



Updates made September 28, 2022 are in green

Course Information

ME 35400: Machine Design

Course Description

Design, analysis, and selection of machine components for fluctuating loading. Application of design fundamentals to mechanical components and integration of components to form systems. Open-ended design projects reinforce the design process. 3 credit hours.

Prerequisites

ME 26300: Introduction to Mechanical Engineering Design, Innovation, and Entrepreneurship

ME 27400: Basic Mechanics II

ME 32300: Mechanics of Materials

Meeting Times, Instructors and Resources for Course Assistance

ME 35400-003 (CRN 24609) MWF 10:30 am – 11:20 am Face-to-Face WALC B058	ME 35400-001 (CRN 24607) MWF 12:30 pm – 1:20 pm Face-to-Face WALC 2087	ME 35400-002 (CRN 24608) MWF 3:30 pm – 4:20 pm Face-to-Face WALC 1132
Beth Hess Associate Professor of Engineering Practice BethHess@purdue.edu		Semih Akin Lambert Fellow sakin@purdue.edu

A schedule of instructor and TA office hours will be posted on the course website (<https://www.purdue.edu/freeform/me354/>). The course instructors are available via e-mail. E-mails will typically be responded to within one business day.

Learning Resources, Technology and Texts

The course textbook is:

Shigley's Mechanical Engineering Design, Eleventh Edition, R.G. Budynas and J.K. Nisbett. McGraw-Hill Education, New York, 2020. [ISBN: 978-1-264-08776-1].

A loose-leaf version of the Shigley text may be purchased online for \$85. The link to the online site is available on the course website.

Additional resources will be posted the course website. You may also be asked to utilize other technology during lecture in order to facilitate questions and discussion (e.g., HotSeat, Slack, Piazza).

Learning Outcomes

By the end of the course, you will be able to:

1. Apply fundamental concepts from statics, dynamics, and mechanics of materials to the design of machine components and/or systems.
2. Apply static and fatigue failure theories to the design of machine components and/or systems.
3. Select standard machine components and materials.
4. Apply problem-solving and communication skills through design projects.

Assignments

A total of 400 points can be earned this semester.

Lecture quizzes:	60
In-class quizzes:	40
Exam 1:	100
Exam 2:	100
Final Exam:	100

Homework problems are assigned from the Shigley text, but will not be collected. Homework solutions will be posted on the course website.

Lecture quizzes will be taken on Gradescope for **most** Lectures, with the exceptions of Lectures 19, 34, and 41-44, with the lowest three quiz grades dropped from the final grade calculation. Lecture quizzes must be completed by 11:59 pm EDT on the next lecture date. For example, the Lecture 1 (August 22) quiz must be submitted by 11:59 pm EDT on August 24. The Lecture 3 (August 26) quiz must be submitted by 11:59 pm EDT on August 29. Make-up lecture quizzes will not be offered.

In-class quizzes will be given throughout the semester and may be announced or unannounced. The lowest 10% of your in-class quiz scores will be dropped from the final grade calculation. Make-up in-class quizzes will not be offered.

Quizzes will not be due during the quiet period (December 5-10).

Exam dates and times are specified on the course schedule. Make-up exams will not be offered. Exams will be closed-book and closed-note, but an equation sheet will be provided. A calculator is the only electronic resource that is allowed on exams, and will be in accordance with the ME calculator policy (<https://engineering.purdue.edu/ME/Undergraduate/calculatorPolicy>).

If you are unable to take one of the exams at the specified time due to an excused absence, you will have the option of replacing the missed exam score with the average of the remaining two scores.

Re-grade requests for all graded assignments will be accepted. Re-grade requests must be submitted via Gradescope within one week of assignment return. A re-grade may result in a grade increase, decrease, or no change.

Grading Scale

Final grades will be calculated by adding the total points earned and translating those numbers (out of 400) to letter grades. If needed, your total points will be rounded to an integer. The grade cutoffs will not be more stringent than the following.

A+	388 – 400	A	372 – 377	A-	360 – 371
B+	348 – 359	B	332 – 347	B-	320 – 331
C+	308 – 319	C	292 – 307	C-	280 – 291
D+	268 – 279	D	252 – 267	D-	240 – 251
F	239 or below				

It is possible for, depending on the class averages at the end of the semester, the grade cutoffs to be adjusted. However, the grades in this course are not curved with an intent of satisfying particular preset grade distribution goals.

You are expected to comply with the guidelines for academic integrity as specified in this document. Failure to do so will result in a notification to the Office of the Dean of Students (ODOS). In addition to notifying ODOS, potential consequences of a lapse in academic integrity include, but are not limited to, the following.

- Earning a zero (0) for the assignment.
- Earning an F in ME 35400.

Attendance Policy

This course follows Purdue’s academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled.

When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, you should inform your instructor of the situation as far in advance as possible.

For unanticipated or emergency absences when advance notification to your instructor is not possible, you should e-mail your instructor as soon as possible.

When you are unable to make direct contact with your instructor and are unable to leave word with your instructor’s department because of circumstances beyond your control, and in cases falling under excused absence regulations, you or your representative should contact or go to the [Office of the Dean of Students website](#) to complete appropriate forms for instructor notification.

Under academic regulations, excused absences may be granted for cases of grief/bereavement, military service, jury duty, parenting leave, or emergent or urgent medical care. For details, see the [Academic Regulations & Student Conduct section](#) of the University Catalog website.

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must miss class at any point in time during the semester, you should e-mail your instructor as soon as possible. For COVID-19 concerns, please see the [Fall 2022: What you need to know](#) guidance published July 27.

If you find yourself too sick to progress in the course, notify your adviser and notify the instructor via e-mail. Arrangements will be made based on the particular situation.

Classroom Guidance Regarding Protect Purdue

If you have a substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols, you are encouraged to report the behavior to and discuss the next steps with your instructor. You also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#) and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds.

You are encouraged to alert university officials to potential breaches of this value by either e-mailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern.

More details are available on our course Brightspace table of contents, under University Policies.

You are encouraged to work together to learn the material. Your submitted work must be your work and must not be copied from other sources. Consult your instructor if you are uncertain about the difference between collaborating and copying.

All content provided by instructors (e.g., lecture notes, videos, assignments) are considered to be derivative works and are subject to the instructors' copyrights. As such, these materials cannot be sold, bartered, or posted online without the instructor's express written permission.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach their potential.

In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

A link to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Accessibility

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are encouraged to discuss these with your instructor. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours. CAPS also offers resources specific to COVID-19 on its website. Topics range from "Adjusting to the New Normal" to "How to Talk with Professors about Personal Matters."

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the [Critical Needs Fund](#).

Please also familiarize yourself with the following resources.

- Anyone on campus can submit a [Student of Concern](#) report if they are unsure where to go or in what way they can help a student. It does not need to be an emergency.
- The [ACE Campus Food Pantry](#) is open to the entire Purdue community.
- The [Center for Advocacy, Response, and Education](#) (CARE) is open to the entire Purdue community. CARE provides support and advocacy for survivors of sexual violence, dating violence, and stalking.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by circumstances beyond the instructor's control.

Relevant changes to this course will be posted on Brightspace and you will be notified by e-mail. You are expected to read your @purdue.edu e-mail on a frequent basis.

Course Schedule

Lecture	Date	Topic	Reading	Homework
1	M Aug 22	Introduction to Machine Design. Factor of Safety.	Chapter 1	–
2	W Aug 24	Combined Stress.	3-4 to 3-12	3-85, 3-92
3	F Aug 26	Static Failure Theories: Ductile Materials.	5-4 to 5-7	5-56, 5-61
4	M Aug 29	Static Failure Theories: Brittle Materials.	5-8 to 5-11	5-19
5	W Aug 31	Fatigue Analysis Methods.	5-12, 6-1 to 6-7	–
6	F Sep 2	Stress-Life Method. S-N Diagrams.	6-7, 6-8, 6-19	6-3, 6-5
	M Sep 5	No class – Labor Day		
7	W Sep 7	Marin Factors.	6-9, 6-19	6-10
8	F Sep 9	Stress Concentration and Notch Sensitivity.	6-10, 6-19	6-14
9	M Sep 12	Characterizing Cyclic Loading.	6-11, 6-12, 6-19	6-17
10	W Sep 14	Fatigue Failure Criteria.	6-13, 6-19	–
11	F Sep 16	<i>Guest Speaker – When Design Goes Wrong: Analyzing and Preventing Failure</i>		
12	M Sep 19	Fatigue Analysis for Pure Shear.	6-13, 6-19	–
13	W Sep 21	Combinations of Loading Modes.	6-16, 6-19	6-43, 6-48, 6-54, 6-57
14	F Sep 23	Shaft Design.	7-1 to 7-6	7-4, 7-18
15	M Sep 26	Design of Keys.	7-7	–
16	W Sep 28	Limits and Fits.	7-8	7-41, 7-45
17	F Sep 30	Compression Springs: Stresses and Spring Rates.	10-1 to 10-6	10-10
18	M Oct 3	Compression Springs: Static and Fatigue Loading.	10-7 to 10-10	10-22
19	W Oct 5	Review.	–	–
20	W Oct 5	Exam 1 – 8-10 pm in ARMS 1010 or RHPH 172, covering Lectures 1-14		
	F Oct 7	No class – Evening exam make-up		
	M Oct 10	No class – October Break		
21	W Oct 12	Extension Springs.	10-11	–
22	F Oct 14	Torsion Springs.	10-12	–
23	M Oct 17	Material properties.	2-1 to 2-8	2-2, 2-6
24	W Oct 19	Material processing. Material selection.	2-9 to 2-22	2-12, 2-22
25	F Oct 21	Contact Stresses.	3-19, 6-18	3-151, 3-154
26	M Oct 24	Rolling Element Bearings: Life, Load, and Reliability.	11-1 to 11-5	11-8, 11-10
27	W Oct 26	Rolling Element Bearings: Combined Loading.	11-6	11-23, 11-28
28	F Oct 28	Lubrication.	12-1 to 12-6	–
29	M Oct 31	Journal Bearings.	12-7 to 12-12	12-2, 12-3
30	W Nov 2	Gear Geometry.	13-1 to 13-12	13-1, 13-3, 13-8
31	F Nov 4	Gear Loads.	13-13 to 13-17	13-40, 13-43
32	M Nov 7	Spur Gear Bending.	Chapter 14	14-25
33	W Nov 9	Review.	–	–
34	W Nov 9	Exam 2 – 8-10 pm in ARMS 1010 or RHPH 172, covering Lectures 15-29		
	F Nov 11	No class – Evening exam make-up		

Lecture	Date	Topic	Reading	Homework	
35	M	Nov 14	Spur Gear Wear.	Chapter 14	14-26, 14-27
36	W	Nov 16	Gear Mesh Design.	14-9	13-33, 13-38, 13-43
37	F	Nov 18	Bevel Gears.	15-1 to 15-5	15-1, 15-2
38	M	Nov 21	Worm Gears.	15-6 to 15-9	15-14
	W	Nov 23	No class – Thanksgiving Vacation		
	F	Nov 25	No class – Thanksgiving Vacation		
39	M	Nov 28	Thread Standards. Threaded Fasteners.	8-1, 8-3	–
40	W	Nov 30	Bolted Joints. Bolt Stiffness.	8-4	8-17 ab, 8-19 ab
41	F	Dec 2	Member Stiffness. Joint Constant.	8-5	8-17 c, 8-19 c, 8-22
42	M	Dec 5	Bolt Strength. Factors of Safety.	8-6 to 8-9, 8-11	8-32, 8-50
43	W	Dec 7	Geometric Dimensioning and Tolerancing (GD&T).	Chapter 20	–
44	F	Dec 9	Review.	–	–
Final exam – to be scheduled during the week of December 12, covering Lectures 30-43					