Mechanical Engineering Department

Chairperson
Jeffrey Ge, Light Engineering Building 113 (631) 632-8305

Graduate Program Director
Toshio Nakamura, Light Engineering Building 137 (631) 632-8312

Graduate Coordinator
Dianna Berger, Light Engineering Building 113A (631) 632-8340 email: MechanicalEngineeringGraduate@stonybrook.edu

Degrees Awarded
M.S. in Mechanical Engineering; Ph.D. in Mechanical Engineering

Web Site
https://me.stonybrook.edu/graduate

Application
https://graduateadmissions.stonybrook.edu/apply/

Description of the Mechanical Engineering Department

The Department of Mechanical Engineering, in the College of Engineering and Applied Sciences, offers graduate work leading to the Master of Science and Doctor of Philosophy degrees. The department offers a broad curriculum with concentrations in Design and Manufacturing, Solid Mechanics, and Thermal Sciences and Fluid Mechanics. Additional information is also available at the department's Web site: https://me.stonybrook.edu/

Admission Requirements

For admission to the M.S. and Ph.D. programs in Mechanical Engineering the following are required:

- A bachelor's degree in mechanical engineering, or a closely related field.
- A grade point average of at least B in undergraduate study and previous graduate study (if applicable).
- Graduate Record Examination (GRE) General Test is not required currently but it may still be submitted.

Accelerated B.E./M.S. Degree

Undergraduate mechanical engineering majors with strong academic performance (GPA of 3.2 or above) may apply for admission to the Accelerated Bachelor of Engineering/Master of Science (B.E./M.S.) degree program in mechanical engineering at the end of their junior year. Once accepted into this program, students will be permitted to take up to 9 graduate credits in replacement of the required technical electives. These credits will be applied towards both their Bachelor's degree and Master's degree. Note in order to count more than 6 credits (i.e., 3rd graduate course), the student must be enrolled in the graduate program. More information about this program may be obtained from the graduate program director or the Department Web site.

Facilities and Areas of Specialization for the Mechanical Engineering Department

Design and Manufacturing
Studies include CAD/CAM, kinematics and mechanisms, robotics, vehicles, manufacturing systems, dynamics and vibration, control, design optimization, mechatronics, microelectromechanical systems (MEMS), micro/nano-technologies, smart structures, and energy harvesting. Research topics cover task driven creative design of mechanical and electro-mechanical systems, such as high performance machinery and robots, mechanisms, and sensors, including dynamics, motion, control, and vibration-related problems; traditional and advanced manufacturing, manufacturing process modeling, human augmented systems, and intelligent fault detection and diagnosis; clean energy systems. Applied courses emphasize case studies, dynamics and control, finite element methods, and computer graphics. Also featured are an array of equipment and software for research and teaching, such as mechatronic systems, robots, CAD/CAM stations, CMM, desktop rapid prototyping machine, software for computer-aided engineering.

Mechatronics synergistically integrates mechanical engineering, electrical engineering, software, and controls into smart electromechanical products and systems. Research in this area highlights modeling, analysis, design, control, and prototyping in a system-level approach, which requires a broad knowledge of mechanics, materials, mechanical design, manufacturing, vibration, dynamics, sensors, actuators, electronics, signals and control. Applications include industrial and laboratory automation, biomedical devices, servo machines, vehicle systems, smart structures, and energy systems.

Solid Mechanics

The mechanical behavior of advanced materials and structures is studied with emphasis on mathematical modeling and simulation of deformation, failure, stability, and microstructural transformation. These issues span a wide range of interests that focus on various materials, systems, and multiple length scales. Research topics include fracture mechanisms of embedded flaws in coatings and thin films, delamination in composites, and the mechanical properties and behavior of micron-scale structures and systems, such as microelectromechanical systems.

Also investigated are the constitutive modeling and failure characterization of ceramics, polymers, and heterogeneous multi-component materials, soft materials and nano- and micro-mechanics of defect formation. Experimentally based research programs focus on the mechanical, thermomechanical, and failure behavior of a wide variety of materials such as metals, polymers, ceramics, hard and soft biological tissues, and composites under both static and dynamic loading conditions. Optical techniques of strain analysis, including moiré methods, laser and white-light speckle methods, holographic interferometry, photoelasticity, and classical interferometry are developed and applied to solid mechanics problems such as fracture, wave propagation, metal forming, vibration, and deformation of micron-scale structures and systems such as MEMS. Characterization of micron and nano-scale materials and structures is accomplished with instrumented-indentation and scanning probe microscopy techniques for wear and harsh environment applications. Research is also conducted to characterize the failure mechanics of various engineered heterogeneous materials systems, ranging from functionally layered/ graded coatings to nanocomposites under impact loading and high-temperature conditions. Specialized equipment includes high-speed digital cameras, scanning electron microscope, and split Hopkinson pressure bars, and in situ micromechanical high-temperature fatigue testing system.

Thermal Sciences and Fluid Mechanics

Fluid Mechanics: Current research areas include theoretical, computational, and experimental studies of micro- and nanofluidic devices, complex fluids and colloidal materials for applications in separation processes and energy conversion. Wetting and adsorption in micro/nanostructured materials and nanoparticle transport in multiphase systems. Numerical and theoretical studies including direct simulation of turbulent flows and turbulent transport at modest Reynolds numbers, stochastic modeling of the turbulent transport of temperature, and spectral closure approximations for chemically reactive flows. Additional current topic includes advanced combustor design and flow control, and the behavior of chemically reacting species in turbulent flows.

Thermal Sciences: Current topics include measurement of thermophysical properties, laser-material interaction, materials processing, heat transfer in advanced energy systems, advanced combustion processes, and internal combustion engines. The ultra-fast thermal processing and laser-based measurement laboratory has an amplified oscillator/ regenerative amplifier, a femtosecond autocorrelator, and a host of optoelectronics and light sources. The thermal science research laboratory has a visualization and digital image processing system. Studies also include methods and analytical tools for predicting, modeling and correlating the thermodynamic/thermophysical properties of the fluids. Current studies include the development of statistical mechanical techniques to assess the relation between intermolecular forces and the thermodynamic, dielectric, optical, and transport properties of fluids, fluid mixtures, and suspensions. Research is also being conducted on the modern formalism of thermodynamics; on combustion heat engines, aiming at achieving high fuel efficiency and engine performance; and on building energy dynamics. The Advanced Combustion Research laboratory includes three single-cylinder research engines equipped with state-of-the art instrumentation and data acquisition systems. These research engines are used to investigate advanced and low temperature combustion processes for use in future power generation and propulsion systems. Experimental research on combustion is supported by modeling activities using Computational Fluid Dynamics (CFD) and system level modeling

Energy Technologies: The Energy Technologies program consists of a set of graduate courses designed to offer practical laboratory and design experience on modern energy conversion systems. The Energy Technologies Laboratory contains experimental facilities and equipment that are used to study the design and operating characteristics of fuel cells, wind turbines, photovoltaics, thermo-electrics, heat pumps, optical and infrared sensors, as well as motors, generators, and batteries. Thermal sciences and fluid mechanics are the core disciplines of the emerging field of energy technologies and sustainability science—a vibrant field of research and innovation. The Energy Technologies Laboratory contains fuel cell, wind turbine, photovoltaic, thermoelectric, heat pump, optical and infrared sensors, and motor/generator/battery facilities.

Requirements of the Mechanical Engineering Department

Academic Standing

An average GPA of 3.0 or higher in all coursework, exclusive of MEC 599, 698 and 699, (, is a minimum requirement for satisfactory status in the graduate program. In the doctoral program, a 3.5 grade point average or higher is expected.

Requirements for the M.S. Degree in Mechanical Engineering

A minimum of 30 credits is required for the M.S. degree. There are two options, M.S. with thesis and M.S. without thesis as noted below.

A. Course Requirements

1. M.S. with thesis: With successful thesis, up to 9 combined 'thesis' credits of MEC 596, 597, 599 and/or 696 may be counted toward the requirement. Note the thesis credits may be less than 9 credits, but the total graduate credits must be at least 30 credits.

2. M.S. without thesis: No more than 6 combined ‘project’ credits of MEC 596, 597 and/or 696 may be applied toward the 30 credit requirements. Note submission of the Final Report is required for those project courses. No credit for MEC 599 is approved for fulfilling this requirement.

3. All full-time graduate students are required to register for MEC 691 (Mechanical Engineering Seminar) each semester and obtain a satisfactory grade.

4. A minimum of 18 graduate credits, of which 15 credits are in courses other than MEC 599 and MEC 696, must be taken in the Department of Mechanical Engineering. All courses taken outside the department for application to the graduate degree requirements are subject to approval of the student’s advisor and the graduate program director.

B. Transfer Credits

A maximum of 12 graduate credits may be transferred from other programs toward the M.S. degree. These may include up to 6 credits from other institutions. The maximum also includes any credits received from taking Mechanical Engineering courses while having non-degree status at Stony Brook as an SPD or GSP student. Credits used to obtain any prior degrees are not eligible for transfer. All requests for transfer of credits require the approval of the graduate program director. For non-mechanical engineering courses, those directly relevant and/or fundamental to mechanical engineering topics may be approved.

C. Thesis Requirements
A student choosing the thesis option must select a research advisor. Upon completion, the thesis must be defended in an oral examination before a faculty committee of at least three members of which at least two must be Mechanical Engineering faculty. A student choosing the thesis option may not switch to the non-thesis option without permission of the graduate program committee. A student who has ever been appointed as a teaching, graduate, or research assistant must choose the thesis option unless otherwise approved by the graduate program committee.

- Thesis title, defense date, and committee list must be submitted to the Graduate Program Secretary at least two weeks before the scheduled date.
- The thesis defense date must be scheduled at least two weeks before the thesis submission deadline set by the Graduate School
- Thesis format must adhere to the guideline set by the Graduate School. An electronic copy of the thesis (i.e., PDF file) including the signature page must be submitted to the Department before the semester end.

Requirements for the Ph.D. Degree in Mechanical Engineering

A. Course Requirements
1. 18 approved graduate course credits beyond the M.S. degree requirement. A minimum of 9 credits, excluding MEC 599, MEC 696 and MEC 699, must be taken in the department.

2. MEC 507. The graduate program director may waive this requirement if the student has taken sufficient applied mathematics courses elsewhere.

3. All full-time graduate students are required to register for MEC 691 each semester and obtain a satisfactory grade.

4. All courses taken outside the department for application to the graduate degree requirements are subject to approval of the student's advisor and the graduate program director. The advisor may impose additional course requirements.

B. Transfer Credits
A maximum of 6 graduate credits from other programs, including those of other institutions, may be transferred toward the Ph.D. degree. Credits used to obtain any prior degrees are not eligible for transfer. Requests for transfer of credits must be approved by the graduate program director.

C. Written Qualifying Examination
The written qualifying examination is offered once every year, usually in January. Students who enter the graduate program with an M.S. degree from another institution are encouraged to take the examination the first time it is offered after they begin academic residency. Students who enter the graduate program without an M.S. degree are encouraged to take the examination the first time it is offered following three academic semesters in residence. Both categories of students who fail to take this opportunity must take the examination the next time it is offered during their residency. Part-time students should follow a rule based on graduate course credit hours (determined by the equivalence of 9 credits with one semester in residence). Each student can take the written qualifying examination two times before being dismissed from the Ph.D. program.

The written qualifying examination consists of two parts. Part I covers applied mathematics. Part II corresponds to the student's core area of concentration, selected from one of the following:

1. Design and Manufacturing

2. Solid Mechanics

3. Thermal Sciences and Fluid Mechanics

More precise information on the exam, including a list of suggested courses for each subject in the exam, is available in the departmental office, as are samples of previous examination questions.

Each student taking the examination is required to submit a written statement to the graduate program director with a declaration of both areas chosen at least one month before the announced exam date.

D. Minor Area of Concentration
In addition to the major area of concentration, each student must select a minor area from the following list: Thermodynamics and Heat Transfer, Fluid Mechanics, Solid Mechanics, Design and Manufacturing, Electrical Engineering, Material Science and Engineering, Computer Science, Applied Mathematics (not in the general area) , and Biomedical Engineering. A petition to select a minor area that is not contained in this list must be approved by the Graduate Program Director. More information is available at https://me.stonybrook.edu/graduate/phdminorreq.php.

A student will be required to take a coherent sequence of three graduate level courses in the minor area and obtain a grade of B or better in each of the courses. However, students must submit a list of five courses from the proposed minor field no later than the time he or she applies to take the qualifying exam. The courses in the minor field must be approved by the Graduate Program Director, with the recommendation of the student's advisor. Upon submission of the list of five courses, students must provide an explanation for the list, how the courses are related, and the rationale for the courses. Note that students are not required to have taken the courses in the minor field before taking the qualifying exam. However, the minor requirement must be satisfied before the student can be admitted to candidacy.

E. Advancement to Candidacy
A student will be advanced to candidacy for the Ph.D. degree when all formal coursework has been completed and all the requirements listed in items A through E have been satisfied. These requirements must be completed within one calendar year after passing the written qualifying

examination. Advancement to candidacy must be one year before the beginning of the semester in which a student plans to defend his/her dissertation.

F. Teaching

Ph.D. students are required to take 3 credits of MEC 698 Practicum in Teaching II or obtain approval of equivalent teaching experience from the Graduate Program Director as part of the degree requirement. MEC 698 is taken under a faculty advisor who is responsible for proving feedback and making a formal evaluation of the student's work. The form of this practicum may include making class presentations, teaching in recitation classes, and preparation and supervision of laboratory classes. All Teaching Assistants are required to take MEC 697 Practicum in Teaching I, which does not meet this requirement.

G. Dissertation

The student chooses a dissertation topic in consultation with his/her doctoral dissertation advisor as soon as possible after passing the written qualifying examination. Dissertation research is an apprenticeship for the candidate, who, under the supervision of the dissertation advisor, independently carries out original work of significance. Within one year after passing the written qualifying examination, a dissertation examining committee is established. The committee must include at least three members from the Department of Mechanical Engineering, including the dissertation advisor, and at least one member from another program or from outside the University. The committee must be approved by the graduate program director upon recommendation by the dissertation advisor. The official recommendation for the appointment of the dissertation examining committee is made to the Dean of the Graduate School.

The dissertation examining committee provides a means of exposing the candidate’s ideas to a variety of views, and helps to guide and oversee the candidate’s research progress, which is reviewed by the committee each year. The chairperson of the committee must submit a written report to the graduate program director on the student’s progress after each review.

Dissertation Proposal*:* In addition, the student is required to submit a written dissertation proposal and present it in an oral examination conducted by the dissertation examining committee. The written dissertation proposal must be distributed to the committee members at least two weeks before the oral examination. The oral examination probes the doctoral student’s ability and examines the progress, direction and methodology of the dissertation research. The student will be examined on the dissertation topic and its objective, the problem formulation, research approach, and knowledge in related areas. The majority of the dissertation examining committee must approve the student’s performance. The approved dissertation proposal is expected to be submitted at least 1 year before the dissertation defense.

Dissertation Defense: At the completion of the dissertation, approval of the dissertation involves a formal oral defense. The formal defense is open to all interested members of the University community. The final approval of the dissertation must be by a majority vote of the dissertation examining committee.

- The proposed dissertation defense must be scheduled at least two weeks before the thesis submission deadline set by the Graduate School (generally the semester end date).
- Committee Appointment Form must be submitted to the Graduate Program Secretary at least five weeks before the scheduled
- Doctoral Defense Announcement Form which includes title, abstract, date, the location must be submitted to the Graduate Program Secretary at least four weeks before the scheduled
- Copies of proposed dissertation must be given to the committee members as well as to the Department office for examination by the faculty at least two weeks before the scheduled
- The approved dissertation (with the signature page) must be submitted before the thesis submission deadline set by the Graduate School for each semester.
- Dissertation format must adhere to the guideline set by the Graduate School. It must be also electronically submitted (ProQuest). See https://www.grad.stonybrook.edu/CurrentStudents/t&d.shtmlfor the detailed information.
- One copy of the approved dissertation, including the signed signature page must be submitted to the Department.

Faculty of Mechanical Engineering Department

Professors

Chiang, Fu-pen, Distinguished Professor, Ph.D., 1966, University of Florida: Experimental mechanics; solid mechanics; photoelasticity; moiré and laser methods for stress analysis; mechanics of soft tissues and heart.

Ge, Q. Jeffrey, Professor and Chair, Ph.D., 1990, University of California, Irvine: Design kinematics; robotics; CAD/CAM; mechanical systems analysis and simulation.

Kao, Imin, Professor. Ph.D., 1991, Stanford University: Robotics; stiffness control; wiresaw manufactururing process; manufacturing automation; Taguchi methods.

Longtin, Jon P. Professor, P.E., Ph.D., 1995, University of California, Berkeley: Heat transfer at fast time scales; ultrafast laser liquid- and laser-solid interactions; laser processing, sensors, building energy, energy efficiency, novel heating and cooling technologies.

Nakamura, Toshio, Professor, Ph.D., 1986, Brown University: Solid mechanics, composite materials, computational fracture mechanics, mechanics of thermal sprayed coatings.

Associate Professors

Chen, Shikui, Associate Professor. Ph.D., 2010, Northwestern University: Mechanical Engineering. Ph.D., 2006, Chinese University of Hong Kong: Automation and Computer Aided Engineering.

Colosqui, Carlos, Associate Professor, Ph.D. 2009, Boston University: Thermal-fluids, microfluidics, colloidal systems, fuel cells, and nano/micro-electromechanical Systems (N/MEMS).

Cubaud, Thomas, Associate Professor, Ph.D., 2001, Paris-Sud University/ESPCI, France: microfluidics, interfacial fluid phenomena and wetting, multiphase flows, miscible flows, and complex fluids.

Hwang, David (Jae-Seok), Associate Professor. Ph.D., 2005, University of California at Berkeley: Micro-and nanoscle heat transfer, laser-assisted solar photovoltaic manufacturing and diagnostics, advanced diagnostics of light-matter interaction.

Kukta, Robert V., Associate Professor, Ph.D., 1998, Brown University: Solid mechanics; mechanics of thin films; micromechanical modeling of defects in crystals, crystal growth, self-assembly, surface science.

Ladeinde, Foluso, Associate Professor, Ph.D., 1988, Cornell University: Turbulent flows, high-speed chemically reacting flows; noise source prediction and propagation.

Mamalis, Sotirios, Associate Professor, Ph.D. 2012, University of Michigan: Internal combustion engines, modeling of advanced combustion processes, thermodynamic analysis of power generation and propulsion systems.

Rastegar, Jahangir, Associate Professor. Ph.D., 1976, Stanford University: Kinematics, dynamics and control of high-performance machinery, optimal design of mechanical systems.

Wang, Lifeng, Associate Professor. Ph.D., 2006, Tsinghua University: materials modeling, computational mechanics, micro- and nano-mechanics, materials testing and characterization, rapid prototyping and 3D printing, and composites.

Assistant Professors

Assanis, Dimitris, Assistant Professor. Ph.D., 2016, University of Michigan: Power generation and propulsion systems with an emphasis on advanced combustion modes and alternative fuels for internal combustion engines. Assessment of energy and environmental implications of connected & automated vehicles.

Chakraborty, Nilanjan, Assistant Professor, Ph. D., 2008, Rensselaer Polytechnic Institute: Robot motion planning, multi-robot coordination, human-robot interaction, mechanism design, multi-body dynamics, distributed intelligent systems for energy automation, sensor networks, Distributed Algorithms, Combinatorial Optimization.

Kirane, Kedar, Assistant Professor. Ph.D. 2014, Northwestern University: Solid mechanics, fracture mechanics, scaling, fatigue quasibrittle materials, geo-mechanics, poro-mechanics, poly-crystal plasticity, probabilistic mechanics, multi-scale modeling

Purwar, Anurag, Assistant Professor. Ph.D., 2005, Stony Brook University: CAD/CAM, computational kinematics, design automation, robotics

Yao, Shanshan, Assistant Professor. Ph.D., 2016, North Carolina State University: Nano/micro materials and structures, nano/micro manufacturing, flexible and stretchable electronics, soft actuators and tobotics.

Number of teaching, graduate, and research assistantships, Fall 2019: 41

NOTE: The course descriptions for this program can be found in the corresponding program PDF or at COURSE SEARCH.