

## Lab 1 Handout

### Objectives:

Learn the design of ALU and Register Files which are the two main building blocks in a CPU. Refer to the “SMILE\_CPU\_lab1.ppt”

### Practical:

Please complete the following exercises.

1. Design a 32-bit ALU that could perform the following arithmetic and logic operations:
  - Logic operations: AND, OR, XOR, NOP
  - Arithmetic operations: ADD, SUB
  - Shift & Rotate operations: SLL (Shift Left), SRR (Shift Right), RLL (Rotate Left) and RRL (Rotate Right)
  - a) Please write down the function table which describes the inputs, outputs and the control lines.
  - b) Modify the reference code for ALU and make it work. Then write a testbench to verify the correctness of the ALU.
2. Design a 32-bit register file contains 32 registers.
  - a) Please write down the function table which describes the inputs, outputs and the control lines.
  - b) Modify the reference code for register file and make it work. Then verify the register file using a testbench.
3. Design a datapath unit using the 32-bit ALU and 32-bit register file designed in (1) & (2). The datapath unit should be able to carry out the following operations:
  - a. Read and store data into the register file
  - b. Execute the ALU operations using the data from register file
  - c. Store the result back into the register file.