

## MAE 3242-001 Mechanical Design I

Summer 2017

**Instructor:** Dr. Baxter R. (Bob) Mullins, Jr., P.E.

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**Faculty Profile:** <https://www.uta.edu/profiles/baxter-mullins>

**Office Hours:** MoWe 1:00pm – 2:00pm

**Section Information:** MAE 3242-001

**Time and Place of Class Meetings:** MoWe 8:00am – 9:20am, Nedderman Hall (NH) 111

**Description of Course Content:** MAE 3242. MECHANICAL DESIGN I. 2 Hours. The overall nature of design as a process is presented along with various models, methods, techniques, and tools for the various phases of the process to provide the student with an excellent understanding of how to design. Students learn to design mechanical components based on stress/deflection and the associated failure theories.

**Prerequisite:** C or better in each of the following, MAE 2312, MAE 2323, and MAE 3324.

**Additional Course Information:** This course is structured to provide the student the necessary fundamentals of solving engineering design problems with an “industrial perspective” of the material and its use in that environment. The instructor will be your “customer/client/manager” and you, the student, are the “engineer” providing the requested analysis and presentation of the results in an organized manner based on standard practices and processes. The intent is to prepare the student to quickly perform at a high-level in industry upon graduation. To that end there are very specific processes to be followed and an expected quality of work products. Failure to follow the procedures may affect your final grade.

### Course Content:

1. Introduction to Design
  - a. Machine design and design process
  - b. Problem formulation and calculation
  - c. Industry standards and processes
  - d. Engineering requirements
2. Materials and processes
  - a. Material property definitions
  - b. Statistical nature of materials
3. Kinematics and load determination
  - a. Mechanisms and degrees of freedom
  - b. Analyzing 1-DOF mechanisms
  - c. Analyzing linkage motion
  - d. Cam design and analysis
  - e. Free-body diagrams and load analysis
  - f. Dynamic, vibration, and impact loading

- g. Beam loading
- 4. Examination of stress, strain and deflection
  - a. Principal of stress and strain
  - b. Plane stress and strain
  - c. Mohr's Circle
  - d. Direct shear stress, bearing stress, and tearout
  - e. Beams, bending stresses, and deflection
  - f. Castigliano's Method
  - g. Torsion, spring-rates, stress concentrations
  - h. Axial Compression in columns
  - i. Stresses in cylinders
- 5. Static Failure theories
  - a. Failure of ductile materials, von Mises-Hencky Theory
  - b. Failure of Brittle Materials under static loads
  - c. Fracture mechanics
  - d. Static failure analysis
- 6. Fatigue failure theories
  - a. Mechanisms of fatigue failure
  - b. Fatigue-failure models
  - c. Machine-design considerations
  - d. Measuring and estimating fatigue failure criteria
  - e. Notch, stress concentrations, residual stresses
  - f. Designing for high-cycle fatigue
  - g. Designing for fluctuating uniaxial stresses
  - h. Designing for multiaxial stresses in fatigue

Every day "Rules-of-Thumb," will be presented and discussed throughout the semester.

Theory formulation, variable definition, analysis procedure and results presentation will follow industry standards. This shall include standard industrial practices developed by national and international agencies including ISO, Six Sigma, government (e.g., FARs, MIL STD) and professional organizations (e.g. AIAA, MSAE, SAE).

**Student Learning Outcomes:** By the end of this course students will have:

- Introduction to the design processes
- Reviewed mechanics of materials theories and their applications to mechanical design
- Use of variation techniques, tools and methods that can be used at each stage
- Learned failure theories for mechanical materials and part designs
- Introduction to safety factors for different materials and structural load condition
- Introduction to failure theories for mechanical parts

**Required Textbooks and Other Course Materials:**

- Norton, Robert L., *Machine Design: An Integrated approach (5th ed.)*, Prentice Hall, Boston, 2014.
- Handouts provided by instructor

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

**References:**

- Shigley, Joseph E., and Mischke, Charles R., *Mechanical Engineering Design, 6<sup>th</sup> ed.*, McGraw Hill, Boston, 2001.
- Radzevich, Stephen P., *Dudley's Handbook of Practical Gear Design and Manufacture, Third Edition*, CRC Press, 2013.
- Flabel, Jean-Claude, *Practical Stress Analysis for Design Engineers: Design & Analysis of Aerospace Vehicle Structures*, Lake City Publishing Company, Hayden, Idaho, 1997.
- Young, Warren C. and Budynas, Richard G., *Roark's Formulas for Stress and Strain, 7<sup>th</sup> ed.*, McGraw-Hill, New York, 2002.
- Pilkey, Walter D., *Peterson's Stress Concentration Factors, 2<sup>nd</sup> ed.*, John Wiley & Sons, Inc., New York, 1997.
- Braun, E.F., *Analysis and Design of Flight Vehicle Structures*, Tri-State Offset Company, 1973.
- Niu, Michael Chun-Yung, *Airframe Stress Analysis and Sizing, 3<sup>rd</sup> ed.*, Adaso/Adastr Engineering Center, 2011.
- Niu, Michael Chun-Yung and Niu, Mike, *Airframe Structural Design: Practical Design Information and Data on Aircraft Structures 2nd Edition*, Adaso/Adastr Engineering Center; 2nd edition (October 31, 2011)
- Niu, Michael Chun-Yung and Niu, Mike, *Composite Airframe Structures, Third Edition*, Hong Kong Conmilit Press Ltd.; Third edition (December 31, 2010).
- Perry, David J., *Aircraft Structures*, Dover Books on Aeronautical Engineering, 2011.
- Hull, Elizabeth, et al., *Requirements Engineering*, Springer, 2011
- Ehrlenspiel, Klaus, et al., *Cost Efficient Design*, Springer, 2007.
- Whitney, Daniel E., *Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development 1st Edition*, Oxford Series on Advanced Manufacturing, 2004.
- Other topics important to today's designers: Design for Cost, Design for Assembly, Design for Six-Sigma, Continuous Improvement, Quality Management, ISO 9001 for Manufacturing or Assembly, etc.

**Descriptions of major assignments and examinations:**

- Weekly assignments, portions of each will be graded
- 1 Midterms, 1 Final
- Weekly 10-min Quizzes

**Attendance:** At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in 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. 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

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student grade of F, faculty report 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 Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Students taking this course are expected to attend every class, to arrive on time, and to stay in class until they are dismissed. Students who fail to adhere to the attendance policy can expect an impact on their grade. Attendance will be considered in the assignment of the final letter grade. Students will not be penalized in the case of an emergency, or an incident beyond the student's control.

### Grading:

- |                  |     |   |
|------------------|-----|---|
| • Mid Term       | 25% |   |
| • Final          | 30% |   |
| • Quizzes        | 25% |   |
| • Key Assignment | 10% | Key Assignment must be successfully completed to pass the course. |
| • Assignments    | 10% | Late work accepted up to one class late with 50% grade penalty.   |

Lowest-grade assignment and lowest-grade quiz not included in course grade assessment.

Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels; see "Student Support Services," below. Students are expected to monitor BlackBoard on a regular basis. Broadcast emails to students will be made to notify students as needs arise.

### Tentative Grading Scale

### Letter Grade

≥ 85%	A
75% to <85%	B
65% to <75%	C
55% to <65%	D
<55%	F

**Make-up Exams:** UTA regulations permitting, missed midterm and/or final exam 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.

**Make-up Quizzes:** There will be NO make-up quizzes.

**Course Schedule:** A course schedule will be provided in Blackboard. Exam dates and reading assignments are provided on the schedule. Homework assignments and project assignments will be updated on a continuous basis. Homework assignments will be assigned weekly and uploaded to Blackboard.

### Use of Electronic Devices

- Cellphone use in class is prohibited.
- No internet capable devices (i.e. laptops, tablet devices or calculators) can be used during exams.
- Only simple, hand calculators are permitted during class exams.
- Laptops, tablet devices, etc. may be used during lectures for taking personal notes with permission of the professor. All other uses are prohibited.

- No audio and/or video recordings by the students are permitted.

**Expectations for Out-of-Class Study:** A general rule of thumb is this: for every credit hour earned, a student should spend 3 hours per week working outside of class. Hence, a 2-credit course might have a minimum expectation of 9 hours of reading, study, etc. Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 3 hours for each classroom hour or 9 hours per week (summer) of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

**Grade Grievances:** Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog. For undergraduate courses, see <http://catalog.uta.edu/academicregulations/grades/#undergraduatetext>. For student complaints, see <http://www.uta.edu/deanofstudents/student-complaints/index.php>.

**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://wweb.uta.edu/aao/fao/>).

**The Office for Students with Disabilities, (OSD)** [www.uta.edu/disability](http://www.uta.edu/disability) or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability).

**Counseling and Psychological Services, (CAPS)** [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [uta.edu/eos](http://uta.edu/eos).*

**Title IX Policy:** The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or [jmhood@uta.edu](mailto:jmhood@uta.edu).*

**Academic Integrity:** Students enrolled all UT Arlington courses 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 in their courses by 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. Additional information is available at <https://www.uta.edu/conduct/>.

**Lab Safety Training:** No lab training is required for this course.

**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>.

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Student Feedback Survey:** At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are 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 via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** for semester-long courses, 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 individuals with disabilities.

If any student in this class has a physical/sensory disabilities, please meet with me *in private* to discuss needs for assistance in the event of an emergency evacuation.

Students should subscribe to the MavAlert system that will send information in case of an emergency to their cell phones or email accounts. Anyone can subscribe at <https://mavalert.uta.edu/> or <https://mavalert.uta.edu/register.php>

**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](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

**The IDEAS Center** (2<sup>nd</sup> Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email [IDEAS@uta.edu](mailto:IDEAS@uta.edu) or call (817) 272-6593.

**The English Writing Center (411LIBR):** The Writing Center Offers free tutoring in 20-, 40-, or 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Our hours are 9 am to 8 pm Mon.-Thurs., 9 am-3 pm Fri. and Noon-6 pm Sat. and Sun. Register and make appointments online at <http://uta.mywconline.com>. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see [www.uta.edu/owl](http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library's 2<sup>nd</sup> floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library's hours of operation. <http://library.uta.edu/academic-plaza>

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### **Course Schedule**

Summer 11 Weeks 2017

June 5	First day of classes
June 22	Census date
July 4	Independence Day holiday
July 17	Mid-term exam - 8:00am – 9:20am
July 20	Last day to drop classes; submit requests to advisor prior to 4:00 pm
Aug. 10	Last day of classes
Aug. 14	Final Exam – 8:00am – 10:00am

***“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. –Baxter R. Mullins, Jr.”***

**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.



**General Information**

Library Home Page [library.uta.edu](http://library.uta.edu)

**Resources for Students**

**Academic Help**

- Academic Plaza Consultation Services [library.uta.edu/academic-plaza](http://library.uta.edu/academic-plaza)
- Ask Us [ask.uta.edu/](http://ask.uta.edu/)
- Library Tutorials [library.uta.edu/how-to](http://library.uta.edu/how-to)
- Subject and Course Research Guides [libguides.uta.edu](http://libguides.uta.edu)
- Subject Librarians [library.uta.edu/subject-librarians](http://library.uta.edu/subject-librarians)

**Resources**

- A to Z List of Library Databases [libguides.uta.edu/az.php](http://libguides.uta.edu/az.php)
- Course Reserves [pulse.uta.edu/vwebv/enterCourseReserve.do](http://pulse.uta.edu/vwebv/enterCourseReserve.do)
- FabLab [fablab.uta.edu/](http://fablab.uta.edu/)
- Special Collections [library.uta.edu/special-collections](http://library.uta.edu/special-collections)
- Study Room Reservations [openroom.uta.edu/](http://openroom.uta.edu/)

**Teaching & Learning Services for Faculty**

- Copyright Consultation [library-sc@listserv.uta.edu](mailto:library-sc@listserv.uta.edu)
- Course Research Guide Development, Andy Herzog [amherzog@uta.edu](mailto:amherzog@uta.edu) or your subject librarian
- Data Visualization Instruction, Peace Ossom-Williamson [peace@uta.edu](mailto:peace@uta.edu)
- Digital Humanities Instruction, Rafia Mirza [rafia@uta.edu](mailto:rafia@uta.edu)
- Graduate Student Research Skills Instruction, Andy Herzog [amherzog@uta.edu](mailto:amherzog@uta.edu) or your subject librarian
- Project or Problem-Based Instruction, Gretchen Trkay [gtrkay@uta.edu](mailto:gtrkay@uta.edu)
- Undergraduate Research Skills Instruction, Gretchen Trkay [gtrkay@uta.edu](mailto:gtrkay@uta.edu) or your subject librarian.

**MAE 3242-001 Mechanical Design I**

Summer 2017

*MAE 3243-001 – Engineering Design I*  
Summer Semester 2017

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**Engineering Design I**

**MAE 3242-001**  
**2 HOURS CREDIT**

**SUMMER 2017**

***SYLLABUS***

By signing this syllabus, the student acknowledges that he/she has read and understood this document.

Print Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Prepared by: Baxter R. Mullins, Jr.  
Date: 3 June 2017