

**AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS**, 3 credits

Meets on Mondays from 6:15pm -9:15pm

Dr. Wenqing Xu

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Office Hours: Monday 3pm -5pm; or by appointment

Course Material:

Course materials will be uploaded to Villanova Blackboard, including lecture slides and videos, homework assignment and solutions, projects guidelines, and additional reading materials.

Students can access the course website using their Villanova student ID via the link below,

<https://elearning.villanova.edu/webapps/login/>

Required Text: Mark M. Benjamin (2014). Water Chemistry, Waveland Press, Inc.

Software: Visual MINTEQ (<http://rymd.lwr.kth.se/english/oursoftware/vminteq/download.html>)

References: V.L. Snoeyink and D. Jenkins (1980). Water Chemistry, Wiley

W. Stumm and J.J. Morgan. (1996). Aquatic Chemistry, 3<sup>rd</sup> Edition, John Wiley.

J.N. Jensen (2003). A Problem-Solving Approach to Aquatic Chemistry, John Wiley.

Course Summary and Objectives:

CEE 7701 is designed to introduce students to fundamental principles that govern chemical processes in natural and engineered aquatic systems, and to employ quantitative approaches to solve problems using these principles. Upon successful completion of this course, students will be able to apply these principles to solve problems associated with a number of environmental engineering and science processes, including water and wastewater treatment, contaminant remediation, water quality modeling, global warming, air-water exchange of chemicals, soil processes and many more.

Key course topics include the thermodynamic and kinetic basis for the composition of aquatic systems, acid-base chemistry, alkalinity and pH buffering, aqueous/gas/solid equilibrium, redox processes, computer software for solving complex chemical equilibrium problems, and reaction kinetics. Analytical and numerical approaches to solving chemical problems will be illustrated using topics of interest to environmental engineers and scientists.

Class Structure and Grading:

Homework Assignments 25%

Exam I 20%

Exam II 25%

Project 30% (10% Phase I +20% Phase II)

Grades will be awarded using a scale aimed at measuring student mastery of course material. The following grade “floors” are guaranteed by the instructor: students scoring  $\geq 90\%$  are guaranteed to receive at least an A-, 80 – 89% will receive at least a B-, 70 – 79% will receive at least a C-, and 60 - 69% will receive at least a D-. **The instructor will not raise the minimum percentages required to achieve each grade, but may lower them depending on exam grade distributions.**

Course Policies:

**Reading** the assigned book sections prior to the class period is required. Students are responsible for both the material covered in class and reading material that might not be explicitly covered due to class time constraints.

**In-class exercises** are used to reinforce problem-solving approaches presented during lectures. Students will work in small groups, and it is best if students alternate roles during individual problems. A final number is not always necessary for these problems--a description of the solution process will be acceptable in many cases.

**Homework Assignments** are due at the beginning of class on the due date. Assignments turned in up to 24 hours late will incur a 25% penalty, and 25% will be deducted for each day late thereafter. To receive full credit on problem sets, all steps to solving problems need to be presented in a clear and logical manner. **All problem assumptions, known parameters, and governing equations should be clearly listed, and all assumptions should be adequately tested when feasible.** The graders will be instructed to deduct points for sloppy presentations. Please refer to the academic ethic session before completing all assignments.

**Exams** are non-cumulative, closed book, and closed notes. Students will be on their honor not to use programming functions in their calculators during exams. Exams will take place during the regularly scheduled class period. Exam II is scheduled during the final exam period (December 14). Makeup exams will not be granted without prior approval or appropriate documentation for missing the exam. Practice exams will be posted on the course web site prior to the exam dates to help you study.

**Project** constitutes 30% of your grades and will involve two presentations with specific deliverables (on Nov 9<sup>th</sup> and Dec 7<sup>th</sup>). The project will involve analyzing a specific water quality problem in Environmental Engineering using the tools that we learn throughout the semester. More detailed will be discussed later in this semester.

**Attendance** is expected unless serious circumstances prevent it, in which case I would appreciate your speaking with me about your absence. Students are expected to show up promptly for class and following break periods in class. Arriving late for class is a distraction to your fellow students. As a courtesy to the instructor and your fellow students, please make sure all cellular phones are turned off during class periods.

### Villanova Mission Statement

“Villanova University is a Catholic Augustinian community of higher education, committed to excellence and distinction in the discovery, dissemination and application of knowledge. Inspired by the life and teaching of Jesus Christ, the University is grounded in the wisdom of the Catholic intellectual tradition and advances a deeper understanding of the relationship between faith and reason. Villanova emphasizes and celebrates the liberal arts and sciences as foundational to all academic programs. The University community welcomes and respects members of all faiths who seek to nurture a concern for the common good and who share an enthusiasm for the challenge of responsible and productive citizenship in order to build a just and peaceful world.”

### Academic Ethics

The strength of the university depends on academic and personal integrity. In this course, you **MUST** be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

Report any violations you witness to the instructor. For the first offense, a student who violates the Code of Villanova University will receive 0 points for the assignment. The violation will be reported by the instructor to the Dean’s office and recorded in the student’s file. In addition, the student will be expected to complete an education program. For the second offense, the student will be dismissed from the University and the reason noted on the student’s official transcript. You may consult the Code of Academic Integrity of Villanova University using the link below, <https://www1.villanova.edu/villanova/vpaa/studentservices/policies/integrity/code.html>

### Academic Accommodation

If you have a diagnosed disability and plan to utilize academic accommodation, please contact Gregory Hannah, advisor to students with disabilities @ 610-519-3209 or visit the office on the second floor of the Connelly Center as soon as possible. The Office of Disability Services collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students.

Tentative Course Outline

Lecture	Date	Topic	Class Readings
1	Aug. 24	Introduction (chemistry review, methods of expressing concentration)	Chapter 1
2	Aug. 31	Chemical Reactivity, reactions, and equilibrium	Chapter 2
	Sept. 7	<b>No Class – Labor Day</b>	
3	Sept. 14	Stoichiometry and Chemical Kinetics	Chapter 3
4	Sept. 21	Chemical Equilibrium, Chemical Potential and Thermodynamics	Chapter 4
	Sept. 28	<b>Exam I (covers lecture 1-4)</b>	
5	Oct. 5	Acid-Base Chemistry: Part I	Chapter 5
	Oct. 12	<b>No Class – Fall Break</b>	
6	Oct. 19	Acid-Base Chemistry: Part II	Chapter 6
7	Oct. 26	Chemical Equilibrium Software	Chapter 7
8	Nov. 2	Titration and Buffers	Chapter 8
	Nov. 9	<b>Presentation Phase I</b>	
9	Nov. 16	Gas Liquid Equilibrium	Chapter 9
10	Nov. 16	Adsorption Reactions	Chapter 13
11	Nov. 23	Redox Reaction: Part I	Chapter 12
12	Nov. 30	Redox Reaction: Part II	Chapter 12
	Dec. 7	<b>Presentation Phase II</b>	
	Dec. 12	<b>Exam II (covers lecture 5-12)</b>	