San José State University
Aerospace Engineering Department
AE114, Aerospace Structural Analysis II, Spring 2019

Course and Contact Information

Instructor:	J. M. Hunter
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Office Hours:	Monday & Wednesday 10:30 – 11:30, Monday 2 – 4, Wednesday 2 – 3
Class Days/Time:	Monday & Wednesday 4:30 – 5:45pm
Classroom:	BBC 004

Course Format

Course Description

Aircraft and spacecraft structural analysis and design. Conventional and introductory finite element methods. Bending and shear stress analysis as well as shear flow analysis. Aircraft wing and fuselage design considerations for simplified models and actual structures. Matrix structural analysis of joint displacement and axial bar stress as well as design of spacecraft truss structures.

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 the 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 (CLO)

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. Calculate shearing stress and angle of twist along a shaft-type structure in 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. Using Finite Element Method, assemble the stiffness matrix for a spacecraft truss structure.
12. Analyze a spacecraft truss structure to determine axial force and joint displacement.
13. Design and carry out experiments to define material or geometric properties of the cantilever beam, torsional beam and Beechcraft tail section.

Textbook Bruhn: Analysis and Design of Aircraft Structures

References
Sheppard: Statics
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

This course consists of 8 - 10 homework assignments, 3 lab problems, several quizzes, a midterm exam and a final exam. The homework assignments and lab problems are designed to directly support the Course Learning Objectives. More details can be found from University Syllabus Policy S16-9 at http://www.sjsu.edu/senate/docs/S16-9.pdf.

Final Examination

A comprehensive written final exam will be given on Friday May 17, 2:45 – 5:00pm

Grading Information

Grades are derived from homework, exams and the project. Each homework problem is worth 10 points. Partial credit is assigned based on the demonstrated understanding of concepts and analytical/numerical results. More guidelines on grading information and class attendance can be found from the following two university policies:

- University Syllabus Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf)
- University policy F15-12 (http://www.sjsu.edu/senate/docs/F15-12.pdf)

Determination of Grades

Homework	20%
Lab Problems	10%
Two Midterm Exams	50%
Final Exam	20%

Grading Scale: 100 – 97% A+; 96.9 – 93% A; 92.9 – 90% A-; 89.9 – 87% B+; 86.9 – 83% B; 82.9 – 80% B-; 79.9 – 77% C+; 76.9 – 73% C; 72.9 – 70% C-; 69.9 – 67% D+; 66.9 – 63% D; 62.9 – 60% D-; < 59.9% F
All exams must be taken to receive a passing grade.

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/

AE Department Policies http://www.sjsu.edu/ae/programs/policies/

Spring 2019 Semester Schedule

Lecture	Lecture Outline
1	Class Introduction, Strength of Materials Review
2	History of Strength of Materials
3	Two-Dimensional Inertia Properties of Wing Sections
4	History of Aircraft Structures; Structural Design Considerations for Contemporary Aircraft
5	Bending Moments on Beam Columns
6	Pure Torsion and Pure Bending
7&8	Aircraft Static Testing: Strain Gauges and Data Acquisition
9 & 10	Torsion of Circular Cross Sections, Thin-Walled Cross Sections
11 & 12	Non-Symmetrical Bending Stresses; Shear Center
13	Structural Design Considerations for Contemporary Aircraft
14 & 15	Shear Flow and Shear Center in an Open Section
16	Shear Flow in a Section with Stringers
17	Analysis of Wing Structures
18	Components of Fuselage Design
19 & 20	Fuselage Stress Analysis
21 & 22	Loads and Stresses on Ribs and Frames
23	Analysis of a Whole Wing
24	History of Spacecraft Structures
25	Introduction to Finite Element Analysis
26	Booms and Truss Structures
27	Axial Force and Joint Displacement
28	Final Exam Review