

Syllabus

This syllabus is subject to change. You will be notified of any changes as far in advance as possible via an announcement on Brightspace. Monitor your Purdue email daily for updates.

Course Information

Course number and title: AAE 59000 Design of Composite Materials and Structures

Meeting days, time and location: MW 10:30 – 11:45 am, HAMP 2117

Instructional modality: HyFlex model

Prerequisites: AAE 352

Credits: 3

Instructor Contact Information

Instructor: Dianyun Zhang, Ph.D.

Office location: ARMS 3233

Office phone number: (765)496-5231

Email: dianyun@purdue.edu

Office hours: TBA

Office hour location: Office/Zoom

TA Contact Information

TBA

Learning Resources, Technology & Texts

Required textbook: No required textbook. Lecture notes will be provided.

Recommended textbook:

- Christos Kassapoglou, Design and Analysis of Composite Structures with Applications to Aerospace Structures, Wiley, 2nd edition, 2013.
- Isaac Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press, 2nd Edition, 2005.
- Michael Hyer, Stress Analysis of Fiber-Reinforced Composite Materials, DEStech Publications, Inc., 2009.
- Kuen Lin, *Composite Materials: Materials, Manufacturing, Analysis, Design and Repair*, CreateSpace independent Publishing Platform, 2nd Edition, 2015.

Brightspace learning management system (LMS): Access the course via Purdue's Brightspace learning management system. Begin with the Start Here tab, which describes how the course Brightspace is organized. It is strongly suggested that you explore and become familiar not only with the site

navigation but with content and resources available for this course. See the Student Services widget on the campus homepage for resources such as Technology Help, Academic Help, Campus Resources, and Protect Purdue.

Course Description

The goal of this course is to equip students with the fundamental principles and knowledge for designing structural parts made from fiber-reinforced composite materials. Students will develop computer codes for predicting composite properties, designing composite parts, and predicting the part performance under specified loading and environmental conditions. The course begins with a brief introduction of composite materials including their constituent properties, applications, advantages and limitations, and manufacturing techniques. The theory of elasticity of anisotropic solids, micromechanics, and the Classical Lamination Plate Theory (CLPT) will be introduced, followed by the discussion of the failure behavior, vibration and buckling, and hygrothermal effects. Design of skin-stiffened and sandwich structures will also be discussed. The course concludes with a discussion on the consideration of manufacturing-induced defects for composites design.

Learning Outcomes

On completing this course, the student shall be able to:

1. Identify the types of composite materials, the constituents, manufacturing techniques, and the applications of these materials.
2. Determine the effective composite properties based on the constituent fiber and matrix properties, microstructure, and stacking sequences.
3. Estimate manufacturing-induced residual stresses and the resulting geometrical distortions.
4. Apply design guidelines for laminated composites and determine how parameters such as ply orientation and stacking sequence affect the laminates stiffnesses and strengths.
5. Apply design guidelines for skin-stiffened and sandwich structures.
6. Perform trade studies to select the appropriate material(s) and manufacturing method for a given application.
7. Develop computer program for designing and analyzing composite structures.

Course Outline

Module 1: Introduction to Composite Materials and Basic Concepts

Module 2: Design of Composite Materials: Microstructure

Module 3: Design of Composite Laminates

Module 4: Design of Skin-Stiffened Structures

Module 5: Design of Sandwich Structures

Module 6: Hygrothermal Effects and Manufacturing-Induced Defects

Module 7: Composite Design Process & Design Guidelines

Assignments and Grading

Your learning will be assessed through a combination of ~11 homework sets, 1 midterm, and 1 final project spread throughout the academic period. Details on these assignments and exams, including a schedule of due dates, rubrics to guide evaluation, and guidelines on discussion participation and evaluation will be posted on the course website.

Course Components	Weight
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Homework	50%
Midterm Exam	25%
Final Project	25%

Homework

Homework will be assigned on a weekly basis and is worth 50% of your overall grade. The lowest homework grade will be dropped at the end of the semester. The assignments must be done in a neat and presentable manner with all calculations and free-body diagrams shown. **All final answers must be boxed** and include the numeric value or expression and the units when applicable. Discussion of homework problems with your classmates is encouraged, however, you must show your own work. Simply copying answers is prohibited and will be considered violating Purdue Honor Pledge and receive no credit. See also **Academic Integrity**.

Midterm Exam

There will be one midterm exam. **All final answers must be boxed** and include the numeric value or expression and the units when applicable. Any in-class notes, textbooks, or other resources are allowed on the exam. However, working together is prohibited. Students must sign an honor code statement verifying that they have not worked together on the exam. The instructor reserves the right to enact punitive measures commensurate with the offense if the work-alone requirement is violated. Reasonable accommodations will be made for students having exceptional circumstances preventing them from taking exams during the scheduled times. However, requests for such accommodation must be made as soon as possible. The instructor reserves the right to use the discretion regarding this, and conflicts will be mediated through the college/university. See also **Academic Integrity**.

Final Project

The final project includes a presentation and written report. Details will be given in the project description posted in Brightspace.

Grading Scale:

A+ \geq 96.67%
 96.67% > A \geq 93.33%
 93.33% > A- \geq 90%

90% > B+ \geq 86.67%
 86.67% > B \geq 83.33%
 83.33% > B- \geq 80%

80% > C+ \geq 76.67%
 76.67% > C \geq 73.33%
 73.33% > C- \geq 70%

70% > D+ \geq 67.67%
 67.67% > D \geq 63.33%
 63.33% > D- \geq 60%

F < 60%

The instructor reserves the right to curve or to not curve the class.

Course Logistics

- All course due dates are identified in Brightspace. Deadlines are based on **Eastern Time**; if you are in a different time zone, please adjust your submittal times accordingly. *The instructor reserves the right to change dates accordingly as the semester progresses. All changes will be communicated in an appropriate manner.*
- All assignments are due by 11:59 p.m. ET on the due date specified in Brightspace.
- Deadlines are an unavoidable part of being a professional and this course is no exception. Course requirements must be completed and posted or submitted on or before the specified due date and delivery time deadline.
- Late Homework Submission:
 - Submission after 1 day (24 hours) past the original due date will receive a 10% grade deduction.
 - Submission after 2 days (48 hours) past the original due date will receive a 20% grade deduction.
 - Submission after 3 days (72 hours) past the original due date will not be accepted and will receive a zero.
- **Late Exam will NOT be accepted.**
- An assignment file should be appended by your username, such as "HW1-kim53.pdf". This will make it easier for me to manage assignment files."

Attendance Policy during COVID-19

Students are expected to attend all classes in-person unless they are ill or otherwise unable to attend class. If they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus, students should stay home and contact the Protect Purdue Health Center (496-INFO).

In the current context of COVID-19, in-person attendance cannot be a factor in the final grades. However, timely completion of alternative assessments can certainly be part of the final grade. Students need to inform the instructor of any conflict that can be anticipated and will affect the timely submission of an assignment or the ability to take an exam.

Classroom engagement is extremely important and associated with your overall success in the course. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester. Student survey data from Fall 2020 emphasized students' views of in-person course opportunities as critical to their learning, engagement with faculty/TAs, and ability to interact with peers.

Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link to the Dean of Students under "Campus Resources".

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must quarantine or isolate at any point in time during the semester, please reach out to me via email so that we can communicate about how you can continue to learn remotely. Work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmg@purdue.edu. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation.

Classroom Guidance Regarding Protect Purdue

The [Protect Purdue Plan](#), which includes the [Protect Purdue Pledge](#), is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask [in classrooms and campus building](#), at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace before and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not properly wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#).”

Related Considerations:

1. A listing of recommended safe practices for the specific class or laboratory setting (other PPE or safety behavior) can be found at the links below.
 - [Overarching SOP for Classrooms, Instructional Laboratories, and Experiential Courses](#)
2. References Supporting Protect Purdue Compliance:
 - Office of the Dean of Students [Protect Purdue Compliance Plan: Ask, Offer, Leave, Report](#)
 - Office of the Dean of Students [Managing Classroom Behavior and Expectations](#)

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect

among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Appendix A - Guidelines for Academic Integrity

In a society that increasingly questions the value of higher education, upholding academic integrity takes on added significance. The time and effort necessary to champion high expectations of academic integrity are well understood, and the University is in full support of faculty and instructors who uphold these standards. Please consider these five steps for your class.

- 1. Define academic dishonesty for your class in your syllabus and emphasize it on the first day of class. The OSRR website offers a [faculty guide on responding to academic dishonesty](#). Revisit your expectations at key junctures of the semester (e.g., before an exam or term project).*
- 2. Provide greater clarity to students about what is acceptable and unacceptable. Some classes routinely use team assignments and encourage collaboration for projects, labs, or homework. Yet at other times of the term, students are expected to work independently. Be very clear about your expectations for each assignment.*

3. *Students should be told prior to – and as part of – the instructions on each test what is acceptable in terms of notes, phones, calculators, etc. From class to class our practices vary widely so, here again, it's important to be very clear in your expectations.*
4. *Define penalties that will be enforced for academic dishonesty. One example might be:*
“Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructor’s discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered.”
5. *At a minimum, if you penalize a student’s grade by deducting points, report the instance of scholastic dishonesty using the [OSRR reporting form](#). Reporting all incidents helps to ensure consistent treatment both at the course level and across the institution. Staff members from OSRR are available to consult on an individual basis. Their office is in B50 of Schleman Hall, and their phone is 765-494-1250.*
6. *While faculty and instructors have raised concerns about student academic integrity, students have indicated that some instructors appear reluctant to uphold academic standards. Be clear in your syllabus on the steps you will take in your class to uphold academic integrity. In addition, students should be made aware that they can report issues of academic integrity that they observe, and may do so anonymously, through the OSRR by calling 765-494-8778 or emailing integrity@purdue.edu.*

Course Evaluation

During the last two weeks of the semester, you will be provided with an opportunity to give feedback on this course and your instructor. Purdue uses an online course evaluation system. You will receive an official email from evaluation administrators with a link to the online evaluation site. You will have up to 10 days to complete this evaluation. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

Netiquette

Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you are not to attack an individual. Our differences, some of which are outlined in the University's nondiscrimination statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience. Please read the Netiquette rules for this course:

- Monitor how much space/time you are taking up in any discussion. Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could lead to misinterpretation.
- Keep an “open-mind” and be willing to express even your minority opinion.
- Think and edit before you push the ‘Send’ button.

Seek and take in feedback from others; learning from other people is an important life skill.

Diversity & Inclusion Statement

We strive for equity, providing equal access and opportunity, and working to maximize student potential. This requires both instructor and students to identify and remove barriers that may prevent someone from full access or full participation. You can help by:

- Contacting me, anonymously if needed, if you see a potential barrier for someone or yourself in participating fully in the class. This might be a physical barrier such as access to technology or a personal situation.
- Suggesting ways in which members of our class can support each other. Virtual study groups and discussion boards are examples, but I encourage you to be creative in your ideas.

Getting to know each other as contributing members of our learning community. Everyone has something to contribute, and while I designed the course to take advantage of the wealth of knowledge, expertise, and experience we bring together, I cannot do it well without your participation. There are many opportunities built into this course for this type of work. It is important we do it together.