



**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. |
| Name:Ayush Mayekar                    |
| Roll Number:28                        |
| Date of Performance:                  |
| Date of Submission:                   |



# Vidyavardhini's College of Engineering and Technology

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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.

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

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

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

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

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

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

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

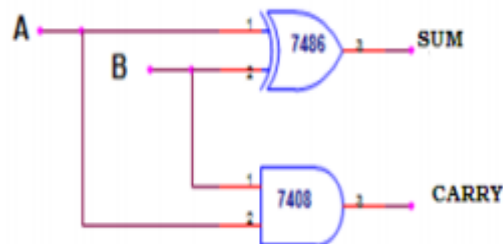


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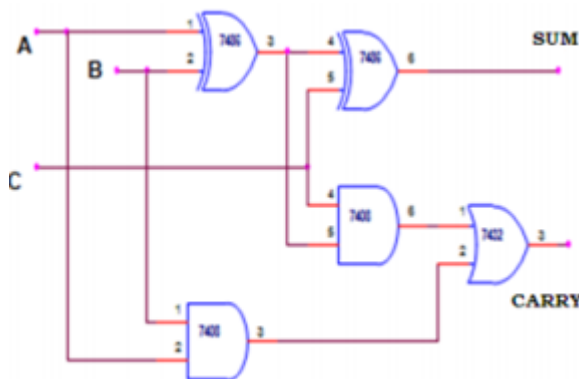
$$\text{Borrow} = A'B + A'(C_{in}) + B(C_{in})$$

### 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 -

The experiment conducted with Logisim, focusing on both half adders and full adders, has offered profound insights into the core principles of digital logic design. Our successful demonstration of basic addition operations using half adders expanded our comprehension to include full adders, which are equipped to manage carry inputs. This hands-on experience not only solidified our grasp of binary arithmetic but also emphasized the pivotal role these components play in the construction of intricate digital circuits.