

JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY, GUNA
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Course: Computer Organization & Architecture Lab
Course Code: 18B17CI474
B. Tech. (CSE VI Sem.)
Experiment # 6

Aim: Design of Arithmetic Logic Shift Unit.

An arithmetic logic shift unit (generally known as ALU) is one of the important units of the central processing unit (CPU) of a computer system. It does all processes related to arithmetic and logic operations that need to be done on instruction words. In some microprocessor architectures, the ALU is divided into the arithmetic, logic and shift units. The design and implementation of the ALU is an important architecture design problem. Block diagrams of four operations ALU with two control (select) lines are shown here below:-

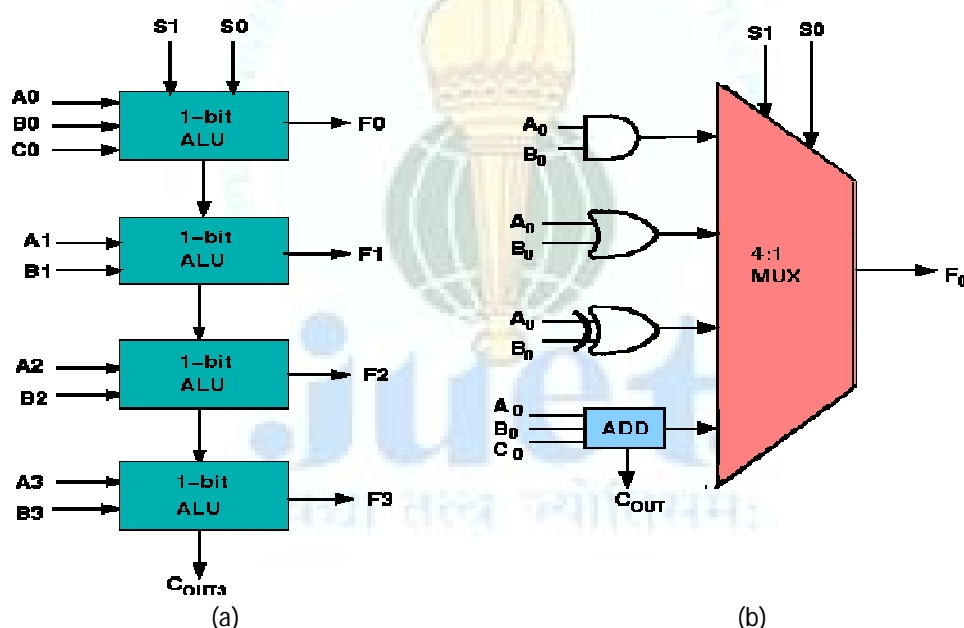


Fig. 1: Block diagrams (a) 4-bit-4-operation ALU (b) 1-bit-4-operation ALU

Exercise#1: Design and verify N-bit, 8-operations (given in Table) Arithmetic Logic Shift Unit as shown in block diagram of figure-2.

Control Signals	Operations
$S_2S_1S_0$	Arithmetic Operations
000	Transfer : $F = A$
001	Subtract: $F = A - B \ (A + \overline{B} + 1)$
010	Addition: $F = A + B$
011	Decrement: $F = A - 1$
Logical Operations	
100	XOR: $F = A \oplus B$
101	2's complement of A: $F = \overline{A} + 1$
Shift Operations	
110	Circular right shift of A: $F = cir A$
111	logical left shift of A: $F = shl B$

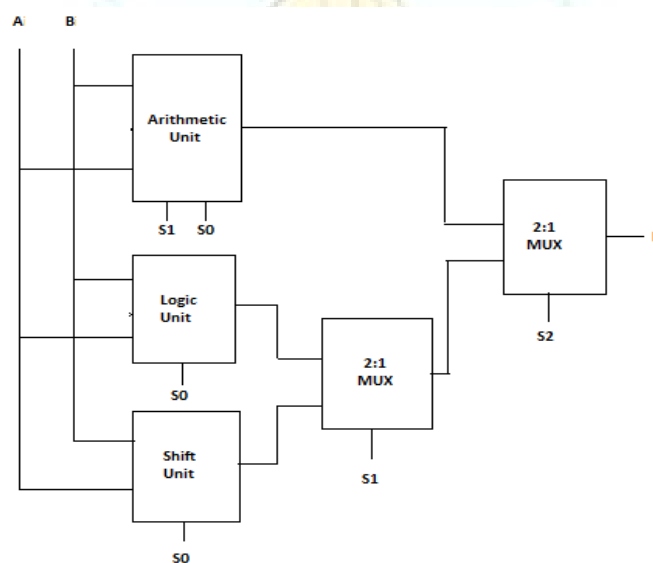


Figure-2: Block diagram of N-bit, 8-operation ALU

Steps to be followed to design ALU:-

- Include following two additional libraries to perform arithmetic operations directly:
`use IEEE.STD_LOGIC_ARITH.ALL`
`use IEEE.STD_LOGIC_UNSIGNED.ALL`
- Take control signals and input/output signals in the form of bus.
- Design arithmetic, logical and shift operator modules individually using **behavioral style of architecture**.
- Use all these three design modules as components in the **structural style of architecture** for the final design of ALU.