Mechanical and Aerospace Engineering, M.S.

The Mechanical and Aerospace Engineering faculty have special interest and expertise in five thrust areas: continuum mechanics; power, propulsion, and environment; micro/nanomechanics; and systems and design.

Continuum mechanics faculty study the physics of fluids, physics and chemistry of solids, and structural mechanics. Areas of emphasis in fluid mechanics include incompressible and compressible turbulent flows, multiphase flows, chemically reacting and other nonequilibrium flows, aeroacoustics, aerooptics, and fluid-solid interaction. In the field of solid mechanics, research and course work emphasize theoretical and computational approaches which contribute to a basic understanding of and new insight into the properties and behavior of condensed matter. General areas of interest are large-strain and large-rotation inelastic solids, constitutive modeling, and fracture mechanics. Computational algorithms center on boundary element methods and the new class of meshless methods. Studies in structural mechanics involve the analysis and synthesis of low-mass structures, smart structures, and engineered materials, with emphasis on stiffness, stability, toughness, damage tolerance, longevity, optimal life-cycle costs and self-adaptivity.

Research in power, propulsion, and environment encompasses aerospace propulsion, combustion and thermophysics, fuel cell technologies, and atmospheric physics and impacts. In aerospace propulsion, particular emphasis is placed in the areas of turbomachinery, spray combustion, combustion instability, innovative engine cycles, and compressible turbulent mixing. The topic of combustion and thermophysics addresses the fundamental fluid-dynamical, heat-transfer, and 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. The area of atmospheric physics and impacts deals with the modeling and controlling of chemical pollution, particle dispersion, and noise emission caused by energy-generation and propulsion devices. Research on atmospheric turbulence addresses the energy exchanges between the Earth’s land and ocean surfaces and the overlying atmosphere. Micro/nanomechanics encompasses the thrusts of miniaturization engineering, mechatronics, and biotechnology. Miniaturization engineering is relevant to the development of small-scale mechanical, chemical and biological systems for applications in biotechnology, automotive, robotic, and alternative energy applications. It involves the establishment of scaling laws, manufacturing methods, materials options and modeling from the atom to the macrosystem. Mechatronic design is the integrated and optimal design of a mechanical system and its embedded control system. Main focus research is the design, modeling, and characterization of Micro-Electro-Mechanical Systems (MEMS). Particular emphasis is placed on analysis and design of algorithmic methods and physical systems that realize sensor-based motion planning. The thematic area of biotechnology involves the understanding, modeling, and application of fundamental phenomena in mechanical engineering, electrical engineering, and chemistry towards the development of bio-sensors and actuators.

Systems and design research is conducted in the areas of dynamic systems optimization and control, biomechanical engineering, robotics and machine learning, and design engineering. Advanced concepts in dynamics, optimization and control are applied to the areas of biorobotics, flight trajectory design, guidance and navigation, learning systems, micro sensors and actuators, flexible structures, combustion, fuel cells, and fluid-optical interactions.

Biomechanical engineering integrates physiology with engineering in order to develop innovative devices and algorithms for medical diagnosis and treatment. The focus of robotics and machine learning is the creation of machines with human-like intelligence capabilities for learning. Faculty in design engineering develop 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.

Aerospace engineering research efforts combine specialties from each of the four 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, 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 major. 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.