

## Chemistry 628 – Electronics Spring, 2013

Professor Robert J. Hamers

Office hours: By appointment

(I am happy to talk to students at almost any time, but recommend contacting me first to be sure I am free).

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The goal of this course is to provide you with a practical introduction to electronics as it applies to chemical research and/or chemical instrumentation. After taking this course you should be able to better understand the electronics behind modern chemical instrumentation, to interconnect and modify commercial instrumental modules for use in new applications, and to build new instrumental modules based on operational amplifiers and/or other integrated circuits.

To help meet this objective you will be required to 1) attend lecture and complete periodic problem sets, 2) complete two take-home exams, 3) complete the laboratory exercises and their corresponding report sheets, and 4) complete a laboratory project where you build a working module using printed circuit board construction techniques.

Grading: Your course grade will be based on: Problem sets ~20%, Exams ~ 30%, Regular Labs ~40%, and Project ~10%.

**Lecture:** Attendance at lecture is required. We will attempt to cover the following topics:

Direct Current Circuits- Ohm's Law, voltage dividers, Kirchhoff's laws, Superposition Principle, Thevenin's theorem, and Norton's theorem

AC Circuits- complex transfer functions and impedance analysis of RC, RL, and RLC circuits

Operational Amplifiers- basic concepts, applications, frequency response, feedback theory, and noise

Diodes and Transistors- semiconductor physics and applications

Mixed Digital/Analog Circuits- basic digital terminology, A to D conversion, comparators, timers, oscillators, flip flops, registers, multivibrators, phase-locked loops

Signal Processing- Fourier analysis, noise, sampling, lock-in detection, heterodyne detection

Other topics of interest- power supply regulation, optoelectronics, transmitter/receiver

Circuits, microwave techniques

**The following text is required:**

Introductory Electronics for Scientists and Engineers, 2<sup>nd</sup> Ed. Robert E. Simpson.

**In addition, the following books may be helpful:**

Practical Electronics for Inventors, 2<sup>nd</sup> Ed. Paul Scherz

The Art of Electronics, 2<sup>nd</sup> Ed. Paul Horowitz and Winfield Hill

Op Amps for Everyone, 2<sup>nd</sup> Ed. Ron Mancini (available free as a pdf file)

**Laboratory:** Learning electronics is best accomplished by *doing* electronics. The laboratory component of the class will provide you with the opportunity to gain practical experience in the design and testing of electronic circuits..