

# Lab Report 4

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## Experiment 4 - Arithmetic and Logic Unit (ALU)

### **Objective:**

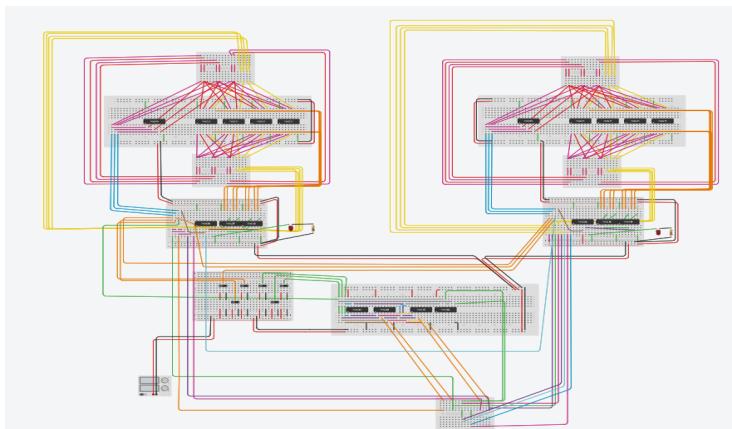
Designing, assembling and testing an Arithmetic and Logic Unit capable of performing 8 arithmetic operations.

### **Electronic Components Required:**

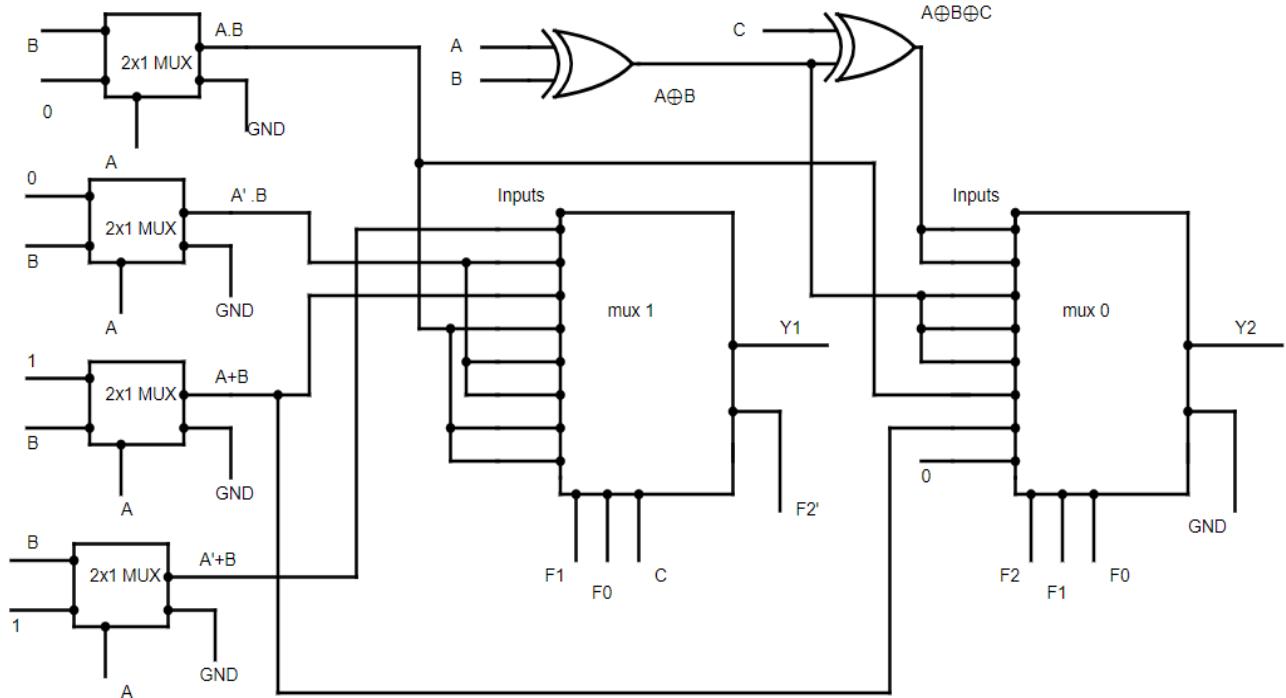
1. Digital Test Kit
2. 74LS151 IC 8:1 MUX
3. 74LS157 IC Quad 2:1 MUX
4. 74HC86 IC XOR Gate
5. Voltage Supply
6. Normal Wires

### **Reference Circuit:**

1. Tinkercad Screenshot



## 2. Circuit Diagram



### Procedure:

1. Connect two 8-to-1 MUX ICs and 1 Quad 2-input MUXs to the breadboard.
2. Connect the VCC and GND of the breadboard to the ICs.
3. Make all the connections to the ICs as per the reference diagram.
4. Observe outputs of MUX 0 and MUX 1 for all combinations of input and tabulate your observations.

Note: In the lab, we used switches instead of Arduinos to give inputs for the ALU.

## Observations:

The following Truth Table was noted down

$F_2 F_1 F_0$	Operation	$Y_1$ (Output of MUX <sub>1</sub> )	$Y_0$ (Output of MUX <sub>0</sub> )
000	Zero	0	0
001	A OR B	0	A+B
010	A AND B	0	A.B
011	A XOR B	0	$A \oplus B$
100	A PLUS B	CARRY	SUM
101	A MINUS B	BORROW	DIFFERENCE
110	A PLUS B PLUS C	CARRY	SUM
111	A MINUS B MINUS C	BORROW	DIFFERENCE

Complete Truth Table:

### 1. Logic Operations

$F_2 F_1 F_0$	Operation	A	B	$Y_0$
000	0	X	X	0

$F_2 F_1 F_0$	Operation	A	B	$Y_0$
001	A+B	0	0	0
		0	1	1
		1	0	1
		1	1	1

<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>Y<sub>0</sub></b>
010	A.B	0	0	0
		0	1	0
		1	0	0
		1	1	1

<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>Y<sub>0</sub></b>
011	A $\oplus$ B	0	0	0
		0	1	1
		1	0	1
		1	1	0

## 2. Arithmetic Operations

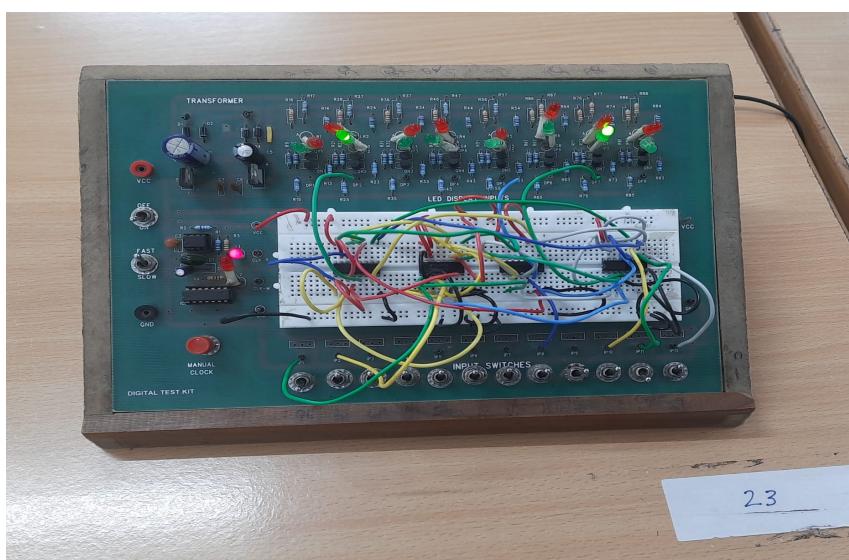
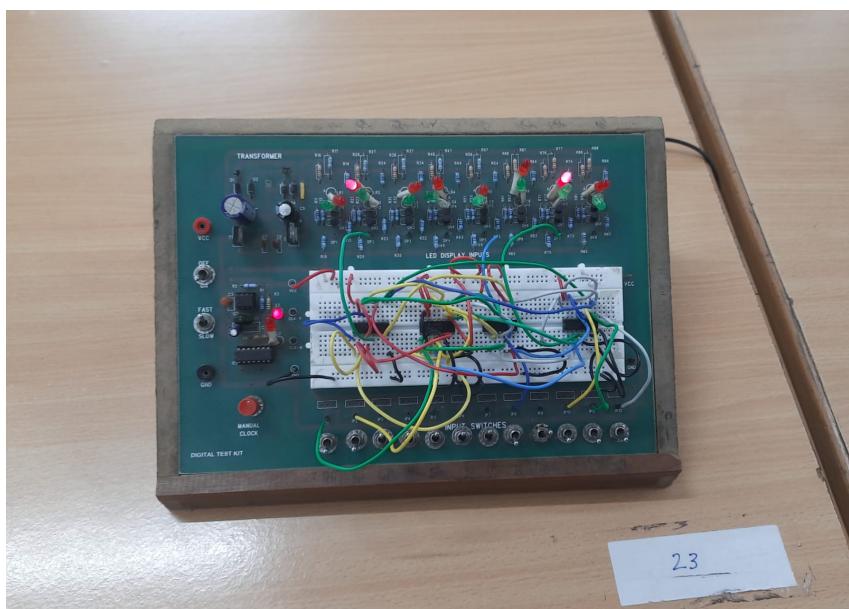
<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>Y<sub>1</sub></b>	<b>Y<sub>0</sub></b>
100	A PLUS B	0	0	0	0
		0	1	0	1
		1	0	0	1
		1	1	1	1

<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>Y<sub>1</sub></b>	<b>Y<sub>0</sub></b>
101	A MINUS B	0	0	0	0
		0	1	1	1
		1	0	0	1
		1	1	0	0

<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>Y<sub>1</sub></b>	<b>Y<sub>0</sub></b>
110	A PLUS B PLUS C	0	0	0	0	0
		0	0	1	0	1
		0	1	0	0	1
		0	1	1	1	0
		1	0	0	0	1
		1	0	1	1	0
		1	1	0	1	0
		1	1	1	1	1

<b>F<sub>2</sub>F<sub>1</sub>F<sub>0</sub></b>	<b>Operation</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>Y<sub>1</sub></b>	<b>Y<sub>0</sub></b>
110	A MINUS B MINUS C	0	0	0	0	0
		0	0	1	1	1
		0	1	0	1	1
		0	1	1	1	0
		1	0	0	0	1
		1	0	1	0	0
		1	1	0	0	0
		1	1	1	1	1





## **Conclusions:**

We have created an Arithmetic and Logic Unit that does basic arithmetic operations.

## **Link for Tinkercad Simulation:**

<https://www.tinkercad.com/things/hmas4lTa9Rr-epic-alis/editel?sharecode=97VmxFc-7MaxHsrD03lFcCW--w91Uzng9vILveHFPU>