CEE 241 Water Quality

Fall Quarter 2014

Time and Place: Lectures, Mon./Wed./Fri.: 9:10 am – 10 am, HMNSS 1406
Discussion, Fri.: 2:10 pm - 3 pm, INTS 2138

Instructor: Dr. Haizhou Liu
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Office Hour: Wed./Fri. 3:30 pm – 4:30 pm or by appointment

Textbook: *Water Chemistry, 2nd edition,* Benjamin (Waveland Press, 2014)

Reference: *Water Chemistry*, Brezonik and Arnold (Oxford, 2011)
Aquatic Chemistry, Stumm and Morgan (Wiley, 1996)
Water Chemistry, Snoeyink and Jenkins (Wiley, 1980)
Aqueous Environmental Geochemistry, Langmuir (Prentice-Hall, 1997)
A Problem-solving Approach to Aquatic Chemistry, Jensen (Wiley, 2003)
Principles & Applications of Aquatic Chemistry, Morel & Hering (Wiley, 1993)

Others: Supplemental reading materials will be posted on iLearn course website.

Course Description:

Fundamentals of chemical equilibria as applied in environmental engineering processes. Chemistry topics include acid-base equilibrium, the carbonate system, metal-ligand coordination, mineral surface interactions, redox reactions, and surface/colloid chemistry. Applied environmental systems include water quality and treatment, soil remediation, and outdoor air pollution.

Learning Objectives:

Students will learn: (1) fundamental principles of aquatic chemistry including acid/base, metal complexation, mineral solubility, and oxidation-reduction reactions; (2) solve chemical equilibria problems in the context of processes in natural and engineered waters; (3) learn applications of aquatic chemistry principles such as water treatment, nutrient cycling, and pollutant fate in air, water, and soil; (4) learn technical writing skills.

Grading: Homework (25%)
Midterm Exam (25%)
Final Exam (30%)
Research Paper (20%)

Class schedule (subject to adjustment)

Session	Date	Topics	Reading
1	10/3	Introduction; Perspectives on chemical equilibrium; Concentration scales	Ch. 1
2	10/3	Discussion: concentration and activity; activity coefficients	Ch.2
3	10/8	Thermodynamic fundamentals	Ch.1,2
4,5	10/10	Thermodynamic interpretation of equilibrium	Ch.2
6	10/13	Chemical activity; activity coefficients in solution;	Ch.3
7	10/15	Acidity constants, acid strength	Ch.4
8, 9	10/17	Graphical representation of acid/base equilibria,	
10	10/20	Mass and charge balances, numerical solutions of acid/base problems	
11	10/22	Graphical solutions of acid/base problems, proton condition	Ch.5
12,13	10/24	Numerical solutions of acid/base problem;	
14	10/27	Identifying dominant species; The *TOT*H equations	
15	10/29	Software for chemical equilibrium problems: MINEQL+	Ch. 6
16,17	10/31	MINEQL+: acids and bases; fixed activity species	
18	11/3	Titrations	
19	11/5	Alkalinity	Ch. 7
20	11/7	Buffers	
21	11/7	Midterm Exam	
22	11/10	Gas/liquid equilibrium	Ch. 8
23	11/12	Acidic and basic gases	
24,25	11/14	Metals in solution: coordination chemistry and speciation	
26	11/17	Predominance area diagrams; solution equilibrium with metal hydroxides	
27	11/19	Solution equilibrium with metal carbonates and hydroxides	
28,29	11/21	Systems with potential precipitation of solids	
30	11/24	Systems with potential precipitation of solids	Ch. 9
31	11/26	Precipitation of solids in MINEQL+; predominance area diagrams with solids	Ch. 10
32,33	11/29	Thanksgiving Holiday	
34	12/1	Oxidation-reduction reactions: Introduction, redox speciation	
35	12/3	Redox reactions and energy	Ch. 11
36,37	12/5	Solid-liquid interface	Ch. 12
38	12/8	Applications	Notes
39,40	12/10	Applications	Notes
	TBD	Final Exam	