

CEE 6312 Chemical Principles in Environmental Engineering

Fall, 2021

Tuesday & Thursday 9:30–10:45 AM
ES&T L1125

Course Description: This course is designed to teach students a fundamental understanding of the chemical and related processes that affect the chemistry of water resources, and develop their ability to apply chemical equilibrium and kinetic principles to solve quantitative problems regarding the behavior of chemical substances in water.

Key Topics:

- I. Background fundamentals: *thermodynamics; chemical equilibrium; activity-concentration relationship; reaction kinetics; compositions and reactions of natural waters*
- II. Water chemistry: *acid-base systems; chemical speciation; air-water exchange; complexation/solubility of metals in water; redox reactions*
- III. Advanced topics: *chemistry of oxidants in water treatment; adsorption; speciation modeling*

Prerequisites: college-level general chemistry is a minimum requirement; exposure to additional content in organic, inorganic, biological and/or environmental chemistry may also be helpful.

Instructor: Dr. Ching-Hua Huang, Professor

E-mail: ching-hua.huang@ce.gatech.edu; Phone: 404-663-1102; Office: DEEL 306

Office Hour: Virtual office hour. Email Dr. Huang for appointments.

Course Website: <http://canvas.gatech.edu/>

Course Format: This course is in a “flipped” format, meaning that the lectures on fundamental principles are recorded and uploaded at the course website. **The students are required to watch the lecture videos prior to the class.** When the class meets, the class time is used primarily for discussion and example problems. Questions related to the fundamental principles will be addressed, but the materials will not be taught entirely again in the class time.

Useful books:

1. “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 GT Library, <https://ebookcentral.proquest.com/lib/gatech/detail.action?docID=800831>)
2. “Water Chemistry” by Mark M. Benjamin, 2015, Second Edition, Waveland Press Inc., ISBN: 978-1-4786-2308-3.
3. “Aquatic Chemistry”, W. Stumm and J. J. Morgan, 1996, John Wiley & Sons, New York. (on-line book available via GT Library)

Grading:

Weekly problems	12 %
Group project & presentation	18 %

Exam I	20 %
Exam II	25 %
Exam III	25 %

Course Policies:

In-person classes:

- Students should watch the lectures recordings on fundamental principles. Class time will be used for discussion, example problems, and Q&A.
- To attend in-person class safely, I strongly advise everyone to get vaccinated against COVID, participate in regular campus surveillance testing, and conducts daily self-check for health conditions. While inside the classroom, I strongly encourage facial masks for everyone.

Students are expected to be familiar with and abide by the Institute guidelines, information, and updates related to Covid-19. You can find campus operational updates, Frequently Asked Questions, and details on campus surveillance testing and vaccine appointments on the [Tech Moving Forward site](#).

Communications:

- Weekly agenda
- Students are encouraged to submit the “muddiest point” questions at Piazza or in class
- Tue/Thur class time and office hour
- Emails via Canvas
- Study groups
- Course surveys

Weekly Problems, Group Project and Exams:

- Weekly problem set will be given, and is due by the following week’s Thursday. 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).
- A group project will be given to be worked in teams. The project report should be prepared in typing in a MS Word file. A cover page is required which should contain the project name and student names. At the end of the semester, a group presentation is to be given on the project. More specific instructions will come with the assignment.
- Three in-class, closed-book exams will be conducted. A general scientific calculator is needed for the exam.

Late assignments:

- 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.

Academic Integrity:

- Students in this class are expected to abide by the Georgia Tech Honor Code and avoid any instances of academic misconduct.
- Plagiarizing is defined by Webster's Dictionary as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source." If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.
- Cheating off of another person's quiz, problems or report is unethical and unacceptable. Cheating off of anyone else's work is a direct violation of the GT Academic Honor Code, and will be dealt with accordingly.
- Unauthorized use of any previous semester course materials, such as exams, homework, problems, reports, and any other coursework, other than that provided by the instructor, is prohibited in this course. Using these materials will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code.
- **Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards.** For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>
- Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities:

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Resources:

The [CARE Center](#) and the [Counseling Center](#), Stamps Health Services, and the Dean of Students Office will offer both in-person and virtual appointments. Student Center services and operations are available on the [Student Center](#) website. For more information on these and other student services, contact the Dean of Students or the [Division of Student Life](#).

Appendix:

Georgia Tech Grading Definition

A: Excellent; B: Good; C: Satisfactory; D: Passing; F: Failure

A	Mastery of course content at the highest level of attainment that can reasonably be expected of students at the materials covered. The A grade means the students have shown an outstanding performance in the subject under study.
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B	Strong performance demonstrating a high level of attainment for a student at the course materials covered. The B grade means the student has shown proficient knowledge in the subject under study.
C	A totally acceptable performance demonstrating an adequate level of attainment for a student at the course materials covered. The C grade means that the students show competency in most of the topics in the subject under study.
D	A marginal performance in the required exercises demonstrating a minimal passing level of attainment. The D grade means that the students show deficiency in several topics in the subject under study but have put forth sincere effort in meeting the requirements set in the course.
F	For whatever reason, an unacceptable performance. The F grade indicates that the student's performance in the required exercises has revealed almost no understanding of the course content or there has been a major lack of effort in meeting the requirements set in the course.

Tentative Course Schedule (subject to change):

Date	Lecture Topic	Exam/Assignment
Week 1 (8/24, 26)	Introduction Background knowledge	Weekly problems
Week 2 (8/31, 9/2)	Thermodynamics and reaction equilibrium	
Week 3-5 (9/7, 9) (9/14, 16) (9/21, 23)	Acid/Base Chemistry - quantitative equilibrium calculations - logC-pH diagrams - titrations, buffer intensity - alkalinity	Project (two parts due 10/19 and 11/23)
Week 6 (9/28, 30)	Air-Water Equilibrium Alkalinity in open systems	Exam I (9/30)
Week 7-9 (10/5, 7) (10/12, 14) (10/19, 21)	Metals in Water - coordination chemistry - metal ion hydrolysis - precipitation & dissolution - solubility control	
Week 10-12 (10/26, 28) (11/2, 4) (11/9, 11)	Redox Chemistry - redox background - pe and E_H - Redox reactions - pe-pH diagrams	Exam II (11/4)
Week 13 (11/16, 18)	Adsorption Reaction kinetics	
Week 14 (11/23, 25)	Review	<i>11/25: Holiday</i>
Week 15-16 (11/30, 12/2, 7)	Speciation modeling & examples Project presentations	Project presentation (12/7)
Week 17 (12/16)	<i>Final Exam Period</i>	Exam III (12/16) 8:00-10:50 AM