MECHANICAL ENGINEERING (PHD)

Graduate School

Program Website (https://www.engineering.cornell.edu/mae/phd/)

CIP: 14.1901 | **HEGIS:** 0910.00 | **NYSED:** 78715

Graduate Field

Mechanical Engineering (https://catalog.cornell.edu/graduate-school/mechanical-engineering/)

Program Description

The program emphasizes basic mechanical sciences to prepare students for the diversity found at the frontiers of research and industrial development. The faculty is particularly strong and active in biomechanical engineering, fluid dynamics, turbulence, combustion, thermal systems engineering, multiphase flows, energy and power systems, transport processes in microgravity, mechanical systems and design, control and robotics, dynamics and control of space structures, mechanics of materials and materials processing, materials microgravity sciences and computational mechanics.

Biomechanical engineering

Analysis and design of biomechanical systems for orthopedic surgery; development of computer-aided design and analysis techniques for bone-implant systems; skeletal adaptation and bone structural behavior; mechanics and dynamics of human and animal motion and coordination.

Combustion

Combustion processes for practical energy-conversion devices; computational techniques for turbulent combustion; incineration of municipal and hazardous waste; combustion in a microgravity environment; computer simulations of rapid granular flows; models of pneumatic transport; laser imaging studies of turbulent combustion; development and application of laser tomography for combustion measurements.

Energy and power systems

Combustion and transport processes in gas turbine combustors.

Fluid mechanics

Theoretical and experimental studies of turbulence with applications to industrial, meteorological and oceanographic flows; construction of consistent turbulence models; experimental studies of transition to turbulence and three dimensionalities in wakes, shear flows, and boundary layers; linear and nonlinear wave propagation and stability studies of vortex flows; experimental investigations of vortex structure; vortex-induced vibration; fundamental vortex interactions; wing vortex wake dynamics; splash dynamics of droplets on surfaces.

Heat transfer

Experiments in critical heat flux and boiling instability; heat transfer in electronic components; radiosity for realistic images in computer graphics; transport phenomena in materials processing; inverse heat transfer problems; computational design and control of thermal systems and processes.

Materials processing and precision engineering

Experiments and modeling of microstructure and damage evolution in metals; modeling, optimal design and robust control of deformation, solidification and crystal growth processes; computational mechanics.

Mechanical systems and design

Spatial and dynamical modeling and the use of models in analysis, design, and control; magnetic bearings; application of nonlinear dynamics and chaos to mechanical systems; guidance, estimation, and trajectory optimization; multi-variable robust control; dimensional tolerances and metrology; metatheories for design; design analysis of fluid film bearings; tribology.

Multiphase flows

Experimental circulating fluidization; impact of particles on other particles or solid boundaries; scale-up and heat transfer in fluidized beds; development of instrumentation for gas-solid suspensions; granular flows down inclines; theories and numerical simulations of collisional granular materials; microgravity experiments on the flow, heat transfer and segregation of collisional granular materials and gas-solid suspensions; development of instrumentation for the snow pack and snow avalanches; suspension theories; rheology of polymer melts; two-phase boiling.

The Ph.D. programs provide advanced levels of training suitable for students pursuing careers in research and development, education, or advanced engineering analysis and design. Applicants may apply for the Ph.D. program directly from a bachelor's degree.

Concentrations

- Biomedical mechanics
- Dynamics and control
- Energy and sustainability
- Fluid dynamics
- Micro- and nanoscale engineering
- Solid mechanics and materials
- Thermal science

Program Information

- Instruction Mode: In Person
- Location: Ithaca, NY
- Minimum Credits for Degree: 72

Program Requirements

- Minimum of 6 semesters of GRAD 9010 Graduate-Level Research (12 credits per semester)
- Minimum Semesters for Degree: 6

Graduate School Milestones

- Responsible Conduct of Research Training: Required
- Open Researcher and Contributor ID (ORCID): Required
- Student Progress Reviews (SPR) begin: First Year
- Examination for admission to candidacy (A Exam): By the end of third year, before seventh semester begins
- Defense of Dissertation (B Exam): By end of fourteenth semester

Field Specific Milestones

- Qualifying Examination (Q Exam): Spring of first year; students with an MS may take their Q exam in the fall if the topic is offered.
- Two semesters of teaching assistantship required.

Course Requirements

Additional course requirements may be set by the student's Special Committee. Program specific requirements that apply to all students are included below.

- MAE 6949 Seminar for M.S. and First-Year MAE Ph.D. Students (One enrollment, 1 credit)
- MAE 7999 Mechanical and Aerospace Engineering Colloquium (Two enrollments, 2 credits)

University Graduation Requirements Requirements for All Students

In order to receive a Cornell degree, a student must satisfy academic and non-academic requirements.

Academic Requirements

A student's college determines degree requirements such as residency, number of credits, distribution of credits, and grade averages. It is the student's responsibility to be aware of the specific major, degree, distribution, college, and graduation requirements for completing their chosen program of study. See the individual requirements listed by each college or school or contact the college registrar's office (https://registrar.cornell.edu/service-resources/college-registrar-directory/) for more information.

Non-academic Requirements

Conduct Matters. Students must satisfy any outstanding sanctions, penalties or remedies imposed or agreed to under the Student Code of Conduct (Code) or Policy 6.4. Where a formal complaint under the Code or Policy 6.4 is pending, the University will withhold awarding a degree otherwise earned until the adjudication process set forth in those procedures is complete, including the satisfaction of any sanctions, penalties or remedies imposed.

Financial Obligations. Outstanding financial obligations will not impact the awarding of a degree otherwise earned or a student's ability to access their official transcript. However, the University may withhold issuing a diploma until any outstanding financial obligations owing to the University are satisfied.

Learning Outcomes

- Make an original and substantial contribution to the discipline
  -Think originally and independently to develop concepts and methodologies.
  -Identify new research opportunities within one's field.
- Demonstrate advanced research skills
  -Synthesize existing knowledge, identifying and accessing appropriate resources and other sources of relevant information and critically analyzing and evaluating one's own findings and those of other.
  -Master application of existing research methodologies, techniques, and technical skills.
- Demonstrate commitment to advancing the values of scholarship
  -Keep abreast of current advances within one's field and related areas.
  -Commit to professional development through engagement in professional societies, publication, and other knowledge transfer modes.
  -Create an environment that supports learning—through teaching, collaborative inquiry, mentoring, or demonstration.
- Demonstrate professional skills
  -Advance ethical standards in the discipline.
  -Communicate in a style appropriate to the discipline.
  -Listen, give, and receive feedback effectively.