Chemistry 213: Inorganic Chemistry

Instructor: Patrick Lutz (he/him/his), Sci. Ctr. N379, (440) 775-8892, patrick.lutz@oberlin.edu
I generally respond to emails within 24 hours during the week.

Class meetings: MWF, 10:00am–10:50pm, Science Center A255

Laboratory meetings: Monday or Tuesday, 1:30–4:30pm, Science Center N389

Student hours: Monday, 4:30–5:30pm and Wednesday, 2:00–3:30pm

Your success in this course is one of my highest priorities. The times listed above are designated as student hours, but if my office door is open (even just a little bit), feel free to knock and I'll try to help out if I have time. If you would prefer to meet virtually, please let me know in advance so that I can make arrangements.

Learning goals:

1. Rationalize and predict chemical properties of elements and their compounds using concepts related to atomic structure.
2. Describe the bonding and structure of covalent, ionic, and metallic compounds.
3. Classify molecules based on their symmetry properties.
4. Predict and rationalize the outcomes of major classes of inorganic reactions, including acid/base reactions, redox reactions, and reactions of coordination complexes and organometallic compounds.
5. Synthesize and characterize inorganic compounds in lab.

Prerequisites: C– or better in CHEM 102 or CHEM 103

Required texts and materials:

1. *Inorganic Chemistry*, 7th edition (2018) by Weller, Overton, Rourke, and Armstrong (referred to as "Weller"). Note that reading assignments and suggested problems will be drawn from the 7th edition and may not match with other versions.
2. *Chemistry 213 Coursepack* (provided)
3. *Chemistry 213 Laboratory Manual* (provided)
4. Laboratory safety goggles (available in lab)
5. Laboratory notebook – composition notebooks will be provided in lab, but any *permanently-bound* notebook is acceptable. It is fine to continue using a notebook from a previous semester, but you shouldn't use the same notebook for two courses this term.

Zoom link: https://oberlin.zoom.us/j/81059929579?pwd=YkpTcTBGdjdLZzBMNHQ4MkVBU3VBdz09
meeting ID = **810 5992 9579**
password = **dx2-y2**

Gradescope:
Lecture – https://www.gradescope.com/courses/367961, entry code **5VEBNY**
Lab – https://www.gradescope.com/courses/370683, entry code **ERZ5GD**

Course format:
Course meetings will be primarily held in-person (pandemic-permitting), though the first two lecture meetings will be remote. I will endeavor to use a mixture of lecture and other activities; you may occasionally be asked to watch prerecorded lecture videos in order to free up more class time for active learning opportunities. The material in any such videos should be considered a core part of the course and is fair game for assessment on problem sets, exams, etc.

We're in year 3 of a pandemic; things are weird. Please let me know as soon as possible if you will need to miss class so that we can figure out how to keep you on track. The policies and procedures described throughout this syllabus are subject to change in response to changing circumstances, or just because we discover that some aspect of the course does not work as well as intended. Of course, I will communicate any important changes as soon as I can.

Evaluation:
Grades will be determined using the components in the table below.

problem sets	15%
3 midterm exams	36%
final exam	19%
participation	5%
lab reports	20%
lab notebook	5%

The scale for determining final grades is shown below. Note that you *must* take the final to receive a passing grade. Grades are based on your score alone; there is no "class curve" and you are not competing directly against your fellow students. It is possible that I could lower the grade borders if aspects of the course prove more challenging than anticipated, but I will not *raise* the cut-offs.

A–	≥ 90%
B–	≥ 80%
C–	≥ 70%
D–	≥ 50%

Problem sets will be distributed approximately weekly, and are due on Gradescope at 11:59pm on the days listed on the syllabus. Problem sets may be evaluated for completeness, correctness, or some combination of the two by spot-grading a subset of the problems. You are welcome to work with classmates on these assignments, but recognize that the goal of the problem sets is not for you to simply write down the correct answers. Rather, the goal is for you to practice and apply course material in order to prepare you for the exams. Relying on another student's work without your own intellectual engagement is both against the honor code and counterproductive to your learning.

Late problem sets will not be accepted after the answer key is posted. In calculating the final course grades, your lowest problem set score will be automatically dropped.

Exams: There will be three closed-book, in-class midterm exams and one cumulative final exam for this course given on the dates listed on the course schedule. The midterms are worth a combined 36% of the final grade, and the final exam is worth 19%. For some exams, you may need use of a scientific or graphing calculator (a cell phone is not acceptable).

Participation: There is no formal attendance policy for CHEM 213, but you will get the most out of this course if you regularly attend class. We will occasionally work on group activities in class, which may or may not be announced ahead of time. Students who participate in ≥50% of these activities will receive full participation credit. As such, having to miss a day or two will not penalize your grade; please don't come to class if you are sick!

Lab report forms can be found at the end of the lab manual and should be submitted on Gradescope. The report for a given lab is typically due 11:59pm on the Wednesday of the following week, but see the schedule for the full list of deadlines. In calculating the final course grades, your lowest lab report score will be automatically dropped.

Lab notebook: A critical aspect of a scientist's work is maintaining a detailed log of operations performed and observations in the lab. Further details about the required content for the lab notebook are available in the *Chemistry 213 Laboratory Manual.* You will be required to submit scans of your Lab 1 notebook pages to Gradescope along with your Lab 1 report. Your lab notebook will be collected at the end of the semester in order to assess your work for the remaining experiments.

Study guides: Each week, a study guide will be distributed that contains the key learning goals along with recommended reading from the textbook and a list of relevant textbook problems. These problems will not be collected, but they are a good resource if you would like extra practice with the course material. Answers to the textbook problems will be posted on Blackboard.

There is much, much more detail in the textbook than we have time to cover in one semester. In your preparations, you should focus on material in the course notes, problem sets, and/or study guides.

Course materials: Materials from CHEM 213 should not be distributed outside of the educational framework of this course (including and especially online) without prior permission of the instructor.

Accommodations: If you have a disability that may have some impact on your work in this class and for which you may require accommodations, please see the instructor and the Office of Disability Resources [disability.resources@oberlin.edu, (440) 775-5588] so that appropriate accommodations can be arranged. A disability may be disclosed at any point during the

semester but should be brought up with at least 24 hours' notice before an exam or other assignment deadline so there is adequate time to make the necessary arrangements.

Inclusivity: The course instructor and TAs are committed to cultivating an inclusive and supportive learning environment that respects and celebrates a rich variety of backgrounds and perspectives. Please speak with the course instructor or the Chemistry Department chair, Jason Belitsky, if you have an experience in this class that is not consistent with this commitment.

Honor code: You must write and sign the Honor Pledge ("I have adhered to the Honor Code in this assignment") in order to receive credit for problem sets, lab reports, and exams in CHEM 213. You are encouraged to discuss lab experiments with your classmates, but all parts of the lab reports (including data, calculations, and answers to questions) must represent your own work.

Semester schedule: A tentative schedule of topics is shown beginning on the next page. Note that the exact coverage from day to day may vary a bit, but updates will be provided as necessary.

Day	Date	Topics	Suggested Reading in Weller	Assignments
Fri	Feb 18	course intro (remote class)		
Mon	Feb 21	1 (remote class) atomic structure, quantum numbers	1.1–1.3	intro survey due
Wed	Feb 23	2 orbital shapes and shielding	1.4–1.5; 9.1	
Fri	Feb 25	3 periodic trends	1.6–1.7; 9.2	
Mon	Feb 28	4 Lewis structures and VSEPR	2.1–2.6	PS1 due
Wed	Mar 2	5 molecular orbital theory intro	2.7	
Fri	Mar 4	6 MO for homonuclear diatomics	2.8	
Mon	Mar 7	7 MO for heteronuclear diatomics	2.9–2.10	PS2 due
Wed	Mar 9	8 symmetry elements and operations	3.1	Lab 1 Report & notebook pages due
Fri	Mar 11	9 point groups, character tables	3.2	
Mon	Mar 14	10 applications of symmetry, MO theory revisited	3.3–3.4, 3.6–3.7	PS3 due on Tuesday
Wed	Mar 16	catch-up day		Lab 2 Report due
Fri	Mar 18	**Exam 1**		

Day	Date	Topics	Suggested Reading in Weller	Assignments
Mon	Mar 21	11 ionic and metallic bonding, intro to solid-state structures	2.13; 4.1	
Wed	Mar 23	12 close packing, X-ray diffraction	4.2–4.5; 8.1; handout	Lab 3 Report due
Fri	Mar 25	13 ionic compounds, radius ratio	4.9–4.10	
Mon	Mar 28	14 energetics of ionic bonding	4.11–4.13	
Wed	Mar 30	15 band theory, metallic bonding	9.4; 4.18–4.19	PS4 due
Fri	Apr 1	16 semiconductors and superconductors	4.20; 24.19, 24.6e	Lab 5 Report due
Apr 2–10		Spring Break		
Mon	Apr 11	17 acid/base definitions, frontier orbitals	5.1ac, 5.6, 5.8, 5.12, 5.14; handout	
Wed	Apr 13	18 hard and soft acids/bases	5.10	PS5 due
Fri	Apr 15	19 oxidation and reduction	6.1–6.7, 6.12	
Mon	Apr 18	20 Frost and Pourbaix diagrams	6.9, 6.13–6.15	PS6 due
Wed	Apr 20	catch-up day		Lab 4 Report due
Fri	Apr 22	**Exam 2**		

Day	Date	Topics	Suggested Reading in Weller	Assignments
Mon	Apr 25	21 intro to coordination compounds, nomenclature	7.1–7.2	
Wed	Apr 27	22 coordination geometry and isomers	7.3–7.4, 7.7–7.10	Lab 6 Report due
Fri	Apr 29	23 crystal field theory for octahedrals, spectrochemical series	20.1a–d	
Mon	May 2	24 ligand field theory, π-donors and π-acceptors	20.2	PS7 due
Wed	May 4	25 d-orbitals for other geometries, angular overlap method, Jahn–Teller distortion	20.1e–h, handout	Lab 7 Report due
Fri	May 6	26 ligand substitution, *trans* effect	21.1–21.4	
Mon	May 9	27 organometallics: electron counting, 18-electron “rule”	22.1–22.17	PS8 due
Wed	May 11	28 elementary organometallic reactions	22.21–22.26	Lab 8 Report due
Fri	May 13	29 transition metal catalysis	2.14; 22.27–22.29	
Mon	May 16	30 drawing catalytic cycles	22.30–22.32	PS9 due
Wed	May 18	catch-up day		Lab 9 report due
Fri	May 20	**Exam 3**		

Day	Date	Topics	Suggested Reading in Weller	Assignments
Mon	May 23	TBD	TBD	
Wed	May 25	TBD	TBD	Lab 10 Report and lab notebook due
May 27–30		Reading Period optional review session (details TBA)		
Tues	May 31 7:00pm	**Final Exam**		