Mechanical Engineering, PhD

Research

The mechanical engineering graduate program in the College of Engineering emphasizes in-depth learning and research. In collaboration with faculty across campus, the mechanical engineering faculty are currently researching a diverse range of topics within the field. For more information, see the Department of Mechanical Engineering website.

Design and Uncertainty Quantification

The Design and Uncertainty Quantification focus area is concerned with the design optimization of complex mechanical systems in the presence of uncertainty. The focus area emphasizes developments of sound theoretical foundation, novel computational methods and algorithms, and modern software tools aimed at creating state-of-the-art engineering design of automotive, aerospace, naval, nuclear, and biomedical systems. Current areas of excellence include artificial muscles and smart materials design, ship hydrodynamics, design sensitivity analysis, uncertainty quantification, and reliability-based design optimization.

Fluid Dynamics

The Fluid Dynamics focus area covers a wide variety of topics with flow of liquids and gases as the common denominator. The graduate program in fluid dynamics emphasizes fundamental principles and applications, and the numerical and experimental techniques used to obtain and analyze fluid flows. Areas of concentration include computational fluid dynamics, experimental fluid dynamics, medical flows, naval hydrodynamics, biologically inspired air and underwater vehicles, multiphase flows, cavitation and ventilation, and fluid-structure interaction and turbulence, among others.

Heat Transfer and Combustion

The Heat Transfer and Combustion focus area applies to real-world systems in manufacturing and materials processing, propulsion, energy production, and other areas. The graduate program emphasizes fundamental principles and techniques required for experimental and theoretical research. Current areas of research include solidification of materials, metal casting, 3D printing, laser-materials interaction, power plants and propulsion devices such as automobile and aircraft engines, energy conservation and production, energy storage, complex reactive materials, and machine learning in computational modeling and simulation.

Manufacturing and Materials

The Manufacturing and Materials focus area involves fundamental materials processing science, technological advancement in manufacturing applications, and the development of new manufacturing processes and new material functions. Current and emerging thrust areas include solidification, metal casting, laser materials processing, micro- and nanofabrication, joining, ultrasonic welding, machining, microstructure evolution, manufacturing process modeling and simulation, artificial muscles, artificial camouflage, smart materials, and material characterizations. These research activities are well supported by federal and state agencies and the manufacturing industry.

Robotics, Controls, and Autonomous Systems

Robotics, Controls, and Autonomous Systems (RCAS) are concerned with the modeling, analysis, design, and control of dynamic systems. The graduate program in RCAS emphasizes fundamental principles and techniques of robotics, control theory, and artificial intelligence. Areas of concentration include computational intelligence, dynamic autonomous systems, cyber-physical systems, and networked robotic systems with potential applications in self-driving cars; medical and assistive robots for surgery and rehabilitation; industrial co-robots for human-robot collaboration; and uncrewed aerial, ground, and underwater vehicles.

Solid Mechanics and Multibody Dynamics

Solid Mechanics and Multibody Dynamics are concerned with the behavior of solid materials and flexible bodies, especially their deformation, motion, and stress responses under the action of applied loads. The graduate program in solid mechanics and multibody dynamics emphasizes the theoretical foundations and problem-solving techniques for engineering applications. Current research focuses of the faculty include multiscale mechanics of materials, biomechanics, vehicle dynamics, computational mechanics, multibody dynamics, and optimization.

Learning Outcomes

Graduates will:

- have extensive knowledge of mechanical engineering topics and mastery of advanced concepts in their specific area of study;
- be able to identify, formulate, analyze, and solve research problems, thereby advancing knowledge through creative scholarship; and
- develop professional skills that include effective communication, leadership, and ethical conduct in professional, social, and scholarly activities.

Requirements

The Doctor of Philosophy program in mechanical engineering requires 72 s.h. of graduate credit, including a minimum of 42 s.h. in mechanical engineering courses (prefix ME) with at least 12 s.h. selected from courses numbered 6000 or above. Students also must complete a minimum of 12 s.h. in thesis research in ME:7299 Research: Mechanical Engineering PhD Dissertation. A maximum of 30 credits of transfer credit may be applied toward the degree and coursework requirements. Students must maintain a cumulative grade-point average higher than 3.25 to earn the degree.

To be formally admitted to the PhD program, students must pass the qualifying examination. Information regarding the details of the qualifying exam procedure can be obtained from the Department of Mechanical Engineering website.

Students must complete ENGR:7270 Engineering Ethics during their first fall semester of enrollment. They must register for ME:6191 Graduate Seminar: Mechanical Engineering each fall and spring semester until successful completion of their final examination or thesis defense; credit in these courses does not substitute for regular coursework or research credit hours. They must have their course plan approved by their advisor prior to registration each semester.

Admission

Applicants must meet the admission requirements of the Graduate College; for detailed information about Graduate College policies, see the Manual of Rules and Regulations on the Graduate College website.

Minimum Requirements for Admission

Graduate Record Examination (GRE) General Test Requirements

GRE scores have been waived for applications to begin the program in the fall 2022 and spring 2023 semesters.

International Student Requirements

Requirements include a TOEFL score of 550 or higher on the paper-based test (PBT) or a score of 81 or higher on the internet-based test (iBT). Alternatively, an International English Language Testing System (IELTS) score of 7 is required.

Newly admitted graduate students who present TOEFL scores below 600 on the PBT or below 100 on the iBT are required to complete an English Proficiency Evaluation on campus before their first registration for classes. IELTS test takers, regardless of score, are required to take an on-campus English Proficiency Evaluation.

There is no conditional admission for graduate students whose TOEFL scores are below 550 on the PBT, below 81 on the iBT, or below 6.5 on the IELTS.

Applicants with lower grade-point averages (GPAs) and/or GRE or TOEFL test scores may be considered for conditional admission under exceptional circumstances. Those admitted conditionally must achieve regular standing within one semester (excluding summer sessions) after admission by attaining a GPA of at least 3.00 on their first 9 s.h. at the University of Iowa. The Graduate College cancels registration for the subsequent semester for students who have not submitted their GRE and/or TOEFL scores by the end of the first semester after admission.

Some of the requirements may be waived in select cases when other components of the application are particularly outstanding. Satisfaction of the requirements does not guarantee admission.

Other Requirements

Students must have earned a minimum GPA of at least 3.00 on a 4.00 scale, submit three letters of recommendation, unofficial transcripts (with official transcripts submitted if accepted), and a statement of purpose.

Applying for Admission

Refer to the University of Iowa Graduate Admissions website for information about applying for graduate studies.

Graduate Application Deadlines

Applications for fall: Jan. 15 (application deadline), March 1 (admission decision).

Applications for spring: Sept. 1 (application deadline), Oct. 1 (admission decision).

All requirements must be fulfilled by the respective deadline dates. Applicants who apply after a deadline date must be sponsored by a mechanical engineering faculty member for a deadline waiver.

Financial Support

Financial support is available to PhD students, primarily through graduate assistantships in teaching or research from the Department of Mechanical Engineering, the Driving Safety Research Institute, IIHR—Hydroscience and Engineering, and the University of Iowa Technology Institute. These awards may be made on a semester, academic year, or calendar year basis. Awards and reappointments are competitive and are based on a student's potential contribution to the teaching and research goals of the department. Students who fulfill their assistantship responsibilities and continue to make satisfactory progress toward their degree objective receive preference in new assistantship awards.

Students with assistantship appointments of one-quarter-time or more must register for a minimum of 9 s.h. during fall and spring semesters until they have completed 72 s.h. of coursework and research beyond the baccalaureate degree. Once they meet these minimums, students must register for a graduate seminar each semester until they have successfully completed their final examination or thesis defense. All registrations should accurately reflect the amount and type of work undertaken, the use of university facilities, and the amount of consultation with the faculty.

Career Advancement

Engineering Career Services develops and promotes experiential education and professional opportunities for students in the College of Engineering. Professional staff coordinate the college's co-op and internship program, engage in employer outreach, and provide opportunities for students to network with employers, including an engineering career fair each semester and other programming related to career development.

Engineering Career Services offers individual advising and class presentations on résumé and cover letter preparation, job and internship search strategies, interviewing skills, job offer evaluation, and much more. Engineering Career Services partners with the Pomerantz Career Center to facilitate on-campus interviewing, postgraduation outcome collection, and the university's online recruiting system, Handshake.

Academic Plans

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

Mechanical Engineering, PhD

Course	Title	Hours
Academic Career		
Any Semester		
72 s.h. must be graduate level coursework; a maximum of 30 s.h. of graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a, b, c]		
	Hours	**0**
First Year		
Any Semester		
Qualifying Exam [d]		
	Hours	**0**
Fall		
ENGR:7270	Engineering Ethics [e, f]	1
ME required course		3
ME required course		3
ME required course		3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**11**
Spring		
ME required course		3
ME required course		3
Elective course [h]		3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Second Year		
Fall		
ME required course		3
ME required course		3
Elective course [h]		3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Spring		
ME required course		3
ME required course		3
Elective course [h]		3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Third Year		
Any Semester		
Dissertation Prospectus [i]		
Comprehensive Exam [j]		
	Hours	**0**
Fall		
ME required course		3
Elective course [h]		3
ME:7299	Research: Mechanical Engineering PhD Dissertation [k]	3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Spring		
ME required course		3
Elective course [h]		3
ME:7299	Research: Mechanical Engineering PhD Dissertation [k]	3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Fourth Year		
Fall		
Elective course [h]		3
Elective course [h]		3
ME:7299	Research: Mechanical Engineering PhD Dissertation [k]	3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
	Hours	**10**
Spring		
Elective course [h]		3
Elective course [h]		3
ME:7299	Research: Mechanical Engineering PhD Dissertation [k]	3
ME:6191	Graduate Seminar: Mechanical Engineering [f, g]	1
Final Exam [l]		
	Hours	**10**
	Total Hours	**81**

a Students may design their program around a particular research and study area; see General Catalog and ME website for specifics. Work with faculty advisor to determine appropriate graduate level coursework and sequence.

b A minimum of 42 s.h. (not including thesis research) must be from courses taken beyond the BS degree. Of these a minimum of 12 s.h. must be from Mechanical Engineering courses numbered 6000 or higher. Students may also select Mechanical Engineering courses numbered 4100 or higher except for ME:4186 which is not eligible for graduate credit.

c Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.

d Complete two qualifying exam courses during first two semesters in the program; must take ME:5113 plus one graduate level course in a focus area with a grade of A-minus or higher in each. Focus area courses are chosen in consultation with the faculty advisor from a specified list. More information is found in the General Catalog and on department website.

e Must be completed during first semester.

f Credit for this course does not substitute for regular coursework or research credit hours.

g Attendance required every fall and spring semester until degree completion.

h Work with academic advisor to determine elective graduate coursework and sequence.

i Submit dissertation prospectus to the exam committee not later than two weeks before the comprehensive exam.

j Oral exam to be completed after passing the qualifying exam and upon completion of coursework in the specified area of study no later than 28 months after entering the doctoral program. The exam will focus on the dissertation prospectus and related areas.

k Complete a minimum 12 s.h. of credit in thesis research.
l Dissertation defense.