

CHEM 0970

General Chemistry for Engineers 2

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Catalog Description

Chem 0970 covers energy changes in chemical reactions, properties of gases, liquids, and solids, physical properties of solutions, entropy and free energy, chemical equilibrium, acid-base equilibria and solubility equilibria, electrochemistry, chemical kinetics, nuclear chemistry, and modern materials.

Chem 0960 is required for Chem 0970.

Credit hours: 3.0

Course Objectives

Fundamental concepts and principles of chemistry are important to engineers. Knowledge on chemistry will help engineers to communicate with chemists, and more importantly, to understand the properties of working objects. To gain such knowledge, this two-semester course (including Chem 0960) covers a relatively broad yet important range of topics. Learning objectives related to specific topics will be listed in the lecture slides as each chapter goes. Upon successful completion of this course, you should gain “global” skills as follows:

- Be able to communicate chemistry using basic chemistry vocabulary.
- Predict material properties using basic concepts and principles of chemistry.
- Explain scientific methods e.g. how theory is constructed and tested via experimental efforts, particularly in chemistry.
- Demonstrate both qualitative and quantitative problem solving skills using knowledge on structural chemistry, stoichiometry, thermochemistry, chemical equilibrium, and reaction kinetics.

Required Textbook

- *Chemistry: Atoms First, 2nd edition* by Julia Burdge and Jason Overby, 2014.

Course Format

We will adopt a study format combining both lecture and group study feature in intensive individual practice and student-instructor interaction. We also use flipped class to maximize your learning effectiveness.

In the first meet of the week, you will expect a “normal” lecture during which I talk most of the time. But please be prepared for random questions I would ask to get you involved.

For the majority time of the second meet, you will have a group study on a studio assignment to solve a problem set before class ends. You will work in groups where in-group discussion is encouraged. Solve the problems together instead of break it into parts with everyone working on his or her part alone. At the end of the class, you should check with an instructor (professor or teaching assistant) before you leave the classroom. The Studio assignment is a pass/not-pass work which contributes to your overall grade.

For the after class homework, you can still discuss with others but should complete it INDEPENDENTLY, meaning that you can't copy others' work or let others copy yours.

Recitation

There will be a one hour recitation each week during which an instructor will answer your questions. Although this session is not required to attend, I highly encourage you to come, provided that students who attend recitations in a regular basis have a better grade.

Grades

Exams 1 & 2	200 pts
Final Exam	150 pts
Homework	40 pts
Studio work	30 pts
Group presentation	30 pts
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Total	450 pts

Please expect a midterm exam after lecture 4 (week 4) and lecture 8 (Week 8). Each midterm exam will last one and a half hour covering all content after the previous exam.

The final exam is 2.5 hours long and will cover content thought out the course, with emphasis on the content after the second midterm.

Studio assignment and homework will be given weekly to help you practice and check your mastery of class content. Remember that altogether they take 17% of the total grade. Failure in those can cost you more than a letter grade (A to B, B to C, etc.)!

If you have any questions for any of your grades, you should contact Prof. Quan within three days after the grade is released. Any requests for regrading will be denied after this three-day period.

Letter Grade

Final letter grade will be given according to the following scheme:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
≥ 88%	≥ 85%	≥ 81%	≥ 78%	≥ 75%	≥ 71%	≥ 68%	≥ 65%	≥ 61%	≥ 55%	≥ 50%	< 50%

Grades might be curved at the end of the semester if the class average is low (I do give hard exams). However, curving is not guaranteed. You should only rely on your performance in all the assignments and exams.

Absence and Makeup

In principle, any absence in exams is not allowed except for irresistible reasons (diseases, accidents, deaths, etc.). For other reasons, you should contact me in advance. Make-up exams will not be guaranteed.

Failure of the Course

If you unfortunately failed the course (assigned an F), you can either retake the course or pass a make-up exam at the beginning of the next semester. Based on your performance in the make-up exam, a “D” or an “F” should be expected as the final grade.

Copyrights

If not specifically pointed out, all materials used in this course are copyrighted, meaning that without my explicit permission you do not have the right to copy any of the materials for any purpose other than your own personal academic use. The copyrighted materials used in this course include but do not limit to syllabi, exams, class slides, problem sets, and other handouts.

Academic Integrity

Upon accepting admission to SCUPI, you immediately assume to follow the SCUPI academic integrity guidelines. See a staff in the administrative office if you are not aware of it. The guidelines should be followed in homework, examinations, and other academic work. Violations of these guidelines may result in zero points for an exam or failure for the course.

Study Tips

- Do your homework ON YOUR OWN!!! You can discuss with a friend, but do it independently. Make sure you can solve similar problems after completion.
- Come to classes and take notes. You may find it's hard to understand your instructor. Keep on trying and it will get easier. Even if you have learned some of the topics in high school, you may find minor to huge differences.
- Attend recitation sessions with questions.
- Consult a text book in Chinese if you have trouble understanding the required text book. However, make sure you learn all the terminology in English. The exam is in English!
- Study your notes every day. Memorizing basic facts, terms, and principles is a must. Chemistry is a subject based on workings of this objective world!
- Come to my office hour and let me know any trouble you might have.

Course Content

Lecture	Topics
1	Thermodynamics of chemical reactions, enthalpy, calorimetry, Hess's law, standard enthalpies of formation, bond enthalpy, lattice energy, stability of covalent and ionic compounds
2	The kinetic molecular theory of gases, gas pressure, the gas law, the ideal gas equation, real gas, mole fractions and Dalton's law of partial pressures, reactions with gaseous reactants and products
3	Properties of liquids and solids, types of crystalline solids, phase changes, phase diagrams
4	Molecular view of solution process, concentration units, factors that affect solubility, colligative properties, colloids (EXAM 1)
5	Spontaneity, entropy, entropy change in a system and the universe, Gibbs free-energy change and spontaneity prediction
6	Equilibrium, chemical equilibrium and free energy, equilibrium concentration calculation, Le Chatelier's principle, factors that affect equilibrium

7	Bronsted and Lewis acid and base, pH and pOH scales, acid and base strength, ionization constant of weak acid and base, conjugate acid-base pairs, acid-base properties of salt, oxides, and hydroxides
8	The common ion effect, buffer solutions, acid-base titrations, solubility equilibrium, factors affecting solubility, ion separation using solubility difference (EXAM 2)
9	Galvanic cells and standard reduction potentials, spontaneity of redox reactions, batteries, electrolysis, corrosion
10	Collision theory of chemical reactions, reaction rate measurement and expression, factors affecting reaction rates (concentration, time, temperature), reaction mechanisms, catalysis
11	Nuclear stability, nuclear reactions, natural radioactivity, transmutation, fission, fusion, uses of isotopes, biological effects of radiation.
12	Polymers, ceramics, and composite materials, liquid crystals, biomedical materials, nanotechnology, semiconductors, super conductors (Final)

Modifications to online teaching during spring 2020.

1. Students download the class slides from BB and study at least half of the content BEFORE the class starts.
2. When class starts following the normal schedule, students finish the rest of the slides and solve the Studio work in groups. Meanwhile instructors and TAs are available to answer students' questions.
3. Instructors and TAs will randomly call a student and check his/her quality of study by asking related questions.
4. During the self- and group-study period, an online poll is open to collect questions and concerns from the students. A live lecture on those questions will be given for the last 30 min of the class.