Erik Jonsson School of Engineering and Computer Science

Department of Mechanical Engineering

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 and dynamic systems, manufacturing and design innovation, mechanics and materials, and thermal and 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 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 have the preparation to become technical leaders in emerging and existing scientific and industrial fields in Texas and the nation.

Facilities

The Engineering and Computer Science Building and the Natural Science and Engineering Research Laboratory provide extensive facilities for teaching and research. These include wind tunnels, materials test systems with temperature chambers, nanoindenter, high impact facilities, ultra-high speed camera, 3D printers, computer clusters, 3D vibration measurement apparatus for microsystems, ultra-fast lasers, motion capture system, DMA, XPS, FTIR, NMR, TGA, DSC, XRD, µ-Raman, fluorescence spectrometer, AFM, FIB/SEM, and atomic resolution 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.

Concentration Areas

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

- Dynamic Systems and Control (DSC)
- Manufacturing and Design Innovation (MDI)
- Mechanics and Materials (MM)
Thermal and 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 (ME).

Fast Track Baccalaureate/Master’s Degrees

In response to the need for advanced education in Mechanical Engineering, a Fast Track program is available to well-qualified UT Dallas undergraduate students. Qualified seniors may take up to 15 graduate semester credit hours that may be used to complete the baccalaureate degree and also to satisfy the requirements for the master’s degree. This is accomplished by (1) taking courses (typically electives) during one or more summer semesters, and (2) beginning graduate coursework during the senior year. Details are available from the Associate Dean for Undergraduate Education.

Master of Science in Mechanical Engineering

33 semester credit hours minimum

Department Faculty

Professors: Hongbing Lu, S.O. Reza Moheimani, Dong Qian, Mario A. Rotea, Seung M. You

Associate Professors: Fatemeh Hassanipour, Stefano Leonardi, Yaoyu Li, Arif Malik, Walter E. Voit

Clinical Associate Professors: Dani Fadda, Robert Hart

Assistant Professors: William Anderson, Wonjae Choi, Robert D. Gregg, Giacomo (Valerio) Iungo, Ann Majewicz, Majid Minary, Wooram Park, Zhenpeng Qin, Tyler Summers, Yonas Tadesse, Jie Zhang

Senior Lecturers: Terry V. Baughn, James Hilkert, Oziel Rios, P.L. Stephan Thamban


Admission Requirements

The University’s general admission requirements are discussed on the Graduate Admission page (catalog.utdallas.edu/2016/graduate/admission).
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 institution of higher education in the U.S. or from a comparable institution abroad,

• A grade point average (GPA) in upper-division quantitative coursework of 3.0 or better on a 4.0 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/2016/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 long semesters in the program. The plan of study is based upon the student's choice of concentration area.

Courses taken without advisor's approval will not be counted towards the 33 semester credit 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 semester credit hours cannot be counted in a MS ME degree plan unless a thesis is written and successfully defended.
Required Major Courses: 12 semester credit hours

A MS student in ME must take one core course from each of the four concentration areas in the list below, and must receive a grade of B- or better in the four core courses. A student must maintain a grade point average (GPA) of at least 3.0 to remain in good standing and satisfy the degree requirements.

**Dynamic Systems and Control**
- **MECH 6300** (EECS 6331, SYSM 6307) Linear Systems
- **MECH 6314** (SYSM 6306, BMEN 6372) Engineering Systems: Modeling and Simulation

**Manufacturing and Design Innovation**
- **MECH 6303** Computer Aided Design

**Mechanics and Materials**
- **MECH 6306** Continuum Mechanics
- **MECH 6350** Advanced Solid Mechanics

**Thermal and Fluid Sciences**
- **MECH 6370** Incompressible Fluid Mechanics
- **MECH 6373** Convective Heat Transfer
- **MECH 6374** Conductive and Radiative Heat Transfer

**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. Courses counted towards satisfying requirements on Required Major Courses cannot be counted towards satisfying requirements on Prescribed Electives. 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 and Controls (DSC)**

MS students must take at least 3 courses from one concentration area.
- **MECH 5308** (BMEN 5375, EECS 5375) Introduction to Robotics
- **MECH 5310** Intermediate Dynamics
- **MECH 6300** (EECS 6331, SYSM 6307) Linear Systems
MECH 6311 Advanced Mechanical Vibrations
MECH 6312 (EECS 6349) Random Processes
MECH 6313 (EECS 6336, BMEN 6388, SYSE 6324) Nonlinear Systems
MECH 6314 (SYSM 6306, BMEN 6372) Engineering Systems: Modeling and Simulation
MECH 6316 (SYSE 6322) Digital Control of Automotive Powertrain Systems
MECH 6317 (EECS 6302, SYSM 6302) Dynamics of Complex Networks and Systems
MECH 6318 (SYSM 6305) Optimization Theory and Practice
MECH 6323 (SYSE 6323, EECS 6323) Robust Control Systems
MECH 6324 (BMEN 6324, EECS 6324) Robot Control
MECH 6V29 Special Topics in Controls and Dynamic Systems

Manufacturing and Design Innovation (MDI)

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

MECH 6311 Advanced Mechanical Vibrations
MECH 6314 (BMEN 6372, SYSM 6306) Engineering Systems: Modeling and Simulation
MECH 6317 (EECS 6302, SYSM 6302) Dynamics of Complex Networks and Systems
MECH 6318 (SYSM 6305) Optimization Theory and Practice
MECH 6330 Multiscale Design and Optimization
MECH 6333 Materials Design and Manufacturing
MECH 6334 Smart Materials and Structures
MECH 6335 (OPRE 6340) Flexible Manufacturing Strategies
MECH 6337 (SYSM 6301) Systems Engineering, Architecture and Design
MECH 6338 Reliability-Based Design
MECH 6341 (EEMF 6348, MSEN 6348) Lithography and Nanofabrication
MECH 6347 (EEMF 6382, MSEN 6382) Introduction to MEMS
MECH 6348 (EEMF 6322, MSEN 6322) Semiconductor Processing Technology
MECH 6353 Computational Mechanics
MECH 6354 Experimental Mechanics
MECH 6V49 Special Topics in Manufacturing and Design Innovation
Mechanics and Materials (MM)

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

- **MECH 6306** Continuum Mechanics
- **MECH 6350** Advanced Solid Mechanics
- **MECH 6351** Finite Element Techniques I
- **MECH 6353** Computational Mechanics
- **MECH 6354** Experimental Mechanics
- **MECH 6355** Viscoelasticity
- **MECH 6356** Fracture Mechanics
- **MECH 6367 (MSEN 6310)** Mechanical Properties of Materials
- **MECH 6368 (MSEN 6350)** Imperfections in Solids
- **MECH 6V69** Special Topics in Mechanics and Materials

Thermal and Fluid Sciences (TFS)

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

- **MECH 5370** Introduction to Wind Energy
- **MECH 5372** Introduction to Compressible Fluid Mechanics
- **MECH 5373** Thermal Management of Microelectronics
- **MECH 5376** Introduction to Computational Thermal Fluid Science
- **MECH 5383 (EEMF 5383, MSEN 5383, PHYS 5383)** Plasma Technology
- **MECH 6370** Incompressible Fluid Mechanics
- **MECH 6371** Computational Fluid Dynamics
- **MECH 6372** Turbulent Flows
- **MECH 6373** Convective Heat Transfer
- **MECH 6374** Conductive and Radiative Heat Transfer
- **MECH 6375** Boiling Heat Transfer and Two-Phase Flow
- **MECH 6376** Experimental Thermal and Fluid Dynamics
- **MECH 6377** Advanced Thermodynamics
- **MECH 6383 (EEMF 6383, PHYS 6383)** Plasma Science
**MECH 6V89** Special Topics in Thermal and Fluid Sciences

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 (1-9 semester credit hours)

**MECH 6V98** Thesis (3 semester credit hours minimum)

All electives must be approved by the faculty advisor.

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# Doctor of Philosophy in Mechanical Engineering

*78 semester credit hours minimum beyond the baccalaureate degree*

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## Department Faculty

**Professors:** Hongbing Lu, S.O. Reza Moheimani, Dong Qian, Mario A. Rotea, Seung M. You

**Associate Professors:** Fatemeh Hassanipour, Stefano Leonardi, Yaoyu Li, Arif Malik, Walter E. Voit

**Clinical Associate Professor:** Dani Fadda, Robert Hart

**Assistant Professors:** William Anderson, Wonjae Choi, Robert D. Gregg, Giacomo (Valerio) Iungo, Ann Majewicz, Majid Minary, Wooram Park, Zhenpeng Qin, Tyler Summers, Yonas Tadesse, Jie Zhang

**UT Dallas Affiliated Faculty:** Andrew J. Blanchard, Yves J. Chabal, Kyeongjae (KJ) Cho, Babak Fahimi, Bruce E. Gnade, Matthew J. Goeckner, Wenchuang (Walter) Hu, Jiyoung Kim, Moon J. Kim, Jeong-Bong Lee, Mark W. Spong, Mathukumalli Vidyasagar, Robert M. Wallace, Steve Yurkovich

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## Admission Requirements

The University's general admission requirements are discussed on the [Graduate Admission](catalog.utdallas.edu/2016/graduate/admission) page.

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 institution of higher education in the U.S. or from a comparable institution abroad.
- A grade point average (GPA) of 3.3 or better on a 4.0 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 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 the student's 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 Graduate Policies and Procedures page (catalog.utdallas.edu/2016/graduate/policies/policy).

Doctoral students must have a faculty advisor and an approved plan of study within the first two consecutive long semesters in the program. The faculty advisor shall be a faculty member, or affiliated faculty member, in Mechanical Engineering (ME). 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>
Transfer of graduate level credit into a doctoral program in mechanical engineering is limited to a maximum of 27 semester credit hours of graduate course work upon approval by the graduate committee based on the recommendation by dissertation advisor.

**Required Major Courses: 12 semester credit hours**

A PhD student in ME must take one core course from each of the four concentration areas in the list below, and must receive a grade of B- or better in the four core courses.

**Dynamic Systems and Control**
- **MECH 6300** (EECS 6331, SYSM 6307) Linear Systems
- **MECH 6314** (SYSM 6306, BMEN 6372) Engineering Systems: Modeling and Simulation

**Manufacturing and Design Innovation**
- **MECH 6303** Computer Aided Design

**Mechanics and Materials**
- **MECH 6306** Continuum Mechanics
- **MECH 6350** Advanced Solid Mechanics

**Thermal and Fluid Sciences**
- **MECH 6370** Incompressible Fluid Mechanics
- **MECH 6373** Convective Heat Transfer
- **MECH 6374** Conductive and Radiative Heat Transfer

**Prescribed Electives within Concentration Areas: 12 semester credit 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.

Courses counted towards satisfying requirements on Required Major Courses cannot be counted towards satisfying requirements on Prescribed Electives. 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 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 and Controls (DSC)**
PhD students must take at least 4 courses from one concentration area.

MECH 6300 (EECS 6331, SYSM 6307) Linear Systems
MECH 6311 Advanced Mechanical Vibrations
MECH 6312 (EECS 6349) Random Processes
MECH 6313 (EECS 6336, BMEN 6388, SYSE 6324) Nonlinear Systems
MECH 6314 (SYSM 6306, BMEN 6372) Engineering Systems: Modeling and Simulation
MECH 6316 (SYSE 6322) Digital Control of Automotive Powertrain Systems
MECH 6317 (SYSM 6302) Dynamics of Complex Networks and Systems
MECH 6318 (SYSM 6305) Optimization Theory and Practice
MECH 6323 (SYSE 6323, EECS 6323) Robust Control Systems
MECH 6324 (BMEN 6324, EECS 6324) Robot Control
MECH 6V29 Special Topics in Controls and Dynamic Systems

Manufacturing and Design Innovation (MDI)

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

MECH 6311 Advanced Mechanical Vibrations
MECH 6314 (BMEN 6372, SYSM 6306) Engineering Systems: Modeling and Simulation
MECH 6317 (EECS 6302, SYSM 6302) Dynamics of Complex Networks and Systems
MECH 6318 (SYSM 6305) Optimization Theory and Practice
MECH 6330 Multiscale Design and Optimization
MECH 6333 Materials Design and Manufacturing
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MECH 6335 (OPRE 6340) Flexible Manufacturing Strategies
MECH 6337 (SYSM 6301) Systems Engineering, Architecture and Design
MECH 6338 Reliability-Based Design
MECH 6341 (EEMF 6348, MSEN 6348) Lithography and Nanofabrication
MECH 6347 (EEMF 6382, MSEN 6382) Introduction to MEMS
MECH 6348 (EEMF 6322, MSEN 6322) Semiconductor Processing Technology
MECH 6353 Computational Mechanics
MECH 6354 Experimental Mechanics
MECH 6V49 Special Topics in Manufacturing and Design Innovation

Mechanics and Materials (MM)

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

MECH 6306 Continuum Mechanics
MECH 6350 Advanced Solid Mechanics
MECH 6351 Finite Element Techniques I
MECH 6353 Computational Mechanics
MECH 6354 Experimental Mechanics
MECH 6355 Viscoelasticity
MECH 6356 Fracture Mechanics
MECH 6367 (MSEN 6310) Mechanical Properties of Materials
MECH 6368 (MSEN 6350) Imperfections in Solids
MECH 6V69 Special Topics in Mechanics and Materials

Thermal and Fluid Sciences (TFS)

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

MECH 6370 Incompressible Fluid Mechanics
MECH 6371 Computational Fluid Dynamics
MECH 6372 Turbulent Flows
MECH 6373 Convective Heat Transfer
MECH 6374 Conductive and Radiative Heat Transfer
MECH 6375 Boiling Heat Transfer and Two-Phase Flow
MECH 6376 Experimental Thermal and Fluid Dynamics
MECH 6377 Advanced Thermodynamics
MECH 6383 (EEMF 6383, PHYS 6383) Plasma Science
MECH 6V89 Special Topics in Thermal and Fluid Sciences
Mathematics Electives: 6 semester credit hours

The following is a list of suggested elective courses in mathematics.

Two courses are required for mathematics electives.

- **MATH 6303** Theory of Complex Functions I
- **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
- **MATH 6340** Numerical Linear Algebra
- **MECH 6391 (EEGR 6381)** Computational Methods in Engineering
- **MECH 6392** Advanced Mathematics for Mechanical Engineers I
- **MECH 6393** Advanced Mathematics for Mechanical Engineers II
- **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 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 need to complete the following:

- Qualifying Exam (QE): It tests fundamental knowledge in mathematics and one concentration area of mechanical engineering. A student entering the PhD program must take this exam within 3 long semesters. A student has at most two attempts made within two consecutive semesters at this qualifying exam. The exam will be given during the fall and spring semesters.
- 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.

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

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

**MECH 8V99** Dissertation (6 semester credit 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.

## Non-Degree Seeking Students in Mechanical Engineering

"Non-Degree Seeking" is a term which applies to students who are taking selected courses and who have not applied to, or been accepted into, a degree program. A student may be taking classes for various reasons; i.e., personal or professional enhancement, to transfer courses to another university, to correct a grade deficiency. Students who have not taken the GRE or GMAT, or who are awaiting results, may also be classified non-degree seeking.

A non-degree seeking student must meet the same academic eligibility requirements and English proficiency requirements as ME graduate degree seeking students. Non-degree seeking students who are ultimately admitted to a MS graduate degree program may transfer no more than 15 non-degree semester credit hours to the ME graduate degree program. A new application must be submitted when transferring from non-degree to degree seeking status.