Introduction to Environmental Science & Engineering (ESE-6/EPS-6)

Latest Syllabus (7/16 updated)

Fall 2024 (updated on 7/16)

Lectures: Mondays & Wednesdays 10:30-11:45 AM

Labs: Tue 3:45-6:30 & Wed 3:45-6:30 on the following days (at the Science Engineering Complex)

- 9/10 (or 9/11) - Mass Balance ;
- 9/24 (or 9/25) - Solar Power Lab ;
- 10/8 (10/9) - HazeL Assembly ;
- 11/5 (11/6) - Soil Lab;
- 11/19 (11/20) - Water Lab

Sections (all other weeks; in Cambridge):

- T 4:30-5:45 (MD G135)
- Wed 4:30-5:45 (MD G125)

Instructors:

Prof. Steve Wofsy (wofsy@g.harvard.edu) - Office Hours by appointment

Dr. Bryan Yoon (byoon@seas.harvard.edu) - Office Hours: TBA

Teaching Fellows:

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Course Description

This course will provide students with an introduction to environmental science and engineering by providing an overview of current environmental issues, including climate change, air pollution, and water pollution. Students critically evaluate underlying science and knowledge limitations and explore the nexus between scientific knowledge, regulatory frameworks, and engineering solutions to some of the world's most pressing environmental problems. The course will emphasize the interconnected biological, geological, and chemical cycles of the earth system, including the multi-dimensional impacts of human activity.

Learning Outcomes

At the end of this course, students will be able to:

- apply knowledge of the fundamental chemistry and physics of the earth and the environment.
- identify, conceptualize, and analyze environmental issues with human causation
- identify, conceptualize, and analyze engineering solutions to environmental issues

Skills comprising the learning outcomes at the end of the course:

- At the start: ESE-6 is accessible to Freshmen with limited science preparation, and appropriate for science-oriented students
- At the end: Students should be:

- quantitative and numerate
- capable of basic coding (making graphs, analyzing data; novice or higher level when using R/Python)
- able to think and write analytically
- able to prepare and deliver effective presentations

Recommended Prep

This course presumes a basic background in chemistry, physics, and mathematics at the Math 1B level. This course does not assume any background in programming or statistics, and we will be developing these skills throughout the semester (in R or Python)

Required Readings

There is no required textbook for the course. Required readings will be assigned from a variety of sources and will be available on the course website and/or provided in class.

Course Structure and Assessment

10% Pre/In-class Exercises

10% Attendance

30% Problem Sets

20% Labs

30% Final Project & Presentation:

- 10% Proposal and questions
- 10% Data collection and initial analysis
- 10% Final presentation and written documentation

Course Policies & Expectations

- **Lectures.** The class will meet two times a week from 10:30 am-11:45 am on Mondays and Wednesdays. Regular attendance at lectures and participation in discussions and activities is expected and required. We will periodically check for attendance, and missing a lecture without instructorsâ€™ approval, doctorâ€™s note, or Resident Deanâ€™s letter will result in a 1% loss in the course grade.

- **Readings.** Required readings will be assigned periodically. Readings should be completed prior to class.

- **Problem Sets.** Problem sets will be used to reinforce concepts introduced in class and are due at the end of the day (5:00 PM) on the assigned due date. Requests for extensions must be submitted for approval by the instructors prior to the scheduled due date.

- **Labs.** There will be five labs in the course this semester. Lab sessions (5 total) will be held at the

SEAS Science & Engineering Complex in Allston.

- **Sections.** Your lab periods will be used for Section meetings when there are no scheduled labs. The Sections will cover basics in computational programming that correspond to the lecture and lab contents. Depending on your section, you will be using either R or Python.

- **Final Project.** Students will work in small groups of three to complete a final project. All students will receive an aerosol particle counter that can monitor air quality and calibrate their devices with their peers for objective comparison. Once calibrated, these particle counters can be used to explore how air quality changes across different times and spaces. Each group will formulate a hypothesis, write a proposal, collect their own data, and present their findings. This project should be fun and introduce students to environmental research and data visualization techniques that complement in-class assignments throughout the semester. A series of milestones for the project will be provided throughout the class.

- **Grading:** Any questions on graded material must be brought to a TFâ€™s attention within 14 days of the original due date. Any student who believes they should have received more points for any reason other than a simple addition error of the points awarded must provide a written statement making the case. We reserve the right to fully re-evaluate any graded material which may result in an increase or decrease in the original grade.

- **Late submission:** Each student is given a 4-day late submission grace period ***for the entire semester***. Your late submission penalties will accumulate in 1-day increments (***rounded up*** to the nearest day for each assignment; **maximum two days per assignment**). For example, a 2-hour late submission for Assignment 1 and a 10-minute late submission for Assignment 2 would translate into a 2-day deduction from the 7-day grace period. This late submission grace period is provided to offer flexibility for all different types of personal/academic issues that may impact your life (e.g., medical conditions, religious holidays, personal/family emergencies)**.** There is no need to communicate with the TFs or instructors regarding late submissions until you use up all your grace period. Late assignments beyond the 2-day limit receive a 10% grade penalty per day. All late assignments past the 4-day period will also receive a 10% grade penalty per day. If you need more accommodations, please email the instructors with appropriate documents (e.g., a doctorâ€™s note; a letter from your Resident Dean or DAO).

- **Course Website.** Information about required components of the course will regularly be disseminated via the course website on Canvas. Students are responsible for ensuring that their notification settings in Canvas are set to receive all course communications in a timely manner.

- **Academic Integrity**. Discussion and the exchange of ideas are essential to academic work, but **all submitted assignments in this course must be identifiable as a student's distinct work**.
  - For homework assignments and labs, students are encouraged to consult with classmates as they work on problem sets to enhance learning. However, after discussions with peers, each student must write up and turn in an individual set of solutions that represents their individual mastery of the problems.
  - Photographing and/or copying another studentâ€™s work is not permitted.

Tentative Schedule (updated

Module	Week	Topics	Assignments	Lab
Intro & Environmental Systems	1-2	Course Intro; Mass Balance; conservation of energy; units, scales, and dimensions	PS 1	Mass Balance

Climate	3-5	Electromagnetic Spectrum; Solar Irradiance; Greenhouse gasses; Heatwave and human health; Evapotranspiration; Soil moisture	PS 2	Solar Panel Lab
Air pollution & Aerosol	6-7	Particulate matter; primary and secondary pollution; aerosol;	PS 3	HazeL Assembly
	8	Spring Break	Soil Collection	
Biogeochemical Cycles	9-11	C/N cycles; soil formation; watershed processes; methane sources; algal blooms	PS 4	Soil Lab
Aquatic Systems and Organic Pollutants	12-13	Anthropogenic Perturbation to Aquatic Systems; Organofluorine; PFAS; Environmental Regulation	PS 5	Water Lab
Wrap up	14-15	Wrap-Up and Final Presentations		