Mechanical Engineering (M E)

Courses primarily for undergraduates:

(2-2) Cr. 3. F.S. Prereq: M E majors only. MATH 142 or satisfactory scores on Mathematics placement examinations; credit or enrollment in MATH 165. Introduction to the field of Mechanical Engineering through problem-solving in a range of topics including statics, mechanics of materials and thermo-fluids. Techniques to professionally present and communicate solutions. Use of MATLAB computer programming to aid problem solving, including curve fitting and graphing. Only one of M E 160, ENGR 160, C E 160, CPR E 185, E E 185, S E 185 and I E 148 may count towards graduation.

(2-2) Cr. 3. F.S. Prereq: Satisfactory scores on mathematics placement assessments; credit or enrollment in MATH 142 Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

M E 190. Learning Communities.
(1-0) Cr. 1. Repeatable. F.S.
Enrollment in M E learning communities.

(1-0) Cr. R. F.S. Prereq: Sophomore classification
Preparation for a career in mechanical engineering; discussion of opportunities for leadership, undergraduate research, experiential learning.

M E 220. Global Sustainability.
(Cross-listed with ANTHR, ENV S, GLOBE, MAT E, SOC, T SC); (3-0) Cr. 3. F.S.
An introduction to the key global issues in sustainability. Focuses on interconnected roles of energy, materials, human resources, economics, and technology in building and maintaining sustainable systems. Applications discussed will include challenges in both the developed and developing world and will examine the role of technology in a resource-constrained world. Cannot be used for technical elective credit in any engineering department. Meets International Perspectives Requirement.

M E 231. Engineering Thermodynamics I.
(3-0) Cr. 3. F.S.SS. Prereq: MATH 265, CHEM 167, PHYS 222 Fundamental concepts based on zeroth, first and second laws of thermodynamics. Properties and processes for ideal gases and solid-liquid-vapor phases of pure substances. Applications to vapor power cycles. Credit for either M E 231 or 330, but not both. may be applied toward graduation.

M E 270. Introduction to Mechanical Engineering Design.
(1-6) Cr. 3. F.S. Prereq: M E 160 or equivalent, M E 170 or equivalent, PHYS 221 Overview of mechanical engineering design with applications to thermal and mechanical systems. Introduction to current design practices used in industry. Semester-long team project focused on addressing societal needs. Past projects include designing human powered charging systems and products for developing nations.

M E 298. Cooperative Education.
Cr. R. F.S.SS. Prereq: Permission of department
First professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 324. Manufacturing Engineering.
(3-0) Cr. 3. F.S.SS. Prereq: M E 270, E M 324, MAT E 273 and M E 324L or permission of instructor
Fundamentals of manufacturing processes including forming, machining, casting and welding with emphasis on design considerations in manufacturing. Mechanical behavior of metallic materials. Modern manufacturing practices.

M E 324L. Manufacturing Engineering Laboratory.
(0-2) Cr. 1. F.S.SS. Prereq: M E 270, MAT E 273 Laboratory exercises in metrology, mechanical testing (tensile/compression and hardness tests), computer aided design (CAD), machining operations, metal welding, metal casting, and bulk/sheet metal forming.

M E 325. Mechanical Component Design.
(3-0) Cr. 3. F.S.SS. Prereq: M E 170, E M 324, and STAT 305 Philosophy of design and design methodology. Consideration of stresses and failure models useful for static and fatigue loading. Analysis, selection and synthesis of machine elements.

M E 332. Engineering Thermodynamics II.
(3-0) Cr. 3. F.S.SS. Prereq: M E 231 Gas power cycles. Fundamentals of gas mixtures, psychrometry, and thermochemistry. Applications to one-dimensional compressible flow, refrigeration, air conditioning and combustion processes.

(3-2) Cr. 4. F.S.SS. Prereq: M E 345, MATH 266 or MATH 267, credit or enrollment in M E 332. Incompressible and compressible fluid flow fundamentals. Dimensional analysis and similarity. Internal and external flow applications. Lab experiments emphasizing concepts in thermodynamics and fluid flow. Written reports are required.


M E 396. Summer Internship.
Cr. R. Repeatable. SS. Prereq: Permission of department and Engineering Career Services Summer professional work period.

M E 397. Engineering Internship.
Cr. R. Repeatable. F.S. Prereq: Permission of department and Engineering Career Services Professional work period, one semester maximum per academic year.

M E 398. Cooperative Education.
Cr. R. F.S.SS. Prereq: M E 298, permission of department and Engineering Career Services Second professional work period in the cooperative education program. Students must register for this course before commencing work.

M E 410. Mechanical Engineering Applications of Mechatronics.
(2-2) Cr. 3. S. Prereq: E E 442, E E 448, credit or enrollment in M E 421 Fundamentals of sensor characterization, signal conditioning and motion control, coupled with concepts of embedded computer control. Digital and analog components used for interfacing with computer controlled systems. Mechanical system analysis combined with various control approaches. Focus on automation of hydraulic actuation processes. Laboratory experiences provide hands-on development of mechanical systems.

M E 411. Automatic Controls.
(2-2) Cr. 3. F. Prereq: M E 421 Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.

M E 412. Ethical Responsibilities of a Practicing Engineer.
(3-0) Cr. 3. F. Prereq: Credit or enrollment in M E 325 The study of ethics in engineering design and the engineering profession. A comprehensive look at when ethical decisions must be made and an approach to make them. The approach takes into account moral, legal, technical, experiential, and standards to aid in ethical decision making. Each area will be studied through lectures, debates, guest speakers, class discussion, and case studies.

M E 413. Fluid Power Engineering.
(Cross-listed with A B E); (3-2) Cr. 3. F. Prereq: Credit or enrollment in E M 378 or M E 335, A B E 216 or M E 270 Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions.

M E 415. Mechanical Systems Design.
(0-6) Cr. 3. F.S. Prereq: M E 324, M E 325 Mechanical Engineering Capstone Design course. Team approach to solving design problems involving mechanical systems. Teams will use current design practices they will encounter in industry. Document decisions concerning form and function, material specification, manufacturing methods, safety, cost, and conformance with codes and standards. Solution description includes oral and written reports. Projects often worked with industry sponsors.
ME 417. Advanced Machine Design. (Dual-listed with M E 517). (3-0) Cr. 3. S. Prereq: M E 325, MAT E 273
Stress life, strain life, and fracture mechanics approaches to fatigue life and design with metals, polymers and ceramics. Introduction to material selection in design of machine components. Thermal and structural considerations in design of machine components and hybrid materials. Course project and relevant literature review required for graduate credit.

ME 418. Mechanical Considerations in Robotics. (Dual-listed with M E 518). (3-0) Cr. 3. S. Prereq: Credit or enrollment in M E 421
Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

ME 419. Computer-Aided Design. (3-0) Cr. 3. F. Prereq: M E 325
Theory and applications of computer-aided design. Computer graphics programming, solid modeling, assembly modeling, and finite element modeling. Mechanical simulation, process engineering, rapid prototyping and manufacturing integration.

ME 421. System Dynamics and Control. (3-2) Cr. 4. F.S.SS. Prereq: E E 442, E E 448, E M 345, MATH 267
Modeling and simulation of mechanical, electrical, fluid, and/or thermal systems. Development of equations of motion and dynamic response characteristics in time and frequency domains. Fundamentals of classical control applications, including mathematical analysis and design for closed loop control systems. Introduction to computer interfacing for simulation, data acquisition, and control. Laboratory exercises for hands-on system investigation and control implementation.

ME 423. Creativity and Imagination for Engineering and Design. (Dual-listed with M E 523). (3-0) Cr. 3. F. Prereq: Graduation classification
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

ME 425. Optimization Methods for Complex Designs. (Dual-listed with M E 525). (3-0) Cr. 3. S. Prereq: M E 160, MATH 265
Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.

ME 433. Alternative Energy. (3-0) Cr. 3. F. Prereq: PHYS 221/PHYS 222 and CHEM 167
Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Effects of engine components and operating conditions on performance. Written reports required.

ME 441. Engineering Acoustics. (Cross-listed with E E, E M). (2-2) Cr. 3. Alt. S., offered even-numbered years.
Prereq: PHYS 221 and MATH 268 or MATH 267
Properties of sounds waves and noise metrics (pressure, power levels, etc)

ME 442. Heating and Air Conditioning Design. (3-0) Cr. 3. F. Prereq: M E 335
Heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems.

ME 443. Fundamentals of Heating, Ventilating, and Air Conditioning. (3-0) Cr. 3. F. Prereq: Credit or enrollment in M E 436
Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems.

ME 444. Elements and Performance of Power Plants. (3-0) Cr. 3. S. Prereq: M E 332, credit or enrollment in M E 335
Basic principles, thermodynamics, engineering analysis of power plant systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns.

ME 449. Internal Combustion Engines. (3-1) Cr. 3. F. Prereq: M E 335
Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Effects of engine components and operating conditions on performance. Written reports required.

ME 451. Machine Vision. (Dual-listed with M E 556). Cr. 3. Repeatable. Prereq: MATH 317, M E 421 or permission of instructor
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

ME 466. Multidisciplinary Engineering Design I. (Cross-listed with A B E, AER E, CPR E, E E, ENGR, I E, MAT E). (1-4) Cr. 3.
Repeatable. F.S. Prereq: Student must be within two semesters of graduation and permission of instructor
Application of team design concepts to projects of a multidisciplinary nature. Concurrent treatment of design, manufacturing and life cycle considerations. Application of design tools such as CAD, CAM and FEM. Design methodologies, project scheduling, cost estimating, quality control, manufacturing processes. Development of a prototype and appropriate documentation in the form of written reports, oral presentations, computer models and engineering drawings.

ME 467. Multidisciplinary Engineering Design II. (Cross-listed with AER E, CPR E, E E, ENGR, I E, MAT E). (1-4) Cr. 3.
Repeatable, maximum of 2 times, F.S. Prereq: Student must be within two semesters of graduation or receive permission of instructor.
Build and test of a conceptual design. Detail design, manufacturability, test criteria and procedures. Application of design tools such as CAD and CAM and manufacturing techniques such as rapid prototyping. Development and testing of a full-scale prototype with appropriate documentation in the form of design journals, written reports, oral presentations and computer models and engineering drawings.

ME 475. Modeling and Simulation. (3-0) Cr. 3. S. Prereq: M E 421, credit or enrollment in M E 436
Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite element methods.
M E 479. Sustainability Science for Engineering Design. 
(3-0) Cr. 3. S. Prereq: Any engineering design course. 
Scientific principles and quantitative methods concerning sustainability. Analysis of environmental issues associated with engineering design and product manufacturing in an economic and social context. Heuristic and analytical methods for assessing the sustainability of existing or potential product/service designs. Application to a design problem in teams.

M E 484. Technology, Globalization and Culture. 
(Dual-listed with M E 584), (Cross-listed with WLC). (3-0) Cr. 3. F. Prereq: senior classification for M E 484; graduate classification for M E 584. Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists. 
Meets International Perspectives Requirement.

M E 486. Appropriate Technology Design. 
(3-0) Cr. 3. F. Prereq: M E 231, M E 270, enrollment in M E 335; or permission of instructor. 
Hands-on design experience utilizing knowledge acquired in core mechanical engineering courses. Emphasis with engineering problem formulation and solution, oral and written communication, team decision-making and ethical conduct. Design projects include engineering considerations in appropriate technology which have multidisciplinary components in economics and sociology.

M E 490. Independent Study. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490H. Independent Study: Honors. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490J. Independent Study: Thermodynamics and Energy Utilization. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490M. Independent Study: Nuclear Engineering. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490O. Independent Study: Design and Optimization. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490P. Dynamic Systems and Controls. 
Cr. 1. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490R. Independent Study: Thermo-fluids. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 490S. Independent Study: Emerging Areas. 
Cr. 1-6. Repeatable. Prereq: Senior classification. Investigation of topics holding special interest of students and faculty. Election of course and topic must be approved in advance by supervising faculty.

M E 496. Cooperative Education. 
Cr. R. Repeatable. F.S.SS. Prereq: M E 298, permission of department and Engineering Career Services. Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.

Courses primarily for graduate students, open to qualified undergraduates:

M E 511. Advanced Control Design. 
(3-0) Cr. 3. S. Prereq: M E 411. Application of control design methods using continuous, discrete, and frequency-based models. Approaches include classical, pole assignment, model reference, internal model, and adaptive control methods. Mechanical design projects.

(Dual-listed with M E 417). (3-0) Cr. 3. S. Prereq: M E 325, MAT E 273. Stress life, strain life, and fracture mechanics approaches to fatigue life and design with metals, polymers and ceramics. Introduction to material selection in design of machine components. Thermal and structural considerations in design of machine components and hybrid materials. Course project and relevant literature review required for graduate credit.

M E 518. Mechanical Considerations in Robotics. 
(Dual-listed with M E 418). (3-0) Cr. 3. S. Prereq: Credit or enrollment in M E 421. Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

M E 520. Material and Manufacturing Considerations in Design. 

M E 521. Mechanical Behavior and Manufacturing of Polymers and Composites. 

M E 523. Creativity and Imaginaton for Engineering and Design. 
(Dual-listed with M E 423). (3-0) Cr. 3. F. Prereq: Graduate classification. Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

(Dual-listed with M E 425). (Cross-listed with HCI). (3-0) Cr. 3. S. Prereq: M E 160, MATH 265. Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.


M E 528. Micro/Nanomanufacturing. 
(3-0) Cr. 3. Alt. S., offered even-numbered years. Prereq: M E 324. Concepts and applications of micro/nanotechnology appropriate to the manufacturing field. An overview of micro/nano-fabrication techniques including mechanical, EDM, laser and lithography. MEMS device fabrication. Scaling laws. Top down and bottom up approaches of nanomanufaturing. Experimental or theoretical project leading to potential submission of a manuscript for journal or conference.

M E 530. Advanced Thermodynamics. 
(3-0) Cr. 3. S. Prereq: M E 332. Fundamentals of thermodynamics from the classical viewpoint with emphasis on the use of the first and second laws for analysis of thermal systems. Generalized thermodynamic relationships. Computer applications of thermodynamic properties and system analysis. Selected topics.
Cr. 3. Repeatable. Prereq: any undergraduate thermodynamics course; mathematics through differential equations
Introduction to energy systems including economic and thermodynamic principles. Various production systems will be analyzed. Application to transportation and building systems will be emphasized. Sustainability, climate change and other current energy system topics.

(Cross-listed with AER E). (3-0) Cr. 3. S. Prereq: AER E 310, 311 or equivalent

M E 535. Thermochemical Processing of Biomass.
(Cross-listed with BRT). (3-0) Cr. 3. S. Prereq: Undergraduate course work in thermodynamics and transport phenomena
Introduction to thermal and catalytic processes for the conversion of biomass to biofuels and other biobased products. Topics include gasification, fast pyrolysis, hydrothermal processing, syngas to synfuels, and bio-oil upgrading. Application of thermodynamics, heat transfer, and fluid dynamics to bioenergy and biofuels.

(3-0) Cr. 3. S. Prereq: M E 436
Advanced treatment of heat transmission by conduction, convection, and radiation.

(3-0) Cr. 3. F. Prereq: Credit or enrollment in M E 436
Detailed analysis of incompressible/compressible, viscous/inviscid, laminar/turbulent, and developing fluid flows on a particle-point control volume basis.

(3-0) Cr. 3. S. Prereq: M E 332 or CH E 381

M E 543. Introduction to Random Vibrations and Nonlinear Dynamics.
(Cross-listed with E M). (3-0) Cr. 3. Alt. S., offered odd-numbered years. Prereq: 444
Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

M E 545. Thermal Systems Design.
(3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: M E 436
Integrating thermodynamics, fluid mechanics, and heat transfer to model thermal equipment and to simulate thermal systems. Second law and parametric analysis; cost estimation, life cycle analysis and optimization. Some computer programming required.

(Cross-listed with AER E). (3-0) Cr. 3. F. Prereq: AER E 310 or M E 335, and programming experience

M E 547. Computational Fluid Mechanics and Heat Transfer II.
(Cross-listed with AER E). (3-0) Cr. 3. S. Prereq: AER E 546 or equivalent
Application of computational methods to current problems in fluid mechanics and heat transfer. Methods for solving the Navier-Stokes and reduced equation sets such as the Euler, boundary layer, and parabolized forms of the conservation equations. Introduction to relevant aspects of grid generation and turbulence modeling.

M E 552. Advanced Acoustics.
(Cross-listed with E M). (3-0) Cr. 3. F. Prereq: E M 451
Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; nonlinear acoustics; radiation force; cavitation; and ray acoustics.

(Dual-listed with M E 456). Cr. 3. Repeatable. Prereq: MATH 317, M E 421 or permission of instructor
Broad exposure to the study of creativity, both in scientific research and in engineering design practice. Exploration of the subject includes readings from a variety of fields; in-class discussion and activities; and individual and team projects that enable students to develop their creativity. Graduate students also will do independent research on creativity and develop a related teaching module.

(Cross-listed with COM S, CPR E). (3-0) Cr. 3. F.S. Prereq: M E 421, programming experience in C

M E 561. Scanning Probe Microscopy.
(2-1) Cr. 3. Alt. F., offered even-numbered years. Prereq: First year physics, chemistry
Introduction to the scanning probe microscopy (SPM, also known as atomic force microscope or AFM) and associated measurement techniques. Overview or instrumentation system, basic principles of operation, probe-sample interaction and various operational modes to obtain micro/nanoscale structure and force spectroscopy of material surfaces. Examples of SPM significance and applications in science and engineering research, nanotechnology and other industries. Laboratory work involving use of a scanning probe microscope system is an integral part of the course.

(3-0) Cr. 3. Alt. F., offered odd-numbered years. Prereq: E M 324 and M E 325
Review of Fundamentals: (Elasticity, Electromagnetism, Mechanical response), Mechanics of thermally, electrostatically and magnetically actuated microsystems, Mechanics and design of nanostructured materials, mechanics of surface stress engineering and its implications to sensors and thin film structures.

M E 564. Fracture and Fatigue.
(Cross-listed with AER E, EM M, S E). (3-0) Cr. 3. Alt. F., offered even-numbered years. Prereq: E M 324 and either MAT E 216 or MAT E 273 or MAT E 392.
Undergraduates: Permission of instructor
Materials and mechanics approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

(Cross-listed with AER E, E M). (3-0) Cr. 3. S. Prereq: EM 510 or EM 516 or EM 514

(Cross-listed with AER E, E E). (3-0) Cr. 3. F. Prereq: E E 324 or AER E 331 or M E 370 or M E 411 or MATH 341

M E 574. Optimal Control.
(Cross-listed with AER E, E E). (3-0) Cr. 3. S. Prereq: E E 577

M E 575. Introduction to Robust Control.
(Cross-listed with AER E, E E). (3-0) Cr. 3. Prereq: E E 577
(Cross-listed with AER E, E E). (3-0) Cr. 3. F. Prereq: E E 475 or AER E 432 or M E 411 or MATH 415; and MATH 267  

M E 577. Linear Systems.  
(Cross-listed with AER E, E E, MATH). (3-0) Cr. 3. F. Prereq: E E 324 or AER E 331 or MATH 415; and MATH 207  

(Cross-listed with AER E, E E, MATH). (3-0) Cr. 3. S. Prereq: E E 577  

M E 580. Virtual Environments, Virtual Worlds, and Application.  
(Cross-listed with HCI). (3-0) Cr. 3. F. Prereq: Senior or Graduate status.  
A systematic introduction to the underpinnings of Virtual Environments (VE), Virtual Worlds, advanced displays and immersive technologies; and an overview of some of the applications areas particularly virtual engineering.

M E 584. Technology, Globalization and Culture.  
(Dual-listed with M E 484). (Cross-listed with WLC). (3-0) Cr. 3. F. Prereq: senior classification for M E 484; graduate classification for M E 584  
Cross-disciplinary examination of the present and future impact of globalization with a focus on preparing students for leadership roles in diverse professional, social, and cultural contexts. Facilitate an understanding of the threats and opportunities inherent in the globalization process as they are perceived by practicing professionals and articulated in debates on globalization. Use of a digital forum for presenting and analyzing globalization issues by on-campus and off-campus specialists.  
Meets International Perspectives Requirement.

M E 590. Special Topics.  
Cr. 1-8. Repeatable.

M E 590Q. Special Topics: Independent Literature Investigation.  
Cr. 1-8. Repeatable.

M E 590T. Special Topics: Biological and Nanoscale Sciences.  
Cr. 1-8. Repeatable.

M E 590U. Special Topics: Complex Fluid Systems.  
Cr. 1-8. Repeatable.

M E 590V. Special Topics: Clean Energy Technologies.  
Cr. 1-8. Repeatable.

M E 590W. Special Topics: Design and Manufacturing Innovation.  
Cr. 1-8. Repeatable.

M E 590Z. Special Topics: Simulation and Visualization.  
Cr. 1-8. Repeatable.

M E 599. Creative Component.  
Cr. arr. Repeatable.

Courses for graduate students:

M E 600. Seminar.  
Cr. R. Repeatable.  
(1-0).

M E 625. Surface Modeling.  
(3-0) Cr. 3. Alt., offered even-numbered years. Prereq: M E 557, programming experience in C  

(Cross-listed with CH E). (3-0) Cr. 3. Alt., offered odd-numbered years. Prereq: M E 538  
Single particle, multiparticle and two-phase fluid flow phenomena (gas-solid, liquid-solid and gas-liquid mixtures); particle interactions, transport phenomena, wall effects; bubbles, equations of multiphase flow. Dense phase (fluidized and packed beds) and ducked flows; momentum, heat and mass transfer. Computer solutions.

(3-0) Cr. 3. Alt., offered even-numbered years. Prereq: M E 436  
Convection heat transfer to internal or external flows under laminar or turbulent conditions. Dimensionless parameters. Classical solutions of Newtonian viscous flows. Forced and free convection. Special topics.

(3-0) Cr. 3. F. Prereq: M E 436  

M E 647. Advanced Computational Fluid Dynamics.  
(Cross-listed with AER E). (3-0) Cr. 3. S. Prereq: AER E 547  

M E 690. Advanced Topics.  
Cr. arr. Repeatable.  
Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690A. Advanced Topics: Advanced Machine Design.  
Cr. arr. Repeatable.  
Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690C. Advanced Topics: Engineering Computation.  
Cr. arr. Repeatable.  
Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690Q. Advanced Topics: Independent Literature Investigation.  
Cr. arr. Repeatable.  
Investigation of advanced topics of special interest to graduate students in mechanical engineering.

M E 690T. Advanced Topics: Biological and Nanoscale Sciences.  
Cr. arr. Repeatable. F.S.SS.  
Investigation of Special Topics: Biological and Nanoscale Sciences of special interest to graduate students in mechanical engineering.

Cr. arr. Repeatable. F.S.SS.  
Investigation of Special Topics: Complex Fluid Systems of special interest to graduate students in mechanical engineering.

M E 690V. Advanced Topics: Clean Energy Technologies.  
Cr. arr. F.S.SS.  
Investigation of Special Topics: Clean Energy Technologies of special interest to graduate students in mechanical engineering.

M E 690W. Advanced Topics: Design and Manufacturing Innovation.  
Cr. arr. Repeatable.  
Investigation of Design & Manufacturing Innovation of special interest to graduate students in mechanical engineering.

M E 690Z. Advanced Topics: Simulation and Visualization.  
Cr. arr. Repeatable. F.S.SS.  
Investigation of Special Topics: Simulation and Visualization of special interest to graduate students in mechanical engineering.

M E 697. Engineering Internship.  
Cr. R. Repeatable. Prereq: Permission of Director of Graduate Education, graduate classification  
One semester and one summer maximum per academic year professional work period. Offered on a satisfactory-fail basis only.

Cr. arr. Repeatable.  
Offered on a satisfactory-fail basis only.