

## MECH 4336: Principles of Engineering Design Spring 2023

Class Reference Number: 23668

Class Time and Location: T 10:30-11:50am, LART 208

Lab and Project Location: R 10:30-11:50 TBD

Textbook: “Shigley’s Mechanical Engineering Design” by Budynas and Nisbett  
or same book you used in MECH 3334

References: “Roark’s Formulas for Stress and Strain” by Young and Budynas,  
“Machinery’s Handbook” and “Standard Handbook of Machine Design” by  
Shigley and Mischke.

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Office Hours: TR 1:00 - 2:30 pm, or by appointment

Prerequisite:

### Course Objectives

At the end of the course, students would have learned the following:

- 1) To understand and apply the previous knowledge from Statics, Dynamics and Mechanics of Materials
- 2) Insight and experience into “design processes” using Additive Manufacturing (AM)
- 3) The establishment of design requirements and the application of your studies of mathematics, physics, engineering mechanics, and materials to assess if the design requirements are satisfied
- 4) Analysis, dimensioning and design methods for various mechanical elements and systems containing these.

### Course Overview

There will be brief reviews of some of the concepts from mechanics of materials, dynamics as well as design. This will be primarily in the context of analyzing a given design ability to meet the specified design requirements. There will be individual projects associated with this effort. Then we will focus on the design theory and equations for various mechanical elements such as fastened and welded joints, bearings, gears, etc. There will be a group projects related to the design of a system that employs one or more of these mechanical elements discussed in the reviews.

### Course Delivery Mode

This class will be in the conventional lecture mode, but supplemental material will be given via YouTube and Blackboard so it is expected that you have access to these entities. Additionally, the class will focus

on practical testing sessions and group projects that will require design and construction with additive manufacturing.

## Approximate Class Schedule

This is a rough estimate of the class readings, assignments, lectures and evaluations for the semester. This may change as the semester progresses. Please check Blackboard for a more detailed and updated schedule of assignments, readings and lectures.

| WEEK | TOPICS   | EXAM/PROJECT             |
|------|--|--------------------------|
| 1    | Statics, Mechanics of materials, Failure criteria, Design Process review |                          |
| 2    | Statics, Mechanics of materials, Failure criteria, Design Process review |                          |
| 3    | (1)Additive Manufacturing<br>(2)Structures                               | Group Project 1 assigned |
| 3    | Project 1 development  |                          |
| 4    | Project 1 testing  | Group Project 1 due      |
| 5    | Project 1 report and presentation  | ***                      |
| 6    | (3)Design of fastened joints   |                          |
| 7    | (4)Dimensioning and tolerances   |                          |
| 8    | (5)Gears   | Ind. Project 2 assigned  |
| 9    | Project 2 development  |                          |
| 10   | Project 2 testing  | Ind. Project 2 due       |
| 11   | Project 2 report and presentation  |                          |
| 12   | (6)Mechanisms  | Group Project 3 assigned |
| 13   | Development of mechanisms  |                          |
| 14   | Development of mechanisms  | Group Project 3 due      |
| 15   | Fabrication and testing of mechanisms                                    |                          |

Main engineering knowledge applied per project:

- **Project 1** – Mechanics and Materials
- **Project 2** – Dynamics
- **Project 3** – Mechanisms

## Project Reports

At the end of each project a printed final report will be required. This report is a reflection on your final design as well as the required engineering analysis needed to support your design. Drafting engineering documents that have brevity and clarity are critical to the design process. Your final project report should have the following sections

1. *Design overview*: A short description of the design. What it is and basically what it does. This should only be a paragraph or so.
2. *System requirements*: This is a very critical section. You must clearly state the design requirements and operating conditions needed. This needs to have a clear diagram of all the expected operating loads that the system will see so that you can show that your design meets these requirements.
3. *Design description*: A brief description of your design and how basically it meets the system requirements.
4. *Engineering justification of requirements*: This is a significant section. This section contains all the engineering calculations to show that your design meets all the system requirements. This will include a detailed stress analysis on each component, connection, fit etc. The factor of safety of each component to each loading must be clearly summarized (preferably in a few tables).

5. *Brief design narrative*: This is typically not in an engineering report, but for this class I am quite interested in how you arrived at your final design. This section is for you to briefly summarize your group's design process.

## Homework and Readings

Homework and readings may be assigned in class and due to a later date. I will typically not be collecting homework, but solutions will be provided. Occasionally I will collect a homework assignment for grading, so it is required that you do bring your completed assignment/project report to class. Late assignments/projects will not be accepted. Also, I may give a homework or closely related problem as an unannounced quiz

## Approved Calculators (Scientific Calculators)

- **Casio**: All **fx-115** models. Any Casio calculator must contain fx-115 in its model name.
- **Hewlett-Packard**: The **HP33s** and **HP 35s** models, but no others
- **Texas Instruments**: All **TI-30X** and **TI-36X** models. Any Texas Instruments calculator must contain either **TI-30X** or **TI-36X** in its model name.

## Grades

Your grade for this course will be assessed based on your performance in delivering project reports (20 %), the performance of your designs (50 %) and your participation and collaboration on the development of your designs (30 %). Quizzes may be given throughout the semester and will count as class participation. The content of a quiz could be the materials covered in previous sessions or covered that day. There will be no make-up quizzes. Every student is required to collaborate with the corresponding design's team in order to receive a grade. No collaboration work, no grade.

Your final grade will be calculated based on the points you have accumulated as follows:

|          |                      |
|----------|----------------------|
| <b>A</b> | $\geq 90$            |
| <b>B</b> | $\geq 75$ but $< 90$ |
| <b>C</b> | $\geq 65$ but $< 75$ |
| <b>D</b> | $\geq 50$ but $< 65$ |
| <b>F</b> | $< 50$               |

The instructor reserves the right to revise this grading plan. However, students will be informed of any changes during the semester.

## Attendance and Tardiness

Attendance is mandatory. Absence can be checked by the instructor through exams, roll calling, randomly picked names for problem solving in class, or other mechanisms. **You will receive an F grade if you miss more than five unjustified classes without previously notifying the instructor.** The instructor appreciates all efforts to attend the class. Part of being a professional is being on time and being prepared to do your job. This applies to your career as a student as much as it does to your future career as an engineer. Coming to class late is unprofessional and is very disruptive to the class. It interferes with the instructor's presentation, but more important, it interferes with the other students' concentration. You are expected to be in class and testing sessions, as well as prepared to participate as soon as the class starts. If

you are late to class, you are to come in quietly and take a seat in the least disruptive manner. There will be no penalty for being up to 15 min late. However, all exams, and quizzes will be given at the beginning of the classes. No additional time will be allowed for late attendees.

## Study Aids

### Instructor's Office Hour

You are always welcomed to visit the instructors at the posted hours or by making an appointment.

### Teaching Assistant

TBA

### ACES and the Tutoring Center

Students are reminded of the tutoring services available in the ACES and the library. These services are provided to you by the University. Check the schedules and make use of the services.

## Policy on Cheating

Students are expected to be above reproach in all scholastic activities. Students who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the university. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts. (Regents: Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22). Scholastic dishonesty harms the individual, all students, and the integrity of the university; policies on scholastic dishonesty will be strictly enforced. ***Student having any mobile communication device out during exam or quiz will be considered to be engaged in academic dishonesty.***

If any academic dishonesty is suspected, the student will be referred to the Office of Student Life. This includes copying during and exam, receiving outside help, etc. If you are unsure about what constitutes academic dishonesty please consult the following site:

<http://studentaffairs.utep.edu/Default.aspx?tabid=4386>

## Special Accommodations

**If you need different classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to [cass@utep.edu](mailto:cass@utep.edu), or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at [www.sa.utep.edu/cass](http://www.sa.utep.edu/cass).**