

ASEN 5212 – Composite Structures and Materials

Spring 2023

The goal of the class is to introduce students to the concepts and tools necessary to analyze and design composite structures, with an emphasis on fiber reinforced composites. At the end of the class, the students will be able to:

- Describe different types of composite architectures and constituents.
- Select the correct combination of matrix and fibers for a given application.
- Perform basic homogenization analysis to estimate lamina properties.
- Differentiate between fiber- and matrix-dominated behavior.
- Calculate the properties of a laminate based on the different lamina.
- Predict the failure mode of a composite as a function of the loading.
- Assess the effect of environmental factors on different composites.
- Describe and compare different experimental techniques to characterize composites.

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Lecture times and location: Tuesday and Thursday, 8:30am – 9:45am
AERO 232 and Zoom

Office hours times and location: TBD

Zoom link for the semester:

Prerequisites: ASEN 3112 or equivalent required. ASEN 5012 is recommended. Matlab will be used in assignments, and coding proficiency is expected.

Course communication:

- Announcements will be made through Canvas and Slack. Students are required to join both. The instructor will make every possible effort to post all announcements in both platforms; however, in case there is a mishap, students are **strongly recommended to pay attention to both platforms**.
- Grades will be posted to Gradescope and Canvas. However, the final grade in Canvas will not correspond to the real grade, which will be calculated separately.
- Technical questions and discussion must be limited to Slack; in particular, use the public channels, instead of privately messaging the instructor. That helps other students, and fosters discussion.

- Students will also be able to use email to communicate with the instructor. Please, start the subject of each email with “ASEN 5212”. This will make sure that emails can be identified at the end of the course.

TEXTBOOK

No textbook is required. Material for the class will be posted in Canvas. Suggested reading includes:

- *Introduction to Composite Materials Design*, Ever J. Barbero, CRC Press.
- *Engineering Mechanics of Composite Materials*, Isaac M. Daniel and Ori Ishai, Oxford University Press.
- *Mechanics of Composite Materials*, Robert M. Jones, Taylor & Francis.
- *Mechanics of Composite Materials*, Richard M. Christensen, Dover.

GRADING

The final grade will be evaluated based on homework assignments (30%), two midterm exams (20% each) and a final project (30%). All must be written in Word/Latex, or by hand and then scanned, and then submitted to Gradescope.

Plagiarism or any other form of cheating in any of the assignments, exams, or the final project will result in failing the course. As a reminder: using someone else’s code, or not referencing the source of items (images, formulas, etc.) used in homework or project reports, are also forms of plagiarism.

Requests to regrade any item need to be submitted within **two weeks of the date in which the assignment or exam is returned to students**. Regrade requests will be submitted through Gradescope. Note: this procedure can only be used in the case of mistakes during grading, not to argue about the rubric.

HOMEWORK ASSIGNMENTS

Homework assignments must be turned in before the due time, which will be specified in each homework set. No late assignments will be accepted for credit. Six or seven homework assignments are expected through the semester, with due dates approximately every other week.

The assignment with lowest grade will be dropped when evaluating the final grade. In addition, the assignment with the second lowest grade will be substituted by the average of that assignment, and the rest of assignments. Example: If the scores in the homework assignments are 80, 60, 90,

95, 65, 85, then the score of 60 will be dropped, and the score of 65 will instead be substituted by $(65 + (80 + 90 + 95 + 85)/4)/2$.

There will be the opportunity to submit a correction of your assignment for a small bonus in grade. If you submit a document with a self-grading, based on the provided solution and rubric, you will receive a 5% bonus. If you submit a correction (i.e., explaining what you did wrong, why, and what you should have done), you will recover 20% of the grade you lost. There will be specific instructions released with the solution of every assignment. More details will be provided on the first lecture.

EXAMS

The exams will be take-home, and will take place on March 16th and April 27th. The specific material covered on each midterm will be detailed in class and in written announcements.

FINAL PROJECT

The purpose of the project is to allow students to apply the material learned in the course. It can be done in groups of up to three students. It will be graded based on relevance, technical quality, and overall writing and presentation. Details on the project, including topics, timeline, and the possibility of oral presentations, will be provided later. More details will be provided on the first lecture.

COURSE CONTENT

The following list of topics is not comprehensive. The instructor reserves the right to adapt the course content to adapt to the progress of the course and the interest of the students.

- Introduction to composite materials
- Constituents and manufacturing techniques
- Micromechanics of lamina – Stiffness
- Micromechanics of lamina – Strength and failure
- Macromechanics of lamina – Stiffness
- Macromechanics of lamina – Strength and failure
- Mechanics of multidirectional composites
- Environmental conditions
- Experimental methods
- Novel composites

COURSE EXPECTATIONS AND LIFE DURING POST-COVID

This a graduate course, and as such, professionalism, initiative and self-sufficiency are expected from students. Deadlines (for assignments, for regrading requests, to give notice of conflicts) will be enforced, if nothing else to ensure fairness among students. Students are encouraged to attend office hours and receive all the help needed to complete assignments; however, they will be expected to come with specific questions after having already attempted to solve the assignments.

The grading and timing for the assignments, particularly when it relates to dropping those with low scores, is designed to add flexibility and allow students to deal with short term emergencies without affecting their grade. Please, do not ask for an extension for the homework assignments, even if it is short. Be on time or let that the assignment that is dropped.

This is also a course based on previous material (e.g., basics in stress and strain, constitutive laws) that will be reviewed only briefly if at all. Students are expected to review independently if they need to refresh concepts; suggested reading will be provided if needed/requested.

However.

I understand that life happens, particularly after the craziness of the last couple of years, and this will still to the Fall of 2022. If you have an emergency (loss of job, sickness in family, mental health issues, other unforeseen and significant difficulties), please let the instructor know as soon as possible. Even if you are just overwhelmed by your life situation, please let me know as soon as possible. I expect professional, serious, focused students, not robots. But I can only help you if you give me enough warning, and we can take action when it is still possible to do so (not, say, after the solution for an assignment is posted). So, if something happens, let me know, and we will figure something out.

Let's try to have the best semester possible.

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). Please notify the instructor by email if you are to be absent due to illness or quarantine; it is not required to state the nature of the illness.

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, students must let the instructor know of any such conflicts within the first two weeks of the semester so that reasonable arrangements can be worked out. See the [campus policy regarding religious observances](#) for full details.