

# Mechanical Engineering

## **ME 135 Engr Graphics and Comm 3 cr**

Graphical representation of objects, orthographic, oblique, and isometric views. Freehand lettering and sketching, computer aided graphics, presentation of graphics based on numerical data using spreadsheet, word processor and presentation software. Fee.

Pre-requisite: MA 125 Minimum Grade of C. MA 125 can be taken concurrently with this course.

## **ME 312 Mech Engr Thermodynamics 3 cr**

Thermodynamics power and refrigeration cycles, gas mixtures, psychometrics, and combustion. One-half hour of design.

Pre-requisite: EG 270 Minimum Grade of C.

## **ME 314 Machine Component Design 3 cr**

Analysis and design of machine elements to accomplish given tasks within limits of stress and size. One hour of design.

Pre-requisite: EG 284 Minimum Grade of C and EG 315 Minimum Grade of C.

## **ME 316 Instrumentatn & Exp Method 3 cr**

Measuring system analysis and design, signal conditioning, analysis of data, statistical error analysis, communication of results.

Pre-requisite: (EG 220 Minimum Grade of C and MA 238 Minimum Grade of C and PH 202 Minimum Grade of C and ME 328 Minimum Grade of C).

## **ME 317 Heat Transfer 3 cr**

Steady and transient, multi-dimensional conduction, forced and natural convection, radiation, and heat exchangers. One-half hour of design.

Pre-requisite: EG 270 Minimum Grade of C and ME 328 Minimum Grade of C and MA 238 Minimum Grade of C and EG 360 Minimum Grade of C.

## **ME 319 Instrumentatn & Exp Method Lab 1 cr**

Laboratory component of ME 316 Instrumentation. The same grade will be given in both courses.

Co-requisite: ME 316

Pre-requisite: EG 220 Minimum Grade of D and (MA 238 Minimum Grade of D or MA 338 Minimum Grade of D) and (PH 202 Minimum Grade of D or PH 217 Minimum Grade of D).

## **ME 326 Materials Science 3 cr**

Mechanical, chemical, and physical properties of materials. Relationship between structure, processing, and properties engineering materials. One-half hour of design.

Pre-requisite: (PH 202 Minimum Grade of C or PH 217 Minimum Grade of C) and (CH 115 Minimum Grade of C or CH 131 Minimum Grade of C) and EG 315 Minimum Grade of C.

## **ME 328 ME Analysis 4 cr**

Numerical solutions of differential equations with applications to ME simulation and design. Introduction to Finite Element Analysis. One-half hour of design.

Pre-requisite: MA 227 Minimum Grade of C and MA 237 Minimum Grade of C and MA 238 Minimum Grade of C.

## **ME 336 Material Science Lab-W 1 cr**

Experimental study on the effect of thermal and mechanical processing on properties.

Pre-requisite: ME 326 Minimum Grade of D and PH 202 Minimum Grade of C and CH 131 Minimum Grade of C and EG 315 Minimum Grade of C. ME 326 can be taken concurrently with this course.

## **ME 365 Design of Fluid Power Systems 3 cr**

Fluid power components are studied in detail. Design of complete hydraulic systems is stressed. One hour of design.

Pre-requisite: EG 284 Minimum Grade of D and EG 315 Minimum Grade of D and (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 328 Minimum Grade of D.

## **ME 410 Principles of Eng Design-W 3 cr**

In this course, students learn to apply engineering theory and methods to the design process. Topics include problem definition, concept development and evaluation, project management, materials selection, risk analysis, quality improvement and ethics in design (0-3-0).

Pre-requisite: ME 314 Minimum Grade of C and EG 231 Minimum Grade of C and ME 336 Minimum Grade of C and ME 317 Minimum Grade of C and ME 316 Minimum Grade of C. ME 336 and ME 317 can be taken concurrently with this course.

## **ME 411 Thermal System Design 3 cr**

Thermal system design using principles of thermodynamics, fluid mechanics, heat transfer, and numerical simulation. Communication of results. Three hours of design.

Pre-requisite: ME 312 Minimum Grade of D and ME 317 Minimum Grade of D and ME 328 Minimum Grade of D and (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D).

## **ME 412 Thermal Science Laboratory 1 cr**

Experimental study of thermal science principles and systems. Communication of results.

Pre-requisite: ME 312 Minimum Grade of D and ME 316 Minimum Grade of D and ME 317 Minimum Grade of D and (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D).

## **ME 414 Capstone Design 1 cr**

This course is considered a "Senior Capstone Course."

Co-requisite: ME 416

Pre-requisite: ME 410 Minimum Grade of D.

- ME 416 Capstone Design Project** 2 cr  
This is a team-based capstone project course. Each team is assigned a unique design problem in mechanical engineering or a closely-related field. Students must be enrolled concurrently in ME 414 - Capstone Design.  
Co-requisite: ME 414  
Pre-requisite: ME 410 Minimum Grade of D.
- ME 417 Dynamics of Machines** 3 cr  
A study of the effects of external forces and moments on the motion of machines. Topics include the study of the position, velocity and acceleration of machine components during operation and the determination of forces on the connections and members. One hour of design.  
Pre-requisite: EG 284 Minimum Grade of D and EG 315 Minimum Grade of D and ME 328 Minimum Grade of D.
- ME 419 Computer Aided Design & Manu** 3 cr  
Introduction to computer aided design (CAD) and computer aided manufacturing (CAM) principles and their practical applications as fundamental elements of contemporary product design and manufacturing. This course is dual listed with an equivalent 500-level mechanical engineering course. One hour of design.  
Pre-requisite: ME 135 Minimum Grade of D and ME 314 Minimum Grade of D.
- ME 421 Mechanical System Design** 3 cr  
A study of design techniques as applied to mechanical components and systems. Computer simulation and numerical techniques. Communication of results. Three hours of design.  
Pre-requisite: ME 314 Minimum Grade of D and ME 328 Minimum Grade of D.
- ME 422 Gas Turbines** 3 cr  
Introduction to gas turbines covering thermodynamics, fluid mechanics, combustion, cycle analysis, compressors, turbines and component design. One hour of credit.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D.
- ME 426 Dynamic Systems and Control** 3 cr  
Modeling dynamic systems. Introduction to the principles of feedback control systems. Analysis of linear systems.  
Pre-requisite: (MA 238 Minimum Grade of D or MA 338 Minimum Grade of D) and ME 316 Minimum Grade of D and ME 328 Minimum Grade of D.
- ME 429 Controls & Instr. Lab** 1 cr  
Design and implementation of analog and digital feedback control of systems. Design and implementation of measurement systems, including signal conditioning, analog-to-digital and digital-to-analog conversion, statistical estimation of error, data analysis. Communication of laboratory results is emphasized.  
Pre-requisite: ME 426 Minimum Grade of D. ME 426 can be taken concurrently with this course.
- ME 430 Mechanism Synthesis** 3 cr  
Kinematic synthesis of planar linkages for function, path, and motion generation. Topics include: degrees of freedom; graphical, linear analytical, and nonlinear analytical methods; and curvature theory. This course is dual-listed with an equivalent 500-level mechanical engineering course. One hour of design.  
Pre-requisite: EG 284 Minimum Grade of D and ME 328 Minimum Grade of D.
- ME 431 Gas Dynamics** 3 cr  
Introduction to compressible fluid flow. Conservation laws, isentropic flow, adiabatic flow, flow with heat transfer, normal shock. One hour of design.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D.
- ME 432 Advanced Thermodynamics** 3 cr  
Continuation of Mechanical Engineering Thermodynamics to develop a broader and deeper understanding of thermal energy transformations. One hour of design.  
Pre-requisite: ME 312 Minimum Grade of D.
- ME 438 Finite Element Analysis** 3 cr  
Introduction to the finite element method. Engineering application to stress-strain analysis is emphasized. Other field problems are also considered. This course is dual-listed with an equivalent 500-level mechanical engineering course.  
Pre-requisite: ME 328 Minimum Grade of D.
- ME 439 Boundary Elements I** 3 cr  
Fundamental concepts of the boundary element method of numerically solving partial differential equations. Application to potential flow problems in heat transfer. This course is dual listed with an equivalent 500-level mechanical engineering course.  
Pre-requisite: ME 328 Minimum Grade of D.
- ME 441 Microprocessors for Mech Engr** 3 cr  
Basic concepts of programming and applying microprocessors to the control of mechanical systems. Assembly language programming. Memory decoding and use. Input and output circuits. Interfacing with the PIA.  
Pre-requisite: EG 220 Minimum Grade of D and ME 316 Minimum Grade of D.
- ME 450 Heat Vent and Air Conditioning** 3 cr  
Addresses the heating and cooling of buildings. Covers related engineering sciences, cooling and heating loads, systems, and equipment. One hour of design.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D and ME 317 Minimum Grade of D.

- ME 451 Refrigeration Systems** 3 cr  
Study of refrigeration systems including solutions of typical engineering design problems. Concepts from fluid mechanics, thermodynamics, and heat transfer are used. One hour of design.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D and ME 317 Minimum Grade of D.
- ME 452 Combustion** 3 cr  
Introduction to the theory of combustion processes, chemical equilibrium, adiabatic flame temperatures, reaction kinetics. This course is dual listed with an equivalent 500-level mechanical engineering courses.  
Pre-requisite: ME 312 Minimum Grade of D.
- ME 453 IC Engines** 3 cr  
Principles for analysis and design of internal combustion (I.C.) engines. Topics: include fuel-air cycles, fuel, air and exhaust flows, heat and mass transfer, engine performance.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D and ME 317 Minimum Grade of D.
- ME 460 Intro to Marine Engineering** 3 cr  
Categorization of Ships, Ship Geometry and Hydrostatics, Ship Stability, Ship Hazards, Resistance and Power, Propellers and Propulsion Systems, Ship Dynamics and Control.  
Pre-requisite: EG 360 Minimum Grade of D and EG 315 Minimum Grade of D.
- ME 461 Turbomachinery** 3 cr  
Energy transfer between fluid and rotor; fluid flow in turbomachines, centrifugal and axial flow pumps and compressors; radial and axial flow turbines. One hour of design.  
Pre-requisite: (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D) and ME 312 Minimum Grade of D.
- ME 466 Aerospace Propulsion** 3 cr  
Airbreathing engines course. Apply fluids, thermodynamics, and heat transfer to analysis of air breathing engines. Topics to include: ideal cycle analysis, component performance, non-ideal cycle analysis, and blade aerodynamics.  
Pre-requisite: ME 312 Minimum Grade of D and ME 317 Minimum Grade of D and (EG 360 Minimum Grade of D or CE 365 Minimum Grade of D or ME 324 Minimum Grade of D).
- ME 469 Aircraft Stability and Control** 3 cr  
Introduction to flight dynamics of aerospace vehicles. Basic overview of stability analysis and linear feedback control.  
Pre-requisite: ME 328 Minimum Grade of C and EG 360 Minimum Grade of C.
- ME 472 Vibration Analysis-Synthesis** 3 cr  
Steady-state and transient vibration analysis of discrete and continuous systems. Vibration problems as related to design are also included.  
Pre-requisite: EG 284 Minimum Grade of C and EG 315 Minimum Grade of C and ME 328 Minimum Grade of D.
- ME 474 Noise and Vibration Control** 3 cr  
Principles of acoustics; human response to noise; control of noise and vibration by means of vibration isolation, sound barriers, and absorption. One hour of design.  
Pre-requisite: ME 472 Minimum Grade of D.
- ME 490 Special Topics** 1 TO 3 cr  
Topics of current mechanical engineering interest.  
Prerequisite: Consent of instructor
- ME 494 Directed Studies** 1 TO 3 cr  
Selected mechanical engineering topics of special or current interest not available to regularly scheduled courses.  
Prerequisite: Consent of instructor.
- ME 499 Honors Senior Project - H** 1 TO 6 cr  
Under the advice and guidance of a faculty mentor, honors students will identify and carry out a research project, relevant to the field of Mechanical Engineering study, that will lead to a formal presentation at the Annual Honors Student Colloquium. The senior project will be judged and graded by three faculty, chaired by the honors mentor. This course is required for Honors recognition. A minimum of 4 credit hours is required, but students may enroll for a maximum of 6 credit hours over two semesters. Prerequisites: Completion of an approved project prospectus.
- ME 518 Adv Mechanical Engr Analysis** 3 cr  
Application of numerical methods including finite differences; finite element and boundary element techniques to the solution of problems in Mechanical Engineering.  
Prerequisite: Consent of instructor.
- ME 519 Computer Aided Design/Manufac** 3 cr  
Introduction to computer aided design (CAD) and computer aided manufacturing (CAM) principles and their practical applications as fundamental elements of contemporary product design and manufacturing. This course is dual listed with an equivalent 400-level mechanical engineering course.
- ME 520 Advanced Fluid Mechanics** 3 cr  
Analysis of steady and unsteady motion of a viscous fluid. Topics include: conservation equations, Newtonian fluids and the Navier-Stokes equations, vorticity, analytical solutions, boundary layers, instability of viscous flows.  
Prerequisite: Consent of instructor.
- ME 522 Gas Turbines** 3 cr  
Introduction to gas turbines covering thermodynamics, fluid mechanics, combustion, cycle analysis, compressors, turbines, and component matching.  
Pre-requisite: ME 520 Minimum Grade of C.

- ME 525 Boundary Layer Theory** 3 cr  
Development of Navier-Stokes and boundary layer equations, perturbation theory application and boundary layer transition. Prerequisite: Consent of instructor.
- ME 530 Mechanism Synthesis** 3 cr  
Kinematic synthesis of planar linkages for function, path, and motion generation. Topics include: degrees of freedom; graphical, linear analytical, and nonlinear analytical methods; and curvature theory. This course is dual-listed with an equivalent 400-level mechanical engineering course. Prerequisite: Consent of instructor.
- ME 538 Finite Element Analysis** 3 cr  
Introduction to the finite element method. Engineering application to stress-strain analysis is emphasized. Other field problems are also considered. This course is dual-listed with an equivalent 400-level mechanical engineering course. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C or MA 508 Minimum Grade of C. MA 507 and MA 508 can be taken concurrently with this course.
- ME 539 Boundary Elements I** 3 cr  
Fundamental concepts of the boundary element method of numerically solving partial differential equations. Application to potential flow problems in heat transfer. This course is dual listed with an equivalent 400 level mechanical engineering course. Requires special permission of instructor.
- ME 540 Advanced Heat Transfer** 3 cr  
Steady and transient conduction, external and internal forced convection, natural convection, radiation with participating media, boiling heat transfer, Stefan condition. Prerequisite: Consent of instructor.
- ME 541 Conduction Heat Transfer** 3 cr  
Closed form analytical and approximate numerical solutions of one, two- and three-dimensional steady state and transient problems in conduction heat transfer. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C.
- ME 542 Convection Heat Transfer** 3 cr  
Fundamental laws of motion and energy balance for a viscous fluid, classical solution of the Navier-Stokes and energy equations, laminar/turbulent hydrodynamic and thermal boundary layers, convection heat transfer in laminar/ turbulent internal flows. Prerequisite: Consent of instructor.
- ME 543 Radiation Heat Transfer** 3 cr  
Blackbody radiation, diffuse-gray surfaces, radiative exchange in a multi-surface enclosure, gas radiation in enclosures with participating media, introduction to available numerical methods. Prerequisite: Consent of instructor.
- ME 544 Heat Trans - Change of Phase** 3 cr  
Boiling heat transfer and critical heat flux, condensation heat transfer, Stefan problem, freezing and melting, ablation, introduction to available numerical techniques. Prerequisite: Consent of instructor. Pre-requisite: ME 540 Minimum Grade of C or ME 542 Minimum Grade of C.
- ME 545 Exp Fluid Mech and Heat Trans** 3 cr  
Uncertainty analysis, system response, sampling theory and FFT, differential pressure measurement and multi-hole probes, thermo-couple and RTD, thermal anemometry, LDV and other non-intrusive optical methods, flow visualization. Prerequisites: Consent of instructor
- ME 550 Combustion** 3 cr  
Introduction to the theory of combustion processes, chemical equilibrium, adiabatic flame temperature, reaction kinetics, flame structure. This course is dual-listed with an equivalent 400-level mechanical engineering course. Prerequisite: Consent of instructor.
- ME 551 Classical Thermodynamics** 3 cr  
Postulational treatment of the physical laws of equilibrium, equations of state, processes, equilibrium, stability, reactive systems, phase transition. Prerequisite: Consent of instructor.
- ME 552 Statistical Thermodynamics** 3 cr  
Principles of kinetic theory, quantum mechanics, and statistical mechanics with particular reference to thermodynamic systems. Conclusions of classical thermodynamics are established from the microscopic viewpoint. Prerequisite: Consent of instructor.
- ME 553 IC Engines** 3 cr  
Principles for analysis and design of internal combustion (I.C.) engines. Topics include: fuel-air cycles, fuel, air and exhaust flows, heat and mass transfer, engine performance.
- ME 560 Compressible Fluid Flow** 3 cr  
Foundations of fluid dynamics and thermodynamics of one dimensional flow and heat transfer, isentropic flow, shock waves and method of characteristics. Prerequisite: Consent of Instructor.
- ME 561 Turbomachinery** 3 cr  
Energy transfer between fluid and rotor; fluid flow in turbomachines, centrifugal and axial-flow pumps and compressors; radial and axial flow turbines. Prerequisite: Consent of instructor.
- ME 562 Comp Fluid Dyn - Heat Trans I** 3 cr  
Derivation of conservation equations, numerical solution of inviscid and viscous incompressible flow problems, emphasis on finite volume method, introduction to finite element and spectral method. Prerequisite: Consent of instructor.

- ME 563 Comp Fluid Dyn - Heat Trans II** 3 cr  
Governing equations in general coordinates, differential geometry for curvilinear coordinates, grid generations, numerical uncertainties. Prerequisite: Consent of instructor. Pre-requisite: ME 562 Minimum Grade of C.
- ME 564 Turbulent Flow** 3 cr  
Reynolds equations, statistics of turbulence, analysis of free and wall turbulence, turbulence models. Prerequisite: Consent of instructor. Pre-requisite: ME 520 Minimum Grade of C.
- ME 565 Lubrication** 3 cr  
Friction of solids and fluids. Lubricants. Theory of sliding bearings. Multi-dimensional bearings with constant forces and velocities. Solid, hydrodynamic and gas lubrication. Design of bearings. Prerequisite: Consent of instructor.
- ME 566 Aerospace Propulsion** 3 cr  
Airbreathing engines course. Apply fluids, thermodynamics, and heat transfer to analysis of air breathing engines. Topics to include: ideal cycle analysis, component performance, non-ideal cycle analysis, and blade aerodynamics.
- ME 569 Aircraft Stability and Control** 3 cr  
Introduction to flight dynamics of aerospace vehicles. Basic overview of stability analysis and linear feedback control. Co-requisite: MA 507
- ME 571 Advanced Engineering Dynamics** 3 cr  
Three-dimensional kinematics and kinetics of particles and rigid bodies, energy, momentum, and stability; application of Lagrange's equations to machinery and gyro dynamics. Prerequisite: Consent of instructor.
- ME 572 Advanced Vibrations** 3 cr  
Free and forced vibrations of mechanical systems having lumped mass and elasticity; introduction to vibrations of continuous systems; engineering applications. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C or MA 508 Minimum Grade of C. MA 507 and MA 508 can be taken concurrently with this course.
- ME 573 Vibrations of Continuous Sys** 3 cr  
Equations of motion for strings, membranes, bars, and plates with various boundary conditions, steady state and transient solutions, exact and approximate methods; wave propagation in elastic media. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C.
- ME 574 Nonlinear Vibrations** 3 cr  
Vibrations of damped and undamped systems with nonlinear restoring forces; free and forced oscillations in self-sustained systems; Hills equation and its application to the study of the stability of nonlinear oscillations. Prerequisites: Consent of instructor. Pre-requisite: ME 572 Minimum Grade of C and MA 508 Minimum Grade of C.
- ME 575 Continuum Mechanics** 3 cr  
Cartesian tensor analysis. Analysis of stress and strain, fundamental laws of continuum mechanics. Constitutive equations, application to solid and fluid mechanics. Prerequisite: Consent of instructor.
- ME 582 Advanced Materials Science** 3 cr  
Classical and quantum mechanical model of atoms, bonding, magnetism, superconductivity, high strength low density materials, corrosion, biomedical materials. Prerequisite: Consent of the instructor.
- ME 583 Applied Elasticity** 3 cr  
Classical problems in elasticity, torsion and bending theory, plane problems in rectangular and polar coordinates; axisymmetric problems, thermoelasticity. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C or MA 508 Minimum Grade of C. MA 507 and MA 508 can be taken concurrently with this course.
- ME 584 Introductory Metal Theory** 3 cr  
Theories of metal to explain electrical conductivity and scattering process, electronic and lattice heat capacity, magnetic behavior, cohesion and lattice constant. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C.
- ME 585 Theory of Plates** 3 cr  
Basic equations of rectangular and circular plates with various boundary conditions; classical solutions and approximate methods in the theory of thin plates. Prerequisite: Consent of instructor. Pre-requisite: MA 507 Minimum Grade of C.
- ME 586 Theory of Shells** 3 cr  
Introduction to differential geometry; general equations for arbitrary shells; shallow shell theory with applications; solutions to membrane and bending theory for shells of revolution. Prerequisite: Consent of instructor. Pre-requisite: ME 585 Minimum Grade of C.
- ME 589 Biomechanics** 3 cr  
Discrete mass and continuum mechanics description of biological materials, biodynamics of limb and gross body motions, various models for injury to head, neck, torso, and extremities. Prerequisite: Consent of instructor.
- ME 590 Sp Top -** 1 TO 3 cr  
Topics of current mechanical engineering interest. Prerequisite: Consent of instructor.
- ME 592 Directed Independent Study** 1 TO 3 cr  
Directed study, under the guidance of a faculty advisor, of a topic from the field of Mechanical Engineering not offered in a regularly scheduled course. Requires permission of the instructor.
- ME 594 Projects in Mechanical Engr** 1 TO 3 cr  
May be repeated for credit. Prerequisite: Approved proposal and consent of director of engineering graduate studies.

**ME 599 Thesis**

**1 TO 6 cr**

Thesis research may be taken more than once. Prerequisite:  
Approved prospectus.