## Class Information

Section 1: MWF 1:10-12, 2228 Howe
Prerequisite: E M 324, credit or enrollment in MATH 266 OR MATH 267
Web site: http://thermal.cnde.iastate.edu/aere321

## Textbook and References

- T.H.G. Megson, Aircraft Structures for Engineering Students 6e, 2017
- A. Kassimali, Matrix Analysis of Structures 2e, 2012
- D. J. Peery, Aircraft Structures, 1950
- R.C. Hibbeler, Mechanics of Materials 10e, 2017
- Other supplemental materials provided on subject basis

## Teaching Staff:

Instructor – C. Thomas Chiou, cchiou@iastate.edu,
https://www.cnde.iastate.edu/directory/?user_page=cchiou,
https://www.cnde.iastate.edu/research/terahertz-imaging/
Teaching assistant – Shujaut Bader, shbader@iastate.edu

## Office Hours:

Chiou - 2361 Howe MWF 2-3; Bader – 2238 Howe TU 2-3 or by appointment

## Student Learning Outcomes/Objectives:

By completion of the course, students will be able to:

- Understand the airframe loads and structural components/materials used in aircrafts
- Understand basic principles of mechanics of materials, elasticity and failure theories
- Understand the principles of and energy methods in engineering structures
- Analyze solid and thin-walled beams (open and closed) in bending, shear and torsion and thin plates, 2-D frames under loading
- Solve 1-D and 2-D problems by computer programming using the matrix stiffness method of analysis
- Understand and analyze structural stability in airframe structures
- Understand the importance of vibration and structural dynamics in load analysis

## Policy of Prerequisite:

It is the policy of the Department of Aerospace Engineering and the College of Engineering to require all students enrolled in this course to have satisfied all of the course's prerequisite requirements. If it is discovered that a student has not met any applicable prerequisite requirements, he/she will be required to immediately drop the course. The failure to drop the course will result in a final course grade of 'F', regardless of course performance. Students who discover they have improperly enrolled in a course without meeting the applicable prerequisite requirements are strongly encouraged to meet with advising staff to promptly drop the course and make alternative scheduling arrangements or discuss if an official waiver of the pre-requisite requirements may be applicable.

## Grading:

Homework: 15%,
Computer projects: 12%,
In-class quiz/work: 20%
Exams: exam 1 - 18%, exam 2 - 17%, exam 3 - 18%

Homework problems are assigned weekly and are to be worked on standard 8½"X11" engineering papers and stapled. Unless stated otherwise, **the homework problems are due about one week from they are assigned, usually at the beginning of the Wednesday class.** There are also computer-programming projects for which MATLAB, Python, Java, C/C++, Fortran, etc. are the recommended languages. These projects are due online to class web site. If a student is new to computer programming, a help file for accessing MATLAB is available in class web site. For further assistance, please contact the teaching staff.

**All assignments must be individually worked. Plagiarism and academic dishonesty will not be tolerated.**

Individual weighting factor will be applied to each homework, quiz and computer assignment. The following grade scale will be used, but the final grade may be adjusted or rescaled at instructor's discretion. **For missed in-class quizzes/work or exams, consideration for makeups will only be given to those extenuating circumstances such as hospitalization, family emergency, military obligation and academic conference - proof will be required**.

| Letter Grade | Percentage | Letter Grade | Percentage |
|---|---|---|---|
| A | >89.99% | C | 70-73.99% |
| A- | 87-89.99% | C- | 67-69.99% |
| B+ | 84-86.99% | D+ | 64-66.99% |
| B | 80-83.99% | D | 60-63.99% |
| B- | 77-79.99% | D- | 57-59.99% |
| C+ | 74-76.99% | F | 0 -56.99% |

## Academic Dishonesty

The class will follow Iowa State University's policy on academic dishonesty. **Any student suspected of academic dishonesty will be reported to the Dean of Students Office:**
http://www.dso.iastate.edu/ja/academic/misconduct.html

## Accommodation

Please contact the instructor as soon as possible if a student has a conflict and/or need an accommodation for valid reasons, including disability, illness, religious practices and observances and military service. Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. Students in need of disability accommodations please also bring the SAAR form with recommendations for accommodations from the Disability Resources Office when meeting with the instructor. The Disability Resources Office is located in Room 1076 on the main floor of the Student Services Building (515-294-7220, disabilityresources@iastate.edu). Retroactive requests for accommodations will not be honored.

## Harassment, Discrimination and Equal Participation

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. **Exclusion, discrimination, and harassment will not be tolerated.** Any student who is experiencing or has concerns about such behavior should contact the instructor, Student Assistance at 515-294-1020, email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

## Dead Week

This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook: http://www.provost.iastate.edu/resources/faculty-handbook with the exceptions of last homework or exam.

## Academic Issues

If a student is experiencing, or has experienced, a problem with any of the above issues, please email academicissues@iastate.edu

## Tentative Topics Outline and Schedule

| Unit | Week & Date | | Topics | Assignment |
|---|---|---|---|---|
| 1 | 1 | M 8-21 | Course introduction; aircraft loads | |
| 2 | | W 8-23 | Basic elasticity: stress & strain | |
| 3 | | F 8-25 | Review of stress & strain transformation, Mohr's cycle | |
| 4 | 2 | M 8-28 | Basic elasticity: stress-strain relationships, Hooke's law | Homework 1 |
| 5 | | W 8-30 | 2-D elasticity problems, stress functions, St. Venant's principle | |
| 6 | | F 9-1 | Stress concentration | |
| | 3 | M 9-4 | **University holiday, no class** | |
| 7 | | W 9-6 | Review of mechanics of materials: axial loading, torsion and beam bending | Homework 2 |
| 8 | | F 9-8 | Review of mechanics of materials: axial loading, torsion and beam bending | |
| 9 | 4 | M 9-11 | Review of mechanics of materials: axial loading, torsion and beam bending | Homework 3 |
| 10 | | W 9-13 | Review of mechanics of materials: axial loading, torsion and beam bending | |
| 11 | | F 9-15 | Review elasticity and Homework 1 | |
| 12 | 5 | M 9-18 | Energy method - static loading | |
| 13 | | W 9-20 | Energy method - impact loading | |
| 14 | | F 9-22 | Principle of virtual work - unit load method | |

| Unit | | Week & Date | Topics | Assignment |
|---|---|---|---|---|
| 15 | 6 | M 9-25 | Weeks 1-5 review | Homework 4 |
| 16 | | W 9-27 | **Exam 1** | |
| 17 | | F 9-29 | Reciprocity theorem, Castigliano theorem | |
| 18 | 7 | M 10-2 | Review of exam 1 | |
| 19 | | W 10-4 | Review of exam 1 | |
| 20 | | F 10-6 | Properties of aircraft materials; airworthiness; fatigue and failure theory | |
| 21 | 8 | M 10-9 | Stiffness method: analysis of beam | Project 1 |
| 22 | | W 10-11 | Stiffness method: analysis of beam | |
| 23 | | F 10-13 | Stiffness method: analysis of beam | |
| 24 | 9 | M 10-16 | Stiffness method: analysis of frame | Project 2 |
| 25 | | W 10-18 | Stiffness method: analysis of frame | |
| 26 | | F 10-20 | Unsymmetric beam | |
| 27 | 10 | M 10-23 | Unsymmetric beam revisited | Homework 5 |
| 28 | | W 10-25 | Shear in beam, shear flow | |
| 29 | | F 10-27 | Shear in beam, shear flow | |
| 30 | 11 | M 10-30 | Weeks 6-10 review | |
| 31 | | W 11-1 | **Exam 2** | |
| 32 | | F 11-3 | Shear of thin walled beam, shear center | |
| 33 | 12 | M 11-6 | Review of exam 2 | Homework 6 |
| 34 | | W 11-8 | Torsion in beam | |
| 35 | | F 11-10 | Torsion of open section beam | |
| 36 | 13 | M 11-13 | Torsion of thin-walled beam | |
| 37 | | W 11-15 | Combined open and closed section beam | |
| 38 | | F 11-17 | Combined open and closed section beam | |
| **Thanksgiving break (November 20-24)** | | | | |
| 39 | 14 | M 11-27 | Bending of thin plate | Homework 7 |
| 40 | | W 11-29 | Structural stability and column buckling | |
| 41 | | F 12-1 | Introduction to vibrations | |
| 42 | 15 | M 12-4 | Introduction to structural dynamics | |
| 43 | | W 12-6 | Weeks 11-15 review | |
| 44 | | F 12-8 | **Exam 3** | |
| | | | Review of exam 3, 1-2pm, Friday, December 15 | |