Advanced Electronics and Instrumentation (PHYS 116)

Lecture and Lab: Sequoia 140
M 1:00 – 5:00
W 2:00 – 5:00

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Course Summary

Physics 116 is an advanced topics course in electronics and instrumentation for scientists. Topics for the course include noise reduction techniques, signal recovery, frequency analysis, transfer functions, computerized instrument control, and instrument development.

Office Hours

10:00 – 11:00 Monday and Tuesday and, as always, by appointment.

Required Texts

DeGraffenreid, W. (ed.), *Advanced Electronics and Instrumentation*. McGraw-Hill, 2004.

Simpson, R. *Introductory Electronics for Scientists and Engineers.*

Bishop, R. *LabVIEW Student Edition*. Pearson – Prentice Hall.

Recommended for Consideration

National Instruments USB-6008; can be purchased from the Physics Department.

Modus Operandi

Physics 116 formally consist of one hour of lecture and six hours of laboratory per week. In some cases, we may use part of the "lab" time for lectures. For the sanity of students and instructor, lectures *will not* exceed two hours. There is not a manual, so experiments will be distributed electronically via instructor's website.

Grading

Your final grade you earn will be based on the following breakdown:

Homework	10 %
Lab Skills	5 %
Lab Reports	20 %
Project	25 %
Midterm Exam (1 one-hour long exam)	15 %
Final Exam (1 two-hour long final)	25 %
Total	100 %

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.

Homework

Homework will be assigned on a somewhat regular basis, especially during the first half of the semester. The due date will be clearly indicated. Late homework ***will not*** be accepted.

Lab Reports

The lab reports are not expected to be *formal,* but rather a detailed summary of what was observed and learned during the week. Most of the reports will be a summary of the LabVIEW program, with discussion of any problems encountered or any cool new tricks that you learned. LabVIEW VIs should be emailed to me.

Some labs will involve construction of electronic circuits. Reports on these experiements should include, in addition to the above:

- sketches of circuits that you designed, if any
- tables and/or graphs of results, and
- comparison of results to predictions.

Lab reports are due one week after the completion of the exercise and late reports are subject to significant penalty. Labs are all equally weighted and will be graded on a 10 point scale.

Project

You are required to build a project in the last month of the semester. This project should demonstrate your mastery of electronics and instrumentation. In an ideal case, the project will integrate electronics and computerized data acquisition and analysis. Types of projects to consider are those that automate data collection for advanced physics lab, optics lab, or research environments. Stand-alone, handheld devices are also acceptable projects with prior approval. The Department of Physics and Astronomy can provide support for these projects, but any unusual or particularly costly components may require student purchase. Your project requires a written report, due by noon at the end of final's week. The report should include: motivation, description, results, and a self analysis of your work. The 116 projects functionality will be emphasized more in grading than 115, and it needs to be "scientifically useful," rather than just "useful."

Exams

Exams are closed book, closed notes. I will provide sheets of Laplace and Fourier Transforms as needed. The midterm exam is tentatively scheduled for Wed. March 26. It is one hour long. The final exam is scheduled for will be held on Monday the 19th or Wednesday the 21st of May; class majority will decide. It will be two hours long. There may be a practical portion on the final.

Additional Information

Other useful texts:

S.W. Smith, *The Scientist and Engineer's Guide to Digital Signal Processing.* Available at: http://www.dspguide.com/pdfbook.htm.

K.R. Fowler, *Electronic Instrument Design.* (Available at bookstore in EEE section – it is used in their senior project course EEE193 I think)

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

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