ENGINEERING MECHANICS, B.S.

With a degree in engineering mechanics, our graduates design, measure and analyze complex structures in everything from networks of human cells and novel materials constructed at the nanoscale, to roller coasters and spacecraft. Engineering mechanics is the home of aerospace engineering (http://guide.wisc.edu/undergraduate/engineering/engineering-physics/engineering-mechanics-bs/engineering-mechanics-aerospace-engineering-bs/) at UW-Madison. Our curriculum prepares students for careers in a wide variety of fields, including health, clean energy, space exploration, and many more. As one of the smaller engineering majors, we focus on building a community that supports our students' success during their degree and as they launch their careers.

Engineering mechanics is the study of forces and the resulting deformations, accelerations, motions, vibrations, and other responses they cause. It forms the foundation of aerospace, mechanical or civil engineering, and is fundamental to important parts of biomedical engineering, chemical engineering, materials science, and other engineering disciplines.

Graduates of engineering mechanics apply their expertise in a variety of areas.

Wind turbines, wave power systems, transmission towers, and pipelines all respond to their environments in different ways. The safety and performance of these systems depend on a detailed understanding of how the environmental forces lead to deformations and vibrations that might cause failure. Principles of aerospace engineering are important when wind and water are involved as their flows make the analysis even more challenging, requiring sophisticated mathematical and analytical tools.

At slightly smaller scales, engineering mechanics is fundamental to the design and innovation of vehicles of every type, from sports cars to tractors to aircraft and satellites. Understanding engineering mechanics principles can provide insight to expand the way these vehicles are used while making their operation more sustainable. For some vehicles, aerospace engineering sheds light on their aerodynamic interaction with their environment, as well as the propulsion systems and complexity of controlling vehicles in flight. Landing a rover on Mars requires engineering mechanics to design the rover itself as well as the delivery system.

Innovations in engineering mechanics allow many of the products in our everyday lives to be made lighter, stronger, or cheaper by carefully understanding how they perform and when they fail due to the forces from the outside. In addition to enabling new functionality and aesthetic design, these modifications open the door for improved energy efficiency, selection of green materials, and longer lifetimes, all with broader societal benefits.

Modern technology allows us to fabricate machines at the microscopic scale with moving parts that are only visible under a microscope. Understanding how these micromachines respond to forces from each other or their environment is important to ensure that they function correctly. At this same scale, we can build novel materials whose properties depend on the microscopic structures that define them rather than their chemical composition. Engineering mechanics allows us to design these materials with properties that are not found in nature.

Our curriculum starts with a rich physics and math base to prepare our graduates for advanced analytical and computational skills that they will apply to this range of technologies. We transition from these fundamentals to engineering problem-solving approaches that can be applied to increasingly complex systems, while students build skills in computational modeling and simulation. Students in the aerospace engineering option will take a course in the wind tunnel to refine their understanding of the basics of aerodynamics.

As one of the smaller engineering majors, we focus on building a community that supports our students' success during their degree and as they launch their careers. Many students participate in undergraduate research across one of the biggest research portfolios in the College of Engineering. An alumni network across industry sectors—from John Deere to Tesla to Boeing to SpaceX—provides support for students to find internships and launch their careers.

ENGINEERING MECHANICS PROGRAM EDUCATIONAL OBJECTIVES

The faculty recognize that our graduates will choose to use the knowledge and skills they have acquired during their undergraduate years to pursue a wide variety of career and life goals and we encourage this diversity of paths. Regarding the Engineering Mechanics program, we initially expect graduates will begin their careers in fields that utilize their knowledge, education and training in solid mechanics, fluid mechanics and dynamics/vibration in a variety of jobs in mechanical, aerospace, manufacturing and other engineering fields.

Our educational objectives for the engineering mechanics program are to allow them to:

1. Exhibit strong performance and continuous development in problem-solving, leadership, teamwork, and communication, initially applied to engineering mechanics, and demonstrating an unwavering commitment to excellence.
2. Demonstrate continuing commitment to, and interest in, his or her training and education, as well as those of others.
3. Transition seamlessly into a professional environment and make continuing, well-informed career choices.
4. Contribute to their communities.

HOW TO GET IN

ADMISSION TO THE COLLEGE AS A FRESHMAN

Students applying to UW–Madison (https://www.admissions.wisc.edu/apply/) need to indicate an engineering major (https://engineering.wisc.edu/degrees-programs/undergraduate/) as their first choice in order to be considered for direct admission to the College of Engineering. Direct admission to a major means students will start in the program of their choice in the College of Engineering and will need to meet progression requirements (https://engineering.wisc.edu/student-services/undergraduate-student-advising/progression/) at the end of the first year to guarantee advancement in that program.

CROSS-CAMPUS TRANSFER TO ENGINEERING

UW–Madison students in other schools and colleges on campus must meet minimum admission requirements (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for admission

consideration to engineering degree granting classifications. Cross-campus admission is competitive and selective, and the grade point average expectations may increase as demand trends change. The student's overall academic record at UW–Madison is also considered. Students apply to their intended engineering program by submitting the online application by stated deadlines for spring and fall. The College of Engineering offers an online information tutorial and drop-in advising (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for students to learn about the cross-campus transfer process.

OFF-CAMPUS TRANSFER TO ENGINEERING

With careful planning, students at other accredited institutions can transfer coursework that will apply toward engineering degree requirements at UW–Madison. Off-campus transfer applicants are considered for direct admission to the College of Engineering by applying to the Office of Admissions with an engineering major listed as their first choice. Those who are admitted to their intended engineering program must meet progression requirements (https://engineering.wisc.edu/admissions/undergraduate/transfer-from-off-campus/) at the point of transfer or within their first two semesters at UW–Madison to guarantee advancement in that program. A minimum of 30 credits in residence in the College of Engineering is required after transferring, and all students must meet all requirements for their major in the college. Transfer admission to the College of Engineering is competitive and selective, and students who have exceeded the 80 credit limit at the time of application are not eligible to apply.

The College of Engineering has dual degree programs with select four-year UW System campuses. Eligible dual degree applicants are not subject to the 80 credit limit.

Off-campus transfer students are encouraged to discuss their interests, academic background, and admission options with the Transfer Coordinator in the College of Engineering: ugtransfer@engr.wisc.edu or 608-262-2473.

SECOND BACHELOR'S DEGREE

The College of Engineering does not accept second undergraduate degree applications. Second degree student (https://engineering.wisc.edu/admissions/undergraduate/adult-students-second-degree-students/)s (https://engineering.wisc.edu/student-services/undergraduate-student-advising/) might explore the Biological Systems Engineering program at UW–Madison, an undergraduate engineering degree elsewhere, or a graduate program in the College of Engineering.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the *Guide*.

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

ENGINEERING MECHANICS CURRICULUM

The following curriculum applies to students who entered the College of Engineering in fall 2023 or later.

SUMMARY OF REQUIREMENTS

Code	Title	Credits
Mathematics and Statistics [1]		22
Science [1]		10
Engineering Science		27
Engineering Mechanics Core		31
EMA Electives		9
Technical Electives		5
Communication Skills		8
Liberal Studies		16
Total Credits		**128**

1

If the Mathematics and Statistics and the Science requirements are fulfilled with fewer than 30 credits combined, additional math/science credits will be needed to meet the math/science auxiliary credit condition.

MATHEMATICS AND STATISTICS

Code	Title	Credits
MATH 221	Calculus and Analytic Geometry 1	5
or MATH 217	Calculus with Algebra and Trigonometry II	
or MATH 275		
MATH 222	Calculus and Analytic Geometry 2	4
or MATH 276		
MATH 234	Calculus--Functions of Several Variables	4
MATH 320	Linear Algebra and Differential Equations	3
MATH 321	Applied Mathematical Analysis	3
STAT 324	Introductory Applied Statistics for Engineers	3
Total Credits		**22**

SCIENCE

Code	Title	Credits
Select one of the following:		5-9
CHEM 109	Advanced General Chemistry	
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
PHYSICS 202	General Physics	5
Total Credits		**10-14**

ENGINEERING SCIENCE

Code	Title	Credits
M E 201	Introduction to Mechanical Engineering	3
M E 231	Geometric Modeling for Design and Manufacturing	3
E P 271	Engineering Problem Solving I	3-4
or COMP SCI 200	Programming I	
or COMP SCI 220	Data Science Programming I	
M S & E 350	Introduction to Materials Science	3
M E 361	Thermodynamics	3
M E 363	Fluid Dynamics	3
or CIV ENGR 310	Fluid Mechanics	
M E 364	Elementary Heat Transfer	3
E C E 376	Electrical and Electronic Circuits	3
or PHYSICS 321	Electric Circuits and Electronics	
Computing Elective (Select One)		3
COMP SCI 300	Programming II	
COMP SCI 412	Introduction to Numerical Methods	
E M A/E P 471	Intermediate Problem Solving for Engineers	
E M A/E P 476	Introduction to Scientific Computing for Engineering Physics	
Total Credits		**27-28**

ENGINEERING MECHANICS CORE

Code	Title	Credits
E M A 201	Statics (with a grade of C or better)	3
E M A 202	Dynamics	3
or M E 240	Dynamics	
E M A 303	Mechanics of Materials	3
or M E 306	Mechanics of Materials	
E M A/M E 307	Mechanics of Materials Lab	1
E M A 405	Practicum in Finite Elements	3
E M A 469	Design Problems in Engineering	3
E M A 506	Advanced Mechanics of Materials I	3
Experimental Mechanics Elective (Select One)		*3*
E M A/M E 570	Experimental Mechanics	
E M A/M E 540	Experimental Vibration and Dynamic System Analysis	
E M A 611	Advanced Mechanical Testing of Materials	
E M A 522	Aerodynamics Lab	
E M A 521	Aerodynamics	3
or M E 563	Intermediate Fluid Dynamics	
E M A 542	Advanced Dynamics	3
or E M A 545	Mechanical Vibrations	
E M A 569	Senior Design Project	3
Total Credits		**31**

ENGINEERING MECHANICS AND AEROSPACE ENGINEERING ELECTIVES

Code	Title	Credits
Select 9 credits from any E M A course numbered 500 and above		9

TECHNICAL ELECTIVES

Code	Title	Credits
Select 5 credits from:		**5**
E M A 1	Cooperative Education Program (no more than 3 credits)	
Courses numbered 300+ in the College of Engineering except for E P D/INTEREGR		
Up to 3 credits of independent study such as E M A 599; independent study from other engineering subjects may be approved on an individual basis		
Courses numbered 300+ MATH, PHYSICS, COMP SCI, STAT (except STAT 301), ASTRON, MED PHYS, and CHEM departments		
PHYSICS 205	Modern Physics for Engineers	
or PHYSICS 241	Introduction to Modern Physics	
Students may also propose any class that they feel will benefit their education path with pre-requisite of two physics or calculus classes. For these courses the advisor will review the request and if approved, recommend a DARS substitution.		

COMMUNICATION SKILLS

Code	Title	Credits
ENGL 100	Introduction to College Composition	3
or COM ARTS 100	Introduction to Speech Composition	
or LSC 100	Science and Storytelling	
or ESL 118	Academic Writing II	
E P D 275	Technical Presentations	2
INTEREGR 397	Engineering Communication	3
Total Credits		**8**

LIBERAL STUDIES

Code	Title	Credits
College of Engineering Liberal Studies Requirements		
Complete Requirements (http://guide.wisc.edu/undergraduate/engineering/#requirementstext) [1]		16
Total Credits		**16**

1

Students must take 16 credits that carry H, S, L, or Z breadth designators. These credits must fulfill the following sub-requirements:

1. A minimum of two courses from the same subject area (https://registrar.wisc.edu/subjectareas/) (the description before the course number). At least one of these two courses must be designated as above the elementary level (I, A, or D) in the course listing.
2. A minimum of 6 credits designated as humanities (H, L, or Z in the course listing), and an additional minimum of 3 credits designated as social science (S or Z in the course listing). Foreign language courses count as H credits. Retroactive credits for language courses may not be used to meet the Liberal Studies credit requirement (they can be used for subrequirement 1 above).
3. At least 3 credits in courses designated as ethnic studies (lower case "e" in the course listing). These courses may help satisfy subrequirements 1 and 2 above, but they count only once toward the total required. *Note:* Some courses may have "e" designation but not H, S, L, or Z designation; these courses do not count toward the Liberal Studies requirement.

TOTAL CREDITS: 128

For information on credit load, adding or dropping courses, course substitutions, pass/fail, auditing courses, dean's honor list, repeating courses, probation, and graduation, see the College of Engineering Official Regulations (http://guide.wisc.edu/undergraduate/engineering/#policiesandregulationstext).

NAMED OPTIONS IN ENGINEERING MECHANICS

Students may elect to declare a named option under the Engineering Mechanics BS. The named option in Aerospace Engineering can be declared as of Fall 2020. The named option in Astronautics is suspended as of Summer 2020; the last term to earn the named option is Summer 2026.

View as listView as grid

- ENGINEERING MECHANICS: AEROSPACE ENGINEERING (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/ENGINEERING/MECHANICAL-ENGINEERING/ENGINEERING-MECHANICS-BS/ENGINEERING-MECHANICS-AEROSPACE-ENGINEERING-BS/)
- ENGINEERING MECHANICS: ASTRONAUTICS (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/ENGINEERING/MECHANICAL-ENGINEERING/ENGINEERING-MECHANICS-BS/ENGINEERING-MECHANICS-ASTRONAUTICS-BS/)

HONORS IN UNDERGRADUATE RESEARCH PROGRAM

Qualified undergraduates may earn a Honors in Research designation on their transcript and diploma by completing 8 credits of undergraduate honors research, including a senior thesis. Further information is available in the department office.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree	To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.
Residency	Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.
Quality of Work	Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an 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 factors
3. an ability to communicate effectively with a range of audiences
4. an 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
5. an 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
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

First Year			
Fall	**Credits**	**Spring**	**Credits**
CHEM 109[1]		5 E M A 201[3]	3
MATH 221		5 MATH 222	4
Communication A		3 M E 231	3
M E 201[2]		3 M S & E 350	3

or Liberal Studies Elective		Liberal Studies Elective or	3
		M E 201[2]	
	16		**16**

Second Year

Fall	Credits	Spring	Credits
MATH 234	4	MATH 320	3
PHYSICS 202	5	Technical Elective	3
E M A 202[4]	3	M E 361	3
E P 271	3	E M A 303[4]	3
E P D 275 or COM ARTS 105	2	E M A/M E 307[4]	1
		Liberal Studies Elective	3
	17		**16**

Third Year

Fall	Credits	Spring	Credits
E M A 506	3	E M A 405	3
E M A 542 or 545[5]	3	Experimental Mechanics Course[6]	3
MATH 321	3	M E 363 or CIV ENGR 310	3
STAT 324	3	Computing Elective	3
INTEREGR 397	3	Technical Elective	2
Liberal Studies Elective	3		
	18		**14**

Fourth Year

Fall	Credits	Spring	Credits
E M A 469	3	E M A 569	3
E M A 521[7]	3	EMA Elective	3
EMA Elective	3	EMA Elective	3
E C E 376 or PHYSICS 321	3-4	M E 364	3
Liberal Studies Elective	4	Liberal Studies Elective	3
	16-17		**15**

Total Credits 128-129

1

It is recommended that students take CHEM 109 Advanced General Chemistry for 5 credits. However, depending on their high school chemistry experience, students may substitute this with CHEM 103 General Chemistry I and CHEM 104 General Chemistry II for a total of 9 credits.

2

M E 201 Introduction to Mechanical Engineering can be taken in first or second semester

3

Students may substitute PHYSICS 201 General Physics, 5 credits, for E M A 201 Statics, 3 credits, with the approval of their advisor.

4

After completing E M A 201 Statics, students may take E M A 202 Dynamics and E M A 303 Mechanics of Materials/E M A/M E 307 Mechanics of Materials Lab in either order or concurrently.

5

Students electing E M A 545 Mechanical Vibrations instead of E M A 542 Advanced Dynamics should note that E M A 545 Mechanical Vibrations is offered in the spring semester only.

6

E M A 611 Advanced Mechanical Testing of Materials or E M A/M E 540 Experimental Vibration and Dynamic System Analysis or E M A/M E 570 Experimental Mechanics or E M A 522 Aerodynamics Lab. Note that E M A/M E 540 and E M A/M E 570 are typically offered in the fall. E M A 611 and E M A 522 are typically offered in the spring.

7

M E 563 Intermediate Fluid Dynamics may be substituted for E M A 521 Aerodynamics. Note that M E 563 is offered in the spring semester only.

ADVISING AND CAREERS

ADVISING

Each College of Engineering program has academic advisors dedicated to serving its students. Program advisors can help current College of Engineering students with questions about accessing courses, navigating degree requirements, resolving academic issues and more. Students can find their assigned advisor on the homepage of their student center.

Continuing students who have fulfilled the progression requirements will also be assigned an Engineering Mechanics faculty advisor. Before enrolling in courses each semester, students must meet with their faculty advisor for assistance in planning courses and reviewing degree requirements. Faculty advisors are a valuable resource, as they can provide students with in-depth guidance on course content, internship and job opportunities, research, and more.

ENGINEERING CAREER SERVICES

Engineering Career Services (ECS) assists students in identifying pre-professional work-based learning experiences such as co-ops and summer internships, considering and applying to graduate or professional school, and finding full-time professional employment during their graduation year.

ECS offers two major career fairs per year, assists with resume writing and interviewing skills, hosts workshops on the job search, and meets one-on-one with students to discuss offer negotiations.

Students are encouraged to utilize the ECS office early in their academic careers. For comprehensive information on ECS programs and workshops, see the ECS website or call 608-262-3471.

PEOPLE

PROFESSORS

Darryl Thelen (Chair)
Riccardo Bonazza
Curt Bronkhorst
Wendy Crone
Christian Franck
Jaal Ghandhi
Sage Kokjohn
Roderic Lakes
Dan Negrut

Gregory F. Nellis
Tim Osswald
Frank Pfefferkorn
Xiaoping Qian
Douglas Reindl
David Rothamer
Scott T. Sanders
Krishnan Suresh
Mario F. Trujillo
Lih-sheng Turng
Fabian Waleffe

ASSOCIATE PROFESSORS

Peter Adamczyk
Mark Anderson
Lianyi Chen
Melih Eriten
Katherine Fu
Tom N. Krupenkin
Franklin Miller
Sangkee Min
Jacob Notbohm
Wenxiao Pan
James Pikul
Pavana Prabhakar
Alejandro Roldan-Alzate
Michael Zinn

ASSISTANT PROFESSORS

Joseph Andrews
Jennifer Franck
Corinne Henak
Eric Kazyak
Allison Mahvi
Luca Mastropasque
Josh Roth
Shiva Rudraraju
Stephan Rudykh
Ramathasan Thevamaran
Dakota Thompson
Mike Wagner
Michael Wehner
Jinlong Wu
Xiaobin Xiong
Xiangru Xu

LECTURERS, TEACHING FACULTY, AND TEACHING PROFESSORS

Arganthael Berson
Glenn Bower
Michael Cheadle
Michael De Cicco
Jennifer Detlor
Randy Jackson
Andrew Mikkelson
Jason Oakley
Erick L. Oberstar
Jeffrey Roessler

See also Mechanical Engineering Faculty Directory (https://directory.engr.wisc.edu/me/faculty/).

RESOURCES AND SCHOLARSHIPS

FACILITIES

Facilities available for instruction and research include:

Mechanics Holographic Lab
Viscoelasticity and Composites Lab
Wisconsin Laboratory for Structures and Materials Testing: Materials Testing Lab
Wind Tunnel Laboratory
Structural Mechanics Lab
Structural Dynamics and Vibrations Lab
Fatigue/Fracture Lab
Instructional Computing Lab (in Computer Aided Engineering)
Research Computing Lab

SCHOLARSHIPS

The College of Engineering has several types of scholarships available to incoming and current engineering students. Students should explore the Wisconsin Scholarship Hub (WiSH), where you can apply to and find specific information on scholarships at UW-Madison. You can use WiSH to find engineering scholarships available through the College of Engineering; the Inclusion, Equity, and Diversity in Engineering Student Center; and other UW and external organizations. (Please note: students must be currently enrolled in, or have applied to, the College of Engineering to be considered for engineering scholarships.) To be matched with these available scholarship funds an application is required and the system is typically open to students in the spring of each year. Questions on the process can be directed to: coescholarships@engr.wisc.edu. Additional financial assistance may be awarded through the Office of Student Financial Aid (333 E. Campus Mall RM 9701, 262-3060).

ACCREDITATION

ACCREDITATION

Accredited by the Engineering Accreditation Commission of ABET (https://www.abet.org), https://www.abet.org, under the commission's General Criteria and Program Criteria for Engineering Mechanics and Similarly Named Engineering Programs.

Note: Undergraduate Program Educational Objectives and Student Outcomes are made publicly available at the Departmental website. (In this Guide, the program's Student Outcomes are designated by our campus as "Learning Outcomes.")