# Department of Civil and Environmental Engineering
# University of Connecticut
# CE/ENVE-4310 Environmental Modeling
# Spring 2017

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***Class meets:*** MoWeFr 9:05AM-9:55AM in AUST163
***TA Office Hours:*** MoWeFr 10:30AM-11:30AM or by appointment

***Website (HuskyCT):*** http://huskyct.uconn.edu (all assignments will be uploaded in HuskyCT at the due date; students are expected to check the HuskyCT section of the course at least one time between classes; email announcements will be sent out using HuskyCT as a means of direct communication and updates related to the course)

Textbook: *Environmental Modeling, Fate and Transport of pollutants in water, air, and soil*, Jerald L. Schnoor, John Wiley and Sons, 1996, 682 pp.

**This course will give insight to the following questions:**

- Why do we need a model?
- How to develop and solve mathematical models for chemical pollutants in natural waters and the atmosphere?
- When is a "modeling exercise" successful?
- What are the uncertainties involved in environmental modeling?
- How can we use data to calibrate/evaluate model parameters and/or control model predictions?
- What transport and fate properties do contaminants have in natural systems?

**Coarse description**
Prerequisite: CE 2310 and (CHEG 3123 or CE 3120); enrollment in the School of Engineering. Systematic approach for analyzing contamination problems. Systems theory and modeling will be used to assess the predominant processes that control the fate and mobility of pollutants in the environment. Assessments of lake eutrophication, conventional pollutants in rivers and estuaries, toxic chemicals in groundwater and atmospheric pollution.

**Course goals and objectives**
The ***goal*** of this course is to provide sufficient knowledge on numerical modeling techniques and enable you to efficiently solve environmental engineering problems.
*Objectives:*

1. Apply analytical solutions vs. numerical approximations to solve environmental problems

2. Evaluate boundary and initial conditions and build intuition about system behavior through modeling
3. Make assessments of lake eutrophication, conventional pollutants in rivers, groundwater, and air pollution.
4. Evaluate the quality and efficiency of an environmental model application

**Learning objectives. At the end of this course you will be able to:**

1. Analyze and evaluate pros and cons of environmental models (*homework; lectures*)
2. Develop numerical models using Matlab to solve an environmental problem (*computer labs; projects*)
3. Collaborate with colleagues to compile or create new knowledge about an environmental problem (*in-class activities; final project*)

**Required Materials**

The materials you need to successfully complete the course are listed below.

**1.** Textbook: Environmental Modeling, Fate and Transport of pollutants in water, air, and soil, Jerald L. Schnoor, John Wiley and Sons, 1996, 682 pp.
**2.** Handouts on specific topics (will be distributed in class)
**3.** I-clickers for Quizzes

*Note:* We will be using i-clickers periodically throughout the course for Quizzes, mostly at the end of a section (might be a chapter or a topic). Participation in the i-clicker sessions will be rewarded with **1 grade point** for each session and is counted towards class participation. The answers will not be graded as they are meant to indicate the quality of knowledge gained and highlight the parts that need to be clarified and discussed further.

**Projects and Computer Labs (learning objectives 2 and 3):**

There will be three modeling project assignments during the semester and one final project that will be on a topic of your choice. A special session will be devoted to discuss the final project requirements (see course schedule). I will always be available to answer questions and guide you through the development of your projects. All you need to do is ask! The topics of the three projects are listed below:

1. Numerical solution of groundwater flow
2. Modeling pollutant concentration in a river: uncertainty analysis
3. Air pollution concentrations downwind of a power plant using a Gaussian plume model

One requirement for the three projects is the use of Matlab to construct the models. Five (5) computer lab sessions are scheduled to work on Matlab commands and code structure in order for you to gain experience with the tools. The computer labs will take place in Engineering II (EII 305, 306 & 307). Your grade is influenced by your participation and interaction with the instructor, TA and colleagues. The computer lab sessions are listed below:

1. Session#1: Matlab introduction and examples (2 classes)
2. Session#2: Analytical vs. numerical solutions in Matlab (1 class)
3. Session#3: Numerical approximation to a PDE using Matlab (1 class)
4. Session#4: The logistic growth/population model using Matlab (1 class)

**Environmental Modeling topics covered during the semester:**

- Introductory lectures on systems theory, modeling and assessment (chapter 1; hmwk#1);
- Ordinary and Partial Differential Equations (Handouts; hmwk#2)
- Basic derivations for transport of contaminants in natural systems (chapter 2; hmwk#3);
- Basic processes and kinetics of chemical reactions (chapter 3; hmwk#4);

- Computer codes with applications in model calibration and uncertainty evaluation (handouts);
- Application: Eutrophication (chapter 5; hmwk#5);
- Application: Modeling pollutants in rivers (chapter 6; hmwk#6);
- Application: Modeling fate and transport of pollutants in groundwater (chapter 9);
- Application: Modeling air pollution (handouts);
- Application: Climate Change and General Circulation Models (chapter 11).

**Tentative Course schedule**

The course schedule might change in the event of inclement weather or other unforeseeable circumstances. The updated schedule and any subsequent changes will be communicated through HuskyCT.

| WEEK | DATE | TOPIC | MATERIAL | ASSIGNMENTS |
|---|---|---|---|---|
| Week 1 | 01/18 | Intro to Environ. Modeling | Schnoor Chp1 | |
| | 01/20 | Intro to Environ. Modeling+final projects | Schnoor Chp1 | Assign Hmwk#1 |
| Week 2 | 01/23 | Transport Processes | Schnoor Chp2 | |
| | 01/25 | Transport Processes | Schnoor Chp2 | |
| | 01/27 | ODE: Numerical&Analytical Methods | Handouts | Hmwk#1 Due, Hmwk#2 |
| Week 3 | 01/30 | Matlab session#1 (EII 305-7) | Handouts | |
| | 02/01 | PDE: Numerical Methods | Handouts | |
| | 02/03 | PDE: Numerical Methods | | Hmwk#2 due date |
| Week 4 | 02/06 | Matlab session#1 (EII 305-7) | Handouts | |
| | 02/08 | PDE: Numerical Methods | | |
| | 02/10 | PDE: Numerical Methods | | |
| Week 5 | 02/13 | Matlab session#2 (EII 305-7) | | Hmwk#3, **Project #1** |
| | 02/15 | Quiz + Runge/Kutta scheme | | |
| | 02/17 | Transport models | Schnoor Chp2 | Hmwk#3 due date |
| Week 6 | 02/20 | Matlab session#3 (EII 305-7) | | Final Projects selection |
| | 02/22 | Reaction Kinetics I | Schnoor Chp3 | |
| | 02/24 | Reaction Kinetics II | Schnoor Chp3 | |
| Week 7 | 02/27 | Reaction Kinetics II | Chp3 | **Proj#1 due date**, Hmwk#4 |
| | 03/01 | Quiz | Schnoor Chp5 | **Assign Proj. #2** |
| | 03/03 | Eutrophication | Schnoor Chp5 | Hmwk#4 due |
| Week 8 | 03/06 | Matlab session#4 (EII 305-7) | | |
| | 03/08 | Eutrophication | Schnoor Chp5 | Hmwk#5 |
| | 03/10 | Eutrophication | Schnoor Chp5 | |
| **SPRING BREAK** | 03/13-03/17 | | | |
| Week 9 | 03/20 | River Pollution | Schnoor Chp 6 | **Proj.#2 due date** |
| | 03/22 | River Pollution | Schnoor Chp 6 | Hmwk#6 |
| | 03/24 | **MIDTERM EXAM** | | |
| Week 10 | 03/27 | River pollution | Schnoor Chp6 | |
| | 03/29 | Invited seminar | | |
| | 03/31 | River pollution | | |
| Week 11 | 04/03 | Midterm solutions | | Hmwk#6 due |
| | 04/05 | Air Pollution | | |
| | 04/07 | Air Pollution | Handouts | **Assign proj#3** |
| Week 12 | 04/10 | Air Pollution | | |
| | 04/12 | Groundwater flow | Schnoor Chp9 | |
| | 04/14 | Groundwater Flow | Schnoor Chp9 | |
| Week 13 | 04/17 | Quiz: Chp 6, 9 and Air Pollution | | **Proj.#3 due date** |
| | 04/19 | Wet&Dry Deposition | SchnoorChp10 | |

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|---|---|---|---|---|
| | 04/21 | Global Change | SchnoorChp11 | |
| Week 14 | 04/24<br>04/26<br>04/28 | Final Projects<br>Final Projects<br>Final Projects | | |
| **Week 15** | **TBD** | **FINAL EXAM** | | **AUST 163** |

**Assessment**
The assessment will be based on class participation, homework assignments, projects, midterm and final exams. I will provide feedback on your grades continuously throughout the semester.

*Weighting of course requirements:*

Participation/Homework/Projects: 30%
Final Project: 20%
Midterm Exam: 25%
Final Exam: 25%

| **Grade conversion chart** | | | |
|---|---|---|---|
| Excellent | A | 4 | 91 - 100 |
| | A- | 3.7 | 89 - 90 |
| Very Good | B+ | 3.3 | 87 - 88 |
| Good | B | 3 | 81 - 86 |
| | B- | 2.7 | 79 - 80 |
| | C+ | 2.3 | 77 - 78 |
| Average | C | 2 | 71 - 76 |
| Fair | C- | 1.7 | 69 - 70 |
| Poor | D+ | 1.3 | 67 - 68 |
| | D | 1 | 61 - 66 |
| Merely Passing | D- | 0.7 | 59 - 60 |
| Failure | F | 0 | <59 |

**Code of conduct:**
All students that participate in the class are expected to be respectful towards others and their views. Distracting behavior will not be tolerated and will lead to a deduction of up to 20 points from the final grade. This course requires your active involvement. If you want to learn as much as possible, you are invited to come to class ready to initiate ideas and participate in vivid discussions on the course material. There are no "right" or "wrong" questions and all will be treated with equal respect. Students are expected to conduct themselves in accordance with UConn's Student Conduct Code (http://community.uconn.edu/the-student-code/).

**Academic Integrity Statement**
This course expects all students to act in accordance with the Guidelines for Academic Integrity at the University of Connecticut. Because questions of intellectual property are important to the field of this course, we will discuss academic honesty as a topic and not just a policy. If you have questions about academic integrity or intellectual property, you should consult with your instructor. Additionally, consult UConn's guidelines for academic integrity.

## POLICY STATEMENTS

**Collaboration Policy:**
Students are encouraged to work together (in groups of 2 or 3) on homework assignments in the interest of gaining better understanding of the material. However, any evidence of direct copying will result in a zero homework grade for all involved parties.

Copying from solutions manuals will also result in a zero homework grade. Collaborating on exams will result in an F for the course for all parties involved.

**Final Exam Policy**
In accordance with UConn policy, students are required to be available for their final exam and/or complete any assessment during the time stated. If you have a conflict with this time you must obtain official permission to schedule a make-up exam with the Office of Student Support and Advocacy (OSSA). If permission is granted, OSSA will notify the instructor. Please note that vacations, previously purchased tickets or reservations, graduations, social events, misreading the assessment schedule, and oversleeping are not viable reasons for rescheduling a final.

**Policy Against Discrimination, Harassment and Inappropriate Romantic Relationships**
The University is committed to maintaining an environment free of discrimination or discriminatory harassment directed toward any person or group within its community – students, employees, or visitors. Academic and professional excellence can flourish only when each member of our community is assured an atmosphere of mutual respect. All members of the University community are responsible for the maintenance of an academic and work environment in which people are free to learn and work without fear of discrimination or discriminatory harassment. In addition, inappropriate Romantic relationships can undermine the University's mission when those in positions of authority abuse or appear to abuse their authority. To that end, and in accordance with federal and state law, the University prohibits discrimination and discriminatory harassment, as well as inappropriate Romantic relationships, and such behavior will be met with appropriate disciplinary action, up to and including dismissal from the University. More information is available at http://policy.uconn.edu/?p=2884.

**Sexual Assault Reporting Policy**
To protect the campus community, all non-confidential University employees (including faculty) are required to report assaults they witness or are told about to the Office of Diversity & Equity under the Sexual Assault Response Policy. The University takes all reports with the utmost seriousness. Please be aware that while the information you provide will remain private, it will not be confidential and will be shared with University officials who can help.
More information is available at http://sexualviolence.uconn.edu/.