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 more advanced engineering problems, while the management plan is for those who wish to include managerial training in their program of preparation.

The Rayen School of 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.

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.

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.

COURSE	TITLE	S.H.
Core courses		
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Technical Concentraiton Coursese		
MECH 6904	Advanced Thermodynamics	3
MECH 6915	Failure Analysis	3
MECH 6925	Computational Heat Transfer	3
MECH 6930	Advanced Fluid Mechanics and Heat Transfer	3
MECH 6945	Advanced Dynamics	3
MECH 5892	Control of Mechanical Systems	3
Thesis		
MECH 6990	Thesis	2-6

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/O structure and interface. Cross-listed as CHEN 6985 and ECEN 6985.

MECH 6990 Thesis 2-6 s.h.
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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.

a. Demonstrate subject mastery and competence in the area of mechanical engineering specialization in order to practice as an influential mechanical engineer.
b. Demonstrate the ability to use common theoretical, experimental, and computational techniques in mechanical engineering.
c. Demonstrate the ability to use effectively oral and written communication to convey engineering concepts to a broad audience and to successfully practice engineering in a multi-disciplinary team.
d. Demonstrate an understanding of the need for, and ability to engage in life-long learning by participation in professional societies, professional registration, publications, technical and scientific presentations at professional meetings, enrollment in a doctoral program, etc.
e. Demonstrate an understanding the impact of engineering solutions in a global, environmental, social, and economic context. Understand the importance of sustainability in contemporary global context.
f. Demonstrate the ability to conduct independent research relevant to solve in an original and effective manner the problem(s) at hand.
g. Demonstrate an understanding of professionally and ethically responsible practices in mechanical engineering.