EE 361L Digital Systems and Computer Design Lab

Credits: 1

Categorization of credits: Engineering topic

Instructor's or course coordinator: Galen Sasaki, Jan. 9, 2021.

Designation: Required by Computer Engineering, Elective for Electrical Engineering

Text Book and Other Required Materials: There are lab handouts and the following textbook is required: "Logic Design and Verification Using SystemVerilog (Revised)" by Donald Thomas. The following textbook is a reference: "Computer Organization and Design: The Hardware/Software Interface: ARM Edition" by Patterson and Hennessey.

Catalog Description: EE 361L Digital Systems and Computer Design Lab (1) (1 3-hr Lab) Laboratory for 361, experiments on digital systems and interfacing. Co-requisite: 361.

Pre- and Co-requisites: Co-requisite: EE 361 Digital Systems and Computer Design

Class/Lab Schedule: one 3-hr lab session per week.

Topics Covered:

Lab assignments:

- Microcontrollers: Introduction to micro-controllers, e.g., PIC 16F684A, including design applications and tools such as MPLab. There is a design assignment and an assignment that includes interrupts.
- CPU Presentations: Research project on processors (e.g., Intel and ARM processors) resulting in a written report and an oral (Powerpoint) presentation in a lab period.
- Hardware Description Language (HDL) and Field Programmable Gated Arrays (FPGAs): Introduction assignments to design and implement combinational and sequential circuits using HDL and FPGAs. Tools used are HDL functional simulators (e.g., Xilinx Webpack and EDA Playground) and FPGA tools (e.g., Xilinx Webpack and Digilent Basys3 FPGA boards).
- Computer Design and Implementation: Design and implement a five-stage, pipelined computer. Tools used are HDL functional simulators and FPGA tools.

The lab assignments are done in teams of 2, though there are cases when the teams have 3 members.

Course Objectives and Relationship to Program Objectives:

The course objectives are (*i*) to apply micro-controllers to design, (*ii*) design and implement computer circuts, (*iii*) research issues of processor design, (*iv*) understand and apply HDL and FPGA technologies and tools, (*v*) understand and implement a processor, (*vi*) write technical reports, and (*vii*) give a clear oral presentation on a technical topic.

The laboratory course addresses the following Program Objectives: 1, 2, 3, 4, 5.

Course Outcomes and Their Relationship to Program Outcomes

The following are the course outcomes and the subset of Program Outcomes (numbered 1-8 in square braces "[ ]") they address:

- Apply micro-controllers to design problems. At least one design should include interrupts. [1,2,7,8]
- Design using HDL and FPGAs. [1,2,7,8]
- Design and implement a processor using HDL and FPGAs. [1,2,7].
- Know how to use design tools including functional simulators, logic synthesizers, and hardware description languages (e.g., VHDL and SystemVerilog). [7]
- Research a processor and give written and oral reports about its important features. [1,2,7]
- Write clear technical reports. (The course is Writing Intensive (WI).) [3]
- Know how to work in a team. (Lab assignments require group work.) [5]

Contribution of Course to Meeting the Professional Component

Engineering topics: 60%. Technical Writing: 40%

Computer Usage: Computers are used in all lab assignment except Assignment 1. Software tools are used for the micro-controllers, HDL, and FPGAs. Powerpoint is used in oral presentations. The Internet is used for research and getting information from the course's web site.

Design Credits and Features:

The course has 1 design credit. With the exception of Assignments 1 and 3, all laboratory assignments are design oriented. Therefore, we assign 1 design credit out of the 1 credit hour of the lab.