ENVE 641/CHEM 605 (3 credits)
Aquatic Chemistry
FALL 2015, Duckering 341

Instructor Srijan Aggarwal, Ph.D., Assistant Professor
Department of Civil and Environmental Engineering
Email: saggarwal@alaska.edu
Office: Duckering 271, Tel: 907-747-6120

Lectures Monday, Wednesday 8:45 am – 10:15 am

Class location **Duckering 341**

Office hours Mon,Wed: 10:30AM -11:30 AM
or By appointment/by 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 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%
Class Project.....……15%
Midterm Exam ..…… 20%
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, whichever gives best grades.

Additional Notes and Policies

1. **Academic integrity.** Academic dishonesty includes cheating, fabricating or falsifying information or sources, improper collaboration, submitting the same paper for different classes without permission, and plagiarism. **Plagiarism** occurs when writers deliberately or unintentionally use another person's language, ideas, or materials and present them as their own without properly acknowledging and citing the source. Plagiarism in this course results in one or more of the following consequences: failure of the assignment, failure of the course, and/or disciplinary action by the University. Cite sources carefully, completely, and meticulously; when in doubt, cite.

   Each student must become aware of UAF's policy on academic integrity as detailed in the *Student Code of Conduct*, p. 50 of the 2014-2015 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 "Aquatic Chemistry" in the subject line. Students are expected to check their UAF 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.

4. **Quizzes.** 5-7 quizzes will be conducted during the semester. Students will be allowed to drop ONE quiz score with the least score. Quizzes may or may not be announced (see #5). No make-up quizzes.

5. **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. In addition, surprise spot quizzes may be held to assess completion of assigned readings from the prior class.

6. **Homeworks.** Homework problems will be assigned on a weekly basis. Homework assignments are due in a week's time - at the **beginning** the class period. Late homework **may be submitted up to two days late.** However, the late submission will be **penalized 50% of the grade** and any homework submitted after two days of the due date will not be accepted.

7. **Class Projects:** Your project will be a literature review based on a topic of your choosing (in consultation with the instructor). The paper should be 12-15 pages in length (1.5 spacing, 1" margins, 12 pt font, not including references). The following are essential:
   - The introduction must provide a concise description of the chosen topic and the broader environmental context.

- The body of the paper should provide a review of information from the literature relevant to understanding the problem from a chemical perspective (structure, thermodynamics, kinetics).
- Your conclusions must include a critical assessment of the literature on your topic.

8. **Make up exams:** Exams must be taken on the dates scheduled (Detailed course calendar to be posted on Blackboard). 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.
9. **Absence.** If you are absent from any class it is your responsibility to inform yourself about the class material or any announcements. If you miss a quiz or homework you receive a "zero grade", except when you have made arrangements beforehand for reasons as stated above.
10. **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. **You may not use a "smart phone" or other communication device as a calculator on any Quiz or Exam.**
11. **Incomplete.** An "incomplete" will not be given unless severe illness, family tragedy, or a sudden transfer is involved. A written explanation and the completion of the appropriate UAF paperwork must be submitted in all cases.
12. **Practice.** Aquatic Chemistry is a foundational course in environmental chemistry and engineering, and the best way to learn is to practice a lot. If you have time, work on as many unassigned problems as you can.
13. **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