

CHEM 0970

General Chemistry for Engineers 2

Spring 2019

Section 1: 09:10 - 11:55 Wed.

Section 2: 15:40 - 18:25 Mon.

Section 3: 15:40 - 18:25 Wed.

Lecturer: Dr. Xinfeng (Kevin) Quan

TA: Mengren Liu (QQ1324611595), Hao Ai (QQ614081079), Yuyang Wang
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Office hour: 9:30 am - 16:30 pm Tue. (Except for lunch break)

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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.

Course Format

We will adopt a study format combining both lecture and group study. Intensive individual practice and student - instructor interaction are highly expected. We also use flipped class to maximize your learning effectiveness.

A typical class is divided into two parts. In the first part, you will expect a “normal” lecture during which I talk mostly. But please be prepared for random questions I would ask to get you involved. Related questions are

welcome **any time** during the class. Feel free to interrupt me. I won't feel annoyed but pleased.

During the second part (the last 45 min to 1 hr of the class), 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. Please solve the problems together instead of break it into parts with everyone working on his or her part alone. Or you can split the questions, but explain to each other how each problem is solved. The goal is you have the good practice of most problems. At the end of the class, you should check with an instructor (professor or teaching assistant) before you leave. The Studio assignment is a pass/ not-pass work which contributes to your overall grade. Usually 2 - 3 days ahead of the class, you will be assigned to watch several short videos which cover important topics that I **will NOT lecture** in class **BUT test** in exams. Yes, you have to study those parts on your own. However, I will check answers of the questions in the videos at the beginning of the class or in some other ways. **DO WATCH** those videos to avoid confusion in lectures.

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

Recitation

No recitation this semester, since few students came to recitations in the past. Contact your TA or me via email or QQ if you have questions.

Homework

- Homework is due the beginning of each lecture in the week after. Late homework will not be accepted.

- Please put your name, ID last four digits, and section number on the upper right corner and staple on the upper left corner. Use A4 size sheets.
- If your handwriting is illegible, print your homework on A4 sheets.

Grades

| | |
|-------------|---------|
| Exams 1 & 2 | 200 pts |
| Final Exam | 150 pts |
| Homework | 40 pts |
| Studio work | 30 pts |
| <hr/> | |
| Total | 420 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 throughout the course, with emphasis on the content after the second midterm. Exam guide will be offered at least one week before each exam.

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

schedule

| 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 |

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|----|---|
| | idea 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) |

