

MAE 3315-001: Aircraft Structure Statics

Spring 2014

Instructor(s): Ashfaq Adnan

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Email Address: aadnan@uta.edu

Office Hours: 3:30 pm – 4:30 pm; Tu Th (or, by appointment)

Time and Place of Class Meetings: FA 148, Fine Arts (FA)

Tu-Th 9:30 am – 10:50 am

Description of Course Content: The course is intended to provide students with a clear and thorough presentation of both the theory and applications of the fundamental principles of mechanics of materials that used in aircraft structural design.

Course Prerequisites: MAE 2312 Solid Mechanics or Equivalent

Textbooks: C.T. Sun, Mechanics of Aircraft Structures, 2nd Edition, Published by John Wiley & Sons, Inc. in 2006

The text book will be used as reference, and for some reading and homework assignments.

Student Learning Outcomes: The course is intended to provide students with a clear and thorough presentation of both the theory and application of the fundamental principles of mechanics of materials for aircraft structural design. Students will develop an understanding of the meaning of stress and strain, and the relation between them for isotropic and anisotropic materials. They will also learn to use analytical/empirical tools for determining the distribution of load (or displacement) in typical aerospace structural components. In addition, they will develop an understanding of the relation between applied load and aerospace component failure/fracture. They will then use this skill to select appropriate aerospace materials against component failure.

Course Content: The topics listed below will be covered during this course.

Part I: Essential Concepts

Ch. 1: Aircraft Structures and Materials

- Introduction to design and analysis concepts of aircraft structure
- Brief review of elementary mechanics of solids
- Structural elements in aircraft structures
- Mechanical properties of aircraft materials.

Ch. 2: Essential Analytical Tool: Elasticity

- Concept of displacement, strain and stress.
- Static equilibrium conditions.
- Linear elastic stress-strain relations.

- Plane elasticity

Part II: Structural Mechanics

Ch. 3: Torsion

- Torsion of uniform bars
- Bars with circular sections
- Bars with rectangular sections
- Closed single-cell sections
- Multi-cell sections

Ch. 4: Bending and Flexural Shear

- Simple beam theory
- Bidirectional bending
- Transverse shear in beams
- Deformation of thin-walled beams.

Ch 5: Shear Flow in Thin-Walled Sections

- Concept of shear flow
- Shear center
- Shear flow in open and closed sections
- Combined flexural and torsional shear flow.
- Multi-cell closed sections.

Part III: Material Selection and Failure Prediction

Ch 6: Failure Criteria for Isotropic Materials.

- Failure criteria for brittle materials
- Yielding of ductile materials
- Fracture mechanics
- Fatigue Failure

Ch 7: Elastic Buckling

- Buckling and its sources
- Elementary buckling analysis
- Buckling of structures
- Post buckling behaviors

There will be 12 homework assignments, two midterm exams and one final exam.

Course Grading Policy:

1 st Midterm	100
2 nd Midterm	100
Homework	50
Final Exam	150
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Semester Total points	400

Tentative Grading Scale	Letter Grade
340 or above	A
300 – 339	B
260 – 299	C
220 – 259	D
000 – 220	F

Important Dates:

1st Midterm: Tuesday, February 20, 2014, 9:30 am – 10:45 am.

Syllabus: All class materials, solved problems, homework and reading assignments that are covered to date.

2nd Midterm: Tuesday, April 3, 2014, 9:30 am – 10:45 am.

Syllabus: All class materials, solved problems, homework and reading assignments that are covered between 1st midterm and to date.

Homework: Assigned weekly during the Thursday class and due before the next Thursday class unless otherwise stated.

Final Exam: On the date scheduled by the University during the Final Exam Period. Covers all class materials including homework, solved problems, reading assignments and midterm exams.

Note:

- All students MUST check blackboard and UTA email periodically. All HWs, announcements and course related information will be made available to Blackboard only.
- All homework assignments should be prepared on instructor-approved papers and turned in with a coversheet. The template for the coversheet will be uploaded to Blackboard before the 1st HW assignment is due.
- Homework turned in **LATE** will receive a 20% penalty per day until solution for that Homework is posted. Solutions to HWs will be posted within one week from the due date.
- No **LATE** home work will be accepted after the solution is made available to students. [NO EXCEPTIONS]
- UTA regulations permitting, missed midterms and/or final exams can only be rescheduled when missed due to major health problems or circumstances beyond the student's control.
- With instructor's discretion, students will be required to reschedule the missed exams at the earliest time possible.

First Class: January 14, 2014

Martin Luther King Jr. Day: January 20, 2014

Census Date: January 29, 2014

Spring Breaks: March 10 – 14, 2014.

Last day to drop class: March 28, 2014.

Last day of class: May 2, 2014.

Attendance Policy: Students are strongly recommended to attend each class.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wwwb.uta.edu/aao/fao/>).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: Students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office

of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory" shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

Woolf Hall 406 Computer Teaching Lab Policies:

1. WH 406 must be officially reserved for all events including classroom instructions due to the limited classroom space equipped with computers and scheduling logistics. Please see Lanie or Janet for reservation.
2. WH 406 is a computer teaching lab. Faculty and Instructors must be present while students occupy this room. When an instructor leaves the room, students are to leave WH 406 as well. Instructors should encourage students to use WH 320 if needed after class is over. The computer lab in WH 320 is available for MAE student access 24/7.
3. WH 406 doors are not to be propped open. Propped doors are considered a security breach by the UTA Police Department and a hazard violation by the Fire Inspector.
4. Food, drink, and tobacco products are prohibited in WH 406.

Course Schedule

Date	Day	Lecture	Note	Topic
14-Jan-14	Tuesday	Lecture 1		Chapter 1 Characteristics of Aircraft Structures and Materials <ul style="list-style-type: none">Basic structural elements;Structural loads;Review shear moment diagram;Aircraft materials
16-Jan-14	Thursday	Lecture 2	HW 1 Assigned	
21-Jan-14	Tuesday	Lecture 3		Chapter 2 Introduction to Elasticity <ul style="list-style-type: none">Basic concepts of stress/strain;Principal stresses and their planes;Maximum shears and their planes;Stress transformation;Linear stress/strain relationship;Elastic strain energyPlane stress/plane strain;Equation of equilibrium;Airy stress function
23-Jan-14	Thursday	Lecture 4	HW 1 Due HW 2 Assigned	
28-Jan-14	Tuesday	Lecture 5		
30-Jan-14	Thursday	Lecture 6	HW 2 Due HW 3 Assigned	
4-Feb-14	Tuesday	Lecture 7		
6-Feb-14	Thursday	Lecture 8	HW 3 Due HW 4 Assigned	Chapter 3 Torsion <ul style="list-style-type: none">Torsion of uniform bars with circular cross-sections;Torsion of uniform bars with rectangular cross-section;Torsional rigidity;Closed Single-Cell Thin-Walled Sections.Multicell Thin-Walled Sections.REVIEW of Chapter 1 to 3
11-Feb-14	Tuesday	Lecture 9		
13-Feb-14	Thursday	Lecture 10	HW 4 Due HW 5 Assigned	
18-Feb-14	Tuesday	Lecture 11		
20-Feb-14	Thursday	Mid-Term Exam 1	*** EXAM ***	
25-Feb-14	Tuesday	Lecture 12		Chapter 4 Bending and Flexural Shear <ul style="list-style-type: none">Simple beam theoryBidirectional bendingTransverse shear in beamsDeformation of thin-walled beams.
27-Feb-14	Thursday	Lecture 13	HW 5 Due HW 6 Assigned	
4-Mar-14	Tuesday	Lecture 14		
6-Mar-14	Thursday	Lecture 15	HW 6 Due HW 7 Assigned	
11-Mar-14	Tuesday	No Lecture	Spring Break	
13-Mar-14	Thursday	No Lecture		
18-Mar-14	Tuesday	Lecture 16		Chapter 5 Shear Flow in Thin-Walled Sections <ul style="list-style-type: none">Concept of shear flowShear centerShear flow in open and closed sectionsCombined flexural and torsional shear flow.Multi-cell closed sections.REVIEW of Chapter 4 to 5
20-Mar-14	Thursday	Lecture 17	HW 7 Due HW 8 Assigned	
25-Mar-14	Tuesday	Lecture 18		
27-Mar-14	Thursday	Lecture 19	HW 8 Due HW 9 Assigned	
1-Apr-14	Tuesday	Lecture 20		

3-Apr-14	Thursday	Mid-Term Exam 2		*** EXAM ***
8-Apr-14	Tuesday	Lecture 21		Chapter 6 Failure Criteria for Isotropic Materials. <ul style="list-style-type: none"> • Failure criteria for brittle materials • Yielding of ductile materials • Fracture mechanics • Fatigue Failure
10-Apr-14	Thursday	Lecture 22	HW 9 Due HW 10 Assigned	
15-Apr-14	Tuesday	Lecture 23		
17-Apr-14	Thursday	Lecture 24	HW 10 Due HW 11 Assigned	
22-Apr-14	Tuesday	Lecture 25		Chapter 7 Elastic Buckling <ul style="list-style-type: none"> • Buckling and its sources • Elementary buckling analysis • Buckling of structures • Post buckling behaviors
24-Apr-14	Thursday	Lecture 26	HW 11 Due HW 12 Assigned	
29-Apr-14	Tuesday	Lecture 27		
1-May-14	Thursday	Lecture 28	HW 12 Due	
				REVIEW

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. –Ashfaq Adnan