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Undergraduate Bulletin

Contact

Timothy Prickel
Registrar
(812) 877- 8438

Course Descriptions - Mechanical Engineering

Professors Adams, Brackin, Burchett, Chambers, Cornwell, Cunningham, Ferro, Fine, Fisher, Gibson, Jakubowski, Layton, Lui, Mayhew, Mech, Merkel, Olson, Purdy, Richards, Sanders, Stamper, Stienstra, and White.

ME 123 Computer Applications I 4R-0L-4C W,S Pre: None
Software tools and engineering processes for mechanical engineers. Topics may include: structured programming (Matlab), simulation of rigid body motion (Working Model), presentation software (Powerpoint, HTML), and spreadsheets. Introduction to teaming and creativity.

ME 193 Selected Topics in Design Hours as assigned. Maximum 4 credits per term. F,W,S
Selected student design projects. May include testing and/or computer aided design.

ME 201 Thermodynamics I 4R-0L-4C W Pre: MA 112
Covers first law of thermodynamics, second law of thermodynamics, concept of entropy, simple process analysis, properties of pure substances, equations of state, and state diagrams. Stresses use of property tables and charts and application of the first and the second laws to open and closed systems undergoing changes.

ME 293 Selected Topics in Design. Hours as assigned. Maximum 4 credits per term. F,W,S Pre: Sophomore class standing
Selected student design projects. May include testing and/or computer aided design.

ME 301 Thermodynamics II 4R-0L-4C F,W Pre: ES 202 or ME 201
Applies property and component background to the analysis of various power and refrigeration cycles. Presents gas and gas-vapor mixtures, psychometric processes, and combustion. Introduces compressible flow.

ME 302 Heat Transfer 4R-0L-4C S,F Pre: MA 222 and ES 202 or CHE 301 or EM 301
Introduces the basic modes of heat transfer, heat transfer properties, steady and unsteady one-dimensional heat conduction, free and forced convection, radiation and heat exchangers. Other topics may include numerical methods and boiling and condensation.

ME 303 Kinematics of Machinery 3R-0L-3C F Pre: ES 204
This is an introduction to kinematics, the study of motion without regard to forces. The course examines the motion of planar mechanisms, particularly 4-bar mechanisms, various slider-crank mechanisms, cams, and gear trains. Students will develop analytical skills to determine the behavior of these mechanisms. The students will apply these analytical skills to design mechanisms to perform specific functions.

ME 305 Introduction to Aerospace Engineering 4R-0L-4C S Pre: ES 202
Application of fundamental engineering concepts to aerospace systems. Aircraft performance and stability. Physical properties of the standard atmosphere. Aerodynamics of the airplane including lift, drag and pitching moment estimation. Introduction to orbital mechanics.

ME 311 Mechanical Measurements 1R-3L-2C W,S Pre: Junior class standing
Fundamentals of measurement and measuring devices in mechanical engineering. Instrument characteristics (e.g., response, rise time), data and

error analysis, and calibration. Experiments with modern basic instrumentation applied to measurement of time, frequency, force, strain, velocity, acceleration, temperature, pressure and flow rate.

ME 317 Design for Manufacturing 3R-0L-3C W Pre: EM 104

This is an introductory course that examines the interactions between design and manufacturing from the designer□s point of view. Common manufacturing processes will be introduced and design guidelines will be developed for each process. The successful student will leave this class with an appreciation that a designer must consider the method of manufacture during the design process to ensure that a product is functional, economically viable, and safe.

ME 318 Material Processing in Manufacturing 4R-0L-4C Pre: ME 328

An introductory course in the control of the properties of materials during manufacturing. Covers the interrelationship between material properties and the principal manufacturing processes like hot and cold working, casting, welding, heat treating and machining. Emphasizes the importance of considering manufacturability when making material selection decisions in design.

ME 323 Computer Applications II 2R-0L-2C W,S Pre: ME 123, MA 221 Co: MA 222

Introduction to structured programming and applied numerical methods in scientific computing. The course uses applied problems in engineering and mathematics to introduce numerical methods such as numerical interpolation, finite differencing, integration, root finding, and linear algebraic system solutions. Matlab is taught as a vehicle for solving the problems numerically in a structured high speed environment.

ME 328 Materials Engineering 4R-0L-4C F Pre: CHEM 111 or CHEM 201

Introduces properties of metals, ceramics, polymers, and composites. Relates material processing to properties through underlying material structure. Overviews the materials available to engineers and discusses applications and material selection.

ME 380 Creative Design 4R-0L-4C W Pre: Permission of instructor

Emphasis on the creative process in engineering design. Students will develop their design capability by exploring various conceptual blocks, using creative enhancement techniques and participating in □on-the-spot□ design.

ME 393 Selected Topics in Design. Hours as assigned. Maximum 4 credits per term. F,W,S Pre: Junior class standing

Selected student design projects. May include testing and/or computer aided design.

***ME 402 Advanced Heat Transfer 4R-0L-4C Pre: ME 302**

This course covers additional topics in conduction, convection and radiation heat transfer as well as an introduction to mass transfer, phase change and numerical methods.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 405 Theoretical Aerodynamics 4R-0L-4C F Pre: ES 202**

Introduction to aerodynamics theory. Development of equations of conservation of mass and momentum. Vorticity, induced velocity and irrotational flow. Stream function, velocity potential, Laplace□s equation and the principle of superposition. Flow about a body, the Kutta-Joukowski Theorem. Concepts of thin airfoil and finite wing theory. Exact solutions to elementary viscous flow problems.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 406 Control Systems 3R-3L-4C F Pre: ES 205

Basic principles of feedback control theory. Mathematical modeling and

performance analysis of dynamical systems. Includes stability analysis, root locus compensation and design, frequency response analysis. Implementation of control system analysis and design is gained with several laboratory experiences.

ME 407 Power Plants 4R-0L-4C S Pre: ME 301

Steam, cogeneration and combined cycles are studied with the aid of property software. Various components of the cycles are studied in detail. A survey of alternative power sources is presented. Tours of power plants are taken when available.

ME 408 Renewable Energy 4R-0L-4C Pre: ES 202 or equivalent

Covers renewable energy sources such as solar heating and cooling, wind energy, biomass, and photovoltaic energy. Surveys the energy availability of these sources and life cycle cost and present value used to evaluate the system. Students will design a system which utilizes a renewable energy source and economically evaluate the system.

ME 409 Air Conditioning 4R-0L-4C F Pre: ES 202 and ME 302 or consent of instructor

Human comfort and the properties of air. Air conditioning in residences, public and industrial buildings using vapor compression and absorption units. Cooling loads, psychrometry, fans, duct sizing and layout, automatic control, and acoustic design considerations.

ME 410 Internal Combustion Engines 4R-0L-4C F Pre: ES 202

Study of spark ignition and compression ignition engines. Influences of engine design features on performance, economy, and air pollution. Influence of the combustion process, carburetion, fuel injection and ignition characteristics on engine operation.

ME 411 Propulsion Systems 4R-0L-4C S Pre: ME 301

Application of basic principles in the study of the performance characteristics of air and space vehicles. Aerodynamics of steady one dimensional isentropic compressible flow. Shock waves, gas turbines, turbojet, turbofan, turboprop, turboshaft, ram jet, rocket, nuclear propulsion and space propulsion systems are discussed and compared.

ME 415 Corrosion and Engineering Materials 4R-0L-4C Pre: ME 328 or CHE 362

Presents fundamentals of metallurgy and corrosion mechanisms in engineering metals. Discusses various classes of corrosion and methods of mitigating corrosion with emphasis on practical situations.

ME 416 Introduction to MEMS: Fabrication and Applications 3R-3L-4C S Pre: JR or SR standing

Properties of silicon wafers; wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor.

***ME 417 Advanced Materials Engineering 4R-0L-4C Pre: ME 328 and EM 203**

Fundamentals of deformation and fracture in metals, polymers, and ceramics with application to design. Emphasis on time-temperature dependence of polymers, brittle behavior of advanced ceramics, and the fracture mechanics approach to design of high strength and critical application materials.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 419 Advanced MEMS: Modeling and Packaging 3R-3L-4C F Pre: PH410 or equivalent course

Design process, modeling; analytical and numerical. Actuators; dynamics and thermal issues. Use of software for layout and simulation. Characterization and reliability of MEMS devices. Electrical interfacing and packaging of MEMS.

Microsensors, microfluidic systems, applications in engineering, biology, chemistry, and physics.

ME 420 Consulting Engineering Seminar 2R-0L-2C S Pre: Junior class standing

Discusses problems in the field of consulting engineering; seminars presented by practicing consulting engineers.

ME 421 Mechanical Engineering Laboratory 0R-6L-2C F,W Pre: ME 311 and RH 330

Introduction to engineering experimentation, centered on an experimental project planned and executed by students. Uncertainty analysis, instrumentation systems, and statistical design of experiments. Emphasis on project on project planning and execution, developing a scope of work, interim deliverables, and reporting engineering results.

***ME 422 Finite Elements for Engineering Applications 4R-1L-4C W Pre: Junior class standing**

Introduces finite element methodology from a strongly theoretical perspective. Emphasizes solving various one-dimensional, transient, non-linear problem statements including heat conduction, beam deflection, convection/diffusion (transport), gas dynamic shocks, and open channel flows. Assesses higher order bases, time stepping procedures, iterative solvers, and finite difference methodologies. Utilizes Matlab for computational experiments.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 424 Composite Materials and Mechanics 3R-3L-4C Arranged Pre: ES 202

Introduces materials and mechanics of composites with emphasis on high performance polymer matrix composites. Topics include material selection, laminate analysis, manufacturing, joining, and testing. A team design-built-test project is required.

ME 425 Aerospace Engineering Laboratory 1R-3L-2C Pre: ES 202

Introduction to experiment planning and execution. Projects involve wind tunnel testing including measurement of forces and moments and flow visualization. Student organized and executed with direct faculty consultation. Emphasis on written presentation.

ME 426 Turbomachinery 4R-0L-4C Pre: ES 205 and ES 202 or equivalent

Introduces the theory and issues related to the design of axial and radial flow turbines, compressors and pumps. Euler□s equation and vector diagrams are used to evaluate energy transfer and efficiency.

***ME 427 Introduction to Computational Fluid Dynamics 4R-0L-4C Pre: ES 202 and ME 323**

Introduces the finite difference method to solve problems in fluid mechanics and heat transfer.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 430 Mechatronic Systems 3R-3L-4C F,W Pre: ECE 207, ME 323 or consent of instructor

Applications of microprocessors and microcontrollers and digital electronics to the design and utilizations of embedded control systems in smart systems and products. Topics include Boolean logic and algebra, system hardware and software development, and interfacing for mechanical applications.

***ME 435 Robotics Engineering 3R-3L-4C W Pre: Senior class standing**

Interdisciplinary course in engineering systems applied to computer controlled automata. Topics include kinematics, control, operation, sensing, and design as applied to various types of industrial and other robots and programmable manipulators. A related project is required.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 450 Engineering Design 3R-3L-4C W Pre: EM 203
Application of fundamentals of engineering mechanics in analysis and synthesis of machine components and machine systems with special emphasis on stress/strength analysis and fatigue failures. Group projects are used to illustrate the course concepts.

ME 460 Machine Design 3R-3L-4C S Pre: ME 450
Design of mechanical components and systems including threaded fasteners, springs, bearings, gears, shafts, clutches, brakes, belts, chains, and couplings. Group projects are used to illustrate the course concepts.

ME 461 Aircraft Design 4R-0L-4C W Pre: ME 305 or consent of instructor
Fundamentals of conceptual aircraft design. Aerodynamic analysis, design constraints based on customer requirements, mission profiles, aircraft sizing, optimization, and presentation of performance capabilities. Oral and written communication emphasized. Design teams. Can be taken in lieu of ME 460, Machine Design or ME 462, Thermal Design.

ME 462 Thermal Design 4R-0L-4C W,S Pre: ES 202 and ME 302
Applications of the thermodynamic, heat transfer, and fluid flow principles to the modeling and design of thermal systems. These systems include pumps, fans, and heat and mass exchangers. A team project which includes the design, construction and testing of a fluid or thermal device or system provides the focus for the course.

ME 470 Engineering System Design 3R-3L-4C F Pre: Senior class standing
Design of multi-component systems with consideration of societal and economic factors. Useful design techniques (such as modeling, CPM, optimization, probabilistic approaches, etc.) and factors influencing design (such as human factors, products liability, ethics, safety, etc.) are presented and discussed. Laboratory assignments emphasize case studies. *(Students completing ME470 may not receive credit for EMGT 461.)*

ME 490-491 Directed Research. Hours as assigned. Maximum 4 credits per term. F,W,S Pre: Completion of freshman and sophomore course requirements and approval of adviser and course instructor
Selected projects for student research.

ME 493 Selected Topics in Design. Hours as assigned. Maximum 4 credits per term. F,W,S Pre: Senior class standing
Selected student design projects. May include testing and/or computer aided design.

ME 497 Special Topics in Mechanical Engineering 4R-0L-4C Arranged
Topics of current interests in mechanical engineering.

NOTE: Maximum 8 credits total in ME 193, ME 293, ME 393, ME 490, ME 491 and ME 493.

UNDERGRADUATE-GRADUATE COURSES

ME 490-491 Directed Research. Hours as assigned. Maximum 4 credits per term. F,W,S Pre: Completion of freshman and sophomore course requirements and approval of adviser and course instructor.

***ME 501 Advanced Thermodynamics 4R-0L-4C F Pre: ME 301 or equivalent**
Study of advanced thermodynamic topics: modeling of transient systems, exergy (availability) analysis, equations of state and thermodynamics relationships for simple, compressible substances.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 502 Topics in Heat Transfer 4R-0L-4C Arranged Pre: ME 302**

Course may be repeated for different heat transfer topics.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 503 Viscous Fluid Flow 4R-0L-4C Pre: ES 202**

Material and spatial descriptions of fluid motion. The Reynolds transport equation. The stress tensor and governing equations for the motion of viscous fluids. Newtonian fluids, the Navier-Stokes equations. Asymptotic solutions including fully developed channel flow, oscillating flat plate, wakes and jets. Introduction to boundary layers and turbulent flow including Reynolds averaging.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 505 Modeling and Simulation of Dynamic Systems 4R-0L-4C Pre: ES 205, MA 222**

Modeling and simulation of engineering components and systems. Emphasis on a unified work-energy approach to modeling physical systems, model formulation using a differential-algebraic form of Lagrange□s equation, and the numerical solution of the resulting initial-value problem. Applications are explored using modeling and simulation projects.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 506 Advanced Control Systems 4R-0L-4C Pre: ME 406 or equivalent or consent of instructor**

Physical models for control; system response, analysis and design. Time domain; system response, analysis and design. Frequency domain; state variable representation/description; stability, controllability, observability; linear quadratic regulator, pole-placement, state estimation/observers.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 507 Applied Nonlinear Control Systems 4R-0L-4C Pre: ME 406 or equivalent or consent of instructor**

Analysis and design of controls for inherently nonlinear systems and the use of nonlinear elements in design. Techniques for analysis and design include, stability by Liaqunov, describing functions, phase plane analysis, sliding control, adaptive control and control of multi-input systems.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 510 Gas Dynamics 4R-0L-4C F Pre: ES 202**

Introduction to the dynamics of a compressible flow. Equations of motion for subsonic and supersonic flow. Nozzle flow. Normal and oblique shock waves, Prandtl-Meyer flow. Steady and unsteady, one dimensional gas flow with friction and heat transfer

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective..*

***ME 511 Numerical Methods for Dynamic Systems Analysis 4R-0L-4C Pre: ES 205 and ME 323**

Applications of approximate numerical solution techniques, including the finite element method, to the analysis of dynamic, continuous systems. Introduction to variational principles in mechanics for purposes of formulating governing equations of motion.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 512 Light Weight Structures 4R-0L-4C S Pre: MA 222 and EM 203**

Applies the principles of mechanics to the structural analysis of mechanical and aerospace components. Covers stress tensors, shear flow in open and closed sections, beam columns, unsym-metrical bending. Castigliano□s

theorem, statically indeterminate structures , thin walled pressure vessels, introduction to elasticity.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 513 Environmental Noise 4R-0L-4C F Pre: Senior class standing**

Introduces noise and its sources as a potential public health hazard. Covers the basics of sound propagation relating to noise measurement and analysis. Emphasizes effects on humans and the environment. Covers methods of noise and vibration control and abatement including absorption, enclosures, vibration isolation, damping, and mufflers. Team projects involving noise measurement and reduction are required.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 516 Introduction to MEMS: Fabrication and Applications 3R-3L-4C S Pre: JR or SR standing

Properties of silicon wafers; wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor.

Students enrolled in PH510, ME516, ECE516, CHE505, BE516 must do project work on a topic selected by the instructor.

***ME 518 Advanced Kinematics 4R-0L-4C S Pre: ME 303**

Considers the analysis, design, and simulation of planar and spatial mechanisms. The mechanisms examined are parallel manipulators, serial manipulators, and compliant mechanisms. These mechanisms are analyzed for position, velocity, acceleration, and workspace. The techniques used for the analysis include vector approaches, homogeneous transformations, and dual number techniques.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

ME 519 Advanced MEMS: Modeling and Packaging 3R-3L-4C F Pre: PH410 or equivalent course

Design process, modeling; analytical and numerical. Actuators; dynamics and thermal issues. Use of software for layout and simulation. Characterization and reliability of MEMS devices. Electrical interfacing and packaging of MEMS. Microsensors, microfluidic systems, applications in engineering, biology, chemistry, and physics.

Students enrolled in PH511, ME519, ECE519, CHE519, BE519 must do project work on a topic selected by the instructor.

***ME 520 Computer-Aided Design and Manufacturing (CAD/CAM) 4R-0L-4C S Pre: ME 323 and senior class standing**

Use and management of computer in engineering for drafting, design management, documentation, and manufacturing. Covers drafting methods and standards, design data management, CNC operations and implementation.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 522 Advanced Finite Element Analysis 4R-1L-4C S Pre: ME 422**

A continuation of ME 422. Includes multi-dimensional extensions of 2-D theory for transient, nonlinear problem statements in engineering. Utilizes Matlab and Ansys for developing and assessing FEA solutions to real world problems via theory developed in ME 422.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 590 Thesis Research F,W,S**

Credits as assigned; however, not more than 12 credits will be applied toward the requirements of an M.S. degree.

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective.*

***ME 597 Selected Topics for Graduate Students. Credits as assigned. Maximum 4 credits per term. F,W,S**

** May be used to satisfy Mechanical Engineering requirement for an advanced technical elective..*

5500 Wabash Avenue / Terre Haute, IN 47803 / (812) 877-1511