CE 574 – Chemical Principles of Environmental Engineering - Fall 2025

Instructor: Diyuan Wang
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Lectures: Tue/Thur 11:45am – 1:00pm, 136 Monteith Engineering Research Center

Moodle Site: https://moodle-courses2527.wolfware.ncsu.edu/course/view.php?id=3416

Office Hours: After class and by appointment. To make an appointment, please email me and be sure to put "CE 574" in the subject heading so that we will know that the message is about the course.

Required Text: Benjamin, M.M. *Water Chemistry*, 2nd ed., Waveland Press, 2015.

Useful References: APHA, AWWA, WEF, *Standard Methods for the Examination of Water and Wastewater*, 22nd ed., E.W. Rice et al., eds., American Public Health Association, Washington, DC (2012).

Sawyer, C.N., P.L. McCarty, and G.F. Parkin, Chemistry for Environmental Engineering and Science, 5th ed., McGraw-Hill, Inc., New York, NY (2003).

Snoeyink, V.L. and D. Jenkins. *Water Chemistry*, Wiley & Sons, 1980.

Stumm, W. and J.J. Morgan, *Aquatic Chemistry*, 3rd ed., Wiley-Interscience, New York, NY (1996). Available as an online resource via the NC State University Library web site (see https://catalog.lib.ncsu.edu/catalog/NCSU1698423)

COURSE OBJECTIVES

Many aspects of environmental engineering involve the treatment of water for human consumption and the treatment of wastes prior to their release into the environment. In addition, an understanding of the chemical fate of pollutants in the environment is important. Chemical reactions are therefore important in both engineered treatment processes and in natural systems in which wastes may be attenuated. The objective of this course is to provide students with an understanding of inorganic chemistry sufficient to understand the principles behind the behavior of chemicals in both natural environments and in engineered treatment processes. Topics to be covered include acids and bases, buffering, alkalinity, precipitation and dissolution, complexation by inorganic ligands and by naturally occurring organic matter, oxidation - reduction reactions, the effect of redox conditions on metals speciation and the interaction of oxidation-reduction chemistry with biological activity. Practical aspects of chemical analysis including sampling, preservation, and quality control will be addressed.

Grading: Exam 1 - 20%, Exam 2 - 30%, Exam 3 - 30%, Homework - 10%, Project - 10%

Students wishing to audit the course must meet with the instructor to develop requirements for a grade of S (satisfactory).

Homework Policy

The homework assignments are critical to your learning the material and 80% of homework assignments must be turned in to receive a grade other than F for the class. You are **strongly** encouraged to work in groups of 2 to 3 and to turn in **one joint** assignment with the names of all contributors. Although homework **must be turned in on time**, homework will not be graded beyond a quick check to be certain that you are doing the problems. Satisfactory completion of all regularly assigned homework will constitute 10% of your grade. Homework solutions will be available electronically on receipt of each assignment. There will be 1 to 2 homework assignments that will be graded.

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Format for Homework Assignments

1. Homework must be turned in on engineering, squared, or lined paper. Writing on both sides of the paper is acceptable.
2. All students' names should be in the upper right-hand corner of the first page. The homework assignment number should be on the next line.
3. Homework pages should be stapled together and **should not** be folded or paper-clipped. Do not fold the assignment in half.
4. Do **not** use a cover sheet.
5. Homework must be neatly written with answers underlined or in a box.
6. Problems solutions should be presented in the order in which they are assigned with the problem number clearly labeled at the top of the solution and again if the solution extends to a second page. Work must be presented so that it is possible to understand the solution.
7. All numbers in all steps of a solution should have units attached.

Useful Resources

- Learning with Moodle, a student's guide to using Moodle: https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226

HEALTH AND PARTICIPATION IN CLASS

- NCSU Covid Information: https://healthypack.dasa.ncsu.edu/services-provided/covid-19/
- Course Attendance: NC State attendance policies can be found at: https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you will not be penalized for missing class. However, you will be expected to develop a plan to keep up with your coursework during any such

absence. COVID 19-related absences will be considered excused; documentation need only involve communication with me.

- If you test positive for COVID-19 or are told by a healthcare provider that you are presumed positive for the virus, please work with me on health accommodations and follow other university guidelines. https://healthypack.dasa.ncsu.edu/services-provided/covid-19/

ACADEMIC INTEGRITY STATEMENT

Students are expected to adhere to the guidelines for academic integrity as outlined in the NC State University Code of Student Conduct. Cheating and plagiarism will result in loss of credit for the test or assignment in question. Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02).
For details see https://studentconduct.dasa.ncsu.edu/academic-integrity-overview/.

STUDENTS WITH DISABILITIES

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01)

OTHER NCSU REGULATIONS

Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) which pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

- Equal Opportunity and Non-Discrimination Policy Statement https://policies.ncsu.edu/policy/pol-04-25-05 with additional references at https://oied.ncsu.edu/divweb/policies/
- Code of Student Conduct https://policies.ncsu.edu/policy/pol-11-35-01.

Syllabus

Date		Topic	Reading
August	19	Lecture 1: Introduction, Water Basics	Ch. 1
	21	Lecture 2: Concentration, Units	
	26	Lecture 3: Concentration, Units	
	28	Lecture 4: Chemical Reactivity (Activity)	Ch. 2
September	2	Lecture 5: Kinetic model for equilibrium and Reaction Kinetics	Ch. 3
	4	Lecture 6: Thermodynamics and Thermodynamic Model for Equilibrium	Ch. 4
	9	Lecture 7: Thermodynamics and Thermodynamic Model for Equilibrium	
	11	Lecture 8: Acid-Base Chemistry	Ch. 5
	16	**Wellness Day - No Classes**	
	18	Lecture 9: Acid-Base Chemistry	
	23	Lecture 10: Acid-Base Chemistry	
	25	Lecture 11: Acid-Base Chemistry	
	30	Lecture 12: Acid-Base Chemistry	
October	2	Lecture 13: Acid-Base Chemistry	Ch. 6
	7	Lecture 14: Acid-Base Chemistry	
	9	Lecture 15: Acid-Base Chemistry	
	14	**Fall Break - No Classes**	
	16	Lecture 16: Acid-Base Chemistry	
	21	Lecture 17: Titration, Alkalinity	Ch. 7&8
	23	Lecture 18: Titration, Alkalinity	
	28	Lecture 19: MINTEQ Equilibrium Model	
	30	Lecture 20: Alkalinity, Buffers, Acidity	
November	4	Lecture 21: Gas/liquid equilibrium – Open Systems	Ch. 9
	6	Lecture 22: Gas/liquid equilibrium – Open Systems	
	11	Lecture 23: Complexation	Ch. 10
	13	Lecture 24: Complexation	
	18	Lecture 25: Solubility	Ch. 11
	20	Lecture 26: Solubility, MINTEQ	
	25	Lecture 27: Oxidation-Reduction Reactions	Ch. 12
	27	**Thanksgiving Holiday - No Classes**	
December	2	Lecture 28: Oxidation-Reduction Reactions, MINTEQ	

The first exam will be ~ September 25
The second exam will be ~ October 30
The third exam will be on Thursday, December 4 from 12:00 – 2:30pm

MINTEQ Project Presentation will be ~ December 4