

ELEC 205 Design Assignment 4

Due by 29 May 2025

ASM Design Problem Statement

Design a simple calculator with the following specifications.

1. The circuit should be an ASM design to construct a non-programmable datapath and control unit.
2. The circuit should take two 4-bit binary numbers **X** and **Y**, represented in the two's complement system, as input and perform each of the following operations with indicated outputs:
 - a. Addition: **X + Y**, 4-bit result, 1-bit carry out, 1-bit overflow
 - b. Subtraction: **X - Y**, 4-bit result, 1-bit carry out, 1-bit overflow
 - c. Computation-1: **2X + Y/2**, 4-bit result
 - d. Computation-2: **X/2 - 2Y**, 4-bit result
3. The operation type should be a 2-bit input (00 for addition, 01 for subtraction, 10 for computation-1, 11 for computation-2).
4. There should be a 1-bit start input (push-button) with an active high for starting the operations. After the two 4-bit inputs and the 2-bit operation type have been set, activating the start input should initiate the computation.
5. The result should be displayed in a seven-segment display only after the computation is finalized.
6. The circuit should be implemented using D flip-flops, registers/counters, adders/subtractors, combinational logic circuits, and a clock signal.

Tasks

Grading will be based on the following components.

- a) (10 pts) Pseudo-code of your algorithm.
- b) (20 pts) ASM chart of your design.
- c) (20 pts) Datapath design with a clear list of components and input/output signals.
- d) (20 pts) Control unit design with output functions that derive inputs of the datapath.
- e) (20 pts) Schematic entry of your designed circuit in Logisim. Include a screenshot of your schematic entry in your report.
- f) (10 pts) Simulation of your design and verification of the functionality in Logisim. Include screenshots in your report.

Submission

Submit the following files:

- Your report in PDF format, documenting your design and screenshots of your Logisim circuit.
- Your complete Logisim circuit file (.circ).