

CHEN 4521: Physical Chemistry for Engineers
Spring 2022, TR 11:30AM-12:45PM or 1:00-2:15PM,
Zoom link TBA (see front Canvas page), then JSCBB A115

Instructors: Prof. Andrew Goodwin, JSCBB D318, andrew.goodwin@colorado.edu
Office Hours: Zoom F 1:30-3PM
Prof. Charles Musgrave, JSCBB E1B45, charles.musgrave@colorado.edu
Office Hours: TBA

Teaching Assistants: Hector Sanchez-Moran hector.sanchez-moran@colorado.edu
Recitation: Zoom W 5:30-6:30PM. Office Hours: Zoom W 6:30-7:30PM
Ritu Raj ritu.raj@colorado.edu. OH: TBA
Claire Niemet claire.niemet@colorado.edu. OH: TBA
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→ We will hold extra office hours around exam times.
→ All office hours and recitations will begin Week 2 (1/17+).

Textbook (Required): Peter Atkins, Julio de Paula, and James Keeler. Physical Chemistry. 11th ed. (Note: Physical Chemistry: Thermodynamics, Structure, and Change. Earlier editions OK too!)
First two volumes!

Prerequisites: APPM 2350: Calculus 3 for Engineers
CHEM 1211: General Chemistry for Engineers (grade of C- or better)
→ We recommend that you review the following:

- Materials and Energy Balances: (Chapters 5-8 in Felder: compression factor, energy, enthalpy, work, First Law, partial pressure, vapor pressure, phase transitions, phase diagrams)
- Mathematics: (multivariable calculus, partial derivatives, multiple derivatives, Taylor Series, logarithms, rules of differentiation and integration)
- Physics: (phases, physical properties, mass, energy, electromagnetic waves)
- Chemistry: (atoms, molecules, molecular structure, electrons, orbitals)

Communication: Announcements, homework assignments, quizzes, and other communication will be run through Canvas at canvas.colorado.edu. Please feel free to email your instructor or TA **but be sure to include "CHEN 4521" at the beginning of your subject line** so we can find it! We will also set up a Discord server for discussions, link TBA.

Grading: Class attendance: 10% (3 drops allowed)
Homework: 20% (1 drop allowed)
Midterms: 2 x 15% = 30%
Final exams: 2 x 20% = 40%
→ Note that since exams count for most of your grade, you must be sure that you are learning the material sufficiently! Do not simply rely on your classmates for help!

Class Attendance: Class attendance is mandatory and will be enforced by Zoom polling. Note, if you are an international student in a different time zone please contact Prof. Goodwin ASAP.

Homework: Due every **Friday at 11:59pm**. Homework must be submitted via Gradescope in PDF format as scanned or photographed from a handwritten page. You may work together, but you must submit separate work! Late HW will not be accepted for credit.

Exams: See schedule. You must work separately on the exams, with only allowed resources.

CHEN 4521, Spring 2022: Approximate Class Schedule.

<u>Date</u>	<u>Topic</u>	<u>Reading (Atkins)</u>
1/11	The First Law, Properties of Gases, Heat and Work	Found'ns A and B, Ch. 1A, 2A
1/13	Equations of State and Intermolecular Forces	Ch. 1C, 2A
1/18	First Law and Working with State Functions	Ch. 2A, 2B, 2D
1/20	Process Paths, Adiabatic Processes, Second Law	Ch. 2D-2E, 3A
1/25	Entropy, Second Law, Process Cycles, Efficiency	Ch. 3A-3B, 13A
1/27	Process Cycles, Efficiency, Spontaneity, Free Energy	Ch. 3A-3C
2/1	Spontaneity, Free Energy, Maxwell's Relations*	Ch. 3C-3D
2/3	MIDTERM IN CLASS	
2/8	Maxwell's Relations and Chemical Potential	Ch. 3C, 3D, 4A
2/11	Phase Diagrams and Phase Transitions	Ch. 4A-4B
2/15	Thermodynamics of Mixtures	Ch. 5A
2/17	Ideal and Regular Solutions, Activity Coefficients	Ch. 5B, 5E
2/22	Binary Systems	Ch. 5C
2/24	REVIEW	
3/1	MID-FINAL IN CLASS	
3/3	The Boltzmann distribution; Quantized energy	Ch. 13A, 7A
3/8	Particle-Wave Duality, the Wavefunction	Ch. 7A-7B
3/10	Schrodinger's Equation, Operators	Ch. 7B-7C
3/15	QM Postulates	Ch. 7C
3/17	Quantized translation and Confinement (1D)	Ch. 7D
3/21-25	<i>SPRING BREAK (NO CLASS)</i>	
3/29	2D and 3D translation	Ch. 7D
3/31	Boltzmann revisited: Translational partition, monatomic gas	Ch. 13A
4/5	MIDTERM IN CLASS	
4/7	Quantized vibration	Ch. 7E
4/12	Quantized rotation	Ch. 7F
4/14	Molecular Partition Functions	Ch. 13A-C
4/19	The Canonical Ensemble	Ch. 13D
4/21	Internal Energy and Entropy	Ch. 13E
4/26	Derived functions (Enthalpy, Free Energy)	Ch. 13F
4/28	REVIEW	
TBA	FINAL EXAM: TBA	

* Time permitting

Class Policies:

This Syllabus rearticulates CU Boulder Required Syllabus Statements online:

<https://www.colorado.edu/academicaffairs/policies-customs-guidelines/required-syllabus-statements>

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

The University of Colorado Boulder (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](#).

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.

Religious Holidays and Observances

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 let an instructor know **as soon as possible** of an upcoming obligation, **minimum one week prior**. See the [campus policy regarding religious observances](#) for full details.

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 Code of Conduct](#).

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).

To alert your professor of an illness-related (including COVID-19) absence, please email your professor as soon as possible with the subject line "CHEN 4521: illness". We will work with you in terms of deadlines and absences.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information does not 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](#).

The following list includes some examples of dishonest acts (not comprehensive!) for which a hearing may result:

1. Talking to each other during an exam time, inside or outside the exam room.
2. Bringing any unallowed information into the exam.
3. Searching for unallowed information during an exam.
4. Alteration, forgery, or falsification of official records (such as modification of graded homework problems or exams for which you are seeking additional credit, including regrades).
5. Allowing another person to take an exam or submit homework for you (false identification).
6. Knowingly providing material of your own or of others to a fellow student.
7. Possession or observation of examinations or solutions to examinations prior to the date and time of the exam.
8. Allowing another person to answer clicker questions for you, or answering clicker questions for someone else.
9. Attempting to bribe, threaten, or otherwise influence an instructor or TA, or having another person attempt to do this for you.

