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# EXPERIMENT NUMBER 3

## TITLE: HALF SUBTRACTOR AND FULL SUBTRACTOR

## • OBJECTIVE:

**To verify the truth table of half subtractor by using the ICs of XOR, NOT and AND gates and of full subtractor by using the ICs of XOR, AND, NOT and OR gates respectively and analyse the working of half subtractor and full subtractor circuit with the help of LEDs in simulator 1 and verify the truth table only of half subtractor and full subtractor in simulator 2.**

## • APPARTUS REQUIRED:

- Power supply
- LED
- Resistance
- IC 7486(XORGate), 7404 Hex Inverters, 7408ANDGate)

## • THEORY:

### ➢ Half Subtractor -

The half-subtractor is a combinational circuit which is used to perform subtraction of two bits. It has two inputs, A (minuend) and B (subtrahend) and two outputs Difference and Borrow. The logic symbol and truth table are shown below.

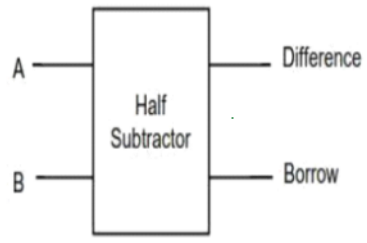



Figure-1:Logic Symbol of Half subtractor

| Inputs | | Outputs | |
|---|---|---|---|
| A | B | Difference | Borrow |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |

Figure-2:Truth Table of Half subtractor

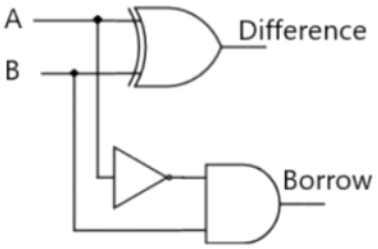



Figure-3:Circuit Diagram of Half subtractor

From the above truth table we can find the boolean expression.

**Difference = A ⊕ B**
**Borrow = A' B**

### ➢ Full Subtractor:

Borrow = A' B

## ➢ Full Subtractor:

A full subtractor is a combinational circuit that performs subtraction involving three bits, namely A (minuend), B (subtrahend), and Bin (borrow-in) . It accepts three inputs: A (minuend), B (subtrahend) and a Bin (borrow bit) and it produces two outputs: D (difference) and Bout (borrow out). The logic symbol and truth table are shown below.

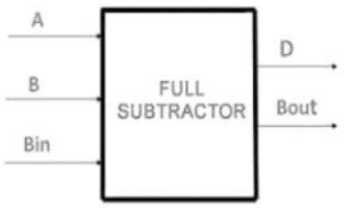



Figure : Logic Symbol of Full subtractor

| A | B | $B_{in}$ | D | $B_{out}$ |
|---|---|---|---|---|
| 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 |

Figure : Truth Table of Full subtractor

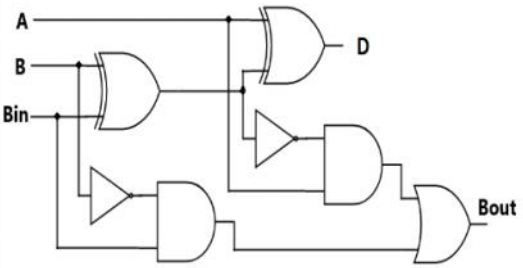


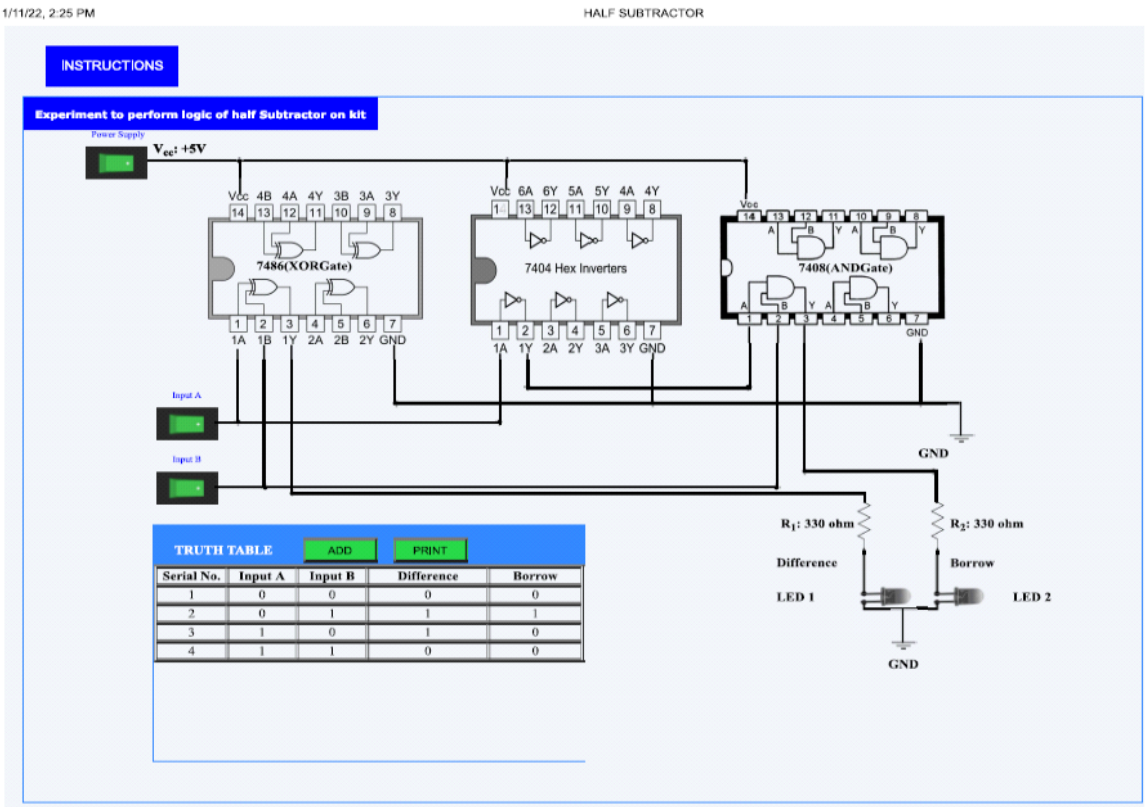

Figure : Circuit Diagram of Full subtractor

From the above truth table we can find the boolean expression.

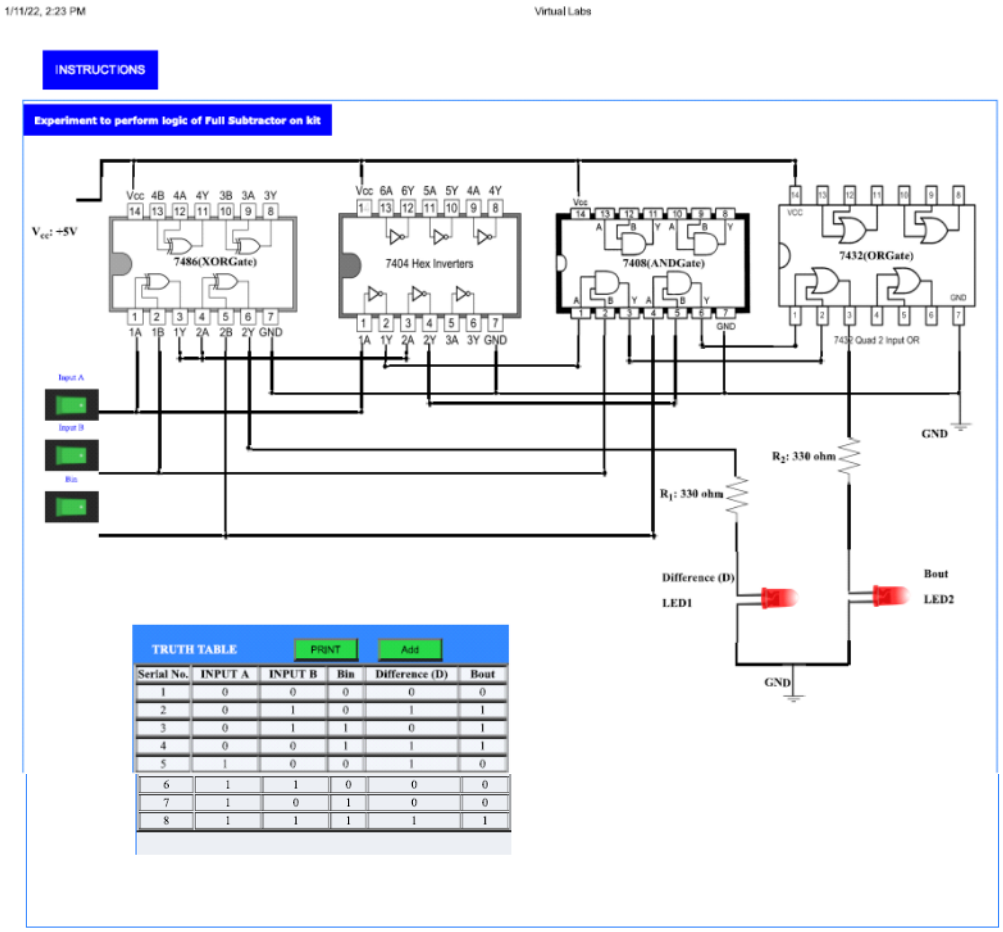
**D = A ⊕ B ⊕ Bin**
**Bout = A' Bin + A' B + B Bin**

## • ***CIRCUIT DIAGRAM:***

### ➢ HALF SUBTRACTOR {SIMULATION 1}-

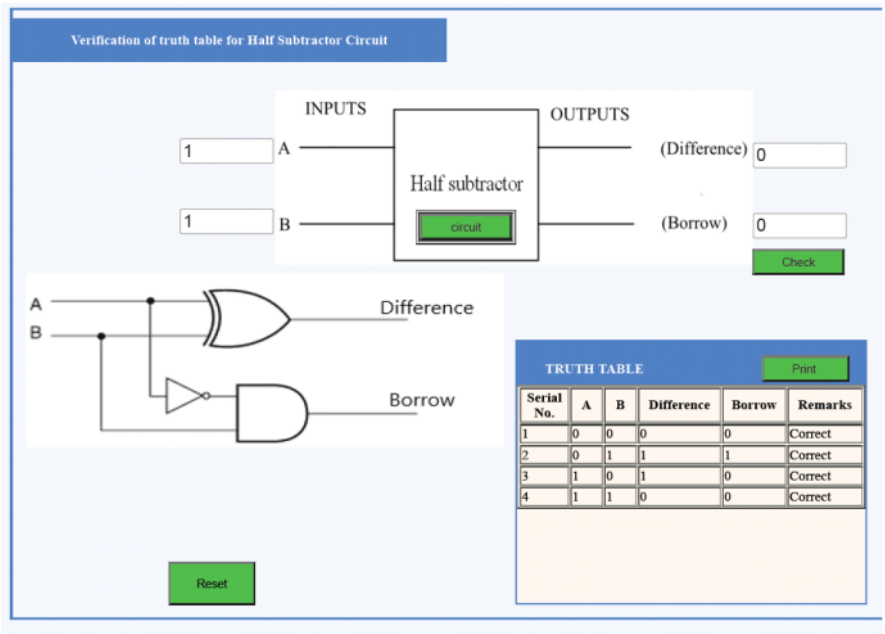


➢ *FULL SUBTRACTOR {SIMULATION 1}-*

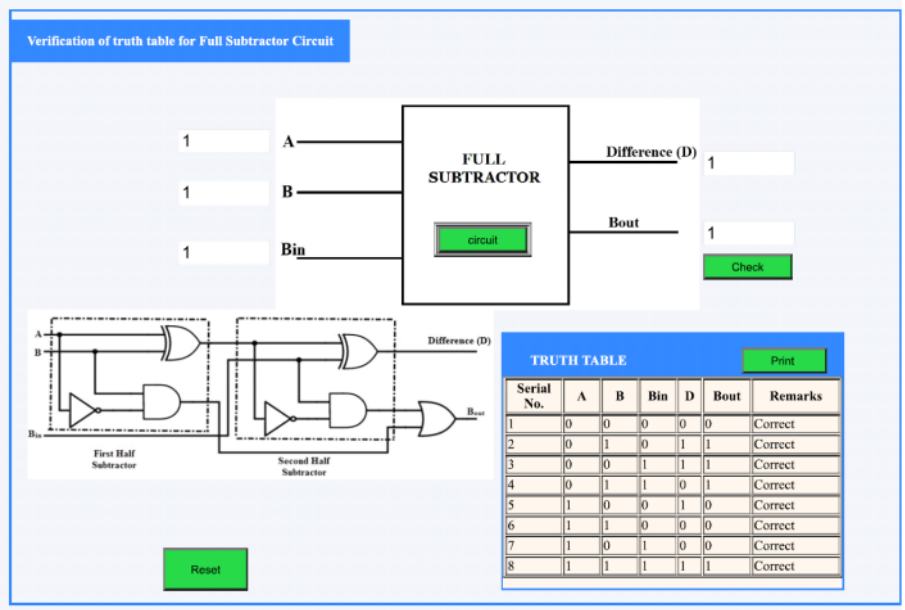



- ***CALCULATION:***

➢ VERIFICATION OF TRUTH TABLE FOR HALF SUBTRACTOR {SIMULATOR 2}:



➢ VERIFICATION OF TRUTH TABLE FOR FULL SUBTRACTOR {SIMULATOR 2}:




| Serial No. | A | B | Bin | D | Bout | Remarks |
|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | Correct |
| 2 | 0 | 1 | 0 | 1 | 1 | Correct |
| 3 | 0 | 0 | 1 | 1 | 1 | Correct |
| 4 | 0 | 1 | 1 | 0 | 1 | Correct |
| 5 | 1 | 0 | 0 | 1 | 0 | Correct |
| 6 | 1 | 1 | 0 | 0 | 0 | Correct |
| 7 | 1 | 0 | 1 | 0 | 0 | Correct |
| 8 | 1 | 1 | 1 | 1 | 1 | Correct |

## • *RESULT AND CONCLUSION:*

➢ Verified Truth Table of Half Subtractor successfully using EX-OR, NOT, and AND Gates.
➢ Verified Truth Table of Full subtractor successfully using EX-OR, OR ,NOT, and AND Gates.

## • *PRECAUTIONS:*

➢ All the connections should be made properly as per the circuit diagram.
➢ Connections should be tight and easy to inspect.
➢ Keep the switch turned off while making connections.