



**Vidyavardhini's College of Engineering and Technology**

**Department of Artificial Intelligence & Data Science**

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Experiment No. 3
To realize half adder and full adder.
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Roll Number: <b>32</b>
Date of Performance: <b>14 / 08 / 24</b>
Date of Submission:



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## Department of Artificial Intelligence & Data Science

**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 numbers A and B. The full adder has three inputs A, B, and CARRY in, the circuit has two outputs CARRY out and SUM.

$$\text{Sum} = (A \oplus B) \oplus \text{Cin}$$

$$\text{Carry} = AB + \text{Cin} (A \oplus B)$$

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

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

$$\text{Carry} = A' B$$

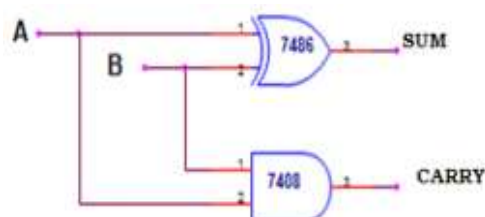
Subtracting two single-bit binary values, B, Cin from a single-bit value A produces a difference bit D and a borrow out Br bit. This is called full subtraction. The Boolean functions describing the full-subtractor are

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

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

**Circuit Diagram and Truth Table -**

**Half-adder**



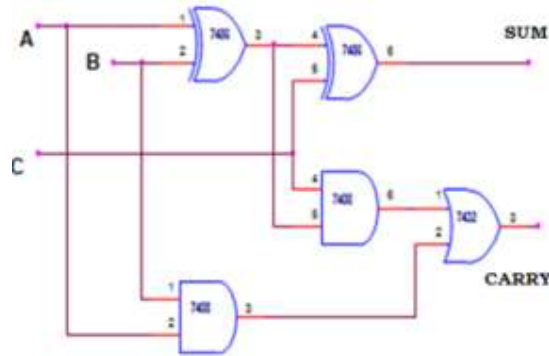
A	B	SUM	CARRY
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



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### Full-adder

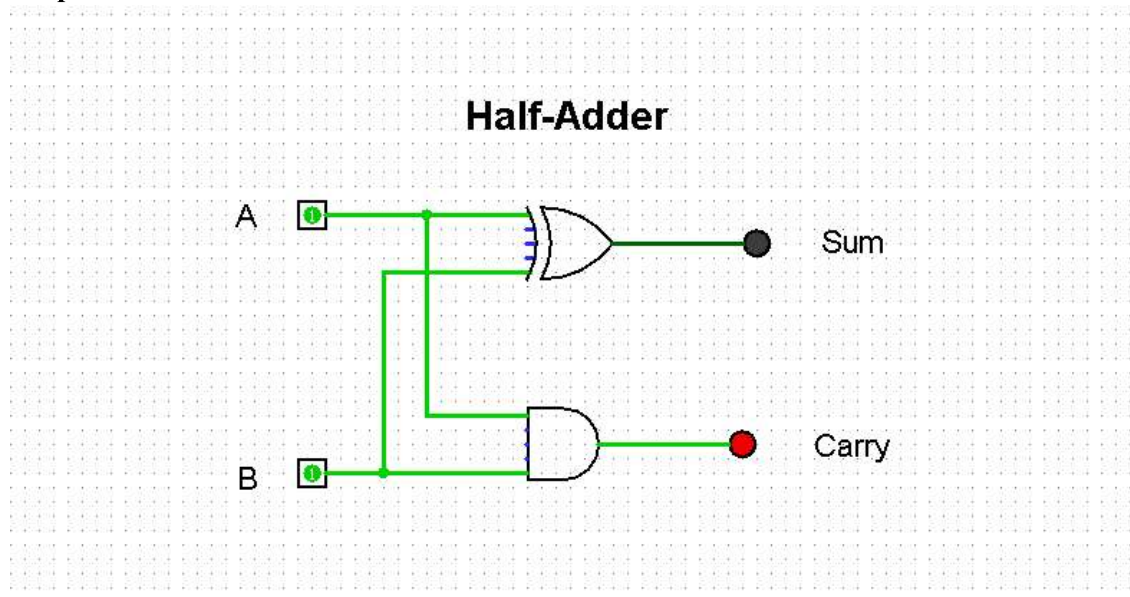


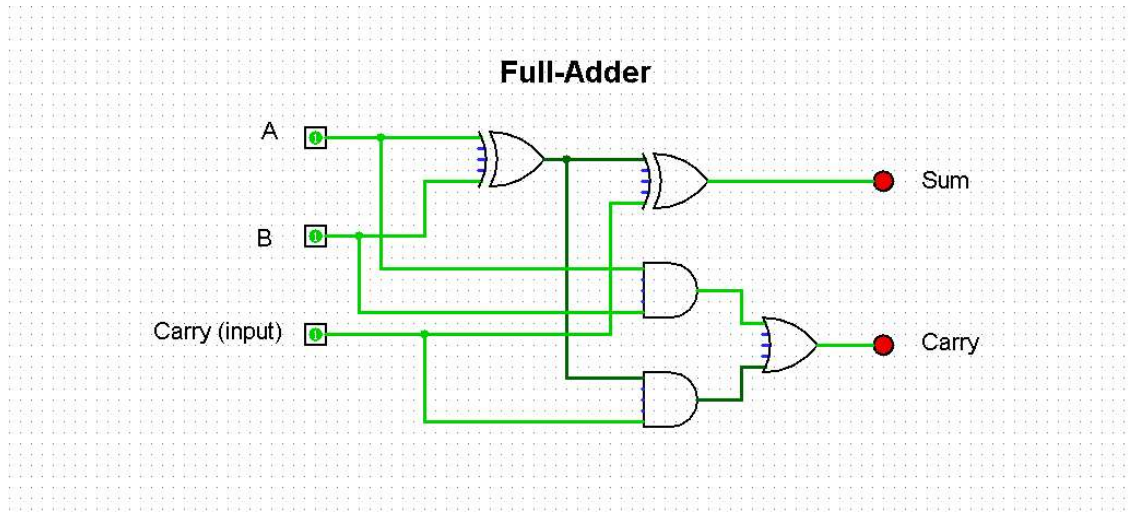
A	B	C	SUM	CARRY
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

### 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 to verify their truth tables.

### Output -





#### Conclusion -

In this experiment, we successfully demonstrated the realization of basic logic gates—AND, OR, and NOT—using only universal gates, specifically NAND and NOR gates, through the Logisim software. By constructing and analyzing circuits within the software environment, we confirmed that universal gates are indeed capable of implementing any combinational logic function. This practical exercise highlighted the versatility of NAND and NOR gates in digital circuit design, proving their ability to replicate fundamental logic operations and construct complex logic systems. The outputs observed in the simulations matched the expected results from the truth tables, validating the effective application of universal gates in achieving various logic functions.