

# CEE 635 Environmental Chemistry

Department of Civil, Environmental, and Construction Engineering

**Lecture Time:** TBD

**Location:** TBD

**Instructor:** **Dr. Juhee Kim, Assistant Professor**

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Office Hours: Email Dr. Kim for appointments.

**General:** This course is designed to teach students a fundamental understanding of the chemical processes influencing the chemistry of water resources. Students will develop their ability to apply chemical equilibrium and kinetic principles to analyze and solve quantitative problems regarding the behavior of chemical substances in water.

**Key Topics:**

1. Background fundamentals: *thermodynamics; chemical equilibrium; activity and activity coefficient; reaction kinetics; compositions and reactions of natural waters*
2. Water chemistry: *acid-base; chemical speciation; air-water exchange; complexation/solubility of metals in water; redox reactions; adsorption*
3. Advanced topics: *chemistry of oxidants in water treatment*

**Prerequisites:** College-level general chemistry; environmental engineering

**Textbooks:**

1. “*Water Chemistry*” Mark M. Benjamin, 2015, Second Edition, Waveland Press Inc., ISBN: 978-1-4786-2308-3.
2. “*Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems*”, P. L. Brezonik and W. A. Arnold, 2011, Oxford University Press. (On-line book available via UHM Library, [https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII\\_MANOA/1rbop20/cdi\\_askewsholts\\_vlebooks\\_9780199813544](https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/1rbop20/cdi_askewsholts_vlebooks_9780199813544))
3. “*Aquatic Chemistry*”, W. Stumm and J. J. Morgan, 1996, John Wiley & Sons, ISBN: 0471511846

**Homework:**

1. Weekly assignment
2. Reading materials

- Students are encouraged to discuss the problems with peers in the study group, but must submit individually completed work. The solutions should be in neat handwriting on 8.5"x11" white papers, with student's name shown on the first page. In the solution, clearly show your calculations, state employed assumptions, and mark the final answer in each question. Credits will be granted based on: 100% (complete work with minor errors), 50% (incomplete work or major errors), or 0% (minimum work or no submission).
- In general, late assignments **will not be accepted** past the due time. However, each student can have up to 3 late days without any penalty on assignments (exams excluded) of his/her choice in this semester. Exceptions will be made if prior permission has been granted by the instructor or an emergency with persisting impact has occurred.

### **Project Report and Presentation:**

- The project report should be prepared by typing in an MS Word file. A cover page is required which should contain the project name and student name. At the end of the semester, a presentation is to be given on the project. More specific instructions will come with the assignment.

### **Exams:**

Midterm I (75 min): Closed book, Taking-in class  
 Midterm II: Take-home exam  
 Final (2 hr): Closed book, Taking-in class

### **Grading:**

Homework	10 %
Project report	15 %
Project presentation	5 %
Midterm I	15 %
Midterm II	25 %
Final	30 %

### **Communications:**

Emails to UH email accounts and announcements on Laulima  
 (<https://laulima.hawaii.edu/portal>)  
 Weekly agenda  
 Office hour and class time  
 Course surveys

### **Course policy:**

1. Cheating is NOT allowed and will result in a grade F. Collaboration is allowed and encouraged during the preparation of homework, although students must turn in their individual answers. No collaboration whatsoever is allowed during the mid-term and final examinations. During those tests, questions can only be directed to the instructor.

2. Disruptive classroom behavior, such as grandstanding, prolonged chattering, noisy electric devices, will NOT be tolerated.
3. University rules and policies regarding absences due to illness, field trips, research, conference participation, political activism, and other reasons will be followed.
4. UH-M College of Engineering Academic Integrity Statement: The College of Engineering, in order to prevent the use of unauthorized academic assistance, bans the use of any electronic communication devices, including but not limited to, smart phones, smart tablets, smart watches, and related technology while completing closed notes/book quizzes, examinations, or other deliverables in which the faculty expressly outlines these expectations. Additionally, per the University of Hawai'i Student Conduct Code, the following additional actions may constitute a violation of Academic Dishonesty: - the use of any unauthorized assistance in taking quizzes, tests, or examinations - use of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments - the acquisition, without permission, of tests or other academic material belonging to a member of the UH faculty, staff or student body (i.e. use of Chegg or similar website to reference old tests, assignments, etc. without permission) - engaging in any behavior specifically prohibited by a faculty member in the course syllabus or class discussion The immediate disciplinary actions will be at the discretion of the instructor but may result in reporting to the Department, College, and/or the Office of Judicial Affairs where, if found in violation, the resulting sanction(s) may include expulsion from the University.

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### Tentative Course Schedule (subject to change):

Week	Topics	Homework/Exam
Week 1	Introduction Background knowledge	<i>Reading Material</i>
Week 2-3	Thermodynamics and reaction equilibrium	<i>Weekly assignment</i>
Week 4-6	Acid/Base Chemistry - quantitative equilibrium calculations - logC-pH diagrams titrations, buffer intensity - alkalinity	<i>Weekly assignment</i>
Week 7-8	Air-Water Equilibrium Alkalinity in open system	<i>Weekly assignment</i> <b>MIDTERM EXAM I</b>
Week 9-11	Metal Chemistry - coordination chemistry - metal ion hydrolysis - precipitation & dissolution - solubility control MINTEQ Software	<i>Weekly assignment</i> <b>PROJECT REPORT</b>
Week 12-14	Redox Chemistry - redox background - pe and E <sub>H</sub> - Redox reactions pe-pH diagrams	<b>MIDTERM EXAM II</b> <i>Weekly assignment</i>
Week 15	Adsorption Reaction kinetics	<i>Weekly assignment</i>
Week 16	Project presentation	<b>PROJECT PRESENTATION</b>
Week 17	Final Exam Period	<b>FINAL EXAM</b>

Note: exact topics covered in each week may change depending on class progress.