

San José State University
Aerospace Engineering
AE 250 – Advanced Aerospace Structures and Materials – Spring 2019

Instructor	Dr. Maria Chierichetti
Office Location	
Email	Maria.chierichetti@sjsu.com
Office Hours	T 4:30 – 5:45 pm in Eng. 272-G
Class Days/Time	T-TR 6:00 – 7:15 pm
Final Project Presentations	No - final exam
Classroom	SH 100
Prerequisites	Graduate standing in AE or instructor consent
Credit	3 units

GWAR

Course Description

Design and analysis of modern flight structures including static and dynamic structural response; materials design including metals, alloys, composites. Introduction to modern computational methods including finite elements.

Course Goals

1. To provide graduate level experience in aerospace structures.
2. To develop students' engineering judgment in the design of aerospace structures.
3. To develop students' ability to estimate when an aerospace structure will fail.

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Resolve the pertinent stresses affecting metallic and composite structures.
2. Define and solve a simplified and idealized model of an aeronautical structure
3. Identify when and how failure can occur.
4. Discuss how to set-up a finite element model of a simplified structure.
5. Derive Euler-Bernoulli beam theory
6. Set-up a simple model for an elongated structure in order to compute stresses due to bending
7. Draw the distribution of bending moment and shear force in a wing
8. Compute the area moment of inertia of a general cross-section
9. Find the neutral axis for a general cross-section

10. Compute the deformed shape of a beam-like structure
11. Compute the axial stresses of a beam like structure
12. Compute the shear stresses in a thin-walled beam-like structure due to bending
13. Evaluate the location of maximum stresses in a beam-like structure
14. Compute the shear stresses over the cross-section of a slender structure due to pure torsion
15. Compute the torsion constant of a thin-walled cross-section
16. Describe what warping is
17. Recommend a cross-sectional design for optimal torsional behavior
18. Compute the shear center for open and closed sections
19. Compute the shear stress distribution due to combined bending and torsion
20. Explain the basic principles of finite element analysis
21. Discuss how to discretize a structure
22. Describe the characteristics of the main basic elements
23. Calculate the stiffness matrix for axial one-dimensional elements (springs & bars)
24. Explain the concept of shape functions
25. Implement a FE model in Matlab for a simple truss structure and obtain a static deformation due to a concentrated load
26. Evaluate the maximum applied load that a structure made of brittle material can carry
27. Evaluate the maximum applied load that a structure made of ductile material can carry
28. Determine the correct model to evaluate structural failure for different types of materials
29. Understand the differences between different strength criteria
30. Understand the differences between different yield criteria
31. Describe the state of stress when cracks form
32. Describe the process of propagation of cracks and its relation to applied loads
33. Compute the energy released during crack extension
34. Describe fatigue failure
35. Define fatigue life
36. Use the S-N curve to estimate fatigue life of variable amplitude loading using the Palmgren-Miner rule
37. Describe what composites are and their advantages
38. Describe manufacturing processes such as open mold/wet processes, pre-pregs/vacuum process as well as filament winding, with their advantages/disadvantages
39. Obtain the material properties of a lamina given matrix and fibers properties
40. Describe how a change in material properties of fibers/matrix changes the material properties of the lamina
41. Obtain the stress-strain relationship for a lamina of non isotropic material
42. Obtain the stress-strain relationship for a lamina of non isotropic materials rotated from the main axis
43. Describe the stacking sequence of a laminate
44. Obtain the stiffness matrices for a laminate composed of several plies
45. Set-up a simple model for static aeroelastic analysis
46. Describe the concept of aeroelastic tailoring

Recommended Text

L.P. Kollar and G.S. Springer, Mechanics of Composites Structures, Cambridge University Press, 2003 (ebook available through SJSU library).

Additional Resources

- C.T. Sun, Mechanics of aircraft structures, John Wiley and Sons, 2nd edition, 2006.

- T.H.G. Megson, Aircraft Structures for Engineering Students, Elsevier, 4th edition, 2007 (ebook available through SJSU library).
- T.L. Anderson, Fracture Mechanics: fundamentals and applications, 3rd edition, Taylor and Francis.
- Additional resources posted in Canvas
- http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_I/index.html

Course Requirements and Assignments

Lecture and in-class participation

In-class participation is very important since lectures will be interactive and collaborative. In-class demonstrations, examples and group activities are meant to develop understanding of concepts and problem solving skills. Students are asked to have access to Matlab during classes.

Homework assignments

Assignments are due in class on Thursdays, unless specified otherwise. Students are allowed to work in collaboration for the solution of an assignment as long as each student turns in their own work. It is expected that your assignments will present a clean and organized thought process and methodology to solve the problem at hand.

NB: Homeworks are due at the BEGINNING of class. If you're late, your hw is late

Grading Policies

Homework assignments	50%	Due on Thursdays at the beginning of class (otherwise it is considered late)
Midterm 1	15%	Tentative: March 7 th , 2019
Midterm 2	15%	Tentative: April 18 th , 2019
Final exam	20%	May 21 st , 2019 (comprehensive)

This course is *letter-graded* as follows:

85% < A-, A, A+; 70% < B-, B, B+; 65% < C; 60% < D; 59% or less: F

The instructor reserves the right to modify the letter-percentage relation at her discretion.

Additional class policies

- In case of issues with grading, students need to discuss with the instructor no more than a week after the assignment is handed back to the class. After a week, no re-grading will be provided.

Topics

I have defined the following topics to be covered

- Review of elasticity
- Modeling of beam structures for isotropic and composite materials
- Failure and fracture analysis for isotropic and composite materials
- Introduction to Finite Elements
- Introduction to aeroelasticity

Tentative Course Schedule

The schedule is subject to change with fair notice on CANVAS.

Week	Date	Topics covered	Assignments
1	22-Jan	No class	
	24-Jan	Introduction - review of elasticity	
2	29-Jan	Review of elasticity	
	31-Jan		
3	5-Feb	Review of elasticity	
	7-Feb		HW#1 due on 02/07
4	12-Feb	Thin-walled beams in bending	
	14-Feb		
5	19-Feb	Thin-walled beams in shear	
	21-Feb		HW#2 due on 02/21
6	26-Feb	Thin-walled beams in torsion	
	28-Feb		
7	5-Mar	Review for midterm	
	7-Mar	MIDTERM # 1	HW#3 due on 03/07
8	12-Mar	Intro to the finite element method	
	14-Mar		
9	19-Mar	Fracture and fatigue of metallic structures	
	21-Mar		HW#4 due on 03/21
10	26-Mar	Composites & lamination theory	
	28-Mar		
11	2-Apr	SPRING BREAK	
	4-Apr		
12	9-Apr	Composites & lamination theory	
	11-Apr		HW#5 due on 04/11
13	16-Apr	Composites & lamination theory	
	18-Apr	MIDTERM # 2	
14	23-Apr	Introduction to aeroelasticity	
	25-Apr		HW#6 due on 05/02
15	30-Apr	Introduction to aeroelasticity	
	2-May		
16	7-May	Introduction to aeroelasticity	
	9-May		HW#7 due on 05/09
17	14-May	NO CLASS	
	16-May		
FINAL EXAM	21-May	5:15pm - 7:30pm	comprehensive

UNIVERSITY POLICIES

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at <http://www.sjsu.edu/gup/syllabusinfo/>

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Add/drop deadlines can be found on the current academic year calendars document on the [Academic Calendars webpage](#). Students should be aware of the current deadlines and penalties for dropping classes ([Late Drop Information](#)). Information about the latest changes and news is available at the [Advising Hub](#).

Accommodation to Students' Religious Holidays

[University Policy S14-7](#) states that 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.

Consent for Recording of Class and Public Sharing of Instructor Material

[University Policy S12-7](#), requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- “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 F15-7](#) 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. Visit the [Student Conduct and Ethical Development](#) website for more information.

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](#) requires that students with disabilities requesting accommodations must register with the [Accessible Education Center \(AEC\)](#) to establish a record of their disability.

SJSU Writing Center

The San José State University Writing Center offers a variety of resources to help students become better writers, and all of our services are free for SJSU students. Our mission is to enhance the writing skills of SJSU students so they can communicate clearly in any setting (informal, academic, or professional). We accomplish this goal through creating original writing resources, offering workshops, and conducting one-on-one and small-group tutoring sessions.

The SJSU Writing Center has two locations: We conduct drop-in tutoring sessions in Clark Hall, Suite 126; we conduct scheduled appointments on the second floor of the MLK Library. All our writing tutors 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 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](#) at <http://www.sjsu.edu/writingcenter>.

SJSU Counseling and Psychological Services

The SJSU Counseling and Psychological Services is located on the corner of 7th Street and San Carlos in the new Student Wellness Center, Room 300B. Professional psychologists, social workers, and counselors are available to provide confidential 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 and Psychological Services website](#) at <http://www.sjsu.edu/counseling>

AEROSPACE ENGINEERING POLICIES

AE Department Policies and SJSU policies are posted at <http://www.sjsu.edu/ae/programs/policies/>

Attendance

Attendance will not be taken during class but **will be taken during lab**. If you miss a class you are still responsible for any material discussed or assignments given. A large portion of each class will be used for problem solving in small groups. All students are expected to participate in class discussions and problem solving. Students who are often absent will find themselves at a disadvantage during the tests. **If you miss a lab session, you will get zero score on this lab.**

Electronic Devices

Cell phone use is prohibited during class/lab. Turn off or silence your cell phones, and music/media players while in class / lab. Do not answer your phone and do not text during class / lab. If you violate these policies you will be asked to leave the class / lab with subsequent loss of points. Furthermore, repeated violations and disruption of the class will be referred to the SJSU's Judicial Affairs Officer.

Intellectual Property Rights

The intellectual property rights for any student work performed in any AE course under supervision of an AE faculty member and/or collaboration of outside agencies or companies belong to and are commonly owned by all participating parties (e.g. supervising faculty member(s), student(s), outside agency/company, etc.). It follows that any publications or patents resulting from such collaborative efforts must bear the names of all contributors, including the supervising faculty.

Teamwork

- You are required to work in teams for a number of assignments. Please make yourself available to meet and work with your teammates outside of class.
- Instructor will normally form all the teams.
- At the end of each project or team assignment, each team must submit along with their report each member's peer evaluation of the other members in a separate, sealed envelope. All peer evaluation forms must be included in the team report. If you disagree with the scores you receive from your peers, you may provide an explanation to your instructor in writing and request an individual exam on the assignment. To get full credit on a team assignment, your teammates must give you at least 85% in all areas of peer review. Otherwise, your score for this assignment will be your team's score multiplied by the average peer review score.
- If your name appears on a team paper, you are expected to be able to explain whatever answer / solution / derivation is on the paper. Failure to explain the team's answer by any individual is considered a violation of academic integrity (see University Policies below) and will result in a grade of zero for the team.

For issues related to Canvas, please contact the eCampus Help Desk.

Phone: (408) 924-2337

Submit a help ticket using the following URL: <https://isupport.sjsu.edu/ecampus/ContentPages/Incident.aspx>.

While logged into Canvas, click on the word **Help** on the upper right corner of the screen.
