Chemistry 2610
Inorganic Chemistry
Fall 2024

Classes Meet: TR 1:45-3:15
Recitations: Mondays, 12-1 pm or 5:15-6:15 pm

Instructor: Tom Mallouk, mallouk@sas.upenn.edu
Office phone: (215) 898-4859

Office hours TW 1:30-2:30 PM
Location TBA

Learning Goals: The objective of this course is for students to understand bonding in inorganic compounds, periodic trends in redox and acid-base equilibria, and the structures of solid elements and simple compounds. Building on this knowledge we will develop a conceptual framework for understanding the stability and the electronic, magnetic, electrochemical, and mechanical properties of inorganic solids. We will also connect the chemistry of inorganic materials to some of their current and emerging applications. By the end of the course you should know many of the elements in the periodic table as good friends, and the others at least as familiar acquaintances.

Textbook: The Chem 2610 text is a student-written Wikibook that was born in Spring semester of 2014 (https://en.wikibooks.org/wiki/Introduction_to_Inorganic_Chemistry). The text will be supplemented with notes on some topics, and we will continue to make improvements to the text this semester (see below). A backup textbook that is recommended but not required is Miessler & Tarr, *Inorganic Chemistry,* 5th Ed. (2021). Other popular inorganic textbooks include Shriver & Atkins *Inorganic Chemistry*, 5th Ed., and Huheey et al, *Inorganic Chemistry*, 4th Ed. (2008).

We will post on Canvas supplementary reading as well as Powerpoint notes that you should bring to class. These notes are in outline form and will be filled in during class. Please visit the course *Modules* page to download these notes before the day of the relevant lecture.

Your participation is important to the success of this course, both for you and your classmates. The textbook and notes contain the information that I intend to cover in class. But, there is hardly anything I can go over from these sources that will be of more value than your questions and an open discussion. In Chem 2610 you can text your questions and comments anonymously to the front of the room (if you prefer that to raising your hand).[1] We will also have in-class discussions on concepts that are likely to be covered on exams. Class participation counts for 2% of your grade in this course (see below).

Grading will be based on weekly homework (15%), recitation worksheets (10%), two midterm exams and a cumulative final exam (20% each), and a term paper/oral presentation (15%).

[1] Cell phone 814-571-6115. Please note that my ability to text anything back to you is severely limited by carpal tunnel syndrome and the capabilities of my "vintage" cell phone. My top texting speed is about 3 words per minute. If you send me a text outside of class, I can answer back "yes," "no," or "see me" (I have these messages saved for you as "drafts"). Texting me a question only works during class, when I can answer orally!

Solutions to homework will be posted on the course Canvas site on the due date, and for this reason late homework will not be graded. We will drop your lowest problem set score in computing your final grade. Up to 2 percentage points of extra credit are available for in-class participation. There is also an opportunity for additional extra credit (see below) by contributing to the course *Wikibook*.

Examination schedule: Closed-book midterm exams will be held at 6:30 PM on the evenings of *Tuesday, Sept. 24* and *Tuesday, Oct. 29*. There will be a cumulative final exam during the final exam period (place and time TBA)

Term Papers and Lightning Talks: All students in Chem 2610 will write a ~2500 word term paper on a topic of their choice and present a 7-minute powerpoint "lightning talk" during the last two weeks of classes and recitations. This assignment is described in more detail in a separate file. Topics must be approved **by Tuesday, Oct. 1**. Term papers will be due on **Tuesday, Oct. 22**, and cannot be accepted later. Your paper will be peer-reviewed by your classmates, edited by you, and then assigned a final grade by your instructor.

Wikibook project: Students may receive up to five extra credit percentage points for substantial contributions to the course textbook. These contributions could include improving the figures and layout of the book, editing existing content, or contributing new content. All such contributions must be made prior to the last day of class and require instructor approval in advance.

Academic Help: Your TAs and I will be available for help outside of class. TA drop-in hours and locations will be posted on the course CANVAS site. You may also arrange for help outside of these times by email. Please do not hesitate to let me or your TA know if you are having difficulty. If at any point you want additional academic help, I encourage you to contact the Penn Tutoring Center. It is best to get connected with a tutor early in the semester before all spots are filled. (It can be difficult to get a tutor if you wait until exam week.) More information can be found here: https://www.vpul.upenn.edu/tutoring/

Ed Discussion: We will use Ed Discussion as a discussion board for problem solving and general inorganic chemistry concepts. You should post questions on Ed Discussion for your classmates or your instructors and TAs to answer, and read the questions and answers posted by other students. Ed Discussion is a great resource for keeping up with the material and preparing for exams. Please note (see section on *Academic Integrity* below) that **solutions to homework problems** should not be posted on Ed Discussion prior to the due date of the assignment.

Academic Integrity: Penn's code of academic integrity can be found here:
https://catalog.upenn.edu/pennbook/code-of-academic-integrity/
Your instructor and TAs consider it an honor to work with some of the best students in the world, and in turn we expect honorable behavior from you. While we encourage you to interact with and learn from your classmates, all materials you submit for grading must be your own work. Specific examples of academic dishonesty in this course include, but are not limited to:

- Plagiarism or use of AI-generated text in your term paper
- Posting or otherwise communicating homework answers before the assignment is due
- Communicating with someone else during an exam

- Receiving information from any person during an exam
- Providing a false excuse for missed exams

The consequences of these infractions may range from a grade of "0" on the assignment or exam in question to an F in the course. It is our obligation to enforce these rules and to report infractions to the Office of Student Conduct.

Community in the Chemistry Department at Penn: One of the goals of the course is to develop a community with a shared appreciation of chemistry, where everyone has a sense of belonging. This can only happen if all members of the course community, the instructor, TAs, and students, work together to create a supportive, inclusive environment that welcomes all students, regardless of their race, ethnicity, gender identity, sexuality, religious beliefs, political views, physical or mental health status, or socioeconomic status. Mutual support, inclusivity, and belonging are all core values of this course and of Penn Chemistry. All participants in this course deserve and should expect to be treated with kindness and respect by all other members of the community. If you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss the matter with me, or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below).

Formal and Informal Accommodations: The Chemistry Department at Penn is committed to assisting students requiring special accommodations for circumstances that are registered with the Office of Student Disability Services (SDS; https://www.vpul.upenn.edu/lrc/sds). If you are not formally registered with SDS and experience learning disabilities or other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with me or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below) so that we can help you to secure the resources to promote your success.

Mental Health Resources: At Penn Chemistry we care about the holistic well-being of our undergraduates. While your focus should be on academics, it important to attend to your physical and mental health as well. Anxiety and depression are very common in high-stress environments. If you are concerned about yourself or a friend, please reach out to either the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program (see below) who will direct you to the appropriate resources. If you, or anybody you know, is in need of mental health care, please refer to the following campus resources: (1) Counseling and Psychological Services, CAPSLinks to an external site. 215-898-7021 (off hours and weekends 215-349-5490); (2) Department of Public Safety 215-898-7333, or 511 if imminent danger to themselves or others; (3) Finding Programs for Student Wellness through University Life; and (4) Student Health Services.

For help with any of these issues, please feel free to reach out to the Chemistry Undergraduate Office [Professor Jeffrey Winkler, Undergraduate Chair (winkler@upenn.edu) or Ms. Candice Adams, Undergraduate Coordinator (chemugrad@sas.upenn.edu)] or the Biochemistry Undergraduate Office [Professor Jeffrey Saven (saven@sas.upenn.edu), Co-Chairs Undergraduate Biochemistry Program or Ms. Leslie Shinn, Undergraduate Biochemistry Program Coordinator (biochemistry@sas.upenn.edu)] who will direct you to the appropriate resources.

Chemistry 2610 - *Course Outline and Tentative Schedule*

Week/Lectures	Topics	Reading Assignment*
Aug 27-29	Chemical bonding: Lewis structures, VSEPR	Chapter 1
Sept 3- 17	Valence bond and molecular orbital theory	Chapters 1 & 2
Sept 19	Acid-base chemistry	Chapter 3
Sept 24	Redox stability and redox reactions	Chapter 4
Exam 1: Tuesday, Sept. 24, 6:30 PM		
Sept 26	Coordination chemistry, crystal field theory	Chapter 5.1-5.5
Oct 1-15	Coordination and organometallic chemistry	Chapter 5.6-5.11
Oct 17-22	Metals and alloys	Chapter 6 & 7
Oct 24-31	Ionic and covalent solids - structures	Chapter 8
Exam 2: Tuesday, Oct. 29, 6:30 PM		
Nov 5-7	Ionic and covalent solids - energetics	Chapter 9
Nov 12-14	Electronic and magnetic properties of materials	Chapter 10.1-10.4
Nov 19-21	Group IV, semiconductors, properties and devices	Chapter 10.5-10.9
Nov 26	Nanoscale inorganic chemistry	Chapter 11
Dec 3-5	Student lightning talks	

Cumulative Final Exam: In the final exam period, date and time TBA

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*Unless otherwise noted, all reading assignments are from *Introduction to Inorganic Chemistry* (http://en.wikibooks.org/wiki/Introduction_to_Inorganic_Chemistry)
See Modules tab on course Canvas site for supplementary reading and/or class notes

CHEMISTRY 2610

TERM PAPERS AND LIGHTNING TALKS

Chem 2610 students are required to write a ~2500-word (5-10 page) paper on a topic of current interest involving inorganic chemistry, and to present it in oral form during a "lightning talk" session. There are no strict rules about the content and style of these papers, but in general they should be aimed at the level of your classmates, who are familiar with the general principles of inorganic chemistry but not informed about your specialized topic.

Timeline for term papers and lightning talks:

Tuesday, Oct. 1	Deadline for topic approval by instructor
Tuesday, Oct. 22	Deadline for electronic submission of your term paper via Canvas
Week of Oct. 29	You will receive three term papers to review
Tuesday, Nov. 12	Deadline for receipt of reviews
Tuesday, Nov. 26	Deadline for receipt of revised term papers (hard copy)
Weeks of Dec. 2 and Dec. 9	Lightning talks in class and recitation sessions

Your paper and talk should review a current topic that you find interesting. On the next page are examples of topics from previous semesters. Many other topics are of course possible, but you must obtain approval of your topic from the instructor *no later than* **Oct. 1**. Your paper is due on **Oct. 22**. The only rules are that your topic must pertain at least periferally to inorganic chemistry, and it must not be too broad to be reasonably covered in the time and space allotted.

The grading of your project will be based primarily on its *content* and *originality*. The first is self-explanatory. Your work is expected to be original in the sense that drawing most of your information from only one or two sources, or paraphrasing any source excessively, is strongly discouraged. Your paper should include illustrative figures and a bibliography of source material (including author, journal, date, page, and title of all articles). References to this material should be annotated in the text, in the style of a scientific review article. Shoot for 5-15 journal articles as citations. Although they are useful for gathering background information, textbooks and websites should *not* be used as your primary literature sources, and they should *not* appear among the literature cited in your paper. If you find that a textbook or Wikipedia article does a good job of describing your topic, then you have chosen one that is not sufficiently current or specific. Your paper will also be original in the sense that *no two students may choose the same topic*. Hopefully this rule will motivate you to think about your topic and have it approved well before the deadline.

Your term paper must be submitted *electronically as a PDF file* before 11:59 PM on **Oct. 22**, via the Canvas assignments tab. Include your name in the pdf filename. I will not accept your paper after the deadline, as we need all papers to begin the peer review process; consequently, if you do not submit your paper by the deadline, you will automatically lose *half the points* of your term paper grade. Your paper will be peer reviewed by three (anonymous) classmates, and you will also receive three papers to review by e-mail. A set of reviewer instructions will be provided with these three manuscripts. Reviews must be returned by e-mail to your instructor no later than **Nov. 12**. *Failure to complete your reviews on time will cost you one letter grade on this assignment*. Your reviewer comments will be returned to the author verbatim, but your identity as a reviewer will not be revealed to the author. Final versions of the term papers, which

incorporate the reviewers' suggestions, must be submitted (*as a hard copy*, to the instructor) by class time on Tuesday, **Nov. 26**.

Your oral presentation counts as 1/3 of your grade on this project. You will be assigned a date and time (in your recitation section, or during class time) to present your talk, which should consist of a title slide plus **four (or fewer)** PowerPoint slides. You will have 7 minutes (strictly enforced!) to present your talk, plus 3 minutes for questions. Please email your slides to your instructor at least one day before your presentation. We will have them loaded up on the classroom computer to minimize delays between talks.

Some previous term paper topics:

Arsenic in drinking water
BN nanotubes
Biosynthesis of Fe-S clusters
Blue inorganic pigments
Carbonic anhydrase mimics
Carbon nanothreads
Catalytic nanomotors
Carbon nanotube springs
Cation exchange in nanoparticle synthesis
Cesium recovery from nuclear waste
Cobalt-based water splitting catalysts
Coordination chemistry cages
CO_2 capture in metal-organic frameworks
CO_2 capture by alkaline minerals
Cross-coupling catalysis with 3d metals
Electrides and alkalides
Electron crystallography of molecules
Electron transfer in cytochrome P450
Gas solubility in microporous water
Giant magnetoresistance
Graphene electronics
Borides harder than diamonds
Hydrogenase model compounds
Infrared plasmonics
Inorganic molecular qubits
Inorganic polysulfide chemistry
Interstellar aluminum compounds
Lanthanide separations
Lanthanide-dependent enzymes
Liquid metal batteries
Lithium battery recycling chemistry
Luminescent silicon nanocrystals
Metal-organic redox flow batteries
Metal organic frameworks as catalysts
Fe^{2+} progenitors of reactive oxygen species
Metal chalcogenide valleytronics
Methane hydrates
Methane monooxygenase
Metallic hydrogen
Metallo-crowns
Negative thermal expansion compounds
Nitrogenase model compounds
Non-innocent and redox active ligands
Perchlorate contamination and remediation
Phase change optical memories
Photocatalytic chemistry of $Ru(bpy)_3^{2+}$
Polysilanes 1-D and 2-D
Porphyrin chemical sensor arrays
Platinum anti-cancer drugs
Hybrid improper ferroelectrics
Ruthenium complex LED's
Self-cleaning glass
Single-molecule magnets
Solar thermal water splitting with CeO_2
Solid state proton conductors
Supramolecular hosts for gold recovery
Panoscopic design of thermoelectrics
Rapid thermal metathesis reactions
Shape memory alloys
Spherical nucleic acids based on nano-Au
Spin crossover in transition metal complexes
Stabilizing perovskite solar cells
Sulfate reducing bacteria in water treatment
Technetium medical imaging
Triplet-state electroluminescence
Vapor-phase synthesis of MXenes
Zero valent metals for environmental remediation
Zinc-air batteries