Syllabus
Electronics I – Physics 252: Introduction to Analog Circuits

Instructors

Prof. Seth Aubin
Office: room 333 (3rd floor back hall), tel: 1-3545
Lab: room 15 (basement next to machine shop), tel: 1-3532
e-mail: saubin@wm.edu
web: http://www.physics.wm.edu/~saubin/index.html

Guangzhi Qu, T. A. and grader
Office: 243
Tel: 1-3570

Matthew Simons, T. A.
Office: 314b
Tel: 1-3557

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

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 analysis 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 be 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