Chemistry F202: Basic Inorganic Chemistry, 3.0 Credits
Spring Semester, 2019

Instructor:	Dr. William A. Howard
Office:	Reichardt Building Room 190
Laboratory	Reichardt Building Room 191
Telephone:	474-6019 (Office)
Email:	wahoward@alaska.edu

Lecture Meetings:	Tuesday, Thursday, 9:45 AM – 10:45 AM, Reichardt Room 165
Lab Meetings:	Friday, 2:15 – 5:15 PM, Reichardt Room 245
Office Hours:	Tuesday, Thursday, 10:45 – 11:45 AM

Required Texts: Foundations of Inorganic Chemistry, Gary Wulfsberg, University Science Books, 2018. ISBN 978-1-891389-95-5

Laboratory experiments and all laboratory assignments will be posted on Blackboard.

Suggested Materials: non-programmable calculator, molecular ball-and-stick models

Prerequisites: Successful completion (C- or higher) of Chemistry F106X is required.

Catalog Description:

CHEM F202 Basic Inorganic Chemistry (n)
3 Credits
Offered Spring
Introduction to coordination theory, crystal field theory, kinetics and mechanisms of substitutions and redox reactions, unit cells and ionic bonding, periodic law, and descriptive chemistry of selected main group elements.

Prerequisites: CHEM F106X.
Lecture + Lab + Other: 2 + 3 + 0

Course Description: Basic Inorganic Chemistry F202 is an introductory course in inorganic chemistry and is completely separate from Inorganic Chemistry F402. Chemistry F202 has a laboratory component as well as a lecture component, but one grade covering both the lab and the lecture is given.
The final exam will be a standardized exam prepared by the American Chemical Society (ACS) that consists of 60 multiple choice questions. **The lectures are focused on preparing students for this final exam.** Topics in the lecture include atomic structure and properties, molecular structure and point symmetry, Valence Bond Theory and Molecular Orbital Theory, solvent properties and acid-base chemistry, solid state chemistry, an introduction to coordination chemistry and Crystal Field Theory, and some descriptive chemistry of the halogens. The laboratory experiments will generally follow the lectures and will cover the same or very similar material. Understanding these topics

Lectures and Reading Assignments:

Basic Inorganic Chemistry F202: Schedule of Lectures			
Spring, 2019, William A. Howard			
Week No.	**Date**	**Reading**	**Classroom Lecture**
1	Jan. 15	Sections 1.1 – 1.3	Syllabus, Periodic Table and Ions
	Jan. 17	Sections 1.4 – 1.6	Oxidation Numbers, Atomic Radii, and Electronegativity Trends
2	Jan. 22	Sections 2.1 – 2.3	Cation Acidity
	Jan. 24	Sections 2.4 – 2.6	Predominance Diagrams
3	Jan. 29	Sections 3.1 – 3.3	Lewis Structures, Lewis Acids & Bases, Bond Strength Trends
	Jan. 31	Sections 3.4 – 3.6	Fluoro and Oxo Anions
4	Feb. 5	Sections 3.7 – 3.9	Predominance Diagrams, Oxo Compounds Nomenclature
	Feb. 7	Sections 4.1 – 4.2	Ionic Lattices, Radius Ratio Rules, Lattice Energy
5	Feb. 12	Sections 4.3 – 4.5	Solubility Energetics
	Feb. 14	Sections 5.1 – 5.3	Denticity, Chelate Effect, Bridging Ligands
6	Feb. 19	Sections 5.4 – 5.6	Hard-Soft Acid-Base Theory
	Feb. 21	Sections 5.7 – 5.8	Hard-Soft Theory Applications in Biology and Medicine
7	Feb. 26	Sections 6.1 – 6.3	Standard Reduction Potentials
	Feb. 28	Sections 6.4 – 6.6	Hard-Soft Theory, pH, and Thermodynamics in Redox Rxns
8	Mar. 5	Sections 7.1 – 7.2	Crystal Field Theory, High Spin vs. Low Spin
	Mar. 7	Sections 7.3 – 7.5	Electronic Absorption Spectroscopy
9	Mar. 12		**NO CLASS – SPRING BREAK**
	Mar. 14		**NO CLASS – SPRING BREAK**
10	Mar. 19	Sections 7.6 – 7.8	Other Geometries, Rates, Mechanisms of Substitutions
	Mar. 21	Sections 8.1 – 8.3	Oxide Materials, Close Packing of Anions
11	Mar. 26	Sections 8.4 – 8.7	Physical & Chemical Properties of Oxide Materials
	Mar. 28	Sections 9.1 – 9.3	Atomic Structure, Slater's Rules, Periodic Trends
12	Apr. 2	Sections 9.4 – 9.6	Atomic Radii, Relativistic Effects, Electronegativities
	Apr. 4	Sections 10.1 – 10.2	Point Symmetry Operations, Point Groups
13	Apr. 9	Sections 10.3 – 10.4	Character Tables, Mulliken Symbols
	Apr. 11	Sections 11.1 – 11.3	Molecular Orbital Theory, Electronic Spectroscopy
14	Apr. 16	Sections 11.4 – 11.6	MO Diagrams for Simple Structures, Types of Ligands
	Apr. 18	Sections 12.1 – 12.3	Structures and Properties of Non-Metallic Elements
15	Apr. 23	Sections 12.4 – 12.6	Structure & Bonding in Ionic, Covalent, and Metallic Substances
	Apr. 25		Review for Final Exam
16	**Apr. 30**	8:00 – 10:00 AM	**Final Exam (cumulative)**

is essential for any student majoring in chemistry and who wishes to pursue chemistry-related research as a career objective. Chemistry F202 is a required course for a BS Chemistry degree, a BA Chemistry Degree, a BS Environmental Chemistry degree, and a BS Forensics Chemistry degree. Chemistry F202 is required for ACS-accredited BS degrees in biochemistry/molecular biology, but not required for non-accredited degrees. Moreover, Chemistry F202 is recommended but not required for a minor in either chemistry or biochemistry.

General Course Goals: Students will become familiar with the language of inorganic chemistry (definitions of terms, how to name coordination complexes, etc.), and some of the foundational theories in this discipline, such as Valence Bond Theory, Molecular Orbital Theory, and Crystal Field Theory. This course will also reinforce some ideas learned in previous general chemistry courses. The laboratory portion of the course will give students an opportunity to learn methods of synthesis and isolation of coordination complexes, and how to test experimentally some of the ideas discussed in the lecture. Finally, the success of the students will be measured in terms of the final exam scores: if a student achieves a score of 70% (42 right answers out of 60 questions) or higher on the standardized ACS final exam, then the course goals will have been achieved.

Student Learning Outcomes: As a result of successfully passing Basic Inorganic Chemistry F202, the student will (1) be able to explain Valence Bond Theory, Molecular Orbital Theory, and Crystal Field Theory and solve chemical problems involving these theories, (2) be able to synthesize and isolate pure samples of coordination complexes in the laboratory, (3) be familiar with Point Symmetry and be able to classify the symmetry of bodies, (4) understand concepts from general chemistry that might have not been understood when the student first encountered them, (5) know how to name and describe the chemical and physical properties of coordination complexes.

Instructional Methods: Learning will be accomplished by reading the text book, attending lecture, solving voluntary homework problems, taking exams, and fully participating in the lab exercises. This course also has a laboratory section to give physical examples of the concepts learned in class.

Grades: There are some conditions that, if met, will result in an "automatic grade." These conditions are:

1) The final exam in this course will be a standardized, national final exam, prepared by the American Chemical Society. If a student obtains a final exam score at the 90^{th} percentile (47 right answers out of 60 multiple choice questions) or higher, then that student will receive a final letter grade of A for this course, provided that the student has completed at least 8 lab reports.

2) If a student obtains a final exam score that is equal to or higher than the 80^{th} percentile (44 right answers out of 60 multiple choice questions) but lower than the 90^{th} percentile, then that student will receive a final letter grade of B for this course, provided that the student has completed at least 8 lab reports. (If this student would have obtained an A in

this course without this special condition, then the student will receive an A as the final letter grade.)

3) If a student does not take the final exam and has no legitimate reason (sickness, death in the family, etc.) for missing the exam, then that student will receive a letter grade of F for this course – regardless of all other homework and exam scores.

4) If a student completes fewer than 8 lab reports, then that student's final letter grade for this course will be an F, regardless of all other factors.

If a student does not meet any of these special conditions, then that student's grade will be determined by either (1) the student's final percentage score (described below), or (2) a class grading curve (also described below).

Percentage Score: This class will have a total of …

Attendance	28 points
Homework assignments	472 points
3 Practice Exams	300 points
3 Real Exams	300 points
Lab Grade	100 points
Final Exam	100 points
Total Points	1300 points

At the end of the semester, a student's total score will be calculated by adding all the scores of the individual assignments. The student's total score will be divided by 1300, and the result will be multiplied by 100% to get the student's percentage score. The grades will be determined as follows:

Percentage score $\geq 90\%$	Final letter grade = A
$80\% \leq$ percentage score $< 90\%$	Final letter grade = B
$70\% \leq$ percentage score $< 80\%$	Final letter grade = C
$60\% \leq$ percentage score $< 70\%$	Final letter grade = D
Percentage score $< 60\%$	Final letter grade = F

Grading Curve: Let a be the average number of points for the students in this class, and let σ be the standard deviation. If x = the total number of points that a student has at the end of the semester, then the final letter grade is calculated according to the following curve:

$x \geq a + (1.5)\sigma$	A
$a + 1\sigma \leq x \leq a + (1.5)\sigma$	B
$a + \frac{1}{2}\sigma \leq x \leq a + 1\sigma$	C+
$a - \frac{1}{2}\sigma \leq x \leq a + \frac{1}{2}\sigma$	C
$a - 1\sigma \leq x \leq a - \frac{1}{2}\sigma$	C–
$a - (1.5)\sigma \leq x \leq a - 1\sigma$	D
$x \leq a - (1.5)\sigma$	F

The class average (a) and the standard deviation (σ) will change every day, and so Prof. Howard will update the class before each lecture on the current values so that students can see how they are doing.

At the end of the semester, Prof. Howard will determine a letter grade for each student by BOTH methods (the percentage score and the grading curve). The final letter grade will be the higher of the two grades.

Opportunities to Earn Points: Opportunities to earn points include, but are not necessarily limited to, the options shown below.

1. *Attendance.*
   An attendance sheet will be passed around the class every day. Each student should print his or her name on this attendance sheet. Prof. Howard will give each student 1 point per class-day if that student's name is recorded on the attendance sheet.
   If a student misses class for a good reason, then that student should show Dr. Howard a written excuse (from a doctor or a coach, etc.). For such an excused absence, the student will be given 1 point for attendance.
   If a student misses class and does not have a written excuse for missing class, then Dr. Howard will still give the student with an unexcused absence 1 point for attendance, up to 3 points maximum. In other words, students are allowed to have 3 unexcused absences from class with no effect on grades; after the 3rd unexcused absence however, no points will be given for attendance if a student misses class.

2. *Back-of-the-chapter problems.*
   A student may choose to solve as many back-of-the-chapter problems as he or she wants to do. No credit is given for the odd-numbered problems because the solutions to these problems are given at the back of the book. Each even-numbered problem will be worth 1 point, provided that the following criteria are met:

a. The correct answer and all the work are shown. If a student simply gives the correct answer without showing the work or some type of brief explanation, the student will receive a zero.
b. Each problem is shown on one page of paper. (If two consecutive problems are very short, then the student may place the two problems on the same sheet of paper.) No more than one or two problems may be given on the same page of paper. Front and back can be used, so each sheet of paper will have 2 to 4 homework problems. Writing must be legible and large enough for Prof. Howard to read. (If Prof. Howard cannot read the writing, then the problem will receive a zero.)
c. The problems must be turned in to Prof. Howard before the due date. The due dates for all homework assignments are given in the following table.

Assignment	Due Dates: At the beginning of class on …
Chapter 1 problems	Tuesday, January 22
Chapter 2 problems	Tuesday, January 29
Chapter 3 problems	Thursday, February 7
Chapter 4 problems	Thursday, February 14
Chapter 5 problems	Tuesday, February 26
Chapter 6 problems	Tuesday, March 5
Chapter 7 problems	Thursday, March 21
Chapter 8 problems	Thursday, March 28
Chapter 9 problems	Thursday, April 4
Chapter 10 problems	Thursday, April 11
Chapter 11 problems	Thursday, April 18
Chapter 12 problems	Thursday, April 25

** No end-of-chapter problems past the due date will be accepted for any reason. If a student misses a due date and is concerned about losing points, then that student should simply do more problems in the next chapter.
** No work will be accepted for any reason after 5 PM on Monday, April 29.

3. *Practice Exams*
One week before each regular exam, there will be a practice exam given in lab. Each practice exam is worth 100 points and shall consist of 20 multiple choice problems – very similar to the real exam.
After taking the practice exam, the exam will be graded and returned to the students. An answer key will be posted on Blackboard, so that students can see which problems they missed and what the correct answers are. Then, each student will have an opportunity to do point recovery, which is described below:

Point Recovery: For each problem missed on the practice exam, a student may recover some lost points by either (1) visiting Prof. Howard in his office and explaining how to solve the missed problem correctly, or (2) by solving the problem correctly on a piece of paper, scanning the problem, and emailing the scan to Dr. Howard. ***The same rules given for the homework apply to the written point recovery! (See page 5 of this syllabus for the rules.)***
The number of lost points recovered from the point recovery work will depend on when the student turns in the work. The following schedule will be observed for practice tests 1 and 2:

Turn in point recovery within one week after the practice test.	5 points for each correctly solved or correctly explained problem
Turn in point recovery within two weeks after the practice test.	4 points for each correctly solved or correctly explained problem
Turn in point recovery within three weeks after the practice test.	3 points for each correctly solved or correctly explained problem

No point recovery will be accepted after 3 weeks past the practice test, for any reason.
Since practice test 3 is scheduled near the end of the semester, this time table cannot apply to practice test 3. For practice test 3 only, the student must complete the point recovery BEFORE real exam 3 is given, and the student will receive 5 points for each correctly answered or correctly explained problem that was missed on the practice test 3.

4. *Regular, in-class exams.*
   There will be 3 regular, in-class exams, held during the lab periods. Each is closed-book and closed-notes and will consist of 20 multiple choice or short answer problems. Each exam is worth 100 points.
   ** If a student misses an exam for a legitimate reason, that student may make up the exam at a later time. The student should contact Prof. Howard in order to set up a time to take the exam.

5. *Other possible assignments*
   A student may propose assignments not listed in this syllabus in order to get more points. The student and Prof. Howard must agree on the educational value of the assignment, the number of points to be given, and how the assignment will be graded. Then, the student will be given an opportunity to persuade the class to accept the assignment. If the majority of the class votes to accept the assignment, then all students will have equal opportunity to complete this assignment. Again, the student MUST meet with Prof. Howard before beginning the work; if the student simply does an extra assignment without approval from Prof. Howard and the rest of the class, then no points will be given for that work. Moreover, if the student waits until the last day or week of class to propose an assignment, Prof. Howard is likely to reject the proposal.

6. *Laboratory Experiments*
   Each week, Prof. Howard will post a set of handouts on Blackboard for the laboratory experiment to be done the following week. These handouts shall consist of (a) MSDS sheets for the chemicals to be used, (b) a description of the experimental procedure to be done and the theory behind the experiment, (c) and a set of post-lab questions.
   Before coming to lab, the student must read the experimental procedure and the theory behind the experiment. The student must also review the MSDS sheets.
   After completing a laboratory experiment, students will answer the post-lab questions and submit that assignment the following week of lab.
   Please note that examinations will be given during the lab periods, not the lecture periods.
   A late post-lab assignment will be accepted after the due date, provided that the report is submitted within one week after the due date. However, the student will lose 50% of the possible points as a penalty. If the work is past one week late, then the work will not be accepted.

Basic Inorganic Chemistry F202 Laboratory		
Spring 2019		**Prof. Howard**
Week No.	**Date**	**Activity**
1	Jan. 18	Lab 1: What Difference Does an Electron Make?
2	Jan. 25	Lab 2: Some Reactions of Cations
3	Feb. 1	Lab 3: Nonaqueous Reactions of Metal Ions and Compounds
4	Feb. 8	Lab 4: Some Reactions of Oxo Anions
5	Feb. 15	Lab 5: Reactions of Anions with Cations, **Practice Exam 1**
6	Feb. 22	**Real Exam 1**
7	Mar. 1	Lab 6: Competitive Complexation and Precipitation Reactions
8	Mar. 8	Lab 7: Periodicity in the Activity (Electromotive) Series of Metals
9	Mar. 15	**NO LAB – SPRING BREAK**
10	Mar. 22	Lab 8: The Widely Varying Colors of d-Block Metal Complexes
11	Mar. 29	Lab 9: Cubic & Hexagonal Close Packing of Anions, **Practice Exam 2**
12	Apr. 5	**Real Exam 2**
13	Apr. 12	Lab 10: Molecular Orbital Calculations & Their Interpretation
14	Apr. 19	**Practice Exam 3**
15	Apr. 26	**Real Exam 3**

There are 10 laboratory experiments, and 10 sets of post-lab questions to be submitted. Each set of post-lab questions will be worth 10 points, making the total lab grade 100 points.
Make-up labs can be held on April 19 and/or April 26, depending on convenience of schedule for the student and for the TA.
A student must complete a minimum of 8 lab experiments in order to pass this course, regardless of other scores from the lecture portion of the class.

7. Final exam

The final examination is a standardized ACS exam that will be cumulative and will consist of 60 multiple choice questions. This final exam will be in-class, closed-notes, and closed-book. A student MUST take the final examination in order to pass this course.

Monday April 29 at 5 PM: All work (homework assignments, lab reports, exams, point recovery, anything and everything) MUST be turned in before 5 PM on Monday, April 29. Absolutely nothing is accepted for any reason after 5 PM on the last day of classes.

Summary of Resources: See Prof. Howard during office hours for help. Grades will be updated on Blackboard regularly, and Prof. Howard will regularly inform the students of the class average and standard deviation.

Academic Honesty: The Chemistry "Department Policy on Cheating" is this: "*Any student caught cheating will be assigned a course grade of F. The student's academic advisor will be notified of this failing grade and the student will not be allowed to drop the course*."
As a UAF student, you are subject to UAF's Honor Code:

"Students will not collaborate on any quizzes, in-class exams, or take-home exams that will contribute to their grade in a course, unless permission is granted by the instructor of the course. Only those materials permitted by the instructor may be used to assist in quizzes and examinations.
Students will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself (direct quotes or paraphrases) in compositions, theses, and other reports.
No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors.
Violations of the Honor Code will result in a failing grade for the assignment and, ordinarily, for the course in which the violation occurred. Moreover, violation of the Honor Code may result in suspension or expulsion."

Instructor Withdrawal Policy: The instructor reserves the right to withdraw a student from this course for any of the following reasons:

1. The student has refused to wear protective clothing or safety glasses (or goggles) in the laboratory. A student may also be withdrawn for insisting on wearing materials that could compromise safety, such as open-toed shoes or loose clothing.
2. The student's manner of lab work is careless and unsafe. Some examples of unsafe lab work include, but are not limited to, (i) horseplay in the lab, (ii) refusing to follow the instructions of the TA or the instructor, and (iii) eating or drinking in the lab.
3. The student has missed more than 3 labs as of March 29.
4. The student has not participated in class sufficiently as of March 29. Sufficient participation means (a) the student has done at least 1 homework problem per section, (b) the student has obtained exam scores 20% or higher, including or excluding the point recovery work, and (c) the student has attended class at least half the days before March 29.

Important Dates:

- Alaska Civil Rights Day — Jan. 21
- Last day to drop class with 100% refund — Jan. 25
- Last day for withdrawals with class not appearing on record — Jan. 25
- Early Progress Reports due — Feb. 25
- Spring Break — Mar. 11 – 15
- Last day for withdrawals with student receiving "W" — Mar. 29
- UAF Spring Fest (classes NOT canceled) — April 19
- Last day of class — April 29

Student Protections and Services Statement: Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain

types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/

Disabilities and Special Accommodations: Students with documented disabilities who may need reasonable academic accommodations must provide documentation of the disability to Disability Services (http://www.uaf.edu/disability/) in room 208 Whitaker Building, 474-5655, TTY 474-1827, uaf-disabilityservices@alaska.edu. Disability Services will then notify Prof. Howard in writing of the disability and will advise on how the student should be tested and which accommodations should be made.

Veteran Support Services: Walter Crary (wecrary@alaska.edu) is the Veterans Service Officer at the Veterans Resource Center (111 Eielson Building, 474-2475). Fairbanks Vet Center 456-4238. VA Community Based Outpatient Clinic at Ft. Wainwright is 361-6370.