

ME 338 MACHINE ELEMENT (19075) SYLLABUS

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Class Hours: MWF, 2:00 – 3:00 pm | **Classroom:** ETC 2.136

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Course Overview

Prerequisites: ME 334 and EM 319

Course textbook: Shigley's Mechanical Engineering Design, **11th edition**, Budynas & Nisbett, McGraw Hill. <https://www.mheducation.com/highered/product/shigley-s-mechanical-engineering-design-budynas-nisbett/M9780073398211.html>. I have included this textbook in the Longhorn Textbook Access (LTA) program in Fall 2021. LTA is a new initiative between UT Austin, The University Co-op, and textbook publishers to significantly reduce the cost of digital course materials for students. You are automatically opted into the program but can easily opt-out (and back in) via Canvas through the 12th class day. If you remain opted-in at the end of the 12th class day, you will receive a bill through your "[What I Owe](#)" page and have until the end of the 18th class day to pay and retain access. If you do not pay by the 18th class day, you will lose access to the materials after the 20th class day, and your charge will be removed. More information about the LTA program is available at <https://www.universitycoop.com/longhorn-textbook-access>

Course summary: Undergraduate level course on modeling, design, integration, and best practices for the use of machine elements such as bearings, springs, gears, cams, and mechanisms. Modeling and analysis of these elements are based upon the extensive application of physics, mathematics, and core mechanical engineering principles (solid mechanics, fluid mechanics, manufacturing, estimation, and computer simulation). These principles are reinforced via a substantial design project wherein students model, design, fabricate and characterize (optional for spring 2021) a mechanical system that is relevant to a real-world application. Students master the materials via problem sets and quizzes that are directly related to and coordinated with the deliverables of their project. Student assessment is based upon mastery of the course materials and the student's ability to synthesize, model, and fabricate a mechanical device subject to engineering constraints, e.g., cost and time/schedule.

Teaching Mode: As it stands, all classes will still be in-person. Things are very fluid at the moment and may change at any time. But all the classes will be recorded, and the recording can be accessed from your Canvas account.

Course outline: All instructions, assignments, readings, rubrics, and essential information will be on the Canvas website at <https://utexas.instructure.com>. Changes to the schedule may be made at my discretion and if circumstances require, e.g., due to COVID-19 and its variants. It is your responsibility to note these changes when announced. I will do my best to ensure that you receive the changes with as much advanced notice as possible.

Learning outcomes:

- 1) Define yield stress, ultimate stress, elastic modulus, and strain
- 2) Describe how the structure of materials affects the mechanical properties of those materials
- 3) Calculate principal stresses and deflections in mechanical systems
- 4) Calculate von Mises stresses
- 5) Explain the types of failure mechanisms in mechanical systems (ductile, brittle, fatigue, etc.)
- 6) Model failure mechanisms in shafts and beams
- 7) Calculate fatigue life of mechanical systems
- 8) Design shafts and shaft couplings
- 9) Select appropriate bearings for a mechanical system
- 10) Analyze the lifetime of sliding and rolling bearing elements
- 11) Design, model, and analyze gearing systems
- 12) Calculate transmission ratio of gear systems
- 13) Calculate stress in gears
- 14) Design lead screws and belt drives
- 15) Calculate stress and predict failure in bolted joints
- 16) Design springs for mechanical systems
- 17) Use FEA software to analyze the stress, deflection, and fatigue life of mechanical systems
- 18) Create physical embodiments of mechanical systems modeled in class
- 19) Work effectively in problem-solving teams and communicate project results to other engineers

Course Structure

Level-based scaffolding: This course has **four levels**, i.e., Level 1 – Mechanics of material review and failure theory introduction, Level 2 – Static fatigue failure theories, Level 3 – Shaft, gear, belt (handout and/or [SmartBook](#)), and Level 4 – Spring, bearing, and screws & bolted joints (handout and/or [SmartBook](#)). Each level covers independent yet coherently connected content. You must not lag behind the class to proceed successfully to the next level.

Individual learning: There are **seven individual homework assignments** in total. All homework will be assigned on Canvas and must be submitted on Canvas on the **due date by 11:59 pm**. Your work should be uploaded in your own handwriting in the **pdf** file only. Copying and submitting the work of others is a violation of the UT Honor and will be treated as such. Students are required to review the [UT Honor Code](#) and the [Dean of Students web page discussion of plagiarism](#).

Team-based learning: This class will focus on (i) understanding the role of concepts, principles, design process, best practices, mathematics, physics, and engineering modeling within mechanical design; and (ii) rigorous application of concepts, principles, design process, best practices, mathematics, physics, and engineering modeling to realize a complex and high-quality mechanical design. You will learn “by doing” and learn by gaining insight/perspective via interaction with the staff. This year in ME 338, teams of about 5-8 students will model, design, build and characterize the performance of a remote control car. Each team will design a ‘group’ RC car and must build at least one car. The construction and analysis of a device that meets functional requirements is a critical element of receiving a good grade in this class. The final performance evaluation of the RC cars will be performed during the last day of class. If you are able to form a group by yourself, you are welcome to do so. Otherwise, groups will be assigned in order to maximize availability and improve diversity.

Lecture preview and review: The lecture slides will be posted online before the first class of each level. The handwritten notes will also be uploaded every week. Lecture recordings will be available in Canvas. Read corresponding chapters of the textbook is highly recommended before lectures and exams.

Assessment

Exams: There will be four examinations throughout the semester. These exams will be semi-cumulative as prior course information is necessary but will not be directly tested. All required charts and graphs will be included with the exams. There will be no makeup examinations except for valid excuses/justifications supported by proper documentation.

Quizzes: Several in-class exercises (quizzes) will be conducted throughout the semester. Students are given the exams through [McGraw-Hill Connect](#) and will submit their answers on that system. McGraw-Hill Connect can be added in Canvas as a module. Students have until midnight on the date a quiz is given to submit their answers. More information about McGraw-Hill Connect will be provided in a separate document.

Project assessment: The design project will be assessed by two deliverables: 1) **Design notebook:** Each student must keep a design notebook. This must be a dedicated notebook in which all of your ideas, calculations, and records are stored. Loose papers must be stapled or glued in; no loose papers will be included in the grading. We encourage you to paste in pictures of the parts, SolidWorks models, or SolidWorks simulation results when appropriate. The purpose of the design notebooks is to show how you went through the design process and to see what each individual contributed to the final design. These notebooks are meant to be similar to what you would keep at a design firm if you were designing a new piece of equipment. 2) **Project report:** A final report of at most six pages (not including appendices) is required and will be due at the time of the final exam. The purpose of the report is for you to convince the staff that you learned and used the course material properly. The contents of the report are up to the group; however, it would be reasonable to include descriptions of your group's activities, calculations, predictions, results, lessons learned, and performance data. All reports are 12-point font, double-spaced, and 1-inch margins.

Peer evaluation: Each team member will be evaluated by their peers in the same group to assess the individual performance in the project. Peer evaluations will be performed for your performance in group project work.

Grading

A total of **800 points** are available for ME 338. The point breakdown is shown in the table below.

Category	Activities	Points
Individual work	Homework	140 (7)
	Quizzes	60 (4)
	Exams	400 (4)
	Peer evaluation	30
Group work	Design notebook	50
	Project report	120

Grading Policies

- 1) **Letter grades:** A > 93, A- > 90, B+ > 87, B > 83, B- > 80, C+ > 77, C > 73, C- > 70, D+ > 67, D > 63, D- >= 60, F < 60
- 2) All grading concerns and issues must be addressed upon the completion of each activity.
- 3) Late homework will be accepted **up to one week** late with a penalty of **25% off** the score achieved. Late design project submission will **NOT** be accepted.

- 4) Late peer evaluation submission will **NOT** be accepted.
- 5) For project report submissions, each group needs to include a statement specifying the responsibilities of each group member in the group work. Submissions without such a statement will receive a penalty of **25% off** the score.
- 6) In case of any disputes emerge, all efforts should be made to settle the disputes within the group. As a next-to-last resort, the instructor will attempt to mediate to reach a solution. All behavior within the groups must be professional and respectful. **Communication** is the most important factor in achieving efficient and productive group work.

Tentative Course Schedule

	Week	Monday	Wednesday	Friday	Content	Project
1	Aug 23	No Class	Lecture 1	Lecture 2	Chapter 3: 3.1 – 3.10 Chapter 5: 4.1 – 4.6 Chapter 5: 5.1 – 5.3	Read the project description
2	Aug 30	Lecture 3	Lecture 4	Lecture 5; <i>HW1 Due</i>		Conceive ideas and discuss them with your teammates
3	Sep 6	Labor Day	Lecture 6	Lecture 7		First team meeting and change team members if needed
4	Sep 13	Lecture 8	Lecture 9	Lecture 10 <i>HW 2 Due</i>		Submit your final team information
5	Sep 20	Lecture 11	Lecture 12	Exam 1	Chapter 5: 5.4 – 5.11 Chapter 6: 6.1 – 6.3 & 6.7 – 6.17	:
6	Sep 27	Lecture 13	Lecture 14	Lecture 15; <i>HW3 Due</i>		:
7	Oct 4	Lecture 16	Lecture 17	Lecture 18		:
8	Oct 11	Lecture 19	Lecture 20	Lecture 21 <i>HW4 Due</i>		:
9	Oct 18	Lecture 22	Lecture 23	Exam 2	Chapter 7: 7.1 – 7.6 Chapter 13: 13.1 – 13.8 & 13.12 – 13.14 Chapter 14: 14.1 – 14.4 Chapter 17: 17.1 – 17.4	:
10	Oct 25	Lecture 24	Lecture 25	Lecture 26; <i>HW5 Due</i>		Chassis/Axel Design Due
11	Nov 1	Lecture 27	Lecture 28	Lecture 29		:
12	Nov 8	Lecture 30	Lecture 31	Lecture 32 <i>HW6 Due</i>		:
13	Nov 15	Lecture 33	Lecture 34	Exam 3	Chapter 10: 10.1 – 10.10 Chapter 11: 11.1 – 11.8 Chapter 8: 8.1 – 8.11	Drive Design Due
14	Nov 22	Lecture 35	Thanksgiving Break			:
15	Nov 29	Lecture 36	Lecture 37	Lecture 38		Steering Design Due
16	Dec 6	Lecture 39	No Class <i>HW7 Due</i>	Exam 4		CAD Assembly Due
17	Dec 13	Final Project Report Due on Dec 14 Race Day TBD				Final report due

ABET Program Outcomes

ABET Program Outcomes Achieved		
X	1	Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
X	2	Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor.
X	3	Ability to communicate effectively with a range of audiences.
X	4	Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
X	5	Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
X	6	Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
X	7	Ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Academic Honesty

Each student in the course is expected to abide by the University of Texas Honor Code: “As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.” **Plagiarism is taken very seriously at UT.** Therefore, if you use words or ideas that are not your own (or that you have used in previous classes), you must cite your sources. Otherwise, you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UT’s Academic Honesty and the University Honor Code, which can be found at the following web address:

<https://deanofstudents.utexas.edu/conduct/standardsconduct.php>

For more information about academic integrity, please visit:

<https://deanofstudents.utexas.edu/conduct/academicintegrity.php>

Q Drop Policy: If you want to drop a class after the 12th class day, you’ll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester. Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see:

<http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop>

Rules of Civilized Behavior

- 1) Mute your cell phones and put them away before class.
- 2) If you are going to miss class, send an email before class explaining why you will not be there. Do not just tell the instructor; send an email.
- 3) If you must leave class early, inform the instructor before class begins.

University Resources

Services for Students with Disabilities: This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning

environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice) or 512-410-6644 (Video Phone) as soon as possible to request an official letter outlining authorized accommodations. For more information, visit: <http://ddce.utexas.edu/disability/about/> and <https://diversity.utexas.edu/disability/current-students>

SSD will be partnering with Testing and Evaluation Services to pilot a new Campus Testing Center starting in Fall 2021. Students registered with SSD and instructors will receive more details before the start of the Fall semester via email, the SSD website and the SSD Portal about using this new space for accommodated testing.

Counseling and Mental Health Center: Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep, and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus, and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.

<http://www.cmhc.utexas.edu/individualcounseling.html>

The Sanger Learning Center: Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit <http://www.utexas.edu/ugs/slc> or call 512-471-3614 (JES A332).

BeVocal: BeVocal is a university-wide initiative to promote the idea that individual Longhorns have the power to prevent high-risk behavior and harm. At UT Austin, all Longhorns have the power to intervene and reduce harm. To learn more about BeVocal and how you can help to build a culture of care on campus, go to: <https://wellnessnetwork.utexas.edu/BeVocal>.

Undergraduate Writing Center: <http://uwc.utexas.edu/>

Libraries: <http://www.lib.utexas.edu/>

ITS: <http://www.utexas.edu/its/>

Student Emergency Services: <http://deanofstudents.utexas.edu/emergency/>

Safety Information

If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be anonymous. If something doesn't feel right – it probably isn't. Trust your instincts and share your concerns.

Emergency Evacuation Procedures: The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, <http://www.utexas.edu/safet>. Occupants of buildings on The University of Texas at Austin

campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- 1) Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- 2) Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- 3) In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- 4) Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency

Violence / Active Shooter (CADD): **CALL**- 9-1-1. **AVOID**- If possible, self-evacuate to a safe area outside the building. Follow the directions of police officers. **DENY**- Barricade the door with desk, chairs, bookcases, or any items. Move to a place inside the room where you are not visible. Turn off the lights and remain quiet. Remain there until told by police it's safe. **DEFEND**- Use chairs, desks, cell phones, or whatever is immediately available to distract and/or defend yourself and others from attack.

Title IX Reporting: Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

- 1) Intervene to prevent harmful behavior from continuing or escalating.
- 2) Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
- 3) Investigate and discipline violations of the university's [relevant policies](https://titleix.utexas.edu/relevant-policies/) (<https://titleix.utexas.edu/relevant-policies/>).

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, to report any information to the Title IX Office regarding sexual harassment, sexual assault, dating violence, and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. **I am a Responsible Employee and must report any Title IX-related incidents** that are disclosed in writing, discussion, or one-on-one. Before talking with me or with any faculty or staff member about a Title IX-related incident, be sure to ask whether they are a responsible employee. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit <http://www.titleix.utexas.edu/>, contact the Title IX Office via Email at titleix@austin.utexas.edu, or call 512-471-0419.

Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212. The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.