

CHEM/PHYS 454/554: Computer Interfacing

Syllabus

Instructor: Dr. Al Fischer, PhD

Office Hours: By appointment at calendly.com/dralfischer (AP 342)

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Availability: Email and office hours are the best ways to find me; I check emails several times per day through the evening M-F. I also leave my office door open when I am available for drop-in questions, as time allows; if my door is open, you are welcome to stop in for help. (If my door is closed I am not available.) Typically this should be for quick questions that take no more than 5-10 minutes to answer, while scheduled office hours meetings are often 20-30 minutes.

1 Course Description

Electronic devices have become an integral part of experimental chemistry and physics laboratories. This course provides an introduction to the development of custom instruments and data acquisition (DAQ) systems using basic electronic components. Topics may include passive and active analog electronics (RC circuits and op-amps), communication protocols, microcontroller usage and programming, component selection, graphic user interface (GUI) creation, and test and validation methods.

Although this course covers topics from the field of electronics, it is designed to help you be a better experimental scientist; it is not designed to help you become an electrical engineer. Hopefully it will help you develop a practical understanding of electronics and programming so that you will be better able to setup, troubleshoot, construct, and utilize scientific equipment. The course assumes no previous experience in electronics or programming, just a willingness to learn, experiment, and tinker.

This course is cross-listed with PHYS 454 and CHEM 554.

2 Student Learning Outcomes

To achieve a satisfactory grade, students will:

1. Construct and test simple circuits (e.g. RC filters, voltage dividers, etc.) to achieve a stated signal processing goal, using common prototyping and test equipment (e.g. breadboards, multimeters, and oscilloscopes).
2. Utilize manufacturers' data sheets to understand the expected behavior of electronic components.
3. Utilize microcontrollers to interface a computer with physical devices and collect data from sensors, especially those found in typical experimental chemistry or physics laboratories.
4. Design and construct a circuit for use in a laboratory or field instrument using professional tools.
5. Describe circuit and/or instrument performance using common formats, including figures of merit, bills of materials, schematics, and technical data sheets.

6. **Graduate Students Only:** Use SPICE to simulate the expected behavior of circuits.

3 Required Course Materials

Text Book: Scherz, P. and Simon Monk. (2016) *Practical Electronics for Inventors* (Fourth Edition) McGraw Hill Education. (WCU rental book available at the bookstore)

Calculator: Students will need a scientific calculator that is not on a phone for exams (eg. TI-XX, or even something as as a \$10 Casio *fx*-300).

Technology: Students will need a laptop computer meeting Chemistry and Physics [minimum computer requirements](#). In addition, the computer must have a standard [USB-A receptacle](#), or students must supply an appropriate USB-A adapter for their computer. Please bring your computer with you to class each week.

Students will need Python 3 and the [Thonny IDE](#) (both free) or similar IDE installed on their computer to program the Raspberry Pi Pico microcontrollers used in class. Students will also need a program to access the serial port on their computer; [PuTTY](#) is recommended, but many other options exist.

Graduate students will need to use SPICE to model circuit behavior and complete additional training modules. [KiCAD](#) (open-source and free) will be demonstrated in class for this purpose, but many other options for interfacing with SPICE are available.

4 Grading

Final grades will be weighted as per the table below.

Table 1: Grading Categories and Weights

Category	Weight (%)
Lab Activities & Homework (including Graduate Project)	65
Exams and Quizzes	25
Attendance	10
Total:	100

Graduate student grades will include the graduate project assignments in the Homework category; most homework assignments are 4 points, whereas most graduate assignments will count as 8 points, such that the graduate assignments are weighted more heavily than undergraduate assignments. Undergraduates are not required to complete the graduate project assignments, but graduate students are required to complete the undergraduate assignments.

Numeric grades will be converted to a letter grade as follows:

Some items may be graded by computer software. Any answers not in the specified format will not be graded and will receive a score of 0. Written work may be checked for plagiarism using computer software. Plagiarism will NOT be tolerated (see Academic Integrity section, below). Due dates/times are automatically enforced by Canvas.

Table 2: Course Grading Scheme

Number Range	Grade in CHEM 493	Grade in CHEM 593
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97-100	A+	A
93-96.9	A	A
90-92.9	A-	A
87-89.9	B+	B
83-86.9	B	B
80-82.9	B-	B
77-79.9	C+	C
73-76.9	C	C
70-72.9	C-	C
67-69.9	D+	F
63-66.9	D	F
60-62.9	D-	F
<60	F	F

5 Submitting Assignments

Students are required to submit assignments electronically on Canvas. All written assignments should be scanned to a PDF document (unless otherwise specified) using the PawPrint scanners on campus (free for scanning). Pictures taken with a phone are often not suitable for submitting to Canvas. Other assignments should be typed and submitted in the format specified on Canvas. Unless otherwise specified, assignments are due at 23:59:59 on the due date or will be counted late. Any electronic assignments turned in via hardcopy or via email will not be graded. If you are unable to turn your assignment in on Canvas, you should notify your instructor, who will arrange for you to upload it to Canvas via an alternative method.

5.1 Late Work and Makeup Work Policy

Your prompt submission of assignments facilitates my ability to provide prompt feedback. It is expected that all assignments will be submitted by the due date specified on Canvas. As a rule, late work is not accepted, but will be *considered* on a case-by-case basis.

If you experience extenuating circumstances (e.g. a medical emergency, professionally diagnosed illness, or death in the family) or a [university-sponsored absence](#) you may ask to be considered for an extension for an assignment on a case-by-base basis. Communication of the issue to your instructor and identification of when you plan to turn in the assignment are important in such circumstances. For university-sponsored absences, exceptions should be arranged before your absence or will not be granted.

Make up exams are not guaranteed and are generally not allowable, except in cases of a [university-sponsored absence](#) or documented emergency. Students who anticipate needing to take exams outside of the scheduled periods should work with the Office of Student Affairs and/or Office of Accessibility Resources to arrange accommodations. Any student who does not take the exam in class for any reason should make alternative arrangements with their instructor *prior to the exam*; if the instructor is not contacted within 8 hours following the exam start time then the student will be unable to make it up and will receive a 0 on the exam. In cases where a makeup exam is granted, the exam must be taken as soon as possible after the original exam date, and not later than 72 hours after the original exam date (excluding weekends). Any exams not made up after 72 hours will be graded as 0.

6 Attendance Policy

Attendance to all class periods is mandatory. Please email your instructor if you encounter circumstances that absolutely prevent you from making it to class. Students are responsible for covering any material they miss while absent on their own, and remain responsible for any work they miss while absent. Due dates are not extended because a student was absent, unless otherwise agreed upon between the student and instructor in advance. In accordance with the [WCU Catalog](#), "students with more unexcused absences than the credit hours given for a course (for example, three absences in a three-hour course) can expect the instructor to lower their final grade...Missing approximately 10 percent or more of class meeting times (for example, four to five MWF classes, three TR classes, or one laboratory or a class that meets once per week) means losing a significant amount of class work and experience that are very difficult, or impossible, to make up." **As such, students who anticipate missing more than 1 class period should coordinate their absences with the Office of Student Affairs, who will notify their instructors.** Any requests for makeup work from students who have missed more than one class period will not be considered without documentation from Student Affairs.

In this course, attendance will factor into your grade in two ways:

1. **An attendance grade.** Attendance will be recorded in class each week. Attendance will be marked in Canvas at the beginning of class on these days. Students who are present when attendance is taken will receive credit; students who are absent or late will not receive credit. This will be used to calculate the attendance grade, which factors into your final grade per the above description under "Grading". If you have extenuating circumstances that prevent you from attending class or will routinely require you to be a few minutes late to class, please discuss this with your instructor.
2. **Class work and discussions.** Attendance to all classes is **mandatory**, and much of your work this semester will occur in class. Because class discussions involve the entire class they cannot be made up; any students missing the class discussion will not receive credit for assignments related to the discussion.

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