

## Mechanical Engineering M.S. and Ph.D.



### Contact Information

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### Faculty

Professors Langerman (Head), Buck, Dolan, Kalanovic, Kjerengtroen, Korde, Krause, Muci-Kuchler; Associate Professor Sagdeo; Assistant Professors Ellingsen, Skillman, Yoon; Professors Emeritus Pendleton, Gnirk; Instructor Ash.

### Mechanical Engineering

The Department of Mechanical Engineering offers two graduate programs leading to either the master of science or the doctor of philosophy degrees in mechanical engineering. The primary goals of the program are to develop the scholastic ability, independent creativity, and professional competence of an individual to a higher level than is possible in an undergraduate program.

The graduate program offers opportunities for instruction and research in manufacturing,

solid mechanics, transport phenomena, hydrodynamic stability, computational mechanics, multiphase thermal-hydraulics, vibrations, controls, experimental mechanics, fracture mechanics, composite materials, finite element analysis, advanced materials processing, micro machines, and probabilistic design. The graduate program features courses in continuum mechanics, computational methods in transport phenomena, advanced heat transfer, advanced fluid mechanics, engineering analysis, advanced solid mechanics, integrated manufacturing systems, robotics, applied intelligent control, theory of materials behavior, composite materials, advanced mechanical vibrations, advanced mechanical system control, and statistical approaches to reliability.

The mechanical engineering department is one of the largest programs on campus and has well-equipped laboratories. Several faculty members within the department are associated with the Computational Mechanics Laboratory (CML), where high-end workstations are available for pursuing research and design in modeling. Several faculty members are associated with the Center for Advanced Manufacturing and Production (CAMP), where research in advanced manufacturing, advanced composites, and advanced design methodologies is conducted. The department has a strong relationship with the Advanced Materials Processing (AMP) center.

Other labs include the Fluid Mechanics and Heat Transfer Lab, which houses a mach 3 supersonic wind tunnel, Vibrations Lab, Neural Networks and Controls Lab, and Micromechanics Lab. The campus fosters interdisciplinary research, and state-of-the-art equipment such as an electron microscope, atomic force microscope, x-ray diffractometer, Raman spectrometer, laser Vibration Pattern Imager, FADAL VMC40 Vertical Machining Center, Bridgeport Romi CNC lathe, Coordinate Measuring Machine, Injection Molding Machine, IBM 7540 Industrial Robot, and Universal Testing Machines are available in the department or on the campus. Graduate research laboratories also include equipment for modern digital controls and machine vision and thermal image analysis.

## **Master's Program**

The master of science degree program in mechanical engineering can be pursued using either of two (2) equal options. They are:

### **1. Non-Thesis:**

Total credit hours required	32
Seminar ME 790	1
Project ME 788	4
Remaining 27 hours are taken maximum at the 400/500 level	9
minimum at the 600/700 level	18

### **2. Thesis:**

Total credit hours required	30
Seminar ME 790	1
Thesis ME 798	6
Remaining 23 hours are taken maximum at the 400/500 level	9
minimum at the 600/700 level	14

## **Curriculum Notes**

1. 300 level acceptable if outside department and on approved blanket waiver list.

2. Students may enroll in 300/400 level courses only if 500/600 level courses within the major are not being offered or by written permission of the student's major professor and the department head.

It is the belief and policy of the mechanical engineering department that these two options are equivalent in educational value to the student. Within the first semester in residence, each student is requested to carefully evaluate their preference after discussion with the mechanical engineering faculty, and a decision must be made shortly after the beginning of the second semester in residence. In either case the student must by then choose a major professor, and with the major professor's assistance develop a plan of study.

The plan is due by the end of the first full calendar month of the student's second semester

(end of September or end of January) in residence.

The plan will be submitted to:

1. Graduate office
2. The department head
3. Major professor
4. Copy to the student

Each master's degree candidate must select a advisory committee. In addition to the candidate's major professor, the committee must consist of at least one other mechanical engineering professor and a graduate office representative. The graduate office representative, whose appointment must be approved by the graduate dean, must be selected from outside of the mechanical engineering department. The student and his/her supervising professor will nominate the out-of-department committee member after the student has received the nominee's consent.

### **The core curriculum required of all M.S. students includes:**

ME 673 Applied Engineering Analysis I  
ME 773 Applied Engineering Analysis II  
MES 770 Continuum Mechanics

In addition, students should select one course from each of the three areas listed below (or approved substitutions) for a total of six core courses.

### **Thermal Sciences**

ME 612 Transport Phenomena: Momentum  
ME 613 Transport Phenomena: Heat  
ME 616 Computations in Transport Phenomena

### **Mechanical Systems**

ME 623 Advanced Mechanical Vibrations  
ME 722 Advanced Mechanical Design  
EM 680 Advanced Strength of Materials  
MES 713 Advanced Solid Mechanics I

### **Manufacturing and Controls**

ME 683 Advanced Mechanical System Control  
ME 781 Robotics  
ME 782 Integrated Manufacturing Systems

The details of the actual course selections must be developed by the student, the student's academic advisor, and the student's committee. Although there is a fair degree of flexibility, it is assumed that the program will have some meaningful focus. Students should consult the Mechanical Engineering Department Graduate Studies Policy Manual for additional important details.

Entering students usually have a bachelor's degree in mechanical engineering. Qualifying examinations may be required of entering students. A minimum GPA of 3.00 is expected for regular (non-probationary) admission. Applicants who are graduates of institutions that are not accredited by the Accreditation Board of Engineering and Technology (ABET) are required to sit for the Graduate Record Exam and have their scores submitted prior to consideration for admission.

### **Final Examination Thesis Program**

Upon completion of the thesis, mechanical engineering graduate students electing this option will be examined orally over the written thesis and course work as prescribed in the Graduate section. A mechanical engineering graduate student with an accumulated GPA of 3.4 or better in those courses in their graduate program will have their course work exam combined with the thesis defense. For students having an accumulated GPA of less than 3.4 in courses in their graduate program, a separate focused course work oral examination will be administered by the student's graduate committee. The GPA will be computed using midterm grades for the semester in which the student is currently enrolled. The course work examination will examine primarily concepts and fundamentals of those courses selected, rather than the mechanics of problem solution and will, in general, attempt to establish the student's in-depth knowledge of the course content. The student's graduate committee will select specific courses from the student's graduate program in which the student has indicated possible deficiencies. The major professor will inform the student no less than three weeks prior

to the examination what courses have been selected. However, it is the student's responsibility to secure this information from the major professor.

### **Final Examination Non-Thesis Option**

Mechanical engineering graduate students selecting a non-thesis option will be required to pursue a special investigation under the direction of a faculty member. The report on this study will be written and formal although not of thesis quality nor extent. Upon the completion of the special investigation and with the approval of the directing faculty member, the student will be given a formal oral examination over the investigation. Rules concerning an oral examination over course work taken by the student in their graduate program will be identical to the rules stipulated above for those students taking the thesis option.

### **Doctoral Program**

The doctor of philosophy program in mechanical engineering consists of 80 total credits for a student entering the program with a B.S. degree. Students entering the program will be required to submit a plan of study and choose an advisor within the first two semesters of course work.

The curriculum is designed around both options of entering the program with a Bachelor's of Science or Master's of Science degree. For the student designing their program around a B.S. degree, the course work includes 15 hours of core credits, 12 hours of minor credit requirements (if applicable), 29 hours of research publications, advanced field experience, and dissertation, and a remaining 24 credit hours of course work directly determined by the area of emphasis the student chooses to study.

Students completing a doctoral degree are required to enroll for 24 doctoral thesis credits (ME 888) before receiving a degree (students can register for a maximum of 18 in one semester). Doctoral students may not register for thesis credits until the semester after they have passed their preliminary oral examinations.

Each student's Advisory Committee, on behalf of the ME faculty, will evaluate individual student progress through qualifying and comprehensive exams, seminars, the publishing and presentation record of the student, and the dissertation defense process.

Progress toward the Ph.D. degree is undertaken in several parts, including completion of the curriculum, a qualifying exam, a dissertation proposal defense, the preparation of the dissertation, a comprehensive examination, and the defense of the dissertation. There are three different stems, from which the student must choose one as an emphasis. The following section outlines the requirements for the different stems.

### **Curriculum**

The suggested course of study below is modeled around a student entering the program with a B.S. For the suggested course of study from a M.S. to a Ph.D., please contact the department Ph.D. coordinator, Ms. Lisa Carlson, for a curriculum sheet.

#### **Required Core**

ME 673 Applied Engineering Analysis I  
ME 773 Applied Engineering Analysis II  
ME 790 Graduate Seminar  
ME 798 OR 898 Thesis/ Project OR Dissertation  
(6 credits)

#### **Suggested Minor**

12 credit hours (MATH/PHYS/CEE/  
ChE/MES/BME/NANO/GEOE)

### **Thermal Science Emphasis**

#### **Suggested Electives**

Students should take at least one 6\*\* level elective in controls area, one 6\*\* level elective in mechanics area, and one 4\*\* level elective and one 5\*\* level elective (TBD by grad committee).

#### **Suggested Core Courses**

ME 612 Transport Phenomena: Momentum  
ME 613 Transport Phenomena: Heat  
ME 616 Computations in Transport Phenomena

ME 897 Advanced Field Experience (TBD)  
ME 899 Research Publications  
ME 898 Dissertation (30 credits)

### **Solid Mechanics Emphasis**

#### **Suggested Electives**

Students should take at least one 6\*\* level elective in controls area, one 6\*\* level elective in thermal science area, one 4\*\* level elective and one 5\*\* level elective (TBD by grad committee).

#### **Suggested Core Courses**

ME 897 Advanced Field Experience (TBD)  
ME 899 Research Publications  
ME 898 Dissertation (30 credits)

Choose twelve credit hours of electives from list below:

ME 623 Advanced Mechanical Vibrations  
EM 680 Advanced Strength of Materials  
MES 713 Advanced Solid Mechanics I  
MES 714 Advanced Solid Mechanics II  
ME 722 Advanced Mechanical Design

### **Control System Emphasis**

#### **Suggested Electives**

Students should take at least one 6\*\* level elective in mechanics area, one 6\*\* level elective in thermal science area, and one 4\*\* level elective and one 5\*\* level elective (TBD by grad committee).

#### **Suggested Core Courses:**

ME 781 Robotics  
EE 651 Digital Control Systems  
EE 652 Nonlinear and Optimal Control  
ME 897 Advanced Field Experience  
ME 899 Research Publications  
ME 898 Dissertation (30 credits)

The course suggestions for each stem should only be used as a guide to choosing your course of study. Your advisor will work with you to design your program of study around the area of emphasis you choose.