Mechanical Engineering, Ph.D.

Research
The mechanical engineering graduate program in the College of Engineering emphasizes in-depth learning and research. In collaboration with faculty across campus, the 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 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, 3-D 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 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.

Requirements
The Doctor of Philosophy program in mechanical engineering requires 72 s.h. of graduate credit, including research for the dissertation. A minimum of 42 s.h. must be earned in coursework (except thesis research), including at least 18 s.h. in mechanical engineering courses (prefix ME) numbered at the 6000 and 7000 level. At least 12 s.h. of Ph.D. thesis research must be earned in ME:7299 Research: Mechanical Engineering Ph.D. Dissertation, which is graded by a student's advisor. Students must have a final cumulative g.p.a. higher than 3.25 to earn their degree. Students must have their graduate course plan approved by their advisor prior to registration. They must complete ENGR:7270 Engineering Ethics during their first fall semester of enrollment. All students must register for ME:6191 Graduate Seminar: Mechanical Engineering each fall and spring semester until successful completion of their final examination or thesis defense.

To be formally admitted to the Ph.D. program, students must pass the qualifying examination. This examination is administered by the Graduate Committee and consists of a written exam during the first three weeks of their coursework in the spring semester. Upon receiving the M.S. degree in mechanical engineering from The University of Iowa and entering the Ph.D. program, students must take the qualifying examination at its first offering. Students from another institution with a M.S. degree must take the qualifying examination within three semesters (excluding summer session). Those who enter with a B.S. degree must take the qualifying examination within four semesters (excluding summer session).

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

Applicants who have earned a baccalaureate or master's degree in engineering curriculum or in the mathematical or physical sciences are eligible to be considered for admission to graduate study in mechanical engineering. In order to be considered for regular admission, applicants must have a g.p.a. of at least 3.25 on a 4.00 scale on all previous college-level work and Graduate Record Examination (GRE) General Test scores of at least 500 verbal, 750 quantitative, and 4.5 in analytical writing. Students whose first language is not English must score at least 81 (internet-based) on the Test of English as a Foreign language (TOEFL).

Applicants with a lower grade-point average and/or GRE or TOEFL test scores may be considered for conditional admission, under exceptional circumstances. Applicants admitted conditionally must achieve regular standing within one semester (excluding summer sessions) after admission by attaining a g.p.a. 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.

### Financial Support

Financial support is available to Ph.D. students, primarily through graduate assistantships in teaching or research from the Department of Mechanical Engineering, IIHR—Hydroscience and Engineering, the National Advanced Driving Simulator, 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. All applications for financial support should be submitted directly to the department chair.

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 course and research work 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

The engineering profession is a foundation for a variety of careers in industry, medicine, law, government, and consulting.

Engineering Professional Development (EPD) 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.