

CHEN4440 Course Syllabus

Chemical Engineering Materials

<u>Class Meetings:</u>	Mon, Wed & Fri 1:55-2:45 PM	BIOT A108, see Zoom link in Canvas
<u>Office Hours:</u>	Mon 4:00-5 PM Thu 4:00-5 PM	BIOT E225 BIOT B115 See Zoom link for office hours in Canvas
<u>Instructor:</u>	Hendrik Heinz Office: BIOT C126	Phone: 303-735-7517 Email: hendrik.heinz@colorado.edu
<u>Adv. TA:</u>	Evan Flitz	Email: evan.flitz@colorado.edu
<u>TA:</u>	Jie Zeng	Email: jie.zeng@colorado.edu
<u>CA:</u>	John Semenchuk	Email: john.semenchuk@colorado.edu
<u>Text:</u>	Required: William D. Callister, David G. Rethwisch, <i>Fundamentals of Materials Science and Engineering: An Integrated Approach</i> , 5th ed., Wiley & Sons: New York, 2016, or any newer editions (up to 10 th). ISBN : 978-1-119-12548-3 (binder ready version) ISBN : 978-1-119-12764-2 (e-text, same content) You can also use the zyBook version (10 th edition), which is an online digital version with helpful animations and interactive learning tools: https://www.zybooks.com/catalog/materials-science-and-engineering-an-introduction-10th-edition/ Recommended Optional Texts: Michael F. Ashby, David R. H. Jones, <i>Engineering Materials 1: An Introduction to Properties, Applications, and Design</i> , 4th ed., Butterworth-Heinemann/Elsevier: Oxford, 2014. ISBN : 978-0-08-096665-6 Michael F. Ashby, David R. H. Jones, <i>Engineering Materials 2: An Introduction to Microstructures and Processing</i> , 4th ed., Butterworth-Heinemann/Elsevier: Oxford, 2014. ISBN : 978-0-08-096668-7	

Robert J. Young, Peter A. Lovell, *Introduction to Polymers*, 3rd ed., CRC Press: Boca Raton, 2011.

ISBN: 978-0-8493-3929-5

Other Materials: Lecture notes, clickers, course website on Canvas, piazza for blogs & chats

Instructional Videos: <http://www.learncheme.com/screencasts/materials-science>
Screencasts that supplement the materials from the lectures, book, and homework are a valuable addition to the course. Please take full responsibility for exploring and watching the material, and we are happy to assist with specific assignments upon request.

Prerequisites

- A grade of “C-” or better in Chemical Engineering Thermodynamics (CHEN 3320)
- Completion of at least one semester of Organic Chemistry

Course Learning Objectives

The course aims to introduce the structure and versatile function of the major materials classes: metals, ceramics, polymers, and hierarchically structured composite materials. Relationships between the atomic-scale structure and macroscopic properties will be explored and illustrated using examples from our everyday lives. We will learn concepts of materials chemistry, physics, and engineering that are useful to create lighter cars and aerospace vehicles, greener energy technologies, as well as advanced personal devices and computing power. We will apply the knowledge to case studies and a final research-type project. Discussions will explore crystalline materials, such as metals and alloys, lattices in diamond and highly temperature-resistant ceramics, as well as amorphous polymers with gradual transitions between solid-like and fluid-like behavior. The connection between structure and performance of materials will be exemplified by fascinating limits of mechanical properties, electrical conduction versus insulation, and energy conversion in batteries, fuel cells, and solar cells. We will also learn about production techniques and processing, defects and phase diagrams, as well as lessons from nature-inspired materials structures found in animals and marine life. The course also trains on timely delivery of assignments and teamwork, as well as clearly structured solutions to given problems.

Important Dates

Mon, Jan 13	First Day of class
Mon, Jan 20	Labor Day (no class)
Thu, Feb 13	1st Midterm Exam , 6:30-8:30 PM, A108 Accommodations Exam, 5:30 PM to 8:30 PM, TBA
Fri, Feb 14	No class on day after exam
Thu, Mar 20	2nd Midterm Exam , 6:30-8:30 PM, A108 Accommodations Exam, 5:30 PM to 8:30 PM, TBA

Fri, Mar 21	No class on day after midterm exam
Mon-Fri, Mar 24-28	Spring break , no class
Mon, April 28	Last Day of class
Wed, April 30	Submission of Final Project Report Due
Wed, April 30	Oral presentations of Final Project , 5:30-8:30 PM, A115
	No final Exam

HH may have occasional absences from class due to research activities and university service. Absences can be related to conference attendance to report on research results, seminars at other universities, or important meetings with sponsors. Travel and absences will be scheduled so that impacts on the class are minimal.

Course Communication

Canvas will be used to share lecture notes, homework assignments, and other items of interest. No hard copies of homework assignments will be handed out. Please contact the instructor and TA anytime with questions, including office hours, before and after class, and email for individual appointments.

Attendance

Attendance of nearly all in-person lectures is expected, as is asking questions, participating in class discussion, and in in-class workshops. Occasional absences are understandable, but please let Prof. Heinz know as soon as you are aware that you will need to be absent. An attendance score based on clickers and participation will contribute to the final grade.

Assignments and Evaluation

Assignments consist of the following and will make a percentage contribution towards a maximum percentage score of 100%:

Grade item	Contribution to total score	Estimated breakdown
Participation (iClicker/Polls), in-class workshop credit	15%	~37 classes x 7 P = 259 P Drop lowest 2 days
Weekly homework in groups of 3 or 4 students	12%	~12 HWs x 20 P = 240 P Drop lowest score
Peer evaluation of homework team members	3%	25 P, average score by team members
Quizzes in class	15%	7 x 20 P = 140 P, plus one bonus Quiz (5 P) Drop lowest score
1 st Midterm exam	15%	80 P, includes bonus question

2 nd Midterm exam	15%	80 P, includes bonus question
Final project in a team of 3 students	25%	100 Points 40% written report (40 P) 25% peer evaluation (25 P) 25% oral presentation (25 P) 10% interim reports (10 P)
Total	100%	

We will use **Clicker** questions in class and as part of the workshops that will count toward your final grade. All clicker days will be given the same weight, regardless of the number of points. Leaving your clicker at home or running out of batteries are not valid excuses for being unable to participate in clicker activities. The lowest two grades among the clicker sessions will be dismissed for calculation of the final grade.

Weekly Group Homework will be due except in weeks with exams and the final project report (see Schedule). We will form homework groups of 3 or 4, and weekly homework must be submitted electronically to Canvas, which helps with clarity and faster turnaround of grading. Individual homework assignments are planned to be worth 20 points each. Please complete each problem on a separate page (with your names), otherwise they will not be graded. Compliance of the homework with formatting guidelines and clarity for the reader will be part of grading. Every completed group homework should include a statement (on the first page) "All of us worked on all of these problems together and take full responsibility for the work done in the assignment" and everyone should sign it. No names will be added to the group homework once the homework has been turned in and missing group members will receive a zero score for the respective homework assignment. If someone places their name on a group assignment for which they did not contribute to every problem, the person is considered to have plagiarized.

Several **Quizzes** will be administered at the end of classes throughout the semester, approximately every two weeks. The quizzes will last approximately 15 min and count 20 points.

Two Midterm Exams will be given, and a final project instead of a final exam (see next). The timing is approximately after 1 month and after 2 months. **No make-up exams will be given.** If there is an emergency, please contact me before the exam date to be excused if possible. A chat or an email explaining the reason **in advance** is necessary, followed by a doctor's note or other tangible evidence of a conflict, to be excused. If you are excused from a midterm exam, we may substitute with the grade of the other midterm exam. If you miss an exam due to any reason that is not excused, you will receive an F for the course.

The **Final Project** focuses on a specific materials topic of your choice to study and to develop an innovation proposal. The motivation, specific steps, and parts are described in the project guidelines. The grade for the final project will be determined by the **Interim Reports**, the **Final Project Report**, by an **Oral Presentation**, and by **Peer Evaluations** by your team members. The written Interim Progress Reports and the Final Project Report need to be submitted through Canvas for grading and feedback. An Oral Presentation will be given separately to share your findings with the entire class and receive informal feedback. Peer Evaluations are a major part to reward initiative and engagement for the team.

The **Instructor Evaluation** is based on a review of respectful behavior and engagement in class, homework, and project groups. The grade is based on feedback from the instructor, TAs, and CAs.

Please turn in your assignments on time!!

- Assignments are due at the time/date shown on in the Course Schedule and in Canvas.
- Assignments turned in late within 24 hours after the due date/time will be counted for 50% of possible points.
- **No credit** will be given for assignments turned in 24 hours or more past the due date/time.
- There is no penalty for turning in an assignment early!

If you feel a homework assignment, quiz, or exam has been graded incorrectly, please let the instructor or TA know within one week for a re-grade of the entire assignment/exam. A re-grade request may result in your grade being raised or lowered. Re-grading an assignment/exam will only be possible once for a given assignment.

Grading

According to the weight of individual grade items above, a total percentage score will be calculated and converted into a letter grade at the end of the semester as shown below (Table 2).

Table 2. Correlation of total percentage score with letter grade and GPA.

Percentage	Grade	GPA
93-100	A	4.0
90-93	A-	3.7
87-90	B+	3.3
83-87	B	3.0
80-83	B-	2.7
77-80	C+	2.3
73-77	C	2.0
70-73	C-	1.7
60-70	D	0.7 – 1.3
0-60	F	0

The grades may be curved in favor of the average grade of the class. Curving is not expected and has not been necessary in prior editions of this course.

Requirements for Infectious Diseases

Members of the CU Boulder community and all visitors to campus must follow university, department and building health and safety requirements and all public health orders to reduce the risk of spreading infectious disease.

The CU Boulder campus is currently mask-optional. However, if masks would be again required in classrooms, students who fail to adhere to masking 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.

If you feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the further guidance of the [Public Health Office](#). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home.

Please let Prof. Heinz by email if you are ill or quarantining and will need to miss lecture. We can then attempt hybrid classes and look for other suitable accommodations.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to Prof. Heinz 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 or injury, see [Temporary Medical Conditions](#) under the Students tab on the Disability Services website.

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](#). 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 Student Conduct & Conflict Resolution (honor@colorado.edu); 303-492-5550). Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](#).

Specifically, the following actions would be grounds for concern and academic penalty as deemed appropriate by the instructor and in compliance with University Honor Code.

1. Papers submitted by any student, written in part or in whole by someone other than that student; in addition, submitted papers that have already been submitted for a different class earlier (“resubmission”).
2. Vandalism, destruction of property, stealing.
3. Violation of CU guidelines and standards.

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 let me know of any upcoming observances and holidays at least two weeks in advance.

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 [classroom behavior](#) policy, the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and 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 any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options, visit [Don't Ignore It](#).

Mental Health and Wellness Resources

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [Academic Live Care](#). The Academic Live Care site also provides information about additional wellness services on campus that are available to students.

We are here to help you grow as a student and as a person. Feel free to get in touch about academic topics and beyond the classroom.