ENGINEERING MECHANICS: RESEARCH, M.S.

This is a named option within the Engineering Mechanics M.S. (http://guide.wisc.edu/graduate/engineering-physics/engineering-mechanics-mns/)

This program is broadly structured into several main areas of instruction and research interests in mechanics of materials and astronautics: continuum mechanics, computational mechanics, dynamics and vibration, fluid mechanics, nanomechanics, solid mechanics, and biomechanics. Related fields in which minor work may be done include civil and environmental engineering, chemical and biological engineering, electrical and computer engineering, materials science, mechanical engineering, nuclear engineering and engineering physics, physics, geological engineering and geology, mathematics, statistics, and computer science.

Current faculty research interests include adhesive-bonded joints; composites; failure criteria; analytical and computational solid mechanics; analytical and computational dynamics; multibody dynamics; analytical and computational active and passive space-structure control systems; dynamic stability; nonlinear fracture mechanics of traditional and advanced materials; continuum mechanics; modal analysis; nanomechanics and nanotribology; fluid-structure interaction; non-Newtonian fluid flow; structural mechanics; viscoelasticity; viscoplasticity; cell mechanics; and biomechanics.

Laboratories are well equipped for experimental testing and research; these include holography, Moire, atomic force microscopy, vibration testing, and other optical methods for experimental mechanics research. The department has access to college-wide facilities. The Wisconsin Laboratory for Structures and Materials Testing has facilities for testing large structures, fatigue and vibration labs, and complements the department's laboratories. The Materials Science Center provides state-of-the-art instrumentation, support facilities, and expert technical assistance for research and education in materials. Its facilities include scanning and transmission electron microscopes, image processing and analysis systems, surface and thin film characterization facilities, and x-ray diffraction facilities.

For more information on this specific degree plan, please see the EP website (https://www.engr.wisc.edu/department/engineering-physics/).

ADMISSIONS

Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website.

Graduate admissions is a two-step process between academic programs and the Graduate School. Applicants must meet the minimum requirements (https://grad.wisc.edu/apply/requirements/) of the Graduate School as well as the program(s). Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

APPLICATION REQUIREMENTS and PROCESS

Degree: For admission to graduate study in Engineering Mechanics, an applicant must have a bachelor's degree in engineering, mathematics, or physical science, and an undergraduate record that indicates an ability to successfully pursue graduate study. International applicants must have a degree comparable to a regionally accredited U.S. bachelor's degree.

It is highly recommended that students take courses that cover the same material as these UW-Madison courses before entering the program:

<table>
<thead>
<tr>
<th>Course and Semester Credits</th>
<th>Typical Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Mathematics, 3 cr</td>
<td>MATH 319 or MATH 320 and MATH 321</td>
</tr>
<tr>
<td>Linear Algebra and Matrices, 3 cr</td>
<td>MATH 320 or MATH 340</td>
</tr>
<tr>
<td>Mechanics of Materials, 3 cr</td>
<td>EMA 303</td>
</tr>
<tr>
<td>Dynamics, 3 cr</td>
<td>EMA 202 or PHYSICS 311</td>
</tr>
</tbody>
</table>

Descriptions of course content can be accessed through The Guide (https://guide.wisc.edu/courses/). Students may enter without having taken these courses. However, in such cases the students must inform their advisors, who will help them plan courses of study that will provide adequate background for our department's graduate curriculum. Provisions for admission on probation, or as an applicant for more than one master's degree (e.g., simultaneous MS degrees in two departments) are given in the Graduate School website (http://grad.wisc.edu/).

All applicants must satisfy requirements that are set forth by the Graduate School (https://grad.wisc.edu/apply/requirements/).
**GPA:** The Graduate School requires a minimum undergraduate grade point average of 3.0 on a 4.0 basis on the equivalent of the last 60 semester hours from the most recent bachelor's degree. In special cases, students with grade point averages lower than 3.0 who meet all the general requirements of the Graduate School may be considered for admission on probation.

**GRE:** As a response to the COVID-19 pandemic, the GRE requirement is waived for applications to the Spring 2023, Summer 2023, and Fall 2023 terms, and submission of GRE scores is optional.

**MS-thesis track advisor selection process:** MS applicants who intend to complete a thesis are encouraged to identify potential faculty advisors and seek a confirmation. Please review the department Research (https://engineering.wisc.edu/departments/engineering-physics/research/) and People (https://directory.engr.wisc.edu/display.php?faculty/?page=ep&search=faculty) websites and contact those whose research interests align with yours. Only faculty members listed with the titles of Assistant Professor, Associate Professor, or Professor, can serve as graduate advisors. Do not contact Emeritus faculty, Lecturers, Research Scientists, or Faculty Associates. You are also encouraged to inquire about possible funding opportunities. If a faculty member agrees to be your advisor, ask the person to email an acknowledgment to emgradadmission@engr.wisc.edu.

Each application must include the following:

- Graduate School Application (https://grad.wisc.edu/apply/)
- Academic transcripts
- Statement of purpose
- Resume/CV
- Three letters of recommendation
- GRE Scores (waived in response to the COVID-19 pandemic)
- English Proficiency Score (if required)
- Application Fee

**DEADLINES**

To apply to the EM program, complete applications (https://grad.wisc.edu/apply/), including supportive materials, must be submitted as described below and received by the following deadline dates:

- Fall Semester—December 15
- Spring Semester—October 1
- Summer Session—December 15

**ACADEMIC TRANSCRIPT**

Electronically submit one copy of your transcript of all undergraduate and previous graduate work along with your online application to the Graduate School. Unofficial copies of transcripts will be accepted for review, but official copies are required for admitted students. Please do not send transcripts or any other application materials to the Graduate School or the Department of Engineering Physics unless requested. Please review the requirements set by the Graduate School (https://grad.wisc.edu/apply/requirements/) for additional information about degrees/transcripts.

**STATEMENT OF PURPOSE**

In this document, applicants should explain why they want to pursue further education in Engineering Mechanics and discuss which UW faculty members they would be interested in doing research with during their graduate study (see the Graduate School for more advice on how to structure a personal statement (https://grad.wisc.edu/apply/prepare/)).

**RESUME**

Upload your resume in your application.

**THREE LETTERS OF RECOMMENDATION**

These letters are required from people who can accurately judge the applicant's academic and/or research performance. It is highly recommended these letters be from faculty familiar with the applicant. Letters of recommendation are submitted electronically to graduate programs through the online application. See the Graduate School for FAQs (https://grad.wisc.edu/apply/) regarding letters of recommendation.

**GRE SCORES**

As a response to the COVID-19 pandemic, the GRE requirement is waived for applications to the Spring 2023, Summer 2023, and Fall 2023 terms. Any scores submitted will be accessible by the Admissions Faculty.

Applicants who select to submit GRE scores: Scores should be submitted directly from Educational Testing Services (ETS) using institution code 1846. We do not require a department code, but entering a code is acceptable and will not negatively impact the receipt of your scores.

**ENGLISH PROFICIENCY SCORE**

Every applicant whose native language is not English, or whose undergraduate instruction was not in English, must provide an English proficiency test score. The UW-Madison Graduate School accepts TOEFL or IELTS scores. Your score will not be accepted if it is more than two years old from the start of your admission term. Country of citizenship does not exempt applicants from this requirement. Language of instruction at the college or university level and how recent the language instruction was taken are the determining factors in meeting this requirement.

For more information regarding minimum score requirements and exemption policy, please see the Graduate School Requirements for Admission (https://grad.wisc.edu/apply/requirements/).

**APPLICATION FEE**

Application submission must be accompanied by the one-time application fee. It is non-refundable and can be paid by credit card (Master Card or Visa) or debit/ATM. Additional information about the application fee may be found here (https://grad.wisc.edu/apply/) (scroll to the 'Frequently asked questions).

Fee grants are available through the conditions outlined here by the Graduate School (https://grad.wisc.edu/apply/fee-grant/).

**QUESTIONS:**

If you have questions, please contact emgradadmission@engr.wisc.edu.

**REENTRY ADMISSIONS**

If you were previously enrolled as a graduate student in the Engineering Mechanics program, have not earned your degree, but have had a break in enrollment for a minimum of a fall or spring term, you will need to
re-apply to resume your studies. Please review the Graduate School requirements for previously enrolled students (https://policy.wisc.edu/library/UW-1230/). Your previous faculty advisor (or another EM faculty advisor) must be willing to supply advising support and should e-mail the EM Graduate Student Services Coordinator regarding next steps in the process.

If you were previously enrolled in a UW-Madison graduate degree, completed that degree, have had a break in enrollment since earning the degree and would now like to apply for another UW-Madison program; you are required to submit a new student application through the UW-Madison Graduate School online application. For EM graduate programs, you must follow the entire application process as described above.

CURRENTLY ENROLLED GRADUATE STUDENT ADMISSIONS

Students currently enrolled as a graduate student at UW-Madison, whether in EM or a non-EM graduate program, wishing to apply to this degree program should contact the EM Graduate Admissions Team (emgradadmission@engr.wisc.edu) to inquire about the process and deadlines several months in advance of the anticipated enrollment term. Current students may apply to change or add programs for any term (fall, spring, or summer).

QUESTIONS:

If you have questions, please contact emgradadmission@engr.wisc.edu.

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

PROGRAM RESOURCES

Admission and funding are separate decisions. Not all admitted students are offered support. International applicants must secure a research assistantship, teaching assistantship, fellowship, or independent funding before admission is final. The funding for RAs comes from faculty research grants. Each professor decides on his or her own RA offers. Funded students are expected to maintain full-time enrollment. See the program website (https://www.engr.wisc.edu/department/engineering-physics/academics/ms-engineering-mechanics/) for additional information.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirements#text), in addition to the program requirements listed below.

NAMED OPTION REQUIREMENTS

MODE OF INSTRUCTION

<table>
<thead>
<tr>
<th>Mode of Instruction</th>
<th>Face to Face</th>
<th>Evening/Weekend</th>
<th>Online</th>
<th>Hybrid</th>
<th>Accelerated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students are able to complete a program with minimal disruptions to careers and other commitments.

Evening/Weekend: Courses meet on the UW-Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirements Detail

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Credit Requirement</td>
<td>30 credits</td>
</tr>
<tr>
<td>Minimum Residence Credit Requirement</td>
<td>16 credits</td>
</tr>
<tr>
<td>Minimum Graduate Coursework Requirement</td>
<td>15 credits must be graduate-level coursework. Details can be found in the Graduate School's Minimum Graduate Coursework (50%) policy (<a href="https://policy.wisc.edu/library/UW-1244/">https://policy.wisc.edu/library/UW-1244/</a>).</td>
</tr>
<tr>
<td>Overall Graduate GPA Requirement</td>
<td>3.00 GPA required</td>
</tr>
<tr>
<td>Other Grade Requirements</td>
<td>Courses in which grades of BC, C, or below are received cannot be counted toward the degree except as follows: 1) Credits of C will be allowed provided they are balanced by twice as many credits of A or by four times as many credits of AB, 2) Credits of BC will be allowed provided they are balanced by twice as many credits of AB or by an equal number of credits of A.</td>
</tr>
</tbody>
</table>

Other Grade Requirements

Courses in which grades of BC, C, or below are received cannot be counted toward the degree except as follows:
1) Credits of C will be allowed provided they are balanced by twice as many credits of A or by four times as many credits of AB, 2) Credits of BC will be allowed provided they are balanced by twice as many credits of AB or by an equal number of credits of A.
REQUIRED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP SCI 714</td>
<td>Methods of Computational Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 715</td>
<td>Methods of Computational Mathematics II</td>
<td>3</td>
</tr>
</tbody>
</table>

**Breadth Requirement**

Students must take at least 5 courses from the list below. At least 3 must be identified by *. The courses must span at least 2 of the 3 areas defined below. For each of the 2 areas, the student must take at least 2 courses.

**Solid Mechanics**

| E M A 506 | Advanced Mechanics of Materials I | 3 |
| E M A/CIV ENGR/ M E 508 | Composite Materials | 3 |
| E M A 519 | Fracture Mechanics | 3 |
| E M A/M S & E 541 | Heterogeneous and Multiphase Materials | 3 |
| E M A/M E 570 | Experimental Mechanics | 3 |
| E M A 605 | Introduction to Finite Elements | 3 |
| E M A 611 | Advanced Mechanical Testing of Materials | 3 |
| E M A/E P 615 | Micro- and Nanoscale Mechanics | 3 |
| E M A 622 | Mechanics of Continua | 3 |
| E M A 630 | Viscoelastic Solids | 3 |
| E M A 700 | Theory of Elasticity | 3 |
| E M A/M E 703 | Plasticity Theory and Physics | 3 |
| E M A 705 | Advanced Topics in Finite Elements | 3 |
| E M A/M E 706 | Plates, Shells and Pressure Vessels | 3 |
| E M A/M E 708 | Advanced Composite Materials | 3 |
| E M A/M E 722 | Introduction to Polymer Rheology | 3 |
| M/E/B M E 603 | Topics in Bio-Medical Engineering (Topic: FE for Biomechanics) | 1-3 |
| M E 753 | Friction, Lubrication and Wear | 3 |

**Fluid Mechanics**

| E M A 521 | Aerodynamics | 3 |
| E M A 524 | Rocket Propulsion | 3 |
| E M A 622 | Mechanics of Continua | 3 |
| M E 563 | Intermediate Fluid Dynamics | 3 |
| M E 572 | Intermediate Gas Dynamics | 3 |
| M E 573 | Computational Fluid Dynamics | 3 |
| M E 769 | Combustion Processes | 3 |
| M E 770 | Advanced Experimental Instrumentation | 3 |
| M E 774 | Chem Kinetics of Combust Systems | 3 |
| M E/CIV ENGR/ E M A 775 | Turbulent Heat and Momentum Transfer | 3 |
| MATH 705 | Mathematical Fluid Dynamics | 3 |

**Dynamics**

| E M A 523 | Flight Dynamics and Control | 3 |
| E M A/M E 540 | Experimental Vibration and Dynamic System Analysis | 3 |
| E M A 542 | Advanced Dynamics | 3 |
| E M A 545 | Mechanical Vibrations | 3 |
**Policies**

**Graduate School Policies**

The Graduate School's Academic Policies and Procedures ([https://grad.wisc.edu/acadpolicy/](https://grad.wisc.edu/acadpolicy/)) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

**Named Option-Specific Policies**

**Prior Coursework**

**Graduate Work from Other Institutions**

With advisor and EP Graduate Studies Committee approval, students may use up to 6 credits of relevant coursework from a prior graduate program. Please review the Graduate Program Handbook (see contact box) for information about use and restrictions to this policy.

**UW-Madison Undergraduate**

With faculty approval, students who have received their undergraduate degree from UW-Madison may apply up to 7 credits numbered 400 or above toward the minimum graduate degree credit requirement. This work would not be allowed to count toward the 50% graduate coursework minimum unless taken at the 700 level or above. No credits can be counted toward the minimum graduate residence credit requirement. Coursework earned five or more years prior to admission to a master's degree is not allowed to satisfy requirements.

With faculty approval, students who have received an ABET-accredited undergraduate degree (not including UW-Madison) may be eligible to apply up to 7 credits of their undergraduate coursework toward the Minimum Graduate Degree Credit Requirement. No credits can be counted toward the Minimum Graduate Residence Credit Requirement, nor the Minimum Graduate Coursework (50%) Requirement. Coursework earned five or more years prior to admission to a master’s degree is not allowed to satisfy requirements.

**UW-Madison University Special**

With program approval, students are allowed to count up to 15 credits of coursework numbered 400 or above taken as a UW-Madison Special student toward the minimum graduate residence credit requirement, and the minimum graduate degree credit requirement. UW-Madison coursework taken as a University Special student would not be allowed to count toward the 50% graduate coursework minimum unless taken at the 700 level or above. Coursework earned five or more years prior to admission to a master’s is not allowed to satisfy requirements.

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**Independent Study/Research Credits**

All students must take a minimum of 3 credits of E M A 599. A maximum of 6 credits of E M A 599 may be used toward the 30-credit minimum. Students in the thesis track may use a maximum of 12 credits of E M A 599 and E M A 790, combined, toward the 30-credit minimum. Credit for E M A 790 will be granted toward meeting the M.S. requirements only when a formal M.S. thesis is submitted and approved by the thesis committee.

Thesis pathway: minimum of 3 credits of E M A 599 and a minimum of 6 credits of E M A 790.
PROBATION
A semester GPA below 3.0 will result in the student being placed on academic probation. If a semester GPA of 3.0 is not attained during the subsequent semester of full time enrollment (or 12 credits of enrollment if enrolled part-time) the student may be dismissed from the program or allowed to continue for one additional semester based on advisor appeal to the Graduate School.

ADVISOR / COMMITTEE
Each student is required to meet with his or her advisor prior to registration every semester.

CREDITS PER TERM ALLOWED
15 credits

TIME LIMITS
Students with a Bachelor of Science in Engineering Mechanics or equivalent are typically expected to complete the Master of Science in 3 semesters. Students with non-EM backgrounds will typically be permitted 4 semesters to complete their Master’s if more than 27 credits are required.

GRIEVANCES AND APPEALS
These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://doso.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hib/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
  - Dean of Students Office (https://doso.students.wisc.edu/) (for all students to seek grievance assistance and support)
  - Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
  - Employee Disability Resource Office (https://employeeabilities.wisc.edu/) (for qualified employees or applicants with disabilities to have equal employment opportunities)
  - Graduate School (https://grad.wisc.edu/) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
  - Office of Compliance (https://compliance.wisc.edu/) (for class harassment and discrimination, including sexual harassment and sexual violence)
  - Office of Student Conduct and Community Standards (https://conduct.students.wisc.edu/) (for conflicts involving students)
  - Ombuds Office for Faculty and Staff (http://www.ombuds.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
  - Title IX (https://compliance.wisc.edu/titleix/) (for concerns about discrimination)

EM Grievance Procedures
Students who feel that they have been treated unfairly have the right to a prompt hearing of their grievance. Such complaints may involve course grades, classroom treatment, advising, various forms of harassment, or other issues. Any student or potential student may use these procedures.

- The student should speak first with the person toward whom the grievance is directed. In most cases, grievances can be resolved at this level.
- Should a satisfactory resolution not be achieved, the student should contact the program’s Grievance Advisor to discuss the grievance. The Graduate Student Coordinator can provide students with the name of this faculty member, who facilitates problem resolution through informal channels. The Grievance Advisor is responsible for facilitating any complaints or issues of students. The Grievance Advisor first attempts to help students informally address the grievance prior to any formal complaint. Students are also encouraged to talk with their faculty advisors regarding concerns or difficulties if necessary. University resources for sexual harassment concerns can be found on the UW Office of Equity and Diversity website.
- If the issue is not resolved to the student’s satisfaction, the student can submit the grievance to the Grievance Advisor in writing, within 60 calendar days of the alleged unfair treatment.
- On receipt of a written complaint, a faculty committee will be convened by the Grievance Advisor to manage the grievance. The program faculty committee will obtain a written response from the person toward whom the complaint is directed. The response will be shared with the person filing the grievance.
- The faculty committee will determine a decision regarding the grievance. The Grievance Advisor will report on the action taken by the committee in writing to both the student and the party toward whom the complaint was directed within 15 working days from the date the complaint was received.
- At this point, if either party (the student or the person toward whom the grievance is directed) is unsatisfied with the decision of the faculty committee, the party may file a written appeal. Either party has 10 working days to file a written appeal to the College of Engineering.

The Assistant Dean for Graduate Affairs (engr-dean-graduateaffairs@engr.wisc.edu) provides overall leadership for graduate education in the College of Engineering (CoE) and is a point of contact for graduate students who have concerns about education, mentoring, research, or other difficulties.

The Graduate School has procedures for students wishing to appeal a grievance decision made at the college level. These policies are described in the Academic Policies and Procedures at https://grad.wisc.edu/academic-policies/.

OTHER
n/a
PROFESSIONAL DEVELOPMENT

GRADUATE SCHOOL RESOURCES
Take advantage of the Graduate School’s professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

PEOPLE

FACULTY

PROFESSORS
Paul Wilson (Chair)
Riccardo Bonazza
Curt A. Bronkhorst
Wendy Crone
Chris Hegna
Douglass Henderson
Roderic Lakes
Oliver Schmitz
Carl Sovinec
Kumar Sridharan
Fabian Waleffe

ASSOCIATE PROFESSORS
Adrien Couet

ASSISTANT PROFESSORS
Jennifer Choy
Stephanie Diem
Jennifer Franck
Benedikt Geiger
Benjamin Lindley
Jacob Notbohm
Ramathasan Thevamaran
Yongfeng Zhang

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