

Chemistry 432

Advanced Inorganic Chemistry

General Information

- Instructor:** Dr. Kimberly Lawler-Sagarin
Contact Info: SC 218, x 3202, ksagarin@elmhurst.edu
Texts: *Inorganic Chemistry*, Miessler, Gary and Tarr, Donald; 4nd edition (Required)
Synthesis and Technique in Inorganic Chemistry
by Girolami, Rauchfuss and Angelici, 3rd edition (Required)
- Class Meetings:** MWF 11:45am-12:50pm Schaible Science 138
Lab Meetings: M 1:00pm-5:00pm meet in Schaible Science 209
Office hours: W: 1:30-2:30, TTh 1:30-2:30
These are subject to change. My regular office hours will begin week 2.
- Prerequisite:** CHM 412 - Physical Chemistry: Quantum Mechanics and Spectroscopy (may be concurrent)

Goals of the Course

Inorganic chemistry is a huge and very broad field. This course is organized around developing conceptual understanding of the structure, bonding, and chemistry of inorganic molecules. These concepts have broad applicability beyond inorganic systems - especially in the areas of organic chemistry, biochemistry and materials science. We will take a survey approach and learn a little about solid state compounds, main group compounds, coordination compounds and organometallics. Major course goals are listed here. You are encouraged to consider these and discuss with me how these might apply to your chosen career/life path. Students completing this course will:

1. develop more sophisticated mental models of chemical bonding and molecular spectroscopy grounded in the fundamentals of group theory and quantum theory;
2. develop a broad view of bonding and reactivity in inorganic systems, and will be able to apply these concepts to a wide variety of main group and transition metal compounds from small molecules to large extended systems;
3. be able to apply the concepts, methods, reaction mechanisms, and techniques of inorganic chemistry to simple chemical systems and make predictions for these systems;
4. have the ability to approach unfamiliar and complex chemical systems and to use simple molecules as models for understanding such systems;
5. be facile with electron counting in inorganic systems and to use this to make inferences about chemical bonding, magnetic properties, and reactivity in such systems;
6. be able to use molecular symmetry and molecular orbital theory as an aid for solving problems related to chemical bonding and molecular spectroscopy;
7. be able to use spectroscopic data for inorganic complexes to obtain structural, electronic, and reactive properties of the complex;
8. be familiar with with the range of synthetic laboratory techniques and characterization methods used in inorganic chemistry;
9. acquire specific skills necessary for future work in science or science-related areas, whether it be in this course, other advanced courses, graduate school, medical or business professions, or the industrial laboratory. Specifically, the student will acquire or continue to enhance his/her:
 - facility with computer spreadsheets and graphics, for transforming raw data into quantities of conceptual or theoretical interest;

- capacity to approach unfamiliar problems and determine what information is needed to solve the problem;
 - critical analytic thinking and logical reasoning skills which are of great value in formal scientific research and most other areas of life;
10. acquire a basic vocabulary relating to inorganic chemistry (i.e. the areas of nomenclature, reaction mechanisms, and reaction type) applied to the specialty areas of solid state chemistry, coordination chemistry, and organometallic chemistry.

Grading

As your instructor, my goal is to help and encourage you to learn. All students learn differently, thus I try to utilize a broad range of methods and assignments. This means that there will be a lot of different opportunities for you to apply the concepts we will be investigating this semester. Correspondingly, there are many different ways to earn points and demonstrate your understanding of the material in this course. Grades on all assignments will be given in points. Points in all categories will be approximately equivalent. Each category will be weighted as stated below.

Breakdown

- Exams (3): 100 points each (300 total) = 30.0%
- Final exam: 250 points (includes ACS exam) = 25.0%
- Weekly homework problems and other assignments/quizzes: 225 points = 22.5%
- Laboratory and literature: 225 points = 22.5%
- Instructor evaluation: used to decide borderline cases (within 1% of next highest grade)

Grading Scale

The grading scale will depend in part on my assessment of the difficulty of exams and the final. The grading scale for students completing all course requirements will not be raised above the following scale:

A	92%
A-	90%
B+	86%
B	76%
B-	74%
C+	72%
C	66%
C-	64%
D+	60%
D	54%

This means if you receive an overall percentage of 86.00% and complete all course requirements, you will get a B+.

Course Requirements

To be graded on the grading scale defined above, you must complete all the course requirements listed below:

1. Receive at least a 45% on the non-ACS portion of the final exam
2. Receive at least a 45% *combined average* on the three midterm exams
3. Perform all laboratory experiments
4. Turn in required reports/analyses for all laboratory experiments

5. Turn in at least 75% of the homework assignments with the majority of the problems attempted
6. Achieve an acceptable score on the two repeatable quizzes.

If you do not meet one or more of these requirements you are not eligible for grading on the regular grading scale described in the previous section. Grades in these cases are determined on an individual basis and are at the instructor's discretion. In general, you may expect at least a one-full-grade penalty for each requirement which is not fulfilled. For example, failing the final, skipping an excessive number of homework assignments, or not turning in a laboratory report or analysis will result in a one-letter grade penalty for each instance.

Completing homework assignments is considered **essential** for success in this course.

Students who are conscientious about completing homework and laboratories typically have no trouble earning a good grade in Advanced Inorganic.

College Policies

College policies on incompletes/drops/unauthorized withdrawals will be followed. Also, **read carefully** the Code of Academic Integrity and the Student Rights and Responsibilities section of the current Student Handbook (E Book) to understand College policies regarding plagiarism, cheating, non-discrimination, and policies regarding privacy with regard to student records. All such policies will be strictly enforced.

If you have a diagnosed disability or believe that you have a disability that might require reasonable accommodations for academic instruction please contact the Disability Services Provider (630) 617-3753. It is your responsibility to initiate a request for services from DSP and to provide appropriate verification of disability. Upon disclosure of a disability verified by DSP, any reasonable accommodation will be made.

Homework and Other Assignments

Homework assignments will be assigned and collected approximately weekly. Typically, they will be due Mondays at the beginning of class, however, the first week, we will have an assignment due on Friday.

Each problem statement should be written out, at least in abbreviated fashion, with full solutions following (this makes it easier for me to provide feedback, for you to interpret that feedback, and for you to use the problem sets to study later). Show all your work for mathematical problems. **NO** credit will be given for problems if work is not shown. Final answers should include correct units if appropriate, answers without units will be considered incorrect. Please put your name at the top of your assignment and staple all pages together.

Each problem set will be worth approximately 10-30 points. You will receive partial credit for *seriously* attempting each problem. **One point will be taken off if problem statements aren't included in your assignment.** Homework and assignments are due at the **beginning** of class unless stated otherwise, though I may offer a short grace period on some assignments, allowing you to complete them after class. Please see the section entitled "Policy for Late or Missed Assignments" for additional information.

Homework solutions will be available on Blackboard.

Homework may include computational chemistry exercises. These will utilize the software packages CAChe and Spartan as well as some on-line tools. CAChe is available in SC 209 on the PCs and in SC 228 on the dual-boot Macs when in PC mode. Spartan is available on just a few computers, and you need to check out a USB key for it to operate.

Other Assignments: Additional in-class worksheets and other types of assignments may be assigned periodically in addition to regular problem sets.

Quizzes: There will be several quizzes, but no more than four. One quiz will be on the periodic table and will be repeatable, another will be on coordination compound nomenclature and will also be repeatable. Up to two additional quizzes may be scheduled. Details on the two repeatable quizzes will be described in class the first day.

Important grading note: A maximum of 225 homework/assignment points may be accumulated by a

student. The actual points possible in each of these categories may vary, but the combined total possible will be at least 225 points or will be scaled up proportionally to 225 points.

Collaboration

Working in groups on the homework is not prohibited, in fact, it is encouraged. Group work can greatly facilitate your understanding of a subject. However, the work you present **must be your own**. *This includes all excel-type spreadsheets, graphics, computational problems, and laboratory data.* Do not simply copy the answers from a classmate or copy a problem solution directly from a solutions manual. These activities are considered cheating and will be dealt with in accordance with college policies.

Again, working in groups on the homework is encouraged. However, to fully grasp the concepts associated with inorganic chemistry, I advise you to attempt homework problems on your own before getting help from classmates. Once you have tried the problems on your own, you are in a good position to discuss approaches and strategies with one another.

College policies on academic honesty will be followed. Please **read carefully** the Code of Academic Integrity and the Student Rights and Responsibilities section of the current Student Handbook (E Book) to understand College policies regarding this issue. Please also see the Policy on Academic Honesty adopted by Elmhurst's Division of Natural Sciences (<http://www.elmhurst.edu/~earls/honestypolicy.html>).

Policy for Late or Missed Assignments

Because everyone has a bad week, gets sick, or just runs behind, you will be given a series of Late Certificates. Late assignments will ***NOT*** be accepted for regular grading unless accompanied by a certificate or the assignment is postponed for the entire class. Exceptions to this policy will only be made in the case of serious (and documented) illness or tragedy. (See: "What if I run out of certificates?" below)

You will receive five "flexible" Late Certificates. Each certificate is good for turning in one assignment one "class day" late. A class day is any MWF in which the college is holding class. This applies to both lecture and lab assignments. Late certificates may be combined and are good for any type of assignment, including a missed in-class assignment. They should be saved until you really need them!

A student with three or more unused late certificates at the end of the term may choose to redo (for up to full credit) any ONE assignment. The rationale for this is that use of three late certificates at once may result in the student receiving a higher score than their classmates due to difficult problems being worked out in class after the due date and similar situations.

"What if I run out of certificates?"

If you run out of certificates for routine mishaps and delays and have to miss any additional assignment(s), you may turn in the assignment(s) at the end of the semester. These assignments will be counted toward the homework completion course requirement (completing 75% of assigned work), and will be considered in the instructor evaluation. Additionally, the instructor may choose to award partial points for completing these assignments, but in no case will this exceed 40% of the score the assignment would have earned if it was turned in on time. It is the student's responsibility to turn in the homework for consideration. Points may be awarded at the instructor's discretion based on extenuating circumstances, quality of the assignment (grade it would have received if turned in on time) and other factors. *Please do NOT fall behind. There will be no exceptions to this policy.* Homework assignments in this course are frequent and it is essential to stay caught up with current material.

Laboratory

The laboratory will contribute 225 points to your final grade in Advanced Inorganic. Laboratory activities will include experiments, calculations, lab work-ups, reports, and literature presentations and discussions. A schedule, along with grading details, is provided in the laboratory schedule and assignments document.

Briefly, two formal reports will be required. Data analysis and associated calculations will be required on the remaining experiments. Additional assignments based on the literature will be incorporated. Like the homework, students may accumulate up to 225 points. If fewer points are assigned than planned, then the total will be scaled up proportionally (based on 100% = 225 points).

Exams

There will be three 60 minute midterm exams. Each exam may include lecture material, lab material, homework and assigned reading in the text as well as any additional reading or activities assigned. You are responsible for the assigned reading in the text regardless of whether that material has been discussed in lecture. No exams will be dropped. It is your responsibility to be aware of scheduled exam dates and any rescheduled exams.

I will grant permission to make up an exam if the absence is due to any of the following: (1) serious illness; (2) an order from the US Military; (3) officially representing the College; (4) death in the immediate family. All such instances will require documentation before a make-up exam will be given.

Students producing the required documentation in a timely manner will be allowed to take a make-up exam.

Students with an unauthorized absence on an exam day will be able to make up the exam with a 20% point penalty.

The final exam will be comprehensive and is scheduled for Wednesday of finals' week, December 14th, 10:30 a.m. Individual students may request to take the exam at another time (in groups) during finals' week (no earlier than Tuesday afternoon) if that better fits into their finals' week schedules, however, the class final exam time will not be moved.

Instructor Evaluation

Instructor evaluation will be based on classroom attendance, attitude, effort on homework, improvement or consistently good progress, and my evaluation of your understanding of the material in the course. This will be used to decide borderline cases. If you are on the borderline between two grades, you may be bumped up to the higher grade if you attend and arrive on time to 95% of class meetings, have not skipped assignments, and you meet any one of the following additional requirements: 1) excellent effort on homework [all assignments turned in with at least 85% of the problems attempted on each, 92% or better overall score]; 2) improvement on exams throughout the semester [> 20 point improvement]; 3) consistently good progress (no bombed exams); or 4) if it is the opinion of the instructor that you understand the material better than your exams indicate. Note these criteria will only be used in borderline cases (within 1% of next highest grade).

Computer Software, E-mail and Web Access, etc.

Many documents in the course will be available in electronic format through the web in some way. Because of this, I ask that you arrange to have or do the following:

- Web access, either through your home/dorm or by arranging your schedule to accommodate some time in one of the on-campus labs each week.
- If you will primarily be using your own computer, obtain Acrobat reader or another pdf display program. Acrobat Reader can be downloaded for free from Adobe (<http://www.adobe.com/>). Most on-campus computers should have this. (Many of the documents I will distribute will be in "pdf" format, hence the requirement.)
- An e-mail account which you check frequently. Accounts are available for free to all Elmhurst College students from Academic Computing Labs, but you are free to use any address you like.

Tentative Lecture Schedule:

Inorganic chemistry is an area of chemistry that has grown considerably in the last few decades. We will pay particular attention to fundamental concepts of structure, bonding, and reactivity as we study different types of inorganic systems. This will allow us to focus on understanding, rather than memorizing.

The following is a guide indicating approximately how much time we will spend on each chapter. This is only a guide. We may deviate substantially from this schedule spending more time on subjects as needed. Exams may be rescheduled, but you will always receive notice 1 week prior to the new exam date. I try to coordinate exams with other upper division chemistry classes, such as pchem and biochem, thus some exams may be moved to accommodate these classes. I have placed pchem and inorganic exams on different days and have also avoided 315 dates, but we may move things around if it seems necessary. Students taking pchem may want to arrange to take their 432 final exam on another date during finals week, as both final exams fall on the same day.

*Inorganic Chemistry: That which is left over after the organic, analytical,
and physical chemists get through picking over the periodic table.
– random quote from cyberspace*

Week #	Day	Date	Text Chpt.	Topics
1	M	Aug. 29	1	Introduction to Inorganic Chemistry
	W	Aug. 31	2	Electron configuration, Slater's Rules
	F	Sept. 2	2	Periodic Trends, Atomic/Covalent/Ionic Radii
2	M	Sept. 5	*	No Class - Labor Day!
	W	Sept. 7	3	VSEPR and Lewis Dot Details
	F	Sept. 9	7	Solid State Intro, Crystal Structures
3	M	Sept. 12	7	Structure of Binary Ionic Solids, Radius Ratios
	W	Sept. 14	7	Lattice Energy, More Complex Structures
	F	Sept. 16	7	Electron Counting, Bonding in Solids
4	M	Sept. 19	7	Properties and Electrons in the Solid State
	W	Sept. 21	8	Main Group Extended Solids
	F	Sept. 23	-	exam 1
5	M	Sept. 26	4	Symmetry Point Groups
	W	Sept. 28	4	Character Tables
	F	Sept. 30	4	Group Theory in Spectroscopy
6	M	Oct. 3	5	Molecular Orbital (MO) Theory - Diatomics
	W	Oct. 5	5	MO Theory - Details of Orbital Mixing
	F	Oct. 7	5	MO Theory - Larger Molecules, FMOs
7	M	Oct. 10	*	No Class - Fall Recess!
	W	Oct. 12	5	MO Theory - SALCs
	F	Oct. 14	6	Acid-Base Concepts
8	M	Oct. 17	6	HSAB Theory, Acid-Base Strength
	W	Oct. 19	8	Selected Main Group Topics: Boranes, Carbides, Group 15
	F	Oct. 21	9	Common and IUPAC Naming of Coordination Compounds
9	M	Oct. 24	9	Isomerism in Coordination Compounds
	W	Oct. 26	9	Common Coordination Numbers and Structures
	F	Oct. 28	-	exam 2
10	M	Oct. 31	10	Coordination Compounds and MO Theory
	W	Nov. 2	10	Ligand Field Theory, LFSE
	F	Nov. 4	10	Angular Overlap Method, Magnetic Moments
11	M	Nov. 7	11	Term Symbols for Multielectron Atoms
	W	Nov. 9	11	Electronic Spectra for Coordination Compounds
	F	Nov. 11	11	Tanabe-Sugano Diagrams, Jahn Teller
12	M	Nov. 14	11	Applications, High Spin/Low Spin Complexes
	W	Nov. 16	12	Coordination Compounds Reaction Mechanisms
	F	Nov. 18	12	Coordination Compounds Reaction Mechanisms (con't)
13	M	Nov. 21	13	Organometallic Chemistry - Ligands/Nomenclature
	W	Nov. 23	13	18-Electron Rule, Bonding in Organometallics
	F	Nov. 25	*	No Class - Thanksgiving Break!
14	M	Nov. 28	13	Organometallics: Bridges, Clusters, Multiple Bonds
	W	Nov. 30	14	Common Reaction Mechanisms in Organometallics
	F	Dec. 2	14	More Organometallic Reaction Mechanisms/Catalysis
15	M	Dec. 5	-	exam 3
	W	Dec. 7	15/16	Selected Topics
	F	Dec. 9	15/16	Selected Topics
16	M	Dec. 12	*	No Classes - Reading Day
	W	Dec. 14	-	Final Exam 10:30 am
	-	-	-	Happy Winter Break!

Table 1: Tentative Schedule - Chemistry 432 - Fall 2011

Week #	Day	Date	Text Chpt.	Lecture Assignments Due	Exams
1	M	Aug. 29	1		
	W	Aug. 31	2		
	F	Sept. 2	2	Homework 1	
2	M	Sept. 5	*		No Class - Labor Day!
	W	Sept. 7	3		
	F	Sept. 9	7		
3	M	Sept. 12	7	Homework 2	
	W	Sept. 14	7		
	F	Sept. 16	7		
4	M	Sept. 19	7	Homework 3	
	W	Sept. 21	8		
	F	Sept. 23	-		exam 1
5	M	Sept. 26	4	Homework 4	
	W	Sept. 28	4		
	F	Sept. 30	4		
6	M	Oct. 3	5	Homework 5	
	W	Oct. 5	5		
	F	Oct. 7	5		
7	M	Oct. 10	*		No Class - Fall Recess!
	W	Oct. 12	5		
	F	Oct. 14	6		
8	M	Oct. 17	6	Homework 6	
	W	Oct. 19	8		
	F	Oct. 21	9		
9	M	Oct. 24	9	Homework 7	
	W	Oct. 26	9		
	F	Oct. 28	-		exam 2
10	M	Oct. 31	10		
	W	Nov. 2	10		
	F	Nov. 4	10		
11	M	Nov. 7	11	Homework 8	
	W	Nov. 9	11		
	F	Nov. 11	11		
12	M	Nov. 14	11	Homework 9	
	W	Nov. 16	12		
	F	Nov. 18	12		
13	M	Nov. 21	13	Homework 10	
	W	Nov. 23	13		
	F	Nov. 25	*		No Class - Thanksgiving Break!
14	M	Nov. 28	13	Homework 11	
	W	Nov. 30	14		
	F	Dec. 2	14		
15	M	Dec. 5	-		exam 3
	W	Dec. 7	15/16		
	F	Dec. 9	15/16	Homework 12	
16	M	Dec. 12	*		No Classes - Reading Day
	W	Dec. 14	-		Final Exam 10:30 am
	-				Happy Winter Break!

Table 2: Tentative Schedule - Chemistry 432 - Fall 2011