

MECHANICAL AND AEROSPACE ENGINEERING

No other profession unleashes the spirit of innovation like Mechanical Engineering and Aerospace Engineering. From research to real-world applications, mechanical and aerospace engineers discover how to improve lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways. Few have such a direct and positive effect on everyday lives and we count on mechanical and aerospace engineers, and their imaginations, to help us meet the needs of the 21st century.

Mechanical and aerospace engineers know that life takes engineering, and that their disciplines provide freedom to explore, shape the future, encompass an enterprising spirit and call for limitless imagination.

Engineering makes a world of difference and is essential to our health, happiness and safety. Creative problem solving, while turning dreams into reality, is the core of Mechanical and Aerospace Engineering. These professional disciplines involve the invention, design and manufacture of devices, machines and systems that serve the ever-changing needs of modern society.

Mechanical engineering is an exceedingly diverse field that spans an exceptionally wide range of systems, devices and vehicles. Mechanical engineers are vitally concerned with all forms of energy production, utilization and conservation. They are the key professionals in bringing about the green revolution, finding ways to reduce or eliminate pollution, minimize waste, reduce energy usage, and re-use waste, scrap and recycled goods. They deal with everything mechanical and energy-consuming, whether small or large, simple or complex—from fuel cells to nuclear power plants, gas turbine engines to interplanetary space vehicles, artificial limbs to life support systems, robotic manipulators to complex automatic packaging machines, precision instruments to construction machinery, household appliances to mass transit systems, heating and air-conditioning systems to off-shore drilling platforms, and powered home and garden appliances to vehicles of all types. In virtually every organization where engineers are employed, mechanical engineers will be found.

The BS degree program in mechanical engineering, together with the premedical option in mechanical engineering, is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET) under the criteria for mechanical and similarly named engineering programs. In the Fall 2018 semester, there will be a new petroleum option offered for the BS degree in mechanical engineering.

Aerospace engineering is concerned with the science and technology of flight, and the design of air, land and sea vehicles for transportation and exploration. This exciting field has led people to the moon and continues to lead in the expansion of frontiers deeper into space and into the ocean's depths. Because of their unique backgrounds in aerodynamics and lightweight structures, aerospace engineers are becoming increasingly involved in solving some of society's most pressing and complex problems, such as high-speed ground transportation and pollution of the environment. The BS degree program in aerospace engineering is accredited by the Engineering Accreditation Commission of the ABET under the criteria for aerospace and similarly named engineering programs.

MAE Mission

The mission of the School of Mechanical and Aerospace Engineering is to create a vibrant and stimulating learning and research environment and to instruct and encourage our students to reach their full potential in technical expertise, innovative expression, intellectual curiosity, and collaborative design.

MAE Mission for Undergraduate Instruction

The School of Mechanical and Aerospace Engineering will support the MAE and CEAT missions and the mission for instruction of Oklahoma State University by providing a first class education to students that is grounded in engineering fundamentals. The Faculty of MAE are committed to preparing engineers who are:

- Competitive nationwide and internationally for employment opportunities and who will become respected achievers within their discipline.
- Well prepared for the pursuit of advanced studies at any university.
- Prepared for a lifetime of continuing development, which is demanded by disciplines involved with rapidly progressing technology.

Rigor

The GPA requirements for MAE professional school admission and the degree requirements for graduation are the highest in CEAT (see Departmental GPA Requirements, item f). This is essential to fulfill the MAE Mission for Undergraduate Instruction.

Program Educational Objectives

Program educational objectives are statements that describe the expected accomplishments and professional status of mechanical and aerospace engineering graduates three to five years beyond the baccalaureate degree. The School of Mechanical and Aerospace Engineering at Oklahoma State University is dedicated to graduating mechanical and aerospace engineers who:

1. Develop exemplary careers and become leaders to the greater benefit of society.
2. Earn a reputation as responsible and ethical professionals.
3. Develop innovative technologies and adapt to changing professional and societal norms with wisdom and integrity.

Student Outcomes and Specific Program Criteria

The student outcomes for students graduating from the mechanical and aerospace engineering BS programs are:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics;
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors;
3. an ability to communicate effectively with a range of audiences;

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts;
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies;

ABET requires specific program criteria which must be supported by the curricula and are unique to engineering disciplines. For the BSME Program, the specific ME program criteria are broken into three elements. The ME curriculum prepares graduates to:

1. ME1- demonstrate an ability to apply principles of engineering, basic science and mathematics (including multivariate calculus and differential equations);
2. ME2- demonstrate an ability to model, analyze, design, and realize physical systems, components or processes; and
3. ME3 – be prepared to work professionally in either thermal or mechanical systems areas while taking courses in each area.

For the BSAE Program, the specific AE program criteria are also broken into three elements. The AE curriculum prepares graduates with:

1. AE1 – knowledge of the following aeronautical topics: aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control;
2. AE2 – knowledge of some of the following astronautical topics: orbital mechanics, space environment, attitude determination and control, telecommunications, space structures and rocket propulsion; and
3. AE3 – graduates must have design competence which includes integration of aeronautical or astronautical topics.

Because mechanical engineering is perhaps the broadest of all engineering disciplines, the program provides not only excellent grounding in all engineering fundamentals, but also allows some flexibility in selecting controlled technical electives to suit the student's interests. In this selection, no one area may be unduly emphasized at the expense of another. For the aerospace engineering, biomedical engineering, and premedical programs, prescribed course work provides students with more focused development. Graduates are fully competent as mechanical or aerospace engineers, with abilities in design, and in-depth knowledge in their areas of concentration.

As a fundamental component of all BS programs, engineering design is strongly emphasized in the junior and senior years but is integrated throughout the curriculum. Most MAE courses at the 3000- and 4000-levels include some design content, ranging from a minimum of one-half to a maximum of four credit hours of design content. Each professional school course builds upon the preceding mechanical and aerospace engineering courses to develop in the student the ability to identify and solve meaningful engineering problems. The coursework is specifically sequenced and interrelated to provide design experience at each level, leading to progressively more complex, open-ended problems. The coursework includes sensitizing students to socially-related technical

problems and their responsibilities as engineering professionals to behave ethically and protect occupational and public safety. The program culminates in a senior-year design course in which students integrate analysis, synthesis and other abilities they have developed throughout the earlier portions of their study into a capstone experience. The design experiences include the fundamental elements and features of design with realistic constraints such as economics, safety, reliability, social and environmental impact, and other factors. At this point, students are able to design components, systems and processes that meet specific requirements, including such pertinent societal considerations as ethics, safety, environmental impact and aesthetics. Students develop and display the ability to design and conduct experiments essential to specific studies and to analyze experimental results to draw meaningful conclusions.

An integral part of this educational continuum, from basic science through comprehensive engineering design, are learning experiences that facilitate the students' abilities to function effectively in both individual and team environments. The program also provides every graduate with adequate learning experiences to develop effective written and oral communication skills. State-of-the-art computational tools are introduced and used as a part of their problem-solving experiences. Finally, the students' experience in solving ever-more-challenging problems gives them the ability to continue to learn independently throughout their professional careers.

The broad background and problem-solving ability of mechanical and aerospace engineers make them suited to engage in one or more of the following activities: research, development, design, production, operation, management, technical sales and private consulting. Versatility is their trademark. A bachelor's degree in mechanical or aerospace engineering is also an excellent background for entering other professional schools such as medicine, dentistry, law or business (MBA). The premedical option in mechanical engineering is available for students wishing to enroll in medical school.

In the professional school, (essentially the junior and senior years of the program) mechanical and aerospace engineering students extend their study of the engineering sciences and consider applications of fundamental principles and analysis tools to the solution of real technological problems of society. Some design courses involve students in the solution of authentic, current and significant engineering problems provided by industrial firms. Students may also help smaller firms that need assistance with the development of new products.

The student designs, with the guidance of an adviser, an individualized program of study consistent with his or her interests and career plans. Some students terminate their studies with a bachelor's degree, while others receive one of several graduate degrees.

Courses

MAE 3013 Engineering Analysis and Methods I

Prerequisites: A grade of "C" or higher in PHYS 2114 and MATH 2233.

Description: Setup and solution of equations which govern mechanical engineering systems. Application and solution of the governing equations to describe the steady state or transient behavior of dynamics, mechanics and circuit problems. Linear sets of equations, ODEs will be used to describe systems. Solutions may be simplified using complex numbers of Fourier/Laplace transforms. Numerical methods for solutions will be covered. Data analysis, quality control and statistical hypothesis testing will be covered.

Credit hours: 3

Contact hours: Lecture: 2 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3033 Design of Machines and Mechanisms

Prerequisites: A grade of "C" or higher in ENGR 1332 and MAE 3013 and MAE 3323.

Description: Study of the position, velocity, acceleration, and static and dynamic force behavior of machines and mechanisms. Analysis and synthesis of linkages and gear trains. Characteristics and selection of power sources, including electric motors, hydraulics, pneumatics and internal combustion engines. Lab: Machine tool safety. Use of common machine tools to build machine components. Use of lecture concepts in designing, building, and testing machines and mechanisms.

Credit hours: 3

Contact hours: Lecture: 3 Lab: 2

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 3113 Measurements and Instrumentation

Prerequisites: Admission to MAE professional school. A grade of "C" or higher in ENSC 2123 and ENSC 2613 and MAE 3013.

Description: Application of basic electronic laboratory measurement equipment. Selection and testing of transducers for measurement of displacement, time frequency, velocity, pressure, force, temperature, flow-rate, and vibration, for machine design applications. Considerations of accuracy, uncertainty and repeatability. Design projects involving the use of analog and digital integrated circuits and construction of prototype sensors. Practice in the use of signal processing, including digital filtering and applications of Fast Fourier Transform theory. Practice in the use of computer-based data acquisition systems. Preparation of formal reports, including the presentation of plots, figures and tables.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 3123 Manufacturing Processes

Prerequisites: A grade of "C" or higher in ENSC 2143 and ENSC 3313.

Description: An introduction to manufacturing processes including the fundamental processes of casting, forging, rolling, extrusion, drawing and metal cutting. Quantitative relationships to identify important parameters which influence a given process.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3223 Thermodynamics II

Prerequisites: A grade of "C" or higher in ENSC 2213.

Description: A continuation of ENSC 2213. Irreversibility and availability, power cycles, refrigeration cycles, mixtures and solutions, chemical reactions, phase and chemical equilibrium, and introduction to compressible flow.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3233 Heat Transfer

Prerequisites: A grade of "C" or higher in ENSC 3233.

Description: Mechanisms of heat transfer. Steady and transient conduction, free and forced convection, heat exchanger design and analysis, radiation and multiphase behavior. Numerical methods, dimensional analysis and boundary layer theory.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3253 Applied Aerodynamics and Performance

Prerequisites: Admission to MAE professional school; grades of "C" or higher in ENSC 3233 and MATH 2233 and MAE 3293.

Description: Relevant fluid properties; standard atmospheres; mathematical models of flows about bodies. Characteristic parameters of airfoils and wings. Thin airfoil theory and flows about finite wings. Boundary layers. Propeller theory. Supersonic and hypersonic flows about wings and lifting bodies. Drag polars. Power required for level flight. Rate of climb and descent. Steady turns. Maximum range and endurance. Design applications. Priority enrollment is given to Aerospace Engineering majors.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3293 Fundamentals of Aerodynamics

Prerequisites: A grade of "C" or higher in ENSC 2213 and ENSC 3233 and MATH 2233.

Description: Introduction to aerodynamic concepts; governing equations of gas flows in one and two dimensions. Inviscid, incompressible flow, flow over airfoils, flow over finite wings, 3D flow; Compressible flow; Basic thermodynamic and dynamic equations. Nozzle and duct flows, choking, normal and oblique shock waves, Prandtl-Meyer expansions, subsonic compressible flow over airfoils, compressible flow through nozzles, intro into viscous flows. Priority enrollment is given to Aerospace Engineering majors.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3323 Mechanical Design I

Prerequisites: A grade of "C" or higher in ENSC 2113 and ENSC 2143.

Description: Introduction to the design process. Consideration of reliability, factors of safety, product liability, and economics. Use of codes, standards, and other design resources. Design stress analysis of mechanical components such as beams, rings, cylinders, and shafts. Analysis of stiffness and deflection of straight and curved beams, columns, and links. Consideration of failure theories for various types of engineering materials. Application of fatigue analyses in the design process. Same course as MAE 3324.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3324 Mechanical Design I

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in ENSC 2113 and ENSC 2143 and ENSC 3313.

Description: Introduction to the design process. Consideration of reliability, factors of safety, product liability, and economics. Use of codes, standards, and other design resources. Stress analysis of mechanical components such as beams, rings, cylinders, and shafts. Analysis of stiffness and deflection of straight and curved beams, frames, columns, and links. Consideration of static and fatigue failure theories for various types of engineering materials. Incorporation of stress and deformation analyses and applicable material failure theories iteratively until all design needs and constraints are satisfied. Same course as MAE 3323.

Credit hours: 4

Contact hours: Lecture: 3 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3403 Computer Methods in Analysis and Design

Prerequisites: A grade of "C" or higher in ENGR 1412 and MAE 3013.

Description: Application of linear algebra, numerical methods, statistics, and computer methods in the design, analysis, and simulation of mechanical, thermal, and fluid systems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 3524 Thermal Fluids Design

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in ENSC 2213 and ENSC 3233 or concurrent in MAE 3233.

Description: Design, modeling and simulation of thermal systems. Analysis and modeling of components such as fans, pumps, ducts, pipes, fittings, heat exchangers, and heat pumps.

Credit hours: 4

Contact hours: Lecture: 3 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3723 Systems Analysis

Prerequisites: Grades of "C" or higher in ENSC 2123, ENSC 2613 and MAE 3013.

Description: Physical and mathematical modeling of mechanical, electrical, fluid, thermal and mixed dynamic systems. Systems analysis in the time domain and in the frequency domain, with an emphasis on first and second order systems. Laplace transform method for solving ordinary linear differential equations. Representation of system models using transfer functions, block diagrams and state variable forms. Use of computer methods for solving linear and nonlinear dynamic system models. Same course as MAE 3724.

Credit hours: 3

Contact hours: Lecture: 2 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 3724 Dynamic Systems Analysis and Introduction to Control

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in ENSC 2123 and ENSC 2613 and MAE 3013.

Description: Physical and mathematical modeling of mechanical, electrical, fluid, thermal and mixed dynamic systems. Systems analysis in the time domain and in the frequency domain, with an emphasis on first and second order systems. Laplace transform method for solving ordinary linear differential equations. Representation of system models using transfer functions, block diagrams and state variable forms. Use of computer methods for solving linear and nonlinear dynamic system models. Introduction to dynamic system control. Laboratory investigation to demonstrate application. Same course as MAE 3723.

Credit hours: 4

Contact hours: Lecture: 3 Other: 1

Levels: Undergraduate

Schedule types: Discussion, Combined lecture & discussion, Lecture

Department/School: Mech & Aerospace Engr

MAE 4010 Mechanical and Aerospace Engineering Projects

Prerequisites: Senior standing in MAE and consent of adviser/instructor.

Description: Special projects and independent study in mechanical or aerospace engineering. Offered for variable credit, 1 credit hours, maximum of 6 credit hours.

Credit hours: 1-6

Contact hours: Other: 1

Levels: Graduate, Undergraduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 4053 Automatic Control Systems

Prerequisites: Admission to MAE professional school. A grade of "C" or higher in MAE 3723 or ECEN 3723 or MAE 3724.

Description: Properties of feedback control systems, mathematical models of basic components, state-variable models of feedback systems, design specifications of control systems, time-domain analysis, stability, stability robustness, transform analysis, frequency domain techniques, root-locus, design of single-input-single-output systems and compensation techniques for engineering systems. Same course as ECEN 4413.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4063 Mechanical Vibrations

Prerequisites: Admission to MAE professional school; a grade of "C" or higher in MAE 3723 or MAE 3724.

Description: Lumped parameter analysis of multi-mode vibrating systems. Analysis techniques including classical analytical methods, matrix methods and numerical methods. Selection and design of vibration isolation systems. Selection of vibration instrumentation. Machine dynamics, including balancing, whirl, nonlinear effects, and self-excited vibrations.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4213 Spacecraft Design

Prerequisites: A grade of "C" or higher in MAE 3253 and MAE 3113; admission to MAE professional school.

Description: Elements of basic aerospace engineering concepts focusing on spacecraft design. Fundamental material will include orbital dynamics, rocket theory and launch vehicle performance, principles of spacecraft stability and control, propulsion systems, aerospace structures, space environments and its effect on spacecraft design (thermal, radiation, magnetosphere and solar wind), atmospheric reentry, thermal management, power systems, telecommunications, cost analysis, spacecraft design.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4223 Aerospace Engineering Laboratory

Prerequisites: Admission to MAE professional school; and a grade of "C" or higher in MAE 3113 and MAE 3253 and MAE 4283.

Description: Experimental study of aerospace principles including topics in aeronautics and astronautics. State-of-the-art instrumentation, diagnostic, and computerized data acquisition equipment and techniques applied to experiments including application of low speed wind tunnel testing techniques, rocket propulsion and control-jet experiments, fundamentals of supersonic nozzles, and flight test evaluation of performance, stability, control, and handling qualities of a propeller-driven airplane.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2

Levels: Graduate, Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4243 Aerospace Propulsion and Power

Prerequisites: Grades of "C" or higher in ENSC 3233 and MAE 3293; admission to MAE professional school.

Description: The study of aerospace power and propulsion engines utilizing a gas as the working fluid. Design and analysis of complete aircraft engine systems and individual components of the aircraft engine. Engine component matching for design using analysis routines, including inlets and diffusers, fans and compressors, combustors, turbines, nozzles, and propellers. Additional propulsion and power systems including chemical and non-chemical rocket motors and other internal combustion engines. Priority enrollment is given to Aerospace Engineering majors.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4263 Energy Conversion Systems

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in MAE 3233 and MAE 3223 or MAE 3524.

Description: This course covers the use of renewable and non-renewable energy sources in power production. Energy conversion processes are analyzed, and performance characteristics of components and systems are modeled using modern computational methods. Applications include overall design of conventional Rankine power systems and may also include design of nuclear, solar, wind, wave, thermoelectric, and geothermal energy systems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4273 Experimental Fluid Dynamics

Prerequisites: A grade of "C" or higher in MAE 3113 and ENSC 3233; admission to MAE professional school.

Description: Experimental study of basic and applied fluid dynamics systems with comparisons to analytical predictions. Fluid dynamics instrumentation, digital data acquisition and processing, design of facilities and experiments, technical report writing and design project with experimental verification.

Credit hours: 3

Contact hours: Lecture: 3 Lab: 0

Levels: Graduate, Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4283 Aerospace Vehicle Stability and Control

Prerequisites: A grade of "C" or higher in MAE 3253, MAE 3723 and ENSC 2123; admission to MAE professional school.

Description: Motion and control of aerospace vehicles. Derivation of equations of motion for aircraft and spacecraft. Aerodynamic stability derivatives. Static and dynamic aircraft stability and control. Handling qualities. Satellite orbital and attitude dynamics. Satellite attitude control. Design experience for stability and control in aeronautical and astronautical vehicles.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4313 Advanced Processing of Engineered Materials

Prerequisites: A grade of "C" or higher in ENSC 3313 and admission to MAE professional school.

Description: Introduction of novel processing methods for a range of engineered materials, such as electro-slag remelting, vacuum melting, melting to remove tramp elements, precision casting, sintering, hot-pressing, directional solidification, mechanical alloying, liquid infiltration, net-shaped finishing, superplastic forming, sol-gel processing, float glass process, tape laying, microwave processing, laser processing, CVD and PVD, sputtering, ion plating, ultraprecision machining and grinding, polishing and lapping, multilayer coatings, Czochralski single crystal growth, processing of nanocrystalline materials, engineered surfaces and surface modification, and layer processing for electronic materials.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4333 Mechanical Metallurgy

Prerequisites: A grade of "C" or higher in ENSC 3313 and admission to MAE professional school.

Description: Mechanical deformation processes and strengthening mechanisms in engineering materials. Material failure modes including creep, fatigue, stress corrosion, ductile and brittle fractures.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2

Levels: Graduate, Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4342 Design Projects I

Prerequisites: A grade of "C" or higher in MAE 3113 and MAE 3233 and MAE 3323; admission to MAE professional school.

Description: Two-semester design project with team format. Projects are sponsored by a company, agency, or individual. Team members work with sponsors and faculty who serve as mentors in fields related to their topics. Students complete oral presentations, progress reports, and create a professional log book to document their activities and contributions. Topics include safety, patent law, product liability, report writing, and scheduling.

Credit hours: 2

Contact hours: Lecture: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4344 Design Projects

Prerequisites: Admission to MAE professional school; a grade of "C" or higher in MAE 3113, MAE 3233 or MAE 3524, MAE 3323 or MAE 3324 and MAE 3723 or MAE 3724.

Description: Students work in small teams on a semester-long design project sponsored by a company, agency, or individual. Team members work with mentors from sponsors and with faculty members in fields related to their topics. Presentations on safety, patent law, product liability, report writing, oral presentations, scheduling and ideation. Oral presentations, progress reports, and a professional log book documenting personal activity and contributions.

Credit hours: 4

Contact hours: Lecture: 3 Other: 2

Levels: Graduate, Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4352 Design Projects II

Prerequisites: A grade of "C" or higher in MAE 4342; admission to MAE professional school.

Description: Second of two-semester sequence of senior design courses.

Credit hours: 2

Contact hours: Lecture: 2

Levels: Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4353 Mechanical Design II

Prerequisites: Admission to MAE professional school; a grade of "C" or higher in MAE 3323 or MAE 3324.

Description: Design of power transmission systems, including belts, chains and gears. Selection and application of hydraulic and pneumatic components in machine design applications. Selection of electric motors, actuators, encoders, and related electromechanical components. Design practice in the form of short projects integrating segments of the course. Same course as BAE 4353.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4354 Aerospace Systems Design for Mechanical Engineers

Prerequisites: Admission to MAE professional school; a grade of "C" or higher in MAE 3113, MAE 3233 or MAE 3524, MAE 3323 or MAE 3324 and MAE 3723 or MAE 3724.

Description: Multidisciplinary design of aerospace vehicles. Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized.

Credit hours: 4

Contact hours: Lecture: 3 Other: 2

Levels: Graduate, Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4363 Advanced Methods in Design

Prerequisites: Admission to MAE professional school; grades of "C" or higher in MAE 3113 and MAE 3323 or MAE 3324.

Description: Analytical and experimental techniques for the analysis of vibration, stress, force and motion. The finite element analysis method is introduced. Strain gages, photoelasticity, force gages, deflection gages, accelerometers and other transducers and methods are used in the laboratory. Projects involve the combined use of advanced analytical and experimental methods to realize optimal designs.

Credit hours: 3

Contact hours: Lecture: 2 Other: 2

Levels: Graduate, Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4374 Aerospace System Design

Prerequisites: A grade of "C" or higher in MAE 4243, MAE 4283 and 4513; admission to MAE professional school.

Description: Multidisciplinary design of aerospace vehicles. Multidisciplinary teams that work on a semester-long project that includes the design, construction, and a flight test of an aerospace vehicle optimized for a given set of requirements. Teamwork, leadership and presentation skills emphasized.

Credit hours: 4

Contact hours: Lecture: 3 Other: 1

Levels: Graduate, Undergraduate

Schedule types: Independent Study, Lecture, Combined lecture & IS

Department/School: Mech & Aerospace Engr

MAE 4513 Aerospace Structures I

Prerequisites: Admission to MAE professional school; a grade of "C" or higher in MAE 3323 and MAE 3324.

Description: Design and analysis of flight structures. Topics from two and three-dimensional elasticity. Behavior of composite materials. Stress and deflection analysis of thin-skinned stiffened structures. Introduction to the finite element method and its applicability in the design process. Priority enrollment is given to Aerospace Engineering majors.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4583 Corrosion

Prerequisites: A grade of "C" or better in ENSC 3313; admission to MAE professional school.

Description: Modern theory of corrosion and its applications in preventing and controlling corrosion. Thermodynamics, Pourbaix diagrams, kinetics, polarization, passivation, effect of stress, cathodic protection, alloying, coatings. Lab experiments to characterize, simulate, diagnose and control corrosion.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2

Levels: Undergraduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 4623 Biomechanics

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in MATH 2163 and ENSC 2123 and ENSC 2143 and MAE 3324 or MAE 3323.

Description: This course will provide students with the basic knowledge necessary to conduct biomechanics investigations, design implants and prosthetics, and interact with other medical professionals. Covering a wide selection of topics ranging from cell to whole-body mechanics and behaviors. Specific topics will be: cellular biomechanics, bone biomechanics and fracture, muscle biomechanics and injuries, physiological functions, human motion analysis, biomaterials and implants design, prosthetics design.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4703 Design of Indoor Environmental Systems

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in MAE 3233 and MAE 3223 or MAE 3524.

Description: Design of heating, ventilating and air conditioning systems. Calculation of heating and cooling loads.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4713 Thermal Systems Realization

Prerequisites: Admission to MAE professional school. Grades of "C" or higher in ENSC 2213, ENSC 3233, and MAE 3223 or MAE 3524.

Description: This course will develop the tools required to design, analyze, and improve thermal energy systems. There will be an emphasis on practical understanding and detailed analysis techniques for system components, integration, and design. Some topics included are: the vapor compression cycle (for refrigeration and heat pump applications); compressor and heat exchanger analysis; and waste-heat recovery topics including Organic Rankine Cycles (ORC).

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 4733 Mechatronics Design

Prerequisites: A grade of "C" or higher in MAE 3113 and MAE 3403; admission to MAE professional school.

Description: Design of mechanical and electrical components, including sensors and actuators into an integrated environment using microcontrollers. Software design using an easy-to-program microcontroller embodies the importance of software implementation into the overall engineering system. Design practice with given design projects to build up skills plus an open-ended term design project of the student's choosing.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5000 Master's Thesis

Prerequisites: Graduate standing in MAE and consent of student's adviser.

Description: A student studying for a master's degree who elects to write a thesis must enroll in this course. Offered for variable credit, 1-9 credit hours, maximum of 9 credit hours.

Credit hours: 1-9

Contact hours: Other: 1

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5003 Advanced Biomaterials Science and Engineering

Prerequisites: Graduate standing or consent of instructor.

Description: Engineering issues that are implicit in understanding the interactions of living tissue and processed materials will be introduced. Emphasis is on identifying the processes in which cells interact with surfaces and particulate matter and the outcome of these interactions. Highlighted biological responses will include inflammation and coagulation. Also, biomaterial issues related to drug delivery and tissue engineering will be discussed. Same course as CHE 5263.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5010 Mechanical and Aerospace Engineering Projects

Description: Project in research assigned by the student's adviser. This course may also be used as a temporary number for new graduate course offerings. (3 credit hours). Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.

Credit hours: 1-12

Contact hours: Other: 1

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5013 Physiological System Analysis for Engineers

Prerequisites: Graduate standing or consent of instructor.

Description: Introduce the basic physiology concepts used widely in biomedical engineering research; and introduce and develop engineering concepts and approaches for quantitative analysis of physiological systems. Engineering principles of mechanical properties of various tissue and organ systems under normal and diseased conditions. Same course as CHE 5273.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5023 Advanced Biofluid Mechanics

Prerequisites: Graduate standing or 3233 (or equivalent).

Description: From sub-cellular to the organ level, life is supported by mass transfer processes, which encompass everything from free diffusion to the convection of bulk fluids. Therefore, to understand the body's functions, it is necessary to apply the fundamental fluid mechanics and heat transfer laws to physiological systems. Special emphasis will be placed on different length scales in physiological system, biorheology, conservation laws, mechanical coupling to vessel deformation and relevant physiology.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5030 Engineering Practice

Prerequisites: Graduate standing in MAE and consent of student's adviser.

Description: Solution of real-life engineering design and development problems in an actual or simulated industrial environment. Activities include application of design and testing procedures, economic evaluation and periodic oral and written reporting on one or more assigned problems. Activities must be approved in advance by the adviser. Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.

Credit hours: 1-12

Contact hours: Other: 1

Levels: Graduate

Schedule types: Independent Study

Department/School: Mech & Aerospace Engr

MAE 5033 Advanced Biomedical Engineering

Prerequisites: Consent of instructor.

Description: Principles and engineering analysis of biomedical processes. Artificial organs, biomaterials, tissue engineering, transport in biological systems, biomedical imaging and drug delivery systems. Same course as CHE 5293.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5053 Design of Engineering Experiments**Prerequisites:** Graduate standing.**Description:** The purpose of this course is to teach graduate students how to apply statistical methods to the solution of biological and engineering problems. They will learn how to use statistical methods to design experiments, present and analyze experimental data.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5063 Soft Tissue Mechanics****Prerequisites:** MAE 3323 or an equivalent course with the consent of the instructor.**Description:** Introduction to the most commonly used computational techniques for investigating and analyzing the behavior of biological soft tissues. Application of computational methods such as elasticity, viscoelasticity, and poroelasticity for numerically modeling the properties of biomaterials.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5073 Advanced Mechanical Vibrations****Prerequisites:** MAE 4063 or consent of instructor.**Description:** Analysis of nonlinear vibrations, classical analysis of continuous systems and numerical methods.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5083 Engineering Acoustics****Prerequisites:** Graduate standing or consent of instructor.**Description:** Acoustical analysis and measurement techniques, with emphasis on design applications for noise and vibration control in machinery and in buildings.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5093 Numerical Engineering Analysis****Prerequisites:** Undergraduate course in computer programming and consent of professor.**Description:** Practical digital methods for obtaining steady-state and transient solutions to lumped and distributed mechanical, fluid and thermal problems.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5103 Advanced Dynamics****Prerequisites:** ENSC 2123, MAE 3013 and MAE 3723; and graduate standing or consent of instructor.**Description:** This course will address the effects of forces on the motion of a body or system of bodies to solve real-world engineering problems. It will emphasize the tools of analytical dynamics to develop mathematical models that describe the dynamics of particles, rigid bodies, and systems of particles or rigid bodies. The course will also address the formulation of equations of motion for complex mechanical systems and computational methods for solving these equations.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5113 Diffraction in Materials****Prerequisites:** Graduate standing or consent of instructor.**Description:** Introduction to crystallography and diffraction with an emphasis on X-Ray diffraction, some exposure to Neutron diffraction, radiography and tomography. Applications will focus on mechanical properties measurements. New methods will be surveyed with an emphasis on current research. Same course as MSE 5113.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5123 Advanced Material Removal Processes****Prerequisites:** ENSC 3313 and MAE 3123 and graduate standing or consent of instructor.**Description:** Understanding the fundamental principles and practice (mechanics and material aspects) of machining and grinding of materials. Historical aspects; physics of metal cutting, mechanics of machining (orthogonal and oblique); shear stress and shear strain in machining, dynamometry; tool materials, tool wear, tool life, and machinability; vibrations in machining; thermal aspects of machining, cutting fluids; economics; surface finish accuracy and surface integrity, and grinding.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5133 Mechanical Behavior of Materials****Prerequisites:** ENSC 3313 or equivalent.**Description:** A unified approach to the behavior and response of engineering materials to applied loads. Mechanical and metallurgical fundamentals of deformation processes. Spatial scales of atomic physics, micromechanics and continuum mechanics.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 5143 Tribology

Prerequisites: Graduate standing or consent of instructor.

Description: The principles of tribology. Definition of tribology, contact of solids, surface topography, real area of contact, friction of various materials, basic mechanisms of friction, mechanisms of wear (adhesion, abrasion, fatigue, erosion, and fretting), hardness of solids, frictional heating and surface temperatures, material properties that influence surface interactions, surface roughness measurement, surface integrity residual stresses and subsurface deformation, application of tribology to manufacturing, wear resistant materials, wear-resistant coatings, experimental methods in tribology, surface analytical tools in tribology, scanning tunneling microscopy/atomic force microscopy, wear monitoring and wear prevention, and systems approach to tribology.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5153 Precision Engineering I

Prerequisites: Graduate standing or consent of instructor.

Description: An integrated approach to underlying engineering principles governing product and process designs requiring accuracies typically better than 1 part in 106. Design and control of precision machines and instruments, dimensional and surface metrology, scanning probe microscopy, ultra-precision machining and grinding, and precision assembly.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5163 Precision Manufacturing Process

Prerequisites: MAE 3123 or equivalent.

Description: Introduction to precision manufacturing, design principle of precision machine tools and source of errors, diamond turning and milling, grinding, polishing and lapping, sensors for precision manufacturing, precision manufacturing applications.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5183 Nanostructured Materials

Prerequisites: Graduate standing and basic undergraduate materials science course or equivalent.

Description: Size and shape dependence of material properties at the nanoscale. Interaction, surface energy, functionalization, binding, and immobilization of nanostructures. Top-down and bottom-up nanofabrication, atomic processes and self assembly. Lithography, thin films, functional coating, Langmuir-Blodgett films, layer-by-layer growth. Properties, applications and synthesis of well-studied building blocks; quantum dots (semiconductor nanocrystals), carbon nanostructures (nanotubes and fullerenes), semiconductor nanowires, metal nanoparticles and nanowires.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5233 Advanced Fluid Dynamics I

Prerequisites: ENSC 3233.

Description: Introduction to fluid flows. Governing equations for mass, momentum and energy. Exact solutions of Navier-Stokes' equations. Dimensional analysis and similitude. Potential flows. Boundary layer theory. Low Reynolds number flows. Introduction to vorticity dynamics.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5243 Micro Flows

Prerequisites: Graduate standing or consent of instructor.

Description: Fundamentals and simulation of micro flows including governing equation, slip models, shear- and pressure-driven micro flows. Thermal effects in micro scales. Applications; MEMS and micro propulsion. Numerical methods for continuum simulation and atomistic simulation.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5253 Multiphase Flow

Prerequisites: Graduate standing.

Description: Theory, methods and practical experience for studying complex transient multiphase flows: basic concepts and definition, dynamics of bubbles, drops and rigid particles, gas-liquid transport in ducts, fluid-solid transport in ducts, aerosol and spray systems, foam, fluidization, particle separation systems multiphase flow in porous media, breakup of liquid sheets and jets, modeling, advanced experimental techniques for multiphase flow.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5273 Advanced Fluid Dynamics II

Prerequisites: MAE 5233.

Description: Application of advanced fundamental concepts and methods to vorticity dynamics, gravity waves, instability, and an introduction to turbulence. Specialty topics (e.g. geophysical flows, compressible flows, biofluids) will also be discussed.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5343 Advanced Aerospace Propulsion and Power

Prerequisites: MAE 4243; Graduate Standing or Consent of Instructor.

Description: Advanced analysis of aircraft engines. Preliminary aerodynamic and structural design of major engine components including inlets, compressors, combustors, turbines, mixers, afterburners, and nozzles.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5353 Testing, Control, and Simulation of Thermal Systems

Prerequisites: MAE 3223 or equivalent.

Description: This course introduces the usage of computer software for the simulation and experimental testing of thermal systems and their components. Specifications of sensors and test plans based on uncertainty calculation as well as HVAC controls are introduced.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 3

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 5403 Computer-Aided Analysis and Design

Prerequisites: Undergraduate course in computer programming and consent of professor.

Description: Theory, application and implementation of digital-computer-oriented algorithms for the synthesis, simulation, analysis and design of engineering systems. Advanced FORTRAN methods for optimization, simulation and data analysis. Implementation of these methods uses program libraries, batch processing, remote terminals and graphic display units.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5413 Optimal Control

Prerequisites: MAE 5713 or ECEN 5713.

Description: Optimal control theory for modern systems design. Specification of optimum performance indices. Dynamic programming, calculus of variations and Pontryagin's minimum principle. Iterative numerical techniques for trajectory optimization. Same course as ECEN 5413.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5433 Robotics, Kinematics, Dynamics and Control

Prerequisites: MAE 4053 or ECEN 4413 or consent of instructor.

Description: Kinematic and dynamic analysis of robot manipulators. Inverse kinematics, motion planning and trajectory generation. Industrial practice in robot servo control. Dynamics and control in the presence of constraints. Actuators and sensors. Force sensors and vision systems. Robotic force control and its applications in industry. Passivity based control algorithms. Advanced control techniques for motion and force control. Same course as ECEN 5433.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5463 Nonlinear System Analysis and Control

Prerequisites: MAE 4053 or ECEN 4413.

Description: Failure of superposition of effects; phase-plane analysis; limit-cycles; Lyapunov stability; hyperstability and input-output stability; controllability and observability of nonlinear systems; feedback linearization; robust nonlinear control system design. Same course as ECEN 5463. Previously offered as MAE 5723.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5473 Digital Control Systems

Prerequisites: MAE 4053 or ECEN 4413.

Description: Input output and state space representations of linear discrete-time systems. Approximate methods in discrete-time representation. Stability methods. Controllability, observability, state estimation, and parameter identification. Design and analysis of feedback control system using frequency-domain and state-space methods. Introduction to optimal control. Same course as ECEN 5473.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5483 Advanced Mechatronics Design

Prerequisites: MAE 4733 or similar course and consent of instructor.

Description: Continuation of topics covered in the undergraduate course MAE 4733 Mechatronics Design. Optimizing C programming code for microcontrollers using the assembly language instruction set, RS-232 microcontroller communication protocol, Controller Area Network (CAN) communication protocol plus hands-on CAN bus development boards, advanced topics which could include but are not limited to sensor design, real time operating systems, and advanced communication protocols. Same course as ECEN 5483.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5503 Mechanics of Advanced Composites for Structural Design

Prerequisites: ENSC 2113, ENSC 2143 or consent of instructor.

Description: Basic principles governing the micro-mechanics of a lamina, and the macro-mechanics of a laminate are discussed in detail. Analysis of continuous fiber, short-fiber, and woven-fiber polymer matrix composites. A computer program for an analysis and design of composite laminates is developed.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5513 Stochastic Systems

Prerequisites: ECEN 3513 and 4503 or STAT 4033 or MAE 4053 or MAE 4063 or consent of instructor.

Description: Theory and applications involving probability, random variables, functions of random variables, and stochastic processes, including Gaussian and Markov processes. Correlation, power spectral density, and non-stationary random processes. Response of linear systems to stochastic processes. State-space formulation and covariance analysis. Same course as ECEN 5513. Previously offered as MAE 6063.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5523 Estimation Theory

Prerequisites: MAE 5513 or ECEN 5513.

Description: Stochastic model development, parameter estimation and state estimation. The linear model, model order determination, least squares, estimation, maximum likelihood estimation, Bayesian estimation. Gaussian random vectors, estimation in linear and Gaussian models, state estimation, the Kalman filter, prediction and smoothing. Same course as ECEN 5523.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5533 Theory of Elasticity

Prerequisites: MAE 3323 or consent of instructor.

Description: Basics of tensor calculus, field equations (strain-displacement, compatibility, equilibrium, and constitutive relation), solution of plane elastostatics problems in cartesian and polar coordinates, potential function formulation, introduction to 3D problems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5543 Modern Materials

Prerequisites: ENSC 3313.

Description: Properties, applications and recent innovations of structural engineering materials. Metals, ceramics, polymers and composites considered.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5553 Fatigue and Fracture Mechanics

Prerequisites: MAE 4333 or consent of instructor.

Description: Fracture processes in engineering materials including design considerations, failure avoidance and predictability. Fatigue processes and high-strength, toughness-limited materials.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5563 Finite Element Methods

Prerequisites: Graduate standing or consent of instructor.

Description: Introduction to the finite element method in mechanical engineering. Numerical and mathematical formulations including an introduction to variational methods. Computer applications in solid mechanics, heat transfer and fluid mechanics.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5573 Continuum Mechanics

Prerequisites: Graduate standing or consent of instructor.

Description: Principles governing the mechanics of a continuum. Tensor calculus. Strain and kinematics of deformation. Conservation laws, stress and equilibrium. Constitutive equations of elastic, viscoelastic, and plastic solids. Solving boundary value problems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5583 Corrosion Engineering

Prerequisites: ENSC 3313 or equivalent.

Description: Modern theory of corrosion and its applications in preventing or controlling corrosion damage economically and safely in service. Same course of MSE 5583.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5593 Theory of Viscoelasticity

Prerequisites: Consent of instructor.

Description: Advanced stress analysis in solids exhibiting time-dependent behavior. Material characterization and thermodynamic foundation of the constitutive behavior of time-dependent materials such as polymers, solid propellants and metals near their melting points; time-temperature; superposition principle for thermo-rheologically simple materials; correspondence principle for linearly viscoelastic and associated linearly elastic solutions; integral formulation for quasistatic boundary value problems; treatment of time-varying boundary conditions such as moving boundaries and moving loads; linearly viscoelastic stress waves and approximate methods of linearly viscoelastic stress analysis.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5603 Stability of Structures

Prerequisites: Graduate standing or consent of instructor.

Description: Stability is a fundamental problem in solid mechanics, which is crucial to the safety of structures against collapse. The theory of stability is of great importance for structural engineering, aerospace engineering, nuclear engineering, etc. Elastic and non-elastic theories of stability will be discussed for structures such as columns, frames, thin-walled beams, plates and shells. Energy methods for discrete and continuous structures will also be discussed.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5633 Advanced Thermal Energy Systems Analysis

Prerequisites: MAE 3223 and MAE 3233; Graduate Standing or Consent of Instructor.

Description: This course will develop the tools required to design, analyze, and improve advanced thermal energy systems. There will be an emphasis on practical understanding of components, system integration, and system design. Some topics included are; improvements to the vapor compression cycle (for refrigeration and heat pump applications); compressor and heat exchanger analysis; heat-driven vapor compression cycles; waste-heat recovery topics including Organic Rankine Cycles (ORC) and expander analysis.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5653 Refrigeration

Prerequisites: MAE 3223.

Description: Thermal engineering of refrigeration and heat pump systems, vapor compression systems, absorption refrigeration cycles, cryogenics, compressors, heat exchangers, flow control devices, laboratory simulators and measurements, socio-economics and environmental impact of systems and refrigerants. A general-purpose computer software program is used for analysis and design of several refrigeration systems and components.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5663 Advanced Finite Element Analysis

Prerequisites: MAE 5563 or consent of instructor.

Description: Development of three-dimensional isoparametric solid elements using Lagrange and serendipity family of elements, solution of three-dimensional thermoelasticity problems, linear time dependent problems, variational formulation and computer implementation of structural dynamics analysis using implicitly operators, implementation of three-dimensional diffusion and heat transfer analysis, solution of a nonlinear system of equations, and finite element analysis using commercial software packages.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5673 Mechanics of Fracture, Contact and Friction

Prerequisites: Graduate standing or consent of instructor.

Description: Rigorous derivation and presentation of the equations of fracture mechanics, contact and friction. Equations of solid mechanics and mathematical preliminaries, elastic stress field near a crack tip, stress intensity factors, fracture toughness, Griffith solution and J-integral, elastic-plastic fracture, fatigue, Dugdale model and cohesive zone laws, experimental techniques in fracture mechanics, contact mechanics, friction modeling. More advanced topics and projects will be chosen from interfacial crack growth, subsonic and intersonic dynamic fracture, rate- and state-dependent friction laws, fracture and friction at the small scales (nanomechanics), and finite-element analysis using commercial packages.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate, Undergraduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5683 Thermodynamics and Thermostatistics of Materials

Prerequisites: ENSC 3313 or equivalent.

Description: Notions of energy, entropy, equilibrium, macrostates, and microstates and their relation to material processes and properties. Deriving material properties from equations of state: Maxwell relations. Statistical thermodynamics: predicting material properties from microstates. Partition function. Phase transformations. Thermodynamics of surfaces and defects. Electrochemistry. Same course as MSE 5683.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5693 Phase Transformations in Materials

Prerequisites: Graduate standing or consent of instructor.

Description: Principles of phase transformations in material. Structure of materials, phase diagrams, diffusion, solidification, and diffusional and diffusionless transformations will be covered. Recent developments in materials research relevant to phase transformations. Same course as MSE 5693.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5703 Optimization Applications

Prerequisites: Graduate standing.

Description: A survey of various methods of unconstrained and constrained linear and non-linear optimization. Applications of these methodologies using hand-worked examples and available software packages. Intended for engineering and science students. Same course as CHE 5703, ECEN 5703 & IEM 5023.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5713 Linear Systems**Prerequisites:** Graduate standing or consent of instructor.**Description:** Introduction to the fundamental theory of finite-dimensional linear systems with emphasis on the state-space representation. Mathematical representations of systems; linear dynamic solutions; controllability, observability, and stability; linearization and realization theory; and state feedback and state observer. Same course as ECEN 5713.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5733 Neural Networks****Prerequisites:** Graduate standing.**Description:** Introduction to mathematical analysis of networks and learning rules, and on the application of neural networks to certain engineering problems image and signal processing and control systems. Same course as CHE 5733 & ECEN 5733.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5753 Advanced Experimental Mechanics of Solids****Prerequisites:** MAE 5573 or consent of instructor.**Description:** Application of advanced experimental mechanics techniques to investigate and characterize response of solid materials. Course material includes use of at-a-point and full-field techniques, characterizing rate- and time-dependent material response, and techniques for finite deformation.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mech & Aerospace Engr**MAE 5763 Wave Motion and Vibration of Continuous Media****Prerequisites:** MAE 5573 or consent of instructor.**Description:** Fundamentals of the formulation and solution of the problem of wave motion and vibration in continuous media. Propagation of stress waves and the implication of high-rate loading on mechanics problems.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5773 Intelligent Systems****Prerequisites:** MAE 5733 or ECEN 5733.**Description:** Introduction to the state-of-the-art intelligent control and system successfully deployed to industrial and defense applications. Emerging intelligent algorithms (e.g., bottom-up, top-down, semiotics); reinforcement learning and hybrid systems; and case studies and design projects. Same course as ECEN 5773.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5783 Principles of Autonomous Decision Making****Description:** This course will provide a detailed overview of the fundamental principles of autonomous decision making and their applications to various engineering and computer-science domains. This course will survey popular and emerging techniques in reasoning and perception as well as optimal decision making methodologies. Learning and reasoning paradigms include support vector machines, Gaussian Processes, and Bayesian Nonparametric Learning. Optimal decision making techniques include Markov Decision Processes, Planning and reinforcement learning.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5803 Advanced Thermodynamics I****Prerequisites:** MAE 3223.**Description:** A rigorous examination of the fundamental principles of engineering thermodynamics to include the First Law, Second Law and availability, thermodynamics equations of state for single phase and multi-phase systems, chemically reactive systems, and equilibrium. A general purpose computer software program is used for examination of case studies of thermodynamic processes.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5813 Intermediate Heat Transfer****Prerequisites:** MAE 3233 or equivalent.**Description:** Continuation of the topics covered in the undergraduate heat transfer course (MAE 3233) with the addition of mass transfer. This course covers problems of heat and mass transfer in greater depth and complexity than is done in the undergraduate heat transfer course and incorporates the subjects that are not included or are treated lightly in that course. Analysis will be given greater emphasis than the use of correlations.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5823 Radiation Heat Transfer****Prerequisites:** MAE 3233 or equivalent and graduate standing or consent of instructor.**Description:** The mechanism of the transfer of energy by thermal radiation; radiant properties of materials, energy transfer prediction methods and solar energy topics.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 5833 Transient Simulation of Thermal Systems

Prerequisites: Graduate Standing or consent of instructor.

Description: This course provides an introduction to the transient simulation of building thermal systems. Learned material is reinforced in lab sections as well as in a semester project.

Credit hours: 3

Contact hours: Lecture: 2 Lab: 2

Levels: Graduate

Schedule types: Lab, Lecture, Combined lecture and lab

Department/School: Mech & Aerospace Engr

MAE 5843 Conduction Heat Transfer

Prerequisites: ENSC 3233.

Description: Advanced heat transfer analysis and design, with primary emphasis on conduction.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5853 Computational Heat Transfer

Prerequisites: MAE 3233, graduate standing, knowledge of FORTRAN.

Description: Computational techniques for the solution of two-dimensional heat transfer, fluid flow and related processes in problems of practical interest. A general-purpose computer program used to demonstrate the capabilities of the numerical method through a wide variety of engineering problems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5863 Building Heat Transfer and Simulation

Prerequisites: MAE 3223, MAE 3233, ENSC 3233.

Description: Conduction, convection and radiation heat transfer applied to building thermal simulation. Solar radiation.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5873 Advanced Indoor Environmental Systems

Prerequisites: MAE 4703.

Description: Heating, air-conditioning, ventilation and refrigeration systems. System and component analysis, design and simulation.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5913 Advanced Aerodynamics

Prerequisites: ENSC 3233 or equivalent.

Description: Aerodynamics of the subsonic, transonic, supersonic, and hypersonic flow regimes. Derivation of governing equations and fundamental principles. Analytical and computational analysis methods. Recent developments.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5923 Guidance and Control of Aerospace Vehicles

Prerequisites: MAE 4053 or ECEN 4413 or equivalent.

Description: Navigation, guidance and attitude control of aircraft, launch vehicles and spacecraft. Inertial navigation mechanizations and error analysis. Stability augmentation systems.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5933 Aeroelasticity

Prerequisites: Graduate standing or consent of instructor.

Description: Interaction between fluid dynamic, inertial and elastic forces. Development of analytical and computational methods for analysis. Application to a broad range of problems in engineering.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5943 Unsteady Aerodynamics and Aeroacoustics

Prerequisites: ENSC 3233 or equivalent.

Description: Development of governing fluid dynamic equations for unsteady flows; linear unsteady aerodynamics for isolated and cascaded lifting surfaces; acoustics in moving media; three-dimensional duct acoustics; sound generation from isolated airfoils, cascaded airfoils, rotor-stator interactions, multiple pure-tone sources, propellers and jets.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5953 Aerospace Systems Engineering

Prerequisites: MAE 3253 or equivalent.

Description: Aircraft and spacecraft design from a systems perspective, covering basic systems engineering, cost and weight estimation, basic vehicle performance and trade study analysis, safety and reliability, lifecycle analysis, subsystem integration, risk analysis and management, system realization, and multi-disciplinary optimization (MDO). Additional topics include requirements identification and development, and program planning and control.

Credit hours: 3

Contact hours: Lecture: 3

Levels: Graduate

Schedule types: Lecture

Department/School: Mech & Aerospace Engr

MAE 5963 Unmanned Aerial Systems Design and Analysis**Prerequisites:** Graduate standing or permission of instructor.**Description:** This course covers concepts related to design and operation of unmanned systems focusing on unmanned aircraft, including remotely piloted and autonomous vehicles. History of unmanned systems. Design of unmanned air systems including concepts of operations, communications, payloads, control and navigation, multiple air vehicle architectures, cooperative control and ISR. Design requirements for unmanned versus manned vehicles. Operation in conflicted airspace. Aspects of other unmanned systems, including ground, surface, underwater and space vehicles.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5973 Unmanned Aerial Systems Propulsion****Prerequisites:** Graduate standing or permission of instructor.**Description:** This course will cover propulsion topics used on Unmanned Aerial Systems (UAS). These will include: Historical perspective on UAS propulsion systems; Classification of propulsion types; Propulsion requirements for UAV; Propeller performance and design; Internal combustion engine; Heavy-Fuel ICE; ICE Muffler design; Electric motor; Hybrid-Electric engine; Fuel Cell engine; Flapping Wing propulsion; Jet engine; Propulsion system integration and installation effects.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 5983 Aircraft Certification and Test****Prerequisites:** Graduate standing or consent of instructor.**Description:** Exploration of the major engineering processes for airworthiness certification of manned and unmanned aircraft. Assessment of civil and military airworthiness regulations and their impact on certification program management and testing. Development of foundational concepts and processes for laboratory, ground and flight testing for airworthiness.**Credit hours:** 3**Contact hours:** Lecture: 2 Lab: 2**Levels:** Graduate**Schedule types:** Lab, Lecture, Combined lecture and lab**Department/School:** Mech & Aerospace Engr**MAE 5993 Microstructural Mechanics****Prerequisites:** Graduate standing or consent of instructor.**Description:** Build a framework to understand the various microstructures of materials with their respective roles in controlling mechanical properties. Grain size, orientation, surface facets, compositional gradients, and second or multiple phases, in combination with the three-dimensional arrangement of the various types of imperfections, together constitute the microstructure of a material. An emphasis will be placed on new research areas and exposure to methods for controlling and probing microstructures.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6000 Doctoral Dissertation****Prerequisites:** Admission to MAE PhD program and consent of the student's dissertation adviser.**Description:** Independent research under the direct supervision of the student's doctoral dissertation adviser. Offered for variable credit, 1-15 credit hours, maximum of 30 credit hours.**Credit hours:** 1-15**Contact hours:** Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Mech & Aerospace Engr**MAE 6010 Advanced Study****Prerequisites:** Approval of the student's advisory committee.**Description:** Study and investigation under the supervision of a member of the faculty along lines of interest well advanced of and supported by the 5000-series courses. Offered for variable credit, 1-12 credit hours, maximum of 12 credit hours.**Credit hours:** 1-12**Contact hours:** Other: 1**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Mech & Aerospace Engr**MAE 6123 Advanced Processing of Materials****Prerequisites:** Graduate standing or consent of instructor.**Description:** Rationale for non-traditional machining; various non-traditional machining processes, including electro-discharge machining, electro-chemical machining, plasma arc-, microwave-, and laser assisted processing, waterjet (abrasive) cutting, ultrasonic machining, chemical machining, thermal assisted processing and electron beam machining.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6133 Surface Mechanics****Prerequisites:** Consent of instructor.**Description:** Models and solutions basic to surface studies. Equations of continuum mechanics, thermal field solutions at sliding interfaces, elasticity, plasticity. Applications of solution techniques to surface, surface layer and interface phenomena.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6143 Thermal Analysis of Manufacturing Processes****Prerequisites:** Graduate standing and consent of instructor.**Description:** Thermal analysis of various moving heat source problems encountered in a variety of manufacturing processes, including machining, grinding, polishing, casting, welding, energy beam cutting and other tribological applications such as meshing of gears, cams, bearings. Analysis of both transient and steady state conditions.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

MAE 6233 Turbulent Fluid Dynamics**Prerequisites:** MAE 5233.**Description:** Isotropic turbulence, turbulent wakes and jets, bound turbulent shear flows, transition, hydrodynamic stability and integral calculation methods for turbulent boundary layers.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6263 Computational Fluid Dynamics****Prerequisites:** Graduate standing; MAE 5093 and MAE 5233.**Description:** Numerical method and computational tool development for solving canonical partial differential equations and incompressible Navier-stokes equations employing both finite difference and finite volume algorithms. Strategies for improved pressure-velocity coupling and implicit time-stepping.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6423 System Identification****Prerequisites:** MAE 5473 or MAE 5713 or ECEN 5473 or ECEN 5713.**Description:** Linear and nonlinear system modeling of random systems. Models of linear time-invariant systems, nonparametric methods and preliminary model development, parameter estimation methods, convergence and consistency, asymptotic distributions of parameter estimates, nonlinear modeling. Same course as ECEN 6423.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6453 Adaptive Control****Prerequisites:** MAE 5473 or ECEN 5473 or ECEN 5713 or MAE 5713.**Description:** Analysis and design of control techniques which modify their performance to adapt to changes in system operation. Review of systems analysis techniques, including state variable representations, linearization, discretization, covariance analysis, stability, and linear quadratic gaussian design. On-line parameter estimation, model reference adaptive systems, self-tuning regulators, stable adaptive systems. Same course as ECEN 6453.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6463 Fluid Power Control II****Prerequisites:** MAE 5463 or ECEN 5463.**Description:** Introduction to vector fields and Lie algebra: controllability and observability of nonlinear systems; local decompositions; input-output and state-space representation on nonlinear systems; feedback linearization; controlled invariance and distribution; control of Hamiltonian systems. Same course as ECEN 6463.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6483 Robust Multivariate Control Systems****Prerequisites:** MAE 5713 or ECEN 5713.**Description:** Introduction to multivariable systems: SISO robustness vs. MIMO robustness; multivariable system poles and zeros; MIMO transfer functions; multivariable frequency response analysis; multivariable Nyquist theorem; performance specifications; stability of feedback systems; linear fractional transformations (LFT's); parameterization of all stabilizing controllers; structured singular value; algebraic ricatti equations; H2 optimal control; H-infinity controller design. Same course as ECEN 6483.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr**MAE 6843 Convection Heat Transfer****Prerequisites:** MAE 5233 or equivalent.**Description:** Advanced convective heat transfer in laminar and turbulent flows over external surfaces and inside channels. Heat transfer at high velocities, free convection boundary layers, and mass transfer.**Credit hours:** 3**Contact hours:** Lecture: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Mech & Aerospace Engr

Undergraduate Programs

- Aerospace Engineering, BSAE (<http://catalog.okstate.edu/engineering-architecture-technology/mechanical-aerospace-engineering/aerospace-engineering-bsae>)
- Mechanical Engineering, BSME (<http://catalog.okstate.edu/engineering-architecture-technology/mechanical-aerospace-engineering/mechanical-bsme>)
- Mechanical Engineering: Petroleum, BSME (<http://catalog.okstate.edu/engineering-architecture-technology/mechanical-aerospace-engineering/mechanical-petroleum-bsme>)
- Mechanical Engineering: Pre-Medical, BSME (<http://catalog.okstate.edu/engineering-architecture-technology/mechanical-aerospace-engineering/mechanical-pre-medical-bsme>)

Graduate Programs

The School of Mechanical and Aerospace Engineering offers programs leading to the degree of Master of Science in Mechanical and Aerospace Engineering, and the degree of Doctor of Philosophy in Mechanical and Aerospace Engineering. Both of these degrees offer an option in Unmanned Aerial Systems and prepare the graduate for research and development positions in industry and government, or for the teaching profession in engineering. They are distinguished by the incorporation of a research component.

Students may select coursework and participate in research or design projects in the following areas: aerodynamics, aeroelasticity, biomedical engineering, design, computational mechanics, heat transfer dynamic systems and controls, fluid mechanics, materials, manufacturing processes, refrigeration, solid mechanics thermal and HVAC systems, unmanned aerial systems, and web handling systems. Students are encouraged to take courses in mathematics and science and in other fields of engineering which fit into their programs.

Admission Requirements

Admission to the Graduate College is required of all students pursuing the MS or PhD degree. Graduation from a mechanical or aerospace engineering curriculum accredited by ABET, with scholastic performance distinctly above average, qualifies the student for admission to the School of Mechanical and Aerospace Engineering as a candidate for the MS and PhD degrees. Graduates from disciplines other than mechanical or aerospace engineering may be admitted if an evaluation of their transcripts by the School of Mechanical and Aerospace Engineering indicates they are prepared to take graduate-level course work in mechanical or aerospace engineering, or can be expected to do so after a reasonable amount of prerequisite work.

Degree Requirements

All degree programs follow an approved plan of study designed to satisfy the individual goals of the student, while conforming to the general requirements of the School of Mechanical and Aerospace Engineering and the Graduate College.

The Master of Science degree program with the thesis option requires 24 credit hours of approved graduate-level course work and a suitable research thesis of six credit hours. The non-thesis option requires 35 credit hours of which two must be for an acceptable, directed research activity that results in a written and oral report to the faculty.

A new Master of Engineering degree program is being introduced in the 2018-2019 academic year. This degree has a potential option in Unmanned Aerial Systems. This is a non-thesis degree plan that will require 24 core credit hours and 9 hours of controlled technical electives. A capstone requirement must be satisfied in an MAE 5000- or 6000-graduate-level course.

The Doctor of Philosophy degree requires a minimum of 60 credit hours beyond the master's degree, including a dissertation for which no more than 30 credit hours may be awarded.

Faculty

Daniel E. Fisher, PhD, PE—Professor and Head

Professor and Albert H. Nelson, Jr. Endowed Chair: Daniel E. Fisher, PhD, PE

Associate Head and Noble Foundation Chair in Web Handling and Director, Web Handling Research Center and Professor: James K. Good, PhD, PE

Regents Professor and Herrington Endowed Chair in Advanced Materials: Don A. Lucca, PhD, Drhc, CMfgE

Regents Professor, John Brammer Endowed Professorship: Afshin J. Ghajar, PhD, PE

Regents Professor and OG&E Energy Technology Chair: J.D. Spitler, PhD, PE

Professor and Tom J. Cunningham Endowed Chair: Andrew S. Arena, Jr., PhD

Professor and John Hendrix Chair, Ray & Linda Booker Endowed Professor and Director, Unmanned Systems Research Institute: Jamey D. Jacob, PhD

Associate Dean, OSU-Tulsa, Helmerich Family Endowed Chair and Director, Helmerich Research Center and Professor: Raman P. Singh, PhD
Professors: Geir Hareland, PhD, PE (adjunct); Lawrence L. Hoberock, PhD, PE (emeritus); David G. Lilley, PhD, DSc, PE (emeritus); Richard L. Lowery, PhD, PE (emeritus); Christopher E. Price, PhD, PE (emeritus); Karl N. Reid, ScD (emeritus); Robert L. Swaim, PhD, PE (emeritus); Gary E. Young, PhD, PE (emeritus); Larry D. Zirkle, PhD, PE (emeritus)

Associate Professors: Frank W. Chambers, PhD, PE (emeritus); Jay C. Hanan, PhD; Sandip Harimkar, PhD; James A. Kidd, PhD (clinical); Ali Kaan Kalkan, PhD; Khaled A. Sallam, PhD

Halliburton Professorship Fellow and Assistant Professor: Brian R. Elbing, PhD

Assistant Professors: Aurelie Azoug, PhD; Christian Bach, PhD; He Bai, PhD; Craig Bradshaw, PhD; Imraan Faruque, PhD; Richard J. Gaeta, PhD; Jerome Hausselle, PhD; Balaji Jayaraman, PhD; Rushikesh Kamalapurkar, PhD; James M. Manimala, PhD; Hadi Noori, PhD; Kurt P. Rouser, PhD; Omer San, PhD; Arvind Santhanakrishnan, PhD; Shuodao Wang, PhD; Yujiang "Mike" Xiang, PhD

Assistant Professor of Practice (ENDEAVOR): Qinang Hu, PhD

Lecturers: Joseph P. Connor, Jr. (adjunct assistant professor); Ronald D. Delahoussaye, PhD (adjunct professor); Ehsan Moallem, PhD (adjunct assistant professor)