Digital Electronics

PHYS 432 - Spring 2007

http://physics.uoregon.edu/~torrence/432/

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Lecture           MWF 12:00-12:50 Willamette 112

Lab schedule
Note: An assigned lab time is not strictly required.
Students are encouraged to work the labs on their own.

Labs
Art of Electronics, 2nd Ed., Horowitz and Hill

Textbook
Student Manual for A of E, Hayes and Horowitz (not required)
A copy of each is on reserve in the Science Library.

Overview

This course will introduce the basic concepts of digital electronics. The emphasis will be on a basic working knowledge of electronics, suitable for experimental research in science. The following topics will be covered:

- binary arithmetic and logic gates
- combinational logic: multiplexers, decoders
- sequential logic: flip-flops, counters
- analog-to-digital (A/D) and D/A conversions
- finite state machines
- programmable logic, microprocessors

Grading

Course grades will be based on six weekly homework assignments (30%), six lab assignments (30%), two exams (10% each), and a final project (20%).
In order to pass the course, you must complete the labs, including the final project.

Syllabus

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<th>Week</th>
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<th>Lab (due Friday)</th>
<th>Homework (due Monday)</th>
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<td>Binary Numbers</td>
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it is worth making sure that you can do all of the homework problems. I reserve the right to not grade every single problem in detail.

- **Homework #1**

**Projects**

A key part of this class is the opportunity for each student to pursue a term project of their own design. This project should contain some digital component, although you can also be some analog components if desired. Possible project ideas include:

- self-leveling tilt-meter
- light-following sensor
- reaction timers/stopwatch
- phase-locked loops
- mastermind game
- arbitrary function generator
- amplifier with programmable gain
- bus connections
- gated ADC
- stepper motor encoder/driver
- bar code reader
- credit card reader

The web is a great resource for project ideas, please start thinking about your projects early!

**Project Proposals**

Project proposals are due Monday May 21st at noon. The proposal should include:

- Description of circuit function
- Block diagram of circuit layout
- Part list if non-standard parts
- References
- Fallback solution

You must get your proposal approved by me before you start. If you turn your proposal in early, you will get to start on your project sooner. It is fine to get a project idea from some external source. Please reference this, however, so I can read the original to get a better idea of the project scope. Your proposals will be graded, but essentially just that you turned the proposal in.

**Project Grading**

The final project grade will be based upon the checkout and the write up. You need to schedule an appointment with me to see your project in action before Friday June 8th at 5PM. The write up, which should consist of your lab book development notes, your amended proposal, and a summary of the problems you had and what you would do differently next time, is due by 3PM on Thursday June 14th in lieu of a final exam. No late reports will be accepted!

The idea, execution, and write up will all be considered in the final project grade. You may feel free to work with another person, but please factorize the problem into identifiable pieces. You need to get this arrangement approved by me in advance.

**Project Tools**

The following lists some basic items which may make your project more interesting and useful. A somewhat complete list of available parts can be found in the JC List. Additional parts can be found in the electronics shop on campus. Your TA can help you with this. There is the possibility of ordering specific parts for projects, but this must be arranged in advance. Come talk to me if you think you may need something special. Norvic Electronics (on West 11th) or web-based suppliers like All Electronics are good sources if you need to buy something yourself (or even to just get some ideas).

- Clocks - 555 timer chips or 10 MHz crystal oscillators are available.
- ADCs - we have some integrated ADC chips available. You do not have to build your own.
- Memory - we have an assortment of SRAM, EPROM, and EEPROM available. You will have to figure out on your own how to use the EPROM burner (although I can help).
- Programmable Logic - We have lots of 16v8 PLAs available.
- PIC Microcontrollers - We have 8-pin 12F676 and 14-pin 16F676 or 16F684 PICs. The 16-series work fine for 8-bit applications and have a bit more memory. We also have a few older 16F84A devices. These have more IO pins, but don't have many of the built-in features, like ADCs or oscillators.
- Microprocessors - we have several Rabbit 2000 microprocessors. For any relatively complex problem, using a microprocessor is probably the best solution. Information is available downstairs or at Rabbit Semiconductor. This is probably only suitable for somebody with previous programming experience, as you don't really have time to learn C as well as how to use the Rabbits.