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, 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 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 a minimum of 42 s.h. in mechanical engineering courses (prefix ME) with at least 12 s.h. selected from courses numbered ME:6000 or above. Students also must complete a minimum of 12 s.h. in thesis research in ME:7299 Research: Mechanical Engineering Ph.D. Dissertation. A maximum of 30 credits of transfer credit may be applied toward the degree and coursework requirements. Students must maintain a cumulative g.p.a. higher than 3.25 to earn the degree.

To be formally admitted to the Ph.D. 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 of the Graduate College on the Graduate College website.

Minimum Requirements for Admission

Graduate Record Examination (GRE) General Test Requirements

Quantitative Reasoning: 80th percentile or above (score=159)
Verbal Reasoning: 60th percentile or above (score=152)
Analytical Writing: 50th percentile or above (score=4.0)

International Student Requirements

Requirements include a minimum 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). 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.

Alternatively, a International English Language Testing System (IELTS) score of 7 is required. 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 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 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.

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 g.p.a. 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 Graduate Admissions website for information about applying for graduate studies.

Graduate Application Deadlines

Applications for fall: January 15 (application deadline), March 1 (admission decision)
Applications for spring: September 1 (application deadline), October 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 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.

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 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 also offers individual advising and class presentations on résumé and cover letter preparation, job and internship search strategies, interviewing skills, and job offer evaluation.