DESIGN OF ADDER AND SUBTRACTOR

EXP NO. : 3

DATE :

AIM

To design and construct half adder, full adder, half subtractor and full subtractor circuits and verify the truth table using gates.

APPARATUS REQUIRED

SL.NO.	COMPONENT	SPECIFICATION	QTY.
1.	AND GATE	IC 7408	1
2.	EX-OR GATE	IC 7486	1
3.	NOT GATE	IC 7404	1
4.	OR GATE	IC 7432	1
3.	IC TRAINER KIT	-	1
4.	PATCH CORDS	-	As per Requirement

THEORY

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 from the carry ‘ c’ into the higher adder position. Above circuit is called as a carry signal from the addition of the less significant bits sum from the X-OR Gate the carry out from the AND gate.

FULL ADDER

A full adder is a combinational circuit that forms the arithmetic sum of input; it consists of three inputs and two outputs. A full adder is useful to add three bits at a time but a half adder cannot do so. In full adder sum output will be taken from X-OR Gate, carry output will be taken from OR Gate.

HALF SUBTRACTOR

The half subtractor is constructed using X-OR and AND Gate. The half subtractor has two input and two outputs. The outputs are difference and borrow. The difference can be

applied using X-OR Gate, borrow output can be implemented using an AND Gate and an inverter.

FULL SUBTRACTOR

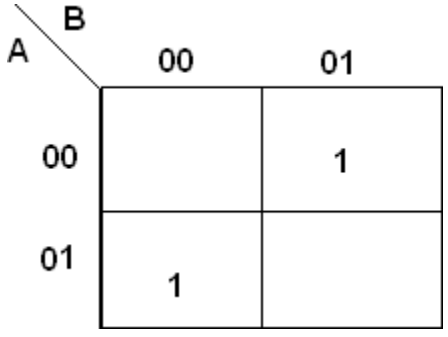
The full subtractor is a combination of X-OR, AND, OR, NOT Gates. In a full subtractor the logic circuit should have three inputs and two outputs. The two half subtractor put together gives a full subtractor .The first half subtractor will be C and A B. The output will be difference output of full subtractor. The expression AB assembles the borrow output of the half subtractor and the second term is the inverted difference output of first X-OR.

HALF ADDER

TRUTH TABLE

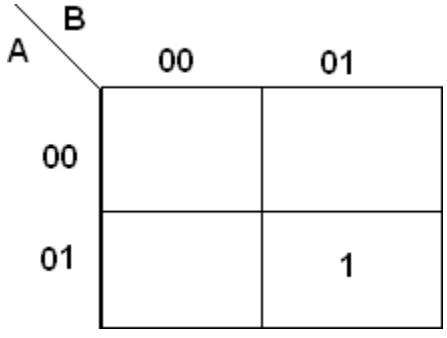
A	B	CARRY	SUM
0	**0**	**0**	**0**
0	**1**	**0**	**1**
1	**0**	**0**	**1**
1	**1**	**1**	**0**

K-MAP FOR SUM



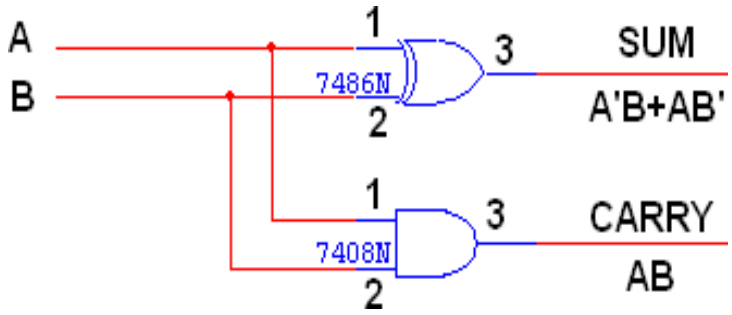
SUM = A'B + AB'

K-MAP FOR CARRY



CARRY = AB

LOGIC DIAGRAM



FULL ADDER

TRUTH TABLE

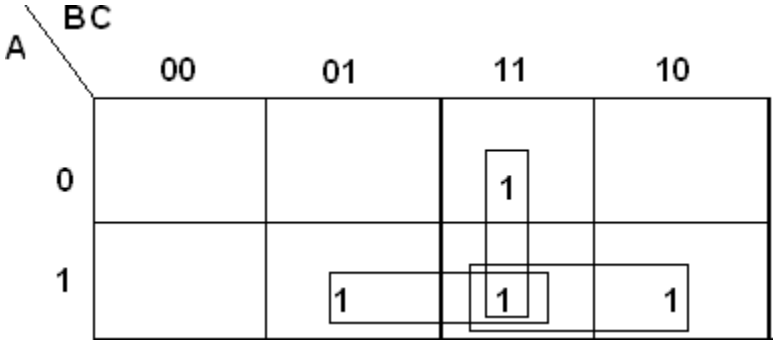
A	B	C	CARRY	SUM
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

K-MAP FOR SUM

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

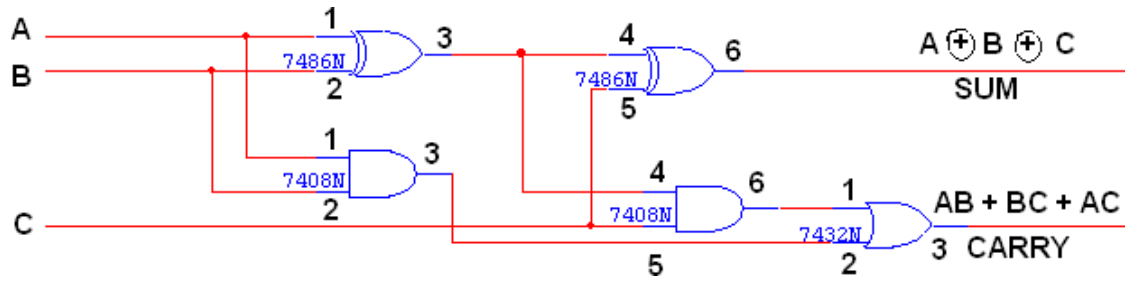
SUM = A’B’C + A’BC’ + ABC’ + ABC

K-MAP FOR CARRY



CARRY = AB + BC + AC

LOGIC DIAGRAM

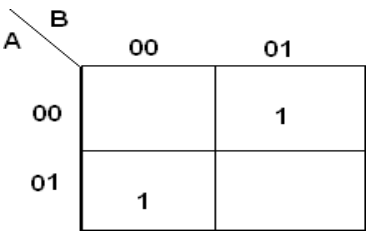


HALF SUBTRACTOR

TRUTH TABLE

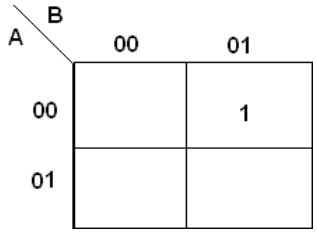
A	B	BORROW	DIFFERENCE
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

K-MAP FOR DIFFERENCE



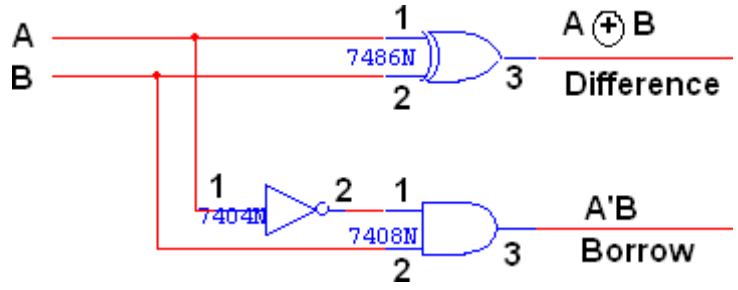
DIFFERENCE = A'B + AB'

K-MAP FOR BORROW



BORROW = A'B

LOGIC DIAGRAM

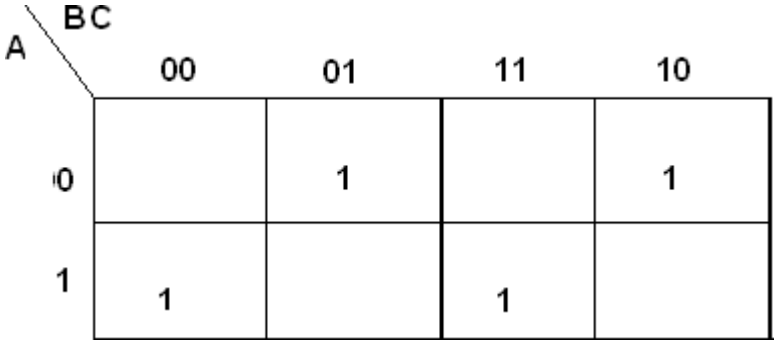


FULL SUBTRACTOR

TRUTH TABLE

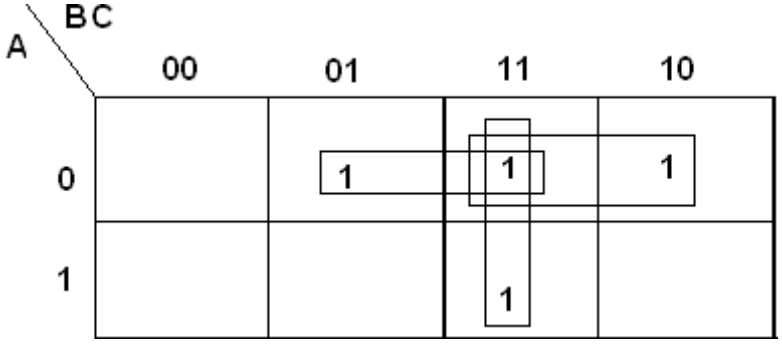
A	B	C	BORROW	DIFFERENCE
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	1
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

K-MAP FOR DIFFERENCE



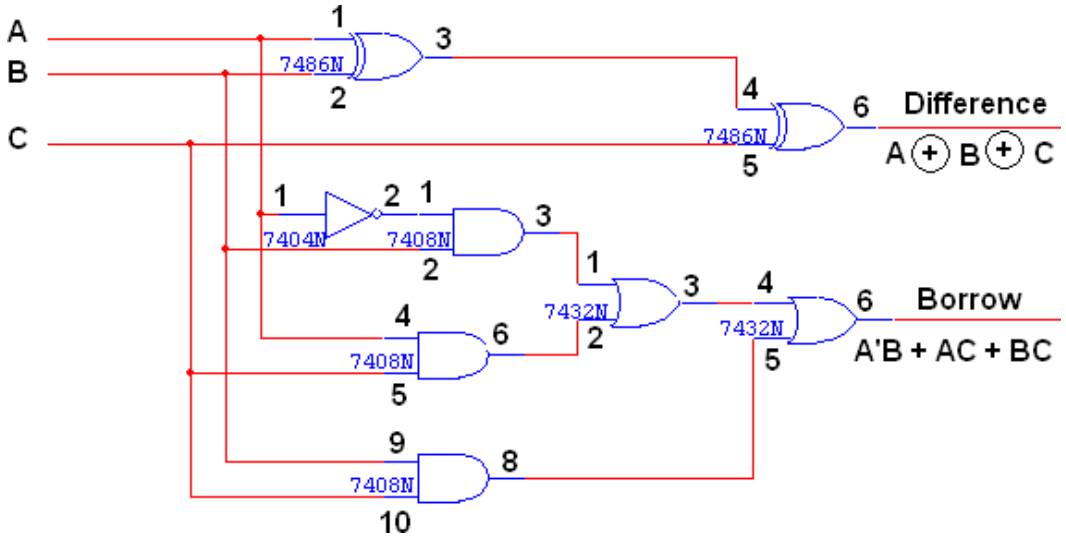
DIFFERENCE = A'B'C + A'BC' + AB'C' + ABC

K-MAP FOR BORROW

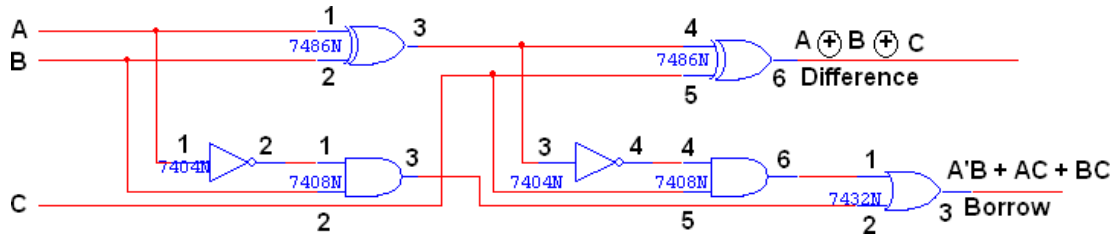


BORROW = A'B + BC + A'C

LOGIC DIAGRAM



FULL SUBTRACTOR USING TWO HALF SUBTRACTOR



PROCEDURE

- Connections are given as per circuit diagram.
- Logical inputs are given as per circuit diagram.
- Observe the output and verify the truth table.

RESULT

Thus, the Adder and Subtractor are studied and verified using logic gates