THE DEPARTMENT OF Mechanical & Industrial Engineering’s graduate programs educate students utilizing advanced contemporary methods to prepare them for professional careers in engineering research, design and teaching. Students’ plans of study are based on their backgrounds and career objectives. Department faculty members have expertise in areas related to applied statistics, design and manufacturing, energy conversion, ergonomics, fluid mechanics, heat transfer, human factors, information technology, mechanical systems, operations research, reliability and production control, and solid mechanics.

Many Mechanical Engineering faculty members conduct research in affiliation with various College of Engineering and University of Iowa centers and institutes, including the Center for Computer-Aided Design (CCAD), IIHR - Hydroscience and Engineering (IIHR), and the National Advanced Driving Simulator (NADS). Department faculty also collaborate with researchers at The University of Iowa Medical School, which manages one of the largest and most distinguished teaching hospitals in the country.

Department of Mechanical & Industrial Engineering

3131 Seamans Center for the Engineering Arts and Sciences

The University of Iowa
Iowa City, Iowa 52242-1527

(319) 335-5668
THE UNIVERSITY OF IOWA

The University of Iowa, a Big Ten University, enrolls approximately 28,000 students and has about 1,200 faculty members. The College of Engineering has approximately 87 tenured and tenure-track faculty members and a combined undergraduate and graduate enrollment of about 2,000 students. The College is well integrated into the university community and capitalizes on its special environment through a multitude of interdisciplinary research efforts and by using the academic richness of the University to enhance curriculum offerings.

MECHANICAL ENGINEERING

The University of Iowa’s Mechanical Engineering Program has broad thrusts in fluid mechanics, mechanical systems, and thermal sciences.

Fluid Mechanics

Graduate study in fluid mechanics is designed to provide students with a foundation in theoretical, computational, and experimental aspects of the subject. Emphasis is on fundamental principles and techniques of solving problems in the various fields of fluids engineering. Considerable emphasis is given to the use of computers, both in the mathematical modeling of flow phenomena and in the acquisition and processing of experimental data. Most fluid mechanics courses are offered by the Mechanical Engineering program, though students are encouraged to take courses offered by the Mathematics, Physics, and Chemistry departments and by other departments in the College of Engineering.

Current fluid mechanics research projects include: biological fluid flows; vortex dynamics; unsteady flows; flow separation and control; fluid-structure interaction; ship hydrodynamics; propulsor flow and propulsor-body interactions; free-surface effects; quantitative flow visualization and image processing; LDV and thermal anemometry for flow analysis; four-dimensional data assimilation; large-eddy simulation of turbulent flows. The fluid mechanics program closely collaborates with the IIHR - Hydroscience and Engineering, which houses some of the most modern research facilities in the world. The equipment available to graduate students includes several wind tunnels and hydraulic flumes, an environmental flow facility, a ship towing tank, two special low-temperature flow facilities for investigation of ice phenomena, hot-wire and laser anemometer systems, particle-image velocimetry systems and computer-based data-acquisition systems. IIHR workshops provide the necessary support. In addition to in-house workstations and computers, department faculty and students make extensive use of supercomputers at several national centers.

Mechanical Systems

Graduate study in mechanical systems provides students with a broad and strong background in theoretical, computational, experimental, and applied aspects of the subject. Emphasis is placed on fundamental principles, computational techniques, and experimentation used to analyze and design mechanical systems. Areas of
concentration include biomechanics, computational mechanics, reliability, optimal design, structural optimization, kinematics, and fatigue and fracture mechanics.

The Mechanical Engineering and Civil & Environmental Engineering programs offer most courses in this area of specialization, though students are encouraged to take courses offered by the Mathematics, Statistics, and Physics Departments in the College of Liberal Arts, and by other departments in the College of Engineering that are relevant to mechanical systems.

Current mechanical systems research projects include design sensitivity analysis of rigid and flexible mechanical systems, real-time dynamic simulation, vehicle system dynamics, multibody mechanics dynamics, probabilistic fatigue fracture, damage mechanics, stochastic finite element and meshless methods, reliability analysis, nanomechanics, and multiscale modeling of mechanical systems.

Computer-based simulation research activities are mostly carried out in the Center for Computer-Aided Design (CCAD). CCAD maintains a variety of high-performance computer systems in support of its technology research and development efforts.

**Thermal Sciences**

Graduate study in thermal sciences provides students with theoretical and experimental aspects to prepare students for careers in industry, teaching, research, or government. Emphasis lies in the fundamentals of thermodynamics and heat transfer, and associated analytical, numerical, and experimental methods used in energy conversion systems. Areas of concentration include: combustion, fluid mechanics, heat transfer, phase-change, and thermodynamics.

The Mechanical Engineering program offers most of the relevant thermal sciences courses. Students are encouraged to supplement these with courses from other areas, such as Mathematics, Physics, and other departments within the College of Engineering, in order to obtain a balanced program. Current research projects include laminar and turbulent heat transfer, metal solidification, fuel cells, natural convection, diffusion flames, spray atomization and combustion, and combustion instabilities. Facilities for research in the thermal sciences and systems consist of a low pressure combustion chamber, a high pressure chamber for atomization study, a test rig for heat transfer to near/supercritical fluids, a diffusion flame test rig, a 20-liter explosion vessel, an air atomization spray apparatus, test stands for melting and solidification studies, and various optical measurement systems. Laser based diagnostics, e.g. laser induced fluorescence, planar imaging and laser Doppler anemometry are available for turbulent flow, heat transfer, and combustion studies.

**General Information on Degrees Granted**

**M.S. in Mechanical Engineering**

The Mechanical Engineering M.S. program requires a minimum of 30 semester hours of course work and research. Students may choose either a thesis or non-thesis option. Normally six, and no more than nine, semester hours of credit for thesis research and writing shall satisfy the 30 semester hour minimum requirement. Students’ Plans of Study are determined through consultation with an advisor, and are then submitted to the Department Chair for approval.

To earn the M.S., students are required to attain a minimum grade point average (GPA) of 3.00 and pass a Final Examination. This exam is administered by a committee of faculty members. The requirements for the M.S. degree are such that students may be able to complete the degree within a calendar year. However, students with assistantship duties or other constraints may take up to two calendar years to complete the degree.

**Doctor of Philosophy Degree (Ph.D.) in Mechanical Engineering**

The Ph.D. program in Mechanical Engineering requires 72 hours of credit, including research for the dissertation. Full-time Ph.D. study is encouraged. To be admitted formally to the doctoral program, students must pass a Qualifying Examination. Students take the Comprehensive Examination after passing the Qualifying Examination and when course work specified in the Plan of Study is nearly completed, but no later than 28 months after the first registration in the Ph.D. program. The Comprehensive Examination is administered by the student’s Ph.D. Committee. Admission to Ph.D. degree candidature is recognized upon successful completion of the Comprehensive Examination. Having satisfactorily completed the Comprehensive Examination, students normally then complete and defend the dissertation at the Final Examination. Requirements for the Ph.D. degree can generally be completed in about three years beyond the M.S. degree.

**Admission to Graduate Programs**

Students who have earned a baccalaureate degree or a master’s degree in an engineering curriculum or a curriculum in the mathematical or physical sci-
ences are eligible to be considered for admission to the graduate program in Mechanical Engineering. In order to be considered for regular admission, the student must have a minimum 3.00 GPA on all previous college-level work, minimum Graduate Record Examination (GRE) scores of 500 Verbal and 750 Quantitative, and a minimum Test of English as a Foreign Language (TOEFL) score of at least 550 (paper based), 213 (computer based) or 81 (internet based). Students may, under exceptional circumstances, be considered for conditional admission with lesser GPA and/or GRE or TOEFL scores.

**GRADUATE STUDENT FUNDING**

Financial support is available to M.S. and Ph.D. students, primarily through teaching and research assistantships, from the Department of Mechanical & Industrial Engineering, the Center for Computer-Aided Design, and IIHR - Hydrosience and Engineering. These awards may be made on a semester, academic year, or calendar year basis. Awards and reappointments are competitive and are based upon the 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 will receive preference in the awarding of new assistantships. Nonresident students with at least a 25% assistantship also qualify for resident tuition fees.

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**FUNDING SOURCES**

The Mechanical Engineering program receives research support from many sources, including the following:

- Air Force Office of Scientific Research (AFOSR)
- Alcoa, Inc.
- Army Research Office (ARO)
- Automotive Research Center
- Batelle Memorial Institute
- Department of Energy (DOE)
- General Motors
- Hitachi Industries Company, Ltd.
- HNI, Inc.
- Iowa Energy Center
- John Deere, Inc.
- Maytag, Inc.
- NASA
- National Highway Traffic Safety Administration (NHTSA)
- National Institutes of Health (NIH)
- National Science Foundation (NSF)
- Office of Naval Research (ONR)
- Rockwell-Collins, Inc.

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**THE UNIVERSITY OF IOWA**

The information provided in this brochure is only a brief overview of the Mechanical Engineering programs. Students are responsible for taking care of all details for graduation prescribed by their departments, and for meeting requirements and deadlines described in the gold leaflet published by The University of Iowa Graduate College and Registrar.

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**Helpful links for prospective graduate students:**

- Department of Mechanical & Industrial Engineering
  - [www.mie.engineering.uiowa.edu](http://www.mie.engineering.uiowa.edu)
- IIHR-Hydrosience & Engineering
  - [www.iihr.uiowa.edu](http://www.iihr.uiowa.edu)
- Center for Computer-Aided Design
  - [www.ccad.uiowa.edu](http://www.ccad.uiowa.edu)
- National Advanced Driving Simulator
  - [www.nads-sc.uiowa.edu](http://www.nads-sc.uiowa.edu)
GRADUATE COURSES

General Courses
58:110 Computer-Aided Engineering
58:111 Numerical Calculations
58:112 Engineering Design Optimization
58:113 Mathematical Methods in Engineering
58:115 Finite Element I
58:131 Manufacturing Systems
58:186 Enhanced Design Experience
58:214 Analytical Methods in Mechanical Systems

Thermal-Fluid Courses
58:125 Biomimetic Fluid Dynamics
58:140 Intermediate Thermodynamics
58:143 Computational Fluid and Thermal Engineering
58:145 Intermediate Heat Transfer
58:146 Modeling of Materials Processing
58:147 Fuel Cells
58:148 Combustion
58:149 Propulsion Engineering
58:160 Intermediate Mechanics of Fluids
58:162 Experimental Methods

58:163 Environmental Fluid Dynamics
58:164 Fundamentals of Wind Turbines
58:245 Diffusive Transport
58:248 Combustion Theory
58:260 Viscous Flow
58:263 Compressive Flow
58:266 Interfacial Flows and Transport Processes
58:267 Multiphase Flow and Heat Transfer

58:268 Turbulent Flow
58:269 Computational Fluid Dynamics and Heat Transfer
58:296 Advanced Topics in Thermal and Fluid Engineering

Mechanical Systems Courses
58:133 Control Theory
58:134 Computer-Based Control Systems
58:136 Digital Human Modeling and Simulation
58:150 Intermediate Mechanics of Deformable Bodies
58:153 Fundamentals of Vibration
58:154 Intermediate Kinematics and Dynamics
58:158 Fatigue/Durability in Design
58:159 Fracture Mechanics
58:179 Continuum Mechanics
58:215 Finite Element II
58:250 Advanced Fracture Mechanics
58:251 Computational Inelasticity
58:252 Advanced Continuum Mechanics
58:254 Energy Principles in Structural Mechanics
58:255 Multiscale Modeling
58:256 Computational Solid Mechanics
58:257 Probabilistic Mechanics and Reliability
58:259 Mechanical Design in Structures
58:278 Nonlinear Elasticity
58:279 Continuum Mechanics and Elasticity
58:295 Advanced Topics in Mechanical Systems

Visit us on the web @ www.mie.engineering.uiowa.edu
Professor Choi teaches courses in optimization, solid mechanics, mechanical design, mathematical and analytical methods, and applied mathematics. His research is in the areas of mechanical systems analysis; design sensitivity analysis and optimal design; computational methods in mechanics; mathematical theory of optimization and its application to mechanical systems; development of design sensitivity analysis and optimization tools; and development of simulation-based concurrent engineering environment.

Professor Lu teaches courses in continuum mechanics and elasticity, solid mechanics, design, and finite element methods. His research is in the areas of biomechanics; finite element formulation for large-strain inelasticity; mechanics of fiber-reinforced membranes; cellular solids; and modeling of materials with microstructures.

Professor Rahman teaches courses in mechanical systems, probabilistic and computational mechanics, and reliability. His research is in the areas of multi-scale mechanics of heterogeneous materials; high-dimensional model representation; stochastic meshfree and finite element methods, stochastic optimization; probabilistic fracture mechanics; and mechanics of nanostructured material.

Professor Stephens teaches courses in fatigue and fracture mechanics and mechanical systems design. His research is in the areas of computational vehicular fatigue life predictions; fatigue crack growth of advanced titanium alloys; and the influence of high mean tensile stress.

Professor Xiao teaches courses in finite element analysis, solid mechanics, dynamics, and multi-scale modeling. His research is in the areas...
of multi-scale modeling and simulation; nano-composites; NEMS (Nano-Electro-Mechanical Systems); and shock wave propagation and spallation.

Olesya Zhupanska, Assistant Professor

- M.S. Mechanics and Applied Mathematics, Kiev National Taras Shevchenko University, Ukraine, 1996.

(319) 335-5678
olesya-zhupanska@uiowa.edu

Professor Zhupanska teaches courses in Intermed Mechanics of Deformable Bodies, and Mechanical Systems. Her research is in the area of mechanics of multifunctional composites and nanocomposites; Electro-magneto-thermo-mechanical coupling in solids; Contact problems with friction and adhesion; and Discrete element modeling.

Christoph Beckermann, UI Foundation Distinguished Professor

- Ph.D., Mechanical Engineering, Purdue University, 1987
- M.S.M.E., Mechanical Engineering, Purdue University, 1984
- Vordiplom, Mechanical Engineering, University of Hannover, 1981

(319) 335-5681
christoph-beckermann@uiowa.edu

Professor Beckermann teaches courses in heat transfer, contemporary issues in mechanical engineering, and biomimetic fluids. His research is in the area of unsteady aerodynamics of biologically-inspired underwater and aerial vehicles, urban microclimate and transport phenomena, and cardiovascular fluid mechanics.

James Buchholz, Assistant Professor

- Ph.D., Mechanical and Aerospace Engineering, Princeton University, 2006
- M.Sc., Mechanical Engineering, University of Alberta, 1997
- B.Sc., Mechanical Engineering, University of Alberta, 1995

(319) 335-5935
james-h-buchholz@uiowa.edu

Professor Buchholz teaches courses in heat transfer, contemporary issues in mechanical engineering, and biomimetic fluids. His research is in the area of unsteady aerodynamics of biologically-inspired underwater and aerial vehicles, urban microclimate and transport phenomena, and cardiovascular fluid mechanics.

P. Barry Butler, Professor and Provost of The University of Iowa

- Ph.D., Mechanical Engineering, University of Illinois at Urbana-Champaign, 1984
- M.S., Aeronautical & Astronautical Engineering, University of Illinois at Urbana-Champaign, 1981
- B.S., Aeronautical & Astronautical Engineering, University of Illinois at Urbana-Champaign, 1979

(319) 335-5672
patrick-butler@uiowa.edu

Professor Butler teaches courses in contemporary issues in mechanical engineering (fundamentals of wind turbines). His research is in the areas of ignition phenomena in energetic materials; real-gas thermochemical processes; reaction in supercritical water medium; and detonation of gas and condensed-phase media.
Pablo M. Carrica,  
Associate Professor

- Ph.D., Mechanical and Industrial Engineering, Instituto Balseiro, Argentina

(319) 335-5381  
pablo-carrica@uiowa.edu

Professor Carrica teaches courses in experimental engineering, thermal and fluid engineering, and contemporary topics in mechanical engineering (two phase flow modeling). His research is in the area of ship hydrodynamics in motions, ship behavior in extreme events and controllers, and bubble entrainment and transport.

Albert Ratner,  
Associate Professor

- Ph.D., Aerospace Engineering, University of Michigan, 2000
- M.S., Mathematics, University of Michigan, 1999
- M.S., Aerospace Engineering, University of Michigan, 1996
- B.S., Engineering and Applied Science, California Institute of Technology, 1995

(319) 384-0883  
albert-ratner@uiowa.edu

Professor Ratner teaches courses in combustion, thermodynamics, and reacting flows. His research is in the areas of flame front dynamics; impact of fuel mixing on combustion instabilities; effectiveness of diagnostic techniques in accurately assessing flame state variables; and hydrocarbon-based liquid rockets.

Ching-Long Lin,  
Professor

- Ph.D., Mechanical Engineering, Stanford University, 1994
- M.Sc., Mechanical Engineering, Stanford University, 1989
- B.Sc., Mechanical Engineering, National Taiwan University, 1986

(319) 335-5673  
lea-der-chen@uiowa.edu

Professor Lin teaches courses in fluid mechanics, turbulence, and computational fluid dynamics, thermal engineering, and heat transfer. His research is in the areas of level-set simulation of two-phase flow, free-surface turbulence, lattice-Boltzmann simulation of liquid-gas, liquid-liquid and fluid-solid interations for microfluidics, four-dimensional assimilation of atmospheric lidar data, and pulmonary flow.

Frederick Stern,  
Professor

- Ph.D., Naval Architecture & Marine Engineering, University of Michigan, 1977
- B.S.E., Naval Architecture & Marine Engineering, University of Michigan, 1975

(319) 335-5215  
frederick-ster@uiowa.edu

Professor Stern teaches courses in fluid mechanics. His research is in the areas of unsteady ship boundary layers, wakes and wave fields; free-surface and wave effects on turbulence; wave-induced separation; marine-propulsor tip-vortex flow and cavitation inception; and unsteady viscous marine-propulsor hydrodynamics.

H.S. Udaykumar,  
Professor

- Ph.D., University of Florida, 1994
- M.S., University of Florida, 1990
- B.Tech, Indian Institute of Technology, Madras, 1988

(319)-384-0832  
ush@engineering.uiowa.edu

Professor Udaykumar teaches courses in interfacial flows and transport processes, design, viscous flow, and thermodynamics. His research is in the areas of computational fluid dynamics, moving boundary problems in material processing, biofluid dynamics, and multi-material flows; heart valve dynamics, mechanics of the gastrointestinal tract, metal-matrix composite manufacture, munitions delivery, and impact and penetration into targets.
DESTINATIONS
Where are our graduates working?

Mechanical Engineering graduates have gone on to hold prestigious positions at widely recognized institutions and companies, both public and private, throughout the world.

Here are just a few destinations from recent graduates:
- Caterpillar, Inc.
- CFD Research Corporation
- Cummins Engine Corporation
- Ford Motor Company
- Hyundai Heavy Industries
- Intel Corporation
- Iowa Energy Center
- Johns Hopkins University
- Kansas State University
- Los Alamos National Lab
- Lucent Technologies
- McGill University
- Medical College of Washington
- NASA/Goddard Space Flight
- National Institute of Standards and Technology
- New Mexico State University
- Penn State University
- Rockwell Science Center
- Sandia National Laboratories
- Seoul National University
- University of Hawaii
- University of Michigan

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For more information about our department, please see our site

www.mie.engineering.uiowa.edu

If you have any questions, please e-mail

mech_eng@engineering.uiowa.edu

on the web @ www.mie.engineering.uiowa.edu