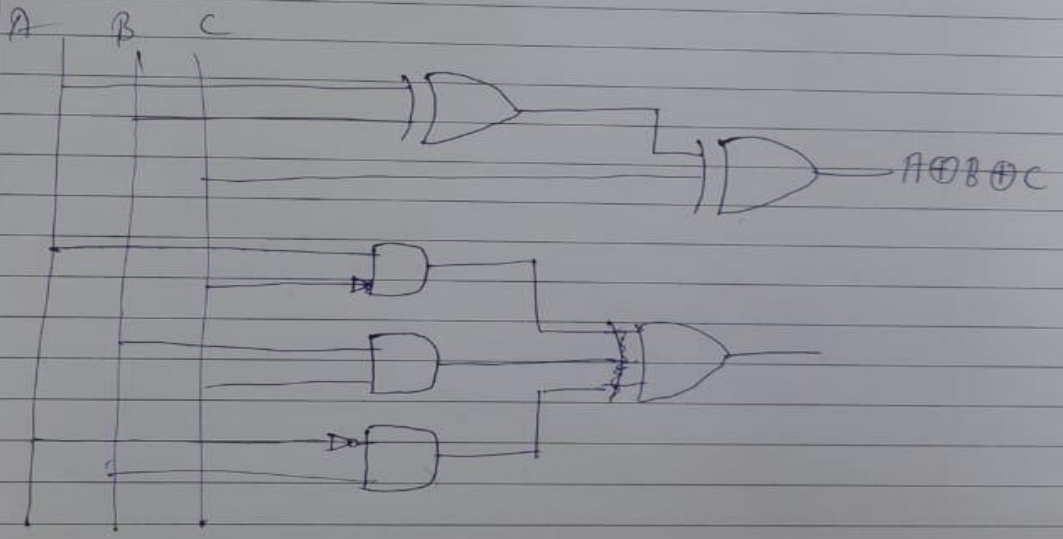


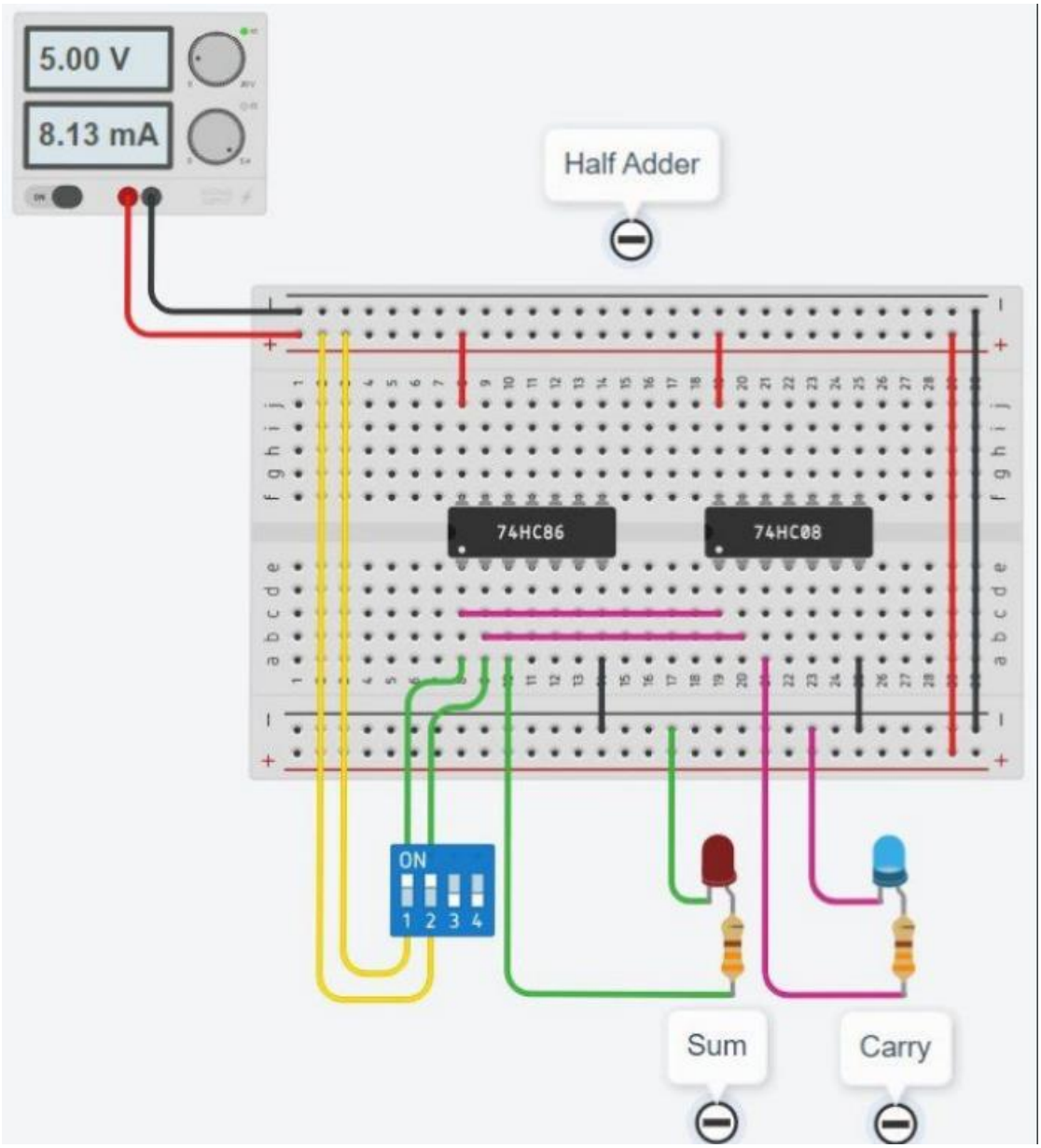
Kmap for borrow:

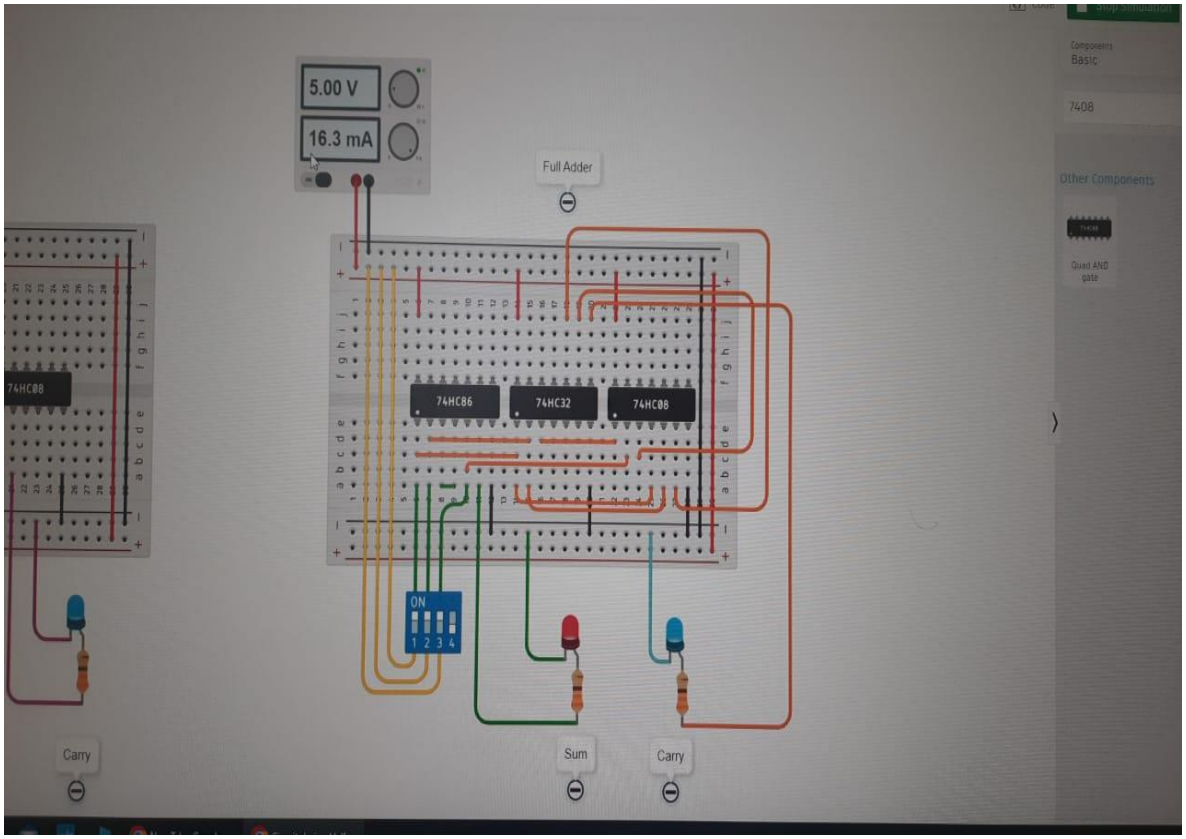


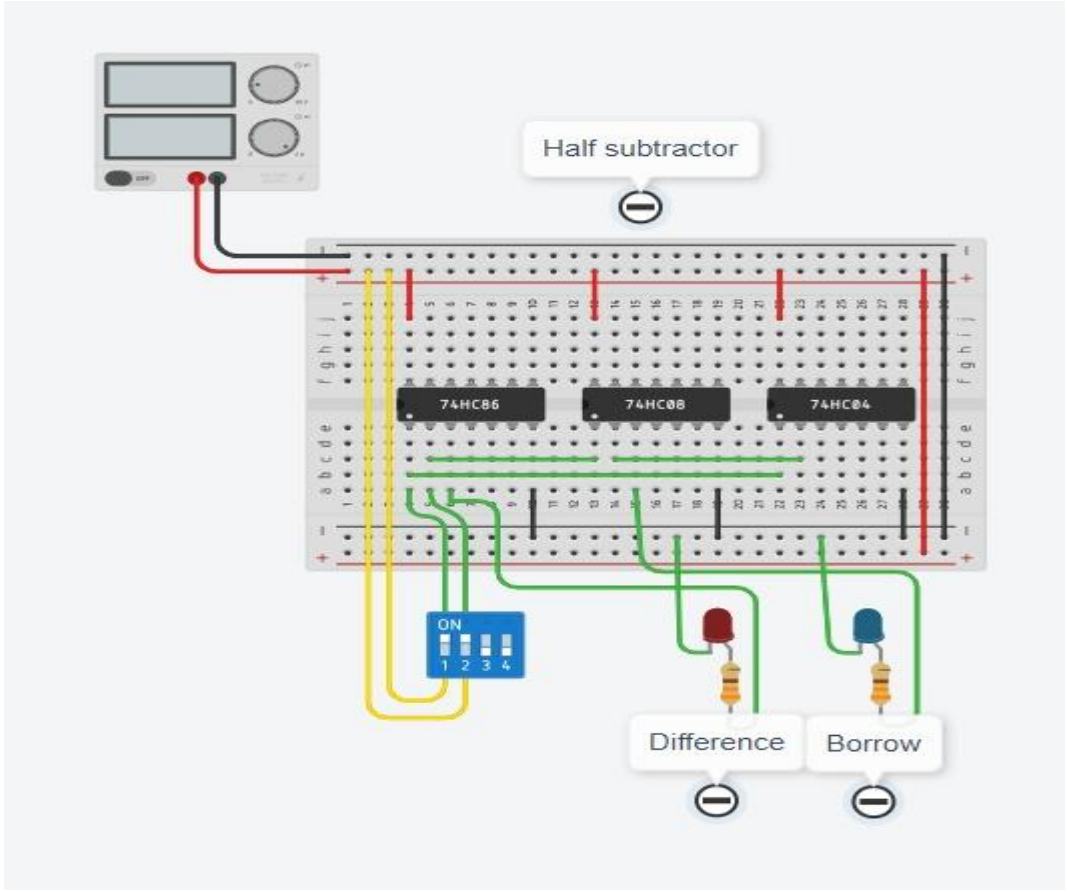
$B = \overline{A}C + BC + \overline{A}B$

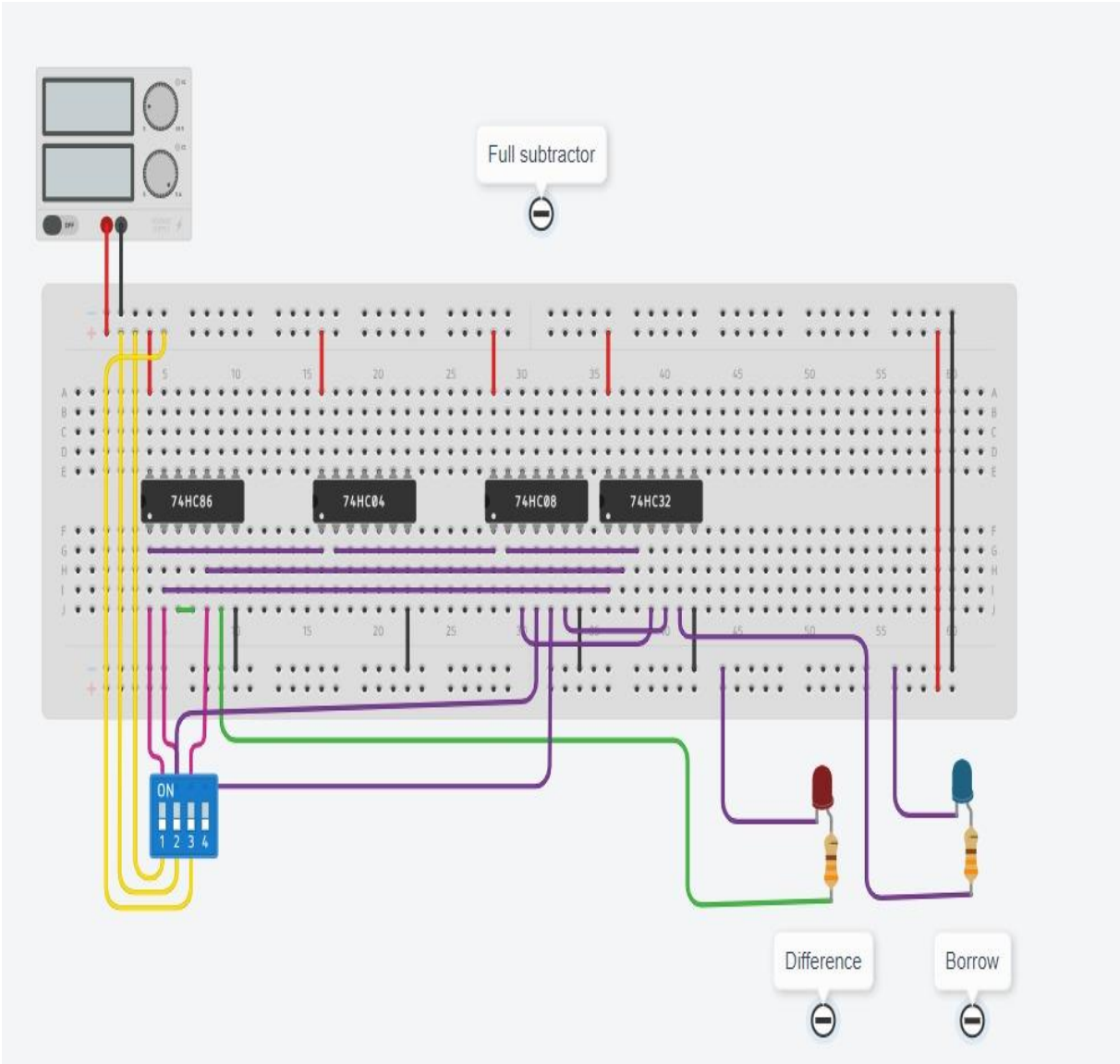
Logic Diagram:

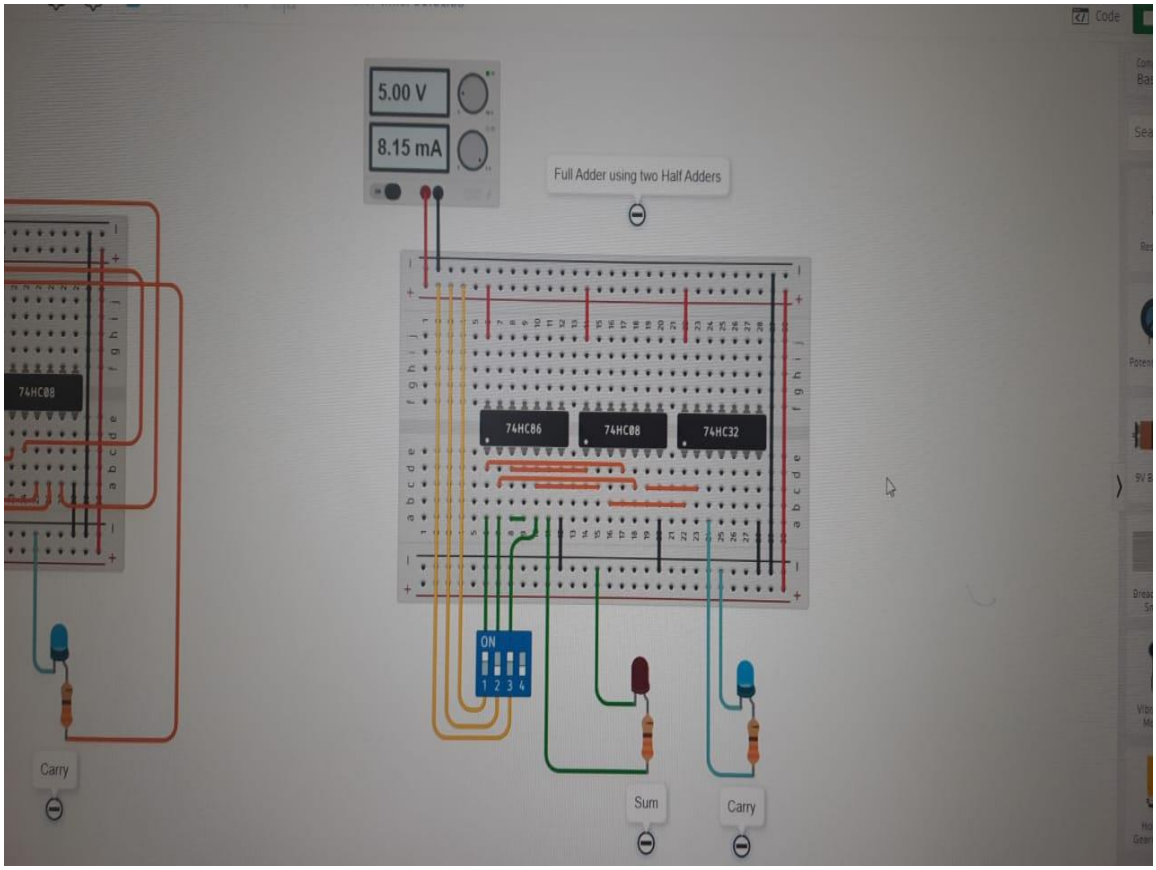


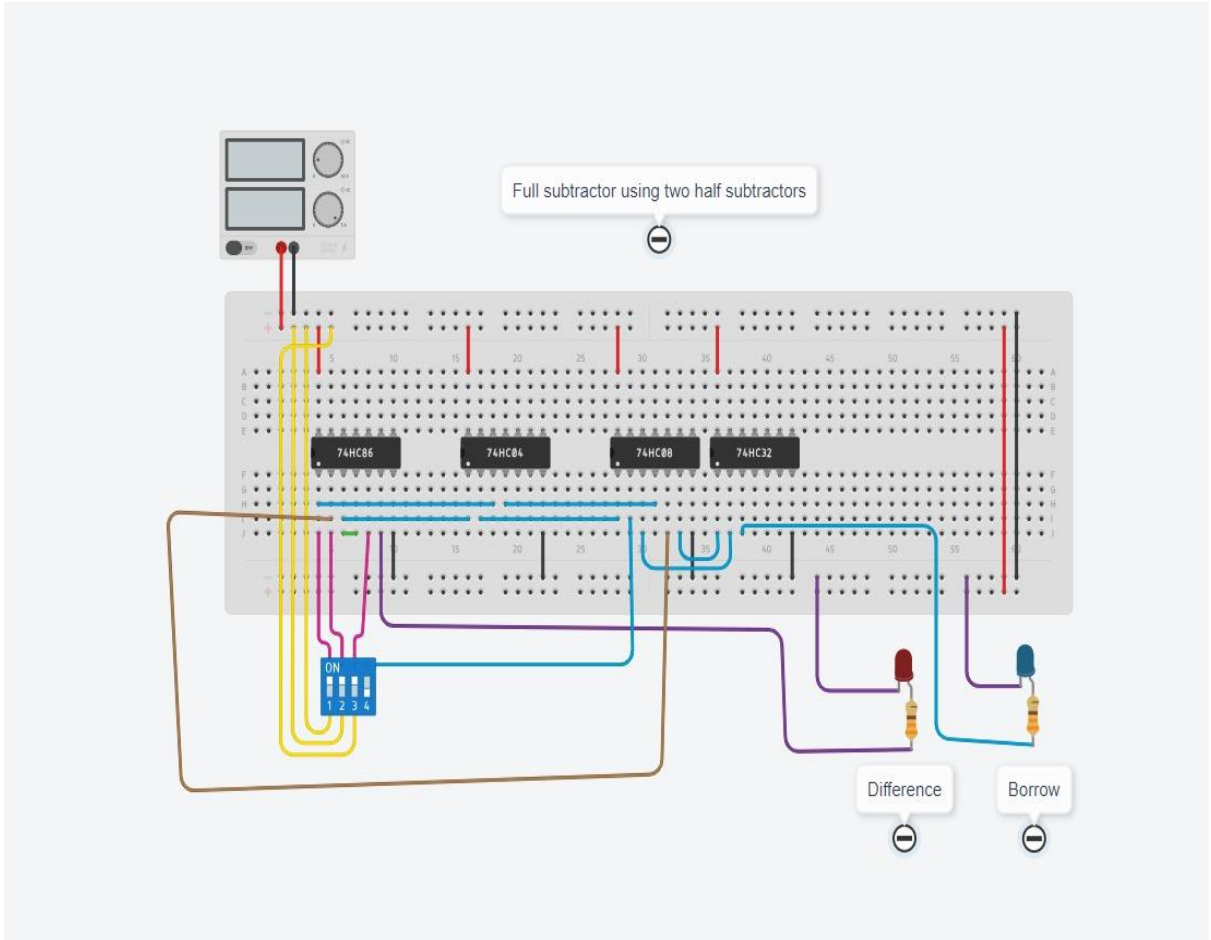

5.00 V
8.13 mA
Half Adder
74HC86
74HC08
ON
1 2 3 4
Sum
Carry

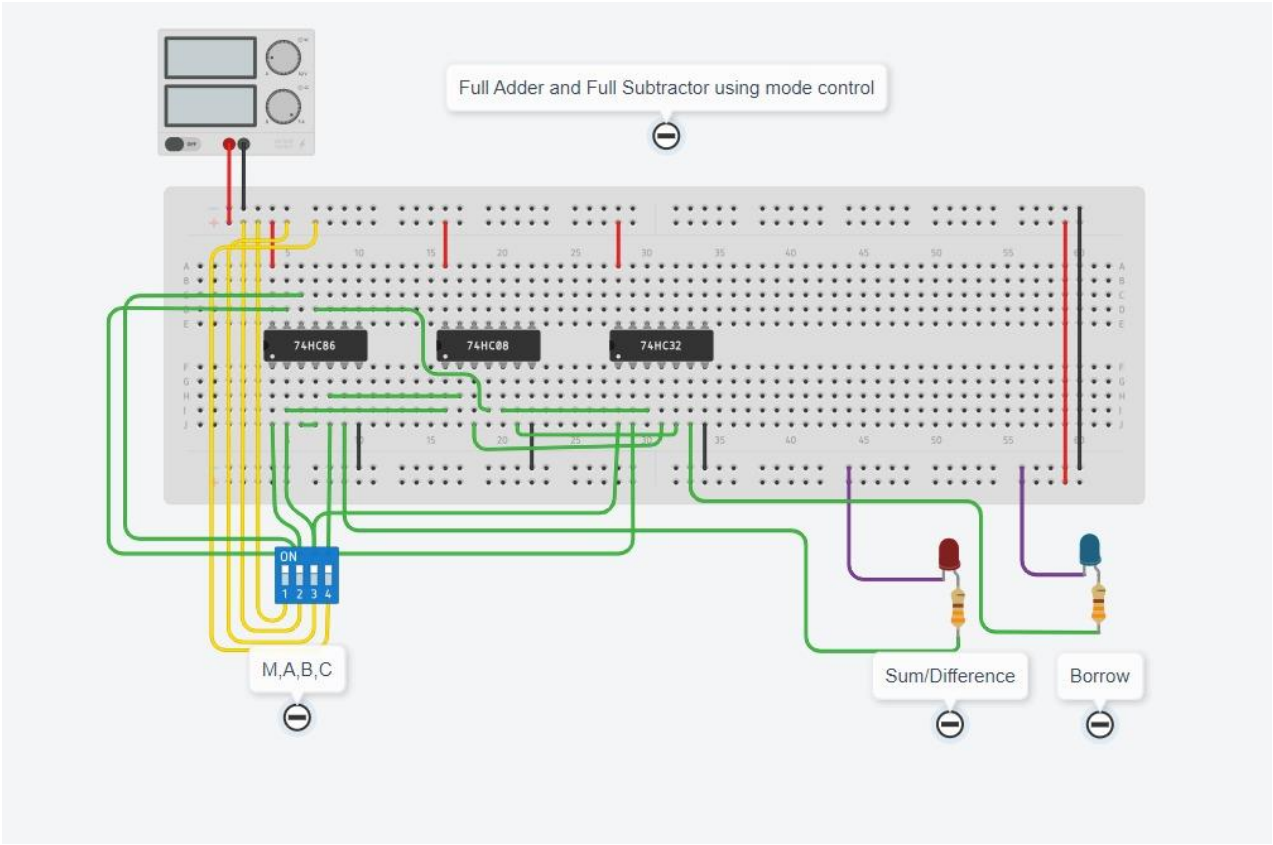

5.00 V
16.3 mA
Full Adder
74HC86
74HC32
74HC08
74HC08
ON
1 2 3 4
Carry
Sum
Carry
Components
Basic
7408
Other Components
Quad AND gate


Half subtractor
74HC86
74HC08
74HC04
ON
1 2 3 4
Difference
Borrow


Full subtractor
74HC86
74HC04
74HC08
74HC32
ON
1 2 3 4
Difference
Borrow


5.00 V
8.15 mA
Full Adder using two Half Adders
74HC08
74HC86
74HC08
74HC32
ON
1 2 3 4
Carry
Sum
Carry


Full subtractor using two half subtractors
74HC86
74HC04
74HC08
74HC32
ON
1 2 3 4
Difference
Borrow


Full Adder and Full Subtractor using mode control
74HC86
74HC08
74HC32
ON
1 2 3 4
M,A,B,C
Sum/Difference
Borrow