CIV ENV 260: Environmental Systems and Processes

Course Syllabus, Spring 2023

Lectures: MWF 9:00-9:50 CST, Kresge Cent. Hall 2-380

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Text: James Mihelcic, *Environmental Engineering: Fundamentals, Sustainability, Design*, 3rd edition, ISBN 978-1119604457. You must have the ***third edition***.

Seth Darling and Douglas Sisterson, *How to Change Minds About Our Changing Climate* (ISBN-13: 978-1615192236). This is an easy, humorous, yet very informative read that we'll use as the basis for four short in-class discussions about climate change and climate action. This will form the basis for your participation grade.

Homework: Problem sets will emphasize engineering calculations for environmental analysis and design. Problems will be assigned on Wednesdays, and be due the Friday of the next week to Canvas. Late homework will be accepted on the Monday following the due date, but will be discounted 20%. Homework will not be accepted after that, as solutions will be posted on Monday afternoon. I encourage you to discuss the homework with your peers, but you must ultimately submit your own independent work. In order to receive credit, homework must be prepared in an understandable fashion, with all work shown. Homework solutions must always include good documentation of solution strategies, equation parameters, and units. Obviously, homework solution files may not be copied.

Laboratories: There will be three laboratories spread throughout the term (see attached schedule). Laboratories will be on Monday afternoons. We will organize two laboratory sections so that each student only has to attend from 2:00-4:00 or 4:00-6:00. Laboratory measurements will be made in groups, but each individual must submit their own report. Lab reports will be brief, and will focus on determining how well the experimental observations follow theoretical predictions.

Exams: One midterm examination will be given, along with a final examination. Exams will test your ability to understand key concepts and perform engineering calculations. Exams will be open-book and open-notes; you can use all class materials, including homework, textbook, and notes, but you cannot use other texts, references, or outside materials. Both examinations will be comprehensive, covering all material presented previously in class.

Grading: Homework (8) 32%, Participation (5%), Laboratories (3) 18%, Midterm exam 20%, Final exam 25%.

Course Objectives and Outcomes:

The objectives of the course are to provide an overview of environmental systems and to develop the ability to quantitatively analyze important physical, chemical, and microbiological processes in natural and engineered systems.

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

1. Understand the important physical, chemical, and biological processes that regulate the dynamics of aquatic systems, the atmosphere, the land surface, and groundwater aquifers.
2. Identify major contaminants of concern to human health and ecological health.
3. Identify environmental resources necessary for modern society and evaluate constraints on sustainable development, such as ensuring ongoing access to sufficient high-quality water supplies and avoiding long-term degradation of aquatic ecosystems.
4. Identify primary sources of drinking water, and key microbiological and chemical parameters that determine the suitability of water for drinking.
5. Understand the regulatory framework for water and air quality.
6. Summarize the major strategies used to remove contaminants from water and air, and how those strategies have been implemented in treatment infrastructure.
7. Formulate steady-state and non-steady-state mass balances for conservative and nonconservative substances in natural systems and constructed systems.
8. Use mass balance models in basic engineering design calculations for treatment systems.
9. Perform basic estimations of health risks associated with natural environmental hazards and regulated contaminant limits.

The course supports the following ABET program outcome criteria for student capability at the completion of their engineering degree:

(O1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(O4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

(O6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

CE260 Spring 2023: Weekly Class schedule*

Week	Lec	Date	Topic	Chapter	Assignment
	1	3/28	Course overview and intro survey		
1	2	3/29	Environmental challenges and solutions.	1	HW 1 assigned
	3	3/31	Mass Balances.	2, 4.1.1-4.1.3	
	4	4/3	Chemical stoichiometry and equilibria.	3.1-3.4	
2	5	4/5	pH and Acid-base equilibria, Alkalinity	3.7	HW 2 assigned
	6	4/7	Gas-liquid partitioning (Henry's Law)	3.5-3.6	HW 1 due
	7	4/10	Precipitation and Dissolution Processes. Hardness.	3.9	
3		4/12	*Guest Lecture- Urban water infrastructure- Dick Lanyon*	3.8, 3.11	HW 3 assigned
	8	4/14	Chemical Kinetics and Redox Reactions		HW 2 due
	9	4/17	Microbial Metabolism	5.1-5.3	
4	10	4/19	Microbial growth processes. COD and BOD.	5.4	HW 4 assigned
	11	4/21	Hydrodynamic transport processes.	4.4	HW 3 due
	12	4/24	Reactor Models I	4.1	Lab 1 (BOD)
5			***Lab 1*** *Biochemical Oxygen Demand*		assigned
	13	4/26	Reactor Models II	4.1	HW 5 assigned
		4/28	Review/Q&A for midterm		HW 4 due
		5/1	***Midterm exam (Format TBA)***		
6	14	5/3	Risk assessment.	6	
	15	5/5	Water quality.	7	Lab 1 due
	16	5/8	Water and wastewater treatment processes.	8.1-8.5, 8.7-8.9,	Lab 2 assigned
7			***Lab 2*** *Completely Mixed Flow Reactor*	4.4.2	
	17	5/10	Water and wastewater treatment processes.	9.1-9.6, 9.11.2	HW 6 assigned
	18	5/12	Air pollution challenges and controls I	11	HW 5 due
	19	5/15	Air pollution challenges and controls II	11	
8	20	5/17	Air pollution challenges and controls III	11	HW 7 assigned
		5/19	*Guest Lecture (tentative)- Global Climate Change*	2.5.3, 4.2	HW 6 + Lab 2 due
	21	5/22	Surface and Groundwater Resources and Contamination	7	Lab 3 assigned
9			***Lab 3*** *Groundwater flow*		
		5/24	*Guest lecture– Marine Climate Change Impacts – Luisa Marcelino*	2.5.3, 4.2	HW 8 assigned
	22	5/26	Urban water issues. Water contamination case study.	Handout	HW 7 due
		5/29	*Memorial Day (No Class)*		
10		5/31	TBD – possible case study		
		6/2	Review. Exit quiz.		HW 8 + Lab 3 due
			Final exam: Tuesday, 6/6 12-2 pm		Comprehensive

** This schedule is tentative, and is likely to change. I will provide updates on the schedule, assigned readings, and other logistics at the start of each class period. Please pay close attention to these.*

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DIVERSITY STATEMENT: As educators and learners, we must share a commitment to diversity and equity, removing barriers to education so that everyone may participate fully in the community. In this course, we respect and embrace the unique experiences that brought each person here, including backgrounds, identities, learning styles, ways of expression, and academic interests. The broad spectrum of perspectives represented by our students enrich everyone's experiences, and we strive to meet each perspective with openness and respect.

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ACADEMIC SUPPORT AND LEARNING ADVANCEMENT (ASLA): If you are looking for help with a course or academic challenge, or if you would simply like to sharpen your study strategies and stay on track, check out Academic Support & Learning Advancement. They offer drop-in tutoring, study groups, academic coaching, and individual consultations for all undergraduates. For more information: northwestern.edu/asla or asla@northwestern.edu.