Physics 405/505 (Digital Electronics Techniques) Syllabus
Prof. Erich Varnes
Fall 2004

Office hours: My office is room 420K in the Physics and Atmospheric Sciences Building, and I will hold office hours on Tuesday from 1-3 pm. If that time is not convenient, you may schedule an alternate time by contacting me at 626-0217 or varnes@physics.arizona.edu

Web page: http://www.physics.arizona.edu/~varnes/Teaching/405-505Spring2005. Homework assignments and solutions and general course information can be found here.

Topics covered: This course is an introduction to electronic techniques used in experimental physics. Topics include op-amps, logic elements and the use of programmable logic. A large emphasis of this course will be on computer-aided schematic capture and simulation. The course will have a one and a half-hour lecture each week accompanied by a three hour lab.

A significant portion of this course will center around computer design and simulation. One tool which will be extensively used is the Electronics Workbench software program which allows one to simulate both analog and digital circuits. This software will allow students to quickly set up and test a variety of circuits. The software will be available in the Physics Department Undergraduate Computer facility (PAS Room 272), which is open 24 hours a day.

The latter part of the course will cover programmable logic. Students will have the opportunity to work with state-of-the-art programming languages and hardware. They will program their own designs, which will then be downloaded into hardware to test their functionality.

Text:
Required:
Cogdell, Foundations of Electronics

Also useful:
Horowitz & Hill, The Art of Electronics
Hamblen & Furman, Rapid Prototyping of Digital Systems

Lab Manual:
Laboratory Manual for Physics 405/505. This manual will be provided during the first week of class.
Prerequisites: Physics 241 or 241H (Introductory Electricity and Magnetism).

Homework: Homework will be assigned each week and is due on Wednesday the week after it is assigned. Since completing the homework is an essential part of preparing for the following lab session, no late homework will be accepted. For students enrolled in Physics 405, the total homework score will make up 40% of the course grade. For those in Physics 505, the homework will make up 30% of the course grade.

Laboratory sessions: A significant fraction of the time commitment for this course will be spent working in the laboratory. During the labs students will have the opportunity to build various circuits to test basic circuit design concepts. The lab work will proceed in three phases throughout the semester. In the first phase, students will use breadboards to test some simple circuits. In the second, students will learn soldering techniques and build circuits on pre-fabricated printed circuit boards. In the final phase, pre-fabricated boards from the Altera Corporation will be used to teach students techniques in programmable logic.

Writeups of the labs will be due the following Monday. The content expected in the reports is specified in your lab manual.

For students enrolled in Physics 405, the total laboratory score will make up 60% of the course grade. For those in Physics 505, the lab will make up 45% of the course grade.

Final project (Physics 505 only): Students enrolled in Physics 505 will be required to complete a final project. This project must use programmable logic and include some of the following components in its design:

- State machine
- Tri-state logic
- Memory or FIFOs
- Arithmetic units

A presentation of the project will be performed during the last week of the semester. Students will be graded on both the design and implementation of the project, and this grade will make up 25% of the course grade.

Students with disabilities who require reasonable accommodations to fully participate in course activities or meet course requirements are encouraged to register with the Disability Resource Center (http://drc.arizona.edu/) and contact me to discuss accessibility issues.

Code of conduct: Students are expected to understand and follow the Student Code of Conduct, which is available at http://w3.arizona.edu/~studpubs/policies/ppmainpg.html.

Schedule of topics:
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<th>Topic(s)</th>
<th>Text</th>
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<tr>
<td>RC and LC circuits</td>
<td>Cogdell, pp 216-229</td>
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<td>Diodes</td>
<td>Cogdell, pp 67-89</td>
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<td>Transistors</td>
<td>Cogdell, pp 89-116</td>
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<td>Feedback and Op-Amps</td>
<td>Cogdell, pp 230-260, 280-294</td>
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<td>D/A and A/D conversion</td>
<td>Cogdell, pp 304-316</td>
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<td>Combinatorial logic</td>
<td>Cogdell, pp 150-161</td>
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<td>Sequential logic</td>
<td>Cogdell, pp 161-172</td>
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<td>Shift registers and buses</td>
<td>Lecture notes &amp; Homework 9</td>
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<td>Design techniques</td>
<td>Lecture notes &amp; Homework 10</td>
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<td>Programmable logic</td>
<td>Lecture notes &amp; Homeworks 11-14</td>
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