

ASEN 1022 – Spring 2024

Materials Science for Aerospace Engineers

Instructor:

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Class Web Site: log on to <https://canvas.colorado.edu>

Homework Site: WileyPlus (In Canvas)

Texts: W.D Callister, *Materials Science and Engineering an Introduction*, 10th edition, Wiley. Note that with WileyPlus you will get access to both the homework assignments and the e-book. Purchase through CU bookstore or Wiley website.

Prerequisites: APPM 1350 or MATH 1300. Required co-requisite courses: COEN 1300 or ECEN 1310 or CSCI 1300 or CSCI 1310 or CSCI 1320 or ASEN 1320.

Course Objectives: The primary objective of this course is to introduce the fundamental understanding of the relationship between composition, structure, processing, and properties of materials. The first half of the course is dedicated to fostering an understanding of fundamental concepts or ideas such as the crystal structures associated with metals. The second half of the course is associated with reviewing the major classes of materials, namely: metals, polymers, ceramics and composites. For each material class, students shall be exposed to where these materials are commonly utilized by engineers or how processing can impart the desired performance characteristics.

Lecture: Monday, Wednesday, Friday from 8:00 am to 8:50 am in MATH 100

Course Structure: The major course topics are listed below.

1. General overview of materials science and chemical bonding
2. Atomic arrangements in solid materials (unit cells, crystallographic planes and directions, defects)
3. Diffusion (diffusion mechanisms)
4. Phase diagrams
5. Polymers
6. Ceramics
7. Metals
8. Composites
9. Failure
10. Famous failures and engineering ethics

The first half of the course is associated with fundamental topics in found most undergraduate materials science courses. Topics include bonding, crystal structures associated with metals, defects, diffusion, etc. The second half of the course delves into the four main types of materials utilized by engineers today, such as metallic alloys, polymers, ceramics, and composites. For each type of material, emphasis is placed on:

- Applications & basic properties
- Mechanical properties (e.g., strength, ductility)
- Processing (how the materials are made, or how properties can be improved)

Graded Assessments:

Syllabus Quiz	3%
In-class activities (e.g., group work, clicker quizzes)	10%
Reading quizzes	17%
Homework	17% (WileyPlus)
Projects (2)	53% (26.5% each)
Total:	100%

- Please verify all your scores and grades on Canvas within 1 week after they are posted; requests to change a score need to be made within this period.
- We reserve the right to make minor changes to this distribution of weights based on variations in assignments.

Letter grade scale:

Letter Grade	%
A	94.00 - 100.00
A-	91.00 - 93.99
B+	88.00 - 90.99
B	85.00 - 87.99
B-	82.00 - 84.99
C+	79.00 - 81.99
C	76.00 - 78.99
C-	73.00 - 75.99
D	63.00 - 72.99
F	Below 63

Note that a “C-,” or minimum overall grade of 73%, is needed pass this course. The overall grade (%) in the class is computed via a weighted average.

Overall grade (%)

$$\begin{aligned} &= \text{Project 1 (\%)} * 0.265 + \text{Project 2 (\%)} * 0.265 + \text{Homework Avg (\%)} * 0.17 \\ &+ \text{Reading Quiz Avg (\%)} * 0.17 + \text{In - Class Activities Avg (\%)} * 0.10 \\ &+ \text{Syllabus Quiz (\%)} * 0.03 \end{aligned}$$

Reading quizzes: Students shall be given reading assignments and then complete a brief quiz taken within Canvas. These quizzes usually consist of multiple choice, true/false, or fill-in-the-blank questions. The reading quizzes are ‘forward looking’ meaning that students shall read the relevant sections in the textbook *prior* to the associated lecture. The purpose of these quizzes is to help students prepare for the lecture by giving a soft introduction to the topics at hand. The reading quizzes shall be made available on Wednesdays at 9:00 am, and they are due the following Sunday, at 11:59 pm. These assessments are open book and notes. The lowest reading quiz score shall be dropped.

In-class activities: Students will frequently work in groups and solve problems in a collaborative setting. These activities are **unannounced** and, as the name suggests, **one must be in the class**, actively participating, to receive credit. The two lowest in-class activity scores shall be dropped. There are **no makeups** for these activities. If you are not feeling well and/or cannot attend class for whatever the reason (e.g., bad traffic) and miss an activity, there is no need to contact the instructor since the lowest two scores are dropped. We understand that ‘life happens’ and we hope this policy provides some flexibility to all students. If you are going to miss school for extended period of time, due to an official academic function (e.g., technical conference), please contact the instructor at least 1 week prior to the trip via email.

Homework: The homework assignments shall be completed via WileyPlus (no paper submissions). Students shall have an unlimited number of attempts for the problems, but if the correct solution is not obtained after the 3rd or 4th try, it is advisable to attend office hours. Homework is typically due on Wednesdays at 11:59 pm. The lowest homework score shall be dropped.

Projects: Two group projects are associated with this course. Projects enable students to connect what was learned in the class to real-world applications. Most engineering problems require a team effort. Thus, students shall be placed into small groups of 3-4 students and work together on the projects listed below. Note that the projects are tentative and may change.

- Project 1 – materials selection for a CAT Bulldozer
- Project 2 – failure analysis and applications of fracture mechanics

Honor Code Policy: Students are expected to adhere to the University Honor Code (see section titled “Honor Code” in subsequent pages). If any student is caught utilizing or accessing unauthorized resources or assistance (e.g., online solution manuals, or websites such as Chegg, copying work from another team’s project, providing your teams’ work to another team, etc.) the consequences shall be grave, such as being given an “**F**” in the course. **Do not gamble with your future.** If you are confused, struggling, or need help, please come talk to the instructional team.

Office Hours: Students can ask questions about concepts, example problems given in the lecture videos, and homework assignments during office hours. The office hour schedule will be released on Canvas the second week of class at the latest.

Evaluated Outcomes: The Department of Aerospace Engineering Sciences has adopted a policy of assigning grades according to evaluated outcomes (Ox) in each course. Each assignment designed and graded to assess some combination of several or a few of the following outcomes:

- O1** Professional context and expectations (ethics, economics, etc.)
- O2** Historical perspective and vision
- O3** Multidisciplinary, system perspective
- O4** Written, oral, graphical communication ability
- O5** Knowledge of key scientific/engineering concepts
- O6** Ability to define and conduct experiments, use instrumentation
- O7** Ability to learn independently, find information
- O8** Ability to work in teams
- O9** Ability to design systems
- O10** Ability to formulate and solve problems
- O11** Ability to use and program computers

Important Notes:

- Come to office hours! We would be delighted to work with you in person when you are struggling with homework or have questions about the lecture material.
- If you are having a family, medical, or personal emergency, or are struggling in the course, please reach out to us via email. Note that emails will be responded to during business hours, i.e., Monday through Friday, 9:00 am – 5:00 pm.
- We will give sufficient advance notice through announcements in class and postings on Canvas if any change is made to the course schedule (e.g., school closing due to inclement weather) or syllabus.
- Canvas will be used to send out announcements, provide comments or clarification on class activities, and to provide general information about course assignments.

- Homework:
 - Homework assignments enable you to PRACTICE the important applications of current material. Remember, you cannot learn to juggle by watching someone juggle, you must attempt it yourself. The same is true with engineering, homework enforces the mental processes that help you to become proficient in a subject. Before beginning any homework assignment, you should read the text and work the examples in the text.
 - Collaboration is permitted on homework. However, we strongly recommend to first work on your own on the homework before comparing your results with your homework team members. You may discuss the means and methods for formulating and solving problems, but you are not free to copy someone's assignment. Copying material from any resource (including solutions manuals) and submitting it as one's own is considered plagiarism and is an Honor Code violation. Remember, the less you think about the problems yourself, the less you learn, and the more difficult it will be to succeed in this course.
 - **No late homework assignments will be accepted.** You will have approximately one week to complete a homework assignment. You will be allowed to drop the lowest homework score at the end of the semester.
 - All homework must be submitted through WileyPlus.
 - Homework solutions will be posted shortly after the submission deadline.
- Grading:
 - Minor adjustments may be made in the determination of final letter grades and with grade cut line.
 - A final course letter grade of "C-" or better is required to fulfill the prerequisite for ASEN 4018.

OFFICIAL UNIVERSITY SYLLABUS STATEMENTS:

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](#).

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. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal. The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are 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, 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). {Faculty: insert your procedure here for students to alert you about absence due to illness or quarantine. Because of FERPA student privacy laws, do not require students to state the nature of their illness when alerting you. Do not require "doctor's notes" for classes missed due to illness; campus health services no longer provide "doctor's notes" or appointment verifications.}

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.

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](#). 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](#).

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 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 contact the instructors if you have a conflict with a quiz or the final exam because of religious obligations.

See the [campus policy regarding religious observances](#) for full details.