

Physics 219 -The Art of Electronics

Wellesley College
Fall, 2005

Course Information and Syllabus

Instructor: Robbie Berg

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Office Hours: Monday. 1:30 - 3:00, Thurs. 4:30 - 6:00



Required Text:

Hayes and Horowitz, *Student Manual for The Art of Electronics*

Optional Text:

Horowitz and Hill, *The Art of Electronics*, Second Edition

Format: I estimate that this course should, on average, require about 10 hours of your time per week. Roughly 2/3 of this time will be spent in the lab and the remaining 1/3 on preparation. The lab will be kept open all the time and you are encouraged to come by after hours (with a buddy) to complete unfinished work or just *play* around with your circuits. (This stuff is tremendous fun... as I hope you will find!) In any event, it's important that your circuit construction keep up with the course.

Grading:

Problem Sets (4) - 15%

Exams (2) - 25% - open lab book.

Lab Work - 25% - This is an (admittedly somewhat subjective) evaluation on my part of how well you are doing in building, and understanding the circuits. I will look at your lab notebooks from time to time to help me evaluate your lab work.

Design Projects-(2) 35% - The first is due on October 21 and the second is due on December 22, the last day of exam period.

Final Exam - There is none.

Lab Notebooks: There will be no formal lab reports required. Instead you should keep a lab notebook to record what you observe in lab, along with a brief explanation of what is going on in the circuits you are building and answers to questions asked in the lab write-up. These notebooks are primarily for your benefit. Maintaining your notebook should be of great help on the exams since you will be allowed to use them when you take the exams.

Outline of Major Topics

Prelude: Getting Started with the LogoChip

LogoChip: A construction kit for electronics
Soldering made simple

DC Circuits

Ohm's Law
Ohm's Law Repealed!: Non-linear devices, light bulbs, diodes, etc.
A first robotic sensor: *touch*
Voltage dividers
Resistive sensors
Input and Output Impedances and the Thevenin Model

Capacitors and Time Varying Circuits

An oscilloscope primer
RC Circuits
Filters: high pass and low pass
Integrators and differentiators

Diodes

I-V curve tracer
Half-wave and full-wave rectifiers
dc power supply
Clamps and limiters
"How does my radio work?"

Introduction to Transistors

Bi-polar transistors: The Golden Rules
Transistor switch
Phototransistor light sensor, reflectance sensor
Field effect transistors
MOSFET power switch

The LogoChip and Some Big Ideas

Logo and Procedural Abstraction
LogoChip Logo By Example
Feedback and Control:
Analog Meets Digital

******* First Design Project: Build Your Own Game *******

Amplifiers

Transistor-based amplifiers:

- Emitter follower
- Input and Output Impedance of amplifiers
- Common emitter
- Push-pull amplifier
- Constant current source

******* First Quiz *******

Op Amps

- Differential amplifiers
- Op amp Golden Rules
- Negative feedback
- Op amp examples: Followers, inverting and non-inverting amps, integrators, and more
- Op amp limitations: slew rate, offset voltage, input bias current
- Comparators and Schmitt triggers
- Relaxation oscillators

More Digital Electronics

Digital Gates and Combinational Logic

- Truth tables and Boolean logic
- Logic gates
- Building logic gates from transistors: CMOS inverter and NAND gates
- Three-state devices

Sequential Logic

- Flip-flops
- Counters
- Shift registers

Memory

- Data logging

***** **Second Quiz** *****

Construction Techniques

Printed circuit board layout

Inside the LogoChip

Microcontroller architecture

Introduction to assembly language

*******Final PROJECT (Due on Dec. 22)*******

Physics 219 Schedule - Fall 2005

Month	Monday	Tuesday	Wednesday	Thursday	Friday
Sept.	5	6 Classes Begin	7 Class #1	8	9 Class #2
	12	13	14 Class #3	15	16 Class #4
	19	20	21 Class #5	22	23 Class #6
	26	27	28 Class #7	29	30 Class #8
Oct.	3	4	5 Class #9	6	7 Class #10
	10 Fall Break	11 Fall Break	12 Class #11	13	14 Class #12
	17	18	19 Class #13	20	21 Class #14 Project 1 Due
	24	25	26 Class #15	27	28 Class #16 Quiz 1
	31	1 Tanner Conference	2 Class #17	3	4 Class #18
Nov.	7	8	9 Class #19	10	11 Class #20
	14	15	16 Class #21	17	18 Class #22
	21	22	23 Thanksgiving Break	24 Thanksgiving Break	25 Thanksgiving Break
	28	29	30 Class #23	1	2 Class #24 Quiz 2
Dec.	5	6	7 Class #25	8	9 Class #24
	12	13 Classes End	14	15	16 Exams Start
	19	20	21	22 Exams End Project 2 Due	