EE 361L Digital Systems and Computer Design Lab

Designation: Elective

Catalog Description: EE 361L Digital Systems and Computer Design Lab (1) (1 3-hr Lab)

Credits: 1

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:
The laboratories are organized as follows, where each lab assignment covers one or more lab sessions (3 hrs/session).

- Introduction. There is an introductory lab session covering procedures. There is no assignment
- Measurement of TTL characteristics. Measurement of voltages and current of different TTL logic gates, followed by calculating characteristics such as fan-out and fan-in.
  - Assignment 1 [1 lab session = 3 hrs]: The measurement and calculation of characteristics are covered.
- Micro-controllers. An introduction to micro-controllers, e.g., PIC16F84A, including design applications.
  - Assignment 2.1 [1 lab session = 3 hrs]: An introduction to the micro-controllers including tutorials on compiler, programming procedures, simulation tool, and debugging.
  - Assignment 2.2 [1 lab session = 3 hrs]: One or two design projects using the microcontroller
  - Assignment 2.3 [1 lab session = 3 hrs]: Design projects that involve interrupts. CPU Presentations.
  - Assignment 3 [2 lab session = 6 hrs]: Research project on processors (e.g., Intel Pentium) resulting in a written report and oral (powerpoint) presentation. The total duration is 4-5 weeks but much of the work is done outside of class. A lab session is for a tutorial on processors by the lab instructor, and another lab session is for the oral presentation by students.
- Hardware description language (HDL) and field programmable gated arrays (FPGAs).
  - Assignment 4.1 [1 lab session = 3 hrs]: Introduction to HDL (e.g., verilog) and FPGAs.
  - Assignment 4.2 [1 lab session = 3 hrs]: Design project using HDL and programming an FPGA.
- Multi-cycle CPU design and implementation.
  - Assignment 5 [4-5 lab sessions = 12-15 hrs]: Design a RISC processor (e.g., multi-cycle MIPS) using HDL. The objective is to write synthesizable code and to correctly configure an FPGA.

Textbook and Other Required Materials:
No textbook, but there are handouts and lab assignment documents. The majority of these
handouts and documents are on the laboratory’s web site.

**Course Objectives and Relationship to Program Objectives:**
The course objectives are (i) to apply micro-controllers to design, (ii) research issues of processor design, (iii) understand and apply HDL and FPGA technologies and tools, (iv) understand and implement a processor, (v) write technical reports, and (vi) 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 1-11 in square braces "[ ]") they address:

- Measure and calculate characteristics of digital circuits. [2]
- Apply micro-controllers to design problems. At least one design should include interrupts. [1,3,5,11]
- Design using HDL and FPGAs. [3,5,9,11]
- Design and implement a processor using HDL and FPGAs. [1,3,5,7,11].
- Know how to use design tools including functional simulators, logic synthesizers, and hardware description languages (e.g., VHDL and Verilog). [9,11]
- Research a processor and give written and oral reports about its important features. [1,3,5,7,9,11]
- Write clear technical reports. (The course is Writing Intensive (W).) [7]
- Know how to work in a team. (Lab assignments require group work.) [4]

**Contribution of Course to Meeting the Professional Component**
Engineering topics: 100%

**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 Assignment 1, all laboratory assignments are design oriented. Therefore, we assign 1 design credit out of the 1 credit hour of the lab.

**Instructor(s):** T. Dobry, Y.F. Dong, L. Macchiarulo, G. Sasaki, X. Zhou.

**Person(s) Preparing Syllabus and Date:** G. Sasaki, November 25, 2008