Chemistry 628 Chemical Instrumentation: Design and Control Applications
Spring 2019

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Pre-requisites are Chem 524 or 621, or graduate standing

Course Description: The design and application of chemical instrumentation; basic principles for monitoring and controlling chemical experiments; optical, electrical and mechanical sensors and transducers of importance to analytical chemical instrumentation.

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 will be able to 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, microcontrollers, and/or other integrated circuits.

To help meet these goals you will be required to: 1) use supporting materials to learn fundamental background information related to electronics. The supporting materials include texts, data sheets, videos, and research papers. 2) complete periodic problem sets, 3) complete one take home exam, 4) complete the laboratory exercises and their corresponding report sheets, and 5) complete a laboratory project.

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

We will attempt to cover the following electronics topics:

Direct Current Circuits- Ohms Law, voltage dividers, Kirchhoff's laws, Superposition Principle, Thevenin's theorem, Norton's theorem, and DC power supplies

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

Diodes and Transistors- semiconductor physics and applications.

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

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

Microcontroller Programming- digital input-output, A to D conversion, Pulse width modulation, serial communication

Signal Processing- Fourier analysis, noise, sampling, lock-in detection, and digital filtering

There is an almost infinite amount of supporting materials to aid in your understanding of these topics. Here are some of the supporting materials that I find useful.

Introductory Electronics for Scientists and Engineers, **2nd Ed**. Robert E. Simpson

Practical Electronics for Inventors, 2nd. Ed. Paul Scherz

The Art of Electronics, 2nd Ed. Paul Horowitz and Winfield Hill

All About Circuits: www.allaboutcircuits.com

EEVBlog: https://www.eevblog.com/

w2aew: https://www.youtube.com/user/w2aew

I will also post book chapters, web pages, application notes, and other supporting items that support the course topics, on our CANVAS page.

Learning electronics is best accomplished by doing electronics and the laboratory will provide you with the opportunity to do electronics. We will follow the schedule below in an attempt cover the course topics. There may be times throughout the semester where you will need to come to the laboratory outside of your scheduled section.

The laboratory activities are done in the electronics shop. Room 2227 Chemstry.

Week 1	1/23– 1/25	Unit 1 Measuring and Filtering
Week 2	1/28 – 2/1	Unit 1 Measuring and Filtering
Week 3	2/4 – 2/8	Unit 1 Measuring and Filtering
Week 4	2/11-2/15	Unit 2 Discrete Solid-state Components
Week 5	2/18 – 2/22	Unit 2 Discrete Solid-state Components
Week 6	2/25 – 3/1	Unit 3 Operational Amplifiers
Week 7	3/4 – 3/8	Unit 3 Operational Amplifiers
Week 8	3/11 – 3/15	Unit 4 Microcontrollers
	3/18 – 3/22	Spring break-Lab Open
Week 9	3/25 - 3/29	Unit 5 Oscillators and timing
Week 10	4/1 – 4/5	Unit 6 LabView-DAQ and signal processing
Week 11	4/8 – 4/12	Project work
Week 12	4/15 - 4/19	Project work
Week 13	4/22 – 4/26	Project work
Week 14	4/29 – 5/3	Project work
Finals Week		Project Due May 10

Rules, rights & responsibilities

Every member of the University of Wisconsin–Madison community has the right to expect to conduct his or her academic and social life in an environment free from threats, danger, or harassment. Students also have the responsibility to conduct themselves in a manner compatible with membership in the university and local communities. UWS Chapters 17 and 18 of the Wisconsin Administrative Code list the university policies students are expected to uphold and describes the procedures used when students are accused of misconduct. Chapter 17 also lists the possible responses the university may apply when a student is found to violate policy. The process used to determine any violations and disciplinary actions is an important part of UWS 17. For the complete text of UWS Chapter 17, see this link, or contact the on-call dean in the Dean of Students Office, 608-263-5700, Room 70 Bascom Hall.

No student may be denied admission to, participation in or the benefits of, or discriminated against in any service, program, course or facility of the [UW] system or its institutions or centers because of the student's race, color, creed, religion, sex, national origin, disability, ancestry, age, sexual orientation, pregnancy, marital status or parental status.

Academic integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

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McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA."
http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

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