ENGINEERING MECHANICS: RESEARCH, M.S.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

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

NAMED OPTION REQUIREMENTS

MODE OF INSTRUCTION

<table>
<thead>
<tr>
<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>
</tr>
</tbody>
</table>

Mode of Instruction Definitions

**Accelerated**: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

**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

**Required Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
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<tr>
<td></td>
<td>The program requires 30 credits of technical coursework approved by the student’s advisor. All courses must numbered 500 or above. At least 15 credits must be taken in courses numbered 600 and above OR from the following list:</td>
<td>15</td>
</tr>
<tr>
<td>E M A/CIV ENGR/</td>
<td>Composite Materials</td>
<td></td>
</tr>
<tr>
<td>M E 508</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E M A 519</td>
<td>Fracture Mechanics</td>
<td></td>
</tr>
<tr>
<td>E M A 522</td>
<td>Aerodynamics Lab</td>
<td></td>
</tr>
<tr>
<td>E M A 523</td>
<td>Flight Dynamics and Control</td>
<td></td>
</tr>
<tr>
<td>E M A/M E 540</td>
<td>Experimental Vibration and Dynamic System Analysis</td>
<td></td>
</tr>
<tr>
<td>E M A/MS &amp; E 541</td>
<td>Heterogeneous and Multiphase Materials</td>
<td></td>
</tr>
<tr>
<td>E M A/E P 547</td>
<td>Engineering Analysis I</td>
<td></td>
</tr>
<tr>
<td>E M A/E P 548</td>
<td>Engineering Analysis II</td>
<td></td>
</tr>
<tr>
<td>E M A/M E 570</td>
<td>Experimental Mechanics</td>
<td></td>
</tr>
<tr>
<td><strong>Mathematics Requirements</strong></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Students must take at least 3 credits (1 course) from the following list:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E M A/E P 547</td>
<td>Engineering Analysis I</td>
<td></td>
</tr>
<tr>
<td>E M A/E P 548</td>
<td>Engineering Analysis II</td>
<td></td>
</tr>
<tr>
<td>MATH 519</td>
<td>Ordinary Differential Equations</td>
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</tbody>
</table>

GPA Requirement

(https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203)/).

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.

Assessments and Examinations

A thesis is not required for a Master’s degree in Engineering Mechanics. Credit for Master’s research (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. If submitting a M.S. thesis, a thesis Oral Defense is required. Candidates must pass an oral exam administered by a three-member committee, selected by the student’s advisor. At least two of the committee members must be members of the UW–Madison Graduate Faculty. (For more information, see https://grad.wisc.edu/documents/committees/). Typically, the student presents an overview of their thesis/research, and then the examiners ask questions in closed session. See the Graduate School’s information https://grad.wisc.edu/current-students/masters-guide/ and note the requirement for an advisor approval page; the form that appears in Appendix C of the Handbook may be used.

Language Requirements

No language requirements.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 521</td>
<td>Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 522</td>
<td>Analysis II</td>
<td></td>
</tr>
<tr>
<td>MATH 540</td>
<td>Linear Algebra II</td>
<td></td>
</tr>
<tr>
<td>MATH 619</td>
<td>Analysis of Partial Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 623</td>
<td>Complex Analysis</td>
<td></td>
</tr>
<tr>
<td>MATH 703</td>
<td>Methods of Applied Mathematics 1</td>
<td></td>
</tr>
<tr>
<td>MATH 704</td>
<td>Methods of Applied Mathematics-2</td>
<td></td>
</tr>
<tr>
<td>MATH/COMP SCI 714</td>
<td>Methods of Computational Mathematics I</td>
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</tr>
</tbody>
</table>

**Breadth Requirement**

Students must take at least 5 courses from the list below. At least 3 must be identified by a *. 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**

- CIV ENGR/M E 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/E 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/E M E 722 Introduction to Polymer Rheology 3
- M E/B M E 516 Finite Elements for Biological and Other Soft Materials 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/M E A 775 Turbulent Heat and Momentum Transfer 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
- E M A/ASTRON 550 Astrodynamics 3
- E M A 610 Structural Finite Element Model Validation * 3
- E M A 642 Satellite Dynamics * 3
- E M A 742 Theory and Applications in Advanced Dynamics * 3
- E M A 745 Advanced Methods in Structural Dynamics * 3
- E M A 747 Nonlinear and Random Mechanical Vibrations * 3
- M E/CIV ENGR 577 Automatic Controls Laboratory 4
- M E 740 Advanced Vibrations 3
- M E 747 Advanced Computer Control of Machines and Processes 3
- M E 748 Optimum Design of Mechanical Elements and Systems 3

**Depth Requirement**

At least 2 courses (6 credits) must numbered 700 or above in mechanics, from the following list:

- Any E M A course except E M A 790, E M A 890, or E M A 990.
- E M A 601 Special Topics courses may only be counted as course numbered 700+ if designated as such by the instructor.
- CBE 720 Microhydrodynamics, Brownian Motion, and Complex Fluids
- CIV ENGR/G L E 730 Engineering Properties of Soils
- CIV ENGR/G L E 735 Soil Dynamics
- MATH 705 Mathematical Fluid Dynamics
- M E 740 Advanced Vibrations
- M E 746 Dynamics of Controlled Systems
- M E 747 Advanced Computer Control of Machines and Processes
- M E 748 Optimum Design of Mechanical Elements and Systems
- M E 751 Advanced Computational Dynamics
- M E 753 Friction, Lubrication and Wear
- M E 769 Combustion Processes
- M E 770 Advanced Experimental Instrumentation
- M E 774 Chem Kinetics of Combust Systems
- M E/CIV ENGR/M A 775 Turbulent Heat and Momentum Transfer

**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\(^1\): minimum of 3 credits of E M A 599 and a minimum of 6 credits of E M A 790

Independent study pathway\(^1\): minimum of 3 credits of E M A 599

\(^1\)These pathways are internal to the program and represent different curricular paths a student can follow to earn this degree. Pathway names do not appear in the Graduate School admissions application, and they will not appear on the transcript.

**Optional Seminar Credits**

Up to 3 credits of Mechanics Seminar may be used to count toward the 30-credit minimum.