Title:

Design AND Implement Subtractor using Logic Gates

- **Objective**:

The purpose of this exercise is to use logic gates to design and build a circuit for a half subtractor and a complete subtractor.

- **Equipment**:

- Breadboard
- Power supply
- Logic gates (AND, OR, XOR)
- Connecting wires

HALF SUBTRACTOR

Truth Table:

A	B	DIFFERENCE	CARRY
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

$K-Map$

$DIFFERENCE$

	0	**1**
0		1
1	1	

$SUM = \overline{A}B + A\overline{B}$

OR

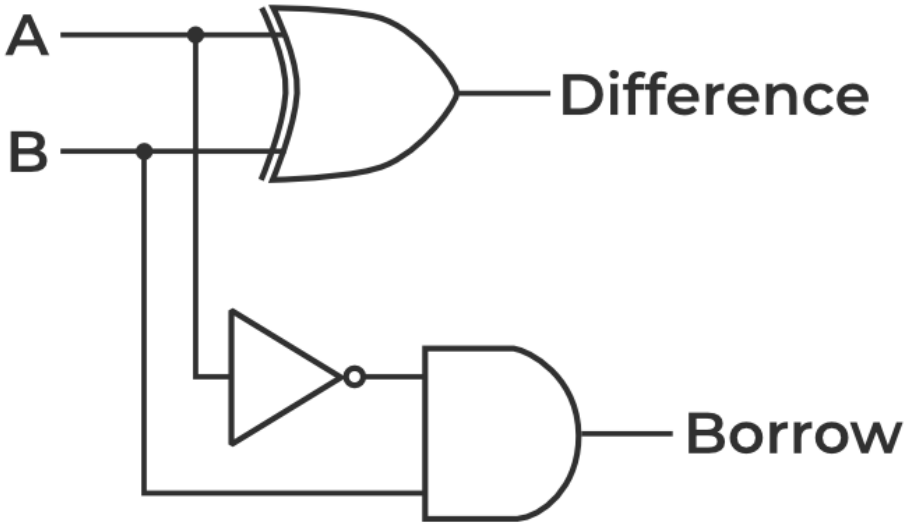
$CARRY$

$CARRY = \overline{A}B$

$SUM = A \oplus B$

	0	1
0		1
1		

LOGIC DIAGRAM:



FULL SUBTRACTOR

Truth Table:

A	B	C	Diff	Carry
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

K – Map

DIFFERENCE ***CARRY***

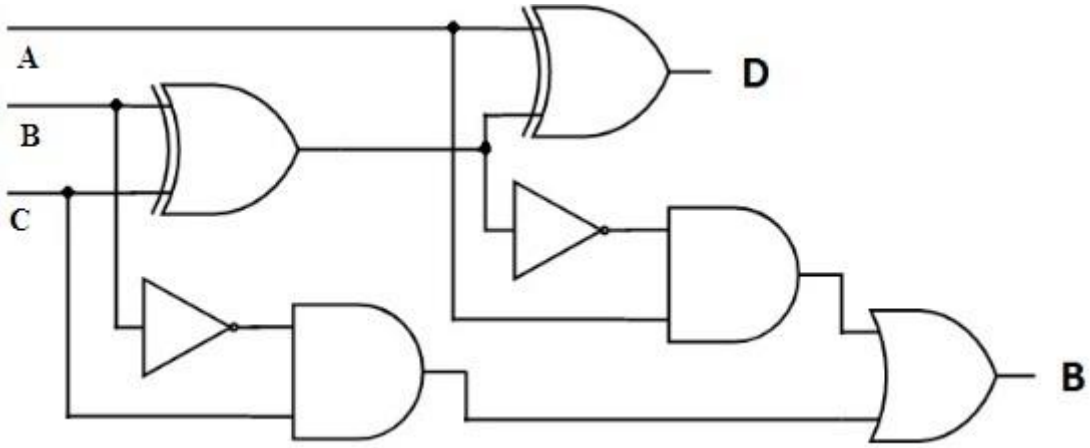
	00	01	11	10
0		1		1
1	1		1	

	00	01	11	10
0		1	1	1
1			1	

$$SUM = A \oplus B \oplus C$$

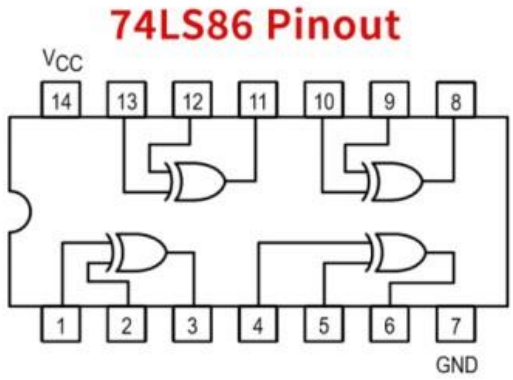
$$CARRY = \overline{A}(B + C) + BC$$

- **LOGIC DIAGRAM:**

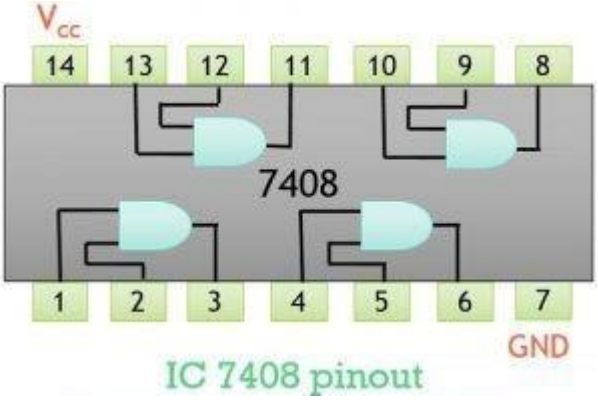


- **Pin Configuration:**

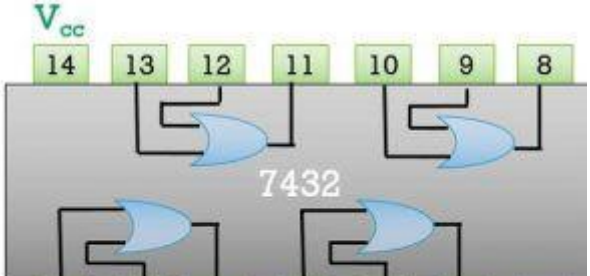
XOR:



AND:



OR:



- **Conclusion**:

In this lab, basic logic gates were used to design and construct a half subtractor and a full subtractor. An AND gate was used to create the borrow-out and an XOR gate was used to create the difference output in the construction of the half subtractor. The two half subtractors were used to construct the complete subtractor: the first half subtractor computed the difference between the two input bits, and the second half subtractor added the borrow-out from the first half subtractor to the third input bit to compute the final difference and borrow-out combined. The circuits for the half subtractor and full subtractor were examined, and their operation was confirmed. These circuits' truth tables were verified, and based on the combinations of inputs, they generated the anticipated outputs. This project gave participants invaluable practical experience with circuit building, binary subtraction, and logic gates.