MASTER OF SCIENCE IN ENGINEERING IN MECHANICAL ENGINEERING

Graduate Program Director

Constantin V. Solomon, PhD
2500 Moser Hall
(330) 941- 1730
vcsolomon@ysu.edu

Program Description

The mechanical engineering graduate program 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, numerical modeling, thermo-fluids systems, advanced materials and manufacturing. 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 Mechanical Engineering (ME) program offers five different plans - thesis, non-thesis, accelerated 4+1 MSE, management, and internship.

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, advanced machine design, advanced materials and manufacturing.

Admission Requirements

DEGREE PROGRAMS

Applicants must meet all of the general requirements for admission to Graduate Studies. Admission to the program is selective and based on the academic and professional qualifications of the applicant. Although GRE is not required for admission, 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. Graduate assistantship is offered to highly qualified applicants based on the needs of the program and the availability of funding.

The Master of Science in Engineering (MSE) may be characterized as being both career-oriented and flexible. Five different plans are available to accommodate the needs of nearly every engineering graduate student. Graduate students enrolled in the Mechanical Engineering (ME) graduate program must complete:

- 30 semester hours for the thesis plan,
- 30 semester hours for the non-thesis plan,
- 30 semester hours for the accelerated 4+1 MSE plan*,
- 33 semester hours for the management plan, or
- 30 semester hours for the internship plan.

*The accelerated 4+1 MSE plan is only available to students already in the YSU Mechanical Engineering undergraduate program.

The degree requirements consist of core courses, technical courses, graduate internships, and project courses. The management plan requires a series of business courses. The internship plan requires 6-9 semester hours of graduate level internship courses. The internship must be in the Mechanical Engineering discipline and comparable to a graduate course work. The internship plan must be approved by the Graduate Program Director.

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 Mechanical Engineering. To obtain a list of core and technical course required in the Mechanical Engineering graduate program, students should contact the Graduate Program Director.

Program Plans

Thesis Plan

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

- 6-9 semester hours of core courses,
- 15-18 semester hours of technical concentration courses, and
- 6 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 research experience with experimental design, literature searches, research methodology, technical report writing, and oral presentation of research results. Additionally, the thesis option can lead the graduate student to a higher level of expertise in the chosen area of specialization. Students enrolled in this plan are required to have a thesis proposal approved by the faculty advisor and the Graduate Program Director before the end of their second semester into the ME graduate program.

Courses requited for the completion of the thesis plan:

COURSE	TITLE	S.H.
Mathematics Courses		6 s.h.
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Master's Thesis		6 s.h.
MECH 6990	Thesis	6
Mechanical Engineering Courses	A minimum of 9 s.h. must be at the 6900 level. Only one course outside the program is allowed.	18 s.h.

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 a doctoral degree. A total of 30 semester hours of coursework is required for this plan. This generally consists of:

- 6-9 semester hours of core courses,
- 18-21 semester hours of technical concentration courses, and
- 3 semester hours of graduate project.

Graduate students following the non-thesis plan must complete the graduate project under the guidance of a faculty advisor. Students are required to have a project proposal approved by the faculty advisor and the Graduate Program Director before the end of their second semester into the ME graduate program. Graduate students 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.

Courses requited for the completion of the non-thesis plan:

COURSE	TITLE	S.H.
Mathematics Courses		6 s.h.
MATH 6910	Advanced Engineering Mathematics 1	3

MATH 6911	Advanced Engineering Mathematics 2	3
Graduate Project		3
		s.h.
Mechanical Engineering Courses A minimum of 9 s.h. must be at the 6900 level. Only one course outside the program is allowed.		21 s.h.

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 33 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 6-9 semester hours of business or industrial and system engineering courses,
- 12-18 semester hours of technical courses, and
- 3 semester hours graduate project.

Students enrolled in this plan are required to have a project proposal approved by the faculty advisor and the Graduate Program Director before the end of their second semester into the graduate program. 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. Students with the Management Plan should consult the Graduate Program Director and the faculty advisor to develop their course plan.

Courses requited for the completion of the management plan:

COURSE	TITLE	S.H.
Mathematics Courses		6 s.h.
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Business or Industrial and System Engineering Courses		9
Graduate Project		3 s.h.
MECH 6992	Graduate Projects	3
Mechanical Engineering Courses A minimum of 9 s.h. must be at the 6900 level. Only one course outside the program is allowed.		15 s.h.

Accelerated 4+1 MSE Plan

Undergraduate students already in the YSU Mechanical Engineering undergraduate program can apply for admission into the accelerated 4+1 MSE in Mechanical Engineering graduate program after completing 78 semester hours with a GPA of 3.3 or higher. After being admitted into the accelerated 4+1 BE/MSE program, students will be allowed a maximum of nine semester hours of graduate coursework to be double-counted towards both bachelor's and master's degrees upon approval by the Graduate Program Director. An additional three hours of graduate coursework at 6000 level can be completed as an undergraduate and used exclusively for graduate credit.

A total of 30 semester hours of coursework is required for this plan. This consists of:

- 6-9 semester hours of core courses,
- 18-21 semester hours of technical courses, and
- 3 semester hours graduate project or 6 semester hours thesis

Courses requited for the completion of the accelerated 4+1 MSE plan:

COURSE	TITLE	S.H.
Mathematics Courses		6 s.h.
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Mechanical Engineering Courses A minimum of 9 s.h. must be at the 6900 level.		21 s.h.
Graduate Project		3 s.h.
MECH 6992	Graduate Projects	3

Internship PLAN

This option is suitable for students who would like to gain practical experience in the industry before graduating with a master's degree. A total of 30 semester hours of coursework is required for this plan. The internship plan consists of:

- 6-9 semester hours of core courses,
- 12-15 semester hours of technical courses, and
- 6-9 semester hours graduate-level internship courses.

Students enrolled in this plan are required to have an internship proposal approved by the Graduate Program Director before the end of their second semester into the program. The graduate internship must be approved by the Mechanical Engineering Graduate Program Director on a case-by-case basis for graduate course credit. The internship shall be in the mechanical engineering discipline and be comparable to a graduate course work. Graduate internship will require at least 300 hours of work for 3 semester hours of graduate credit, 200 hours of work for 2 semester hours of graduate credit, and 100 hours of work for 1 semester hour of graduate credit. Internship students are strongly encouraged to consult with the STEM Professional Services Office to seek internship opportunities.

Courses requited for the completion of the internship plan:

COURSE	TITLE	S.H.
Mathematics Courses		6 s.h.
MATH 6910	Advanced Engineering Mathematics 1	3
MATH 6911	Advanced Engineering Mathematics 2	3
Mechanical Engineering Courses A minimum of 9 S.H. must be at the 6900 level.		12-15 s.h.
Graduate-level internship courses		6-9 s.h.

Mechanical Engineering Requirements

At the time of initial enrollment, the student will select a program plan (thesis, non-thesis, management, or internship) and technical concentration area (mechanical analysis/design of rigid and deformable bodies, analysis/design of thermal-fluid systems, etc.) available through faculty expertise and consultation. The general requirements for each plan are listed above under Program Plans. To obtain a list of core and technical course required in the Mechanical Engineering graduate program, students should contact the Graduate Program Director.

In cooperation with an assigned faculty adviser and the Graduate Program Director, each student will establish a set of academic goals and desired outcomes, and a coursework plan to meet those objectives. Graduate students must meet the Graduate Program Director each semester before registering for courses. Upon completion of the graduate program, all students will complete either a written or an oral assessment of the effectiveness of the program in meeting their established goals and outcomes.

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.

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 4 s.h.
Understand finite differential and finite volumes methods used in CFD. Understand the need for various turbulence models and how to choose them. Become proficient at disseminating the results form a CFD software. Three hours lecture and three hours laboratory per week.
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 6950 Engineering Tribology 3 s.h.
Fundamentals of surface interactions by the effects from surface topography, physical & chemical energies, and mechanical contact. Surface damage mechanisms by frictional contacts including adhesion, abrasion, and fatigue. Fundamental lubrication theories including hydrodynamic, hydrostatic, elastohydrodynamic and boundary layers. Design considerations and selection of tribological machine components. Restrictions: Undergraduate level physics, chemistry, and materials mechanics and science.

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.
Prereq.: Permission of graduate advisor.
Cross-Listed:as CHEN 6983 and ECEN 6983.

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.
.

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.

1. Demonstrate subject mastery and competence in the area of mechanical engineering specialization in order to practice as an influential mechanical engineer.
2. Demonstrate the ability to use common theoretical, experimental, and computational techniques in mechanical engineering.
3. 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.
4. 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.
5. 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.
6. Demonstrate the ability to conduct independent research relevant to solve in an original and effective manner the problem(s) at hand.
7. Demonstrate an understanding of professionally and ethically responsible practices in mechanical engineering.