

San José State University
Aerospace Engineering Department

AE 250
ADVANCED AEROSPACE STRUCTURES AND MATERIALS
Metal vs. Composite structures
Spring 2018

Course and Contact Information

Instructor:	Cecilia Larrosa Wilson
Office Location:	TBD
Email:	cwilson@structint.com
Office Hours:	TBD and by appointment
Class Days/Time:	Monday and Wednesdays 18:00 – 19:15
Classroom:	ENG 164
Prerequisites:	Introductory courses on solid mechanics, mechanics of materials and aerospace structures (AE114), familiarity with Matlab®

Course Description

This course introduces the analysis and design of structures composed of fiber reinforced composite materials. The major focus is on aeronautical and astronautical applications, but other engineering disciplines may be explored through the course project. Analysis and design of structures composed of isotropic materials, like metals, are part of the aerospace structural analysis curriculum. However, the increasing use of composite materials for aerospace structures requires engineers to be familiar with the analysis of composite structures as well. Hence, the course will first review the stress and failure analysis of metallic structures. The main part of the course will introduce composite materials as well as stress analysis, design and failure of composite structures. Students will gain experience in the analysis of both metallic and composite structures and compare and reflect on the use of these materials for a structural design through the course project.

Learning Outcomes

At the end of this course students will be able to:

- 1) Resolve the pertinent stresses affecting metallic and composite structures.
- 2) Identify when and how structural failure can occur.
- 3) Examine an existing structure, choose and employ the appropriate concepts/methods to answer the following questions:
 - a. Is it going to fail? Or
 - b. What is needed to avoid failure?
 - c. How might the design be improved?
 - d. What are the advantages/disadvantages of using different materials?

Required Texts

Textbook (Required)

L.P. Kollar and G.S. Springer, *Mechanics of Composites Structures*, Cambridge University Press

Other Useful Resources

C.T. Sun, *Mechanics of aircraft structures*, John Wiley and Sons

Megson, *Aircraft Structures for Engineering students*, Elsevier

http://discover.sjlibrary.org/iii/encore_sjsu/record/C_Rb4342559

T.L. Anderson, *Fracture Mechanics: fundamentals and applications*, Third Edition, Taylor and Francis

J.M. Gere and B.J. Goodno, *Mechanics of Materials*, eighth edition, ISBN-13: 978-1111577735

Various handouts to be posted online

<https://www.efatigue.com/efatigue.html>

Course Requirements and Assignments

Lecture and in-class participation

In-class participation is very important since lectures will be interactive and collaborative. Students will be asked to work in teams and report on their findings/ideas to the class. In-class demonstrations, examples and group exercises are meant to develop understanding of concepts and problem solving skills. Additionally, these exercises will involve collaboration with others the same way it is done in industry and research teams.

Homework assignments:

- Assignments are due in class on Mondays, unless specified otherwise. Solutions will be posted after class.
- Students are encouraged to work in collaboration with others as long as you (the student) turn in your own work.
- It is expected that your assignments will present a clean and organized thought process and methodology to solve the problem at hand. Think of it as presenting this to your supervisor at work, who did not necessarily work with you but needs to know all the steps you took in order to approve your design/analysis.

Course project:

The project will be discussed more in detail during lecture and on a separate handout. Each team/student will analyze a system/structure using the different methods presented in the course. The final report will involve a reflection, comparison and recommendations about the use of metal or composites.

It is broken down into 3 parts (due dates in course schedule):

- 1) Stress and failure analysis of metallic structure.
- 2) Stress analysis and failure analysis of composite structure.
- 3) Final Report with comparison and recommendations.

Grading Policy

6 Homework assignments	30%	Due as per schedule
Research assignment	10%	April 25 th , 2018
Midterm 1	10%	March 7 th , 2018
Midterm 2	10%	May 7 th , 2018
Course Project	40% ;	Due as per schedule

AE 250, Spring 2018, Course Schedule

Course Schedule

Week	Date	Content / Topics	Assignments
1	24-Jan	Introduction - materials and structures. Stress and strain	
2	29-Jan	Pressure vessels. Torsion.	
	31-Jan	Bending	
3	5-Feb	In class exercise - Bending	HW#1 Review examples pressure vessels, torsion
	7-Feb	Bending + Torsion	
4	12-Feb	Failure modes, failure criteria, Buckling	
	14-Feb	Design considerations : Safety Factors and reliability. Introduce project.	
5	19-Feb	Fracture mechanisms, Linear Elastic Fracture Mechanics	HW #2 due: Bending + Torsion, and Failure
	21-Feb	Fatigue mechanisms and design strategies	
6	26-Feb	Fatigue mechanisms and design strategies	
	28-Feb	Intro to FEA, Project discussion	
7	5-Mar	Intro to Failure Analysis	HW #3 due Fracture and fatigue
	7-Mar	Midterm 1	
8	12-Mar	Composites: Intro and manufacturing	Project Part I: Stress Analysis & Failure of isotropic structure
	14-Mar	Composites - Lamina: Stress and strain, testing to get properties, strength.	
9	19-Mar	Composites - Laminates: Lamination Theory, Hydrothermal stresses	HW#4 due: ply properties and off-axis transformations
	21-Mar	Composites – Laminates – general – failure criteria	
10	26-Mar	Spring Recess. No class.	
	28-Mar		
11	2-Apr	Composites: beams and bending general	HW#5 due: Lamination theory code
	4-Apr	Composites: torsion	
12	9-Apr	Composites: thin wall open section bending	
	11-Apr	Composites: bending + torsion	
13	16-Apr	Composites open example	HW #6 due: Composite Beam analysis
	18-Apr	Composites square tube example	
14	23-Apr	Composites: Progressive failure, damage tolerance. Intro to FEA	
	25-Apr	Composites: Fracture and fatigue. Research Presentations.	Research summary write-up and presentation.
15	30-Apr	Composites Failure Analysis	Project Part 2: Stress Analysis and Failure of composite structure.
	2-May	Composites Review. Project Discussion	
16	7-May	Midterm 2	
	9-May	Project Discussion	
May 18th		Final Project Report Due: Revisions and Discussion; Comparisons and Recommendations.	

University Policies

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's [Catalog Policies](http://info.sjsu.edu/static/catalog/policies.html) section at <http://info.sjsu.edu/static/catalog/policies.html>. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](http://www.sjsu.edu/provost/services/academic_calendars/) at http://www.sjsu.edu/provost/services/academic_calendars/. The [Late Drop Policy](http://www.sjsu.edu/aars/policies/latedrops/policy/) is available at <http://www.sjsu.edu/aars/policies/latedrops/policy/>. Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the [Advising Hub](http://www.sjsu.edu/advising/) at <http://www.sjsu.edu/advising/>.

Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](http://www.sjsu.edu/senate/docs/S12-7.pdf), <http://www.sjsu.edu/senate/docs/S12-7.pdf>, requires students to obtain instructor's permission to record the course:

- “Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material.”
 - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class by class basis.
 - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- “Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent.”

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) at <http://www.sjsu.edu/senate/docs/S07-2.pdf> requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The [Student Conduct and Ethical Development website](http://www.sjsu.edu/studentconduct/) is available at <http://www.sjsu.edu/studentconduct/>.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. [Presidential Directive 97-03](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the [Accessible Education Center](http://www.sjsu.edu/aec) (AEC) at <http://www.sjsu.edu/aec> to establish a record of their disability.

Accommodation to Students' Religious Holidays

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See [University Policy S14-7](http://www.sjsu.edu/senate/docs/S14-7.pdf) at <http://www.sjsu.edu/senate/docs/S14-7.pdf>.

Student Technology Resources

Computer labs for student use are available in the [Academic Success Center](http://www.sjsu.edu/at/asc/) at <http://www.sjsu.edu/at/asc/> located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras; video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit [Peer Connections website](http://peerconnections.sjsu.edu) at <http://peerconnections.sjsu.edu> for more information.

SJSU Writing Center

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the [Writing Center website](http://www.sjsu.edu/writingcenter) at <http://www.sjsu.edu/writingcenter>. For additional resources and updated information, follow the Writing Center

on Twitter and become a fan of the SJSU Writing Center on Facebook. (Note: You need to have a QR Reader to



scan this code.)

SJSU Counseling Services

The SJSU Counseling Services is located on the corner of 7th Street and San Fernando Street, in Room 201, Administration Building. Professional psychologists, social workers, and counselors are available to provide consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit [Counseling Services website](http://www.sjsu.edu/counseling) at <http://www.sjsu.edu/counseling>.