Principles of Customized VLSI Design

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CS 45111 / 55111

Instructor

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Teaching Assistant

none

Course Prerequisites

The *1999-2000 Undergraduate Catalog* lists the prerequisites for this course as *CS 4/5101 Computer Architecture*; an equivalent course taken elsewhere is also acceptable.

Course Overview

The goal of this course is to provide a "computer science"-oriented introduction to VLSI design.

In a computer engineering program, students might take a semester or two of logic design at the sophomore level, followed by several senior- or graduate-level courses on the internals of a VLSI chip, the use of Computer-Aided Design (CAD) tools, and the algorithms employed by those tools. Furthermore, those courses would be supplemented by additional courses in circuit design, electronics, quantum physics, and computer architecture.

Since we do not have 5-10 semesters of work time available to us in this course, or the benefit of a computer engineering background, this course will concentrate on providing an overview of the VLSI design process, and practical training using CAD tools for the design of digital circuits using Field-Programmable Logic Devices (FPLDs).

Textbook

Several textbooks will be used in this course.

The first textbook is required, and will be used for over half of the course:

- *Digital Systems Design and Prototyping Using Field Programmable Logic*, Zoran Salcic and Asim Smailagic, Kluwer Academic Publishers, 1997.

This textbook includes a copy of the Altera Max+PlusII software on a CDROM at the end of the book, you can install it on your home PC if you have one. However, a copy of this software will also be installed on the HP workstation "vlsi.mcs.kent.edu" and on several PCs in the VLSI Design Laboratory (MSB 353), so having a home PC is not a requirement for this course.

The second textbook is listed as "optional". It would be desirable for you to buy it, but since buying two textbooks is sometimes hard, and we won't be using it for a prolonged period, perhaps you can share a copy with someone else in the class:

- *Rapid Prototyping of Digital Systems*, James O. Hamblen and Michael D. Furman, Kluwer Academic Publishers, 2000.

This textbook is primarily a lab manual — it shows you how to use the Altera Max+PlusII CAD tool and the prototyping board that we will be using for projects. The CDROM at the back of this book also has a slightly newer version of this software than the Salcic book, but either version will suffice for our purposes.

The third and final textbook is not required, but I will use it for several lectures at the beginning of the course:

- *Application-Specific Integrated Circuits*, Smith, Addison-Wesley, 1997.

Normally, I would not point out that this book exists, as I often use a variety of additional textbooks in preparing my lectures, and I would be afraid that, by listing those additional books on my syllabus, some students might think that I was somehow suggesting that they should buy those books as well. In this case, however, I will make an exception because Prof. Smith has very generously put *the entire textbook* online. According, when I cover material from this book, you might want to read the online version of that material as well; a link to the book is on the class web page.

Class Web Page

The web page for this class is **http://www.mcs.kent.edu/~walker/classes/vlsi.s00** (links to this page, and to my other classes, are all available on my home page). The web page will contain links to the following course materials:

- Current class syllabus and schedule
- Lecture notes (in PostScript and Adobe PDF format, printed 4-up)
- VLSI design project assignments
- Exam solutions

Other information may be included as well. You might want to check the web page on a regular basis, in particular when a project is outstanding.

Lectures

Students are expected to attend each lecture. I will not take roll, and I understand that it may occasionally be necessary to miss a class, but in general I expect you to attend each lecture

At each class, I will hand out one sheet of paper containing reduced copies of *at most eight* of my slides for that lecture. If you would like to have reduced copies of *all* of my slides for that lecture, the full version of the lecture notes will be on the class web page before the lecture, and you can print them out. Note that you are not required to either look at or print out these notes; they are provided solely for your convenience should you want them. However, you should ***not*** consider skimming these notes to be an adequate substitute for attending the lecture, as they will contain only the text of my slides, not the comments that I will make in class.

My lecture notes will be drawn from a variety of sources. The textbooks listed above will serve as a primary reference, although some material will be drawn from other books on logic design, CAD, VLSI design, etc. I may also use lecture notes from other professors as a reference.

VLSI Design Projects

There will be 3 VLSI design projects during the semester. The following information is ***preliminary*** and subject to change, but should give you some idea of what to expect. The first project will be a manual design of a combinational circuit, entered using the schematic capture tools in Max+PlusII. The second project will be a design of a state machine, entered using AHDL or VHDL in Max+PlusII. The third will be a final project of your choice that must satisfy a set of specific requirements. Tentative due dates are shown on the Class Schedule, attached at the end of this syllabus.

Late Policies

In general, you will have adequate time to complete each assignment. However, you should begin work on each assignment early so that you will have plenty of time to become familiar with it and with the CAD tools that you will be using, and so that you will have time to “sleep on” the difficult parts. Waiting until two days before the due date to start the project is a bad idea.

Late projects ***will*** be accepted with a 10% penalty for ***each day or portion thereof*** that the project is late. Other extensions will not be granted, unless you make *prior* arrangements with me, or have a *documented* illness (in which case I expect you to contact me as soon as possible).

Exams

There will be one exam (held during class) and a final exam (held during finals week). The tentative dates for the exams are shown on the Class Schedule, attached at the end of this syllabus. All exams are closed book and closed notes, and must be individual work. It is expected that you take each exam at the scheduled time, unless you make *prior* arrangements with me, or have a *documented* illness (in which case I expect you to contact me as soon as possible).

Academic Integrity

Student-teacher relationships are built on trust. Students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments which students turn in are their own. Acts which violate this trust undermine the educational process. In this course, the penalty for ***any*** act of academic dishonesty is a final course grade of F.

Cooperation on VLSI Design Projects

For both homework assignments and programming projects, I strongly believe that discussion with your peers is an excellent way to learn. If you don't understand something, discussing it with someone who does can be far more productive than beating your head against the wall.

Having advocated discussion, then, I must be about clear what is allowed, and what is not. In general, students are allowed to cooperate as follows: you are allowed to discuss with other students *the assignment*, and *general methods for solving the assignment*. However, you are ***not allowed*** to work with someone else to actually *solve* the assignment, and you are certainly ***not allowed*** to *copy* anyone else's solution; doing any of these things will be considered cheating, and will be grounds for failing the course.

Note that there is a fine line between discussion and cheating. If you are unsure what is allowed and what isn't, feel free to discuss the distinction with me, but if something feels uncomfortable, it's probably not allowed.

Finally, you should be careful not to give others access to your project. This means that you shouldn't keep your program in a publicly-accessible directory, you shouldn't leave your terminal unattended, and you shouldn't forget to pick up your printouts.

Grades

Your final course grade will be broken down as follows:

- VLSI design projects (3) 50% (Project 1 = 10%, 2 = 15%, 3 = 25%)
- Exams (2) 50% (Exam 1 = 20%, Final exam = 30%)

The final course grade will be determined with A = 90–100, B = 80–99.99, etc. There will be no curve at the end of the course, so you should always be able to determine your course grade.

Students With Disabilities

In accordance with University policy, if you have a documented disability and require accommodations to obtain equal access in this course, please contact the instructor at the beginning of the semester or when given an assignment for which an accommodation is required. Students with disabilities must verify their eligibility through the Office of Student Disability Services (SDS) in the Michael Schwartz Student Services Center (672-3391).