UNIVERSITY OF ASIA PACIFIC

Department of Computer Science & Engineering

Course Title – Digital Logic & System Design Lab

Course Code – CSE 210

Experiment No. – 09

Experiment name – Design & Implement 4-bit ALU.

SUBMITTED BY

Shawan Das.

ID – 19101020

Section – A_1

SUBMITTED TO

Shammi Akhtar

Assistant Professor,

University of Asia Pacific

Date of Performance – 16-03-2021

Date of Submission – 22-03-2021

PROBLEM STATEMENT:

a) Design & Implement 4-bit ALU(Arithmetic & Logic Unit.

OBJECTIVE: The objective of the experiment is to design implement logic expression and diagram of 4-bit ALU including function table.

APPARATUS:

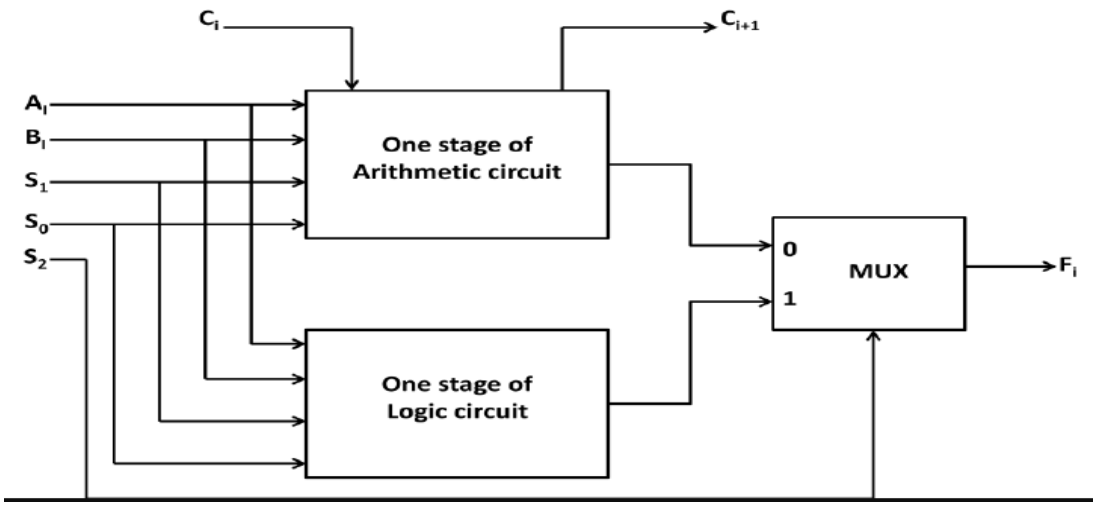
- IC-7408(AND Gate)
- IC-7432(OR Gate)
- IC-7404(NOT Gate)
- IC-7486(X-OR)
- IC-74257
- IC-74153
- Logic Display
- Logic Switch

INTRODUCTION:

An arithmetic logic unit (ALU) is a digital circuit used to perform arithmetic and logic operations. ALU has two parts. First one is Logic unit using logic gates. And second part is Arithmetic unit using Full Adder.

An ALU performs basic arithmetic and logic operations. Examples of arithmetic operations are addition, subtraction, multiplication, and division. Examples of logic operations are comparisons of values such as NOT, AND & OR.

BLOCK DIAGRAM:



FUNCTION TABLE:

Function selectors			Input to Adders		Output	Output
S	**S_1**	**S_0**	**C_{in}**	**B**		
0	0	0	0	0	F = A	Transfer
0	0	0	1	0	F = A+1	Increment
0	0	1	0	B	F = A+B	Addition
0	0	1	1	B	F = A+B+1	Addition with Carry
0	1	0	0	$\bar{B}$	F = A+$\bar{B}$	Add 1's Complement of B to A
0	1	0	1	$\bar{B}$	F = A+$\bar{B}$+1 = A-B	Subtraction
0	1	1	0	1	F = A-1	Decrement (Output Carry Effect)
0	1	1	1	1	F = A	Transfer (Output Carry Effect)
1	0	0	**X**	--	X-OR	--
1	0	1	**X**	--	OR	--
1	1	0	**X**	--	AND	--
1	1	1	**X**	--	NOT	--

VERIFICATION

INPUTS: A= 12, B=10

A_3	A_2	A_1	A_0	B_3	B_2	B_1	B_0
1	1	0	0	1	0	1	0

ARITHMETIC UNIT FUNCTION: S=0

Operation: (S_1 S_0 C_{in})

Operation-1: F = A (A = 12) Output: 1 1 0 0

Operation-2: F = A+1 (12 +1 =13)

Output (1 1 0 1)

A_3	A_2	A_1	A_0
1	1	0	0
		+	1
1	1	0	1

Operation-3: F = A + B (12+10=22)

Output (1 0 1 1 0)

	1	1	0	0
	1	0	1	0
1	0	1	1	0

Operation-4: F = A+B+1 (12+10+1=23)

Output (1 0 1 1 1)

	1	1	0	0
	1	0	1	0
			+	1
1	0	1	1	1

Operation-5: F = A + $\bar{B}$

$\overline{B3}$	$\overline{B2}$	$\overline{B1}$	$\overline{B0}$
0	1	0	1

Output (1 0 0 0 1)

	1	1	0	0
	0	1	0	1
1	0	0	0	1

Operation-6: F=A+$\bar{B}$+1= A-B (12-10=2)

Output (1 0 0 1 0)

	1	1	0	0
	0	1	0	1
			+	1
1	0	0	1	0

Operation-7: F = A-1(Carry Effect)

12-1 = 11

Output(1 1 0 1 1)

	A_3	A_2	A_1	A_0
	1	1	0	0
			-	1
	1	1	0	1	1

Operation-8: F = A(Carry Effect) A = 12

Output (1 1 1 0 0)

LOGIC UNIT FUNCTION: S=1

Operation: (S_1 S_0)

A_3	A_2	A_1	A_0	B_3	B_2	B_1	B_0
1	1	0	0	1	0	1	0

Operation-9: Output (0 1 1 0)

A	1	1	0	0
B	1	0	1	0
X-OR	0	1	1	0

Operation-10: Output (1 1 1 0)

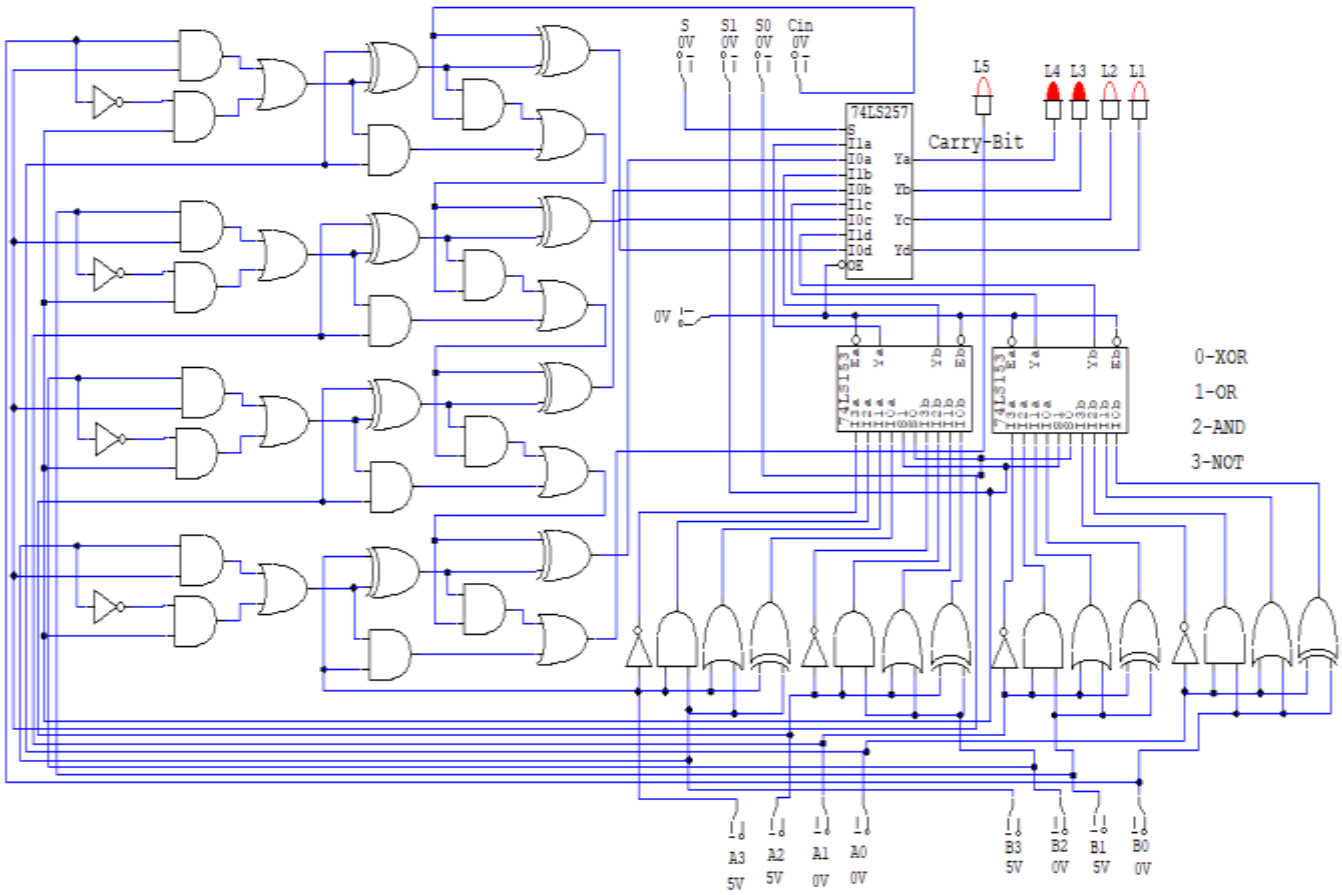
A	1	1	0	0
B	1	0	1	0
OR	1	1	1	0

Operation-11: Output (1 0 0 0)

A	1	1	0	0
B	1	0	1	0
AND	0	0	0	0

Operation-12: NOT operation on input A Output (0 0 1 1)

CIRCUIT DIAGRAM:



DISCUSSION: From this experiment, we learn about the ALU circuit. And how to create an ALU circuit using. Full Adder and two different MUX. We also learn how to use the ALU for performing twelve different logical functions. We have to careful about MUX and their connection. If we connect LU in L1 then we cannot add AU in another L2. We have to maintain this serial. Also, here is lots of wire connection, so should careful about all wires. If any wire sorted with another wire, we will get a wrong output.

So, we should be careful about these points.