Spring 2008 **Syllabus**

Electronics I – Physics 252: Introduction to Analog Circuits

Instructors

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Office hours:

Friday 11:00 – 12:00 (Aubin: rooms 15 and 333)
Thursday 15:00 – 16:00 (Qu)
Monday 15:30 – 16:30 (Simons)

Course Objectives

The primary purpose of this course is to teach you how to design basic analog electronic circuits for connecting one device to another properly and efficiently: this is generally the function of most lab-built electronic circuits.

Along the way, we will also learn how to do basic analog circuit design and to a lesser extent signal acquisition and detection. More specifically, you will learn about the following essential concepts:

- impedance
- amplification
- frequency analysis
- feedback

You will also learn to use the following components and equipment:

- resistors, capacitors, inductors.
- diodes, photo-diodes, transistors, FETs.
- Op-amps, comparators.
- Multimeters, oscilloscopes, function generators.
- Breadboards and soldering irons.
- Modern circuit design and lay-out software.

Texts

There is no official textbook for the course. I will be posting introductory chapters and laboratories created specifically for the course on my website before the lecture. These chapters and labs were originally created by Prof. Jeff Nelson and Prof. Bill Cooke and have been adapted to the current course. While there are many good electronics textbooks, I strongly recommend that you consult the following book frequently for

design tips and concepts: The Art of Electronics (2nd Edition, 1989-1999) by P. Horowitz and W. Hill. It is available in the Physics Library under call number TK7815 .H67 1989. A copy is also available for reading in my office.

Class Format

The class hours are divided into two parts: Lecture and Lab. The lecture will be on Monday 1:00-1:50 pm in room 238, and will cover the concepts to be tested in the lab later in the week. The lab portion of the class will be held on Tuesday 2:00-4:50 pm for Physics 252-02 (20736) and Wednesday for Physics 252-01 (20735).

The labs will be open from 1:00 pm to 6:00 pm for students looking to start early or finish late.

Most labs will include a design component. The designs should be prepared prior to attending lab so as to finish the lab measurements on time.

Evaluations

Your final grade for the course will be determined from the following grading weight distribution:

Notebooks/Lab:	30%
Quizzes/Participation:	15%
Lab Reports:	20%
Midterm:	15%
Final:	20%

Lab books

Your lab book should be a regular style notebook without rings with either line or quadrangle ruling or a computation logbook. It can be obtained at most stationary stores (i.e. Staples, etc …)

Your lab book is the primary record of your work and data. You should record everything that you do in the lab book, so that anyone (such as the instructors and yourself) can understand what you have done and measured. You should include circuit diagrams, observations, questions, answers, design considerations, measurement data, and analysis. Diagrams, data, graphs, and other notes on separate pieces of paper should be glued, taped, or stapled into the lab book. Generally, you cannot write too much down. All notes should be written in pen. Mistakes and errors in design, data ,and analyis will occur, and they should be crossed neatly.

The lab book will be graded on completeness first and neatness second. It should also feature a table of contents. The lab books will be turned in roughly every two weeks and returned before the next lab.

Lab reports

Scientists and engineers communicate their activities and research results through short reports. The instructor will indicate for which labs a lab report is

due: In general, lab reports will be due every other week. The lab report is due by the following Monday in class. Lab books do not need to be submitted for evaluation on Thursday/Friday when a lab report is due the following Monday. However, the lab book results for that week should be complete, since they will be evaluated the following week (along with the following week's material).

The lab report should present what you did in the lab, or some aspect of what you did as long as it encompasses the main theme of the lab. The reports should have the following characteristics and components:

- Typed or printed.
- Short report (max 3 pages single space, but shorter is better).
- Structured with an introduction, a main body, and a conclusion.
- Measurement data should be included in tables and plots.
- All data should be analyzed and interpreted.
- Important measured numbers should include a justified error bar.

Quizzes

There will be frequent 5 minute quizzes at the beginning of lecture and lab to encourage you to review concepts and circuit design.

Midterm test

There will a 1 hour midterm test in lab on February 19-20. There will be a lab session after the midterm.

Final exam

There will be a final exam on April 29 (1:30pm – 4:30pm) covering all course materials.

Due dates/time

Lab books are due by 5pm two days after lab and will be returned by the next lab period (i.e. Thursdays for the Tuesday section and Fridays for the Wednesday section). Reports are due in class the following week.

Late reports or logbooks will have points deducted. If you know you will have a problem getting the report in on time please send us an email as soon as you can to let us know about your situation.

Illness

Please notify the instructor if you are ill, so that arrangements can be made to make up missed labs.

Weekly Topics

Week 0: 1/16 **NO CLASS**

Week 1: 1/22-23 **DC Circuits Basics**
Ohm's Law, Power, network analysis, voltage divider, measurements

Week 2: 1/28-30 **Kirchhoff's Law's and Thevenin's Theorem**
Impedance Matching, Thevenin's Theorem

Week 3: 2/4-6 **Capacitors, Inductors, and Complex Impedance**
Capacitors, inductors, complex impedance, transformers, resonators

Week 4: 2/11-12 **Passive Filters and Transmission Lines**
Filters (RC, Chebychev, Butterworth, etc…), coaxial cables, AM and FM modulation, ground loops

Week 5: 2/18-20 **Diodes**
MIDTERM TEST, diodes, rectifiers, LEDs.

Week 6: 2/25-27 **Transistors 1: BJTs**
Transistors 1: BJTs, gain, amplifiers

---------- Spring Break ----------

Week 7: 3/10-12 **Transistors 2: More BJTs**
Transistors 2: BJTs continued, amplifiers, FETs

Week 8: 3/17-19 **Transistors 3: FETs**
Transistors 3: FETs continued, amplifiers

Week 9: 3/24-26 **Op-Amps 1: Introduction to Op-Amps**
Op-amps 1: Golden rules of op-amps, integrated circuits, simple circuits

Week 10: 3/31-4/2 **Op-Amps 2: detectors, filters, power amplifiers**
Op-amps 2: Op-amp limitations, important circuits

Week 11: 4/7-9 **PID Control Theory**
Feedback: Control theory, PID control

Week 12: 4/14-16 **Electronic Circuit Design Tools**
Design tools (Spice and Eagle).

Week 13: 4/21-23 **Comparators**
Important complex op-amp circuits (comparators, triggers, etc …)

Week 14: 4/29 **(Tuesday, 1:30-4:30)** **FINAL EXAM**