ENGINEERING MECHANICS, B.S.

The Department of Engineering Physics administers the B.S., M.S., and Ph.D. degrees in engineering mechanics. The B.S. degree in engineering mechanics may be accompanied by an option in aerospace engineering (http://guide.wisc.edu/undergraduate/engineering/engineering-physics/engineering-mechanics-bs/engineering-mechanics-aerospace-engineering-bs/) (formerly named astronautics).

Engineering mechanics is the scholarly term for the study of forces and the resulting deformations, accelerations, motions, vibrations and other action that they cause. As such, engineering mechanics forms the foundation of a degree in aerospace, mechanical or civil engineering, and it is fundamental to important parts of biomedical engineering, chemical engineering, materials science, and other engineering disciplines. Hence, a degree in engineering mechanics provides a broad scientific background which enables its graduates to tackle challenging problems in most fields of engineering. The curriculum emphasizes the basic sciences—mathematics, computer science, physics and the engineering sciences—fluid dynamics, thermodynamics, mechanics, materials science, and electrical engineering. Although the degree program is entitled engineering mechanics at UW–Madison, the program is most comparable to aerospace engineering and mechanical engineering programs at various universities across the United States. However, internationally, this field is more commonly known as "mechanics" rather than "mechanical engineering" or "aerospace engineering." A few select universities in the United States offer programs that are similar to UW–Madison's engineering mechanics program under titles such as "engineering science" or "theoretical and applied mechanics."

The objective of the program is to provide the student with a broad background in the fundamental physical sciences and applied mathematics, coordinated with both theoretical and applied engineering methods and experimental techniques. This type of educational background will give the student the degree of versatility necessary for dealing with the variety and complexity of modern technological problems as well as the ability to adapt to the rapidly changing needs and interests of industry, government, and society.

An education in engineering mechanics provides many advantages. First, the foundation offered by a degree in mechanics allows our graduates to more easily interact with co-workers on interdisciplinary teams including chemists, physicists, and mathematicians. Second, many industrial organizations prefer engineers that have a broad, fundamental scientific background rather than a narrow view of just one discipline. Third, and probably most important, great changes have taken place in science and engineering during recent years. Among the most important of these have been the rapid diffusion of scientific knowledge and disciplines into engineering, the increasing use of analytical and computer methods for the solution of practical problems, the need for a better understanding of the properties and behavior of materials, and the increasing need for engineers who can adapt known methods to new situations and develop new experimental and analytical methods. By focusing on core competency in physics and applied mathematics, the engineering mechanics degree prepares students for these challenges.

The required courses taken early in the curriculum are intended to give students a fundamental background in mathematics, science, and engineering. In addition to developing versatility through exposure to important concepts in various scientific fields, the required courses allow students to identify areas of interest. With the relatively large number of elective credits available in the latter part of the program, students may either continue to follow a general program or may prefer to concentrate elective courses in such areas as stress analysis and structural mechanics, dynamics and vibrations, aerodynamics and flight mechanics, experimental mechanics, applied mathematics, materials science, geological engineering, biomechanics, aerospace mechanics, mechanical systems analysis, etc.

Engineering mechanics graduates are sought by most industries and governmental agencies including in particular those participating in the newly developing areas of engineering such as space technology, performance of new structural materials, and so on. Their work often involves participation in design, research and development projects where the problems are sufficiently complex or unusual that their solutions require engineers with (1) a thorough understanding of the fundamentals of engineering, (2) advanced education in the established experimental and analytical methods, and (3) the ability to develop new experimental and analytical methods to attack problems for which standard methods, formulas, and materials have not yet been developed. The program also provides excellent preparation for graduate study in a variety of related disciplines.

ENGINEERING MECHANICS AND NUCLEAR ENGINEERING 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. Similarly, regarding the Nuclear Engineering program, we initially expect graduates will begin their careers in fields that utilize their knowledge, education and training in the interaction of radiation with matter as it applies to power generation, health and medical physics, security and safeguards and other engineering fields.

Whatever path our graduates choose to pursue, our educational objectives for the nuclear engineering and engineering mechanics programs are to allow them to:

1. Exhibit strong performance and continuous development in problem-solving, leadership, teamwork, and communication, initially applied to nuclear engineering or 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://www.engr.wisc.edu/academics/undergraduate-academics/choosing-a-major/) 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://www.engr.wisc.edu/academics/student-services/academic-advising/first-year-undergraduate-students/progression-requirements/) 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 the course and credit requirements for admission to engineering degree granting classifications specified in the general college requirements (https://www.engr.wisc.edu/academics/student-services/academic-advising/cross-campus-students/). The requirements are the minimum for admission consideration. 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://www.engr.wisc.edu/academics/student-services/academic-advising/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://www.engr.wisc.edu/academics/student-services/academic-advising/transfer-students/) 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 earned more than 80 transferable semester credits 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 students (https://www.engr.wisc.edu/admissions/undergraduate-admissions/returning-adults-second-degree-students/) 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 2018 or later.

SUMMARY OF REQUIREMENTS

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

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	Topics in Calculus I	
MATH 222	Calculus and Analytic Geometry 2	4-5
or MATH 276	Topics in Calculus II	
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		22-23

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
INTEREGR 170	Design Practicum	3
M E 231	Geometric Modeling for Design and Manufacturing	3
E P 271	Engineering Problem Solving I	3
or COMP SCI 310	Problem Solving Using Computers	
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

ENGINEERING MECHANICS CORE

Code	Title	Credits
E M A 201	Statics	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 at an academic level that requires two semesters of calculus or two semesters of physics as a prerequisite. E M A 1 may also be used to satisfy this requirement.		5

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 (was EPD 397 prior to Fall 2020)	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 subrequirements:

1. A minimum of two courses from the same department or program. 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/ENGINEERING-PHYSICS/ENGINEERING-MECHANICS-BS/ENGINEERING-MECHANICS-AEROSPACE-ENGINEERING-BS/)
- ENGINEERING MECHANICS: ASTRONAUTICS (HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/ENGINEERING/ENGINEERING-PHYSICS/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
INTEREGR 170[2]	3	M S & E 350	3
		Liberal Studies Elective	3
	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 or COMP SCI 310	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 (was EPD 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 Students who were not able to take INTEREGR 170 Design Practicum as freshmen may, with the approval of their advisor, substitute a course offered in the College of Engineering or in the departments of Chemistry, Computer Sciences, Mathematics, and Physics.

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

Paul Wilson (Chair)
Matt Allen
James Blanchard
Riccardo Bonazza
Curt A. Bronkhorst
Wendy Crone
Chris Hegna
Douglass Henderson
Roderic Lakes
Oliver Schmitz
Leslie Smith
Carl Sovinec
Kumar Sridharan
Fabian Waleffe

ASSOCIATE PROFESSOR

Robert J. Witt

ASSISTANT PROFESSORS

Jennifer Choy
Adrien Couet
Stephanie Diem
Jennifer Franck
Benedikt Geiger
Jacob Notbohm
Ramathasan Thevamaran
Yongfeng Zhang

See also Engineering Physics Faculty Directory (https://directory.engr.wisc.edu/ep/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

Most financial assistance is awarded through the Office of Student Financial Aid (333 E. Campus Mall RM 9701, 262-3060). Some financial assistance is also available from the College of Engineering. Please see your academic advisor or Student Services Center, 1410 Engineering Drive, for more information. The Department has a limited amount of scholarship funds that are awarded on a merit basis, usually at the beginning of the fall semester. An application for departmental scholarships is not necessary; all students are automatically considered in the competition for departmental scholarships.

ACCREDITATION

Accreditation.

Accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (http://www.abet.org/).

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.')