Electronics and Instrumentation (PHYS 115)

Lecture and Lab: Sequoia 140
Tues, Thurs 12:00 – 16:00

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And by Appointment

Course Summary

Physics 115 is an introduction to basic laboratory electronics for scientists. Topics for the course include linear and non-linear circuits, operational amplifiers, transducers, simple digital circuitry, and an introduction to the LabView software package (including DAQ and GBIP). We will also have a quick survey of A/D & D/A conversion and noise reduction techniques.

Texts

R. E. Simpson, *Introductory Electronics for Scientists and Engineers.* Allyn and Bacon, 1987.

W. DeGraffenreid, *Physics 115 Manual, version 5.0.* Available on my website.

Robert H. Bishop, *Learning with LabVIEW 2009.* Pearson Prentice Hall.
Don't worry about getting a "new" copy with student edition on CD; I expect to be able to provide you with student editions.

Modus Operandi

Class meetings will typically consist of one hour of lecture followed by a laboratory session. Some subjects may require additional lecture time, others may require less. Lectures *will not* exceed two hours. The laboratory experiments are all listed in the lab manual. I have found that reading about them ahead of time usually allows one to use their time more efficiently (i.e. they often go home earlier – keep this in mind). There will be a break between lecture and lab. A tentative semester schedule is below.

Week	Date	Material	Date	Material
1	8/31	Intro. I, V, Resistance, Sources Safety and Where to Find Stuff	9/2	Kirchoff's Rules, voltage dividers, Thevenin/Norton Equiv. Lab I - Basic DC Circuits
2	9/7	Intro to AC, Fourier series, Capacitors, RC circuits Lab II - Basic AC Circuits	9/9	Inductors, AC analysis Lab II - Basic AC Circuits
3	9/14	Diodes Lab III - Diodes	9/16	Transistors Lab IV - Transistors & Regulators
4	9/21	Transformers, Impedence Matching, and Transmission Lines Lab IV - Transistors & Regulators	9/23	**Midterm 1 (Material thru 9/14)** Feedback / Op Amps
5	9/28	Intro to Op Amps Lab V - Op Amps	9/30	Op Amps: Filters and Non-linear Apps Lab V - Op Amps
6	10/5	Transducers I Tentative.. May be on 10/7 Lab V - Op Amps	10/7	LabVIEW Campus Workshop Tentative.. May be on 10/5 or 10/12
7	10/12	Transducers II Lab VI - Instr. Amps & Transducers	10/14	Waveform Generators Lab VI - Instr. Amps & Transducers
8	10/19	LabVIEW Review Lab IX - LabVIEW	10/21	 Lab IX - LabVIEW
9	10/26	**Midterm 2 (Material thru 10/14)** Digital Logic / Boolean Algebra	10/28	Logic Families / Number systems Lab VII - Intro to Digital
10	11/2	Digital: Static Circuits Lab VIII - Digital Circuits	11/4	Digital: Dynamic Circuits Lab VIII - Digital Circuits
11	11/9	A/D & D/A Lab X - LabVIEW DAQ	11/11	Veterans Day
12	11/16	A/D & D/A Lab X - LabVIEW DAQ	11/18	Switches and Relays Project
13	11/23	**Midterm 3 (Material Thru 11/16)** Project	**11/25**	Thanksgiving
14	11/30	Electrical Safety Project	12/2	Noise in Circuits Project
15	12/7	Power Supplies Project	12/9	TBA Project
16	12/14 (Tuesday)	Final Exam 12:45 - 2:45		

Grading

Homework ~ 50 Points

Homework will generally be assigned each week and will be collected on Tuesday at the start of class. The homework will consist of three to five problems. The purpose of the homework is to force you to look at the lecture material. Each assignment is worth 5 points. I expect there will be 10 assignments, but this may change. Penalties will be applied for late homework.

Lab Reports 200 Points

The lab reports are *not expected to be formal*, but rather a detailed summary of what was observed and learned during the week. These reports should include:

- sketches of circuits that you designed,
- tables and/or graphs of your results,
- comparison of results to predictions, and
- a discussion of problems that you encountered.

If you keep a very good lab notebook (see below), your report should be fairly easy to prepare; it should be a summary of your notebook.

We will perform 10 experiments; each report will be worth 20 points. Your lab reports will be graded based on the above four categories in addition to your clarity and quality of writing. I consider these five areas to be of equal importance in assigning your score.

Reports are due one week after the experiment is scheduled to be completed. If you miss a lab and make it up on your own time, it is due at the scheduled date unless other arrangements are made with me. Points deducted for late assignments as follows: 2 points per day, but your first 5 late days in the semester are free. This policy will be strictly enforced.

Laboratory Notebook 50 Points

It is very important to keep a good lab notebook. The notebook should contain sketches of circuits, calculations, and recorded data. Basically, anything that you do for the lab portion of the class should be in your notebook. There are several experiments that we will do that will rely on previous work; you don't want to have to reinvent the wheel. For many of you, this is your first "real" lab course, I don't expect that you

will keep a perfect notebook, but I expect that it will get better as the semester progresses. I will collect your laboratory notebooks at the final exam. In my opinion a well-maintained notebook should allow me to repeat your exercises with ease. The grading for the notebook will be: 50 = Excellent; 45 = Very Good; 40 = Good; 30 = Fair; 0 = Not Received.

Project 100 Points

Lab time will be set-aside in the last three weeks for your project. The goal of the project is to "make something useful." The project may be done in *reasonably sized* teams (I'm the judge of what this means). Your score is determined by the (hopefully functioning) work itself as well as a report (each student must prepare their own report). Your report will need to include:

- the motivation for the project,
- circuit diagrams,
- results and/or analysis,
- a discussion on problems that you encountered, and
- changes you would make if you had to do it again.

Your project subject is due to me by 10/31. Failure to get your project subject to me by the deadline will result in an automatic 20 point deduction.

Midterm Exams 300 Points

Three one and a half hour-long exams (closed book), each worth 100 points. The exams are tentatively scheduled for Sept 23, Oct. 26, and Nov. 23, but are subject to change.

Final Exam 200 Points

Two hour-long final (closed book). Comprehensive and covers material introduced after Nov. 23 midterm. The final is scheduled for 12:45 on Tuesday, December 14 in SQU-140.

Estimated Total Possible Points 900 Points

I intend to use standard percentages in assigning grades: A = 90-100%; B = 80-90%, etc. However, I will take into consideration the distribution of scores prior to making a final decision. Notice that "labwork" accounts for over 1/3 of the total grade, I take it seriously.

Academic Dishonesty Statement

The Department of Physics and Astronomy has unanimously approved the following statement:

"The faculty of the Department of Physics and Astronomy will not tolerate academic dishonesty. Falsification of data, copying, unauthorized collaboration, plagiarism, alteration of graded materials, or other actions (as described in, but not necessarily limited to the CSUS Policy Manual) *will be promptly reported to the Office of Student Affairs*. The offending student will be penalized on the assignment in question. Serious infractions will result in course failure and a recommendation for administrative sanctions."

If you have any questions regarding this statement, please come and speak with me about it.

Additional Information

If you have a disability and require accommodations, you need to provide disability documentation to SSWD, Lassen Hall 1008, 916-278-6955. Please discuss your accommodation needs with me after class or during my office hours early in the semester.

This is an upper division physics course, the first one for some of you. In general, you ought to expect to spend 2 – 3 hours on a class for every unit. As this is a four unit course, this means that you shouldn't be surprised to spend 8 – 12 hours to succeed in in this class.

I have collected electronic data sheets and information about our instruments, it is available online: http://www.csus.edu/indiv/d/degraffenreidw/Resource.htm.

Other useful texts:

P. Horowitz and W. Hill, *The Art of Electronics*. (Strongly recommended for those interested experimental physics).

T.C. Hayes, P. Horowitz, *Student Guide for The Art of Electronics*.

J.H. Moore, C.E. Davis, M.A. Coplan and S. Greer, *Building Scientific Apparatus*.