Syllabus – BEE 222: Ecological Engineering Computation

Course Credits - 3 Credits

Prerequisites, Co-requisites and Enforced Prerequisites – None

Course Description: This course is a foundation course in computation thinking and computation skills relevant to ecological engineering. The course consists of two subject area blocks: 1) Computational Thinking and Python, and 2) Hardware/Software Systems for Sensing and Control.

Objectives:

1. Develop computational thinking skills.

2. Gain understanding of principles of computer programming using Python, with applications in the area of ecological engineering.

3. Develop capabilities for programming hardware-based sensing and control systems using microcontrollers.

The first block employs a "flipped classroom" approach: students will be responsible for readings outside of class; it is expected that you will have reviewed the week's readings prior to Wednesday class session. We will meet as a class twice a week (Wednesdays and Fridays) with a focus on problem solving. The Monday class will be optional and will focus on reviewing the week's readings.

Students will be responsible for one homework and one quiz each week of the first block. Both quizzes and homeworks will be due on Wednesday before class. **Late submissions are not allowed**; however, you lowest score will be dropped in assessing your final grade.

The second block utilizes a conventional classroom approach and consists of a series of laboratory exercise in which you will be developing, programming and testing microcontroller-based sensing and control systems. For this section of the course, you will need to purchase a BEE 222 "Care Package" containing a programmable Arduino microcontroller, a set of sensors, and additional materials needed for the laboratory exercises.

Text: Introduction to Python for Science (D. Pine) – available online at http://www.physics.nyu.edu/pine/pymanual/html/pymanMaster.html and as a hardcopy PDF downloadable from this the course website.

Course Content and Schedule:

Block 1 - Computational Thinking and Python. See the online modules for detailed descriptions of weekly schedules. In general, Monday's meeting is attendance-optional and will answer questions about the week's assigned readings and address homework-related questions. Wednesday and Friday sessions will review the week's concepts with a particular emphasis on programming strategy and implementation.

Week	Readings	Quizzes	Homework
1. Getting Set Up Intro to Python	Chapter 1 Chapter 2 (2.4 and later sections)	Quiz 1: Due 4/4	Homework 1: Python Intro (due 4/11)
2. Python Data Types and Data Structures `NumPy`	Chapter 3 (3.1-3.4) Chapter 4	Quiz 2: Due 4/11	Homework 2: Working with Python Data Types (due 4/18)
3. Plotting Data w/ `MatPlotLib` Conditional and Control Statements	Chapter 5.0-5.2.1;5.2.4; remaining sections useful but optional Chapter 6 (6.1-6.2) Section 6.3 is optional	Quiz 3: Due 4/18	Homework 3: Incorporating conditional logic, program flow control (due 4/25)
4. User-defined functions Intro to Numerical Analysis w/ `SciPy`	Chapter 7.1-7.2 Chapter 8.1, 8.2	Quiz 4: Due 4/25	Homework 4: Implementing your own functions, Regression (due 5/2)
5. Numerical Analysis w/ `SciPy`	Chapter 9.3, 9.5, 9.6	Quiz 5: Due 5/2	Homework 5: Problem Solving using SciPy (due 5/9)

Block 2 - Hardware/Software Systems for Sensing and Control

Week	Topics	Readings	In-class Session	Homework
6	Arduino – Introduction		Arduino – Introduction	
7	Sensors Overview		Sensors Overview	
8	Sensor Integration		Sensor Integration	
9	Control Systems		Control Systems	
10	Data Analysis		Simple regression analysis	Homework 6: Data Analysis

Measurable Student Learning Outcomes and Evaluation of Student Performance:

Measurable student learning outcomes and evaluation approach is given in the following table. The letters at the end of each learning outcome are correlated to the ABET requirements for learning outcomes. Student performance will be measured using homework assignments, quizzes, laboratory assignments, and self-assessments. There are no exams in this class.

ABET Learning Outcome	Measurable Student Learning Outcome	Evaluation of Student Performance
B. Ability to Design & Conduct Experiments - Analyze & Interpret Data	1. Analyze ecological datasets using Python 2. Develop simple regression models from data 3. Collect and interpret data from Sensors	1. Homework 3, Quiz 3, Self-assessment 2. Homework 4, Quiz 4, Self Assessment 3. Lab 4, Lab 5, Self Assessment
K. Ability to Understand Techniques, Skills, and Modern Engineering Tools for Engineering Practice	1. Apply optimization techniques to problem solving 2. Be able to assemble circuits from wiring diagrams 3. Be able to program a microprocessor	1. Homework 3, Quiz 3, Self-assessment 2. Lab 1, Lab 2, Self Assessment 3. Lab 1, Lab 2, Self Assessment
N. Ability to Model and Design Ecological Systems	1. Develop simple regression models from data 2. Apply optimization techniques to problem solving 3. Collect and interpret data from Sensors	1. Homework 4 Quiz 4, Self Assessment 2. Homework 5, Quiz 5, Self Assessment 3. Lab 4, Lab 5, Self Assessment

Learning Resources:

Introduction to Python for Computational Science and Engineering (A Beginner's Guide). 2015. Hans Fangohr, University of Southampton. PDF available on course Canvas site.

[x] Lecture	[ ] Experimental	[ ] Thesis
[x] Discussion	[ ] Internship	[ ] Studio
[x] Recitation	[ ] Correspondence	[X] Project
[ ] Laboratory	[ ] Tutorial	[ ] Telecourse/Distance Learning
[ ] Seminar	[ ] Practicum	[ ] Externship
[ ] Independent Studies	[ ] Reading & Conference	[ ] Workshop
[ ] Research	[ ] Exper/Co-op Education	[ ] World Wide Web
[ ] Activity	[ ] Programmed Instruction	[ ] Modular

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:
Academic misconduct is any action that misrepresents a student or group's work, knowledge, or achievement, provides a potential or actual inequitable advantage, or compromises the integrity of the educational process. A complete description of prohibited behaviors as available at: http://studentlife.oregonstate.edu/code. These include the following:
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a) **Cheating**. Unauthorized assistance, or access to or use of unauthorized materials, information, tools, or study aids. Examples include, but are not limited to, unauthorized collaboration or copying on a test or assignment, using prohibited materials and texts, unapproved use of cell phones, internet, or other electronic devices, etc.
b) **Plagiarism**. Representing the words or ideas of another person or presenting someone else's words, data, expressed ideas, or artistry as one's own. Examples include, but are not limited to, presenting someone else's opinions and theories as one's own, using another person's work or words (including unpublished material) without appropriate source documentation or citation, working jointly on a project and then submitting it as one's own, etc.
c) **Falsification**. Fabrication or invention of any information. Examples include, but are not limited to, falsifying research, inventing or falsely altering data, citing fictitious references, falsely recording or reporting attendance, hours, or engagement in activities such as internships, externships, field experiences, clinical activities, etc.
d) **Assisting**. Any action that helps another engage in academic misconduct. Examples include, but are not limited to, providing materials or assistance without approval, altering someone's work, grades or academic records, taking a test/doing an assignment for someone else, compelling acquisition, selling, bribing, paying or accepting payment for academic work or assistance that contributes to academic misconduct, etc.
e) **Tampering**. Interfering with an instructor's evaluation of work by altering materials or documents, tampering with evaluation tools, or other means of interfering.
f) **Multiple submissions of work**. Using or submitting work completed for another or previous class or requirement, without appropriate disclosure, citation, and instructor approval.
g) **Unauthorized recording and use**. Recording and/or dissemination of instructional content without the express permission of the instructor(s), or an approved accommodation coordinated via Disability Access Services.