| **Course Name:** | **Digital Design Laboratory** | **Semester:** | **III** |
| --- | --- | --- | --- |
| **Date of Performance:** | **8/ 8 /23** | **Batch No:** | **C1** |
| **Faculty Name:** |  | **Roll No:** | **16010122257** |
| **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:** The addition of two binary digits is the most basic operation performed by the digital computer. There are two types of adder:   * Half adder * Full adder   **Half Adder:** Half adder is a combinational logic circuit with two inputs and two outputs. It is the basic building block for the 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 circuit is to add A, B, and 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 subtractors:   * 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 BORIN) 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** | **A** | **B** | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **From the truth table (with steps):**  **Full Adder Block Diagram**  **Full Adder Circuit**  **Truth Table for Full Adder**  **From the truth table (with steps):**    **Half Subtractor Block Diagram**  **Half Subtractor Circuit**  **Truth Table for Half Subtractor**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **A** | **B** | **DIFFERENCE(D)** | **BORROW(Bo)** |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |   **From the truth table (with steps) :**  **Full Subtractor Block Diagram**  **Full Subtractor Circuit**  **Truth Table for Full subtractor**   | **A** | **B** | **BIN** | **D** | **BOROUT** | | --- | --- | --- | --- | --- | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |     **From the truth table (with steps):**  **Example:**   | 1) 710 -210 = 510 | |  | | --- | --- | --- | | 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.   **Half Adder Block Diagram**    **Half Adder Circuit**  **Half Adder Circuit Diagram** |
| **Truth Table for Half Adder**  Inputs Outputs  A B A B  0 0 0 0  0 1 1 0  1 0 1 0  1 1 0 1  From the truth table (with steps):  0+0=0 no carry  0+1=1 no carry  1+0=1 no carry  1+1=2=1 0=1 carry,sum=0  Sum=A xor B  Carry=A and B  **Full Adder Block Diagram**    **Post Lab Subjective/Objective type Questions:** |
| **Full Adder Circuit**  **Full Adder Circuit Diagram**  **Truth Table for Full Adder** |
| **Full Adder in Digital Logic - GeeksforGeeks**  From the truth table (with steps):  0+0+0=0  0+0+1=1  0+1+1=2 1 carry+0 sum  0+1+0=1  1+1+0=2 1 carry+0 sum  1+1+1=3 1 carry+1 sum  1+0+0=1  1+0+1=2 1 carry+0 sum  Sum=A’B’C-IN+ A’B C-IN + AB’C-IN’ + AB C-IN  C-out=A’B C-IN+ AB’C-IN +AB C-IN’+ AB C-IN  **Half Subtractor Block Diagram** |
| **Half Subtractor Circuit**  **Pin on Electronic Circuit Diagrams**  **Truth Table for Half Subtractor**   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  |  |  |  | | **A** | **B** | **DIFFERENCE(D)** | **BORROW(Bo)** |  | |  |  |  |  |  | | 1 | 0 | 1 | 0 |  | |  |  |  |  |  | | 1 | 1 | 0 | 0 |  | |  |  |  |  |  | | 0 | 0 | 0 | 0 |  | |  |  |  |  |  | | 0 | 1 | 0 | 1 |  | |  |  |  |  |  |   **From the truth table (with steps) :**  1-0=1  1-1=0  0-0=0  0-1 not possible so borrow=1 and difference=1  Diff=A’B+AB’  Borrow=A’B  **Full Subtractor Block Diagram** |
| **Full Subtractor Circuit**    **Truth Table for Full Subtractor**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **A** | **B** | **C** | **D** | **Br** | **D** | **Br** | |  |  |  |  |  |  |  | | 0 | 0 | 0 | 0 | 0 | – | – | | 0 | 0 | 1 | 1 | 1 | A’B’C | A’B’C | | 0 | 1 | 0 | 1 | 1 | A’BC’ | A’BC’ | | 0 | 1 | 1 | 0 | 1 | – | A’BC | | 1 | 0 | 0 | 1 | 0 | AB’C’ | – | | 1 | 0 | 1 | 0 | 0 | – | – | | 1 | 1 | 0 | 0 | 0 | – | – | | 1 | 1 | 1 | 1 | 1 | ABC | ABC | |
| **From the truth table (with steps):**  **Bout=A’Bin + A’B +B Bin**  **Diff=Bin(A’B’+AB) + Bin’(AB’+A’B)**  **Example:**   |  |  |  | | --- | --- | --- | | 1) 710 -210 = 510 | |  | | 7 |  | 0111 | | 2 |  | 0010 | | 1’C of 2 | | 1101 | |  |  | + 1 | | 2’C of 2 | | 1110 |   0111 + 1110 1 0101  **Pin Diagram IC7483** |
| **Adder**  7483 Datasheet  **Subtractor**  Binary Adders and Subtractors |
| **Post Lab Subjective/Objective type Questions:**   1. Design a full adder using two half adders.   WhatsApp Image 2023-08-13 at 16.03.23 (2).jpeg  WhatsApp Image 2023-08-13 at 16.03.23 (3).jpeg  2.Perform the following Binary subtraction with the help of appropriate ICs:   * 1. 6-4   2. 5-8   3. 7-9 |

|  |
| --- |
| **WhatsApp Image 2023-08-13 at 16.03.23.jpeg** WhatsApp Image 2023-08-13 at 16.03.23 (1).jpeg |

| **Conclusion:** |
| --- |
| WhatsApp Image 2023-08-13 at 16.03.23 (4).jpeg |

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