

MECHANICAL ENGINEERING (ME)

ME 206. PROJECTS. (1-16 Credits)

ME 250. INTRODUCTION TO MANUFACTURING PROCESSES. (1 Credit)

Use of measuring and layout tools, interpretation of blueprints and drawings, identification of engineering materials. Operation of machine tools, including calculation of machining parameters. Operation of gas and MIG welding equipment. Lec/lab. Graded P/N.

Prerequisites: ENGR 248 with C or better

ME 299. SPECIAL TOPICS. (1-16 Credits)

Graded P/N.

Equivalent to: ME 299H

This course is repeatable for 16 credits.

ME 299H. SPECIAL STUDIES. (1-16 Credits)

Graded P/N.

Attributes: HNRS – Honors Course Designator

Equivalent to: ME 299

This course is repeatable for 16 credits.

ME 306. PROJECTS. (1-16 Credits)

This course is repeatable for 16 credits.

ME 311. INTRODUCTION TO THERMAL-FLUID SCIENCES. (4 Credits)

Basic concepts of fluid mechanics, thermodynamics and heat transfer are introduced. Conservation of mass, energy, moment and the second law of thermodynamics are included. CROSSLISTED as NSE 311.

Prerequisites: (ENGR 212 with C or better or ENGR 212H with C or better) and (MTH 256 [C] or MTH 256H [C])

Equivalent to: ME 311H, NSE 311, NSE 311H

ME 311H. INTRODUCTION TO THERMAL-FLUID SCIENCES. (4 Credits)

Basic concepts of fluid mechanics, thermodynamics and heat transfer are introduced. Conservation of mass, energy, moment and the second law of thermodynamics are included. CROSSLISTED as NSE 311H.

Attributes: HNRS – Honors Course Designator

Prerequisites: (ENGR 212 with C or better or ENGR 212H with C or better) and (MTH 256 [C] or MTH 256H [C])

Equivalent to: ENGR 311, ENGR 311H, ME 311, NSE 311, NSE 311H

ME 312. THERMODYNAMICS. (4 Credits)

Exergy destruction, machine and cycle processes, law of corresponding states, non-reactive gas mixtures, reactive mixtures, thermodynamics of compressible fluid flow. CROSSLISTED as NSE 312.

Prerequisites: (MTH 256 with C or better or MTH 256H with C or better) and (ME 311 [C] or ME 311H [C] or NSE 311 [C] or NSE 311H [C] or NE 311 [C] or NE 311H [C])

Equivalent to: ME 312H, NSE 312, NSE 312H

ME 312H. THERMODYNAMICS. (4 Credits)

Exergy destruction, machine and cycle processes, law of corresponding states, non-reactive gas mixtures, reactive mixtures, thermodynamics of compressible fluid flow. CROSSLISTED as NSE 312H.

Attributes: HNRS – Honors Course Designator

Prerequisites: (MTH 256 with C or better or MTH 256H with C or better) and (ME 311 [C] or ME 311H [C] or NSE 311 [C] or NSE 311H [C] or NE 311 [C] or NE 311H [C])

Equivalent to: ME 312, NSE 312, NSE 312H

ME 316. MECHANICS OF MATERIALS. (3 Credits)

Determination of stresses, deflections, and stability of deformable bodies with an introduction to finite element analysis.

Prerequisites: (ENGR 213 with C or better or ENGR 213H with C or better) and (MTH 256 [C] or MTH 256H [C])

ME 317. INTERMEDIATE DYNAMICS. (4 Credits)

Continuation of the study of kinematics and kinetics of particles and rigid bodies, with applications to mechanical systems of current interest to engineers.

Prerequisites: (ENGR 212 with C or better or ENGR 212H with C or better) and (MTH 256 [C] or MTH 256H [C])

Equivalent to: ME 317H

ME 317H. INTERMEDIATE DYNAMICS. (4 Credits)

Continuation of the study of kinematics and kinetics of particles and rigid bodies, with applications to mechanical systems of current interest to engineers.

Attributes: HNRS – Honors Course Designator

Prerequisites: ((ENGR 212 with C or better or ENGR 212H with C or better) and (MTH 256 [C] or MTH 256H [C]))

Equivalent to: ME 317

ME 331. INTRODUCTORY FLUID MECHANICS. (4 Credits)

Introduces the concepts and applications of fluid mechanics and dimensional analysis with an emphasis on fluid behavior, internal and external flows, analysis of engineering applications of incompressible pipe systems, and external aerodynamics. CROSSLISTED as NSE 331.

Prerequisites: ((MTH 254 with C or better or MTH 254H with C or better) and (MTH 256 [C] or MTH 256H [C]) and (ENGR 212 [C] or ENGR 212H [C]) and (ENGR 311 [C] or ME 311 [C] or ME 311H [C] or NSE 311 [C] or NSE 311H [C] or NE 311 [C] or NE 311H [C]))

Equivalent to: ME 331H, NSE 331, NSE 331H

ME 331H. INTRODUCTORY FLUID MECHANICS. (4 Credits)

Introduces the concepts and applications of fluid mechanics and dimensional analysis with an emphasis on fluid behavior, internal and external flows, analysis of engineering applications of incompressible pipe systems, and external aerodynamics. CROSSLISTED as NSE 331H.

Attributes: HNRS – Honors Course Designator

Prerequisites: ((MTH 254 with C or better or MTH 254H with C or better) and (MTH 256 [C] or MTH 256H [C]) and (ENGR 212 [C] or ENGR 212H [C]) and (ENGR 311 [C] or ME 311 [C] or ME 311H [C] or NSE 311 [C] or NSE 311H [C] or NE 311 [C] or NE 311H [C]))

Equivalent to: ME 331, NSE 331, NSE 331H

ME 332. HEAT TRANSFER. (4 Credits)

A treatment of conductive, convective and radiative energy transfer using control volume and differential analysis and prediction of transport properties. CROSSLISTED as NSE 332.

Prerequisites: ((MTH 256 with C or better or MTH 256H with C or better) and (ENGR 212 [C] or ENGR 212H [C]) and (ME 311 [C] or ME 311H [C] or NE 311 [C] or NE 311H [C]) and (ME 331 [C] or ME 331H [C] or NSE 331 [C] or NSE 331H [C] or NE 331 [C] or NE 331H [C]))

Equivalent to: ME 332H, NSE 332, NSE 332H

ME 332H. HEAT TRANSFER. (4 Credits)

A treatment of conductive, convective and radiative energy transfer using control volume and differential analysis and prediction of transport properties. CROSSLISTED as NSE 332H.

Attributes: HNRS – Honors Course Designator

Prerequisites: ((MTH 256 with C or better or MTH 256H with C or better) and (ENGR 212 [C] or ENGR 212H [C]) and (ME 311 [C] or ME 311H [C] or NE 311 [C] or NE 311H [C]) and (ME 331 [C] or ME 331H [C] or NSE 331 [C] or NSE 331H [C] or NE 331 [C] or NE 331H [C]))

Equivalent to: ME 332, NSE 332, NSE 332H

ME 348. ADVANCED SOLID MODELING. (1 Credit)

Practical application of graphical communication theory using advanced solid modeling software to capture design intent and generate engineering drawings. Lec/lab. Graded P/N.

Prerequisites: ENGR 248 with C or better

ME 373. MECHANICAL ENGINEERING METHODS. (3 Credits)

Analytical and numerical methods for solving representative mechanical engineering problems. Lec/rec.

Prerequisites: (ENGR 112 with C or better or ENGR 112H with C or better) and (MTH 256 [C] or MTH 256H [C])

Equivalent to: ME 373H

ME 373H. MECHANICAL ENGINEERING METHODS. (3 Credits)

Analytical and numerical methods for solving representative mechanical engineering problems. Lec/rec.

Attributes: HNRS – Honors Course Designator

Prerequisites: (ENGR 112 with C or better or ENGR 112H with C or better) and (MTH 256 [C] or MTH 256H [C])

Equivalent to: ME 373

ME 382. INTRODUCTION TO DESIGN. (4 Credits)

Organization, planning, economics, and the use of creativity and optimization in solving mechanical design problems. Case studies and/or industrial design problems. Lec/lab.

Prerequisites: ENGR 248 with C or better and ME 250 (may be taken concurrently) [C]

Equivalent to: ME 382H

ME 382H. INTRODUCTION TO DESIGN. (4 Credits)

Organization, planning, economics, and the use of creativity and optimization in solving mechanical design problems. Case studies and/or industrial design problems. Lec/lab.

Attributes: HNRS – Honors Course Designator

Prerequisites: ENGR 248 with C or better and ME 250 (may be taken concurrently) [C]

Equivalent to: ME 382

ME 383. MECHANICAL COMPONENT DESIGN. (4 Credits)

Failure analysis and design of machine components. Lec/lab.

Prerequisites: ME 316 with C or better and ME 250 (may be taken concurrently) [C]

Equivalent to: ME 383H

ME 383H. MECHANICAL COMPONENT DESIGN. (4 Credits)

Failure analysis and design of machine components. Lec/lab.

Attributes: HNRS – Honors Course Designator

Prerequisites: ME 316 with C or better and ME 250 (may be taken concurrently) [C]

Equivalent to: ME 383

ME 401. RESEARCH. (1-16 Credits)

This course is repeatable for 9 credits.

ME 403. THESIS. (1-16 Credits)

This course is repeatable for 16 credits.

ME 405. READING AND CONFERENCE. (1-16 Credits)

Equivalent to: ME 405H

This course is repeatable for 9 credits.

ME 405H. READING AND CONFERENCE. (1-16 Credits)

Attributes: HNRS – Honors Course Designator

Equivalent to: ME 405

This course is repeatable for 9 credits.

ME 406. PROJECTS. (1-16 Credits)

This course is repeatable for 15 credits.

ME 407. SEMINAR. (1-16 Credits)

This course is repeatable for 2 credits.

ME 410. INTERNSHIP. (1-16 Credits)

Credits may not apply toward BS degree in Mechanical Engineering. Graded P/N.

This course is repeatable for 16 credits.

ME 411. AEROSPACE APPLICATIONS IN MECHANICAL ENGINEERING. (4 Credits)

Provides students with the fundamentals of mechanical engineering applications to aerospace. Topics covered include an overview of modern aircraft and spacecraft analysis, with an emphasis on performance, stability, structures, materials, FAA and FAR standards and current professional practices in the conceptual design of aerospace vehicles. Student projects will integrate course topics.

Prerequisites: (ME 316 with C or better and (ME 317 [C] or ME 317H [C]) and (ME 331 [C] or ME 331H [C]) and (ME 373 [C] or ME 373H [C]))

ME 412. DESIGN OF MECHANISMS. (4 Credits)

Analysis and study of the function, classification, position, velocity, and acceleration of multi-element mechanical linkages and mechanisms. Synthesis of mechanisms for specified multiple point paths, quick return, dwell, and straight-line motion. The lecture will instruct students in the kinematic analysis and synthesis of mechanisms through the use of theory and software packages. The laboratory will familiarize students with a modern mechanism design and animation software package. Lec/lab.

Prerequisites: (ME 317 with C or better or ME 317H with C or better) and ME 383 [C]

ME 413. COMPUTER-AIDED DESIGN AND MANUFACTURING. (4 Credits)

Introduces students to the use of computers in several extended areas of product design and manufacturing. These areas include product data management in a sustaining engineering environment; computer-aided manufacturing (CAM) and computer numerical control (CNC) operations and technology; the use of programmable logic controllers (PLCs) for industrial control systems; and the use of simulation software for virtual prototyping for Design/Manufacturing/Validation. Lec/lab.

Prerequisites: ME 382 with C or better or ME 382H with C or better or IE 366 with C or better

ME 420. APPLIED STRESS ANALYSIS. (4 Credits)

Elasticity theory, failure theories, energy methods, finite element analysis.

Prerequisites: ME 316 with C or better

ME 422. MECHANICAL VIBRATIONS. (4 Credits)

Dynamic response of single and multiple degree-of-freedom systems.

Prerequisites: ME 317 with C or better or ME 317H with C or better

Equivalent to: ME 422H

ME 422H. MECHANICAL VIBRATIONS. (4 Credits)

Dynamic response of single and multiple degree-of-freedom systems.

Attributes: HNRS – Honors Course Designator

Prerequisites: ME 317 with C or better or ME 317H with C or better

Equivalent to: ME 422

ME 424. FINITE ELEMENT MODELING OF MECHANICAL ENGINEERING SYSTEMS. (3 Credits)

Application of modern finite element code in the analysis of complex mechanical engineering systems. Extensive use of engineering workstations. Lec/lab.

Prerequisites: ME 420 with C or better or ME 520 with C or better

ME 430. SYSTEMS DYNAMICS AND CONTROL. (4 Credits)

Modeling and analysis of linear continuous systems in time and frequency domains. Fundamentals of single-input-single-output control system design. CROSSLISTED as ECE 451.

Prerequisites: (ME 317 with C or better or ME 317H with C or better or (ECE 351 with C or better and ECE 352 [C] and (ENGR 212 [C] or ENGR 212H [C])))

Equivalent to: ECE 451, ME 430H

ME 430H. SYSTEMS DYNAMICS AND CONTROL. (4 Credits)

Modeling and analysis of linear continuous systems in time and frequency domains. Fundamentals of single-input-single-output control system design. CROSSLISTED as ECE 451.

Attributes: HNRS – Honors Course Designator

Prerequisites: (ME 317 with C or better or ME 317H with C or better or (ECE 351 with C or better and ECE 352 [C] and (ENGR 212 [C] or ENGR 212H [C])))

Equivalent to: ECE 451, ME 430

ME 443. RENEWABLE ENERGY: THERMAL FLUID SYSTEMS. (4 Credits)

Evaluates several thermal/fluid power conversion strategies that deal with both thermal and fluid energy sources in terms of basic conversion technology, resource potential and developmental challenges. There are four modules, each targeting a particular renewable energy system in thermal and fluid sciences.

Prerequisites: (ME 311 with C or better or ME 311H with C or better or NE 311 with C or better or NE 311H with C or better) and (ME 331 [C] or ME 331H [C] or NE 331 [C] or NE 331H [C]) and (ME 332 [C] or ME 332H [C] or NE 332 [C] or NE 332H [C])

ME 444. THERMAL SYSTEMS DESIGN AND ANALYSIS. (4 Credits)

Integration of the concepts, laws, and methodologies from fluid mechanics, heat transfer, and thermodynamics, into a set of practical tools for thermal energy systems design and analysis.

Prerequisites: (ME 332 with C or better or ME 332H with C or better or NSE 332 with C or better or NSE 332H with C or better) and (ME 312 (may be taken concurrently) [C] or ME 312H (may be taken concurrently) [C] or NSE 312 (may be taken concurrently) [C] or NSE 312H (may be taken concurrently) [C])

ME 445. INTRODUCTION TO COMBUSTION. (4 Credits)

Study of combustion science based on the background of chemistry, thermodynamics, fluid mechanics, heat and mass transfer. Stoichiometry, energetics of chemical reactions, flame temperature, equilibrium product analyses, chemical kinetics, and chain reactions.

Prerequisites: (ME 312 with C or better or ME 312H with C or better) and (ME 332 [C] or ME 332H [C])

ME 450. APPLIED HEAT TRANSFER. (4 Credits)

An intermediate heat transfer course seeking to lay a foundation for determining the heating and cooling characteristics with a variety of modern and classical processes. Included is design of multi-component heat transfer systems. Lecture, 110 minutes twice per week.

Prerequisites: ME 332 with C or better or ME 332H with C or better

ME 451. INTRODUCTION TO INSTRUMENTATION AND MEASUREMENT SYSTEMS. (4 Credits)

Function, operation, and application of common mechanical engineering instruments, measurement principles, and statistical analysis. Major elements of measurement systems, including transduction, signal conditioning, and data recording. Function and operation of digital data acquisition systems. Lec/lab.

Prerequisites: (ENGR 202 with C or better or ENGR 202H with C or better) and (ME 311 [C] or ME 311H [C]) and ME 316 [C] and (ME 317 [C] or ME 317H [C]) and (ME 373 [C] or ME 373H [C]) and (ST 314 [C] or ST 314H [C])

ME 452. THERMAL AND FLUIDS SCIENCES LABORATORY. (4 Credits)

Course emphasis is on experiments related to thermodynamics, heat transfer, and fluid mechanics. Proper experimental methods, data and uncertainty analysis related to thermal and fluids measurements are discussed.

Prerequisites: (ME 311 with C or better or ME 311H with C or better) and (ME 331 [C] or ME 331H [C]) and (ME 332 [C] or ME 332H [C])

Equivalent to: ME 452H

ME 452H. THERMAL AND FLUIDS SCIENCES LABORATORY. (4 Credits)

Course emphasis is on experiments related to thermodynamics, heat transfer, and fluid mechanics. Proper experimental methods, data and uncertainty analysis related to thermal and fluids measurements are discussed.

Attributes: HNRS – Honors Course Designator

Prerequisites: (ME 311 with C or better or ME 311H with C or better) and (ME 331 [C] or ME 331H [C]) and (ME 332 [C] or ME 332H [C])

Equivalent to: ME 452

ME 453. STRUCTURE AND MECHANICS LABORATORY. (4 Credits)

Techniques for measurement of structural response and material properties. Proper use of rosette strain gauges, load cells, and displacement transducers. Full-field strain measurement using photoelasticity and digital image correlation. Proper implementation of material testing standards. Characterization of anisotropic composite materials.

Prerequisites: ME 451 with C or better

ME 460. INTERMEDIATE FLUID MECHANICS. (4 Credits)

Ideal fluid flow including potential flow theory. Introduction to compressible flow. Viscous flow and boundary layer theory. Introduction to turbulence.

Prerequisites: ME 331 with C or better or ME 331H with C or better

ME 461. GAS DYNAMICS. (4 Credits)

Studies one-dimensional isentropic flow, nozzles, diffusers, normal and oblique shocks, compressible flow with friction and heating, and an introduction to propulsion systems.

Prerequisites: (ME 312 with C or better or ME 312H with C or better) and (ME 331 [C] or ME 331H [C])

ME 480. MATERIALS SELECTION. (3 Credits)

Selecting materials for engineering applications. The major families of materials, their properties, and how their properties are controlled; case studies and design projects emphasizing materials selection.

Prerequisites: MATS 322 with C or better or ENGR 322 with C or better

ME 484. FRACTURE OF MATERIALS. (3 Credits)

Fracture mechanics and fatigue mechanisms: mechanisms of ductile and brittle fracture. Environmentally induced fracture and fatigue. Considerations in design of engineering materials and structures will be discussed.

Prerequisites: MATS 322 with C or better or ENGR 322 with C or better

ME 497. ^MIME CAPSTONE DESIGN. (4 Credits)

Product design; selection and replacement of major tools, processes, and equipment; paperwork controls; subsystem revision; system or plant revision; selection and training of personnel; long-run policies and strategy. CROSSLISTED as ESE 497 and IE 497. (Writing Intensive Course)

Attributes: CWIC – Core, Skills, WIC

Prerequisites: ((IE 355 with C or better and IE 356 [C] and IE 366 [C] and IE 367 [C] and IE 368 [C] and WR 327 [C])) or ((ENGR 322 [C] or MATS 322 [C]) and (ENGR 391 [C] or ENGR 391H [C]) and ME 250 [C] and (ME 312 [C] or ME 312H [C]) and (ME 317 [C] or ME 317H [C]) and (ME 383 [C] or ME 383H [C]) and WR 327 [C] and (ST 314 [C] or ST 314H [C])) or ((ENGR 390 [C] or BA 360 [C]) and IE 425 [C] and (ME 312 [C] or ME 312H [C]) and (ME 331 [C] or ME 331H [C]) and ESE 355 [C] and ESE 360 [C] and WR 327 [C] and (ST 314 [C] or ST 314H [C]))

Equivalent to: ESE 497, IE 497

ME 498. ^MIME CAPSTONE DESIGN. (4 Credits)

Product design; selection and replacement of major tools, processes, and equipment; paperwork controls; subsystem revision; system or plant revision; selection and training of personnel; long-run policies and strategy. CROSSLISTED as ESE 498 and IE 498. (Writing Intensive Course)

Attributes: CWIC – Core, Skills, WIC

Prerequisites: ESE 497 with C or better or IE 497 with C or better or ME 497 with C or better

Equivalent to: ESE 498, IE 498

ME 499. SPECIAL TOPICS. (0-16 Credits)

Equivalent to: ME 499H

This course is repeatable for 16 credits.

ME 499H. SPECIAL TOPICS. (0-16 Credits)

Attributes: HNRS – Honors Course Designator

Equivalent to: ME 499

This course is repeatable for 16 credits.

ME 501. RESEARCH. (1-16 Credits)

This course is repeatable for 16 credits.

ME 502. INDEPENDENT STUDIES. (1-16 Credits)

This course is repeatable for 16 credits.

ME 503. THESIS. (1-16 Credits)

This course is repeatable for 999 credits.

ME 505. READING AND CONFERENCE. (1-16 Credits)

This course is repeatable for 16 credits.

ME 506. PROJECTS. (1-16 Credits)

Graded P/N.

This course is repeatable for 16 credits.

ME 507. SEMINAR. (1-16 Credits)

This course is repeatable for 16 credits.

ME 508. THERMAL FLUID SCIENCE SEMINAR. (1 Credit)

Student participation seminar experience for 1 course credit. Students will present and listen to seminars concerning ongoing research within the thermal fluid sciences.

ME 509. MATERIALS SCIENCE SEMINAR. (1 Credit)

Student participation seminar experience for one credit; students will listen to seminars concerning ongoing research activities within materials science. Students will also have the opportunity to present their own research results periodically. Graded P/N. CROSSLISTED as MATS 509.

Equivalent to: MATS 509

ME 511. PRECISION MACHINE DESIGN. (3 Credits)

Tolerance analysis and application in design/manufacturing practice, principles of machine design and computational analysis of errors in machine design, sensor mounting and sensor calibration, machine level error budget with geometric and thermal errors, structural design of joints and supports, deterministic damping, exact constraint design for flexures and couplings, bearing systems design, motion and power system design for machine tools. CROSSLISTED as MFGE 511.

Equivalent to: MFGE 511

ME 512. DESIGN OF MECHANISMS. (4 Credits)

Analysis and study of the function, classification, position, velocity, and acceleration of multi-element mechanical linkages and mechanisms. Synthesis of mechanisms for specified multiple point paths, quick return, dwell, and straight-line motion. The lecture will instruct students in the kinematic analysis and synthesis of mechanisms through the use of theory and software packages. The laboratory will familiarize students with a modern mechanism design and animation software package. Lec/lab.

ME 513. BIO-INSPIRED DESIGN. (4 Credits)

Intersection of design and biology that seeks to systematically mine biological knowledge to solve design problems. Investigates inspiration from nature from three different types: visual, conceptual, and computational. Includes design rules, heuristics, principles or patterns to solve engineering problems. Algorithmic bio-inspiration emulates natural algorithms for control or optimization problems.

ME 515. RISK AND RELIABILITY ANALYSIS IN ENGINEERING DESIGN. (4 Credits)

Fundamentals of risk, uncertainty, and reliability. Methods to analyze and quantify the risk of failures, and the reliability of complex systems, including fault tree analysis, reliability block diagrams, probabilistic risk assessment. Introduction to research methods for risk and reliability analysis during the early design stages.

ME 516. MODELING AND ANALYSIS OF COMPLEX SYSTEMS. (4 Credits)

Introduction to challenges and considerations when designing complex systems. Fundamentals of systems engineering and methods used in practice. Models and tools used to enable the use of models for trade studies during the design of complex systems. Model-based design environments and methodologies. Introduction to decision support tools in design.

ME 517. OPTIMIZATION IN DESIGN. (4 Credits)

Optimization methods as applied to engineering design, theory and application of nonlinear optimization techniques for multivariate unconstrained and constrained problems. Model boundedness and sensitivity.

ME 519. SELECTED TOPICS IN DESIGN. (3-4 Credits)

Topics in mechanical design selected from the following: design processes, quality engineering, design for assembly, statistical machine design, the Tagucchi method, and parametric design.

This course is repeatable for 32 credits.

ME 520. APPLIED STRESS ANALYSIS. (4 Credits)

Elasticity theory, failure theories, energy methods, finite element analysis.

ME 521. LINEAR ELASTICITY. (4 Credits)

A general introduction to the theory of elasticity. The solution of 2-D problems using the Airy stress function in rectangular and polar coordinates. The solution of 3-D problems using the Galerkin vector, the Papkovitch-Neuber solution, and complex variable methods. Applications to asymptotic fields at discontinuities, contact and crack problems, and thermoelasticity.

ME 522. MECHANICAL VIBRATIONS. (4 Credits)

Dynamic response of single and multiple degree-of-freedom systems.

ME 523. ADVANCED STRESS ANALYSIS. (4 Credits)

An introduction to the mechanics of nonlinear elastic, plastic, and viscoelastic material behavior including large deformations.

ME 524. FINITE ELEMENT MODELING OF MECHANICAL ENGINEERING SYSTEMS. (3 Credits)

Application of modern finite element code in the analysis of complex mechanical engineering systems. Extensive use of engineering workstations. Lec/lab.

Prerequisites: ME 520 with C or better

ME 526. NUMERICAL METHODS FOR ENGINEERING ANALYSIS. (3 Credits)

Numerical solutions of linear equations, difference equations, ordinary and partial differential equations. CROSSLISTED as NSE 526.

Equivalent to: NSE 526

ME 529. SELECTED TOPICS IN SOLID MECHANICS. (3-4 Credits)

Advanced topics in solid mechanics emphasizing research applications of current interest.

This course is repeatable for 32 credits.

ME 531. LINEAR MULTIVARIABLE CONTROL SYSTEMS I. (4 Credits)

Theoretical design of control systems for systems modeled by linear multivariable differential equations. Topics covered include controllability, observability, state feedback control, pole placement, output feedback, estimator design, and control designs that include both estimators and regulators.

ME 532. LINEAR MULTIVARIABLE CONTROL SYSTEMS II. (4 Credits)

Focuses on designing control systems where the device to be controlled is an uncertain system, yet can be described by a set of linear differential equations. Lec.

Prerequisites: ME 531 with C or better

ME 533. NONLINEAR DYNAMIC ANALYSIS. (4 Credits)

Course focuses on understanding the behavior of nonlinear dynamic systems of interest to mechanical engineers. Lec.

ME 534. NONLINEAR MULTIVARIABLE CONTROL SYSTEMS. (4 Credits)

Focuses on designing control systems when the device to be controlled is mathematically described by a nonlinear set of differential equations. Lec.

Prerequisites: ME 533 with C or better

ME 539. SELECTED TOPICS IN DYNAMICS. (1-16 Credits)

Advanced topics in dynamics emphasizing research applications of current interest.

This course is repeatable for 30 credits.

ME 540. INTERMEDIATE THERMODYNAMICS. (4 Credits)

Students are expected to master classical thermodynamics by way of solving extended problems using software tools. Statistical thermodynamics concepts are also introduced and exercised.

ME 541. LIQUID-VAPOR PHASE CHANGE AND HEAT TRANSFER. (4 Credits)

Advanced treatment of underlying physics and engineering modeling approaches for heat transfer associated with vapor/liquid phase change processes. Topics include thermodynamics and mechanical aspects of phase change processes, pool boiling, filmwise and dropwise condensation, internal convective boiling and condensation, and other emerging areas in phase change heat transfer.

ME 543. RENEWABLE ENERGY: THERMAL FLUID SYSTEMS. (4 Credits)

Evaluates several thermal/fluid power conversion strategies that deal with both thermal and fluid energy sources in terms of basic conversion technology, resource potential and developmental challenges. There are four modules, each targeting a particular renewable energy system in thermal and fluid sciences.

ME 544. ADVANCED POWER GENERATION SYSTEMS. (4 Credits)

Thermal mechanical evaluation of modern power generation technologies, including fossil and nuclear Rankine cycle power plants, gas turbines, cogeneration power plants, distributed power generation and fuel cells. Lec/rec.

ME 545. INTRODUCTION TO COMBUSTION. (4 Credits)

Study of combustion science based on the background of chemistry, thermodynamics, fluid mechanics, heat and mass transfer. Stoichiometry, energetics of chemical reactions, flame temperature, equilibrium product analyses, chemical kinetics, and chain reactions.

ME 546. CONVECTION HEAT TRANSFER. (3 Credits)

An advanced treatment of forced and natural convection heat transfer processes emphasizing underlying physical phenomena. Current topical literature will be considered; analytical and numerical problem solving is included.

ME 547. CONDUCTIVE HEAT TRANSFER. (3 Credits)

Analytical and numerical solutions to steady state and transient conduction problems.

ME 548. RADIATION HEAT TRANSFER. (3 Credits)

Analytical and numerical methods of solution of thermal radiation problems.

ME 549. SELECTED TOPICS IN HEAT TRANSFER. (3 Credits)

Topics in heat transfer including advanced problems in conduction, radiation, and convection. Additional examination of heat transfer in multiphase systems, inverse problems, combined modes, equipment design, solution techniques and other topics of current interest considered, including extensive use of current literature. Not all topics covered each year.

This course is repeatable for 9 credits.

ME 550. APPLIED HEAT TRANSFER. (4 Credits)

An intermediate heat transfer course seeking to lay a foundation for determining the heating and cooling characteristics with a variety of modern and classical processes. Included is design of multi-component heat transfer systems. Lecture, 110 minutes twice per week.

ME 552. MEASUREMENTS IN FLUID MECHANICS AND HEAT TRANSFER. (4 Credits)

Course emphasis is on measurement techniques and data analysis methods related to fluid mechanics and heat transfer. Proper experimental methods, data and uncertainty analyses related to thermal and fluids measurements are discussed. Local and spatial mapping of fluid and thermal fields are highlighted.

ME 553. STRUCTURE AND MECHANICS LABORATORY. (4 Credits)

Techniques for measurement of structural response and material properties. Proper use of rosette strain gauges, load cells, and displacement transducers. Full-field strain measurement using photoelasticity and digital image correlation. Proper implementation of material testing standards. Characterization of anisotropic composite materials.

ME 560. INTERMEDIATE FLUID MECHANICS. (4 Credits)

Ideal fluid flow including potential flow theory. Introduction to compressible flow. Viscous flow and boundary layer theory. Introduction to turbulence.

ME 561. GAS DYNAMICS. (4 Credits)

Studies one-dimensional isentropic flow, nozzles, diffusers, normal and oblique shocks, compressible flow with friction and heating, and an introduction to propulsion systems.

ME 564. TURBULENCE MODELING. (3 Credits)

An introductory course on theory of different turbulence modeling techniques such as Reynolds Averaged Navier Stokes (RANS), Large Eddy Simulation (LES), and Direct Numerical Simulation (DNS) applied to a range of turbulent flows including free shear flows, boundary layers, and internal flows.

Prerequisites: ME 560 with C or better and (ME 565 [C] or ME 566 [C])

ME 565. INCOMPRESSIBLE FLUID MECHANICS. (3 Credits)

Generalized fluid mechanics; kinematics; methods of description, geometry of the vector field, dynamics of nonviscous fluids, potential motion, two-dimensional potential flow with vorticity.

ME 566. VISCOUS FLOW. (3 Credits)

Boundary layer, stability, transition prediction methods, computational methods in fluid mechanics, recent developments.

ME 567. ENGINEERING APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS. (4 Credits)

Basic concepts of computational fluid dynamics, a technique used for solving fully three-dimensional fluid flow problems with no exact solution, will be discussed and applied to general engineering applications using commercially available software. Lec.

ME 568. TURBULENT FLOW DYNAMICS. (4 Credits)

An introductory course of the basic physics of turbulent flows, coverage will include statistical methods and physical interpretation of a range of flows including boundary layer flows, internal flows, and environmental flows.

Prerequisites: ME 560 with C or better

ME 569. SELECTED TOPICS IN FLUID MECHANICS. (2-4 Credits)

Topics in fluid mechanics emphasizing research applications of current interest.

This course is repeatable for 32 credits.

ME 570. STRUCTURE-PROPERTY RELATIONS IN MATERIALS. (4 Credits)

Fundamentals of the interactions between the structure and properties of materials. Atomic bonding and atom interactions. Geometric and algebraic representations of symmetry. Introduction to phase equilibria. Phenomenological background of elasticity and plasticity in materials. Anisotropic materials and tensor representations. Influence of structure on thermal, electrical, and optical properties of materials. CROSSLISTED as MATS 570.

Equivalent to: MATS 570

ME 580. MATERIALS SELECTION. (3 Credits)

Selecting materials for engineering applications. The major families of materials, their properties, and how their properties are controlled; case studies and design projects emphasizing materials selection. Lec/lab.

ME 583. COMPOSITE MATERIALS. (3 Credits)

Fibers and matrices, mechanics of composites, reinforcement and failure mechanisms, properties and applications. Lec/lab.

ME 584. ADVANCED FRACTURE OF MATERIALS. (4 Credits)

Fracture mechanics will be used as a basis for predicting failure of materials, understanding failure mechanisms, and identifying causes of failure. Course will include discussion of recent journal articles, experimental demonstrations, and analysis of real fracture data.

CROSSLISTED as MATS 584.

Equivalent to: MATS 584

ME 585. FATIGUE OF MATERIALS. (4 Credits)

Analyzes the failure of materials by fatigue including how fatigue behavior is characterized, how fatigue failure is predicted, the physical mechanisms responsible for fatigue failure of various materials, and how such behavior is related to the atomic structure and microstructure of the material.

Prerequisites: ME 570 with C or better or MATS 570 with C or better

ME 588. COMPUTATIONAL METHODS IN MATERIALS SCIENCE. (4 Credits)

A broad introduction to important materials science simulation methods. These include molecular dynamics, density functional theory, and Monte Carlo methods. Learning is through a mixture of lecture and hands-on lab projects in which students use computational methods to explore and reinforce fundamental concepts in materials science. Lec/lab.

CROSSLISTED as MATS 588.

Equivalent to: MATS 588

ME 589. SELECTED TOPICS IN MATERIALS. (3 Credits)

Topics in materials science to correspond to areas of graduate research. Topics will be chosen from the following list: optical materials, dielectrics, oxidation and corrosion, ceramics, thermophysical properties, polymers and viscoelasticity, coatings and thin films. Lec/rec.

This course is repeatable for 32 credits.

ME 596. SELECTED TOPICS IN THERMODYNAMICS. (3 Credits)

Topics in thermodynamics including advanced problems in classical thermodynamics and statistical thermodynamics of current interest.

Topics will likely be considered, including extensive use of literature. Not all topics covered each year.

This course is repeatable for 32 credits.

ME 597. PRECISION MOTION GENERATION. (4 Credits)

Introduces fundamental knowledge in mechatronic systems used in manufacturing equipment such as CNC machine tools, and their computer numerical controls. Students will be exposed to sensors and actuators utilized in machine tools, industrial robots and for process automation. Fundamental knowledge to model and identify dynamics of motion delivery systems, design and analysis of accurate position control algorithms for precision motion generation will be covered. Digital motion control design will be introduced. Motion planning and real-time path interpolation algorithms will be covered. Students will be able to design NC systems for 2D motion platforms.

ME 599. SPECIAL TOPICS. (0-16 Credits)

This course is repeatable for 32 credits.

ME 601. RESEARCH. (1-16 Credits)

This course is repeatable for 16 credits.

ME 603. THESIS. (1-16 Credits)

This course is repeatable for 999 credits.

ME 605. READING AND CONFERENCE. (1-16 Credits)

This course is repeatable for 16 credits.

ME 606. PROJECTS. (1-16 Credits)

This course is repeatable for 16 credits.

ME 607. SEMINAR. (1-16 Credits)

This course is repeatable for 16 credits.

ME 611. MODERN PRODUCT DESIGN. (4 Credits)

Modern product development, design and prototyping are covered. Product development and prototyping is examined from a research standpoint in this course. Customer outcomes gathering, functional modeling, product architecture, modern techniques for concept generation and selection are explored. Also covered are recently developed theories and techniques for prototyping. The topics' place in the overall design process is shown through a product development and prototyping project.

ME 613. SUSTAINABLE PRODUCT DESIGN. (4 Credits)

Graduate students will work in multidisciplinary design teams to develop innovative and environmentally friendly products. Combining the principles of integrated product development and sustainable design thinking, students will (a) advance their knowledge of the design process by creating a patent-quality new product, (b) learn and employ environmentally-minded design theory and methods, including various software packages and online tools, and (c) further enhance team-working skills by working collaboratively in a professional design team. Sustainable Product Development is conducted as a collaborative design experience, in that lectures, discussion, and team working time will be integrated into class sessions.

ME 615. DESIGN UNDER UNCERTAINTY. (4 Credits)

Tackles the problem of decision making in engineering design. The fundamental challenge faced in making decisions in engineering designs is that they are almost exclusively decisions made under uncertainty. Sources of uncertainty could result from engineering models, experiments conducted, or lack of knowledge of future events. The course will cover three basic topics 1) how do we quantify uncertainty, 2) how do we account for the uncertainty in decision making, and 3) how do we make design selection decisions about products or systems we design.

Prerequisites: ME 517 with C or better

ME 617. DESIGN AUTOMATION. (4 Credits)

Design automation is the field of study whereby advanced numerical methods are used to automate difficult or tedious design decisions. Typically, such methods are based on numerical optimization and artificial intelligence. They work in tandem with other engineering digital tools like computer-aided design, computer-aided manufacturing, and finite-element analysis. This course builds upon a fundamental understanding of optimization to introduce students to a range of different techniques that may be used to support engineering decision-making. This includes heuristic methods, AI tree-search, discrete and stochastic algorithms. The course concludes with discussion of recent innovations in multi-objective, multi-disciplinary and robust optimization.

Prerequisites: ME 517 with C or better

ME 667. COMPUTATIONAL FLUID DYNAMICS. (3 Credits)

Application of modern computational techniques to solve a wide variety of fluid dynamics problems including both potential and viscous flow with requirements for computer code development.

Prerequisites: (ME 560 with C or better or ME 565 with C or better or ME 566 with C or better) and (ME 526 [C] or ME 575 [C])