**9. Design a simple 8-bit ALU with 4 basic functionalities (add, subtract, multiply & Left-Right shifting) with signed option and incorporate the memory concept of question 3.**

**ALU**

* I made an ALU with addition, subtraction , multiplication , division,

Left-shift, right-shift.

*sel = 3’d0 -> addition*

*sel = 3’d1 -> subtraction*

*sel = 3’d2 -> Multiplication*

*sel = 3’d3 -> Division*

*sel = 3’d4 -> Left shift of a by 1*

*sel = 3’d5 -> Right shift of a by 1*

*sel = other -> output is zero*

* Inputs a[7 ] and b[7] are sign bits
* Output c[8] is sign bit
* I’ve considered all possible sign combinations of a and b to make sure result is correct.
* Each operator is tested and simulation screenshot is provided

**FULL\_DESIGN**

* A top wrapper is made for bram and the ALU
* Test stimulus is given from test bench and Output of ALU is stored in bram

**TEST STIMULUS**

***a = 5 and b = - 8***

**ADDITION**

sel = 0

output = 5 + (- 8) = -3

**SUBTRACTION**

Sel = 1

Output = 5 – (-8) = +13

**MULTIPLICATION**

Sel = 2

Output = 5 \* (-8) = -40

**DIVISION**

Sel = 3

Output = 5 / (-8) = 0

**LEFT SHIFT**

Sel = 4

Output = 5 << 1 = 000001010

**RIGHT SHIFT**

Sel = 5

Output = 5 >> 1 = 000000010

*All outputs are correct and then stored in bram.*