**MECHANICAL ENGINEERING**

Option Coordinator

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### Option Description

The program option in mechanical engineering offers the Master of Science in Engineering with specialization within the general mechanical engineering disciplines. Specializations are available in the areas of mechanical analysis/design and fluid thermal systems. The thesis and non-thesis plans are for students who seek to deepen their theoretical knowledge and strengthen their ability to solve advanced engineering problems, while the management plan is for those who wish to include managerial training in their program of preparation.

The Department of Mechanical Engineering has excellent computer and laboratory facilities that provide for the following design and research capabilities: solid modeling, FEA in stress analysis, structural dynamics and heat transfer, experimental stress analysis, vibrations and noise control, computational and experimental heat transfer and fluid dynamics, and advanced machine design.

The Master of Science in Engineering may be characterized as being both career-oriented and flexible. Program plans and options are available to accommodate the needs of nearly every engineering graduate student. Graduate students enrolled in any of the engineering graduate programs must complete:

- 30 semester hours for the thesis plan,
- 33 semester hours for the nonthesis plan, or
- 36 semester hours for the management plan.

The degree requirements consist of core courses, technical courses, and project courses. The management plan also requires a series of business courses. These degree programs are designed to provide graduate students with the knowledge and skills to excel in professional careers and/or pursue a PhD or doctorate degree in engineering. To obtain a list of core and technical course requirements for a particular engineering discipline, students should contact the option coordinator for the program of interest.

### Program Plans

#### Thesis Plan

Graduate students choosing the thesis plan are required to complete 30 semester hours of graduate coursework. This generally consists of:

- six to nine semester hours of core courses,
- 15-18 semester hours of technical concentration courses, and
- six semester hours of thesis.

This plan is strongly recommended for all candidates who wish to continue their graduate studies beyond the master's degree. The thesis provides firsthand experience with experimental design, literature searches, research methodology, technical report writing, and oral presentation of results. Additionally, the thesis option can lead the graduate student to a higher level of expertise in the chosen area of specialization.

#### Non-thesis Plan

The non-thesis plan is designed for students who wish to enhance their knowledge and skills to succeed in careers as practicing engineers, but are unlikely to pursue a PhD or doctorate degree. A total of 33 semester hours of coursework is required for this plan. In addition to 6-9 semester hours of core courses, every student enrolled in this option is required to complete 21-24 semester hours of technical courses related to their discipline, and a 3-semester-hour graduate project course. A graduate student enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students.

### Management Plan

Students who have been in the work arena and are moving into an engineering management role may wish to choose the management plan. A total of 36 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 9-12 semester hours of business courses,
- 12-18 semester hours of technical courses, and
- a 3-semester-hour graduate project.

A graduate student enrolled in a graduate project course will be required to defend the results of his or her project by giving a presentation to the engineering faculty and students.

### Mechanical Engineering Requirements

At the time of initial enrollment, the student will select a program plan (thesis, non-thesis, or management) and technical concentration area (mechanical analysis/design of rigid and deformable bodies, analysis/design of thermal-fluid systems, etc.). The requirements for each option are listed in the general description of the Master of Science in Engineering program. Lists of required courses and possible electives for each plan may be obtained from the graduate program option coordinator. In cooperation with an assigned faculty adviser, each student will establish a set of academic goals and desired outcomes, and a coursework plan to meet those objectives.

Thesis students who have registered for all required thesis hours and have completed all course requirements but have not finished the thesis are required to maintain current student status if they expect to utilize any University service (e.g. parking, computers, library, advisors' assistance, thesis defense, etc.). This can normally be accomplished by registering for at least one hour of thesis credit in MECH 6990 Thesis.

<table>
<thead>
<tr>
<th>COURSE</th>
<th>TITLE</th>
<th>S.H.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 6910</td>
<td>Advanced Engineering Mathematics 1</td>
<td>3</td>
</tr>
<tr>
<td>MATH 6911</td>
<td>Advanced Engineering Mathematics 2</td>
<td>3</td>
</tr>
<tr>
<td>MECH 6904</td>
<td>Advanced Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 6915</td>
<td>Failure Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MECH 6925</td>
<td>Computational Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>MECH 6930</td>
<td>Advanced Fluid Mechanics and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>MECH 6945</td>
<td>Advanced Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 5892</td>
<td>Control of Mechanical Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

**MECH 5811 Solar Engineering 3 s.h.**

Radiational characteristics of solar energy, glass materials and selective coatings. Analysis of flat plate collectors, concentrators, and thermal storage. System simulation and economic analysis for optimization of basic solar systems.

**Prereq.:** PHYS 2611, MECH 3725 or consent of chairperson.

**MECH 5820 Turbulence 3 s.h.**

Physics of turbulence in thermal-fluid engineering systems; statistical descriptions, energy cascade and scales of turbulent motion. Modeling and simulation of turbulent flows. Examples of turbulence in mixing layers, combustion, and wall-bounded flows.

**Prereq.:** MECH 3720 or PHYS 3705 or CHEN 3786 (or equivalent).
MECH 5825  Heat Transfer 2  3 s.h.
Advanced topics in heat transfer. Multi-dimensional conduction, free
convection, phase change heat transfer and thermal radiation. Integration of
analytical, numerical, and computational methods into design projects.
Prereq.: MECH 3708 and MECH 3725.

MECH 5836  Fluid Power and Control  3 s.h.
Theory of prime movers, turbomachinery, and control systems. Modeling
of hydraulic and pneumatic systems and components. Hydraulic fluids,
pumps, cylinders, valves, motors, compressors, and actuators. Hydraulic and
pneumatic circuit applications and control.
Prereq.: MECH 3725.

MECH 5842  Kinetics of Machines  3 s.h.
Three dimensional kinematics and dynamics of machines. Dynamic analysis
and design; balancing of machines.
Prereq.: MECH 3742.

MECH 5852  Stress and Strain Analysis 2  3 s.h.
Continuation of MECH 3751. Introduction to applied elasticity theory including
plane stress and strain and stress functions. Plastic and creep behavior of
materials. Introduction to instability. Emphasis on design applications.
Prereq.: MECH 3751, MECH 3751L, MATH 3705.

MECH 5872  Engineering Acoustics  3 s.h.
The nature of sound and its propagation; analysis and control of sound and
noise production in mechanical equipment; transmission and absorption
of sound in engineering materials, ultrasonics, structural acoustics, base
measurements, and equipment.
Prereq.: MECH 3708.

MECH 5881  Mechanical Vibrations  3 s.h.
Introduction to mechanical vibrations: single and multi-degree of freedom
systems, free and forced vibrations, impedance and modal analysis including
applications.
Prereq.: MECH 3708.

MECH 5881L  Mechanical Vibrations Laboratory  1 s.h.
Introduction to vibrations measurements. Experiments with mechanical
systems, computer simulation of vibration systems. Experimental
determination of component models and parameters. Three hours laboratory
per week.
Prereq.: MECH 5881.

MECH 5884  Finite Element Analysis  3 s.h.
Fundamental principles of finite element analysis with emphasis on
applications to design in areas of stress analysis, vibrations, and heat transfer.
Use of commercial software.
Prereq.: MECH 3708, MECH 3725, MECH 3751.

MECH 5885  Computational Fluid Dynamics  3 s.h.
Applied numerical analysis, including solution of linear algebraic equations
and ordinary and partial differential equations; modeling of physical processes,
including fluid flow and heat and mass transfer; use of general purpose
computer codes, including commercial computational fluid dynamics software
packages.
Prereq.: MECH 3720 and MECH 3725.

MECH 5892  Control of Mechanical Systems  3 s.h.
Introduction to theory of feedback and control. Performance and stability of
linear systems. Design of feedback control systems. Practical application
and introduction to state-space methods. Two hours lecture and three hours
laboratory per week.
Prereq.: MECH 3708.

MECH 6900  Special Topics  2-4 s.h.
Special topics and new developments in mechanical engineering. Subject
matter and credit hours to be announced in advance of each offering. May be
taken three times.
Prereq.: As announced or permission of instructor.

MECH 6904  Advanced Thermodynamics  3 s.h.
Laws of equilibrium thermodynamics; relations between properties and
aspects of the Second Law. Exergy analysis. Macroscopic and microscopic
considerations for the prediction of properties. Microscopic description based
on classical and quantum statistics. General stability criteria, statistical
equilibrium, and trend toward equilibrium fluctuations.
Prereq.: Permission of graduate advisor.

MECH 6915  Failure Analysis  3 s.h.
Advanced methods in failure analysis of metallics, ceramics, polymers, and
composites. Numerous practical examples will be discussed. Individual
student projects using scanning electron microscopy are required. Three hours
lecture and three hours laboratory.

MECH 6925  Computational Heat Transfer  3 s.h.
Numerical modeling techniques and methods in heat transfer. Computational
analysis of conduction and convection by the finite element method, finite
difference method, and the method of coordinate transformation.
Prereq.: MATH 3705 Differential Equations and MECH 3725 Heat Transfer I, or
permission of instructor.

MECH 6930  Advanced Fluid Mechanics and Heat Transfer  3 s.h.
Viscous and inviscid flows, Navier-Stokes equations, Euler equations, and
complex variables methods. Analytic solutions to advanced heat transfer
problems, advanced boundary-value problems.
Prereq.: MECH 3725 Heat Transfer I or equivalent.

MECH 6945  Advanced Dynamics  3 s.h.
Three-dimensional vector statics; kinematics and kinetics of particles and
rigid bodies; energy, momentum, and stability. LaGrange's equations of motion
for particles and rigid bodies impulse; small oscillations; nonholonomic and
dissipative systems.
Prereq.: Permission of graduate advisor.

MECH 6952  Applied Elasticity  3 s.h.
Equations or equilibrium, compatibility and boundary conditions-their
applications to plane stress and plane strain problems. Stress functions,
strain energy methods, stress distribution in anile symmetrical bodies; special
problems in structures involving torsion and bending of prismatical bars.
Prereq.: MECH 3751 Stress and Strain Analysis I or equivalent, or permission
of graduate advisor.

MECH 6962  Mechanical Design Analysis  3 s.h.
The study of analytical aspects and the application of engineering science
topics to machine elements and machinery. Some case studies in mechanical
design.
Prereq.: Permission of graduate advisor.

MECH 6963  Advanced Stress Analysis  3 s.h.
Theory and engineering applications of the most recent techniques of
experimental stress analysis, brittle coatings, photoelasticity, strain gauges,
photostress.
Prereq.: MECH 3751 Stress and Strain Analysis I or equivalent or permission
of graduate advisor.

MECH 6983  Modern Power Sources  3 s.h.
Analytical and descriptive study of modern power plants. Combustion and
environmental problems with fossil-fueled power plants. Electromagnetic
circuits and devices with emphasis on the principles of electromechanical
energy conversions. Cross-listed as CHEN 6983 and ECEN 6983.
Prereq.: Permission of graduate advisor.

MECH 6985  Electromechanical Motion Devices  3 s.h.
Thermodynamics of batteries, and electric and fuel cells. Power from nuclear
isotopes. Features common to rotating electromagnetic fields. Analysis and
design of electromechanical power components. Logical circuit design with I/0
structure and interface. Cross-listed as CHEN 6985 and ECEN 6985.

MECH 6990  Thesis  2-6 s.h.

MECH 6991  Thesis  2-6 s.h.
MECH 6992  Graduate Projects  3 s.h.
Analysis, design, research, or other independent investigation on projects
selected with the advice and approval of the student's graduate committee.

Admission Requirements

DEGREE PROGRAMS
Applicants must meet all of the general requirements for admission to the
College of Graduate Studies. Admission to the program is selective and
based on the qualifications of the applicant, the needs of the program, and
the availability of funding. Applicants with lesser qualifications may be
granted provisional graduate student status based on evaluation of their
undergraduate records, standardized test (e.g. GRE) results, work experience,
and other professional qualifications.