PHYS 431: Analog Electronics (Winter 2014)

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Course home page: http://atomoptics.uoregon.edu/~dsteck/teaching/14winter/phys431
Schedule: TTh 2:00-3:20, 318 Willamette, plus a 3-hour lab section (11 WIL)
Course reference number: 26172
Credits: 4
Prerequisites: PHYS 203 or equivalent; knowledge of complex numbers; MATH 256
Links: news, lab sections, course notes, labs/homework sets and keys.

Course overview
As a scientist, your goals in studying electronics are somewhat different than, say, an electrical engineer studying the same subject. Without delving into too much of the details of how electronic components work, you need to have simple conceptual models that will allow you to understand schematics well enough to troubleshoot a misbehaving instrument, design a simple circuit to filter a signal, or track down and eliminate noise in a lab measurement. Basically, things that will help you do physics in the laboratory. We will study electronic components and circuits at this basic level, and cover some of the more “realistic” features of components that you need to understand to design and work with more precise circuits, as well as the tricks and techniques you need to make circuits work.

See the tentative syllabus below for a preliminary list of topics we will cover.

Lab: The whole point of electronics is to put theory to work and make (working!) electronic circuits. Thus, the lab component of the course is critical. The goal of the labs is to give you a functional knowledge of electronics and to get you comfortable working with electronic devices.

You will need to attend one 3-hour lab component most weeks (see syllabus below for schedule). There will be multiple lab sections, and we will arrange these during the first week of class.

You should also obtain a laboratory notebook (i.e., as you would use in a real laboratory), permanently bound with quad-ruled pages (like this). This is the primary record of your lab work, and you should record all your notes and measurements in this book.

Texts: There is no required textbook to purchase for this course. The main reference for this course will be Ray Frey's notes posted here.

I will also post course notes on this site as the term progresses.

There are a few books that are good introductions to electronics, and you might consider picking up one or more of these:

- Barnaal, Analog Electronics for Scientific Application is good and readable, and appropriate for the level of this class. Cheap, used copies are widely available.
- Horowitz and Hill, The Art of Electronics, 2nd ed. This is the bible for scientific electronics, and any experimental physicist who works with electronics has a copy. It is a more difficult book, but excellent as a cookbook for designing circuits. The 3rd edition is rumored to be coming out soon, so you may want to hold off on purchasing it unless you can find a cheap copy.
- Moore, Davis, Coplan, and Greer, Building Scientific Apparatus is not exclusively about electronics, but is also a bible for experimental physics, and covers everything from glassblowing to vacuum to electronics.

Grades
Grades for the course will be based on homework, two mid-term exams, and a final exam. The relative weights will be as follows:

- Homework: 20%
- Mid-term exam 1: 10%
- Mid-term exam 2: 15%
- Final exam: 20%
- Labs: 35%

Homework: will be assigned weekly and each assignment will be due in class one week after it is assigned. Thereafter, late homework will be accepted, but at a 25% penalty for each 24 hour period it is turned in late. Partial assignments may be turned in, and only the late portion will be penalized.

Mid-term exam 1: in class, Thursday, January 30.

Mid-term exam 2: in class, Thursday, February 27.

Final exam: The final exam will be held Tuesday, March 18, 1-3 pm, in 318 Willamette.

Labs: There are 7 total lab projects. For each lab, you should turn in a brief report on your work. This is not the same as what you record in your lab notebook. The report should summarize the work you did in the lab. Provide headings for your entries that correspond to the sections in the lab instructions. Clearly indicate the location of required material in your report. Note any unusual or unexpected results. You should turn in your reports in the box in room 11 by 5 pm each Monday.

Pass/fail grading option: a passing grade requires the equivalent of a C-grade on all coursework (homework, labs, and exams).

Computer access
Some of the homework will require access to a computer for basic calculations (in low-level languages such as C or Fortran, or any of several higher-level packages such as Mathematica, Maple, Matlab, Octave, Mathcad, etc.) and basic plotting (e.g., GNUplot, Excel, etc.). I will use Mathematica for examples because of its availability at UO, but it is not necessarily the best choice for any particular problem. Contact the instructor as soon as possible if you do not already have access to such resources.

Syllabus
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<td>7 January</td>
<td>Resistors and Networks</td>
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<td>14 January</td>
<td>Complex Impedance</td>
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<td>19 January</td>
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<td>More Transistors</td>
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Other important dates:
- Last day to drop without a W: 13 January
- Last day to register: 15 January
- Last day to withdraw: 23 February