CHEN 1201: General Chemistry for Engineers 1
Spring 2022

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Class Meeting Times/Dates/Location: M/W/F 1:25-2:15pm
CHEM142 (Christol Chemistry and Biochemistry Building, Main Campus)
Virtual (Synchronously via ZOOM or asynchronously)-Find the links on canvas

Course Communication:

Canvas will be used for, reading quizzes, grades, recorded lecture material, and other class info. You can also access screencasts from there. You are responsible for reading all the information that is posted there. Email is not a good way to clarify questions on the material; those questions should be answered in office hours or recitation. If you need to reach out to us for any logistical issues, please reach out to chen1201@colorado.edu

Office Hours: All office hours will be held either remotely or in person, links for weekly sessions posted on Canvas. In case of any change, you will be notified through announcements on canvas. Locations and times of office hours are posted on canvas. Virtual office hours will be held via zoom. Reservation required for the virtual office hours. For now, it seems like virtual office hours will be our option.

Textbook and Other Required Materials:

Textbook: Nivaldo J. Tro, *Chemistry: A Molecular Approach 5th ed.*, Pearson, 2019.
(Available as "Day 1 Digital Access" through Canvas site, see posted instructions for access)

Course Description:

General Chemistry for Engineers 1 is designed to meet the general chemistry requirement for many engineering students and serve as part one for students whose academic plans require advanced work in chemistry. A basic knowledge of chemistry is important for understanding how the processes and materials used throughout all fields of engineering work. The intent of this course is to provide an introduction to the structures, properties, and fundamental concepts in chemistry. This course will also teach engineering students how to do problem-solving with chemical concepts and provide a chemistry knowledge base of concepts and experimental techniques that they can carry forward into their future engineering careers. Topics include components of matter, stoichiometry, electron configuration, chemical bonding, molecular shapes, covalent bonding, classes of reactions, thermochemistry, gases, atomic structure, organic compounds, intermolecular forces, and phase equilibria. Examples and problems illustrate the application of chemistry to engineering sub-disciplines.

Course Learning Goals:

1. Master basic mathematical skills and fundamental chemical concepts.
2. Understand the connection between macroscopic observations, molecular views, and symbolic representations in chemistry.
3. Recognize the relationship between molecular structure and chemical and physical properties.
4. Understand the basis of and effectively use the periodic table.
5. Analyze complex chemical problems, develop critical thinking skills, and logical approaches to problem solving.
6. Draw and interpret graphs and analyze data in class, in recitation, and on exams.
7. View chemistry as an integrated and logical science.
8. Recognize and explain how chemistry concepts apply to everyday phenomena.
9. Take personal responsibility for learning and develop/enhance self-regulated learning skills.
10. Articulate an understanding of science and develop communication skills.
11. Understand in sufficient depth for later coursework:
12. The Periodic Table and Atomic Structure
    a. Understand the concepts of the electromagnetic spectrum (the nature of light), atomic spectra, and the quantum mechanical model of the atom.
    b. Be able to apply the Pauli Exclusion Principle to the determination of orbital energies and electron configurations.
    c. Be familiar with the trends of the Periodic Table, and be able to relate these trends to chemical behavior such as bonding and the properties of matter.
13. Atoms and Molecules
    a. Understand the fundamental concepts of the atom, including atomic number, mass number, atomic symbols and atomic masses.
    b. Be able to discuss ions and their properties.
    c. Understand the nature of compounds, their formulas and their bonding. Be able to identify and name binary covalent and ionic compounds.

    d. Be able to discuss inorganic and organic chemical systems, and identify their similarities and differences.
14. Molecules, Moles, and Chemical Equations
    a. Be able to write and balance chemical reactions.
    b. Understand aqueous solutions, solvents and solutes. Be able to write and balance chemical equations for aqueous reactions, including acid-base and redox reactions.
    c. Be able to interpret chemical equations, specifically to determine empirical and molecular formulas using moles and molar masses.
15. Stoichiometry
    a. Be able to obtain chemical ratios from a balanced chemical reaction.
    b. Be able to determine limiting reactants, theoretical and percentage yields and solution stoichiometry.
16. Chemical Bonding and Molecular Structure
    a. Be able to identify and describe ionic and covalent type bonding; understand the similarities and differences between the two types of bonding.
    b. Be familiar with the concepts of electronegativity, bond polarity, and the use of Lewis structures in predicting chemical structure.
    c. Be familiar with the model of orbital overlap in chemical bonding, and the use of hybrid orbitals to predict molecular shape.
17. Thermochemistry
    a. Be able to define energy, its forms and the units of energy.
    b. Understand and apply the concepts of heat capacity, calorimetry, and enthalpy.
    c. Be able to apply Hess's Law to the interpretation and prediction of enthalpies of reactions.
    d. Be able to define and use the laws of thermodynamics in characterizing thermochemical reactions.
    e. Be able to use Gibbs Free energy to characterize reaction spontaneity
18. State of Matter: Gases
    a. Be able to correlate structure with bonding and rationalize the resulting properties.
    b. Understand the concepts of pressure, partial pressure, and ideal versus real gases.
    c. Be able to apply the ideal gas law to chemical reactions involving gases.
    d. Understand the postulates of the kinetic-molecular theory of gases and its limitations.
19. States of Matter: Liquid, Solids and Phase Equilibria
    a. Be able to compare and contrast gases, liquids and solids in terms of bonding, structure and properties.
    b. Be able to describe bonding in solids, including models for metallic bonding.
    c. Be able to describe the structures of simple crystalline solids
    d. Understand the difference between types of solids: conductors, semiconductors and insulators.
    e. Be familiar with the types of intermolecular forces.
    f. Be familiar with the physical properties of liquids, including vapor pressure, boiling point, and surface tension.
    g. Be able to interpret simple phase diagrams.
    h. Be able to apply the Clausius-Clapeyron equation to changes in phase.

Class Format:

This class will be taught partly as a "flipped classroom." In other words, much of the direct communication of material will be done outside class through screencasts and reading. Lecture time will be spent on mostly conceptual questions and problem solving. In order for you to benefit from this approach:

a) Reading assignments and screencasts will be assigned for every class. The class will be conducted with the assumption that you have read/watched them.

b) There will be reading quizzes (RQ) due on M/W/F and homework (HW) problems due T/Th for most weeks. RQs are due on 1 PM and HWs are due on 5 PM. It is your responsibility to look for the due dates.

c) Class templates for each class, which include the problems that will be solved in class, will be posted on-line. Please look through these before attending the class and watching recorded videos so you are prepared to follow the content.

Grading:

Generally, this class follows a standard grading scheme:

90 – 100	A-/A
80 – 89	B-/B/B+
70 – 79	C-/C/C+
60 – 69	D-/D/D+
< 60	F

This could change depending on the overall class average at the end of the semester. However, you will not get a grade that is worse than stated above. Exams are NOT curved; they are normalized if there is more than one version.

The grade elements are as follows:

Clicker Questions	10%
Recitation	15%
Homework	15%
On-line reading quizzes	10%
Midterm Exam 1	10%
Midterm Exam 2	10%
Midterm Exam 3	10%
Final Exam	20%
Total:	100%

Exams:

If a student is unable to take an exam due to illness or other emergency, the exam percentage points will be replaced by the final exam. All exams are closed books – any necessary information will be

provided. Student needs to provide proof for an excused absence during an exam by submitting their documentation to accommodation center portal and obtain a temporary letter. Please add both instructors to your accommodation letter and let the course email (chen1201@colorado.edu) to know your issue. It is important to make sure that accommodation center will include a proper duration for the letter.

Exam Dates:

EXAM 1: Ch. 1 – 5	**Tuesday, Feb 8th 8:00 – 9:30 pm**	**Loc: ECCR 265 – ECCR 131**
EXAM 2: Ch. 6 – 8	**Tuesday, March 8th 8:00 – 9:30 pm**	**Loc: ECCR 265 – ECCR 131**
EXAM 3: Ch. 9 – 11	**Tuesday, April 12th 8:00 – 9:30 pm**	**Loc: ECCR 265 – ECCR 131**
FINAL EXAM: Ch. 1 – 14	**Monday, May 2nd 4:30 – 7:00 PM**	**Loc: TBA**

Homework:

All homework will be on-line problems through Mastering Chemistry which can be accessed directly through Canvas. Once you have registered and enrolled, you can log in at any time to complete or review your homework assignments. The only make-up homework that will be offered is for medical or emergency reasons. Your two lowest homework grades will be dropped. All HWs are due on T/R at 5 PM, except for the first week. During sign up or throughout the semester, if you have any technical problems or grading issues, please contact https://support.pearson.com/getsupport/s/contactsupport explaining the issue. This support team is almost always faster and better able to resolve technical issues than your instructor or TA.

Lecture quizzes (Clicker):

All lectures will include short clicker problems. You will receive a percentage of the total clicker grade for each day, regardless of how many questions there are for the day. You will get an overall percentage that will count for 10% of your grade. I will drop two of the lowest clicker scores. Clickers cannot be made up after the scheduled lecture time has passed. Attendance is also part of the clicker grade. (We are giving the students the option of transferring clicker grade to the final exam, meaning if you do not want to participate in the clickers, you have to communicate with the course email and ask us to opt you out of the clickers, In that case your final will be considered 30% of your total grade. This gives you the flexibility regarding the attendance.

Recitations:

Every student is required to attend their scheduled weekly recitation whether it is held in-person (or remotely). The recitations will cover concepts and problems in more detail than can be done in class. You are welcome to suggest topics if you would like. The top ten recitation grades will be counted.

These sessions are held in order to clarify material presented both in class and in the homework or reading quizzes. You are already assigned to a recitation. Please only attend the recitation you are assigned to as there are strict room occupancy restrictions. **Recitation will start on week 2**.

The format of the recitation is as follows:

The TA will start with a presentation covering one or more concepts presented in previous classes, or on homework or reading quizzes. They will cover topics that appear to need clarification, either because of low class scores on the homework or reading quizzes, or by request of the students (must be made by the Friday before recitation). They will then demonstrate 1-3 example problems. The last 15–20 minutes will be used for a recitation quiz that will contain problem(s) similar to possible exam problems. The quiz will be closed book, however, make sure to bring a calculator. Recitation points are based on attendance (30%), quizzes (60%) and participation (10%).

Participation will be measured at the TA's discretion, determined by asking questions, being engaged in the class (i.e. arriving on time, not checking phones, etc.), and will be measured over the entire semester.

The ten highest recitation scores will be counted. However, it is suggested that you attend all the recitations as the information you gain from them is very useful. Remember that recitation is worth 15% of your overall grade. Please make sure you come prepared!

On-line reading quizzes:

There are 3 reading quizzes a week (due MWF) accessed through Canvas. These are based on the assigned reading and screencasts and are due at 1:00pm. Please do not ask to reopen a quiz because you forgot, you missed the deadline, your computer wasn't working, etc. as they will be made available well in advance of the submission deadline. The lowest two quizzes will be dropped; no other quizzes will be dropped for anything other than a medical or emergency reason (Letter needed).

COVID-related illness:

In the case that you should have an illness and are unable to make it to your recitation or complete work by the scheduled deadline, please email the course email directly to let us know you will be unable to attend/complete the work. If your illness prevents you from taking an exam, the exam will be excused, and the percentage points from the missed exam will be absorbed by the final. All these are only for excused medical emergencies and needs to obtain a temporary accommodation letter.

Academic Dishonesty:

Academic dishonesty of any sort as described on the CU Boulder Honor Code https://www.colorado.edu/osccr/honor-code and repeated below is **grounds for failure of the course**.

Academic Dishonesty: Any act in which a student gains, or attempts to gain, an unfair academic advantage over other students.

These acts may include, but are not limited to:

i. **Plagiarism:** Portrayal of another's work or ideas as one's own

ii. **Cheating:** Using prohibited notes or study aids, allowing another party to do one's work/exam and turning in that work/exam as one's own, copying another student's course work, and collaborating on course work when prohibited

iii. **Fabrication:** Falsification or creation of data, research, or resources, altering a graded work without the prior consent of the course instructor

iv. **Lying:** Deliberate falsification with the intent to deceive in written or verbal form as applied to an academic submission

v. **Bribery:** Providing, offering, or taking rewards in exchange for a grade, or, an assignment, or in the aid of Academic Dishonesty

vi. **Threat:** An attempt to intimidate a student, staff, or faculty member for the purpose of receiving an unearned grade or in an effort to prevent the reporting of an Honor Code violation, or in connection with any other form of Academic Dishonesty

vii. **Unauthorized Access:** Gaining unauthorized access to protected academic information including, but not limited to: the Integrated Student Information System (ISIS); a faculty member's computer, files, and/or office; or secure information on an online server

viii. **Clicker Fraud:** Using, or having someone else use, clicker technology fraudulently in an effort to receive academic credit.

ix. **Resubmission:** Submitting the same or similar work in more than one course without permission from all course instructors involved

x. **Aiding Academic Dishonesty:** Intentionally facilitating any act which may help a student to gain an unfair academic advantage including, but not limited to, any of the aforementioned acts.

-And-

All matters not explicitly covered in this syllabus or by college-wide policy are left to the discretion of the instructor.

-And-

This syllabus ad assignment schedule is subject to change or modification with notice. Students will receive notice of any syllabus change either via LMS Announcement or college email or during the class lecture.

-And-

All assignment submissions are as-is and final and I grade what I see. If I go to open your assignment/exam and it shows as being a "corrupt file", it is an incorrect file, submitted in the wrong format, or it shows as a blank screen that is basically sending me nothing, and it earns a '0' as a grade. It is student's responsibility to re-check (Before the due-date deadline) that any file or attachment they have uploaded for an assignment/exam is readable and correct.

-And-

For course work, the stated due-date is not the “do date” meaning … don’t wait until the day the assignment is due to start doing your work! Students are expected, and for most assignments and quizzes, required to start their course work several days before it is actually due in order to have enough time to follow the writing and submission process and to allow for any unplanned “technical or medical difficulties”. Any issues students run into in the last minute will not be treated as an emergency by me, and students will accept all responsibility for not submitting their work on time.

-And-

Asking questions about assignments/quizzes as a delay tactic to gain more time to complete assignments will not be tolerated. We do not have a hotline for this course. In case a question is wrong, modifications will be done afterwards.

-And-

This syllabus is designed to be as comprehensive as possible. It is not a ironclad contract, but a general guide as to how we will proceed and policies under which we will operate. That said, it is very possible that there are issues that may occur that have not been anticipated or addressed. Therefore, I reserve the right to amend this syllabus if necessity demands or to address any issue or concern not covered on a case-by-case basis.

University Policies

Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on classroom behavior and the Student Conduct & Conflict Resolution policies.

Requirements for COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the Student Code of Conduct. If you

require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus.

CU Boulder currently requires masks in classrooms and laboratories regardless of vaccination status. This requirement is a precaution to supplement CU Boulder's COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). You will not need doctor's note for absence in the classroom. Instead 2 clicker sessions will be dropped for everyone to accommodate these types of incidents.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website. If you miss an exam due to a health-related issue, please reach out to us and provide us with the proof in order to excuse your absence for the exam. There won't be any retakes and instead your final's grade will be counted towards the missing exam during the semester.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu; 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and the support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit Don't Ignore It.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please reach out as soon as possible (at least 2 weeks before the exam/quiz date). We will consider each case differently and will be providing a solution.

See the campus policy regarding religious observances for full details.

CHEN1201 Schedule

01/10/22-Class 1	Course Intro: Matter and Measurement	1.1 - 1.6
01/12/22-Class 2	Measurement and Data, Atomic Structure	1.7 – 1.8, 2.1 - 2.6
01/14/22-Class 3	Atomic Mass, Molar Mass	2.7 – 2.9
01/17/22-No Class	Martin Luther King Holiday	N/A
01/19/22-Class 4	Chemical Bonds, Ionic Compounds	3.1 - 3.5
01/21/22-Class 5	Molecular Compounds, Combustion	3.6 - 3.10
01/24/22-Class 6	Organic Compounds, Balancing Equations	3.11, 4.1 – 4.2
01/26/22-Class 7	Stoichiometric Relationships	4.3 – 4.4
01/28/22-Class 8	Chemical Reactions, Intro to Solutions	4.4 – 4.5, 5.2
01/31/22-Class 9	Solution Chemistry	5.2 – 5.4
02/02/22-Class 10	Solution reactions: ions and net ionic equations	5.5 – 5.8
02/04/22-Class 11	Redox Reactions	5.9
02/07/22-Class 12	Catch up, Review	N/A
02/08/22-EXAM 1	Chapters 1-5	
02/09/22-Class 13	Balancing redox reactions	20.2
02/11/22-Class 14	Ideal Gases	6.1 – 6.4
02/14/22-Class 15	Partial Pressure and Gas Mixtures, Intro KMT	6.5 – 6.7
02/16/22-Class 16	Kinetic Molecular Theory and Real Gases	6.8 – 6.10
02/18/22-Class 17	Energy, work, and heat	7.1 – 7.3
02/21/22-Class 18	Quantifying Heat and Work	7.4
02/23/22-Class 19	Calorimetry and Enthalpy	7.5 – 7.7
02/25/22-Class 20	Hess's Law, Std. Enthalpy of Formation	7.8 – 7.9
02/28/22-Class 21	The nature of light	8.1 – 8.2
03/02/22-Class 22	Bohr Model, de Broglie Wavelength	8.3 – 8.4
03/04/22-Class 23	Quantum Numbers, Atomic Orbitals	8.5 – 8.6
03/07/22-Class 24	Catch up, Review	N/A

03/08/22-EXAM 2	Chapters 6-8	N/A
03/09/22-Class 25	Electron Configurations, Valence Electrons	9.1 – 9.4
03/11/22-Class 26	Electron configurations and periodic trends	9.5, 9.6
03/14/22-Class 27	Periodic Trends	9.7 – 9.9
03/16/22-Class 28	Lewis Model, ionic bonding	10.1 – 10.4
03/18/22-Class 29	Covalent bonding, electronegativity	10.5, 10.6
03/21 to 03/25/22	Spring Break- No Classes	N/A
03/28/22-Class 30	Resonance, formal charge	10.7, 10.8
03/30/22-Class 31	Bond Energies and Bond Lengths	10.9 – 10.11
04/01/22-Class 32	VSEPR Model	11.1 – 11.3
04/04/22-Class 33	Molecular Shape and Polarity	11.4 – 11.6
04/06/22-Class 34	Orbital hybridization (no sp3d or sp3d2)	11.7
04/08/22-Class 35	MO Theory	11.8
04/11/22-Class 36	Catch up, Review	N/A
04/12/22 Exam 3	Chapters 9-11	N/A
04/13/22-Class 37	Phases, Intermolecular Forces	12.1 – 12.3
04/15/22-Class 38	Vaporization and Vapor Pressure	12.4, 12.5
04/18/22-Class 39	Phase Changes and Phase Diagrams	12.6 – 12.9
04/20/22-Class 40	Unit cells and basic structures	13.1, 13.3
04/22/22-Class 41	Solutions	14.1 – 14.3
04/25/22-Class 42	Solutions, cont.	14.4 – 14.6 *
04/27/22-Class 43	Catch Up, Review	N/A
04/29/22-No Class	Reading Day	N/A
Final Exam	Chapter 1-14	

(* Vapor pressure lowering with non-volatile solute only)