

**Lab Manual**

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Experiment No: 05**Experiment Name: Design of an ALU****Introduction:**

An ALU (arithmetic-logical unit) is a combinational circuit capable of computing a variety of arithmetic and logical functions. ALU is the brawn of the computer, the device that performs the arithmetic operations like addition and subtraction or logical operations like AND and OR. This section constructs an ALU and illustrates how combinational logic works. Because the MIPS word is 32 bits wide, we need a 32-bit-wide ALU. It can be done by connecting 32 1-bit ALUs to create the desired ALU. We'll therefore start by constructing a 1-bit ALU. But to make things simpler we will build a 16-bit wide ALU by later connecting 16 copies of 1-bit ALU.

Objective:

We will have following objectives to fulfill:

- 1) Build 1-bit ALU with specific set of instructions
- 2) Incorporate equality check (zero signal).
- 3) Build 16-bit ALU by connecting 16 one-bit ALU.

Experiment Details:

Assume, a 16-bit ISA with following fields. The formats of the instruction are as follows:

R-type

op (4 bit)	rs (4 bit)	rt (4 bit)	rd (4 bit)
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I-type

op (4 bit)	rs (4 bit)	rt (4 bit)	immediate (4 bit)
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J-type

op (4 bit)	Target (12 bit)
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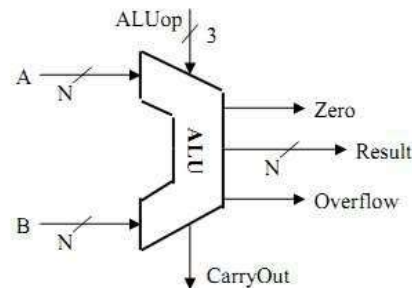
Functional Specifications:

Inputs: 2x16 bit operands – A, B. 1 bit carry input – Cin

Outputs: 1x16 bit result – S, 1 bit Carry Output – Cout

Operations: Add, Sub, And, Or

Functional Specification of the ALU



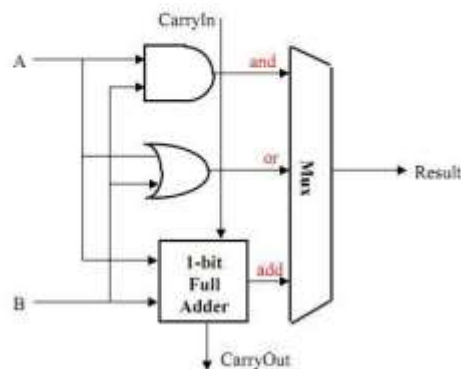
Equipment/Tool
Logisim Tool

1 Bit ALU:

Following is the diagram of 1-bit ALU.

A One Bit ALU

= This 1-bit ALU will perform AND, OR, and ADD



Task Lists

1. Implement the above diagram in logisim. Label each of the input/output/mux selections. Create a table showing necessary control selections required for the execution of each instructions. Create a subcircuit of 1 bit ALU.
2. Incorporate SUB instruction into this. Update the table.
3. Build 16 bit ALU based on this. Create a subcircuit for the 16 bit ALU

Assignment:

1. Design 16bit ALU using 1bit ALU in Logisim. Submit logisim (.circ) file in Google Classroom within the given time by your lab instructor.
2. Prepare and submit the lab report by 11:59 pm today in Google Classroom individually. In the report, you have to include the Screenshot of the circuit as a Circuit Diagram. The screenshot must contain your name and ID along with the circuit.

****Plagiarism and late submission will not be acceptable.**