

Physics 316a—Electronic Instrumentation and Computers
Walter Smith Fall 2008

Description

In a physics program, the subject of electronics plays a double role. First, it provides a large collection of tools that are essential in designing physics experiments of any kind. Second, it can provide an opening to applied physics and engineering. There is hardly any topic in a physics program that is more generally useful than electronics. There are also important physical principles at work in semiconductor electronics, some of which are still areas of active research; we will touch on these to the extent we can manage given our tight schedule.

This course guides you through a comprehensive exploration of basic electronic design, both analog and digital. Topics include transistor and operational amplifier circuits, filters, analog-digital conversion, digital electronics, computer design and interfacing, and even a little assembly language programming. You will construct a microprocessor-based computer. (We'll be using an updated version, not the old one in your student manual.) We will be using circuit simulation software at some points, to give you some experience with this important tool for circuit design. At the end of the class, you will engage in a short independent project, in which you might interface your computer to a device in the outside world (e.g., a voice synthesizer chip, a stepper motor, temperature sensor, etc.), or build an entirely new circuit. As we progress through the course, you should be thinking of ideas for what you'd like to do in this project. The prerequisite for this course is physics 211 or equivalent.

Text and Sources

Required texts:

The Art of Electronics, 2nd Ed. by Paul Horowitz and Winfred Hill. This book is considered the bible on the subject of electronics.

Student Manual for the Art of Electronics by Tom Hayes and Paul Horowitz. This contains most of the laboratory exercises we'll be doing, plus additional explanatory material. We will supplement this heavily with more recent labs that have been developed at Harvard.

Several other electronics texts will be placed on reserve in the library.

Format

We will meet for lab on Monday and Friday afternoons, nominally 1:00-4:00 p.m. (It is not uncommon for students to work later.) I expect you to put in some extra time (ordinarily no more than three hours per week) in lab outside these hours; you will be issued a key to the lab room. We will also meet for recitation at a time and place to be determined.

Walter Smith	INSC L110	Office hours:	M 10:00-11:00
	896-1332(office)		Tu 10:30-11:30, 2:00-3:00
	896-1565 (home)		W 3:30-4:30
	wsmith@haverford.edu		Th 10:30-11:30, 2:30-3:30
			F 10:00-11:00
			or by appointment

Course Requirements

You will need to allocate an average of 12-13 hours per week to this course, including labs and recitation.

Regular attendance: You are expected to attend *all* of the scheduled laboratory and recitation sessions. If you are ill or need to miss class due to special circumstances, you must contact me in advance. Especially in a small course like this, each person counts a lot!

Advance preparation: You should come to lab and recitation prepared. I will inform you in advance of the reading relevant to each session. Reading assignments will sometimes be substantial. You will find it impossible to complete the required lab exercises in the time provided unless you have completed the reading before lab. You need not read the lab itself, but you must read the associated material in the book and/or the instructional parts of the lab manual.

Homework: There will be regular homework assignments, but these will usually be lighter than in other upper-level physics courses. These assignments are an essential part of mastering electronics. You are permitted two one-week extensions without any penalty during the semester when you are stressed out with work. Just turn in a sheet of paper indicating that you are giving yourself a “free extension.” The two extensions must be used for separate problem sets; they cannot be combined to get a two-week extension on one problem set. Save them for when you really need them. Other than these extensions, work turned in late will not be graded, but will be given about 1/3 credit for a reasonable effort. Please do not split up the assignments.

Lab Reports: No formal lab reports are required. However, I will inform you of questions on each lab exercise that should be answered in a brief report. Your answers should include any supporting calculations needed. Your report should also contain graphs or tables asked for in the lab manual, and circuit diagrams (including component values) for any circuits **not** given in the lab manual or handouts. You need **not** include a reiteration of the procedures given in the lab manual or handouts. You **should** use the numbering scheme of the lab manual for your entries. Reports will ordinarily be due at the beginning of the next lab session.

Exams: There will be two 90-minute-long take-home exams (open book) during the semester, plus a 3-hour take home final.

Honor Code

You are encouraged to discuss homework with each other (except on any “individual” problems which may be assigned), but *only after attempting each problem yourself*. (Discussion *without* prior effort, except to clarify what the question is asking, is not permitted.) You may consult with me about any problem (including individual problems), but again only after attempting it yourself. Your written work must be your own.

For your lab reports, you may freely discuss with your partner. (That is, you need not/should not work on your own first before talking things over with your partner.) For the time we have together in lab, team learning is the most effective approach. However, what you write in your report must be your own, even if it simply summarizes what your lab partner has just taught you.

Grading

Midterm exams	16% each	(32% total for two exams)
Final exam	25%	
Homework	20%	
Lab reports	15%	
Final project	8%	