

MECHANICAL ENGINEERING (ME)

ME 1230 Introduction to Mechanical Design (3 credits)

Introduction to engineering design process and analysis techniques, including problem solving skills, development of software learning skills, graphical analysis, data analysis, and documentation skills. The course includes lecture and lab periods each week. Typically Offered: Fall.

Coreqs: MATH 1143 and MATH 1144

ME 2010 Engineering Team Projects (1-3 credits, max 3)

Joint-listed with ME 4010

Students will be introduced to a systems approach to designing, building, and delivering an interdisciplinary engineering project, with an emphasis on learning how to realize a project in an organized team environment. Projects are chosen at the discretion of the department. Additional project duties/assignments required for 4000-level credit. Graded Pass/Fail. Typically Offered: Fall and Spring.

Prereqs: Permission

ME 2040 (s) Special Topics (1-16 credits, max 99)

Credit arranged

ME 2230 Mechanical Design Analysis (3 credits)

Use of design and problem solving methodology to model requirements, conduct project learning, develop concepts, and realize prototypes. Projects feature elements of electromechanical design, rapid prototyping, and experimentation. Typically Offered: Spring.

Prereqs: ENGR 1230, ENGR 2120

Coreqs: MATH 1750

ME 2800 Programming Essentials for Engineers (3 credits)

Introduces fundamental principles and techniques of computing and software programming. The course aims to provide students with an understanding and ability to write small to medium level programs that will allow them to perform computing tasks in various projects or coursework. Topics include procedural programming (methods, parameters, return values, etc.), basic controls and data structures, algorithms and problem-solving strategies, and software development tools and techniques. The course will use Python as the programming language and is intended for students without any prior programming experience. Typically Offered: Fall.

Prereqs: MATH 1143, MATH 1144, ENGR 1230

ME 2900 Computer Aided Design Methods (3 credits)

Engineering drawing literacy, pre-CAD planning, part modeling, assembly modeling, drawing package formulation, culminating team project involving virtual dissection and reassembly of a complex machine. Typically Offered: Fall and Spring.

Prereqs: ENGR 2100

ME 2990 (s) Directed Study (1-16 credits, max 99)

Credit arranged

ME 3130 Dynamic Modeling of Engineering Systems (3 credits)

Application of basic engineering principles to model and analyze the dynamic response of engineering systems; problem solutions will utilize transfer function methods, state variable techniques, and simulation software. Typically Offered: Fall and Spring.

Prereqs: ME 2230, ENGR 2200, ENGR 2400, MATH 3100, and ME Certification

Coreqs: MATH 3300

ME 3220 Mechanical Engineering Thermodynamics (3 credits)

Thermodynamic properties of substances, first and second laws of thermodynamics, thermodynamic analysis of mechanical engineering thermal components and cycles, psychrometric process, and introduction to combustion systems. Typically Offered: Fall and Spring.

Prereqs: CHEM 1111/CHEM 1111L, PHYS 2110/PHYS 2110L, and ME Certification

ME 3250 Machine Component Design I (3 credits)

Study of stress, deflection and stiffness, material properties, static and fatigue failure theory in the context of the analysis and design of machine components such as fasteners, welds, spring design and bearings. Significant use of solid modeling and use of equation solvers. Typically Offered: Spring.

Prereqs: ENGR 3500, ENGR 2150, and ME Certification

ME 3300 Experimental Methods for Engineers (3 credits)

Measurement systems and their application to engineering problems; topics include generalized performance of measurement systems, measuring and control devices, data acquisition and analysis, and report writing. Two lectures and one 2-hour lab per week. Typically Offered: Fall and Spring.

Prereqs: ENGR 2400, and ME Certification

ME 3410 Intermediate Mechanics of Materials (3 credits)

Mechanics of materials approach to three-dimensional stress and strain, unsymmetrical bending, shear centers, curved beams, thick-walled pressure vessels, non-circular torsion, energy methods and advanced strength theories. Introduction to elementary kinematics. Significant use of solid modeling and use of equation solvers. Typically Offered: Fall.

Prereqs: Certification

Coreqs: ENGR 2150

ME 3450 Heat Transfer (3 credits)

Transmission by conduction of heat in steady and unsteady states, by free and forced convection, and by radiation; combined effects of conduction, convection, and radiation. Typically Offered: Fall and Spring.

Prereqs: ME 3220, MATH 3100, and ME Certification

Coreqs: ENGR 3350

ME 3980 (s) Engr Coop Internship I (1-16 credits, max 99)

Credit arranged. Supervised internship in professional engineering settings, integrating academic study with work experience; requires written report to be evaluated by a designated faculty member; details of co-op to be arranged with ME Department before start of co-op; cannot be counted as a technical elective. Graded Pass/Fail.

Prereqs: Permission

ME 4010 Engineering Team Projects (1-3 credits, max 3)

Joint-listed with ME 2010

Students will be introduced to a systems approach to designing, building, and delivering an interdisciplinary engineering project, with an emphasis on learning how to realize a project in an organized team environment. Projects are chosen at the discretion of the department. Additional project duties/assignments required for 4000-level credit. Graded Pass/Fail. Typically Offered: Fall and Spring.

ME 4021 Machine Shop Fundamentals I (1 credit)

Fundamentals of machining focused on manual techniques, including milling machine and lathe operations. Orientation to the mechanical engineering machine shop and hands-on training of proper techniques to safely operate machine shop equipment and perform various machining tasks. Emphasis on comprehensive safety, metrology tools, tolerance inspection, and equipment calibration and maintenance. Typically Offered: Fall and Spring.

Prereqs: ME 2900 and Permission

ME 4022 Machine Shop Fundamentals II (1 credit)

Fundamentals of machining focused on CNC mill and lathe operations, including processes to prepare and create G-Code from CAM software, selection and setup of tooling, material preparation and fixturing, speeds and feeds, and associated safety procedures. Typically Offered: Spring.

Prereqs: ME 4021 and Permission

ME 4023 Machine Shop Leadership and Mentoring (1 credit)

Strengthening of machining knowledge and experience via leading and mentoring of Machine Shop Fundamentals I and or II (ME 4021 or ME 4022). Emphasis on shop safety, proper techniques, and communication. Typically Offered: Fall and Spring.

Prereqs: ME 4021 and Permission

ME 4030 (s) Workshop (1-16 credits, max 99)

Credit arranged

ME 4040 (s) Special Topics (1-16 credits, max 99)

Credit arranged

ME 4070 Group Mentoring (1 credit, max 3)

Topics and practicum in mentoring, leadership, and learning. Students apply what they learn by mentoring in engineering classes featuring laboratory or project work. Students will improve their team, communication, leadership, and mentoring skills and reinforce engineering skills in their mentoring area. Typically Offered: Fall and Spring.

Prereqs: Permission

ME 4100 Principles of Lean Manufacturing (3 credits)

Principles of lean manufacturing are introduced that provide a systematic process for identifying and eliminating non-value activities (waste) in production processes. Students learn these principles through a series of workshops, lectures, and hands-on simulations of lean principles. Students are also introduced to principles of design for manufacturing and assembly (DFMA). The course can include guest speakers and industrial field trips. Typically Offered: Varies.

Prereqs: Junior standing in an engineering discipline or Permission

ME 4120 Gas Dynamics (3 credits)

Compressible flow in ducts and nozzles, shock waves and expansion waves, and adiabatic two-dimensional compressible flow.

Prereqs: MATH 3100, ME 3220 or ENGR 3200, and ENGR 3350

ME 4130 Engineering Acoustics (3 credits)

Joint-listed with ECE 5790, ME 5130

Fundamentals of acoustics including wave theory; transmission through layers, generation and reception; low frequency models; application to sound measurement, transducers, loudspeaker cabinet design, and nondestructive testing; acoustic design project required. Additional projects/assignments required for graduate credit.

Prereqs: ENGR 2400 or ECE 2120, and MATH 3100, or ME 3130

ME 4140 HVAC Systems (3 credits)

Joint-listed with ME 5140

Application of thermodynamics, heat transfer, and fluid flow to understanding the psychrometric performance of systems and equipment; evaluating the performance characteristics, advantages, and disadvantages of the various types of HVAC systems including large tonnage refrigeration/chiller equipment, cooling coils, cooling towers, ducts, fans, and heat pump systems; economics of system and equipment selection.

Prereqs: ME 3450 Cooperative: open to WSU degree-seeking students.

ME 4150 Materials Selection and Design (3 credits)

Selection of materials for use in structural applications; consideration of environment, stress conditions, cost, and performance as guide to properties; optimization of choice of materials and fabrication methods; open-ended problems of real applications in various industries. Recommended Preparation: MSE 3130 and MSE 4560. Typically Offered: Spring.

Prereqs: ENGR 2150 and ENGR 3500

ME 4160 FE Exam Review (1 credit)

Review of ten essential topics on the Mechanical Engineering Fundamentals of Engineering exam, including preparation in each topic area based on online review sessions and solving sample problems. Graded Pass/Fail.

Prereqs: Senior standing

ME 4170 Turbomachinery (3 credits)

Joint-listed with ME 5170

Introduction to the basic principles of modern turbomachinery. Emphasis is placed on steam, gas (combustion), wind and hydraulic turbines. Applications of the principles of fluid mechanics, thermodynamics and aerodynamics to the design and analysis of turbines and compressors are incorporated. Additional technical research report and presentation required for graduate credit. ME 5170 is cooperative: open to WSU degree-seeking students. Recommended Preparation: ENGR 3200, ENGR 3350. Cooperative: open to WSU degree-seeking students.

ME 4200 Fluid Dynamics (3 credits)

Joint-listed with CE 5200, ME 5200

Credit not granted for both ME 4200 and ME 5200. A second fluid dynamics course featuring vector calculus and integral and differential forms of the conservation laws. Topics include fluid properties, fluid statistics, inviscid flow; conservation of mass, momentum, and energy; and turbulence. Other topics may be covered. Additional projects/assignments required for graduate credit.

Prereqs: ENGR 3350, MATH 3100, or Permission

ME 4210 (s) Advanced Computer Aided Design (3 credits)

Use of solid modeling software for advanced component design, creation of complex multi-component assemblies, animation studies, and rendering. Course concludes with one month-long final project.

Prereqs: ME 2900

Coreqs: ME 3410

ME 4240 Mechanical Systems Design I (3 credits)

General Education: Capstone Experience

Study of production realization including project planning, concept design, detail design, and manufacturing processes with multiple realistic constraints. Concepts learned are applied to a two-semester, capstone design project. The project is continued in ME 4260. Typically Offered: Fall.

Prereqs: ME 2900, ME 3130, ME 3250, ME 3300, ME 3450, and Certification

ME 4260 Mechanical Systems Design II (3 credits)

General Education: Capstone Experience

Continuation of each two-semester, capstone design project that was started in ME 4240. Typically Offered: Spring.

Prereqs: ME 4240

ME 4290 Combustion and Aeropropulsion (3 credits)

Joint-listed with ME 5290

Basic concepts related to chemically reacting flows, including thermodynamics, chemical kinetics, and transport processes. Introduction to premixed and non-premixed combustion processes. Description of basic combustion phenomena for non-premixed, premixed flames, and ignition. Oxidation mechanisms for fuels in various combustion processes. Discussion on the formation of pollutants during combustion processes and their subsequent transformations in the atmosphere with an emphasis on the effects of design and operating parameters of combustion devices on the nature and composition of exhaust gases. An introduction to aerospace propulsion concepts, including aircraft jet engine combustors and chemical rocket propellants. Additional projects/assignments are required for graduate credit. Typically Offered: Fall (Odd Years).

Prereqs: ME 3220, MATH 3100, ME 3450, and ENGR 3350

ME 4300 Senior Lab (3 credits)

Detailed lab investigation of engineering problem; statistical design of experiments; application of engineering principles to analyze experimental data; technical report writing; oral communication skills. One lecture and four hours of lab per week.

Prereqs: ME 3130 and ME 3300

ME 4330 Combustion Engine Systems (3 credits)

Theory and characteristics of combustion engines; combustion process analysis; fuels, exhaust emissions and controls; system analysis and modeling.

Coreqs: ME 3450 or Permission

ME 4350 Thermal Energy Systems Design (3 credits)

Application of fluid mechanics, thermodynamics and heat transfer in the design of thermal energy systems; topics include thermal energy system component analysis and selection, component and system simulation, dynamic response of thermal systems, and system optimization.

Prereqs: ME 3450

ME 4360 Sustainable Energy Sources and Systems (3 credits)

An introduction to renewable energy conversion. Topics include solar thermal, solar photovoltaic, and wind energy.

Prereqs: ME 3450 Cooperative: open to WSU degree-seeking students.

ME 4380 Sustainability and Green Design (3 credits)

Joint-listed with ME 5380

Understanding the concept of sustainability; industrial ecology and sustainable engineering, metabolic analysis; sustainable engineering; design for environment and sustainability; life cycle assessment; energy, water, and industrial ecology; the status of resources; and sustainable engineering and economics development.

Prereqs: MATH 3100 Cooperative: open to WSU degree-seeking students.

ME 4390 Advanced Mechanics of Materials (3 credits)

Joint-listed with ME 5390

Limitations of results of elementary mechanics of materials, complex situations of loading and structural geometry, applications to design of machines and structure, introduction to elasticity. Additional projects/assignments are required for graduate credit. Typically Offered: Varies.

Prereqs: ENGR 3500 or CE 3420

ME 4421 Introduction to Aerodynamics (3 credits)

Fundamental principles governing the behavior of airflows over bodies, focusing on applications in mechanical and aerospace engineering. Topics include airfoil theory, inviscid flows, circulation, boundary layers, aerodynamic forces, thin-airfoil theory, vortex panel methods, lifting-line theory, and flow across different regimes (subsonic, transonic, and supersonic). Typically Offered: Fall.

Prereqs: ENGR 3350

ME 4422 Introduction to Aircraft Design (3 credits)

Joint-listed with ME 5422

Aircraft conceptual design, focused on industry practice, including discussion of the design process, initial sizing, selection of thrust-to-weight ratio and wing loading, configuration layout, propulsion integration, systems integration, performance optimization, and trade-off studies. For graduate credit, students will be required to complete an additional class project and a final presentation. Typically Offered: Spring.

Prereqs: ENGR 3350

ME 4424 Introduction to Aerospace Materials (3 credits)

Principles and applications of aerospace materials, including developments in aluminum, titanium, and composites to improve performance. Addressing state-of-the-art approaches, investigation of critical advantages and deficits of core aerospace materials. Current industrial practice will be explored in individual and team research projects. Typically Offered: Spring.

Prereqs: ENGR 2150 and ENGR 3500

ME 4500 Fundamentals of Computational Fluid Dynamics (3 credits)

Governing equations of fluid flow; fundamentals of turbulence modeling; accuracy and stability of discretization schemes; verification and validation; boundary and initial conditions; grid generation; CFD post-processing. Application of CFD software (ANSYS FLUENT) through five hands-on CFD Labs including internal viscous pipe flows, external flows over a 2D airfoil and a circular cylinder, and flows in a 2D driven cavity.

Prereqs: ENGR 3350 and MATH 3300 Cooperative: open to WSU degree-seeking students.

ME 4510 Experimental Methods in Fluid Dynamics (3 credits)

Joint-listed with ME 5510

The objective of this course is to develop the knowledge and skills to be able to design and perform fluid dynamics experiments (and experiments in related areas) and to interpret and report the results. Learn the words, the concepts, and experimental skills in areas including dimensional analysis and scaling of experiments, flow visualization, velocity and flow rate measurements, turbulence measurements, and sediment sizing and transport measurements. Additional projects/assignments required for graduate credit. One 1-1/2 hour lecture and one 3-hour lab per week. Recommended Preparation: ENGL 3170 and ENGR 3350

ME 4540 Assistive Technologies for Physical Impairment (3 credits)

Introduction to assistive and rehabilitative robotics research. Topics include, but are not limited to, normal and pathological function in the brain and body; exoskeleton robotics; human-machine-interfaces; and development of R&D technical skills culminating in a team design project. Typically Offered: Varies.

Prereqs: Junior Standing or Instructor Permission

ME 4550 Biomechanics: Genome to Phenome (3 credits)

Joint-listed with ME 5550

The course introduces students to the history and evolution of plant biomechanics with a specific focus on grass species and crops. A multiscale understanding of biomechanical structures and features will be presented. Students will learn appropriate testing methodologies to quantify material properties of plant tissue at multiple scales. Additional work required for graduate credit. Typically Offered: Fall (Odd Years).

Prereqs: Junior standing or instructor permission.

ME 4580 Finite Element Applications in Engineering (3 credits)

Joint-listed with ME 5580

The finite element method is an essential tool for the design and research activities performed in engineering companies and academic institutions. The goal of this course is to introduce students to the use of the finite element method by focusing on a range of engineering applications and employing an interactive commercial finite element code. Students will learn how to solve various problems from several mechanical engineering areas including solid mechanics, heat transfer and fluid mechanics. When available, analytical solutions will be compared with the finite element solutions for validation purposes. ME 5580 is cooperative: open to WSU degree seeking students.

Prereqs: (ME 3220 or ENGR 3200) and ENGR 3500

Coreqs: ME 3410 or Instructor Permission Cooperative: open to WSU degree-seeking students

ME 4590 Robotic Systems Engineering I (3 credits)

Cross-listed with CS 4553

Joint-listed with CS 5553, ME 5590

Topics to be covered include principles of distributed systems control, interfacing and signal conditioning of sensors and actuators, data acquisition and signal processing, microprocessor-based control, physical modeling, and hardware and software simulation for model validation and control. Typically Offered: Fall and Spring.

Prereqs: Instructor Permission

ME 4610 Fatigue and Fracture Mechanics (3 credits)

Fracture mechanics approach to structural integrity, fracture control, transition temperature, microstructural and environmental effects, fatigue and failure analysis.

Prereqs: ENGR 2150 and ENGR 3500

ME 4640 Robotics Kinematic and Kinetic Analysis (3 credits)

Mathematical analysis of spatial robotics including forward and inverse kinematics of serial and parallel chains using the product-of-exponentials formulation and analyses of forces and velocities via the manipulator Jacobian. Semester hands-on project(s) include(s) the construction of small robot(s) to apply course concept. Typically Offered: Fall.

Prereqs: MATH 3100, MATH 3300, and ME 3130 or equivalent, ME 3300

ME 4660 Compliant Mechanism Design (3 credits)

Joint-listed with ME 5660

Will focus on the design, analysis, and manufacture of compliant mechanisms. Traditional kinematics and elastic deflections will be reviewed, and the area of large-deflection analysis will be introduced. The compliant mechanism theory will be introduced and applied. Additional coursework required for graduate credit. Typically Offered: Fall (Odd Years).

Prereqs: ME 3410

Coreqs: ME 3250 Cooperative: open to WSU degree-seeking students

ME 4720 Mechanical Vibrations (3 credits)

Free and forced vibration of single and multiple degree of freedom systems; response of mechanical systems to inputs of varying complexity, ranging from single frequency to pseudo-random; applications to mechanical design and vibration control.

Prereqs: ENGR 2200, MATH 3100, and ME 3130; or Graduate standing. Cooperative: open to WSU degree-seeking students.

ME 4800 Python Programming for Engineers (3 credits)

Python programming for engineering applications. Topics covered include classes, search methods, input and output, data analysis, visualization, object-orientated methods, third-party libraries, and optimizing code for complex large data analysis. Additional applications of programming in engineering may be explored (e. g. , data acquisition, signal and matrix analysis, GUI development, computer vision, and artificial intelligence.) Typically Offered: Varies.

Prereqs: ENGR 2120

ME 4810 Control Systems (3 credits)

Cross-listed with ECE 4700

Analysis and design of feedback control systems using frequency and time domain methods, and computer-aided design tools.

Prereqs: MATH 3300; Prereq for Electrical Engineering and Computer Engineering majors: ECE 3500 Prereq for Mechanical Engineering majors: ME 3130 Cooperative: open to WSU degree-seeking students.

ME 4900 Solid Modeling, Simulation and Manufacturing Capstone (3 credits)

Use of solid modeling software focused on preparation for certification examinations, introduction to multi-physics numerical simulation, and computer aided manufacturing (CAM). A major final project is required. Typically Offered: Fall.

Prereqs: Permission

ME 4950 Mechanics in Design and Manufacturing (3 credits)

An examination of the mechanics of deformation, shaping, and forming of materials, and the manufacturing processes utilizing them. Discussion of the four main material classes, their properties, and their applications. Topics include elasticity, plasticity, and continuous material flow, microstructural concerns, advanced material failure mechanisms, materials testing, and design for manufacture.

Prereqs: ME 3410

ME 4990 (s) Directed Study (1-16 credits, max 99)

Credit arranged. Selected topics. Detailed report required.

Prereqs: Senior standing and Permission

ME 4999 Undergraduate Research (1-3 credits, max 6)

Undergraduate research under the guidance of faculty, who identify appropriate projects in collaboration with students. Students are expected to actively engage in their research, document their contributions, and present their findings through a final report and/or presentation. Graded Pass/Fail. Typically Offered: Fall and Spring.

Prereqs: Instructor permission

ME 5000 Master's Research and Thesis (1-16 credits, max 99)

Credit arranged

ME 5010 (s) Seminar (1-16 credits, max 99)

Credit arranged

ME 5020 (s) Directed Study (1-16 credits, max 99)

Credit arranged. Supervised study, including critical reading of current literature.

Prereqs: Permission

ME 5030 (s) Workshop (1-16 credits, max 99)

Credit arranged

ME 5040 (s) Special Topics (1-16 credits, max 99)

Credit arranged

ME 5050 (s) Professional Development (1-16 credits, max 99)

Credit arranged

ME 5130 Engineering Acoustics (3 credits)

Cross-listed with ECE 5790

Joint-listed with ME 4130

Fundamentals of acoustics including wave theory; transmission through layers, generation and reception; low frequency models; application to sound measurement, transducers, loudspeaker cabinet design, and nondestructive testing; acoustic design project required. Additional projects/assignments required for graduate credit.

ME 5140 HVAC Systems (3 credits)

Joint-listed with ME 4140

Application of thermodynamics, heat transfer, and fluid flow to understanding the psychrometric performance of systems and equipment; evaluating the performance characteristics, advantages, and disadvantages of the various types of HVAC systems including large tonnage refrigeration/chiller equipment, cooling coils, cooling towers, ducts, fans, and heat pump systems; economics of system and equipment selection. Cooperative: open to WSU degree-seeking students.

ME 5170 Turbomachinery (3 credits)

Joint-listed with ME 4170

Introduction to the basic principles of modern turbomachinery. Emphasis is placed on steam, gas (combustion), wind and hydraulic turbines.

Applications of the principles of fluid mechanics, thermodynamics and aerodynamics to the design and analysis of turbines and compressors are incorporated. Additional technical research report and presentation required for graduate credit. ME 5170 is cooperative: open to WSU degree-seeking students. Recommended Preparation: ENGR 3200, ENGR 3350. Cooperative: open to WSU degree-seeking students.

ME 5190 Fluid Transients (3 credits)

Development of concepts and modeling techniques for unsteady flow of liquid and gas in piping systems; extensive computer programming used to develop tools for analysis, design, and control of transients. Typically Offered: Varies.

Prereqs: MATH 3100 and ENGR 3350. A minimum grade of C or better is required for all pre/coreqs.

ME 5200 Fluid Dynamics (3 credits)

Cross-listed with CE 5200

Joint-listed with ME 4200

Credit not granted for both ME 4200 and ME 5200. A second fluid dynamics course featuring vector calculus and integral and differential forms of the conservation laws. Topics include fluid properties, fluid statistics, inviscid flow; conservation of mass, momentum, and energy; and turbulence. Other topics may be covered. Additional projects/assignments required for graduate credit.

ME 5240 Sustainable Food-Energy-Water Systems (3 credits)

Cross-listed with BE 5240

This course covers sustainability analysis, life cycle assessment, and applications of sustainability across design and manufacturing processes, as well as food-energy-water systems, which establishes the concept of sustainability, and sustainable engineering. This course introduces the intersection of sustainability and food-energy-water systems through sustainable development, sustainability principles, and environmental analysis. Foundational knowledge in physics, chemistry, calculus, engineering materials; engineering design and manufacturing; foundational knowledge in business operations and supply chain. Typically Offered: Spring.

ME 5250 Advanced Heat Transfer (3 credits)

Study of major chemical and physical principles affecting properties of solid state engineering materials. Topics include bonding, carrier statistics, band-gap engineering, optical and transport properties, novel materials systems, characterization, magnetism, and comprehensive introduction to physics of solid state devices.

Prereqs: Permission Cooperative: open to WSU degree-seeking students.

ME 5270 Thermodynamics (3 credits)

Thermodynamic laws for design and optimization of thermodynamic systems, equations of state, properties of ideal and real fluids and fluid mixtures, stability, phase equilibrium, chemical equilibrium, applications of thermodynamic principles.

Prereqs: ME 3220 or ENGR 3200 or Permission Cooperative: open to WSU degree-seeking students.

ME 5290 Combustion and Aeropropulsion (3 credits)

Joint-listed with ME 4290

Basic concepts related to chemically reacting flows, including thermodynamics, chemical kinetics, and transport processes. Introduction to premixed and non-premixed combustion processes. Description of basic combustion phenomena for non-premixed, premixed flames, and ignition. Oxidation mechanisms for fuels in various combustion processes. Discussion on the formation of pollutants during combustion processes and their subsequent transformations in the atmosphere with an emphasis on the effects of design and operating parameters of combustion devices on the nature and composition of exhaust gases. An introduction to aerospace propulsion concepts, including aircraft jet engine combustors and chemical rocket propellants. Additional projects/assignments are required for graduate credit. Typically Offered: Fall (Odd Years).

ME 5380 Sustainability and Green Design (3 credits)

Joint-listed with ME 4380

Understanding the concept of sustainability; industrial ecology and sustainable engineering, metabolic analysis; sustainable engineering; design for environment and sustainability; life cycle assessment; energy, water, and industrial ecology; the status of resources; and sustainable engineering and economics development. Cooperative: open to WSU degree-seeking students.

ME 5390 Advanced Mechanics of Materials (3 credits)

Joint-listed with ME 4390

Limitations of results of elementary mechanics of materials, complex situations of loading and structural geometry, applications to design of machines and structure, introduction to elasticity. Additional projects/assignments are required for graduate credit. Typically Offered: Varies.

ME 5400 Continuum Mechanics (3 credits)

Stress and deformation of continua using tensor analysis; relationship between stress, strain, and strain rates in fluids and solids; applications.

Prereqs: Permission Cooperative: open to WSU degree-seeking students.

ME 5410 Mechanical Engineering Analysis (3 credits)

Mathematical modeling and solutions to mechanical engineering problems; analytical solutions to linear heat and mass diffusion, waves and vibrations; introduction to approximate techniques.

Prereqs: MATH 3300 and MATH 3100 or Equivalent Cooperative: open to WSU degree-seeking students.

ME 5422 Introduction to Aircraft Design (3 credits)

Joint-listed with ME 4422

Aircraft conceptual design, focused on industry practice, including discussion of the design process, initial sizing, selection of thrust-to-weight ratio and wing loading, configuration layout, propulsion integration, systems integration, performance optimization, and trade-off studies. For graduate credit, students will be required to complete an additional class project and a final presentation. Typically Offered: Spring.

ME 5440 Conduction Heat Transfer (3 credits)

Formulation of steady-state and transient one- and multi-dimensional heat conduction problems; analytical solution techniques for linear problems including separation of variables, integral transforms, and Laplace transforms.

Prereqs: ME 3450 or equivalent, or Permission

ME 5460 Convective Heat Transfer (3 credits)

Energy conservation equations; laminar and turbulent forced convective heat transfer; internal and external flow; free convection.

Prereqs: ME 3450 or Permission Cooperative: open to WSU degree-seeking students.

ME 5470 Thermal Radiation Processes (3 credits)

Thermal radiation; radiation interchange among surfaces; radiation in absorbing-emitting gases; combined modes of heat transfer.

Prereqs: ME 3450 or Permission

ME 5490 Finite Element Analysis (3 credits)

Cross-listed with CE 5460

Formulation of theory from basic consideration of mechanics; applications to structural engineering, solid mechanics, soil and rock mechanics; fluid flow.

Prereqs: ME 3410 or CE 3420. A minimum grade of C or better is required for all pre/corequisites. Cooperative: open to WSU degree-seeking students.

ME 5500 Advanced Computational Fluid Dynamics (3 credits)

Introduction to CFD OpenFoam and CFD techniques for heat transfer, free-surface flows, fluid-structure interactions, and dynamic mesh method. Application of CFD through hands-on CFD Labs including OpenFoam solutions to the five canonical flows studied in ME 4500 and ANSYS Multiphysics or OpenFoam solutions to 2D wave generated by a submerged foil, heat transfer through a 2D insulated box, dynamic meshes for two cars crossing each other, and fluid-structure interaction simulation for a flapping membrane. Typically Offered: Spring (Odd Years).

Prereqs: ME 4500 Cooperative: open to WSU degree-seeking students.

ME 5510 Experimental Methods in Fluid Dynamics (3 credits)

Joint-listed with ME 4510

The objective of this course is to develop the knowledge and skills to be able to design and perform fluid dynamics experiments (and experiments in related areas) and to interpret and report the results. Learn the words, the concepts, and experimental skills in areas including dimensional analysis and scaling of experiments, flow visualization, velocity and flow rate measurements, turbulence measurements, and sediment sizing and transport measurements. Additional projects/assignments required for graduate credit. One 1-1/2 hour lecture and one 3-hour lab per week. Recommended Preparation: ENGL 3170 and ENGR 3350

ME 5550 Biomechanics: Genome to Phenome (3 credits)

Joint-listed with ME 4550

The course introduces students to the history and evolution of plant biomechanics with a specific focus on grass species and crops. A multiscale understanding of biomechanical structures and features will be presented. Students will learn appropriate testing methodologies to quantify material properties of plant tissue at multiple scales. Additional work required for graduate credit. Typically Offered: Fall (Odd Years).

ME 5580 Finite Element Applications in Engineering (3 credits)

Joint-listed with ME 4580

The finite element method is an essential tool for the design and research activities performed in engineering companies and academic institutions. The goal of this course is to introduce students to the use of the finite element method by focusing on a range of engineering applications and employing an interactive commercial finite element code. Students will learn how to solve various problems from several mechanical engineering areas including solid mechanics, heat transfer and fluid mechanics. When available, analytical solutions will be compared with the finite element solutions for validation purposes. ME 5580 is cooperative: open to WSU degree seeking students.

Coreqs: ME 3410 or Instructor Permission Cooperative: open to WSU degree-seeking students

ME 5590 Robotic Systems Engineering I (3 credits)

Cross-listed with CS 5553

Joint-listed with CS 4553, ME 4590

Topics to be covered include principles of distributed systems control, interfacing and signal conditioning of sensors and actuators, data acquisition and signal processing, microprocessor-based control, physical modeling, and hardware and software simulation for model validation and control. Typically Offered: Fall and Spring.

ME 5640 Robotic Dynamics, Simulation, and Control (3 credits)

Mathematical analysis of spatial robotics including a review of forward and inverse kinematics and the manipulator Jacobian. Development of robot dynamics via the Lagrangian formulation, numerical simulation, contact modeling, nonlinear and adaptive control, and Lyapunov stability theory.

ME 5660 Compliant Mechanism Design (3 credits)

Joint-listed with ME 4660

Will focus on the design, analysis, and manufacture of compliant mechanisms. Traditional kinematics and elastic deflections will be reviewed, and the area of large-deflection analysis will be introduced. The compliant mechanism theory will be introduced and applied. Additional coursework required for graduate credit. Typically Offered: Fall.

Coreqs: ME 3250 Cooperative: open to WSU degree-seeking students

ME 5690 Heat Exchanger Design (3 credits)

Cross-listed with NE 5240

This course will cover advanced heat exchanger design and apply that knowledge to the design of the following heat exchangers: tube-in-tube heat exchanger, air cooler, compact heat exchanger, feedwater heater, and condenser. Typically Offered: Spring.

Prereqs: Permission

ME 5710 Building Performance Simulation for Integrated Design (3 credits)

Cross-listed with ARCH 5740

This course focuses on design decisions that impact energy, thermal, visual and acoustic comfort with a strong emphasis on building simulation tools. This course provides students with the understanding of the nature of building thermal comfort, building envelope behavior, ventilation requirements, indoor air quality, passive cooling systems, energy conservation, and the importance of iterative building simulation in achieving high performance buildings.

ME 5800 Linear System Theory (3 credits)

Linear spaces and linear operators; descriptions of dynamic systems; input-output descriptions; state-space concepts; canonical forms; controllability and observability; minimal realizations; application to control and general systems analysis; pole assignment; observers.

Prereqs: ECE 4700 or Equivalent Cooperative: open to WSU degree-seeking students.

ME 5830 Reliability of Engineering Systems (3 credits)

Cross-listed with CE 5470

Fundamentals of reliability theory, system reliability analysis including common-mode failures and fault tree and event tree analysis, time-dependent reliability including testing and maintenance, propagation of uncertainty, human reliability analysis, practical applications in component and system design throughout the semester.

Prereqs: Permission Cooperative: open to WSU degree-seeking students.

ME 5980 (s) Internship (1-16 credits, max 99)

Credits arranged

ME 5990 (s) Non-thesis Master's Research (1-16 credits, max 99)

Credit arranged. Research not directly related to a thesis or dissertation.

Prereqs: Permission

ME 6000 Doctoral Research and Dissertation (1-45 credits, max 99)

Credit arranged