COURSE OVERVIEW AND SYLLABUS
CEE 1504
Chemistry in Environmental Engineering

Course Description

Chemistry is all around us; from the flowers that bloom each spring to the colors of our clothes. The principles of chemistry underlie processes that are fundamental to our livelihood. *Chemistry in Environmental Engineering* is focused on the chemical principles that are essential to the field of environmental science and engineering, with particular attention on natural and engineered aqueous systems. For environmental engineering majors, the course further aims to build on the foundational chemistry learned in General Chemistry for Engineers I and II as well as serve to bridge to later courses in the program, such as Fate and Transport, Mass and Energy Balances, and Environmental Engineering Laboratory.

Course Outcomes

This course is designed for students to develop a working knowledge of chemistry as it relates to the field of environmental engineering and science as well as prepare them for their future professional career. The combination of lectures, in-class discussion, in-class problem solving and group work is intended to offer students a diverse and engaging learning experience where they learn not only from the instructor, but also from each other.

Upon completion of this course, students should be able to:

- ***think critically*** about complex challenges at the interface of chemistry and
    - *the natural environment*, such as identification of chemical compounds, their degradation, remediation strategies, and potential risk.
    - *the engineered environment*, such as waste water and drinking water treatment.
- ***apply their knowledge*** of chemistry to solving problems faced in the environment and environmental engineering practice.

General Information

Logistics Tuesday & Thursday 3:00 – 4:15 pm
1045 Benedum Hall

Professor Dr. Leanne M. Gilbertson
202 Benedum Hall
Office hours: TBD and by appointment
E-mail: leanne.gilbertson@pitt.edu

Required Text Chemistry for Environmental Engineering and Science (5th Edition) by Sawyer, McCarty and Parkin

Additional Resources

There is no perfect textbook for any class. We will cover a range of topics in chemistry that are relevant to environmental engineering and environmental science. For alternative explanations and perspectives on any given topic, I encourage you to seek additional resources. A few are listed below. Some of these you can find in the library (U.Pitt or Pittsburgh Public Library). I also have all of them, if you would like to borrow a copy, just let me know!

- *Water Chemistry* by Snoeyink and Jenkins
- *Water Chemistry* by Mark Benjamin
- *Environmental Biotechnology: Principles and Applications* by Rittmann and McCarty
- Your Intro EnvE textbook: *Principles of Environmental Engineering and Science* by Davis and Masten
- Any undergraduate chemistry textbook for general chemistry and organic chemistry. A couple examples include:
  - *Chemistry* by Raymond Chang
  - *Chemistry: A Molecular Approach* by Nivaldo Tro
  - *Organic Chemistry* by Solomons and Fryhle
  - *Organic Chemistry: Structure and Function* by Vollhardt and Schore

Course Expectations and Academic Integrity

Performance Assessment: The homework assignments, in-class exercises, engagement during class, quizzes and examinations are used to assess student progress and learning.

Assignments are mandatory. They are instrumental in helping you grasp fundamental concepts and in exposing you to techniques and skills for applying these principles to real-life situations.

- *Homework assignments* should be done in several sittings; you cannot expect to be successful doing homework quickly the night before it is due. Each student is required to submit an original assignment. However, working together in small groups (2-3) is acceptable as long it is a mutual learning experience for all involved. Direct copying of a peer's assignment is unacceptable, as is splitting up an assignment and exchanging solutions later. If you get stuck and cannot solve a given problem after putting in a reasonable effort, it is completely acceptable for another student who has solved the problem to teach you how to solve it; it is not acceptable to offer or accept a completed solution as a guide. I reserve the right to change this policy if I believe it is being abused.
- *Reading assignments* should be completed before class; they will be discussed in class and supplement the lecture material.

In-class exercises are designed to offer you the opportunity to collaborate with and learn from your diverse group of classmates while working towards a shared and structured objective. Participation and respect are paramount to the success of these activities.

There will be regular in-class quizzes to gauge your mastery of topics and allow time to address any misunderstandings prior to the exams. *Examinations* will be completed outside of class time as outlined in the syllabus. They are not collaborative and will be completed independently. Cheating and dishonesty are not tolerated in any form and will result in a 0 grade. Additional guidelines will be provided when the exams are administered.

Grading Scheme

Assignments	30%
In-Class Engagement	20%
Quizzes	20%
Exams	30%

Laptops, Computers, Tablets and Cell Phones

Occasionally you may be asked to use your electronic devices for in-class or group activities. At all other times, students *should not use their cell phones* during class, unless it is an emergency. Browsing the internet, playing games, and texting friends during class is disrespectful to the instructor and distracts your classmates. Please discuss with Dr. Gilbertson if you wish to use your laptop or tablet for taking notes in class.

Standards for Written Work

- Engineers demonstrate their standard of professionalism primarily through the quality of written work; I expect you to do the same. Sloppy work, no matter how technically correct, is unprofessional and potentially dangerous, as it may be misinterpreted. You will suffer significant point reductions for sloppy work.
- I expect your homework submissions to be neat, thorough and logically organized. When you perform engineering calculations, you must explain your work such that an uninformed reader can follow precisely how and why you performed each step. Practicing engineers must maintain very high standards in the quality of their calculations because engineering calculations are *always* checked independently, by other engineers, as part of the design review process.
- Engineers communicate with drawings, tables and graphs. You must learn to supplement your engineering calculations with clear, concise sketches and graphs. Use this course as an opportunity to start developing this skill.

Lateness and Absence

Late homework assignments will not be accepted. Similarly, make-up exams will not be given unless PRIOR coordination is made with the professor or there is an official note from a physician explicitly stating why attending the scheduled test was impossible.

Discrimination

I am dedicated to establishing an inclusive learning environment that values all students' experiences. Therefore, disrespectful and demeaning statements, attitudes, and behaviors based on age, ability, color/ethnicity/race, gender identity/expression, immigration status,

marital/parental status, military/veteran's status, national origin, political affiliation, religious/spiritual beliefs, sex, sexual orientation, or socioeconomic status will not be tolerated.

School of Engineering Statement on Students with Disabilities

If you have a disability for which you are, or maybe, requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 216 William Pitt Union, (412) 648-7890 / (412) 383-7355 (TTY), as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

REVISED SCHEDULE

Class Meeting	Topic	Associated Readings*	Assignments DUE
5/15/18 (T)	Course Introduction, Review of basic chemical principles	Ch 1 and Ch 2 Sections 2.1-2.6, 2.8	
PHYSICAL CHEMISTRY			
5/17/18 (R)	Thermodynamics, Membrane Processes	Sections 3.1-3.2, 3.7	HW 1
5/22/18 (T)	Electrochemistry	Section 2.7, 3.9	
5/24/18 (R)	Kinetics, Adsorption	Sections 3.10-3.11, 3.12	HW 2
5/29/18 (T)	Physical Chemistry Wrap-Up		
5/31/18 (R)	Physical Chemistry in environmental engineering	Bring relevant article to class, be prepared to present and discuss the connection to physical chemistry in environmental engineering	HW 3
INORGANIC CHEMISTRY			
6/5/18 (T)	Principles of Equilibrium, Acid-Base Part 1	Principles: Sections 2.9, 2.11-2.14 Acid-Base: Sections 4.1-4.4	
6/7/18 (R)	Acid-Base Part 2 (Solving Problems and LogC vs pH Diagrams)	Section 4.5	
6/12/18 (T)	**Exam 1:** Chemical Principles & Physical Chemistry		

6/14/18 (R)	Buffers, Alkalinity, Hardness	Buffers: Sections 4.6-4.7 Alkalinity: Ch 18 Hardness: Ch 19	
6/19/18 (T)	Complex formation	Section 4.8	HW 4
6/21/18 (R)	Precipitation and Dissolution	Section 4.9	HW 5
6/26/18 (T)	Redox and pe vs pH Diagrams	Sections 2.7 and 4.10	HW 6
6/28/18 (R)	Colloids	Ch 7	
7/3/18 (T)	*Inorganic Chemistry* in environmental engineering	Bring relevant article to class, be prepared to present and discuss the connection to inorganic chemistry in environmental engineering	HW 7
7/5/18 (R)	**Exam 2:** Inorganic Chemistry		
ORGANIC CHEMISTRY			
7/10/18 (T)	Carbon, the foundational element; bonds and types of compounds	Sections 5.1-5.7	
7/12/18 (R)	N, S, and halogenated compounds, ring structures	Sections 5.8-5.18	
7/17/18 (T)	Life's building blocks Everyday products and environmental pollutants	Sections 5.19-5.22, 6.8-6.11, 6.15 Sections 5.23-5.32	HW 8
7/19/18 (R)	Organics in the environment and engineered systems	Sections 5.33-5.34, 6.7, 6.13	HW 9
7/24/18 (T)	Structure-property-activity relationships	Section 5.35	
7/26/18 (R)	Green Chemistry		HW 10

7/31/18 (T)	Course Summary	TBD	
8/2/18 (R)	**Exam 3:** Organic Chemistry		