MAE 3315-001: Aerospace Structural Statics

Fall 2019

Instructor Information

Instructor(s):
Ashfaq Adnan

Office Number:
315B Woolf Hall

Office Telephone Number:
(817) 272-2006 (voice),
817-272-5010 (fax)

Email Address:
aadnan@uta.edu

Faculty Profile:
https://mentis.uta.edu/explore/profile/ashfaq-adnan

Office Hours: Tu-Th 3.30-5 pm or by appointment

Course Information

Section Information: MAE 3315-001
Time and Place of Class Meetings: GACB 103
Tu-Th 11.00 am – 12.20 pm

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.

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.

Required Textbooks and Other Course Materials: 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.
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 thing-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

Descriptions of major assignments and examinations:

There will be 10-12 homework assignments, 2 KEY Assignments, two midterm exams and one final exam. ALL assignments will be posted in CANVAS.
Two of the all HW assignments will be designated as KEY ASSIGNMENTS. Each Key assignment will be equivalent to 2 HW assignments. Please check CANVAS for specific instructions about Key Assignments.

Purpose of Key Assignment:

The key assignments are designed to assess students’ ability to “apply their knowledge of Math, Science and Engineering” in solving the assigned problems related to the course content.

Collected data will be analyzed and then entered into ABET review documents.

What is ABET? [http://www.abet.org/]
UTA and ABET? [http://www.uta.edu/engineering/about/accreditation.php]

Why Does ABET Accreditation Matter?

(Taken from the link above)

Accreditation is proof that a collegiate program has met certain standards necessary to produce graduates who are ready to enter their professions. Students who graduate from accredited programs have access to enhanced opportunities in areas such as employment, mobility, and providing a positive impact on society.

ABET is an integral part of each of these areas because it accredits over 3,100 applied science, computing, engineering, and technology programs at more than 660 colleges and universities in 23 countries worldwide. Approximately 85,000 students graduate from ABET-accredited programs each year.

Accreditation is an assurance that the professionals that serve us have a solid educational foundation and are capable of leading the way in innovation, emerging technologies, and in anticipating the welfare and safety needs of the public.

Plan to accomplish: Engineering techniques based on differential equations, constitutive relations, 2-D & 3-D geometry and mechanics of materials will be introduced.

Plan to demonstrate: Assignments that involve stress analysis and applications of simple structural design principles will be given. The students will be tested on their ability to: (a) solve differential equations, (b) evaluate geometric properties of closed/open thin solid sections and (c) apply engineering structural design principles involving axial/bending/torsional/shear/buckling loading scenarios.

Key Assignments for Outcome a: APPLY KNOWLEDGE OF MATH, SCIENCE & ENG.
Key Assignment 1: The first homework is essentially based on the properties of open and closed thin-walled section subjected to axial and torsional loads. The problems examine the students’ ability of analyzing the properties of open and closed section. The problems should also help students understand how torsional/axial load carrying capacity of a structure can be optimized through parametric studies and geometric variations.

Key Assignment 2: The second homework focuses on analyzing aerospace structure under flexural loads. The problems will allow students to evaluate shear flow and shear center of different open and closed-cell structures based on the properties of open and closed thin-walled sections subjected to flexural loads. The problems will also help students obtain geometry-property-performance relations of aerospace structural components.

Exam 1: Tuesday Sept 24, 2019, 11:00 am – 12:15 pm.
Syllabus: All class materials, solved problems, homework and reading assignments that are covered to date.

Exam 2: Thursday October 29, 2019, 11:00 am – 12:15 pm.
**Syllabus:** All class materials, solved problems, homework and reading assignments that are covered between 1st exam and to date.

**Homework:** Assigned weekly during the Tuesday class and due before the following Tuesday class unless otherwise stated.

**Final Exam:** The final exam schedule can be found here: [https://www.uta.edu/records/downloads/Fall_2019_Final_Exam_Dates_04022019.pdf](https://www.uta.edu/records/downloads/Fall_2019_Final_Exam_Dates_04022019.pdf)

As of Aug 20, 2019, the final exam for this class is scheduled as follows:

**Thursday, Dec 5 11 – 1:30 p.m. Please check the above link to confirm.**

The final exam is comprehensive and 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.

**Grading Information**

**Grading Policy:**

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<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>1st Exam</td>
<td>125</td>
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<td>2nd Exam</td>
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<td>Homework</td>
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<td>Final Exam</td>
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Semester Total points 500

**Tentative Grading Scale**

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<tr>
<th>Tentative Score Range</th>
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<td>450 or above</td>
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<td>401 – 449</td>
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# Course Schedule

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th><strong>Chapter 1</strong> Characteristics of Aircraft Structures and Materials</th>
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<tr>
<td></td>
<td>• Basic structural elements;</td>
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<td>• Structural loads;</td>
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<td>• Review shear moment diagram;</td>
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<td>• Aircraft materials</td>
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<td>Lecture 2</td>
<td><strong>Chapter 2</strong> Introduction to Elasticity</td>
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<td>Lecture 3</td>
<td><strong>Chapter 3</strong> Torsion</td>
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<td>Lecture 4</td>
<td><strong>Chapter 4</strong> Bending and Flexural Shear</td>
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<td>Lecture 5</td>
<td><strong>Chapter 5</strong> Shear Flow in Thin-Walled Sections</td>
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<td>Exam 2</td>
<td><strong>Planned:</strong> October 29, 2019</td>
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<td>Lecture 18</td>
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<td>Lecture 20</td>
<td>Chapter 6  Failure Criteria for Isotropic Materials.</td>
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<td>• Failure criteria for brittle materials</td>
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<td>• Yielding of ductile materials</td>
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<th>Lecture 25</th>
<th>Chapter 7  Elastic Buckling</th>
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<td>• Elementary buckling analysis</td>
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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

**Institution Information**

UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the Institutional Information page (http://www.uta.edu/provost/administrative-forms/course-syllabus/syllabus-institutional-policies.php) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

**Additional Information**

**Attendance:**

At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator of student success. Each faculty member is free to develop his or her own methods of evaluating students’ academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients “begin attendance in a course.” UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report must the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Canvas. This date is reported to the Department of Education for federal financial aid recipients.
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
syllabi. 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.

For Fall Semester 2019: We designate November 27 to December 4 as review week. This gives students
a full week before finals for review. While the 28th is Thanksgiving, November 27 and 29 are review days
as are December 2, 3 and 4.

Emergency Exit Procedures:
Should we experience an emergency event that requires evacuation of the building, students should exit
the room and move toward the nearest exit. When exiting the building during an emergency, do not take
an elevator but use the stairwells instead. Faculty members and instructional staff will assist students in
selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Success Programs:
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 by appointment, drop-in tutoring, etutoring, supplemental instruction,
mentoring (time management, study skills, etc.), success coaching, TRIO Student Support Services, and
student success workshops. For additional information, please email resources@uta.edu, or view the
Maverick Resources website.

Emergency Phone Numbers

In case of an on-campus emergency, call the UT Arlington Police Department at 817-272-3003 (non-
campus phone), 2-3003 (campus phone). You may also dial 911. Non-emergency number 817-272-3381

Library Information

Research or General Library Help
Ask for Help
- Academic Plaza Consultation Services (library.uta.edu/academic-plaza)
- Ask Us (ask.uta.edu/)
- Research Coaches (http://libguides.uta.edu/researchcoach)

Resources
- Library Tutorials (library.uta.edu/how-to)
- Subject and Course Research Guides (libguides.uta.edu)
- Librarians by Subject (library.uta.edu/subject-librarians)
- A to Z List of Library Databases (libguides.uta.edu/az.php)
- Course Reserves (https://uta.summon.serialssolutions.com/#!/course_reserves)
- Study Room Reservations (openroom.uta.edu/)