San José State University
Aerospace Engineering
AE114, Aerospace Structures II, Spring 2017

Course and Contact Information

Instructor: Dr. Arun K. Banerjee

Office Location: Engineering 272

Email: arunkanti.banerjee@gmail.com

Office Hours: MW 11:45am – 12:15pm

Class Days/Time: MW 10:30 – 11:45am

Classroom: Engineering 164

Pre-requisites: "C" or better in AE112 or graduate standing

Midterm Exams: Wednesday mid-March & Wednesday April 22

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. Matrix structural analysis of spacecraft truss structure joint displacement.

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

1. Construct the axial force, shear force and bending moment diagrams for aircraft beam structures.
2. Perform a buckling analysis for a beam-column-type structure.
3. Compute bending moment diagram and the position of maximum bending moment for a wing strut and a landing gear strut in compression.
4. Experimentally determine the effect on bending of the rib lightening holes of the Beechcraft 99 tail section.
5. Determine the shear flow distribution for a (closed) multiple-cell wing section under torsion.
6. For a wing section subjected to multiple bending moments, find the bending stress in the wing stringers.

7. 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.
8. Experimentally and analytically determine the shear center of the C-channel cantilever beam.
9. Determine the shear flow distribution and shear center location for a (closed) thin-walled section with stringers.
10. Calculate and experimentally verify the shear center of the Alouette helicopter rotor blade section.
11. Using the 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.

Textbook: Bruhn: Analysis and Design of Aircraft Structures

References: Niu: Airframe Structural Design: Practical Design Information on Aircraft Structures
Megson: Aircraft Structures for Engineering Students
Yang: Finite Element Structural Analysis
Inman: Engineering Vibration

Course Requirements and Assignments

This course consists of 8 – 10 analytical problems, 3 lab problems, 2 midterm exams and a final exam.

More details can be found from University Syllabus Policy S16-9 at http://www.sjsu.edu/senate/docs/S16-9.pdf.

Final Examination or Evaluation

Friday May 19, 9:45 AM to 12:00 PM, Engineering 164

Grading Information

Grades are derived from homework problems and exams. 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

Grading for Course:

Analytical Problems	20%
Lab Problems	20%
Two Hour Exams	40%
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/

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Course Schedule

Lecture	Topics
1 & 2	Statics of Aircraft & Two-Dimensional Inertia Properties of Wing Sections (sections A1 & A3 of Book)
3	History of Aircraft Structures; Structural Design Considerations for Contemporary Aircraft (section A1 of Book)
4 & 5	Bending Moments on Beam Columns (section A5 of Book)
6	Pure Torsion and Pure Bending (section A6 of Book)
7 & 8	Aircraft Static Testing: Strain Gauges and Data Acquisition
9 & 10	Torsion of Circular Cross Sections, Thin-Walled Cross Sections (section A6 of Book)
11 & 12	Non-symmetrical Bending Stresses; Shear Center (section A5 of Book)
13	Structural Design Considerations for Contemporary Aircraft (General)
14 & 15	Shear Flow and Shear Center in an Open Section (section A14 of Book)
16	Shear Flow in a Section with Stringers (Section A15 of Book)
17	Analysis of Wing Structures (Section A19 of Book)
18	Components of Fuselage Design (Section A20 of Book)
19 & 20	Fuselage Stress Analysis (Section A20 of Book)
21 & 22	Loads and Stresses on Ribs & Frames (Section A21 of Book)
23	Analysis of a Whole Wing (Section A22 of Book)
24	History of Spacecraft Structures (Section A1 of Book)
25	Introduction to Finite Element Analysis (Inman's Book, Ch8)
26	Booms and Truss Structures (Inman's Book, Ch8)
27	Axial Force and Joint Displacement (Inman's Book, Ch8)
28	Final Exam Review