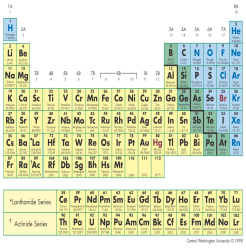

CHE 004A – 2024 Winter

General Chemistry for Physical Sciences and Engineering

MWF, 12:10 - 1:00 PM, Wellman Hall 235

Prof. C. William McCurdy

cwmccurdy@ucdavis.edu
Canvas website: https://canvas.ucdavis.edu/courses/698174
Professor's Office: Chemistry Annex, Room 4467
Office Hours: Monday 4:00-5:30 pm in location TBA. Office hours avoid our lab times to help you attend.
Head TA: Brandon Cutler bjcutler@ucdavis.edu
TA Office Hours: TBA

Class Meetings: We will meet in person in Wellman 235. Almost all campus buildings have filtration and ventilation systems that can mitigate coronavirus spread (https://facilities.ucdavis.edu/ventilation-filtration). Our room in Wellman should have among the better filtration levels on campus (Minimum Efficiency Reporting Value (MERV) 13, 100% outside air and 4 air changes per hour).

Attendance: Learning this material is far easier in person, and questions are best answered in that context. The UC Davis Lecture Capture service is available only for audio recording in our classroom. Slides and images for class will (usually) be posted the day before and always by the day following the lecture. **Attendance in Labs and Discussion sections is *required*.** By Chemistry Department policy ***you must pass the lab to pass the course.*** *All exams are in class*, and attendance is therefore required.

Course Description: This is an introductory general chemistry course directed to best fit the needs students in the physical sciences and engineering, in particular for chemistry majors and chemical engineers. However all students with the prerequisites (see below) are welcome. This course differs from the regular general chemistry course (CHE 2A) by not emphasizing in lecture the more basic concepts of stoichiometry and chemical reactions (which are covered in the lab and discussion sections), and instead covering the following topics in more depth.

- Atomic Shells and Classical Models of Chemical Bonding: Using the simplest concepts of ionic and covalent bonds and the shell model of the atom to understand the periodic table and its meaning
- Introduction to Quantum Mechanics in Chemistry: Mastering the basic concepts of wave mechanics and the interaction of radiation with atoms and molecules
- Quantum Mechanics and Atomic Structure: Understanding the origins of the properties of atoms and the quantum mechanical basis of the periodic table
- Quantum Mechanics and Molecular Structure: Understanding molecular orbitals and the quantum mechanical basis of the chemical bond

- Bonding in Organic Molecules: Application of the molecular orbital and valence bond ideas to understand bonds involving carbon, nitrogen, oxygen and hydrogen
- Bonding in Inorganic Molecules: Coordination compounds and how crystal field and ligand field quantum theory predicts their colors and properties
- Kinetic theory of gases, ideal gas behavior, and intermolecular forces

Prerequisite(s): Prerequisites are high school chemistry and physics, and concurrent enrollment in mathematics at or above the level of MAT 21A strongly recommended; must earn a qualifying score of 28 or better on the Chemistry Placement Exam. The Placement Exam can be taken more than once, but students with lower scores will be administratively dropped from the roster after the third week. High school calculus is strongly recommended, although not formally required. We will make frequent use of derivatives and simple integrals in our study of the quantum mechanical nature of atomic structure and bonding. Concurrent registration in introductory calculus is therefore very strongly recommended.

Texts:
(Oxtoby) Principles of Modern Chemistry, David W. Oxtoby, H. P. Gillis and Laurie J. Butler 2016 8th edition. Cenage; **ISBN:** 978-0-357-67100-9. This text is available through Equitable Access (https://ucdavisstores.com/EquitableAccess). Paper editions are also available and the 7th edition in paper will suffice if that is what you prefer. Links to the text will be on the CANVAS website that you can access with your Equitable Access credentials.

(LAB) Chem 4A Lab Manual The lab manual will be in an electronic copy (.pdf) and will be provided to the students prior to the start of the lab by the head TA

Class communication: All class announcements and assignments, as well as class resources (e.g. notes and outside references and images, recorded lectures, document camera material used during lectures etc.) will be posted on the class Canvas website. You can access that site through the Canvas URL: https://canvas.ucdavis.edu/courses/874213. All announcements to the class will be made from the Canvas website, and students are responsible for setting their Canvas preferences to receive them immediately and directly via email. It is your responsibility to check the Canvas website for any pertinent announcements or information. If you have questions, check Canvas first. Then, your section TA is your next line of contact. You must use your @ucdavis.edu email address. Neither Prof. McCurdy nor the TAs will respond to messages from other domains. To contact the course instructor, use only email with "Chem 4A" in the subject line. **Do *not* use Canvas Messages**.

Academic Etiquette in Emails and Other Communication: Respect of others is a fundamental principle in University classes. In this class we will insist on mutual respect between all parties in all communications. Your instructors and TAs deserve to be treated with respect at all times, and you as students in this class deserve the same respect. Your instructor will always address you as Mr., Ms. or Mx. followed by your last name, or simply by your last name if that is what you prefer. In emails to the instructor, you will please address him as Professor McCurdy or Dr. McCurdy. Emails beginning with "Hey," "Hello," or other informal salutations will not be answered. Emails to your TA should address the TA by personal title followed by the last name unless you are explicitly invited by your TA to do otherwise. A one-page explanation of the rules of

academic etiquette is posted on our website under the Files/ link as Worthen-Etiquette-Handout.pdf

Cheating/Plagiarism: Cheating or plagiarism will result in a referral to Student Judicial Affairs (SJA) https://ossja.ucdavis.edu/code-academic-conduct. A negative judgement from SJA will result in automatic failure of the respective assignment, and may result in dismissal/suspension from the class. In laboratory, all students must use their respective data to finish each post-laboratory exercise. Students are not allowed to copy or post any data, calculations, or answers of any kind from any other person or website. *Note that lab reports must be done entirely independently of your lab partner* or other persons, even when you share data you and your partner took together. You may not copy or paraphrase another's work without appropriate citation. Using Artificial Inteligence bots to write lab reports is cheating. On examinations, you must do your own work and may not consult any outside sources in any way. All suspected violations will be referred to SJA.

Health Services: Here at UC Davis we care about the holistic well-being of our undergraduates. It is all too often that while focusing on academics students forget to attend to both their physical and mental health, resulting in anxiety, depression, and a multitude of detrimental issues. If you, or anybody you know, is in need of mental health care, please refer to the following campus resources: (1) Counseling & Psychological Services (CAPS): North Hall. (530) 752-2349; (2) Urgent Care: Student Health and Wellness Center; (3) 24-Hour Advice Nurse: (530) 752-2349.

Grade Components and Weights:

Labs	20%
Homework Assignments	20%
Discussion	10%
Midterm Exam I	15%
Midterm Exam II	15%
Final Exam	20%

Discussion Sections: Attendance in Discussion Sections is required. The TAs will both review and introduce material that is not covered in Lecture (particularly stoichiometry and other basic topics that we assume you have covered thoroughly in high school courses). *To receive the full credit (10% of the course score) you must attend Discussion.*

Homework Assignments: Homework assignments (problem sets) will be posted weekly on Canvas, accompanied by Canvas announcements. *Please note:* Homework is 20% of your grade in this course. It is one the most important part of the learning experience of this course and preparation for the exams. Make it a priority.

Exams: The midquarter and final exams will be in class, closed book, with no notes or outside resources allowed. There will be no make-up exams, and the policy for *excused* absences will be explained in class.

Week of	Content
Jan. 8	• The experimental characterization of the building blocks of atoms: electrons, protons, neutrons: *Oxtoby 1.4, 1.5* • Summary of concepts from stoichiometry assumed in 4A: *Oxtoby Chap. 1, Chap 2.* Basic stoichiometry will be covered in discussion sessions. • Experimental evidence leading to quantum mechanics *Oxtoby 4.1, 4.2*
Jan. 15	• Monday holiday (Martin Luther King Jr. Day) • The Bohr model and the failure of classical mechanics on the atomic scale *Oxtoby 4.3, 4.4* • The Schrödinger equation. The particle-in-a-box and quantum states. *Oxtoby 4.5-4.7*
Jan. 22	• The quantum states and energy levels of the hydrogen atom *Oxtoby 5.1* • The shell model of many-electron atoms *Oxtoby 5.2 - 5.4* • Periodic properties of the atoms and their electronic structure *Oxtoby 5.5, 3.2, 3.4*
Jan 29	• Electron Affinity and Electronegativity and ionic bonding *Oxtoby 3.5 - 3.8* • Dipole moments, Covalent and polar covalent bonding *Oxtoby 3.9* • Midquarter I – in class, Friday Feb. 2
Feb. 5	• Classical models of bonding: Lewis structures and valence shell electron pair repulsion "theory" *Oxtoby 3.11, 3.12* • Quantum description of bonding, Born-Oppenheimer approximation *Oxtoby 6.1* • Molecular orbitals of H_2^+ *Oxtoby 6.2, 6.3*
Feb12	• Bonding in diatomic molecules, the Linear Combination of Atomic Orbitals (LCAO) approximation *Oxtoby 6.5-6.7* • Valence bond theory, hybrid orbitals and delocation *Oxtoby 6.8 - 6.13*
Feb 19	• Monday holiday (Presidents' Day) • First topics in bonding in organic molecules, the Alkenes and Alkynes *Oxtoby 7.1-7.3* • Aromatic hydrocarbons, the concept of functional groups, Amines and amides, also oxidation states *Oxtoby 7.4-7.6 and 3.12*
Feb. 26	• Finish bonding in organic compounds. Begin bonding in transition metal compounds. *Oxtoby 8.1 and 3.12* • Midquarter II – in class. Friday, March 1
Mar. 4	• Coordination compounds and crystal field theory *Oxtoby 8.2 - 8.4* • Optical properties of coordination compounds *Oxtoby 8.5* • Gases: Pressure, temperature and the ideal gas law *Oxtoby 9.1-9.3*
Mar. 11	• Gases: Pressure, temperature and the ideal gas law *Oxtoby 9.1-9.3* • The kinetic theory of gases *Oxtoby 9.5* • Intermolecular forces and molecular collisions *Oxtoby 9.6, 9.7*
Mar 25	• Final Exam week • Exam: Thursday, March 21, 6:00 p.m. (100 minutes) {Check exam schedule.}

Tentative Schedule of Topics, Readings, and Exams: Weekly reading assignments represent the main topics of the classes, although students are expected to read the chapters in the Oxtoby text in their entirety. Reading the textbook material prior to class is strongly advised. This schedule may be revised slightly during the quarter, but the list of major topics will not change.

Laboratory Schedule: Labs are a required part of the course, and by Chemistry Department policy ***you must pass the lab to pass the course.*** Generally there are no makeup labs. We will nonetheless try to accommodate legitimate abscences due to documented illness or accident.

Dates	Lab weeks	**Lab Experiment**
Jan 10	1 wk	Safety Orientation;
Jan 17	1wk	Expt 1 Calibration of Pipet (CP)
Jan 24	1wk	Expt 2 Charge and Mass of the Electron (CME)
Jan 31	1wk	Expt 5 Measurement of Planck's Constant (h)
Feb 7	1wk	Expt 6 Optical Spectroscopy of Atoms and the Balmer Spectrum of Hydrogen (BSH)
Feb 14	1wk	Expt 7 Quantitative Spectrophotometry and Beer's Law
Feb 21	1wk	Expt 3 Behavior of Gasses (BG)
Feb 28	1wk	Expt 4 Determination of Avogadro's number (NA)
March 7	1wk	Check out

Late Lab attendance: Labs generally require the full lab period to complete. You should arrive on time. If you arrive more than 20 minutes late, your Lab TA may ask you to leave and treat the period as a missed lab.