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

<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>
</tbody>
</table>

The program requires 30 credits of technical coursework approved by the student’s advisor.

All courses must be numbered 500 or above. At least 15 credits must be taken in courses numbered 600 and above OR from the following list:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>E M A/CIV ENGR/508</td>
<td>Composite Materials</td>
</tr>
<tr>
<td>E M A 519</td>
<td>Fracture Mechanics</td>
</tr>
<tr>
<td>E M A 522</td>
<td>Aerodynamics Lab</td>
</tr>
<tr>
<td>E M A 523</td>
<td>Flight Dynamics and Control</td>
</tr>
<tr>
<td>E M A/M E 540</td>
<td>Experimental Vibration and Dynamic System Analysis</td>
</tr>
<tr>
<td>E M A/ M S &amp; E 541</td>
<td>Heterogeneous and Multiphase Materials</td>
</tr>
<tr>
<td>E M A/E P 547</td>
<td>Engineering Analysis I</td>
</tr>
<tr>
<td>E M A/E P 548</td>
<td>Engineering Analysis II</td>
</tr>
<tr>
<td>E M A/M E 570</td>
<td>Experimental Mechanics</td>
</tr>
</tbody>
</table>

The program follows the Graduate School’s GPA Requirement policy (https://policy.wisc.edu/library/UW-1203). 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.

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.

REQUIRED COURSES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>MATH 519</td>
<td>Ordinary Differential Equations</td>
</tr>
</tbody>
</table>

Students must take at least 3 credits (1 course) from the following list:

<table>
<thead>
<tr>
<th>Study</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>E M A/E P 547</td>
<td>Engineering Analysis I</td>
</tr>
<tr>
<td>E M A/E P 548</td>
<td>Engineering Analysis II</td>
</tr>
<tr>
<td>MATH 519</td>
<td>Ordinary Differential Equations</td>
</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
- **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 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/E M A 775** Turbulent Heat and Momentum Transfer 3
- **MATH 705** Mathematical Fluid Dynamics 3

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### 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/E C E 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/E M A 775** Turbulent Heat and Momentum Transfer

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**Independent Study/Research Credits**
All students must take a minimum of 3 credits of EMA 599. A maximum of 6 credits of EMA 599 may be used toward the 30-credit minimum. Students in the thesis track may use a maximum of 12 credits of EMA 599 and EMA 790, combined, toward the 30-credit minimum. Credit for EMA 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 EMA 599 and a minimum of 6 credits of EMA 790

Independent study pathway\(^1\): minimum of 3 credits of EMA 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.