Environmental Instrumentation

ATMOSPHERIC SCIENCES 6910-5–Spring 2010.
1.5 Units (First Half Semester emphasizing Field Studies)
OR 3 Units (Entire Semester)

First Organizational Class Meeting. 703 WBB.December 10. F 11:50-1:45 PM
Final Organizational Class Meeting. 703 WBB. January 14. F 11:50-1:45 PM

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Class website: http://www.chpc.utah.edu/~u0035056/5910/.
Class location: 703 WBB for lectures and meetings. Field sites throughout the Salt Lake Valley
Recommended Text for second half: *Meteorological Measurement Systems*. Fred Brock and Scott Richardson

Course Overview

This is a very unusual course. During the first half of the semester, you have the opportunity to participate in a National Science Foundation field project, the Persistent Cold-Air Pool Study (PCAPS), to take place from December 1 2010-February 7 2011 in the Salt Lake Valley. The goal of the project is to improve understanding of the weather conditions associated with episodes of poor wintertime air quality in the Valley. See http://pcaps.utah.edu for more information. During the second half of the semester, you will be involved in the development of a new interdisciplinary graduate-level course on environmental instrumentation involving faculty from atmospheric sciences, biology, and mechanical engineering.

The first half semester is designed to provide students with hands-on field experience operating environmental instrumentation. There are no prerequisites for this course and it is open to all majors. You will collaborate with scientists and volunteers from the University of Utah and elsewhere to launch rawinsondes as well as collect weather observations from mobile and stationary platforms.

The second half semester is structured more traditionally in terms of lecture and laboratory work regarding the fundamentals of electronic instrumentation followed by applications to a suite of research instrumentation relevant to applications in a number of fields. Minimum prerequisites are: a year of calculus-based physics or other course work encompassing fundamental electronics and some familiarity with structured programming sufficient to be able to manipulate basic data sets and graph them (Matlab, IDL, etc.).

Expected Course Outcomes

After completion of the entire semester-length course, you will have gained the knowledge and experience to be able to do the following:

- State the underlying principles associated with instrumentation and data acquisition units
    - Relate fundamental concepts of resistance, current, capacitance, and voltage to electronic instrumentation
    - Recognize measures of uncertainty, including accuracy and precision, and differences between systematic and random measurement errors
- Develop proficiency integrating instrumentation to data acquisition units and programming those units
    - Use information provided by instrument and data acquisition unit manufacturers to install and query sensors
- Develop proficiency to use environmental instrumentation in the laboratory and outdoors including following defined safety practices and using electronic equipment individually and as part of teams
- Recognize the steps involved in organizing and conducting a scientific field study

Course Format and Requirements

The timing of the field project is out of phase with the formal schedule for spring semester. We strongly prefer students to complete the requirements for the first half semester course from December through January although it is possible to begin at the start of the Spring semester on January 10. Students will not be involved in the field project on December 24-25.

The first half semester is a 1.5 unit field laboratory course such that the expected time commitment in the field is a minimum of 5 hours per week of instruction (or a minimum total of 40 hours). As with any course, there is also additional time required for

training, reading, and preparation. Team scientists will provide training on instrumentation and safety training is also required. Students will also participate in a minimum of five planning sessions for upcoming field days that are scheduled to be held daily.

Students will submit by March 5 a final report (double-spaced, 12 point font, 1 inch margins) summarizing in detail the weather conditions and operations during one cold-air pool episode in which the student participated. Further information about the requirements for the report will be distributed by January 10.

The second half semester is a 1.5 unit lecture/laboratory course with lectures on Tuesday from 2-3:20 and laboratory time on Friday from noon to 3:20. Since this is a course in development, details remain to be worked out. Generally, you will review information prior to each Tuesday's lecture class based on reading assignments. The Tuesday lecture will then review the necessary concepts for that week's lab. The lab assignment for that week will normally be completed and turned in by the following Tuesday's class.

Tentative Second Half Course Outline

- Mar 4. Basics of instrumentation systems, performance specifications. Circuits. Reading Assignment. Appendix D. Chapter 1 and 3. Pgs 117-121. **Lab 1: CR1000 datalogger and time response** (Horel)
- Mar 8, 11. Temperature, relative humidity, pressure, and wind sensors. Chapter 7. **Lab 2: Programming the CR1000** (Horel)
- Mar 15, 18. Snow? (and/or carbon dioxide?). Reading: Measuring Carbon Dioxide in the Atmosphere by Welles and McDermitt (pdf) or Doeksen on measuring snow. **Lab 3: Snow (or CO2?)** (Bowling)
- Mar 22, 25. Spring Break.
- Mar 29, Apr 1. Radiation balance. Chapter 12. **Lab 4: Solar and infrared radiation** (Hoch)
- Apr 5, 8. Boundary layer. **Lab 5: Lidar/Sodar**. (Hoch)
- Apr 12, 15. Turbulence and flux measurements. Reading: Current micrometeorological flux methodologies with applications in agriculture by Meyers and Baldocchi (pdf). **Lab 6: Flux measurements** (Pardyjak)
- Apr 19, 22. Wind power. **Lab 7: Wind turbine** (Pardyjak)
- Apr 26. Air chemistry. Kevin Perry.

Class Policies and Grading

Safety and security is one of the most critical aspects of this course. Severe violations of security and safety procedures will lead to removal from the course and a failing grade. Grades in the first half semester will be determined from: (1) professional participation in field activities (75%) and (2) final report (25%). Professional participation is defined as: following security and safety procedures, being responsible by fulfilling commitments when you voluntarily sign up to participate in a specific field activity, and participating in the field activity in a productive and competent manner.

During the second half of the semester, you will be required to check out equipment for use in the lab and in the field and that equipment remains your responsibility until it is checked back in. Lab and field safety is also critical- follow procedures specified in class. Grades for the second half semester will be determined from: (1) class/lab attendance, participation, and following safety and security procedures (15%) and (2) lab assignments (85%). Plagiarizing, copying, or otherwise misrepresenting ones' work will not be tolerated and will be dealt with as harshly as permitted under University Policy. Do not break the scientific code of honor.

ADA Accommodations

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangement for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.