ENVE 641/CHEM 605 Aquatic Chemistry (3 credits)
FALL 2017

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Lectures Thurs: 2:30 pm - 5:30 pm

Class location **Bunnell 226b**

Office hours M,W: 4:00 PM -5:00 PM or by appointment/email

Course description The goal of this course is to introduce students to the concepts and models used in aquatic chemistry while providing a foundation in the basic principles used in the chemical aspects of environmental science. The course content is centered on the chemical equilibrium and kinetic analysis of the speciation, transformation and partitioning of (primarily) inorganic chemical species in aqueous systems; including the aqueous components of surface and groundwater systems, soils, and the atmosphere. Emphasis is on the study of acid-base chemistry, complexation, precipitation-dissolution and reduction-oxidation reactions.

Textbook *Required:* Water Chemistry by Mark M Benjamin (2nd edition, Waveland press)
Other texts:
1. W. Stumm and J. Morgan, Aquatic Chemistry 3rd ed., Wiley-Interscience Chemistry of Natural Waters, Wiley-Interscience
2. F.M.M. Morel and J.G. Hering, Principles and Applications of Aquatic Chemistry, Wiley-Interscience

Prerequisites Prerequisites: Graduate standing or permission of instructor

Objectives Students will learn to utilize analytical, graphical and computational methods for determining the speciation of multi-component aqueous systems. These skills will be developed through in-class discussions and problem sets. Problem sets will emphasize problem solving skills with examples spanning applications in environmental chemistry and engineering. Concepts and methods developed during the semester will be utilized in a term project which reviews recent literature on a specific problem within the scope of aquatic chemistry.

Grading Policy

Homeworks……..... 30%
Quizzes and Class Participation……. 15%
Midterm Exam ……..……. 20%
Class Project……15%
Final Exam...……..… 20%

Final grades will be awarded according to the following scale:
95-100 **A**; 90- <95 **A-**; 85 - <90 **B+**; 80 - <85 **B**; 75-<80 **B-;**
70 - <75 **C+**; 65 - <70 **C**; 55-<65 **D**; <55 **F**

Either the weighted percentages or a curve maybe used.

Additional Notes and Policies

1. **Academic integrity.** Each student must become aware of UAF's policy on academic integrity as detailed in the *Student Code of Conduct*, of the 2017-2018 catalog. The FIRST violation of the student code will result in immediate failure of the course and/or disciplinary action as per UAF policy.
2. **Communication.** Outside of scheduled lectures and office hours, email is the official form of communication. When sending a message to the instructor, please use ENVE641/CHEM605 in the subject line. Students are expected to check their UAF/preferred email accounts for course updates. In addition, UAF Blackboard will be used for general announcements, distribution of course materials and posting of grades.
3. **Exams.** One mid-term exam and a final will be given during the semester. Each will be designed to test your understanding of critical concepts and your ability to solve problems. Exams are closed book/closed notes, however you may use a **single** 8.5" by 11" cheat sheet of your own creation. If the exams are take home, separate instructions will be provided.
4. **Quizzes.** In general Quizzes will be conducted on a regular basis. No make-up quizzes.
5. **Homeworks.** Homework problems will be assigned every week throughout the semester. Homework assignments are due at the **beginning** of the class on due date. Any assignment submitted after the due date, if accepted, will be subject to a 50% late penalty.
6. **Make up exams:** Exams must be taken on the dates scheduled (see Tentative course schedule on last page). In general there will be no makeup exams. Makeups will be given only under extreme circumstances. It is expected that the student will contact the instructor sufficiently in advance of an exam or have sufficient reason that they could not do so. Valid reasons include severe sickness (attested by physician's certificate), bereavement, or travel on university business (a letter in advance from the supervisor or responsible official).
7. **Attendance.** Class attendance at all lectures is **required** and will be monitored. The professor reserves the right to adjust final grades up or down based on a student's course participation. You are welcome to ask questions in class or during office hours. Class participation and discussion makes the course lively and interesting for everyone.
8. **Calculator.** You are expected to bring your calculator to every class, and be ready to use it. You will not be allowed to use your "smart phone" or other communication devise as a calculator on tests or quizzes. If you do not have an appropriate calculator you may wish to get one on the FE Exam approved list. (Casio fx-115, HP33s, HP35s, TI-30X, or TI-36X)**. You may not use a "smart phone" or other communication device as a calculator on any Quiz or Exam.**
9. **Homework Format:** It is imperative that your submitted work be well organized and neatly presented in order to convey the desired information. Developing these skills of written communication is a critical component of career development. Pay close attention to these while submitting homework and exams.
10. **Disabilities.** If you have specific physical, psychiatric or learning disabilities and require reasonable accommodations, please let me know early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to 'Disability Services' in room 208 of the Whitaker Building and request a letter of accommodation.

Overview of Course Topics:

- Basic aquatic chemistry principles (Ch-1)
- Review of chemical kinetics, equilibrium (Ch-2, 3)
  - Reactivity, activity
  - Kinetics, rate constants, reaction rates
- Review of chemical thermodynamics (Ch-4)
  - Free energy, chemical potential and equilibria
- Aqueous speciation (Ch-5, 6, 7)
  - Acid-Base equilibria
  - pC/pH diagrams
- Carbonate chemistry (Ch-8, 9)
  - Buffering and Alkalinity
- Chemistry of aqueous metals (Ch-10, 11, 12)
  - Complexation
  - Solubility and precipitation
  - Redox chemistry
  - pE/pH predominance diagrams
- Heterogeneous chemistry (Ch-13)
  - Environmental interfaces and adsorption reactions