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|---|---|---|---|
| **Course Name:** | **Digital Design Laboratory** | **Semester:** | **III** |
| **Date of Performance:** | **_23_ / 08 / _2024_____** | **Batch No:** | **E-2** |
| **Faculty Name:** | | **Roll No:** | **16010123325** |
| **Faculty Sign & Date:** | | **Grade/Marks:** | **___/25** |

# Experiment No: 2
# Title: Binary Adders and Subtractors

**Aim and Objective of the Experiment:**

To implement half and full adder–subtractor using gates and IC 7483

**COs to be achieved:**

**CO2**: Use different minimization technique and solve combinational circuits.

**Tools used:**

Trainer kits

**Theory:**

**Adder:** Addition of two binary digits is most basic operation performed by the digital computer. There are two types of adder:

- Half adder
- Full adder

**Half Adder:** Half adder is combinational logic circuit with two inputs and two outputs. It is the basic building block for addition of two single bit numbers.

**Full adder:** A half adder has a provision not to add a carry coming from the lower order bits when multi bit addition is performed. for this purpose a third input terminal is added and this circuits is to add A,B,C where A and B are the nth order bits of the number A and B respectively and C is the carry generated from the addition of (n-1) order bits. This circuit is referred to as full adder.

**Subtractor:** Subtraction of two binary digits is one of the most basic operations performed by digital computer .there are two types of subtractor:

- Half subtractor
- Full subtractor

**Half subtractor:** Logic circuit for the subtraction of B from A where A,B are 1 bit numbers is referred to as half subtract or .the subtract or process has two input and difference and borrow are the two outputs.

**Full subtractor:** As in the case of the addition using logic gates, a full subtractor is made by combining two half-sub tractors and an additional OR-gate. A full subtractor has the borrow in capability (denoted as $BOR_{IN}$) and so allows cascading which results in the possibility of multi-bit subtraction.

**IC 7483**

For subtraction of one binary number from another, we do so by adding 2's complement of the former to the latter number using a full adder circuit.

IC 7483 is a 16 pin, 4-bit full adder. This IC has a provision to add the carry output to transfer and end around carry output using Co and C4 respectively.

**2's complement:** 2's complement of any binary no. can be obtained by adding 1 in 1'scomplement of that no.

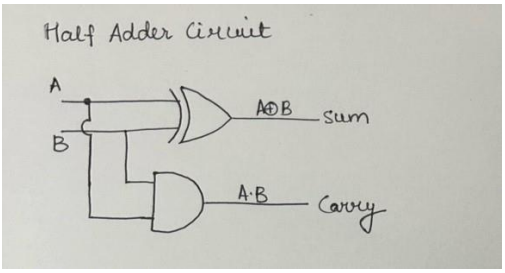
e.g. 2's complement of $+(10)_{10}$ =1010is

| | |
|---|---|
| 1C of 1010 | 0101 |
| | + 1 |
| $-(10)_{10}$ | 0110 |

In 2's complement subtraction using IC 7483, we are representing negative number in 2's complement form and then adding it with 1st number.

**Implementation Details:**
**Half Adder Block Diagram**

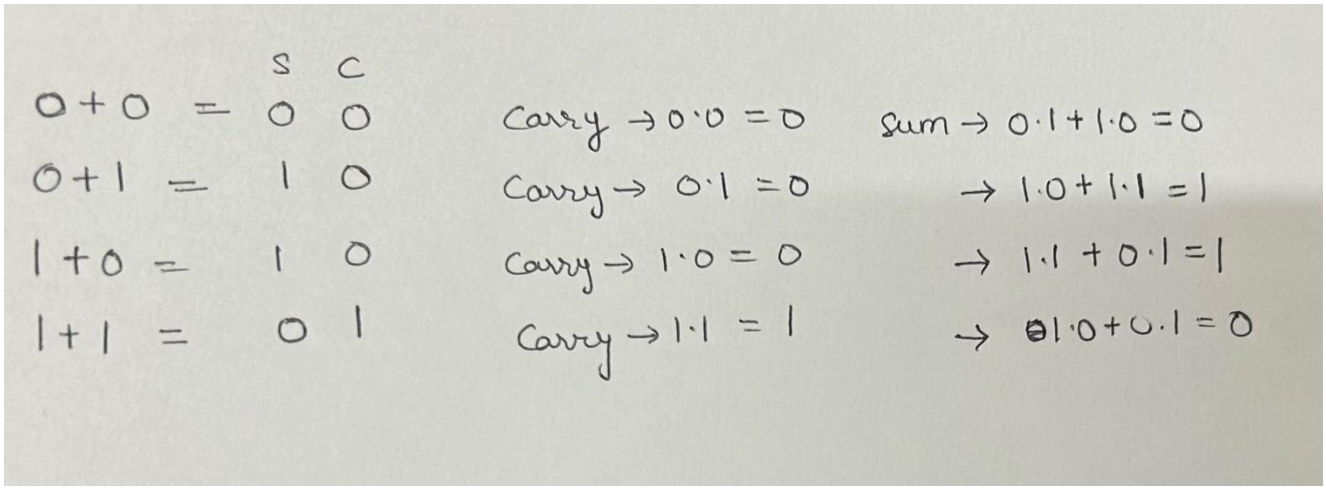

**Half Adder Circuit**



**Truth Table for Half Adder**

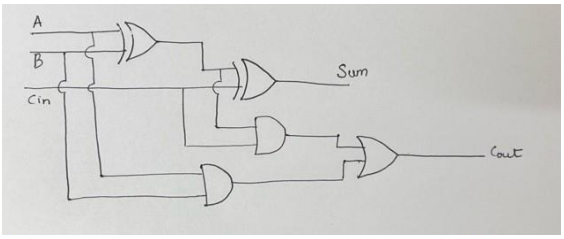
| Inputs | | Outputs | |
|---|---|---|---|
| **A** | **B** | **S** | **C** |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |

**From the truth table (with steps):**




**Full Adder Block Diagram**

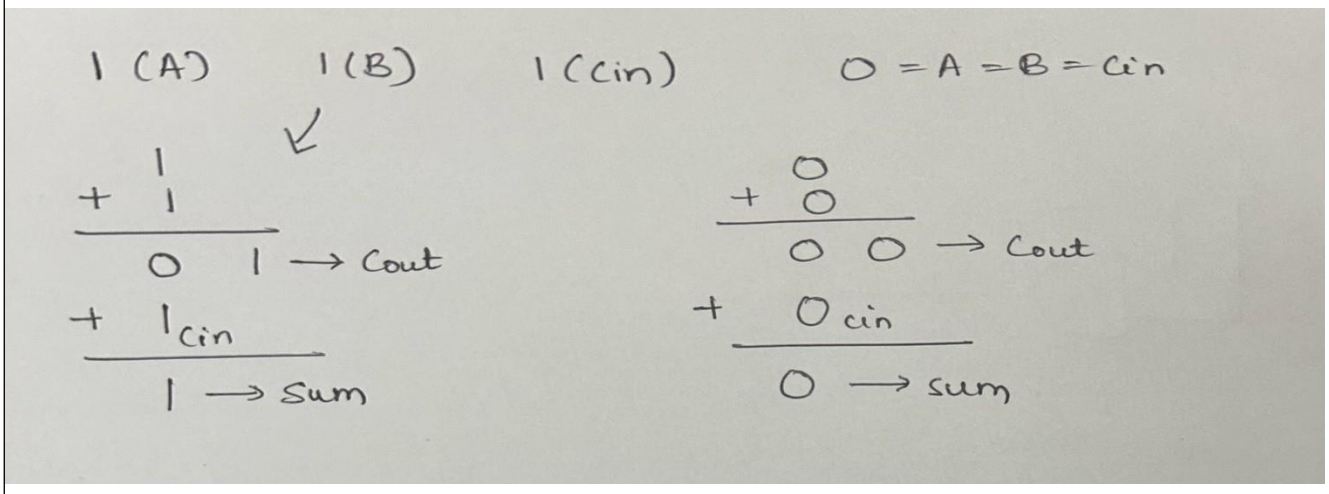
## Full Adder Circuit



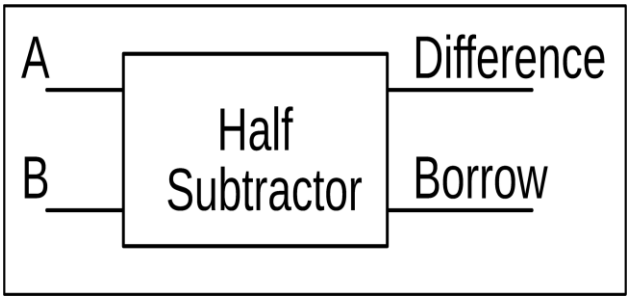

## Truth Table for Full Adder

| Inputs | | | Outputs | |
|---|---|---|---|---|
| **A** | **B** | **$C_{in}$** | **S** | **$C_{out}$** |
| 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 |

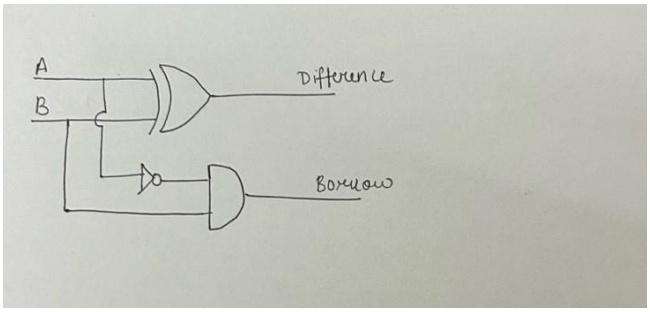
## From the truth table (with steps):



## Half Subtractor Block Diagram



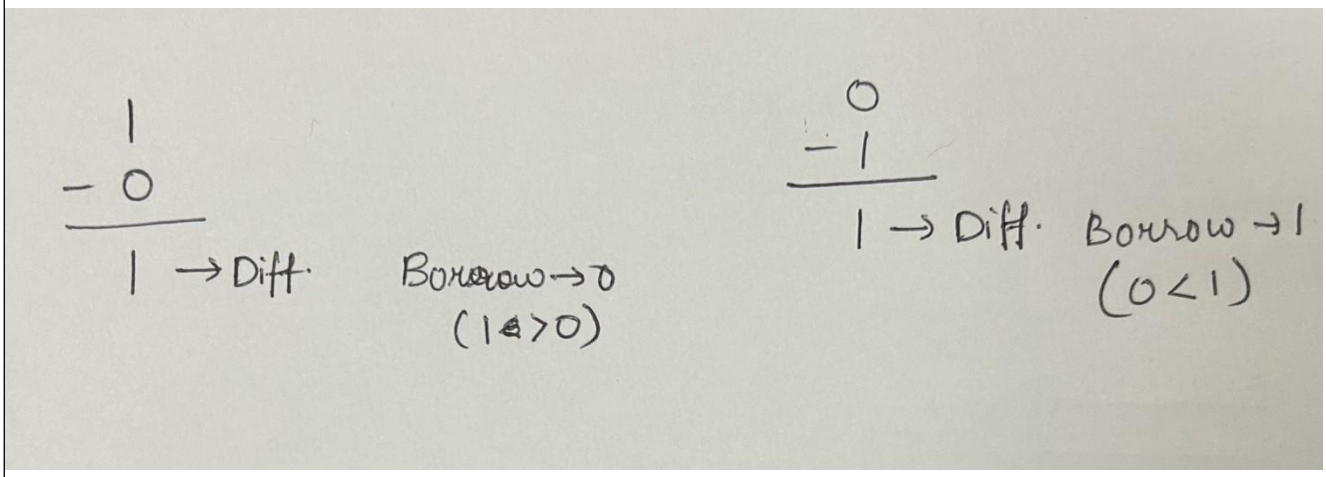

## Half Subtractor Circuit



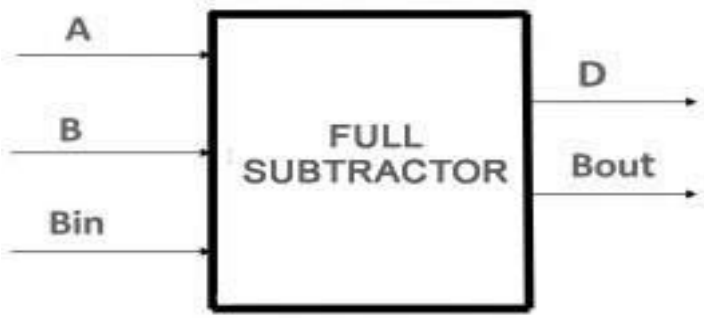

## Truth Table for Half Subtractor

| A | B | DIFFERENCE(D) | BORROW(Bo) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |

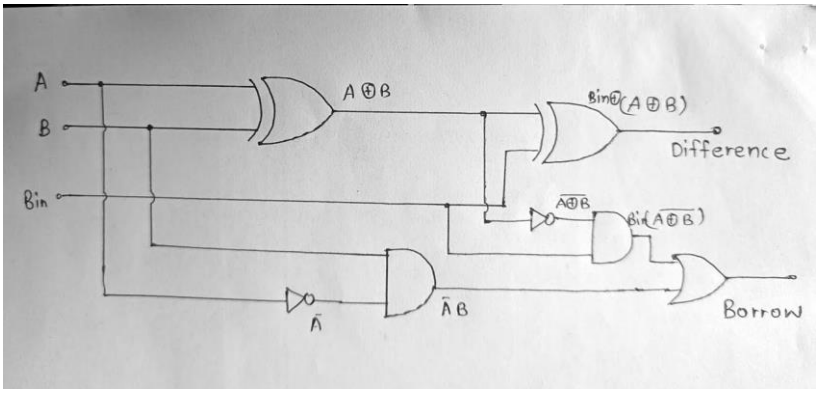
**From the truth table (with steps) :**




**Full Subtractor Block Diagram**



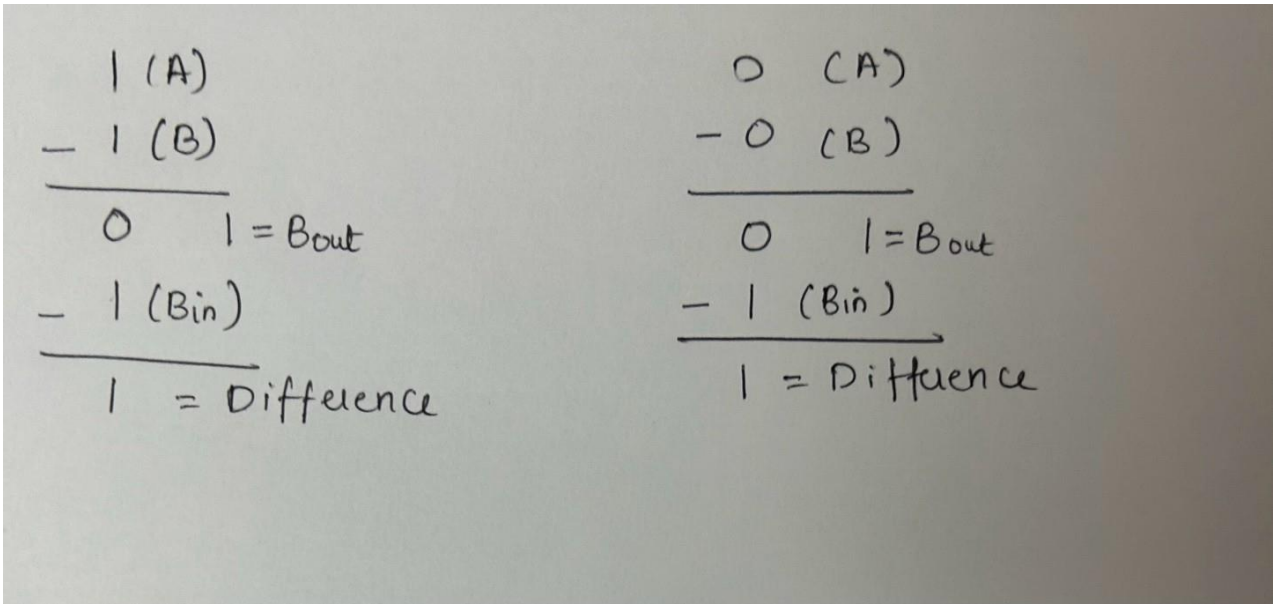

**Full Subtractor Circuit**




**Truth Table for Full subtractor**

| A | B | $B_{IN}$ | D | $BOR_{OUT}$ |
|---|---|---|---|---|
| 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 |

**From the truth table (with steps):**



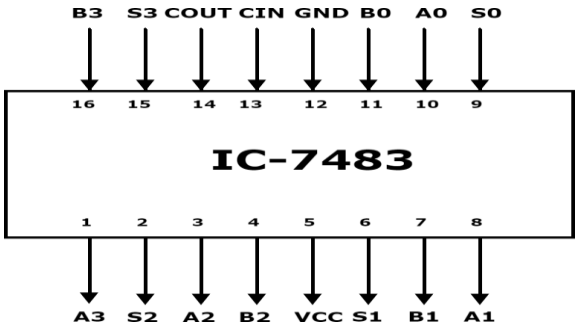

**Example:**

1) $7_{10} - 2_{10} = 5_{10}$

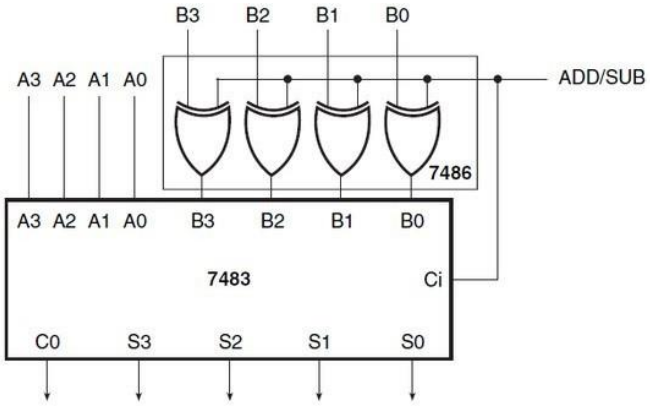
| | |
|---|---|
| 7 | 0111 |
| 2 | 0010 |
| 1'C of 2 | 1101 |
| | + 1 |
| 2'C of 2 | 1110 |

0111 + 1110 1 0101

**Pin Diagram IC7483**




**Adder/Subtractor**



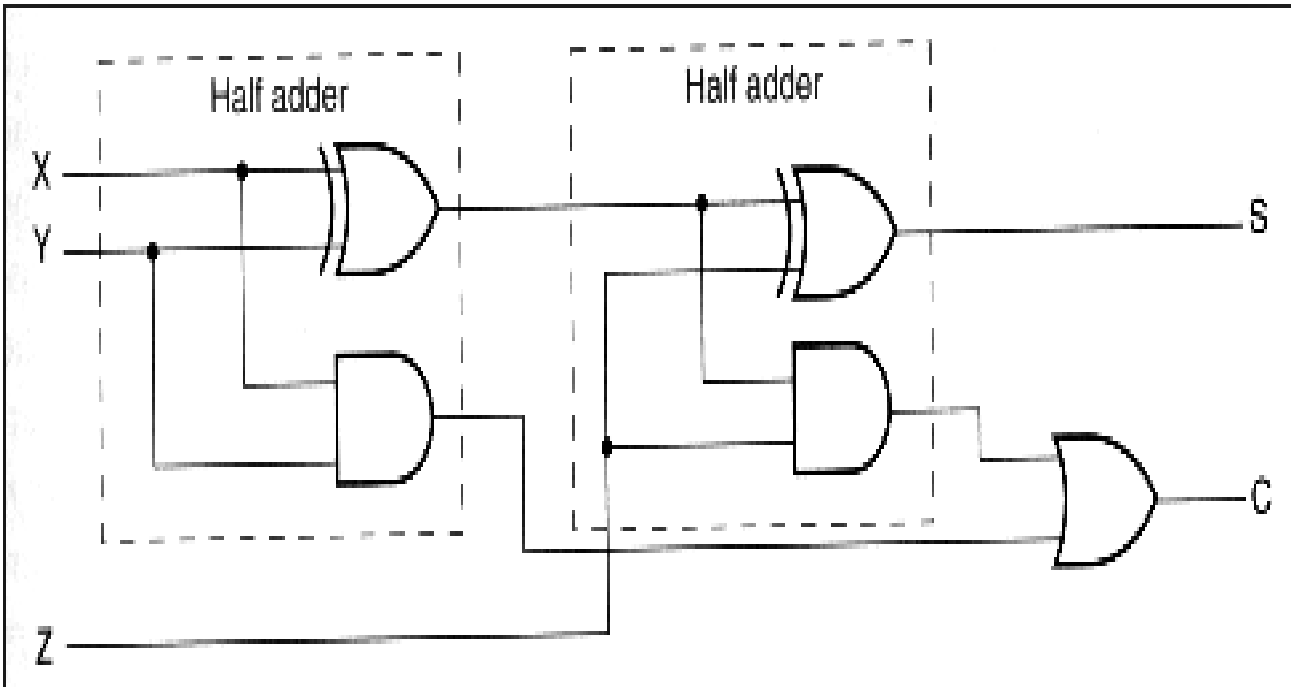

## Implementation Details

**Procedure:**

1) Locate the IC 7483 and 4-not gates block on trainer kit.
2) Connect 1st input no. to A4-A1 input slot and 2nd (negative) no. to B4-B1 through 4-not gates (1C of 2nd no.)
3) Connect high input to Co so that it will get added with 1C of 2nd no. to get 2C.
4) Connect 4-bit output to the output indicators.
5) Switch ON the power supply and monitor the output for various input combinations.

## Post Lab Subjective/Objective type Questions:

1. Design a full adder using two half adders

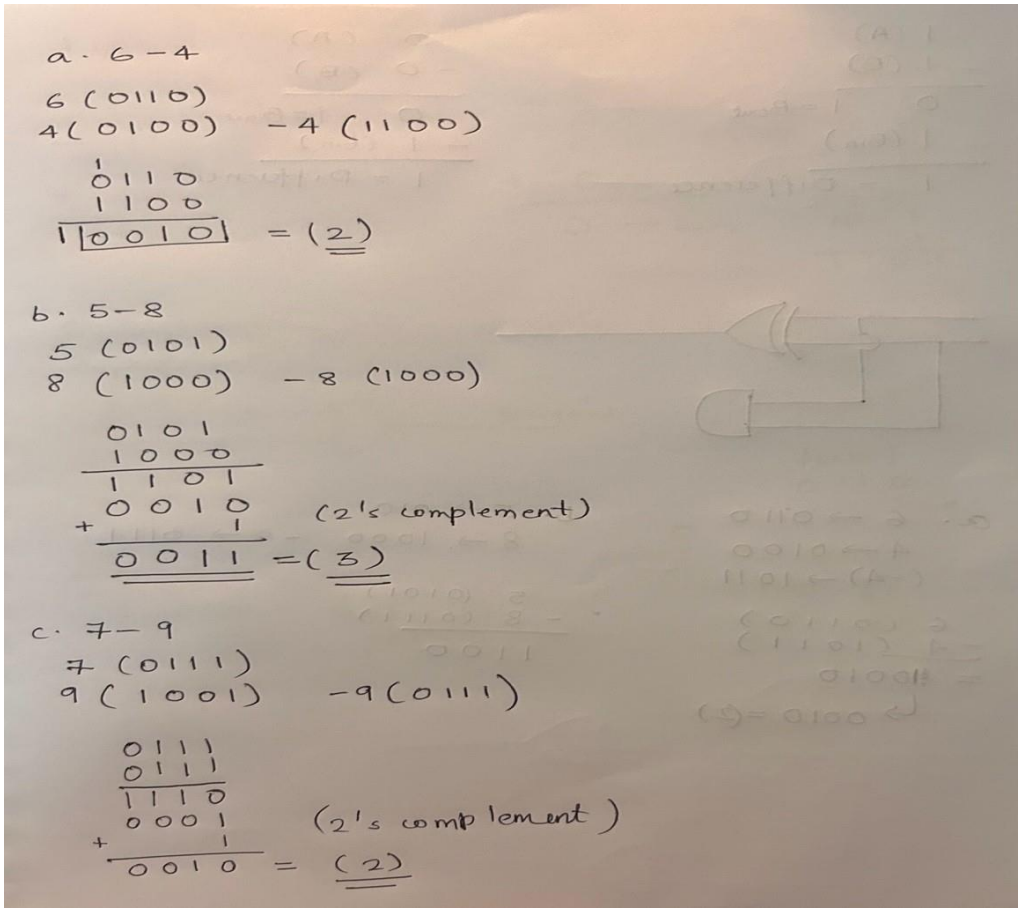





Roll No:_____

2. Perform the following Binary subtraction with the help of appropriate ICs:
   a. 6-4
   b. 5-8
   c. 7-9

These calculations can be implemented using a 4-bit binary adder IC like the 74LS83 by setting the mode for subtraction.




**Conclusion:**

The above experiment highlights the uses and application of control adders/subtractors, half adder subtractor and full adder and subtractor.

**Signature of faculty in-charge with Date:**