

Aerospace Engineering /College of Engineering

## **AerE 321 – Flight Structures Analysis**

### **Fall 2017 Syllabus**

**Instructor:** *Ashraf F. Bastawros, 2347 Howe Hall, 294-2694,*  
***bastaw@iastate.edu***

Office Hours; Monday 4:00-5:00pm or by appointment

**Lectures:** *Rm 2228 Howe Hall*

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## **Course Information**

### **Description**

(3-0) Cr. 3. Introduction to elasticity, airworthiness, and flight loads. Introduction to fatigue. Materials selection for flight applications. Thin walled cross-sections under bending, torsion, and shear loads using classical methods. Shear center. Column buckling. Matrix methods of structural analysis.

### **Student Learning Outcomes/Objectives**

By completion of the course, students should be able to

- Understand the airframe loads and structural components/materials used in aircrafts
- Understand basic principles of elasticity and failure theories
- Understand the principles of virtual work and complementary virtual work and energy methods in engineering structures
- Analyze 2-D trusses, thin-walled beams (open and closed) in bending, shear and torsion, 2-D frames, thin plates in bending
- Solve 1-D and 2-D problems using the matrix methods (Flexibility and Stiffness) of analysis
- Understand and analyze structural stability in columns, thin plates and airframe panels
- Understand the importance of vibration and aeroelasticity in load analysis

### **Prerequisite**

- EM 324, Credit or enrollment in MATH 266 or 267

## Course Policy

1. Lecture attendance is imperative but not mandatory. However, there **will be** class work and quizzes with credits.
2. Homework and Computer Assignment will be assigned on a regular basis (weekly) and will be due on the specified date (as noted on the HWs).
  - All HWs and Computer Assignment will be posted to Black Board (BB).
  - Late homework or Computer Assignment **will not be accepted** without prior approval or valid excuse.
  - Consultation with other students to clear any confusion is encouraged. However, all submitted homework must be your own work.
  - HWs will be worked on a standard 8½”X11” papers and Stapled together.
  - Computer Assignment will be submitted Via BB.
  - BB will close automatically after the posted submission date and time.
3. Homework grading: Each H.W. will comprise a set of problems.
  - Only two problems per homework will be graded.
  - The rest of the problems will be given credit for attempting.
4. Computer Assignment: You are free to utilize a programming language of your choice (MATLAB, Python, Java, C/C++, Fortran, etc). Though Matlab utilization is encouraged. Help files for Matlab will be available on BB if needed.
5. Exams: there will be THREE exams. Dates are marked on the syllabus, though if warranted, changes will be announced in advance.
  - Approval for a make-up exam must be obtained from the instructor three class periods before the scheduled exam time except in an extenuating circumstance. Proof will be required in such cases.
6. Class Work/ Quizzes: The lowest quiz grade will be dropped.
  - There will be one makeup classwork/quiz given at the end of the semester for those who missed more than two classwork/quiz for a valid reason.

## Grading Policy

Percentage	Description
14%	HWs
12%	Computer Assignment
20%	Class Work/ Quizzes
54%	Three Exams/ 18% Each

Letter Grade	Percentage
A	92-100%
A-	89-91%
B+	86-88%
B	81-85%
B-	79-80%
C+	76-78%
C	71-75%
C-	69-70%
D+	66-68%
D	61-65%
F	0-60%

**Text Books:**

1. *Matrix Analysis of Structures*, Aslam Kassimali, 2nd Edition, 2012
2. *Aircraft Structures for Engineering Students*, Fifth Edition, T. H. G. Megson, Butterworth-Heinemann (Elsevier), 2013.
3. Mechanics of Materials, Riley, Sturges and Morris.
4. Analysis of Aircraft Structures: An Introduction, B. K. Donaldson, 2nd ed., Cambridge, 2008.

Outline/Schedule (*Tentative*)

Class	Date	Topics	Read	HW
1	8-21	Introduction		M: Megson K: Kassimali
2	8-23	Aircraft Loads and Structural Components	M 12, 14	
3	8-25	Aircraft Materials, Airworthiness	M 11, 13	
	8-28	Basic Elasticity: Stress-Strain Relationships	M 1	HW # 1
4	8-30	Basic Elasticity: Stress-Strain Relationships	M 1	
5	9-1	Basic Elasticity: Solution Procedure	M2	
6	9-4	<b>NO CLASS – University Holiday</b>		HW # 2
7	9-6	Basic Elasticity: Theories of Failure, Fatigue Failure	M 15	
8	9-8	Basic Elasticity: Fatigue Failure	M 15	
9	9-11	Energy Methods, Strain Energy	M 4	HW # 3
10	9-13	Energy Methods: Strain Energy, Unit Load Method	M 5	
11	9-15	Energy Methods: Unit Load Method	M 5	
12	9-18	<b>Review/Recap</b>		
13	9-20	<b>Exam 1 (Howe 2228, 3:10 to 4:00 pm)</b>		
14	9-22	Matrix Analysis of Structures: Introduction	K 1, M6	
15	9-25	<b>Review of Exam 1 Solution</b>		HW # 4
16	9-27	Matrix Analysis of Structures: Flexibility Method	K 1, M6	
17	9-29	Matrix Analysis of Structures: Matrix Algebra	K 2	
18	10-2	Matrix Analysis of Structures: Matrix Algebra, Plane Trusses	K 2, 3	HW # 5/ Comp. Assign.
19	10-4	Matrix Analysis of Structures: Plane Trusses	K 3	
20	10-6	Matrix Analysis of Structures: Plane Trusses	K 3, 4	
21	10-9	Matrix Analysis of Structures: Beams	K 5	HW # 6/ Comp. Assign
22	10-11	Matrix Analysis of Structures: Beams	K 5	
23	10-13	Matrix Analysis of Structures: Beams	K 5	
24	10-16	Matrix Analysis of Structures: Plane Frames	K 6	
25	10-18	Matrix Analysis of Structures: Plane Frames	K 6	
26	10-20	Matrix Analysis of Structures: Releases/Secondary Effects	K 7	
27	10-23	<b>Review/Recap</b>		
28	10-25	<b>Exam 2 (Howe 2228, 3:10 to 4:00 pm)</b>		
29	10-27	Bending of Thin-Walled Beams	M 16	
30	10-30	Bending of Thin-Walled Beams	M 16	HW # 7
31	11-1	<b>Review of Exam 2 Solution</b>		
32	11-3	Bending of Thin-Walled Beams	M 16	
33	11-6	Shear of Thin-Walled Beams		HW # 8
34	11-8	Shear of Thin-Walled Beams	M 17	
35	11-10	Shear of Thin-Walled Beams	M 17	
36	11-13	Torsion of Solid Sections	M 3	HW # 9
37	11-15	Torsion of Thin-Walled Beams	M 18	
38	11-17	Torsion of Thin-Walled Beams	M 19	
NO CLASS – Thanksgiving Break, November 20-24				
39	11-27	Structural Stability and Buckling – Columns	M 8	HW # 10
40	11-29	Structural Stability and Buckling – Columns	M 8	
41	12-1	Structural Stability and Buckling – Plates, Panels	M 9	
42	12-4	Introduction to Structure vibration and dynamics	M 10	
43	12-6	<b>Review/ Recap</b>		
44	12-8	<b>Exam 3 (Howe 2228, 3:10 to 4:00 pm)</b>		
		<b>Review of Exam 3 Solution, Howe 2228, during planned final exam time</b>		

## Academic Dishonesty

The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

<http://www.dso.iastate.edu/ja/academic/misconduct.html>

## Disability Accommodation

Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact (instructor name) to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with (instructor name), you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email [disabilityresources@iastate.edu](mailto:disabilityresources@iastate.edu) . Retroactive requests for accommodations will not be honored.

## 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> .

## Harassment and Discrimination

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. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email [dso-sas@iastate.edu](mailto:dso-sas@iastate.edu), or the Office of Equal Opportunity and Compliance at 515-294-7612.

## Religious Accommodation

If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request.

You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

## **Academic Issues**

If you are experiencing, or have experienced, a problem with any of the above issues, email [academicissues@iastate.edu](mailto:academicissues@iastate.edu).