Objective:

(i) To understand the behavior of a combinational multiplier by designing and analyzing its module.

(ii) To implement a multiplication unit based on the theoretical concepts and a given logic diagram.

(iii) To verify the multiplication process by checking its input bits and sum outputs.

Equipment List:

(i) Trainer Board

(ii) 4X 7408 AND IC

(iii) 3X 7483 or 74283 4-bit Adder IC

(iv) Wires for connection

Block Diagram:

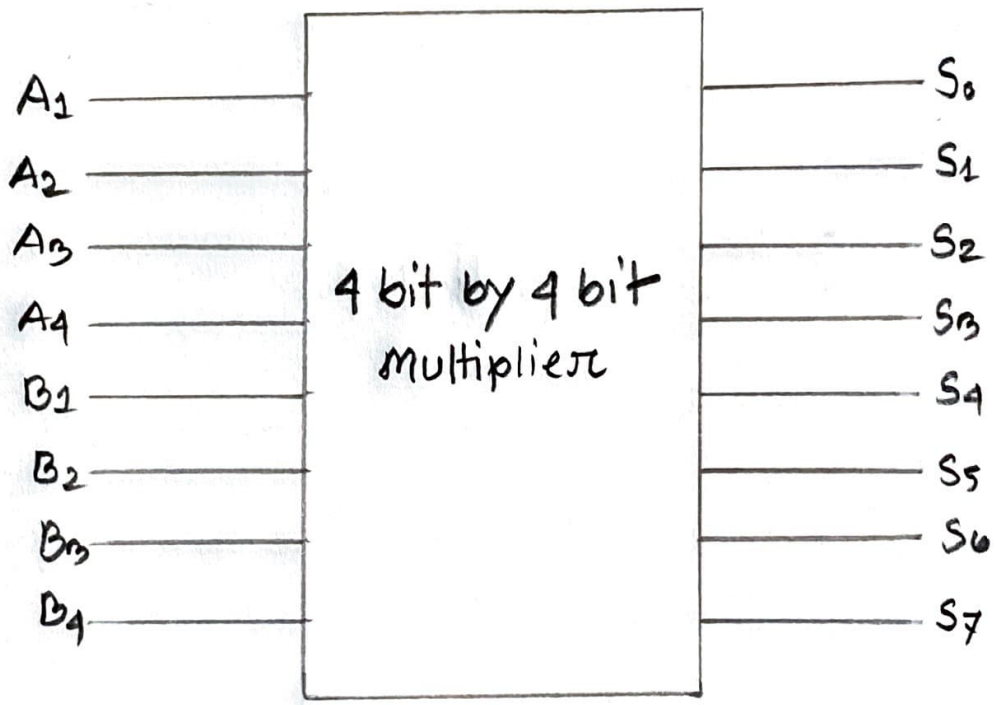

Fig: 4 bit by 4 bit multiplier.

Table 1: Theoretical

multiplicand				multiplier				product								Result in Decimal
B_4	B_3	B_2	B_1	A_4	A_3	A_2	A_1	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	
0	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	10
0	1	1	1	0	0	1	1	0	0	0	1	0	1	0	1	21
0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	32
0	1	0	1	0	1	1	0	0	0	0	1	1	1	1	0	30
1	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	36
1	1	1	1	1	0	1	1	1	0	1	0	0	1	0	1	165
1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	72

Table 2: Experimental

multiplicand				multiplier				product								Result in Decimal
B_4	B_3	B_2	B_1	A_4	A_3	A_2	A_1	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	
0	1	0	1	0	0	1	0	0	0	0	0	1	0	1	0	10
0	1	1	1	0	0	1	1	0	0	0	1	0	1	0	1	21
0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	32
0	1	0	1	0	1	1	0	0	0	0	1	1	1	1	0	30
1	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	36
1	1	1	1	1	0	1	1	1	0	1	0	0	1	0	1	165
1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	72

Logic Circuit Diagram:

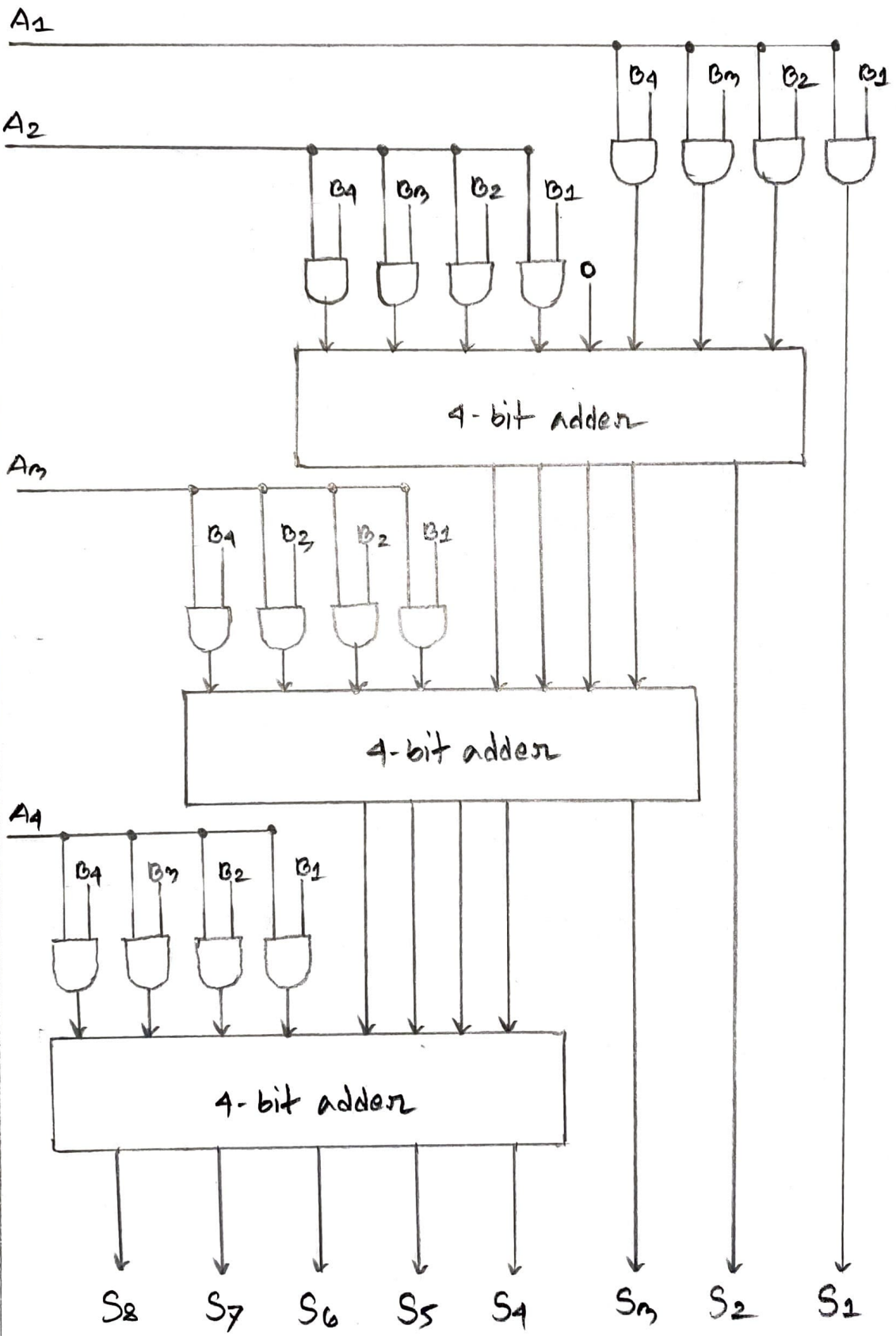

Fig: A 4 bit by 4-bit Binary multiplier

Discussion:

In this experiment, we built a 4-bit by 4-bit binary multiplier using AND logic gates and the binary adders. First, we created and tested the a truth table to predict the expected outcomes. Then we designed the circuit in Logisim to make sure it worked correctly. After that, we implemented it on a trainer board, connected all the necessary components and recorded the result.

While working on the circuit, we faced some issues. Some of the output values were wrong because of loose wire and faulty IC's. Also, the electricity was not stable during the experiment which caused a bit of a hassle for us.

To fix these problems, we checked and secured all wried connection and replaced and faulty IC's. We also tested each part of the circuit separately before putting everything together. This step by step approach helped us get the correct results, which matched our theoretical calculation.