

MECHANICAL ENGINEERING (M E)

M E 101 - Foundations of Mechanical Engineering (2.0 hours)

Nature of mechanical engineering as a profession and as a technological response to human needs. Emphases: design process, problem solving, and engineering experimentation.

Prerequisite: Consent of instructor or department chair.

M E 102 - Engineering Design Graphics (2.0 hours)

Principles and methods of graphic communications, integrated with creative design problem solving: multi-view projections; pictorial drawing; fundamentals of descriptive geometry, sections, and dimensioning.

Prerequisite: Enrolled as a mechanical engineering major; Minimum of C in ME 101 or equivalent with consent of instructor.

M E 200 - Engineering Co-Op (0.0 hours)

Core Curriculum: EL

Full-time cooperative education assignment for mechanical engineering students who alternate periods of full-time school with periods of full-time academic or career-related work in industry. Satisfactory/Unsatisfactory.

Prerequisite: Sophomore standing in the College of Engineering and Technology, 2.0 overall grade point average at Bradley, approval of engineering and technology Co-op coordinator and Co-op faculty advisor.

M E 273 - Computational Methods in ME (3.0 hours)

Computational techniques and programming methods for mechanical engineering problems.

Prerequisite: Minimum grade of C in both PHY 110 and MTH 223.

Corequisite: MTH 224.

M E 280 - Introduction Biomedical Engineering (3.0 hours)

Core Curriculum: MI

Biomedical Engineering is an interdisciplinary field that encompasses biomechanics, biofluidics, medical imaging, bio-instrumentation etc for applications in the medical field. The content introduces a biological overview of the body, from cells to systems, and design and applications of engineering principles to biological systems. The broad objective of this course is to introduce students to the wide landscape early on in their curriculum.

Prerequisite: Science and Engineering Majors

M E 300 - Energy and Society (3.0 hours)

A general education course that covers fossil, renewable, and nuclear forms of energy, the related technologies, and the impact of energy usage on the environment, climate, security and economy. The course will meet in seminar format with discussions led by the instructor supplemented with hands on experiments and demonstrations, guest lectures, presentations by student teams and/or student team debates addressing energy related issues with especially important societal implications.

Prerequisite: Jr/Sr standing or consent of the instructor

M E 301 - Thermodynamics I (3.0 hours)

Emphasis on concepts, laws, and problem solving methodology; properties of materials, especially gases and vapors; simple equations of state; 1st and 2nd laws; introduction to cycles and systems.

Prerequisite: Minimum grade of C in CHM 110, 111; Minimum grade of C in PHY 201; Minimum grade of C in MTH 223.

M E 302 - Thermodynamics II (2.0 hours)

Continuation of ME 301 with emphasis on engineering applications: including more detailed analysis of vapor cycles, power cycles, refrigeration cycles, and heat pump cycles, enhanced second law analysis, and more complex processes that include mixtures, humidification, combustion, and equilibrium.

Prerequisite: minimum grade of C in ME 301.

M E 303 - Instrumentation and Measurement (3.0 hours)

Theory and practice of measurements and instrumentation. Definition of a measurement system that meets specified needs: identification, selection, and specification of instrumentation components. Weekly laboratory.

Prerequisite: ECE 227

Corequisite: COM 103, M E 273, M E 301

M E 308 - Thermodyn Fluid Flow (4.0 hours)

Thermodynamics of fluid flow. Basic concepts of fluid mechanics; utility of the control volume approach to solving conservation equations governing the behavior of compressible and incompressible fluid flows. Design applications in thermal systems, aerodynamics, and convective heat transfer.

Prerequisite: Minimum grade of C in ME 301, MTH 224

M E 341 - Engineering Systems Dynamics (3.0 hours)

Engineering systems dynamics, including mechanical, electrical, fluid, and thermal elements. Concepts of modeling. Mathematical methods for understanding and creating desired response behavior of linear systems.

Prerequisite: Minimum grade of C in PHY 201; Minimum grade of C in MTH 224; Minimum grade of C in CE 250.

M E 342 - Design of Machine Elements (3.0 hours)

Application of stress analysis, deflection analysis, dynamic analysis, and materials to the design of mechanical components and machines. How available manufacturing processes influence nature of machine elements.

Prerequisite: Minimum grade of C in CE 270 and ME 351; prerequisite or concurrent enrollment in ME 303

M E 344 - Kinematics and Dynamics of Machines (3.0 hours)

Kinematic and dynamic analysis and synthesis of mechanisms and machines; kinematics of linkages, cams and gearing systems; different analysis methods. Static and dynamic forces; balancing of rotating and reciprocating machines. Integration of these topics in solving open-ended design problems.

Prerequisite: ME 273, CE 250.

M E 351 - Engineering Materials Science I (3.0 hours)

Understanding how atomic and crystalline structure influences the mechanical properties of metals, polymers, ceramics, composite, and biomedical materials. Thermal processes that influence the underlying structure of solids. Using materials in the engineering design process.

Prerequisite: Minimum grade of C in PHY 110; Minimum grade of C in CHM 112 or Minimum grade of C in CHM 116.

Corequisite: PHY 201.

M E 354 - Principles of Materials Science Laboratory Practices (3.0 hours)

Topics and experiments involving thermal analysis, mechanical measurements, phase transformation, mechanical deformation, diffusion, corrosion, and electrical properties of materials.

Prerequisite: minimum grade of C in ME 351 or equivalent.

M E 390 - Mechanical Engineering Seminar (0.0-1.0 hours)

Selected topics in Mechanical Engineering. Students attend weekly seminars pertaining to all aspects of the field. May be repeated under different topics. Repeatable to a maximum of one hour. Course graded Satisfactory/Unsatisfactory.

M E 403 - Mechanical Engineering Systems Laboratory (3.0 hours)

Student team investigations of thermal and mechanical systems emphasizing definition, planning, design, and execution of experiments involving system modeling and analysis. Written reports and oral presentations are required.

Prerequisite: Minimum grade of C in both ME 303 and CE 270

Corequisite: 300-level English composition, ME 415, ME 441

M E 407 - Power Plant Design (3.0 hours)

Comprehensive study of equipment and thermodynamic cycles relating to modern, fossil fueled power plants. Development of thermal-hydraulic designs for heat exchangers, condensers, steam generators, and turbines for a proto-typical plant. Extensive computational parametric studies for understanding salient parameters governing selection of optimal hardware configurations.

Prerequisite: ME 302, 308.

M E 409 - Mechanical Engineering Projects (1.0-4.0 hours)

Special topics or projects of an experimental, analytical, or creative nature. May be repeated up to 16 credit hours.

Prerequisite: Consent of instructor.

M E 410 - Mechanical Engineering Senior Project I (3.0 hours)

Core Curriculum: WI,EL

Team based investigations of open-ended engineering design problems. Each project will place an emphasis on problem definition, planning, analysis, synthesis, evaluation, and teamwork. The projects may involve experimentation and/or construction of models. Students enrolled in this course are required to be within 3 semesters of graduation and have a minimum ME GPA 2.25.

Prerequisite: Senior standing in ME. Instructor consent may be required.

M E 411 - Mechanical Engineering Senior Design Project II (2.0 hours)

Core Curriculum: EL,WI

Continuation and completion of senior project begun in ME 410.

Prerequisite: ME 410. Instructor consent may be required.

M E 415 - Introduction to Heat Transfer (3.0 hours)

Steady state and transient conduction; external and internal forced convection and free convection; radiation; heat exchanger design.

Prerequisite: ME 302. C or better in ME 308.

M E 441 - Mechanical Control Systems (3.0 hours)

Linear feedback control design and analysis for dynamic systems with applications; examples taken from applications encountered by mechanical and manufacturing engineers. Time and frequency response techniques. System performance analysis.

Prerequisite: ME 341. ECE 227.

M E 448 - Computer Aided Design in Mechanical Engineering (3.0 hours)

Design of mechanical systems and components enhanced by applications of computer graphics. Computer graphics hardware characteristics; transformation and projection geometry; space curves and surface presentations; solid geometric representations. User application CAD packages for finite element analysis and mechanisms and systems simulation.

Prerequisite: senior standing in ME or consent of instructor.

M E 491 - Special Topics in Mechanical Engineering (3.0 hours)

Topics of special interest which may vary each time course is offered.

Topic stated in current Schedule of Classes. Undergraduate students may repeat the course under different topic names up to a maximum of 9 credits.

Prerequisite: Consent of instructor

M E 498 - ME Senior Research Project I (3.0 hours)

Core Curriculum: WI,EL

Team investigations of open-ended engineering research problems. Each project will place an emphasis on problem definition, planning, analysis, synthesis, evaluation, and teamwork. The projects may involve experimentation and/or construction of models. Students enrolled in this course are required to be within 3 semesters of graduation and a minimum ME GPA of 2.25.

Prerequisite: Senior standing in ME. Instructor consent may be required.

M E 499 - ME Senior Research Project II (3.0 hours)

Core Curriculum: WI,EL

Continuation and completion of senior project begun in ME 498.

Prerequisite: ME 498. Instructor consent may be required.

M E 501 - Advanced Thermodynamics (3.0 hours)

Laws and concepts of classical thermodynamics: real gases and equations of state; availability; irreversibility; property relations; potential functions; equilibrium; multicomponent systems.

Prerequisite: ME 302; or graduate standing.

M E 502 - Problems in Advanced Dynamics (3.0 hours)

Application of analytical and graphical methods to problems involving velocities, accelerations, working and inertia forces.

Prerequisite: ME 341; or graduate standing.

M E 503 - Internal Combustion Engines (3.0 hours)

Thermodynamic analysis, thermo-chemistry, and performance characteristics of spark ignition and compression ignition engines.

Prerequisite: ME 301 and ME 302; or graduate standing.

M E 509 - Solar Engineering (3.0 hours)

Nature and characteristics of solar energy as a renewable energy resource. Solar geometry and radiation. Thermodynamics of solar systems; emphasis on 2nd Law considerations. Performance characteristics of collectors, storage systems, house heating systems, cooling and refrigeration, and photovoltaics. Comprehensive design project. Theory and performance characteristics of solar devices and application to design of a comprehensive solar energy system.

Prerequisite: ME 415 or consent of instructor.

M E 515 - Intermediate Heat Transfer (3.0 hours)

In-depth treatment of the three modes of heat transfer; design applications. Development of analytical and specific numerical skills needed for solving design problems involving heat transfer.

Prerequisite: ME 415; or graduate standing.

M E 520 - Gas Dynamics (3.0 hours)

One dimensional flow: wave and shock motion in subsonic and supersonic flow; flow with heat transfer and friction; viscosity effects; similarity. Introduction to multidimensional flow.

Prerequisite: ME 308; or graduate standing.

M E 521 - Intermediate Fluid Mechanics (3.0 hours)

Analysis of statics and dynamics of non-viscous and viscous fluids. Derivation of differential equations of motion. Potential flow; vortex motion; creeping motion; introduction to boundary layer theory; turbulence.

Prerequisite: MTH 224 and ME 308; or graduate standing.

M E 533 - Propulsion Systems (3.0 hours)

Gas turbine analysis; stationary power plants; turboprop, turbojet, and ramjet engines; rocket propulsion; application of thermodynamics.

Prerequisite: ME 308; or graduate standing.

M E 534 - Environmental Engineering-Air Conditioning (3.0 hours)

Core Curriculum: WI

Heating and cooling of moist air; solar radiation; computation of heating and cooling loads; study of heating, ventilating, and cooling systems and equipment; design project.

Prerequisite: ME 301.

M E 535 - Environmental Engineering-Refrigeration (3.0 hours)

Mechanical vapor compression refrigeration cycles; refrigerants; absorption refrigeration; miscellaneous refrigeration processes; cryogenics; semester design project.

Prerequisite: ME 301.

M E 536 - Industrial Pollution Prevention (3.0 hours)

Industrial pollution prevention for small quantity generators such as foundries, metal fabrication, electroplating, electronics, soldering, wood products, cleaning, degreasing, and coating. Study of emerging technologies for pollution prevention. Relationships among energy consumption, waste production, and productivity enhancement. Actual plant assessments.

Prerequisite: Consent of instructor; or graduate standing.

M E 537 - Building Energy Management (3.0 hours)

The energy problem. Energy consumption patterns in existing and new buildings. Analysis of energy saving strategies for existing buildings; developing designs for new, energy efficient buildings, including reliability, comfort, and economic considerations. Formal oral presentations.

M E 540 - Advanced Mechanical Vibrations (3.0 hours)

Principles of vibrations in one or more degrees of freedom; application to machine members.

Prerequisite: ME 341; MTH 224; or graduate standing.

M E 544 - Mechanical Systems Analysis (3.0 hours)

Mathematical modeling of mechanical, electrical, pneumatic, hydraulic, and hybrid physical systems emphasizing a unified approach such as the Bond graph technique. LaPlace, state-variable, and matrix formulation of models. Systems response characteristics, prediction, and analysis.

Prerequisite: ME 341; or graduate standing.

M E 547 - Fluid Power Control Systems (3.0 hours)

Definition and scope of fluid power control systems. Fluid properties. Continuity and power balance equations. Components function, operation, and dynamic performance. Use of perturbation theory for developing linearized transfer functions. Application of conventional control theory.

Prerequisite: ME 301, ME 308; or graduate standing.

M E 548 - Optimization of Mechanical Systems (3.0 hours)

Development and application of optimization techniques in design of engineering systems and elements; mathematical modeling and formulation of design problems for optimization; different optimization methods including linear, non-linear, geometric and dynamic programming; shape optimization. Emphasis on development and choice of appropriate search methods, sensitivity analysis, and programming.

Prerequisite: Senior standing in engineering or consent of department; or graduate standing.

M E 549 - Microprocessor Interfacing in Mechanical Systems (3.0 hours)

Principles of microprocessor hardware and software; integration of microprocessor hardware and software in mechanical systems for data acquisition and control purposes (e.g., robotics, internal combustion engine monitoring systems, and pneumatic controls). Intensive hands-on laboratory exercises and practical problem solving. Introduction of "mechatronics."

Prerequisite: ME 303; ECE 227; proficiency in at least one computer language; or consent of instructor.

M E 554 - Fracture of Solids (3.0 hours)

Mechanical failure caused by stresses, strains, and energy transfers in mechanical parts: conventional design concepts and relationship to occurrence of fracture; mechanics of fracture; fracture toughness; macroscopic and microscopic aspects of fracture; high and low cycle fatigue failures; creep; stress rupture; brittle fracture; wear; case studies of failure analysis. Emphasis on time-dependent failures.

Prerequisite: M E 354 and C E 270; or graduate standing.

M E 556 - Mechanics of Composite Materials (3.0 hours)

Mechanical behavior, analysis, and design of various advanced composite materials: introduction to composite materials and their applications; elasticity of anisotropic solids; micromechanics of fiber reinforced composites and particulate composites; short fiber composites; macromechanics of laminated composites; thermal stresses; failure criteria; fracture and fatigue, reliability, testing, and design of composite materials. Emphasis on developing simple microcomputer programs for analysis. Projects involve curing and testing composites.

Prerequisite: CE 270; or graduate standing.

M E 557 - Advanced Design of Machine Elements (3.0 hours)

Review of mechanical testing, 3-D stress-strain relationship, complex and principal states of stress, yielding and fracture under combined stresses, fracture of cracked members, stress and strain based approaches to fatigue, creep damage analysis, and plastic damage analysis as applied to the design of machine elements.

Prerequisite: ME 342 and ME 351, with a minimum grade of C; or graduate standing in ME. Requires consent of instructor if non-ME Student.

M E 560 - Principles of Robotic Programming (3.0 hours)

Programming of industrial robotic manipulators with external inputs, tactile sensing, and vision sensing. A design project is required. Cross-listed as IME 560.

Prerequisite: graduate or senior standing in engineering or computer science.

M E 561 - Introduction to Robotics (3.0 hours)

Coordinate transformation, forward & inverse kinematics, robot dynamics, robot control, motion planning, actuators and sensors, and robotic vision. A design project is required.

Prerequisite: Graduate or senior standing in engineering or computer science; consent of the instructor

M E 562 - Dynamics, Modeling, and Control of Robots (3.0 hours)

Fundamental concepts and methods to analyze, model, and control robotic systems. Kinematics/dynamics, modeling and controller design of robotic arms, mobile robots, and drones. Plant visits to observe robots in action; hands-on practice using Arduino or Raspberry-Pi.

Prerequisite: M E 344, ECE 227; or consent of instructor.

M E 564 - Sensor, Actuators, and Computer Vision (3.0 hours)

Fundamental principles of sensors, actuators, and computer vision; Image processing, image recognition, and face detection; Introduction to OpenCV and MATLAB computer vision;

Prerequisite: M E 273, M E 303; or consent of instructor

M E 568 - Motion planning (3.0 hours)

This course provides an in-depth treatment of path planning and motion in robotic systems. Common techniques and algorithmic procedures used for planning and decision-making are covered. Case studies include mobile manipulation platforms and multi-robot systems. The student evaluation will be done by tests, homework, and projects.

Prerequisite: Senior or Graduate Standing

M E 573 - Methods of Engineering Analysis (3.0 hours)

Application of principles of analog and digital computers and numerical methods to solve mechanical engineering problems.

Prerequisite: ME 341; ME 273; MTH 224; or graduate standing.

M E 577 - Finite Element Methods in Engineering (3.0 hours)

Theory of finite element methods and applications in mechanical engineering: review of matrix algebra and basic theorem of elasticity. Direct formulation of plane truss element and variational formulations of plane stress/strain, axisymmetric solids, flexural beam, and flat plate elements. Element analysis and isoparametric formulation. Applications to problems of stability, vibrations, thermal stress analysis, and fluid mechanics. Computer programming techniques.

Prerequisite: Senior standing in ME or consent of instructor; or graduate standing.

M E 580 - Biomechanics (3.0 hours)

Human body as a mechanical system. Biomechanics of cells, soft tissue and hard tissue Biomechanics of movement. Laboratory exercises on design and analysis of implants.

Prerequisite: senior or graduate standing in engineering or consent of instructor.

M E 588 - Human Centered Design (3.0 hours)

Principles and practices of biomedical engineering for integration into design. The focus on human limits including physical, visual, cognitive and medical will serve as the basis for technology evaluations and case studies. Design and analysis with team-based, open ended client specific project.

Prerequisite: Senior or graduate standing and consent of instructor

M E 591 - Topics in Mechanical Engineering (3.0-9.0 hours)

Topics of special interest which may vary each time course is offered. Topic stated in current Schedule of Classes. Graduate students may repeat the course under different topic names up to a maximum of 9 credits.

Prerequisite: consent of instructor.

M E 604 - Design of Internal Combustion Engines (3.0 hours)

Detailed study of design of internal combustion engines. Gas-pressure and inertia-force diagrams; determination of bearing loads; torsional vibration analysis; stress analysis and design of components, including piston, connecting rod, crankshaft, flywheel, valve mechanism, and cam layout.

Prerequisite: undergraduate courses in dynamics of machines, internal combustion engines, and machine design, or consent of instructor.

M E 648 - Advanced Computer Aided Design (3.0 hours)

Augmentation of mechanical design through application of computer graphics. Hardware/software characteristics; elements of geometric/solid modeling. Emphasis on integration in the application of the design process through packages for geometric/solid modeling, finite element analysis, and mechanisms and system simulation.

Prerequisite: BSME; or background in mechanical and thermal systems and consent of department chair. Students without a BSME degree may take ME 342, ME 344, ME 415, and ME 411 to help develop an appropriate background for the course.

M E 681 - Research (0.0-6.0 hours)

Research on a project selected by student and advisor.

M E 682 - Research (0.0-6.0 hours)

Individual study on a topic selected by the student with advisor approval. Integration and application of research. Student must produce a product such as a software program or journal article

Prerequisite: consent of instructor.

M E 699 - Thesis (0.0-6.0 hours)

Maximum of 6 semester hours total of research and/or thesis may be applied toward the master's degree.

Prerequisite: consent of department.