

Mechanical and Aerospace Engineering, M.S.

The Mechanical and Aerospace Engineering faculty have special interest and expertise in five thrust areas: dynamics and controls; fluid dynamics and propulsion; mechanics of materials and structures; systems and design; and thermal and transport sciences.

Research in dynamics and controls covers a broad multi-disciplinary area of theory and practical applications. The general aim is to model, analyze and regulate the behavior of dynamical systems in the presence of modeling errors, perturbations and disturbances, while ensuring a level of optimality in carrying out a sought objective. Additional challenges are introduced when the task is to be carried out by a collection of autonomous systems in a distributed, decentralized manner. Estimating parameters and learning while carrying out assigned tasks is yet another layer of increasingly more powerful capabilities becoming available with new technologies and availability of computational resources. Specific areas of interest include control theory and algorithms, autonomous and distributed systems, navigation and flight systems and machine learning.

The area of fluid dynamics and propulsion includes incompressible and compressible turbulent flows, multiphase flows, chemically reacting and other nonequilibrium flows, turbomachinery, electrospays, aeroelasticity, aerodynamic optimization and aeroacoustics. Computational approaches include direct numerical simulation and large-eddy simulation; laboratories include wind tunnels, anechoic chambers, and high-speed jet facilities. Specific areas of interest include: aeroacoustics; aeroelasticity; biomedical flows; combustion theory; computational fluid dynamics; electrospays; jet and rocket propulsion; multiphase flow; and turbomachinery.

The field of mechanics of materials and structures emphasizes theoretical, computational, and experimental approaches that contribute to a fundamental understanding of and new insight into the properties and behavior of materials and structures. Areas of interest include nano- and micro-scale solid mechanics, modeling and design of lightweight structures and materials, deformation and failure mechanisms, smart and morphing structures, uncertainty quantification and propagation, structural synthesis and optimization, and machine learning applications in materials design and modeling. The emphasis of the research efforts is on predicting and enhancing stiffness, shape-change, stability, damage tolerance, manufacturability, optimal life-cycle costs, and self-adaptivity of materials and structures.

Systems and design is a broad disciplinary area that involves the development of methodologies to address issues ranging from defining the size and shape of components needed for force and motion specifications, to characterizing performance in terms of design parameters, cost and complexity. Applications include microdevices; biomechanics; air pollution; manufacturing; and automotive and aerospace systems. Areas of specific interest include: design and control of MEMS; machine information systems integration; computer aided design; robotics including microrobotics; biomechanics; carbon and magnetic MEMS; CD-based fluidics; rehabilitation, prosthetics and exoskeletons; kinematics of spatial motion; design of mechanical systems; modeling of global air pollution; and aerospace systems.

The field of thermal and transport sciences encompasses energy generation and harvesting, environmental impacts, and heat transfer. The topic of combustion addresses the chemical mechanisms governing combustion in diverse settings. Fuel-cell research encompasses the development of fuel-cell technology, hybrid engines and thermionic devices. Activities cover the thermodynamics of energy systems, the controls associated with advanced energy systems and systems analyses. Thermal solutions for emerging areas of nanotechnology are being developed where heat conduction is critical to performance. Areas of specific interest include: combustion and emissions; fuel cell technologies; advanced energy systems; renewable energy; heat transfer; atomization and sprays; reaction kinetics; nanomaterials.

Aerospace engineering research efforts combine specialties from each of the five thrust areas toward the design, modeling, and operation of complex aerospace systems.

Two plans are available to pursue study toward the M.S.: a thesis option and a comprehensive examination option. Opportunities are available for part-time study toward the M.S. The Plan of Study for both options must be developed in consultation with a Faculty Advisor and approved by the Department Graduate Advisor. Opportunities to pursue teaching experiences and to take a course to develop teaching excellence are also offered, and may be integrated into your plan of study.

Plan I: Thesis Option

The thesis option requires completion of eight graduate, technical and science courses; the completion of an original research project with a Faculty Advisor and the writing of the thesis describing it; and approval of the thesis by a thesis committee. This plan is available for those who wish to gain research experience or as preparation for study toward the doctoral degree. Students must complete 12 units of ENGRMAE 296, 3 units of ENGRMAE 298, and four graduate courses from a restricted list in the selected MAE major area. Additionally, four of the eight required graduate courses must be from the MAE Department. With the approval of the Graduate Advisor, one non-core graduate course may be replaced by an upper-division undergraduate course in MAE; this course may not have been used to satisfy the undergraduate degree requirements.

Plan II: Comprehensive Examination Option

The comprehensive examination option requires completion of eleven graduate, technical and science courses, plus a comprehensive exam. Students must complete 3 units of ENGRMAE 298 and four graduate courses from a restricted list. Additionally, six of the eleven required graduate courses must be from the MAE Department. Up to two of the required courses may be replaced by an equivalent number of units of ENGRMAE 294, which includes execution and documentation of a research or design project under a faculty advisor. With the approval of the Graduate Advisor, one graduate course may be replaced by an upper-division undergraduate course in MAE; this course may not be used to satisfy both undergraduate and graduate degree

requirements. Consult the MAE Department (<http://mae.eng.uci.edu/>) website (<http://mae.eng.uci.edu/>) or Graduate Advisor, for detailed information on the comprehensive exam.