San José State University
Department of Aerospace Engineering
AE112, Aerospace Structures I, 50835, Fall, 2022

Course and Contact Information

Instructor:	Joseph Rodriguez
Office Location:	Online via Zoom or Discord
Telephone:	408-209-6130
Email:	Joseph.Rodriguez@sjsu.edu
Office Hours:	TBD
Class Days/Time:	Tuesday & Thursday 6:00pm – 7:40pm
Classroom:	Zoom – Link via Canvas – Be sure to log in with your @sjsu.edu email
Prerequisites:	Grade of "C" or better in Physics 50 and Math 32

Course Description

Aircraft loads, V-n diagram; spacecraft boost loads. Free-body diagrams, 2-D and 3-D force and moment equilibrium. Centroid and area moment of inertia. Shear force and bending moment diagrams; cantilevered wings & internal support structures; stress/strain relationships; Mohr's Circle. Experimental strain measurement.

Course Format

Technology Intensive, Hybrid, and Online Courses

This course adopts an online classroom delivery format. We will meet twice a week via Zoom so an internet connected device (laptop, tablet, smartphone) is required for live lectures.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website. You are responsible for regularly checking with the messaging system through MySJSU on Spartan App Portal (or other communication system as indicated by the instructor) to learn of any updates. For help with using Canvas see Canvas Student Resources page.

Course Goals

1. To review vector algebra and develop the skills of creating a free-body diagram and performing a static equilibrium analysis.
2. To show the application of air loads, inertia loads, mass properties and materials to aircraft structural analysis and design.
3. To provide a fundamental knowledge of the principles of strength of materials.
4. To analyze aircraft and spacecraft structural members in tension, compression and torsion.
5. To calculate centroids and area (section) moments of inertia.
6. To become familiar with experimental strain measurement and its reconciliation with theoretical
7. stress prediction.

Course Learning Outcomes (CLO)

1. Estimate forces and moments applied over an aircraft's flight envelope.
2. Create free-body diagrams of aircraft internal and external structure; solve with vector algebra.

3. Solve for forces and moments applied to typical internal aircraft members.
4. Construct shear force and bending moment diagrams for a cantilevered wing under constant and triangular distributed loads.
5. Learn the principles of strain gage technology, application and use.
6. Compute area properties of two-dimensional wing and fuselage cross sections: centroid and moments/products of inertia.
7. Calculate shear stress and angle of twist along a shaft-type structure in torsion.
8. Draw Mohr's Circle and solve for the maximum principal stresses.
9. Work effectively in teams to design, carry out and analyze results from the Lab Problems.

Required Texts/Readings

Textbook

Beer and Johnston, Statics and mechanics of materials, 3rd edition, ISBN 9781264026562

Other Readings

- Bruhn: Analysis & Design of Flight Vehicle Structures
- Hibbeler: Mechanics of Materials
- Megson: Aircraft Structures for Engineering Students
- Mitiguy: Statics & Introduction to Solid Mechanics
- Niu: Airframe Structural Design: Practical Design Information and Data on Aircraft Structures
- Peery: Aircraft Structures

Other technology requirements / equipment / material

A computer able to remote into a SJSU virtual desktop machine for ANSYS projects.

Course Requirements and Assignments

The assignments for this course consist of analytical, hardware lab problems, and software-based analysis.

"Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus."

Final Examination or Evaluation

The final examination for this course will be a group ANSYS project.

Grading Information

Grades will be determined using a specification grading pedagogy. Each assignment will be evaluated according to a pre-defined rubric, and will receive either a "Meets Expectations" or "Revisions Needed" grade. The final grade in the class will be determined based on the number of assignments that have been evaluated as "Meets Expectations". Students will be allowed to retake some of the assignments. The final class grade will be derived from homework problems, quizzes, lab reports, and a final exam, according to the grade bundles defined in the following sections.

Quizzes: 10 quizzes will be assigned to the students, that will take about 15 minutes to complete. Quizzes will be assigned every Thursday at the beginning of class (6:10pm – synchronously). Each quiz will focus on one of the topics in the table below, which are aligned with the Course Learning Outcomes. Students will be able to progress to a subsequent quiz only after having passed all the previous quizzes (i.e. students can take Q3 only after passing Q1 and Q2). Students will need to pass all quizzes related to the "Essential Topics" (Q1-Q7) to pass the class. Each quiz will be evaluated according to a pre-defined rubric provided to the students, and will receive either a "Meets Expectations" or "Revisions Needed" grade. Additional practice material may be assigned before students are able to retake a quiz.

Grade	*F*	*D*	*C*	*B*	*A*	*A+*
Quizzes Completed	<6	6	7	8	9	10

Once the grade has been determined based upon the number of quizzes completed the below "grade modifiers" will be applied.

Grade Modifiers	*- (minus)*	*No Change*	*+ (plus)*
Final Project	Major Revisions Needed	Minor Revisions Needed	No Revisions Needed
Homework	<8	10	12
Lab Reports	1 Complete Report	2 Complete Reports	3 Complete Reports

Classroom Protocol

This course will be fully online and a certain amount of feedback during live lecture is expected. Spartans will be asked to carry out calculations for everyone and consensus will be called for often.

Cameras are not required to be online except for examination times. Please be sure to be in a comfortable location during examination times.

University Policies

Per University Policy S16-9 ,relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (https://www.sjsu.edu/curriculum/courses/syllabus-info.php). Make sure to visit this page to review and be aware of these university policies and resources.

Additional Information

All reports are required to be completed in the AIAA format.

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Course Schedule

Any changes to the course schedule will be communicated via Canvas announcements

Lesson	Date	Topics, Readings, Assignments
1	8.23	Introduction, units, vector algebra (ch. 1, 2.1:2.3)
2	8.25	Equilibrium of forces in space (2.4-2.5)
3	8.30	Forces & moments / couples, equivalent loads (3.1:3.4)
4	9.1	Equilibrium of rigid bodies (4.1:4.3)
5	9.6	Free body diagrams – Lab introductions – ANSYS introduction
6	9.8	Equilibrium of rigid bodies
7	9.13	Distributes forces (5.3) – V-n diagram
8	9.15	Concentrated loads & Free body diagrams
9	9.20	Centroids (5.1-5.2-5.4-7.1-7.2)
10	9.22	Analysis of frames & machines (6.3-6.4)
11	9.27	Analysis of trusses (6.1-6.2)
12	9.29	Normal stress & strain (8.1:8.4)
13	10.4	Indeterminate structures (9.2) Poisson's ratio & Hooke's law (9.4-9.5)
14	10.6	Shear stress & strain (9.6)
15	10.11	ANSYS software walkthrough
16	10.13	Axial loading (9.7-9.8)
17	10.18	Torsion (10.1-10.2)
18	10.20	Beam: shear force and bending moment diagrams (12.1)
19	10.25	Beam: relation between bending and shear (12.2-12.3)
20	10.27	ANSYS Final project introduction
21	11.1	Stresses in beams (13.2-13.3)
22	11.3	Stresses in beams (13.1)
23	11.8	ANSYS Final project open lecture
24	11.10	Design approaches for aerospace structures
25	11.15	Principal stresses (14.1)

Lesson	Date	Topics, Readings, Assignments
26	11.17	ANSYS Final project culmination goals
27	11.22	Mohr's circle (14.2)
28	11.24	Thanksgiving holiday – Campus closed
29	11.29	Plane strains
30	12.1	ANSYS Final project wrap up
31	12.6	ANSYS Final project presentations
Final Exam		Tuesday, December 13th at 5:15pm – 7:30pm ANSYS Final project presentations (cont.)