GEOL 4777/5777: Geochemistry of Natural Waters (3 Cr.)
Syllabus

Instructor:
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Office hours: Mon. 2-3, Thurs. 9-11. Other times by appointment; you’re welcome to drop by, with the understanding that I will not necessarily always be free.

Prerequisites:
Math 2200, 2205, Chem 1050, 1060, Geol 2010, or consent of instructor

Class meeting times:
Lectures: MWF, 1:10 to 2:00 Currently listed in Rm. 318

The Basic Idea:
Physical chemistry of aqueous solutions, with applications to understanding natural waters. Chemistry of rock weathering, sources and controls on major, minor and trace element composition of natural waters; emphasis on fresh waters, less on seawater. This subject forms the basis for a large amount of scientific research and environmental consulting worldwide – particularly from the point of view of surface and ground water quality.

Textbook:
This book is a classic in the field. I had the first edition of this book when I was an undergraduate (junior). The book covers a remarkably wide range of subject material very concisely. It remains one of the best books out there for instruction at the advanced undergraduate and beginning graduate levels. There are other books that cover similar material, but which are perhaps more suited to graduate students. A list of some of these is found at the end of this syllabus.

Course Requirements:
The course will be graded on the basis of problem sets and two take-home exams. Problem sets will be either weekly or every two weeks, depending on how things seem to be going. Problem sets are due Fridays in class, unless we collectively decide otherwise in class!

Problem Sets: 50% of grade-
I will go through the problem set in some detail, and will review common mistakes with problems in class if needed. The goal of the problem sets is that you understand what is going on. I will be looking for (1) that you turned in a problem set, (2) that you made a reasonable, good-faith effort to solve the problems, and (3) that you came up with a well-reasoned answer. In other words, show me that you are trying and that you are thinking about the problems! A good-faith effort on the problems will prepare you for the exams, and can results in 100% problem set score without too much difficulty. I want you to feel encouraged to get help if you are stuck.
Take-home exams: 50% of grade-

Exam I, Midterm, will be passed out on Wednesday Oct. 15 and is due back to me on Friday Oct. 24 at 1:10 p.m.

Exam II, Final, will be passed out on Monday Dec. 1, and will be due back to me by Monday, Dec. 8 at 3:15 pm.

I recognize that students often work together on the problem sets. I do not mind this, as long as students are learning how things work and not just copying. You are, therefore, expected to reach your own understanding of the problem and to turn in problem solutions that represent your own thinking.

Late problem sets will be penalized in the first week they are late; after that, late problems sets will be given no credit.

For graduate students signed up for GEOL 5777, an extra problem will be assigned for the exams and for some, but perhaps not all, of the problem sets.

EXAMS: Unlike the problem sets, the take-home exams are NOT to be group projects. The problem solutions on the take-home exams are expected to represent your own thinking. You can use written resources to help you, but you may not use your fellow students for help on the exams!

Course Schedule

(This outline represents initial intent only! Depending on how things go, we may deviate substantially from this schedule! Likely, we will touch on other chapters, and may include some introductory computer use)

Weeks 1 - 3: Chapter 2

   Chemical background
      Free energy, activity, and the equilibrium constant; Activity coefficients and solution models; Complexation

Weeks 4 - 6: Chapter 3

   The carbonate system and pH control
      Carbonic acid system; Alkalinity titration; Calcium carbonate
      Solubility: Dolomite and high-Mg calcite; Natural examples

Weeks 7 - 8: Chapters 4 and 5

   Clays
      Structures; Ion exchange; Colloid properties
   Adsorption
      Isotherms; Surface Charge; Surface Complexation

Weeks 9 - 11: Chapters 7 and 8

   Redox equilibrium and redox conditions in natural waters
      Nernst equation; Standard reduction potential; Eh-pH diagrams

Weeks 12 - 14: Chapter 10

   Stability Relationships and Silicate Equilibria
      Hydrolysis, speciation, solubility of metal oxides and hydroxides
Obligatory messages from the Dean’s Office:

1) University Regulation 802, Revision 2, defines academic dishonesty as “an act attempted or performed which misrepresents one’s involvement in an academic task in any way, or permits another student to misrepresent the latter’s involvement in an academic task by assisting the misrepresentation.” There is a well-defined procedure to judge such cases, and serious penalties may be assessed.
   
   Okay, this is where my statements above on what I expect from you on the problem sets is relevant!

2) University Regulation 29, Change 1, states that the instructor can “establish reasonable standards of conduct for each class which should be made known at the outset.”

   Okay, here goes: I expect that student-professor and student-student interactions will take place with respect and courtesy, but I have almost never encountered anything else so I also don’t expect to have any problem. Perhaps the most important part of this is that I encourage you to speak up and ask questions during class, as well as to point out any mistakes I might make up there...

Other recommended books:


