SJSU SAN JOSÉ STATE UNIVERSITY

Charles W Davidson College of Engineering · Aerospace Engineering

Aerospace Structures and Materials II Section 01

AE 114

Spring 2024 3 Unit(s) 01/24/2024 to 05/13/2024 Modified 01/25/2024

Contact Information

Instructor: Dr. Maria Chierichetti

Email: maria.chierichetti@sjsu.edu
Office: ENG272C
Phone: (408)-924-4329
Website: https://www.sjsu.edu/ae/faculty_staff/full-time/maria_chierichetti/index.php (https://www.sjsu.edu/ae/faculty_staff/full-time/maria_chierichetti/index.php)

Office Hours

Monday 12-2pm; Wednesday 12-1pm
ENG272C - my office

Course Description and Requisites

Aircraft, missile, spacecraft structural design and analysis. Static, elastic and stress analysis of structures. Structural materials. Deflection analysis of structural systems. Conventional, stiffened, sandwich and composite structures. Structural dynamics. Thermal effects.

Prerequisite(s): "C" or better in AE 112 or graduate standing.

Letter Graded

Classroom Protocols

AE 114 adopts a flipped classroom approach, and as such Internet connectivity and access to a laptop during class will often be required during classroom activities.

Course Goals

1. To demonstrate the iterative design/analysis process of aerospace structures.
2. To provide a review of strength of materials.
3. To delineate the trade-offs present in structural design of aerospace vehicles.
4. To examine actual aircraft design successes and failures via case studies.
5. To show the application of air loads, mass properties and materials in the consideration of aircraft structural design.

Course Learning Outcomes (CLOs)

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

1. Compute area properties of two-dimensional wing and fuselage cross sections: centroid and moments/products of inertia.
2. Find the orientation of the centroidal principal axes and calculate the centroidal principal moments of inertia.
3. Construct the axial force, shear force and bending moment diagrams for aircraft beam structures.
4. Perform a buckling analysis for beam-column-type wing and fuselage structures.
5. Determine the shear flow distribution for an open section under torsion.
6. Determine the shear flow distribution for a (closed) multiple-cell wing section under torsion.
7. For a wing section subjected to multiple bending moments, find the bending stress in the wing stringers.
8. Plot the shear flow distribution and find the location of the shear center for an (open) thin-walled wing cross section under a shear load.
9. Determine the shear flow distribution and shear center location for a (closed) thin-walled section with stringers.
10. Iterate to a successful aircraft stringer-skin-type wing design using actual material properties – beginning with a baseline configuration.
11. Design and carry out experiments to define material or geometric properties of the cantilever beam, torsional beam and Beechcraft tail section.
12. Describe common fiber-reinforced materials for aerospace applications, and compare their anisotropic behavior to the typical behavior of metals used in aerospace
13. Discuss failure and fracture of aerospace materials, specifically of metals
14. Reconcile experimental measurements with analytical and numerical calculations of a beam under combined bending and torsional loads

Course Materials

Analysis and Design of Aircraft Structures

Author: E.F. Bruhn
Availability: ebook available online as fairly old

Composite Materials for Aircraft Structures

Author: A.A. Baker & M. L. Scott
Publisher: AIAA Education Series
Edition: 3
ISBN: 978-1-62410-326-1
Optional
Availability: 2nd edition available as ebook through SJSU library

Other readings

- Callister and Rethwisch, Materials Science and Engineering: An Introduction, Wiley
- Beer and Johnston, Statics and mechanics of materials, ISBN 9781264026562 (AE112 textbook)
- Niu: Airframe Structural Design: Practical Design Information and Data on Aircraft Structures
- Megson: Aircraft Structures for Engineering Students
- Yang: Finite Element Structural Analysis
- Hibbeler: Mechanics of Materials
- Meirovitch: Fundamentals of Vibrations

Course Requirements and Assignments

Grades are derived from homework problems, two midterms, in-class group work, lab reports, a research related report/essay and reflection assignments a final exam.

Partial credit is assigned based on the demonstrated understanding of concepts and analytical/numerical results.

HOMEWORK

- Bi-weekly
- typically assigned on Wednesday with due date on Tuesday evening ~9pm)

IN CLASS_GROUP WORK

- graded on completion and accuracy,
- will be collected at the end of class
- group-work: I will not accept individual submissions
- If you are not in class, you will get a zero grade for in-class work even if your group submits the assignment
- One in-class group work grade will be dropped in determining the final grade

LAB REPORTS

- 3-4 hands-on experiences
- Out of class
- Brief lab reports (guidelines to follow, similar to AE112)

RESEARCH RELATED REPORT/ESSAY + REFLECTIONS ASSIGNMENTS

- Learn to look for appropriate references & to use appropriate citations
- Problem solving, & self-reflections on problem solving process

EXAMS

- 2 midterms
- 1 final exam during finals week

Grading Information

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.

Criteria

Type	Weight	Topic	Notes
MIDTERM 1	20%		3/6/2024
MIDTERM 2	20%		4/10/2024
FINAL EXAM	20%		Section 01: Th 05/16 7:15-9:30am Section 02: W 05/15 9:45am-12pm
Homework	10%		Bi-weekly
Lab reports	10%		
In class assignments	10%		
AE essay & reflections	10%		

Breakdown

A plus	*960 to 1000*	*96 to 100%*
A	*930 to 959*	*93 to 95%*
A minus	*900 to 929*	*90 to 92%*

B plus	*860 to 899*	*86 to 89 %*
B	*830 to 859*	*83 to 85%*
B minus	*800 to 829*	*80 to 82%*
C plus	*760 to 799*	*76 to 79%*
C	*730 to 759*	*73 to 75%*
C minus	*700 to 729*	*70 to 72%*
D plus	*660 to 699*	*66 to 69%*
D	*630 to 659*	*63 to 65%*
D minus	*600 to 629*	*60 to 62%*

University Policies

Per University Policy S16-9 (PDF) (http://www.sjsu.edu/senate/docs/S16-9.pdf), 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 the Syllabus Information (https://www.sjsu.edu/curriculum/courses/syllabus-info.php) web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

Week	Date	Topics, Assignments, Deadlines	Reading
1	01/24	Class introduction; intro to composites	
2	01/29 & 01/31	Intro to fiber-reinforced composites for aerospace applications	
3	02/05 & 02/07	Two-dimensional inertia properties of wing sections	Bruhn, section A3
4	02/12	Analysis of structural design configurations	
4	02/14	Computing internal forces on wings and airplane body	Bruhn, section A5
5	02/19	Computing internal forces on wings and airplane body	
5	02/21	Buckling of columns	Bruhn, section A5
6	02/26	Combined bending and buckling of wings	
6	02/28	Stresses due to torsion in wing & fuselage cross-sections	Bruhn, section A6
7	03/04	Stresses due to torsion in wing & fuselage cross-sections	
7	03/06	MIDTERM 1	
8	03/11	Axial stresses due to multiple bending in wings	Bruhn, section A13
8	03/13	Axial stresses due to multiple bending in wings	

Week	Date	Topics, Assignments, Deadlines	Reading
9	03/18	Fracture of materials	
9	03/20	Principal stresses; Mohr's circle	
10	03/25	Intro to failure criteria (Von Mises)	
10	03/27	Fatigue	
11	04/01	Spring break	
11	04/03	Spring break	
12	04/08	Review	
12	04/10	MIDTERM 2	
13	04/15	Flexural shear flow in open cross-sections	Bruhn, section A14
13	04/17	Flexural shear flow in open cross-sections	
14	04/22	Flexural shear flow in closed cross-sections	
14	04/24	Flexural shear flow in closed cross-sections	
15	04/29	Shear flow due to bending and torsion in thin-walled wings	Bruhn, section A15
15	05/01	Shear flow due to bending and torsion in thin-walled wings	
15	05/06	Failure of a thin-walled wing under combined loads	

Week	Date	Topics, Assignments, Deadlines	Reading
15	05/08	Review	
16	05/13	Review	