Physics 220: Electronics for Scientists Fall 2008

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Physics 220: Electronics is a survey of a wide range of topics, beginning with analog electronics and going through to modern digital electronics. Starting with simple circuit elements like resistors, capacitors, and inductors, we will briefly review the direct current circuits covered in the intro physics course before progressing to alternating current circuits. We will then move to more complex circuit elements that rely on semiconductor physics, including diodes, transistors and operational amplifiers. For the last section of the course, we will learn the basic concepts of digital electronics, Boolean logic, memory, A/D and D/A conversion, and computer interfacing. Throughout the semester, you will be working in groups on a long-term project to design and implement a new sensor and intelligent response from a Lego Mindstorm NXT robot. Overall, the course will emphasize practical electronics and its applications to experimental physical science.

Lecture:	Tuesdays, Thursdays	9:30 – 10:50 am	Taylor 104
Lab:	Wednesdays	1 - 4 pm	Taylor 009

Text: *The Art of Electronics* by Paul Horowitz & Winfield Hill, 2nd edition

Class Website: www.wooster.edu/physics/lehman/p220_2008.html

Exams: There will be two midterm exams, scheduled for September 23 and November 6. The cumulative final exam is on Friday, December 12th at 9:00 a.m.

Grading: Your grade is determined from the exams, lab reports, and homework by the following proportions:

Lab (including robot project)	35 %
Homework/Participation	10 %
Exam 1	15 %
Exam 2	15 %
Final Exam	25 %

The following scale will be used to determine your final letter grade:

Outstanding (A, A-):	> 90 %
Good (B+, B, B-):	> 80 %
Adequate (C+, C, C-):	> 70 %
Minimally passing (D):	> 60%

Attendance at every class and lab meeting is expected. Your attendance and class participation will be factored into your homework grade. Unannounced quizzes may also be given and will count as part of the homework grade. All exams must be taken when scheduled. Only truly unavoidable conflicts will be considered for rescheduling the exams. The College sets the final exam date, and only the Dean of the Faculty can grant exceptions.

This course is designed so that the average student will do well, corresponding to a *B*. You are not competing against each other; it is possible for everyone to earn an *A* in this course. If I find that I have made the exams more difficult than I intended, I may lower the grade cut-off levels slightly, but I will never raise them. If you make a sincere effort to understand the material, truly explore the labs, and work the homework problems, you will do well in this course.

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Hands-on Experience

There are nine labs designed to help you understand the course material. The lab instructions are posted on the class website in advance. Some labs require preliminary calculations so you should be sure to print and read the labs BEFORE arriving. You must purchase a lab notebook before the first lab meeting. I recommend a composition notebook with grid-lined pages.

During the lab, you will be taking notes, making observations, and drawing conclusions in your notebook. Your notebook is not an ideal representation of how you wanted the lab to go—your notebook should be a **legible**, **complete** record of your actual activities and thought process, mistakes included! Most labs require some graphical analysis of the data including a comparison to the theory. I recommend IGOR for this analysis. Any printouts must be taped (not stapled) into the notebook **neatly**. After completing the data collection and analysis, write a brief summary of the lab in your notebook, including your results and conclusions. There are no formal lab reports in this course.

Completed lab notebooks are due Fridays at 4 p.m. Notebooks will be graded based on the completeness of your exploration of the lab material and on your analysis and interpretation of the results. Lack of detail in your notes and lack of readability will both lead to a lower grade.

In addition to the nine labs, you will also be working in groups to design a new sensor and response for a Lego Mindstorm NXT robot. This project is designed to allow you to pull together many course topics, including sensor design, logic circuits, and computer interfacing. It should also be fun and an opportunity for you to be creative! Details of the project will be given later.

Collaboration

Physics is learned by working problems or doing experiments, not by reading about problems or experiments. You will learn the most if you try things on your own before asking for help, either from your classmates or me. In lab, this means that you should do your own troubleshooting—tracing your circuit, checking that everything is plugged in—rather than passively waiting for help.

Collaboration with your fellow students is recommended, but the materials you hand in must be entirely your own work. You may not directly copy words or equations. A good homework practice is to re-write your solution without looking at your previous notes to be sure you understand each step yourself. When you obtain outside help, you must acknowledge it. For example, "After Hermione suggested that I switch the resistor values, the circuit finally worked!"

Academic Integrity

Cheating on a test, quiz, or homework is a serious breach of academic integrity and is grounds for an F for the entire course. Direct copying of homework is a violation of the Wooster Ethic. Other violations of the Wooster Ethic include copying from any source without proper citation, going beyond what is allowed in a group project, fabricating excuses and lying in connection with your academic work. You will be held responsible for your actions. If you are unsure as to what is permissible, always ask!

Curricular and Extra-curricular Conflicts

The College of Wooster is an academic institution and its fundamental purpose is to stimulate its students to reach the highest standard of intellectual achievement. As an academic institution with this purpose, the College expects students to give the highest priority to their academic responsibilities. When conflicts arise between academic commitments and complementary programs (including athletic, cultural, educational, and volunteer activities), students, faculty, staff, and administrators all share the responsibility of minimizing and resolving them. As a student you have the responsibility to inform me of potential conflicts as soon as you are aware of them, and to discuss and work with me to identify alternative ways to fulfill your academic commitments.

If you know of any conflicts that will require you to miss class or lab, notify me immediately.

Accommodations for Learning Disabilities

Any student with a documented learning disability needing academic accommodations is requested to speak with me and with Pam Rose, Director of the Learning Center (ext. 2595), as early in the semester as possible. All discussions will remain confidential.