Erik Jonsson School of Engineering & Computer Science

Department of Mechanical Engineering

Department Faculty

**Professors:** Xin-Lin Gao, Hongbing Lu, Mario A. Rotea, Seung M. You

**Associate Professors:** Stefano Leonardi, Yaoyu Li, Dong Qian

**Assistant Professors:** Wonjae Choi, Robert D. Gregg, Fatemeh Hassanipour, Majid Minary, Wooram Park, Yonas Tadesse, Walter E. Voit

**Senior Lecturers:** Terry V. Baughn, Robert Hart, James Hilkert, Oziel Rios

Affiliated Faculty

**Professors:** Ray H. Baughman, Andrew J. Blanchard, Gerald O. Burnham, Yves J. Chabal, Kyeongjae (KJ) Cho, Babak Fahimi, Bruce E. Gnade, Matthew J. Goeckner, C. Robert Helms, Jiyoun Kim, Moon J. Kim, Jeong-Bong Lee, Kaushik Rajashekara, Mark W. Spong, Mathukumalli Vidyasagar, Robert M. Wallace, Steve Yurkovich

**Professor Emeritus:** Louis R. Hunt

**Associate Professors:** Gerald O. Burnham, Wenchuang (KJ) Hu

Objectives

The program leading to the MS degree in Mechanical Engineering (ME) provides advanced studies for both recent baccalaureate graduates and experienced engineers in the following core areas: control & dynamic systems, manufacturing & design innovation, mechanics & materials, and thermal & fluid sciences. The program is designed to provide advanced skills in mechanical engineering. The program also provides the foundation for a PhD degree in engineering or closely related disciplines.

The PhD program in Mechanical Engineering at UT Dallas is offered as a joint degree program between UT Dallas and UT Arlington. The objective of the PhD program is to prepare talented doctoral students for careers in which they will create new technologies and processes for the design, manufacturing, control and operation of components and systems in energy, health care, security and defense, and transportation. Given the key enabling role of mechanical engineering in all areas of technology, the graduates of this program will be technical leaders in emerging and existing scientific and industrial fields in Texas and the nation.
Facilities

The Engineering and Computer Science Building and the new Natural Science and Engineering Research Laboratory provide extensive facilities for teaching and research. These include wind tunnels, material test systems, nanoindenter, impact facilities, ultra-high speed camera, DMA, XPS, FTIR, NMR, TGA, DSC, XRD, µ-Raman, Fluorescence Spectrometer, AFM, FIB/SEM, and TEM. A Class 10000 microelectronics clean room facility, including e-beam lithography, sputter deposition, PECVD, LPCVD, etch, ash and evaporation, is available for student projects and research.

In addition to the facilities on campus, cooperative arrangements have been established with many local industries to make their facilities available to UT Dallas graduate engineering students.

Concentration Areas

There are four technical areas of concentration for the graduate degree programs in Mechanical Engineering, which are:

- Dynamic Systems & Control (DSC)
- Manufacturing & Design Innovation (MDI)
- Mechanics & Materials (MM)
- Thermal & Fluid Sciences (TFS)

All graduate students must select a concentration area within the first two semesters in the program.

Scholarship Opportunities

The Erik Jonsson School of Engineering and Computer Science offers competitive scholarships for highly qualified students. Interested students should request application materials by contacting the Department of Mechanical Engineering.

Master of Science in Mechanical Engineering

33 hours minimum

Admission Requirements

The University's general admission requirements are discussed on the [Graduate Admission](catalog.utdallas.edu/2013/graduate/admission) page.

The student entering the MS ME program should meet the following guidelines:

- A bachelor's degree in engineering or one of the natural sciences from an accredited U.S. institution, or from a comparable institution abroad,
- A grade point average in upper-division quantitative coursework of 3.0 or better on a 4-point
scale, and

- GRE revised scores of 150, 160, and 4 for the verbal, quantitative, and analytical writing components, respectively, are advisable based on our experience with student success in the program.

- Three letters of recommendation from individuals who are able to judge the candidate's potential for success in the master's degree program.

- An essay outlining the candidate's background, education and professional goals.

Students from other engineering disciplines or from other areas of science or mathematics may be considered for admission to the program; however, additional coursework may be necessary to complete the master's program.

A student lacking undergraduate prerequisites for graduate courses in mechanical engineering must complete these prerequisites or receive approval from the faculty advisor and the course instructor.

**Degree Requirements**

The University's general degree requirements are discussed on the [Graduate Policies and Procedures page](catalog.utdallas.edu/2013/graduate/policies/policy).

The MS ME requires a minimum of 33 semester credit hours.

All students must have a faculty advisor and an approved plan of study within the first two consecutive semesters in the program. The plan of study is based upon the student's choice of concentration area. Courses taken without advisor approval will not count towards the 33 semester-hour requirement. Successful completion of an approved plan of study leads to the MS ME degree.

The MS ME program has both a thesis and a non-thesis option. All part-time MS ME students will be assigned initially to the non-thesis option. Those wishing to elect the thesis option may do so by obtaining the approval of a faculty thesis supervisor.

All full-time, supported students are required to participate in the thesis option. The thesis option requires six semester credit hours of research, a written thesis submitted to the graduate school, and a formal public defense of the thesis. The supervising committee administers this defense and is chosen in consultation with the student's thesis advisor prior to enrolling for thesis credit. Research and thesis hours cannot be counted in a MS ME degree plan unless a thesis is written and successfully defended.

**Required Major Courses: 12 hours**

The following is a list of required courses that all MS students in Mechanical Engineering must take. A student must receive a grade of B- or better in each of these required courses and maintain a GPA of at least 3.0 to remain in good standing and satisfy the degree requirements.

**MECH 6300** Linear Systems
Prescribed Electives within Concentration Areas

The following is a list of prescribed elective courses. Students must take at least 3 prescribed elective courses from one concentration area. All electives must be approved by faculty advisor.

Note: the presence of a course number in parentheses indicates that this course is cross-listed in another department.

**Dynamic Systems & Controls (DSC)**

*MS students must take at least 3 courses from one concentration area.*

- **MECH 6311** Advanced Mechanical Vibrations
- **MECH 6312** *(EESC 6349)* Random Processes
- **MECH 6313** *(ENGR 6336, BMEN 6388, SYSE 6324)* Nonlinear Control Systems
- **MECH 6314** *(SYSM 6306, BMEN 6372)* Engineering Systems: Modeling & Simulation
- **MECH 6316** *(SYSE 6322)* Digital Control of Automotive Powertrain Systems
- **MECH 6323** *(SYSE 6323)* Robust Control Systems
- **MECH 6324** Robot Control
- **MECH 6V29** Special Topics in Controls and Dynamic Systems

**Manufacturing & Design Innovation (MDI)**

*MS students must take at least 3 courses from one concentration area.*

- **MECH 6330** Multiscale Design & Optimization
- **MECH 6333** Materials Design & Manufacturing
- **MECH 6334** Smart Materials and Structures
- **MECH 6335** *(OPRE 6340)* Flexible Manufacturing Strategies
- **MECH 6341** *(EEMF 6348, MSEN 6348)* Lithography & Nanofabrication
- **MECH 6347** *(EEMF 6382, MSEN 6382)* Introduction to MEMS
- **MECH 6348** *(EEMF 6322, MSEN 6322)* Semiconductor Processing Technology
- **MECH 6V49** Topics in Manufacturing and Design Innovation
Mechanics & Materials (MM)

MS students must take at least 3 courses from one concentration area.

MECH 6350 Advanced Solid Mechanics
MECH 6353 Computational Mechanics
MECH 6354 Experimental Mechanics
MECH 6355 Viscoelasticity
MECH 6367 (MSEN 6310) Mechanical Properties of Materials
MECH 6368 (MSEN 6350) Imperfections in Solids
MECH 6V69 Special Topics in Mechanics and Materials

Thermal & Fluid Sciences (TFS)

MS students must take at least 3 courses from one concentration area.

MECH 6370 Fluid Mechanics
MECH 6371 Computational Fluid Dynamics
MECH 6384 Applied Heat Transfer
MECH 5383 (EEMF 5383, MSEN 5383, PHYS 5383) Plasma Technology
MECH 6380 Advanced Heat Transfer
MECH 6383 (EEMF 6383, PHYS 6383) Plasma Science
MECH 6V89 Special Topics in Thermal and Fluid Sciences

Common courses

MS students must take these common courses.

MECH 6391 (EEGR 6381) Computational Methods in Engineering
MECH 6V97 Special Topics in Mechanical Engineering

Students participating in the non-thesis option must also take 4 graduate level electives. Students participating in the thesis option must take 2 graduate level electives and the following courses to fulfill the research and thesis requirements of the MS ME degree program:

MECH 6V97 Research in Mechanical Engineering (3 hours minimum)
MECH 6V98 Thesis (3 hours minimum)
All electives must be approved by the faculty advisor.

Doctor of Philosophy in Mechanical Engineering
78 hours minimum beyond the baccalaureate degree

Admission Requirements

The University's general admission requirements are discussed on the \textcolor{blue}{Graduate Admission} page (\url{catalog.utdallas.edu/2013/graduate/admission}).

The PhD in Mechanical Engineering is awarded primarily to acknowledge the student's success in an original research project, the description of which is a significant contribution to the scholarly literature. Applicants for the doctoral program are therefore selected by the Mechanical Engineering Graduate Committee on the basis of research aptitude as well as academic record.

The following are guidelines for admission to the PhD program in Mechanical Engineering:

- A master's or bachelor's degree in engineering or one of the natural sciences from an accredited U.S. institution, or from a comparable institution abroad.
- A grade point average of 3.3 or better on a 4-point scale.
- GRE revised scores of 150, 160, and 4 for the verbal, quantitative and analytical components, respectively, are advisable based on our experience with student success. (See also UT Dallas requirements for \textcolor{blue}{English proficiency}).
- Three letters of recommendation from individuals who are familiar with the student's record, and are able to judge the candidate's preparation and ability to succeed in doctoral study in Mechanical Engineering.
- An essay describing motivation for doctoral study and how it relates to their professional goals.

Students from other engineering disciplines or from other areas of science or mathematics may be considered for admission to the program; however, additional coursework may be necessary to complete the PhD program.

For students who are interested in pursuing a PhD but are unable to attend school full-time, there is a part-time option. The guidelines for admission to the program and the degree requirements are the same as for full-time PhD students.

Degree Requirements

The University's general degree requirements are discussed on the \textcolor{blue}{Graduate Policies and Procedures} page (\url{catalog.utdallas.edu/2013/graduate/policies/policy}).

Doctoral students must have a faculty advisor and an approved plan of study within the first two consecutive semesters in the program. The faculty advisor shall be a faculty member, or affiliate
faculty member, in Mechanical Engineering. The plan of study is based upon the student’s choice of concentration area. Each doctoral student must conduct original research in the area of Mechanical Engineering, under the direction of the faculty advisor. A supervisory committee will be formed once the faculty advisor accepts the student for a research project. The student must complete and defend a dissertation on the research project.

The PhD program in Mechanical Engineering requires a minimum of 78 semester credit hours beyond the baccalaureate degree. The breakdown is shown in the table below:

<table>
<thead>
<tr>
<th>Category</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Courses</td>
<td>12</td>
</tr>
<tr>
<td>Prescribed Electives</td>
<td>12</td>
</tr>
<tr>
<td>Mathematics Electives</td>
<td>6</td>
</tr>
<tr>
<td>Free Electives</td>
<td>12</td>
</tr>
<tr>
<td>Dissertation</td>
<td>6 (minimum)</td>
</tr>
<tr>
<td>Other: Research in Mechanical Engineering</td>
<td>30 (minimum)</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
</tr>
</tbody>
</table>

### Required Major Courses: 12 hours

The following is a list of required courses that all PhD students in Mechanical Engineering must take. A student must receive a grade of B- or better in each of these required courses and maintain a GPA of at least 3.0 to remain in good standing and satisfy the degree requirements.

- MECH 6300 Linear Systems
- MECH 6303 Computer Aided Design
- MECH 6306 Continuum Mechanics
- MECH 6307 Thermal and Energy Principles

### Prescribed Electives within Concentration Areas: 12 hours

The following is a list of prescribed elective courses. A PhD student in Mechanical Engineering must take at least 4 courses from the list of prescribed elective courses in one of the four areas of concentration. Upon approval from the student’s faculty advisor and the Mechanical Engineering Graduate Committee, a qualified student can take other courses offered by UT Dallas or UT Arlington to satisfy the requirements on prescribed electives.

Note: the presence of a course number in parentheses indicates that this course is cross-listed in another department.

### Dynamic Systems & Controls (DSC)

PhD students must take at least 4 courses from one concentration area.
MECH 6311  Advanced Mechanical Vibrations
MECH 6312  (EESC 6349) Random Processes
MECH 6313  (ENGR 6336, BMEN 6388, SYSE 6324) Nonlinear Control Systems
MECH 6314  (SYSM 6306, BMEN 6372) Engineering Systems: Modeling & Simulation
MECH 6316  (SYSE 6322) Digital Control of Automotive Powertrain Systems
MECH 6323  (SYSE 6323) Robust Control Systems
MECH 6324  Robot Control
MECH 6V29  Special Topics in Controls and Dynamic Systems

Manufacturing & Design Innovation (MDI)

PhD students must take at least 4 courses from one concentration area.

MECH 6330  Multiscale Design & Optimization
MECH 6333  Materials Design & Manufacturing
MECH 6334  Smart Materials and Structures
MECH 6335  (OPRE 6340) Flexible Manufacturing Strategies
MECH 6341  (EEMF 6348, MSEN 6348) Lithography & Nanofabrication
MECH 6347  (EEMF 6382, MSEN 6382) Introduction to MEMS
MECH 6348  (EEMF 6322, MSEN 6322) Semiconductor Processing Technology
MECH 6V49  Special Topics in Manufacturing and Design Innovation

Mechanics & Materials (MM)

PhD students must take at least 4 courses from one concentration area.

MECH 6350  Advanced Solid Mechanics
MECH 6353  Computational Mechanics
MECH 6354  Experimental Mechanics
MECH 6355  Viscoelasticity
MECH 6367  (MSEN 6310) Mechanical Properties of Materials
MECH 6368  (MSEN 6350) Imperfections in Solids
MECH 6V69  Special Topics in Mechanics and Materials
Thermal & Fluid Sciences (TFS)

PhD students must take at least 4 courses from one concentration area.

- **MECH 6370** Fluid Mechanics
- **MECH 6371** Computational Fluid Dynamics
- **MECH 6384** Applied Heat Transfer
- **MECH 5383 (EEMF 5383, MSEN 5383, PHYS 5383)** Plasma Technology
- **MECH 6380** Advanced Heat Transfer
- **MECH 6383 (EEMF 6383, PHYS 6383)** Plasma Science
- **MECH 6V89** Special Topics in Thermal and Fluid Sciences

**Mathematics Electives: 6 hours**

The following is a list of elective courses in mathematics.

Two courses are required for mathematics electives.

- **MECH 6391 (EEGR 6381)** Computational Methods in Engineering
- **MATH 5301** Elementary Analysis I and **MATH 5302** Elementary Analysis II (or equivalent)
- **MATH 6303** Theory of Complex Functions
- **MATH 6313** Numerical Analysis
- **MATH 6315** Ordinary Differential Equations
- **MATH 6318** Numerical Analysis of Differential Equations
- **MATH 6319** Principles and Techniques in Applied Mathematics I and **MATH 6320** Principles and Techniques in Applied Mathematics II
- **MATH 6308** Inverse Problems and Applications
- **MATH 6321** Optimization
- **STAT 6331** Statistical Inference I
- **STAT 6337** Advanced Statistical Methods I and **STAT 6338** Advanced Statistical Methods II
- **STAT 6339** Linear Statistical Models
- **STAT 6341** Numerical Linear Algebra and Statistical Computing
- **MATH 7313** Partial Differential and Integral Equations I

Upon the approval of a student's faculty advisor, a qualified student can request to take other
graduate courses in mathematics not listed above.

In addition to course requirements, the PhD students would need to complete the following:

- Qualifying Exam (QE): It tests fundamental knowledge in mathematics and one concentration area of mechanical engineering.
- Comprehensive exam (CE): Written dissertation proposal and an exam given by candidate's supervisory committee.
- Final Exam: Completion of a major research project culminating in a dissertation demonstrating an original contribution to the body of knowledge. The dissertation will be defended publicly. The rules for this defense are specified by the Office of the Dean of Graduate Studies.

A student who has passed the QE and maintained the GPA requirements in PhD level organized courses will be admitted to the PhD candidacy.

A student entering the PhD program must pass the QE exam within 3 long semesters. A student has at most two consecutive attempts at the QE. The QE will be given during the fall and spring semesters.

The following courses are required to fulfill the research and dissertation requirements of the PhD degree program:

**MECH 8V70** Research in Mechanical Engineering (30 hours minimum)

**MECH 8V99** Dissertation (6 hours minimum)

Neither a foreign language nor a minor is required for the PhD. However, the student's supervisory committee may impose these or other requirements that it feels are necessary and appropriate to the student's degree program.