Experiment No. 3	
To realize half adder and full adder.	
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Aim - To realize half adder and full adder.

Objective -
1) The objective of this experiment is to understand the function of Half-adder, Full-adder, Half-subtractor and Full-subtractor.
2) Understand how to implement Adder and Subtractor using logic gates.

Components required -
1. IC's - 7486(X-OR), 7432(OR), 7408(AND), 7404 (NOT)
2. Bread Board
3. Connecting wires.

Theory -
      Half adder is a combinational logic circuit with two inputs and two outputs. The half adder circuit is designed to add two single bit binary numbers A and B. It is the basic building block for addition of two single bit numbers. This circuit has two outputs CARRY and SUM.

$$\text{Sum} = A \oplus B$$
$$\text{Carry} = A\,B$$

      Full adder is a combinational logic circuit with three inputs and two outputs. Full adder is developed to overcome the drawback of HALF ADDER circuit. It can add two one bit umbers A and B. The full adder has three inputs A, B, and CARRY in,the circuit has two outputs CARRY out and SUM.

$$\text{Sum} = (A \oplus B) \oplus C_{in}$$
$$\text{Carry} = AB + C_{in}\,(A \oplus B)$$

      Subtracting a single-bit binary value B from another A (i.e. A -B) produces a difference bit D and a borrow out bit B-out. This operation is called half subtraction and the circuit to realize it is called a half subtractor. The Boolean functions describing the half-Subtractor are
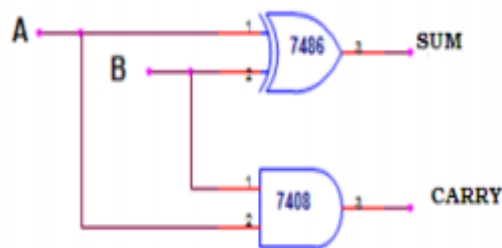
$$\text{Sum} = A \oplus B$$
$$\text{Carry} = A' \, B$$

Subtracting two single-bit binary values, B, Cin from a single-bit value A produces a difference bit D and a borrow out Br bit. This is called full subtraction. The Boolean functions describing the full-subtractor are

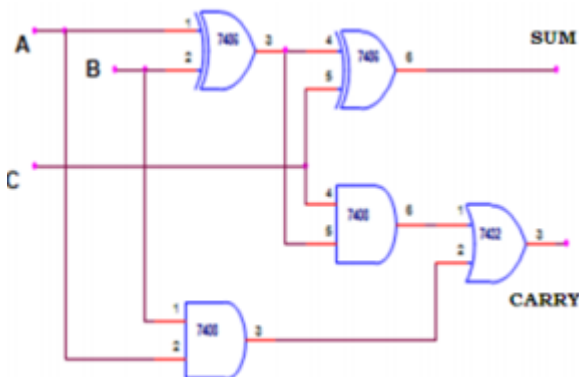$$\text{Difference} = (A \oplus B) \oplus \text{Cin}$$
$$\text{Borrow} = A'B + A'(\text{Cin}) + B(\text{Cin})$$

Circuit Diagram and Truth Table -
Half-adder

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

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

Procedure -
1. Verify the gates.
2. Make the connections as per the circuit diagram.
3. Switch on VCC and apply various combinations of input according to truth table.
4. Note down the output readings for half/full adder and half/full subtractor, Sum/difference and the carry/borrow bit for different combinations of inputs verify their truth tables.
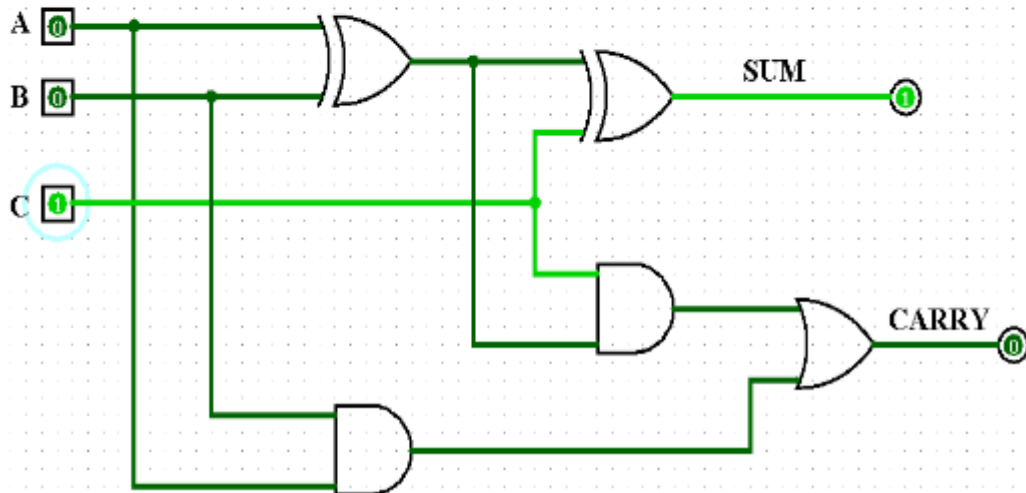
Conclusion -

HALF ADDER
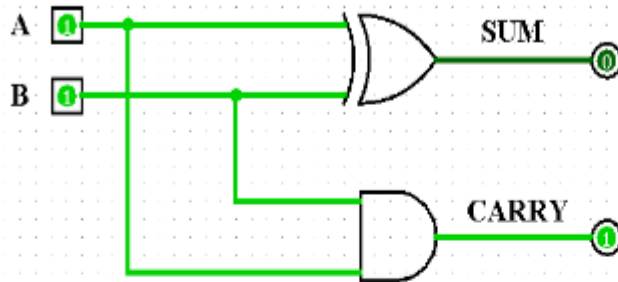
FULL ADDER

The experiment successfully demonstrates the realization of half adder, full adder, half subtractor, and full subtractor circuits using logic gates. The outputs corresponded accurately to the expected results based on the defined truth tables, illustrating a clear understanding of binary addition and subtraction in digital electronics. This hands-on experience enhances the comprehension of combinational logic circuits and their applications in arithmetic operations.