Experiment No. 10
Implement ALU design
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Date of Performance:
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Aim: To implement ALU design

Objective : Objective of 4 bit arithmetic logic unit (with AND, OR, XOR, ADD operation):

1. To understand behaviour of arithmetic logic unit from working module.

2. To Design an arithmetic logic unit for given parameter.

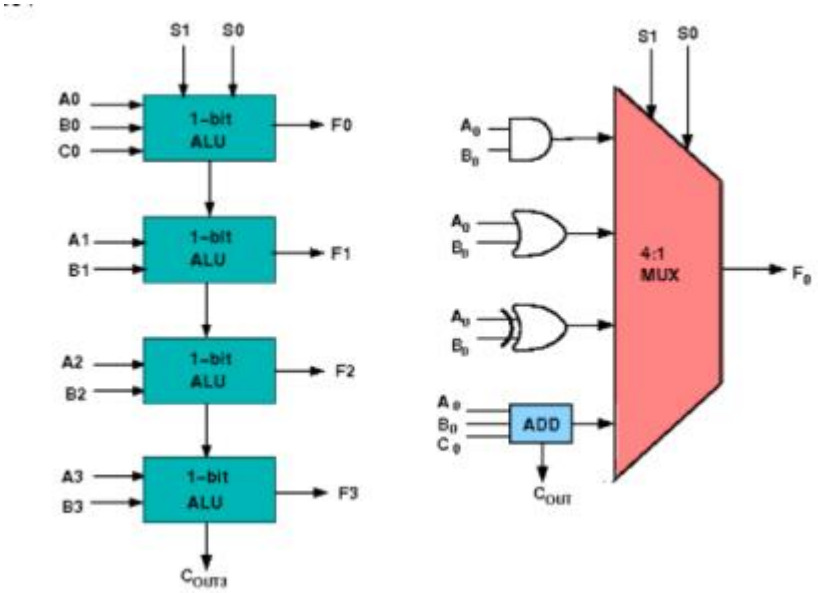
Theory:

ALU or Arithmetic Logical Unit is a digital circuit to do arithmetic operations like

addition, subtraction,division, multiplication and logical oparations like and, or, xor, nand,

nor etc. A simple block diagram of a 4 bit ALU for operations and,or,xor and Add is shown

here :



The 4-bit ALU block is combined using 4 1-bit ALU block

Design Issues :

The circuit functionality of a 1 bit ALU is shown here, depending upon the control

signal S1 and S0 the circuit operates as follows:

for Control signal S1 = 0 , S0 = 0, the output is A And B,

for Control signal S1 = 0 , S0 = 1, the output is A Or B,

for Control signal S1 = 1 , S0 = 0, the output is A Xor B,

for Control signal S1 = 1 , S0 = 1, the output is A Add B.

The truth table for 16-bit ALU with capabilities similar to 74181 is shown here:

Required functionality of ALU (inputs and outputs are active high)

MODE SELECT				F_N FOR ACTIVE HIGH OPERANDS	
INPUTS				LOGIC	ARITHMETIC (NOTE 2)
S3	S2	S1	S0	(M = H)	(M = L) (Cn=L)
L	L	L	L	A'	A
L	L	L	H	A'+B'	A+B
L	L	H	L	A'B	A+B'
L	L	H	H	Logic 0	minus 1
L	H	L	L	(AB)'	A plus AB'
L	H	L	H	B'	(A + B) plus AB'
L	H	H	L	A ⊕ B	A minus B minus 1
L	H	H	H	AB'	AB minus 1
H	L	L	L	A'+B	A plus AB
H	L	L	H	(A ⊕ B)'	A plus B
H	L	H	L	B	(A + B') plus AB
H	L	H	H	AB	AB minus 1
H	H	L	L	Logic 1	A plus A (Note 1)
H	H	L	H	A+B'	(A + B) plus A
H	H	H	L	A+B	(A + B') plus A
H	H	H	H	A	A minus 1

Procedure

1) Start the simulator as directed.This simulator supports 5-valued logic.

2) To design the circuit we need 4 1-bit ALU, 11 Bit switch (to give input,which will

toggle its value with a double click), 5 Bit displays (for seeing output), wires.

3) The pin configuration of a component is shown whenever the mouse is hovered on

any canned component of the palette. Pin numbering starts from 1 and from the bottom left corner (indicating with the circle) and increases anticlockwise.

4) For 1-bit ALU input A0 is in pin-9,B0 is in pin-10, C0 is in pin-11 (this is input carry), for selection of operation, S0 is in pin-12, S1 is in pin-13, output F is in pin-8

and output carry is pin-7

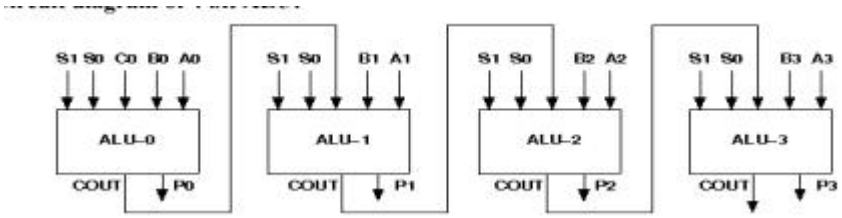
5) Click on the 1-bit ALU component (in the Other Component drawer in the pallet) and

then click on the position of the editor window where you want to add the component

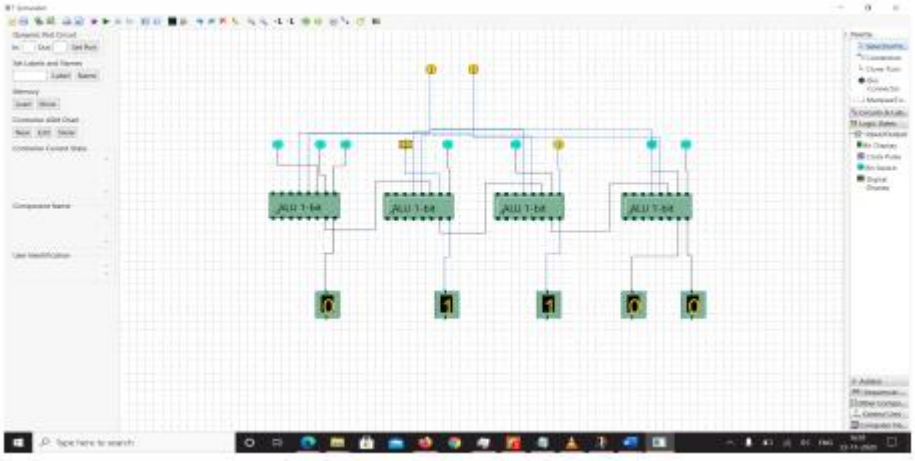
(no drag and drop, simple click will serve the purpose), likewise add 3 more 1-bit ALU (from the Other Component drawer in the pallet), 11 Bit switches and 5 Bit Displays (from Display and Input drawer of the pallet,if it is not seen scroll down in

the drawer), 3 digital display and 1 bit Displays (from Display and Input drawer of the
pallet,if it is not seen scroll down in the drawer)
6) To connect any two components select the Connection menu of Palette, and then click
on the Source terminal and click on the target terminal. According to the circuit diagram connect all the components. Connect the Bit switches with the inputs and Bit
displays component with the outputs. After the connection is over click the selection
tool in the pallete.
7) See the output, in the screenshot diagram we have given the value of S1 S0=11 which
will perform add operation and two number input as A0 A1 A2 A3=0010 and B0 B1
B2 B3=0100 so get output F0 F1 F2 F3=0110 as sum and 0 as carry which is indeed
an add operation.you can also use many other combination of different values and
check the result. The operations are implemented using the truth table for 4 bit ALU
given in the theory

Circuit diagram of 4 bit ALU:



Components required :
To build any 4 bit ALU, we need :
AND gate, OR gate, XOR gate
Full Adder,
4-to-1 MUX
Wires to connect.
Screenshots of ALU design:



CONCLUSION:

Designing and implementing an Arithmetic Logic Unit (ALU) is fundamental in digital computing. It serves as the computational core of processors, performing essential arithmetic and logical operations. Efficiency, flexibility, and customization are key considerations in ALU design, impacting overall system performance. Advancements in ALU design continue to drive progress in computing technology, underscoring its significance in the field.