

# Mechanical & Aerospace Engineering Graduate Programs

## Contact Information

College of Engineering

E2413 Lafferre Hall

573-884-8610

<http://engineering.missouri.edu/mae/>

## About Mechanical & Aerospace Engineering

Like markets merging together to create a global economy, this decade has approached the exciting frontier of joint research. The marriage of Mechanical Engineering to related fields has contributed to a new "Interdisciplinary Era". In meeting the challenges brought on by this co-operative approach to engineering, the Department of Mechanical & Aerospace Engineering (MAE) at the University of Missouri has broadened its scope in both education and research while maintaining strengths in the fundamental disciplines: Dynamics & Control, Design & Manufacturing, Materials & Solids and Thermal & Fluid Science Engineering. Such well-established academic traditions in the undergraduate and graduate curriculum as well as nationally renowned research programs are the basis for MAE having become the largest department in the College of Engineering at MU. An equally important aspect contributing to the quality of the MAE department is the aggressive pursuit of funding, by our faculty, to establish nationally recognized research programs. Well-earned support through sizable funding from both federal agencies and industry are valuable resources in the promotion of our graduate research and undergraduate teaching.

## **Career Opportunities**

Graduate programs are planned to prepare students for advanced professional engineering careers. In recognition of the broad nature of the field of mechanical and aerospace engineering, considerable latitude in programs is encouraged so students may prepare for employment in industry, education and government. The usual purpose of a PhD program is to prepare a person for a career in research or teaching. The program is oriented toward research culminating in a dissertation suitable for publication.

*continued on next page*

## Areas of Study

A student may pursue an area of concentration selected from AI/expert systems, automation, bioengineering, combustion, control, creep and plasticity, design optimization, numerical methods, computational fluid dynamics, fracture mechanics, heat transfer, interactive computer graphics, laser diagnostics, manufacturing systems, materials science, mechanical syntheses, mechatronics, mechanics, parallel computation, residual stress, robotics, thermal systems design and management and ultrasonic nondestructive evaluation.

## Licensure

Information on degree requirements for engineering licensure is detailed under Professional Engineering Registration.

## Facilities and Equipment

The department has several specialized laboratories in aerosol mechanics, combustion, computer control, creep and fracture mechanics, fluid mechanics and heat transfer, manufacturing, materials science and structural dynamics.

Besides the modern instrumentation and equipment normally found in well-equipped mechanical and aerospace engineering laboratories, the department has, or has access to, such specialty items as MTS and Instron material and structural test equipment, wind tunnels, X-ray and a scanning electron microscope facility, computer control systems, a scanning laser vibrometer, a microscale heat transfer and electronic coding laboratory, an experimental stress laboratory, a fluid power laboratory and the university research reactor.

## Information Technology and Computing

A combination of the campus Division of Information Technology and the Engineering Technical Services (ETS) provided advanced engineering computation for College of Engineering faculty and students. CAD/CAM and graphics are the primary emphasis, although artificial intelligence, multiple high-level programming languages and computational and simulation libraries also are available.

The College of Engineering operates one high performance enterprise server, two super minicomputers and 17 HP workstations. The ETS also provides hardware/software support, locally, to nine College of

*continued on next page*

Engineering departments and their affiliated research centers. These units are networked via Ethernet to the superminicomputers operated by the College of Engineering.

The Division of IT operates two remote terminal sites in the Engineering Buildings East. The University also supports an extensive computer system consisting of IBM mainframe computers, remote terminal sites, and PC and Macintosh labs throughout the campus.

### **Financial Aid from the Program**

Admission decisions to the graduate program are made without considerations of a student's financial need. Once admitted, a student may be considered for fellowships, research assistantships (RAs) and teaching assistantships (TAs). Awarding of fellowships is initiated by the department. RAs are awarded by individual faculty members. A student may apply by contacting faculty members directly. Application forms for TAs are available in the department office. International students are not eligible for TAs in their first semester of study. For specific departmental requirements, please refer to the MAE Graduate Handbook. Please see the department website for information on how to contact the professors individually about research assistantships offered.

## **Mechanical and Aerospace Engineering Faculty**

### **James E. Bryan**

assistant professor, PhD, Texas A&M University. Two-phase heat transfer; microscale, MEMS, and macroscale applications with emphasis on electrohydrodynamic/electrostatic force enhancement/control and novel enhanced surface development. Microscale transport; fluid pumping, flow control, and convection enhancement applications with emphasis on electrohydrodynamic/electrostatic force enhancement/control. Thermal systems; design, enhancement, and control (performance and manufacturing process).

### **JK Chen**

William and Nancy Thompson Professor, PhD, Purdue University. Ultrashort laser-material interaction, Nano-to micro-scale to continuum modeling, Thermomechanical damage, Computational mechanics, Composite materials and structures, Impact and penetration mechanics, Fracture mechanics.

*continued on next page*

**Uee Wan Cho**

associate professor, PhD, Brown University. Solid and applied mechanics, materials science, structural and stress analysis, creep, plasticity, and continuum damage mechanics.

**A. Sherif El-Gizawy**

professor, PhD, University of Waterloo, Canada. Manufacturing design, process modeling, integrated computer aided manufacturing, and expert systems applications in manufacturing.

**Roger Fales**

assistant professor, PhD, Iowa State University. Controls, dynamics, off-highway machinery, and fluid power.

**Frank Z. Feng**

professor, director of graduate studies, PhD, University of Minnesota. Dynamics and Control. Nonlinear dynamics in energy transfer and instabilities, vibration control and acoustics for noise suppression, damping characteristics of shape memory alloys, acoustic levitation of bubbles and drops, geometric methods and chaos in dynamical systems, microelectrical/mechanical systems (MEMS).

**Sanjeev K. Khanna**

associate professor, PhD, University of Rhode Island. Design of welded structures and welding engineering; experimental stress analysis; optical mechanics; residual stress measurement; dynamic and quasi-static fracture of monolithic and composite materials; materials characterization; integration of mechanics, design, and manufacturing into the undergraduate curriculum.

**Craig A. Kluever**

professor, PhD, Iowa State University. Guidance and control of aerospace vehicles, orbital mechanics, spacecraft and mission design, and trajectory optimization.

---

*continued on next page*

**Hao Li**

assistant professor, PhD, Stevens Institute of Technology. Mechanical, electrical, and biomedical properties of nanostructured materials, i.e. carbon nanotubes, SiC nanowires, and hydroxyapatite nanofibers; template based nanofabrication; thin films and coatings; surface engineering; chemical vapor deposition; self assembly; ceramic micro/nano composites; bone cements, biomimetic nanocomposites, and scaffolds for tissue engineering.

**Yuyi Lin**

associate professor, PhD, University of California-Berkeley. Dynamics and control of mechanisms, flexible structures and robots, CAD/CAM.

**Stephen J. Lombardo**

associate professor, PhD, University of California-Berkeley. Binder removal by thermal methods, supercritical extraction of binder, synthesis and processing of ceramics for capacitor applications, high voltage capacitors, sintering of ceramics and high temperature reactions, strain mismatch in ceramic processing, particle dynamics in ceramic forming operations, and ceramic membranes.

**Hongbin Ma**

associate professor, PhD, Texas A&M University. Microscale heat transfer and flow process, micro heat pipes, semiconductor refrigeration, high heat flux cooling, thin film deposition, rapid cooling for high-power microelectronic devices, experimental heat transfer.

**Steven P. Neal**

associate professor, PhD, Iowa State University. Ultrasonic characterization of engineering and biomaterials, and solid mechanics. Email address: NealS@missouri.edu

**P. Frank Pai**

C. W. LaPierre Professor, PhD, Virginia Tech. Computational structural mechanics, composite and smart structures, structural health monitoring, nonlinear finite elements, deployable structures, modern nonlinear dynamics, and large deformation processing.

---

*continued on next page*

**Douglas E. Smith**

associate professor, PhD, University of Illinois at Urbana-Champaign. Development of finite element methods for simulation-based design, inverse analyses and computational biomechanics with a focus on design sensitivity analysis, multidisciplinary analysis and optimization, and reliability-based design. Applications include polymer and composites processing, heat treatment, structural optimization, bone remodeling and muscle simulation; and include theoretical development, computer implementation and industrial application.

**Gary L. Solbrekken**

assistant professor, director of undergraduate studies, PhD, University of Minnesota. Thermal design at all scales, development of thermal/fluid measurement systems, thermal management of electronic equipment, solid state energy conversion, and alternate energy generation strategies.

**Robert Tzou**

J. C. Dowell Professor, chair, PhD, Lehigh University. Microscale heat transfer, thermal lagging in ultrafast microelectronic/photonics devices, rapid thermal processing and modeling, anomalous diffusion in amorphous media, thermal control in rapid material processing, effective thermomechanical properties in composites, thermal and strain localization in high-speed penetration, thermomechanical interaction in fracture.

**Richard T. Whelove**

director of undergraduate studies, MEd, University of Missouri. Engineering graphics.

**Robert A. Winholtz**

associate professor, PhD, Northwestern University. Residual stresses, neutron and x-ray measurement of residual and applied stresses, composite and two phase materials.

---

*continued on next page*

**Qingsong Yu**

associate professor, PhD, University of Missouri. Low-temperature plasma processing, plasma diagnosis, thin-film deposition, material surface modification and interface engineering, corrosion protection, polymer nanocomposites, plasma sterilization, bio- and biomedical materials, tissue engineering, electrochemical biosensors, and heat transfer nanofluids.

**Yuwen Zhang**

professor, PhD, University of Connecticut. Phase change heat transfer, transport phenomena in powder and/or gas based Solid Freeform Fabrication (SFF), heat and mass transfer analysis associated with heat pipe science and technology, microscale heat transfer.

**Vitaly E. Gruzdev**

research assistant professor, PhD, S.I. Vavilov State Optical Institute, Russia. Physics of condensed matter, physics of solids, laser interactions with solids, laser engineering and optics, laser methods of material processing, laser methods of remote measurements and control.

**Nam-Jung Kim**

research assistant professor, PhD, University of North Carolina. Synthesis of nanoporous films with lattice ordering through self-assembly, characterization of degraded lattice structures due to various thermal heating, silicon matrix-embedded nano clusters and quantum dots with high densities, diffusion measurement on multiconnected nano-pore channels, design and development of patterned nanosized reactors with different scales.

---

*continued on next page*

# Master of Science in Mechanical & Aerospace Engineering

## **Admission Contact Information:**

Marilyn Estes ([EstesMa@missouri.edu](mailto:EstesMa@missouri.edu))  
E2413 Mechanical & Aerospace Engineering  
Columbia, MO 65211  
573-8824-8610

## **Admission Criteria:**

Fall deadline: May 31

Spring deadline: October 31

Summer deadline: April 30

- Minimum TOEFL score: 500 (paper); 61 (Internet)
- Minimum IELTS academic score: 5.5
- Minimum GPA: 3.0
- BS in same or a closely related field

Lower GPAs require special action and substantiation, such as good test scores on the GRE or other recognized examinations.

## **Required Application Materials**

### To the Graduate School:

- All required Graduate School documents

### To the MAE Program:

- Official Transcripts (all Universities and Colleges attended)
- TOEFL/IELTS scores
- 3 letters of recommendation
- GRE scores
- Statement of Objectives

## **Courses**

See Mechanical and Aerospace Engineering (MAE) graduate courses in [the myZou online system](#).

## **MS Plan of Study**

A plan of study is developed by the student and the adviser, subject to approval. The minimum degree requirement is 30 hours with a minimum of 18 hours at the 8000 level. Included within the 30 hours

*continued on next page*

must be a special project report or thesis. A special project consists of three to five hours of MAE 8085 (Problems). Alternatively, programs directed toward a thesis shall include three to eight hours of MAE 8990 (Research). A thesis or a report is approved by designated faculty committees and is deposited in the department libraries.

Passing the MS final committee fulfills the degree requirements.

## **Doctorate in Mechanical & Aerospace Engineering**

### **Admission Contact Information:**

Marilyn Estes ([EstesMa@missouri.edu](mailto:EstesMa@missouri.edu))  
E2413 Mechanical & Aerospace Engineering  
Columbia, MO 65211  
573-8824-8610

### **Admission Criteria:**

Fall deadline: May 31

Spring deadline: October 31

Summer deadline: April 30

- Minimum TOEFL score: 500 (paper); 61 (Internet)
- Minimum IELTS academic score: 5.5
- Minimum GPA: 3.0
- Strong record in the MS program

Doctoral degree program applicants are closely and individually reviewed.

### **Required Application Materials**

#### To the Graduate School:

- All required Graduate School documents

#### To the MAE Program:

- Official Transcripts (all Universities and Colleges attended)
- TOEFL/IELTS scores
- 3 letters of recommendation (preferably from MS advisor and 2 other letters)
- GRE scores
- Statement of Objectives

*continued on next page*

**Courses**

See Mechanical and Aerospace Engineering (MAE) graduate courses in [the myZou online system](#).

**PhD Degree Requirements**

A minimum of 72 semester hours are required including the credit hours taken during the MS program. Students who received the MS degree from other than MU may transfer a maximum of 30 hours from their MS course work.

A doctoral student must satisfy a special requirement, either proficiency in foreign languages or a collateral field. The collateral field requires a minimum of nine hours of course work in one area other than MAE.

**PhD Plan of Study**

The PhD candidate plans a plan of study and research under the immediate supervision of an adviser and in close cooperation with the doctoral program committee approved by the dean of the Graduate School upon the department's recommendation.

**Qualifying Examination**

A qualifying examination is given soon after the student begins doctoral study. Successful completion of this examination is a prerequisite to formal acceptance into the PhD program.

Students with an MS from MU or another accredited U.S. engineering program will be exempt from the qualifying examination if their MS GPA and total GRE scores satisfy a departmental exemption rule.

**Comprehensive Examination & Dissertation**

A comprehensive examination is given after all course work and language or collateral requirements have been satisfied. Upon completion of the plan of study and research a final examination, essentially a defense of the dissertation, is administered.

END OF PROGRAM DESCRIPTION