ENGINEERING MECHANICS, PH.D.

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.

MAJOR REQUIREMENTS
MODE OF INSTRUCTION

Face to Face	Evening/Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

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

Requirement	Detail
Minimum Credit Requirement	60 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	30 credits must be graduate-level coursework. Details can be found in the Graduate School's Minimum Graduate Coursework (50%) policy (https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/)).In addition, at least 18 of the non-research credits must be in classes having the graduate-level designation.

Overall Graduate GPA Requirement	3.00 GPA required. This program follows the Graduate School's policy: 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	Ph.D. qualifying examination is required of all students. After acceptance of the student's doctoral plan of study, the student must take an oral preliminary examination. Final oral examination is required at the end of the thesis work.
Language Requirements	No language requirements.
Graduate School Breadth Requirement	All doctoral students are required to complete a doctoral minor or graduate/professional certificate as approved by their advisor. Students should select one of the following options: • Option A (External Minor): Fulfillment of this minor requires approval of the doctoral minor program. This minor must be outside of the student's doctoral major program. • Option B (Distributed Minor): Fulfillment of this minor requires 9 course credits. The coursework should form a coherent group of courses for which graduate credit is allowed. The approval of the faculty advisor and ME Graduate Committee is required. • Option C (Graduate/Professional Certificate): Fulfillment of this option requires successful completion of a Graduate/Professional certificate in a program outside of the student's doctoral major program.

REQUIRED COURSES

At least 36 of the required 60 credits must be in classes satisfying the following general requirements and mathematics, breadth and depth requirements.

Code	Title	Credits
General		
All courses must be numbered 500 or above. At least 21 credits must be numbered 600 and above OR from the following list:		21
E M A/CIV ENGR/ M E 508	Composite Materials	
E M A 519	Fracture Mechanics	
E M A 522	Aerodynamics Lab	
E M A 523	Flight Dynamics and Control	
E M A/M E 540	Experimental Vibration and Dynamic System Analysis	
E M A/ M S & E 541	Heterogeneous and Multiphase Materials	
E M A/E P 547	Engineering Analysis I	
E M A/E P 548	Engineering Analysis II	

E M A/M E 570	Experimental Mechanics	

Mathematics Requirements   **6**

At least 6 credits (2 courses) must be in applied mathematics from the following list:

E M A/E P 547	Engineering Analysis I	
E M A/E P 548	Engineering Analysis II	
MATH 519	Ordinary Differential Equations	
MATH 521	Analysis I	
MATH 522	Analysis II	
MATH 540	Linear Algebra II	
MATH 619	Analysis of Partial Differential Equations	
MATH 623	Complex Analysis	
MATH 703	Methods of Applied Mathematics 1	
MATH 704	Methods of Applied Mathematics-2	
MATH/ COMP SCI 714	Methods of Computational Mathematics I	
MATH/ COMP SCI 715	Methods of Computational Mathematics II	

Breadth Requirement

As part of their M.S. or Ph.D., students must have taken courses from at least 2 of the 3 areas defined below. For each of the 2 areas, the student must have taken at least 2 courses. The courses must be at a similar level to those listed below.

Solid Mechanics

E M A 506	Advanced Mechanics of Materials I	3
E M A/CIV ENGR/ M E 508	Composite Materials	3
M E/B M E 516	Finite Elements for Biological and Other Soft 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 753	Friction, Lubrication and Wear	3

Fluid Mechanics

E M A 521	Aerodynamics	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
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   **12**

At least 4 courses (12 credits) must be numbered 700 or above in mechanics, applied mathematics, or computer science. At least 2 of the courses (6 credits) must be from List 1 (below), and the remaining 2 courses (6 credits) may be from List 1 or List 2.

List 1		*6–12*
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 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	
List 2		*0–6*
COMP SCI/ MATH 714	Methods of Computational Mathematics I	
COMP SCI/ MATH 715	Methods of Computational Mathematics II	
COMP SCI/ E C E 760	Machine Learning	
E C E 717	Linear Systems	
E C E 719	Optimal Systems	
E C E/ COMP SCI 761	Mathematical Foundations of Machine Learning	
E C E/CBE/ MATH 777	Nonlinear Dynamics, Bifurcations and Chaos	
E C E/COMP SCI/ STAT 861	Theoretical Foundations of Machine Learning	
MATH 703	Methods of Applied Mathematics 1	
MATH 704	Methods of Applied Mathematics-2	
M E 718	Modeling and Simulation in Polymer Processing	
M E/E C E 739	Kinematics, Dynamics, and Control of Robotic Manipulators	
M E 758	Solid Modeling	
M E 761	Topics in Thermodynamics	
M E 764	Advanced Heat Transfer I– Conduction	
M S & E 748	Structural Analysis of Materials	
M S & E 750	Imperfections and Mechanical Properties	
M S & E 760	Molecular Modeling of Materials	
PHYSICS 711	Theoretical Physics–Dynamics	
PHYSICS 715	Statistical Mechanics	
PHYSICS 721	Theoretical Physics– Electrodynamics	
PHYSICS 731	Quantum Mechanics	
PHYSICS 732	Quantum Mechanics	
PHYSICS 751	Advanced Solid State Physics	
PHYSICS 801	Special Topics in Theoretical Physics (when taught as Nanostructures in Science and Technology)	

It is acceptable for students who earned an M.S. degree in Engineering Mechanics at UW–Madison to use coursework completed while in the M.S. degree program to meet the requirements above.