

MECHANICAL ENGINEERING

Courses

AESP 101 - Introduction into Aerospace Engineering (3 Credits)

Historical overview of air and space flight. Principles of flight and characterization of the atmosphere and space. Vehicle concepts, and an introduction to aerodynamics, materials, structures, propulsion, flight mechanics, control, aircraft systems, and design.

AESP 265 - Aerodynamics I Incompressible Flow (3 Credits)

Fundamentals of inviscid, incompressible flow. Derivation of basic equations for lift, drag and aerodynamic moments through dimensional analysis. Two dimensional flow over airfoils. Airfoil characteristics. Thin airfoil theory, finite wing theory. Wing and body interactions. Aerodynamic drag characteristics. Boundary layers.

Prerequisites: MATH 242, EMCH 201.

AESP 314 - Energy Power and Propulsion (3 Credits)

Introduction to aircraft and rocket engines with emphasis on the performance and characteristics of various types of propulsion systems, including turbojet, turbofan, turboprop, ramjet, scramjet and liquid & solid propellant rockets.

Prerequisites: EMCH 290.

AESP 350 - Aerospace Systems (3 Credits)

Fundamentals of flight control systems, engine control systems, fuel systems, hydraulic systems, landing gears, electrical systems, environmental control systems, emergency systems, avionics and rotary wing systems. Aerospace systems design and development methodology.

Prerequisites: PHYS 212.

AESP 361 - Aerospace Laboratory I (3 Credits)

Aerospace component experiments: drag polar and C_m -alpha curve for an airfoil; fuselage and landing gear drag; compliance matrix of an isotropic and a laminated composite; mechanical and thermal properties of various aerospace materials; reporting.

Prerequisites: STAT 509, AESP 265.

Prerequisite or Corequisite: EMCH 371, EMCH 310.

AESP 362 - Aerospace Laboratory II (3 Credits)

Introduction to experimental determination of structures, propulsion and systems aspects of aerospace engineering. Oral and written presentations and reports.

Prerequisites: AESP 361.

AESP 415 - Aircraft Design Part I Basics (3 Credits)

Aircraft mission analysis; Conceptual aircraft design; Weight estimation; Wing design; Payload compartment design; Stabilizer and control surface design; engine selection; aircraft systems design; performance analysis; trade studies; design verification; design documentation and presentation.

Prerequisites: AESP 265.

Prerequisite or Corequisite: AESP 350 and AESP 314.

Graduation with Leadership Distinction: GLD: Research

AESP 420 - Flight and Orbital Mechanics (3 Credits)

Derivation of the general equations of motion (EoM) for aircraft and space flight. Solution of Aircraft EoM for cruise flight and flight maneuvers including coordinated turns, takeoff and landing. Solution of EoM for orbital mechanics problems including transfer trajectories. Calculation of required specific impulses. Design of interplanetary trajectories.

Prerequisites: MATH 141, EMCH 200, EMCH 310.

AESP 428 - Design I (3 Credits)

Techniques for managing, planning and executing engineering projects. Computer based analysis and synthesis techniques. Manufacturing and assembly techniques. Statistical methods to support manufacturing, safety and reliability based design. Engineering Ethics. Social impact of engineering decisions and projects. Effective written and oral communication.

Prerequisites: AESP 350, EMCH 577.

Prerequisite or Corequisite: AESP 314, EMCH 377.

Graduation with Leadership Distinction: GLD: Research

AESP 466 - Flight Dynamics and Control (3 Credits)

Flight Dynamics and Control is a three-credit course that covers the dynamics of aircraft motion, methods of analysis and design for stability and control, longitudinal motions, lateral-directional motions, and coupled longitudinal and lateral-directional motions.

Prerequisites: EMCH 330 or ENCP 330, AESP 420.

EMCH 101 - Introduction to Mechanical Engineering (3 Credits)

Introduction to Mechanical Engineering; Engineering thinking; Problem-solving skills; University life and academic expectations.

EMCH 111 - Introduction to Computer-Aided Design (3 Credits)

Principles and practice of visualization and graphical representation using modern computer-aided design tools.

EMCH 200 - Statics (3 Credits)

Principles of mechanics; Equilibrium of particles and rigid bodies; Distributed forces, centroids, and centers of gravity; Moments of inertia of areas; Analysis of simple structures and machines; Friction.

Prerequisites: C or better in MATH 141.

EMCH 201 - Introduction to Applied Numerical Methods (3 Credits)

Introduction and application of linear algebra and numerical methods to the solution of physical and engineering problems. Techniques include iterative solution techniques, methods of solving system of equations, and numerical integration and differentiation.

Prerequisites: MATH 141.

Corequisite: MATH 142.

Cross-listed course: ENCP 201, PHYS 311

EMCH 220 - Mechanical Engineering Fundamentals for Non-Majors (3 Credits)

Introduction to the fundamentals of mechanical engineering for other engineering disciplines. Excluded: Mechanical Engineering Majors.

Prerequisites: MATH 142, PHYS 211.

EMCH 260 - Solid Mechanics (3 Credits)

Study of forces and deformation in solids; Basic concepts of stress and strain; Elastic relations between stress and strain; Stress and strain transformations; Applications to mechanical components under axial, torsional, bending and pressure loads.

Prerequisites: C or better in MATH 241; C or better in EMCH 200 or ENCP 200.

EMCH 290 - Thermodynamics (3 Credits)

Definitions, work, heat, and energy; First law of analyses of systems and control volumes; Second law analysis.

Prerequisites: C or better in PHYS 211; C or better in MATH 142.

EMCH 308 - Introduction to Finite Element Stress Analysis (3 Credits)

Introduction to stress analysis for beams, plates, shells, and solids using finite element based computer tools.

Prerequisites: EMCH 260.

EMCH 310 - Dynamics (3 Credits)

Kinematics of particles and rigid bodies; Kinetics of particles, emphasis on Newton's second law: energy and momentum methods for the solution of problems; Applications of plane motion of rigid bodies.

Prerequisites: C or better in MATH 242; C or better in EMCH 200 or ENCP 200.

EMCH 327 - Machine Design (3 Credits)

Design against static failure and fatigue failure of structural members and machine parts; Design and selection of components including: fasteners, welds, shafts, springs, gears, bearings, and chain drives.

Prerequisites: EMCH 260 or ENCP 260.

Graduation with Leadership Distinction: GLD: Research

EMCH 330 - Mechanical Vibrations (3 Credits)

Analysis of forced and damped one-degree-of-freedom systems. Rotating unbalance and vibration isolation. Introduction to two-degrees-of-freedom systems.

Prerequisites: MATH 242 and either EMCH 310 or ENCP 210.

EMCH 332 - Kinematics (3 Credits)

The application of vector and graphical analysis for the determination of positions, velocities and accelerations of planar linkages used in modern machinery.

Prerequisites: D or better in EMCH 310 or ENCP 210.

EMCH 354 - Heat Transfer (3 Credits)

One- and two-dimensional steady and transient heat conduction; Free and forced convection; Boiling and condensation; Radiation; Heat exchangers.

Prerequisites: D or better in EMCH 360 or AESP 265 or ENCP 360.

EMCH 360 - Fluid Mechanics (3 Credits)

Applications of fluid statics and dynamics; Conservation of mass, momentum, and energy; Similitude and dimensional analysis; Open channel flow, lift and drag; Introduction to turbulent flow

Prerequisites: C or better in EMCH 200 or ENCP 200 or BMEN 212; D or better in EMCH 290 or ENCP 290 or BMEN 290; C or better in MATH 242.

EMCH 361 - Laboratory I (3 Credits)

Basic concepts of instruments, measurements, and experimental data analysis; Statistical analysis of experimental data and uncertainty analysis; LabView control, sensors, and measurement of parameters in mechanical engineering systems; Technical writing and presentation.

Prerequisites: D or better in EMCH 290, ENCP 290, or BMEN 290; D or better in EMCH 260 or ENCP 260; D or better in EMCH 201 or ENCP 201; D or better in ELCT 220 or ELCT 221.

EMCH 362 - Laboratory II (3 Credits)

Basic concepts of hypothesis, simple design of experiments to demonstrate principles and applications of fluid dynamics, manufacturing, mechanical properties, heat transfer, and vibration analysis through a series of lab experiments.

Prerequisites: D or better in EMCH 361.

Prerequisite or Corequisite: D or better in EMCH 360 or AESP 265 or ENCP 360; D or better in EMCH 310 or ENCP 210.

EMCH 363 - Mechanical Engineering Laboratory III (3 Credits)

Experiments directly related to advanced mechanical engineering courses. Physical and statistical design of experiments. Written and oral reports.

Prerequisites: EMCH 362.

Prerequisite or Corequisite: EMCH 332, EMCH 354, EMCH 371.

EMCH 367 - Controls (3 Credits)

Introduction to closed-loop control systems in Mechanical Engineering; Development of concepts, including transfer function, feedback, frequency response, and system stability; Programmable logic controllers (PLC); Control system design methods.

Prerequisites: D or better in EMCH 310 or ENCP 210; D or better in EMCH 368.

EMCH 368 - Mechatronics (4 Credits)

Introduction to the principles of integrating mechanical, electrical and computer engineering disciplines within a unified framework towards designing mechatronic systems; Fundamental overview of mechatronics (sensors, signals, actuators, microprocessors and models of mechatronic systems); Experimental exercises using microcontrollers.

Prerequisites: D or better in CSCE 206; D or better in ELCT 220 or ELCT 221; D or better in EMCH 260 or ENCP 260.

EMCH 371 - Materials (3 Credits)

An introduction to the relationships between chemical bonding, crystal structure, phase equilibria, microstructure, and properties of engineering materials.

Prerequisites: D or better in EMCH 260 or ENCP 260.

EMCH 377 - Manufacturing (3 Credits)

Basics of: Deformative Manufacturing, Subtractive Manufacturing, Additive Manufacturing, Assembly Processes; Introduction to: Polymers Manufacturing, Composites Manufacturing, Computer-Aided Manufacturing.

Prerequisites: EMCH 371.

EMCH 380 - Project Management (3 Credits)

Introduction to decision making for engineering projects; Planning methods; Forecasting; Exploratory charts; Team building and leadership; Project scheduling; Project economics.

Prerequisites: C or better in MATH 241.

EMCH 394 - Applied Thermodynamics (3 Credits)

Basics of: Fundamentals of thermodynamics, Thermodynamic properties, Energy and Mass Conservation, Entropy and the Second Law Analysis; Introduction to: Power, Refrigeration, and Heat Pump Cycle Systems for vapor cycles and gas cycles; Application of Thermodynamic concepts to determine changes of enthalpy, entropy, and internal energy related with cycle systems, psychometrics, and combustion process.

Prerequisites: EMCH 201, EMCH 290.

EMCH 427 - Design I (3 Credits)

Open-ended design project initiation including: identifying and ranking customer and project needs, benchmarking appropriate design specifications, planning and project management, functional analysis, innovation and concept generation, learning through mockups, concept ranking and concept selection.

Prerequisites: D or better in EMCH 380.

Prerequisite or Corequisite: D or better in EMCH 332, EMCH 354, EMCH 362, EMCH 371, and EMCH 368.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

EMCH 428 - Design II (3 Credits)

Open-ended design project continuation including: identifying and performing relevant engineering analyses, parametric design refinement, project life cycle economic analysis, product/prototype construction, testing, and evaluation of the design; Consideration of safety, reliability, sustainability, and social impact.

Prerequisites: D or better in EMCH 427.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

EMCH 441 - Automotive System Fundamentals (3 Credits)

Automotive engineering systems, descriptions, and associated operating and design principles. Past, present, and future automotive systems and components.

Prerequisites: EMCH 260, EMCH 394.

EMCH 460 - Special Problems (1-3 Credits)

Individual investigation or studies of special topics. A maximum of three credits may be applied toward a degree. Advance approval of project proposal by advisor and instructor.

Graduation with Leadership Distinction: GLD: Professional and Civic Engagement Internships, GLD: Research

EMCH 497 - Design of Thermal Systems (3 Credits)

Methodology of design, mathematical modeling of thermal equipment, system simulation, system optimization using digital computer, and investment economics. Requires a semester-long design project. Two lectures and one problem session per week.

Prerequisites: EMCH 354, EMCH 394.

Graduation with Leadership Distinction: GLD: Research

EMCH 499 - Fundamentals of Engineering Preparation (1 Credit)

Preparation for the Fundamentals of Engineering Exam. Review general engineering and mechanical engineering-specific areas. Restricted to seniors. May not be used to satisfy program requirements.

EMCH 501 - Engineering Analysis I (3 Credits)

Engineering applications of solution techniques for ordinary and partial differential equations, including Sturm-Liouville theory, special functions, transform techniques, and numerical methods.

Prerequisites: MATH 242.

EMCH 502 - Engineering Analysis II (3 Credits)

Engineering applications of optimization methods, calculus of variations including approximate methods, and probability concepts.

Prerequisites: MATH 242.

EMCH 507 - Computer-Aided Design (3 Credits)

Solid modeling using commercial computer-aided design (CAD) applications package to reverse engineer-manufactured parts. Analytical curves and surfaces, transformation matrices, assembly modeling, and computer tools for analyzing parts and mechanisms.

Prerequisites: EMCH 201, EMCH 327.

EMCH 508 - Finite Element Analysis in Mechanical Engineering (3 Credits)

Development of the fundamental concepts of finite element modeling. Matrix equation assembly and reduction. Mechanical engineering applications in structures, stress analysis, ideal flow, and heat transfer problems.

Prerequisites: EMCH 201, EMCH 327.

EMCH 509 - Computer-Aided Manufacturing (3 Credits)

Optimizing computer-controlled machining processes, programmable logic controllers (PLCs), motion control of servomechanisms, CNC machining practices and programming, and robotics.

Prerequisites: D or better in MATH 241.

EMCH 516 - Control Theory in Mechanical Engineering (3 Credits)

An introduction to closed-loop control systems; development of concepts, including transfer function, feedback, frequency response, and system stability by examples taken from mechanical engineering practice; control system design methods.

Prerequisites: MATH 242, EMCH 330.

EMCH 520 - Technology Planning (3 Credits)

Assessment of technological needs in the organization; coupling research and development to production; selection and evaluation of the technical project/program; technical planning, resource allocation, direction, and control; effective use and development of the engineering staff; the process of and barriers to technological change; technology, values, and policy. Senior or graduate standing.

EMCH 521 - Concurrent Engineering (3 Credits)

A systematic approach to the mechanical design of products, requiring the concurrent design of all related processes.

Prerequisites: EMCH 327.

EMCH 522 - Design for Manufacture and Assembly (3 Credits)

Product design principles for early consideration of issues to shorten product development time and to ensure smooth transition to manufacturing, thus accelerating time-to-market.

Prerequisites: EMCH 327 and EMCH 377.

EMCH 527 - Design of Mechanical Systems (3 Credits)

Summary of mechanical design, project management, product liability and the law, intellectual property ethics and professionalism.

Prerequisites: EMCH 327.

EMCH 528 - Product Safety Engineering (3 Credits)

Design considerations and methodologies for products to ensure adequate safeguards for the prevention of accidents, failures, and injuries. Senior standing.

EMCH 529 - Sustainable Design and Development (3 Credits)

System design and development accomplished with consideration of environmental/ecological, economic, and social constraints. Students will be introduced to sustainable design and accomplish a design project. Senior standing.

EMCH 530 - Introduction to Engineering Optimization (3 Credits)

Mathematical formulation of an optimum design problem, introduction to optimum design concepts and multidisciplinary design optimization. Use of mathematical programming methods for unconstrained and constrained minimization for engineering design optimization.

Prerequisites: C or better in MATH 142, Graduate standing.

EMCH 532 - Intermediate Dynamics (3 Credits)

Kinematics and dynamics of particles and rigid bodies using Newtonian mechanics. Work/energy, impulse/momentum, 3-D motion.

Prerequisites: EMCH 332.

EMCH 535 - Robotics in Mechanical Engineering (3 Credits)

Overview of robotics in practice and research: forward and inverse kinematics, statics and dynamics, trajectory generation, control, vision, and motion planning.

Prerequisites: EMCH 332.

EMCH 544 - Compressible Fluid Flow (3 Credits)

Application of the conservation laws of a compressible fluid to isentropic flows, flow with friction, and flows with heating or cooling. Shock and expansion waves. Nozzle and diffuser design.

Prerequisites: EMCH 354.

EMCH 550 - Introduction to Nuclear Safeguards (3 Credits)

International nuclear non-proliferation programs and activities, proliferation risk assessment, and nuclear materials management and safeguards, including physical protection systems, material accounting and control, monitoring, and regulatory issues.

Prerequisites: CHEM 112, CHEM 112L, PHYS 212, PHYS 212L, MATH 241, MATH 242.

EMCH 551 - Nuclear Energy in the Hydrogen Economy (3 Credits)

The current role of nuclear energy in the US and global energy mix will be described and the potential for future growth will be surveyed, particularly in the development of the hydrogen economy.

Prerequisites: EMCH 354.

EMCH 552 - Introduction to Nuclear Engineering (3 Credits)

Radioactivity and nuclear reactions; steady state and transient nuclear reactor theory.

EMCH 553 - Nuclear Fuel Cycles (3 Credits)

Processing of nuclear fuel including fabrication, irradiation, and waste disposal or storage. In-core and out-of-core fuel management. Fuel cycle economics.

Prerequisites: EMCH 552.

EMCH 554 - Intermediate Heat Transfer (3 Credits)

Radiant heat exchange, combined modes of heat transfer, computer techniques in heat transfer analysis and design, environmental heat transfer.

Prerequisites: EMCH 354.

EMCH 555 - Instrumentation for Nuclear Engineering (3 Credits)

Basic operational principles of radiation detection and nuclear instrumentation systems. Selection of the proper detector to measure radiation. Statistical analysis of results.

Prerequisite or Corequisite: EMCH 552 or PHYS 511.

EMCH 555L - Nuclear Instrumentation Laboratory (1 Credit)

Use of nuclear radiation detection and instrumentation systems and computers. Data acquisition and analysis.

Corequisite: EMCH 555.

EMCH 556 - Introduction to Risk Analysis and Reactor Safety (3 Credits)

An introduction to probabilistic risk assessment (PRA) methods as applied to nuclear power plants but also examples from the chemical industry, aerospace, transportation, and other sectors. Addresses failure and reliability analysis, fault trees, event trees, reactor safety, regulatory practice.

Prerequisites: STAT 509.

EMCH 557 - Introduction to Radiation Shielding and Sources (3 Credits)

Radiation interactions and transport, design of radiation shields, point kernel, and Monte Carlo methods. Dosimetry, buildup factors, radiation sources, and shield materials.

EMCH 558 - Introduction to Nuclear Reactor Systems (3 Credits)

PWR and BWR reactors, reactor system designs for accident prevention and mitigation, protection systems, containment design, emergency cooling requirements, code of federal regulations, and design criteria.

Corequisite: EMCH 552.

EMCH 560 - Intermediate Fluid Mechanics (3 Credits)

Integral and differential analysis of fluids. Potential flow. Boundary layer analysis. Flow in closed and open channels. Flow dynamics of turbomachinery. Steady and unsteady flows.

Prerequisites: EMCH 310, EMCH 360.

EMCH 561 - Current Topics in Mechanical Engineering (1-3 Credits)

Special topics related to current issues in mechanical engineering. Course content varies and will be announced in the schedule of classes by title.

EMCH 562 - Micro/nanofluidics and Lab-on-a-Chip (3 Credits)

Basic fluid mechanics, capillary, drop and micro/nanoparticle, electrokinetics; micropump, mixer, preconcentrator, electrophoresis, microactuator and particle manipulator; sensors for pressure, velocity, concentration, temperature in environmental monitoring/biodefence, clinical diagnostics, drug discovery/delivery.

Prerequisites: D or better in CHEM 112 and CHEM112L or CHEM 142; D or better in PHYS 212.

Cross-listed course: BMEN 532

EMCH 567 - Bio Nano/Micro Electro-Mechanical Systems (3 Credits)

Fundamentals of nano- and microfabrication, metrology and their applications in biomedical engineering and science. The fabrication covers photolithography, nano/microfabrication for nano/microstructures, etching and additive techniques, MEMS integration and packaging, etc. Metrology focuses on characterization of nanostructures with imaging technologies.

Prerequisites: D or better in CHEM 112 and CHEM 112L or CHEM 142; D or better in PHYS 212.

Cross-listed course: BMEN 537

EMCH 571 - Mechanical Behavior of Materials (3 Credits)

Micromechanisms of the deformation and fracture of structural materials; brittle versus ductile behavior; fatigue and creep; strengthening mechanisms; mechanical testing techniques; methods in analysis of mechanical failures.

Prerequisites: EMCH 260, EMCH 371.

EMCH 572 - Physical Metallurgy (3 Credits)

Equilibrium and phase relations in metallic systems; kinetics of phase transformations; annealing and precipitation phenomena.

Prerequisites: EMCH 371.

EMCH 573 - Introduction to Nuclear Materials (3 Credits)

Materials for nuclear applications; materials degradation processes occurring in the nuclear reactor environment. Restricted to Engineering Upper Division and Graduate Students.

EMCH 575 - Adaptive Materials and Smart Structures (3 Credits)

A multidisciplinary introductory course addressing the engineering field of adaptive materials and smart structures.

Prerequisites: EMCH 260, EMCH 310.

EMCH 576 - Fundamentals and Applications of Fuel Cells (3 Credits)

Study of fuel cell principles, fuel cell characterization, characteristics of the major types of fuel cells, fuel cell and stack components, fuel cell stack and system design, fuel cell applications in portable, transportation, and stationary areas, as well as the current status and future research focus of fuel cells. Restricted to: Upper division.

Prerequisites: EMCH 290 or ECHE 310 or ENCP 290.

EMCH 577 - Aerospace Structures I (3 Credits)

Static analysis of aerospace structural elements such as bars, beams, columns, plates, and shells. Topics include, but not limited to elasticity theory, simple beam theory, boundary value problems, and structural stability. Upper division or graduate status.

EMCH 578 - Introduction to Aerodynamics (3 Credits)

Fundamentals of aerodynamics, elements of compressible flow, thin airfoil theory, finite wing theory, flow through nozzles diffusers and wind tunnels, normal and oblique shock waves, elements of the methods of characteristics of finite difference solutions for compressible flows, aspects of hypersonic flow.

EMCH 580 - Mechanics of Solid Biomaterials (3 Credits)

Introduction to the mechanical behavior of solid biomaterials. Structure and mechanical properties of tissue including skin, myocardium, and tendon. Mathematical treatment of anisotropic elasticity, nonlinear elasticity, linear and quasi-linear viscoelasticity, muscle activity.

Prerequisites: MATH 242.

EMCH 584 - Advanced Mechanics of Materials (3 Credits)

Topics in stress analysis, including unsymmetrical bending, three-dimensional stress-strain; torsion; rotational stress; thick-walled pressure vessels; beams on elastic foundations; and stress concentration.

Prerequisites: EMCH 260.

EMCH 585 - Introduction to Composite Materials (3 Credits)

Introduction to fiber reinforced polymer (FRP) composite materials, manufacturing methods and processes. Micro-Mechanics and properties of orthotropic laminated and woven composites. Analysis of composite structures (Mechanics and Synergistic environmental effects). Structure/property relationships. Characterization of modern composite materials. Design considerations.

Prerequisites: EMCH 327, EMCH 371, MATH 242.

EMCH 586 - Experimental Stress Analysis (3 Credits)

Stress analysis utilizing experimental techniques including transmission and scattered light photoelasticity, strain gauges, and brittle coatings. Introduction to modern concepts of coherent optics in stress analysis with emphasis on engineering applications.

Prerequisites: EMCH 260.

EMCH 592 - Introduction to Combustion (3 Credits)

Chemical thermodynamics, reaction kinetics, and combustion phenomena in energy production. Application to the modeling of coal combustion, incineration, and combustion engines.

Prerequisites: EMCH 354, EMCH 394.

EMCH 594 - Solar Heating (3 Credits)

Solar radiation; review of heat transfer and radiation characteristics of relevant materials; flat plate and focusing collectors; energy storage models for design of solar heating systems; system design by computer simulation; direct conversion by solar cells.

Prerequisites: EMCH 290, EMCH 354, or ECHE 321.

EMCH 597 - Thermal Environmental Engineering (3 Credits)

Vapor compression and absorption refrigeration systems. Heat pumps. Properties of refrigerants. Cryogenic refrigeration. Heating and cooling of buildings. Solar heating and cooling systems.

Prerequisites: EMCH 354, EMCH 394.