BEE 361 Ecological Engineering Laboratory
3 Credit Hours
Spring 2017

Lead Instructor: Chad Higgins
Lecture: Gilmore 234    Hours: Wednesday 15:00-17:50
Telephone: 541-737-2286   Pre-Requisites: 1 year physics
Email: chad.higgins@oregonstate.edu   Office hours: open door policy

Catalog Description:
Introduction to modern measurement methods for ecological and environmental applications includes sensors and systems for measuring soil, water and atmospheric properties. Lec/lab.

PREREQS: One year college physics.

Required Text:
None

Recommended Reading:
None

References:
None

Measurement:

The course represents a total of 90 hours effort through the term (both in class and out). The primary focus is providing students hands-on experience with modern techniques and instrumentation used to assess ecological systems. Each week covers a topic relevant for Ecological Engineers entering the workforce. The class will be broken into 2 sessions each week,

1) A 1 hour lecture describing the application, instrumentation and relevance to environmental monitoring
2) A 2 hour lab session where the students use the sensors in the lab (or in the field) to collect real data.

Laboratory work each week will consist of data acquisition, data analysis, error estimation and presentation. Students will be asked to provide lab reports of their work. Reports will be due at the beginning of lecture the following week. Students are encouraged to work in teams of 2-3. But, each student must write their own report.
Table 1. Grading breakdown for BEE 361

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<th>BEE 361</th>
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<td>Weekly Lab reports:</td>
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**BEE 461 Learning Objectives:**

The primary objective of the lab class is to provide students with hands-on experience in ecological data acquisition, interpretation, and presentation. Other objectives include providing the students with experience in communicating technical information to decision makers, and providing example application of mathematics, science, engineering, and ethics. Students will have a clearer perspective on the value of measurement, and the scientific method in dealing with problems in engineering.

Students should be able to accomplish the following upon completion of the course:

1) The ability to form a hypothesis
2) The ability to carry out measurements relevant to ecological engineering
3) The ability to characterize the uncertainty of measurements
4) The ability to identify personal knowledge gaps
5) The ability to use external resources

**ABET Program Learning Objectives met by BEE 361:**

B) Ability to Design & Conduct Experiments - Analyze & Interpret Data.

I) Recognition of the Need for, and Ability to Engage in Life-Long Learning.
## Schedule:

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<th>Lecture</th>
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| **Week 1** | **Instrumentation basics**: Lab safety. What is a sensor? How to choose appropriate instrumentation for the process of interest.  
Lab (bench top): In lab safety training, then combine signal generator with oscilloscope: Observe/determine response time, calibration, noise. Compare observations to spec sheets. Use knowledge gained to deduce a measurement protocol. |
| **Week 2** | **Calibration**: (Jason Kelley) Students design a calibration bench test for pyranometers  
Lab (bench top): solder and calibrate a thermocouple using ice water and boiling water. Acquire data with commercial thermistors, and compare with NIST database and compute error. |
| **Week 3** | **Soil Moisture**: capillary tension and capacitive techniques. Soil characterization with sieves. Applications to Irrigated Ag.  
Lab (bench top/field) Experiments with buckets of soil. Classify soil, and use literature to estimate properties. Use commercial soil water probes to make a water balance of the bucket. Verify measurements with gravimetric techniques. Compute field capacity. |
| **Week 4** | **Survey Techniques**: Review of GIS and basic survey techniques.  
Lab 8 (field): Students create a map of a riparian area (to be used later in the surface water lab). Scavenger hunt for bonus points. |
| **Week 5** | **Surface Water**: Discussion of the water cycle. Introduction to water rights, and water use in the American West. Talk about stream monitoring, measurements of stream flow and stage discharge relationships.  
Lab (field): perform discharge measurements in Oak Creek using 3 methods. Focus on error estimate, and the implications of error on water use and planning. |
| **Week 6** | **Evapotranspiration and Meteorology**: Links to the global water, energy and carbon cycles. Measurement techniques for ET, energy budget, and optical technologies. Introduce the concept of spectroscopy. |
| **Week 7** | **Component Design**: design a build a sensor with arduino components, and 3-D printing |
| **Week 8** | **Water quality**: Provide a summary of fertilizers, nonpoint source pollution and BOD. Talk about assay techniques.  
Lab (wet lab): given a water sample, Perform a BOD assay. Recommend treatment steps given the level of observed BOD |
| **Week 9** | **Experimental Design**: Review of the scientific method, and past field experiments  
Lab (bench): form a hypothesis related to an ecological engineering system, write a proposal describing a set of measurements that would address the hypothesis. |
| **Week 10** | **Site visit/outreach**: (Tentative) Review of relevant physical process and its importance. Give students the constraints of the system  
Lab (field trip) visit local site that uses ecosystem serviced, lab assignment is to design a monitoring strategy given a budget. |

Late reports will be accepted for 3 days following the due date, with 10% of total possible points docked for each day late.
Students with Disabilities:

“Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.”

Academic Dishonesty and Student Conduct:

http://studentlife.oregonstate.edu/code

At Oregon State University academic dishonesty is defined by the Oregon Administrative Rules 576-015-0020.1.a-c as: An intentional act of deception in which a student seeks to claim credit for the work or effort of another person or uses unauthorized materials or fabricated information in any academic work. Academic dishonesty includes:

CHEATING – Use or attempted use of unauthorized materials, information or study aids or an act of deceit by which a student attempts to misrepresent mastery of academic interest of information. This includes unauthorized copying or collaboration on a test or assignment or using prohibited materials and texts.

FABRICATION – falsification or invention of any information (including falsifying research, inventing or exaggerating data and listing incorrect or fictitious references.

ASSISTING – Helping another commit an act of academic dishonesty. This includes paying or bribing someone to acquire a test or an assignment, changing someone’s grades or academic records, or taking a test/doing an assignment for someone else (or allowing someone to do these things for you). It is a violation of Oregon state law to create and offer to sell part or all of an education assignment to another person (ORS 165.114).

TAMPERING – altering or interfering with evaluation instruments and documents.

PLAGIARISM – representing the word or ideas of another person as one’s own OR presenting someone else’s words, ideas, artistry or data as one’s own. This includes copying another person’s work (including unpublished material) without appropriate referencing, presenting someone else’s opinions and theories as one’s own, or working jointly on a project, then submitting it as one’s own.