Department of Mechanical Engineering

The baccalaureate program in mechanical engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone (410) 347-7700.

FACULTY *Professors Mehta (chair), Abou-Hanna, Elbella, Hurt (Emeritus), Okamura (Emeritus), Ratcliff (Emeritus), Safdari, Wessler (Emeritus); Associate Professors Deller, Fakheri, Morris, Peterson (Emeritus), Podlasek; Assistant Professors Kim, McGreevy, Reyer, Zietlow.*

Mission

The mission of the Mechanical Engineering Department is to produce mechanical engineering graduates who possess the acumen, competence, and skills needed to enter, succeed, and lead in professional practice and/or graduate school. The goal is to provide a learning and nurturing environment that stimulates faculty and students to collaborate in solving practical problems, motivates lifelong learning, and helps them reach their highest potential.

The objectives of the department are that a majority of the graduating students of the mechanical engineering program:

1. will be prepared to enter professional practice or pursue advanced studies
2. will be prepared to succeed in local, regional, national, and international practice
3. will be prepared for lifelong learning
4. will realize satisfaction in the educational investment
5. will be prepared to pursue opportunities in mechanical engineering
6. will be prepared to meet global technological and societal changing needs
7. will be prepared to interact globally with engineering technology

Mechanical engineering is the broadest and most versatile of the engineering professions. It utilizes a combination of human, material, and economic resources to translate ideas and theories into realistic problem solutions that satisfy the needs of society. Problems are solved in such varied areas as energy, environment, robotics, assistance for the handicapped, and air, land, sea, and space vehicles.

Mechanical engineers are particularly concerned with the application of the sciences of mechanics and energy to the generation, utilization, and conservation of energy, and to the design of mechanical systems which control forces, motions, and the flow of materials. No two mechanical engineers do exactly the same thing. Their specific careers are the result of choices depending on personal interests and the changing needs of society.

Computers are integrated throughout mechanical engineering. Microcomputers, graphics terminals, and workstations are incorporated into the laboratory where the students receive hands-on experience with computer aided design, microprocessor based instrumentation, measurement and control systems, and the interfacing of microprocessors in the design of mechanical systems.

The breadth of mechanical engineering is illustrated by the organization of the American Society of Mechanical Engineers (ASME), which supports mechanical engineers engaged in many areas. Some of these areas are: applied mechanics, bioengineering, dynamic systems and control including robotics, fluids engineering, heat transfer, materials, management, aerospace, air pollution control, diesel and gas engine power, gas turbines, computer and microprocessor applications, and solar energy.

Mechanical engineers are employed in a variety of service and product industries, in government, and in education. Many are self-employed as consultants. The undergraduate program also offers a particularly broad technical background for persons wishing to enter graduate programs in business, law and medicine.

The faculty believes that engineers must be firmly grounded in the fundamentals of their field and the supporting areas of mathematics, communication, and the sciences, so that graduates will be able to adapt quickly to the rapid changes occurring in our technological society. Therefore the curriculum has been designed to stress the basic tools of knowledge and practice essential to launch one's professional career and a lifelong process of continued learning.

The spectrum of mechanical engineering includes innovation and creation, research, design and synthesis, analysis, development, evaluation, production, and the marketing of machines, systems, and processes. Central to this activity is the design process which leads to the creation of solutions to real-world problems. Therefore the mechanical engineering curriculum integrates design experiences into all levels of the program and into a majority of the professional courses. This culminates in a required comprehensive design experience which is satisfied by a yearlong senior project and by the selection of a technical elective identified as satisfying this requirement in the program.

Studies in the humanities and social sciences serve not only to meet the objectives of a broad education, but also to meet the objectives of the engineering profession. Therefore, studies in the humanities and social sciences must be planned to reflect a rationale or fulfill an objective appropriate to the engineering profession and the University's educational objectives. Since the humanities and social science courses do not build on prerequisites in the same manner as engineering courses, we require at least one course at the 300 level or above to guide the student and ensure depth in his/her humanities and social science selection. The humanities and social science courses should be chosen to satisfy the University general education requirements, and it is recommended that two courses be taken in the same program with one being lower level and the other being at the 300 level or above.

Student chapters of the American Society of Mechanical Engineers (ASME), American Society for Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), and Society of Automotive Engineers (SAE) are sponsored by the department to support and encourage the professional development of the students. A national honorary society for mechanical engineering students, Pi Tau Sigma, is also represented.

In addition to the specific requirements listed for the

College of Engineering and Technology, a minimum grade point average of 2.25 in mechanical engineering courses must be achieved for graduation.

Students wishing to pursue graduate study in mechanical engineering may refer to the graduate catalog where course work leading to the MSME degree is described.

Freshman Year

First Semester

MTH 121 Calculus I	4
COM 103 The Oral Communication Process	3
ENG 101 English Composition	3
ME 101 Foundations of Mechanical Engineering	2
ME 103 Computational Techniques in Mech. Engineering	1
CHM 161 General Chemistry I	4
	17

Second Semester

MTH 122 Calculus II	4
CE 150 Mechanics I (Statics)	3
PHY 110 University Physics I	4
ME 102 Engineering Design Graphics	2
CHM 162 Engineering Chemistry	3
	16

Sophomore Year

First Semester

MTH 223 Calculus III	4
CE 250 Mechanics II (Dynamics)	3
PHY 201 University Physics II	4
MTH 202 Introduction to Numerical Methods	3
Gen. Ed. Western Civilization[1]	3
	17

Second Semester

ME 301 Thermodynamics I	3
MTH 224 Differential Equations	4
CE 301 Mechanics of Materials	3
ME 351 Engineering Materials Science I	3
ECO 100 Introduction to Economics[1] (Gen. Ed. - Social Forces)	3
	16

Junior Year

First Semester

ME 302 Thermodynamics II	2
ME 303 Instrumentation and Measurement	3
ME 308 Thermodynamics of Fluid Flow	4
ME 341 Engineering System Dynamics	3
EE 327 Fundamentals of Electrical Engineering I	3
ENG 300, 301, 304, 305, or 306 Advanced Writing	3
	18

[1]General education courses must be selected from an approved list for each category. They may be taken in any sequence not necessarily in the semester indicated. The courses selected must provide depth and not be limited to a selection of introductory courses. Other University general education requirements are satisfied by specific required courses.

[2]ME 410 and 411 — Enrollment in ME 410 and 411 is restricted to mechanical engineering students who are in the fourth year of the program.

[3]Departmental policy regarding approved technical electives is available in the department office.

Second Semester

ME 344 Kinematics and Dynamics of Machines	3
ME 403 Mechanical Engineering Systems Laboratory	2
ME 415 Introduction to Heat Transfer	3
ME 441 Mechanical Control Systems	3
EE 328 Fund. of Electrical Engineering II	3
Gen. Ed. – Non-Western Civilization[1]	3
	17

Senior Year

First Semester

ME 342 Design of Machine Elements	3
ME 354 Principles of Materials Science Lab Practices	3
ME 410 M.E. Senior Project I[2]	2
Gen. Ed. – Human Values[1]	3
Approved Design Technical Elective[3]	3
Approved Technical Elective[3]	3
	17

Second Semester

ME 411 M.E. Senior Project[2]	2
IME 301 Engineering Economy	3
Gen. Ed. – Social Forces[1]	3
Gen. Ed. – Fine Arts[1]	3
Approved Technical Electives[3]	6
	17

Total Hours 135

Course Descriptions

ME 101 Foundations of Mechanical Engineering
2 hrs.
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.

ME 102 Engineering Design Graphics
2 hrs.
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: ME 101 or consent of instructor.

ME 103 Computational Techniques in Mechanical Engineering
1 hr.
Computational techniques and programming methods for mechanical engineering problems. Prerequisite: consent of instructor or department chair.

ME 200 Engineering Co-op
0 hrs.
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. Prerequisites: sophomore standing in the College of Engineering and Technology, 2.0 overall gradepoint average at Bradley, approval of engineering and technology Co-op coordinator and Co-op advisor.

ME 301 Thermodynamics I
3 hrs.
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. Prerequisites: ME 103 or equivalent; CHM 161; PHY 201; MTH 223.

ME 302 Thermodynamics II
2 hrs.
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.

ME 303 Instrumentation and Measurement
3 hrs.
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. Prerequisites: PHY 201; prerequisites or concurrent enrollment in ME 301, EE 327, MTH 202.

ME 308 Thermodynamics of Fluid Flow
4 hrs.
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. Prerequisites: minimum grade of C in ME 301, MTH 224. Corequisite: ME 303.

ME 341 Engineering Systems Dynamics
3 hrs.
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. Prerequisites: PHY 201; MTH 224; CE 250.

ME 342 Design of Machine Elements
3 hrs.
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. Prerequisites: minimum grade of C in CE 301 and ME 351; prerequisites or concurrent enrollment in ME 303, ME 344, and ME 354.

ME 344 Kinematics and Dynamics of Machines
3 hrs.
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. Prerequisites: MTH 202, CE 250; prerequisite or concurrent enrollment in ME 341.

ME 351 Engineering Materials Science I
3 hrs.
Atomic and crystalline structure of solid materials commonly used in engineering applications. Effects of internal structure on physical properties of materials. Prerequisites: CHM 161; PHY 201.

ME 354 Principles of Materials Science Laboratory Practices
3 hrs.
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.

ME 403 Mechanical Engineering Systems Laboratory
2 hrs.
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. Prerequisites: COM 103; minimum grade of C in ME 303, CE 301, ME 308; Prerequisites or concurrent enrollment in 300-level English composition, ME 302, ME 341, ME 415.

ME 407 Power Plant Design
3 hrs.
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. Prerequisites: ME 302, 308.

ME 409 Mechanical Engineering Projects
1-4 hrs. each semester
Special topics or projects of an experimental, analytical, or creative nature. May be repeated up to 16 credit hours. Prerequisite: consent of instructor.

ME 410 Mechanical Engineering Senior Project I
2 hrs.
Individual or small team investigation of open-ended engineering problems. Emphasis on problem definition, planning, analysis, synthesis, and evaluation. May involve experimentation and/or construction of models. Prerequisites: ME 102, senior standing in ME and consent of instructor. Corequisites: ME 403, ME 342.

ME 411 Mechanical Engineering Senior Project II
2 hrs.
Continuation and completion of senior project begun in ME 410. Prerequisites: ME 410 and consent of instructor.

ME 415 Introduction to Heat Transfer
3 hrs.
Steady state and transient conduction; external and internal forced convection and free convection; radiation; heat exchanger design. Prerequisites: ME 302, ME 308.

ME 441 Mechanical Control Systems
3 hrs.
Sequencing control theory of linear feedback control systems; examples taken from applications encountered by mechanical and manufacturing engineers. Time and frequency response techniques. Analysis and design of fluid powered control systems. Microprocessors and computer control applications. Prerequisites: ME 341. Corequisite: EE 328.

ME 448 Computer Aided Design in Mechanical Engineering
3 hrs.
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.

ME 501 Advanced Thermodynamics
3 hrs.
Laws and concepts of classical thermodynamics: real gases and equations of state; availability; irreversibility; property relations; potential functions; equilibrium; multicomponent systems. Prerequisite: ME 302.

ME 502 Problems in Advanced Dynamics
3 hrs.
Application of analytical and graphical methods to problems involving velocities, accelerations, working and inertia forces. Prerequisite: ME 341.

ME 503 Internal Combustion Engines
3 hrs.
Thermodynamic analysis, thermo-chemistry, and performance characteristics of spark ignition and compression ignition engines. Prerequisites: ME 301; ME 302 or consent of instructor.

ME 504 Experimental Stress Analysis
3 hrs.
Experimental methods of stress analysis. Strain gages and related transducers. Photoelasticity and polariscopes. Instrumentation amplifiers, integrated circuits and other electronics used for connecting transducers with a terminating device. Analog to digital conversion. Extensive hands-on laboratory exercises are emphasized. Prerequisite: ME 303, 403 or consent of instructor.

ME 509 Solar Engineering
3 hrs.
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.

ME 512 Heat Transfer – Convection
3 hrs.
Non-isothermal flow of fluids in Cartesian, cylindrical, spherical, and other coordinate systems: slug flow, laminar flow, flow entrance effects, property variation effects, and turbulent flow. Prerequisite: ME 415.

ME 515 Intermediate Heat Transfer
3 hrs.
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.

ME 520 Gas Dynamics
3 hrs.
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.

ME 521 Intermediate Fluid Mechanics
3 hrs.
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. Prerequisites: MTH 224; ME 308.

ME 533 Propulsion Systems
3 hrs.
Gas turbine analysis; stationary power plants; turboprop, turbojet, and ramjet engines; rocket propulsion; application of thermodynamics. Prerequisite: ME 308.

ME 534 Environmental Engineering – Air Conditioning
3 hrs.
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.

ME 535 Environmental Engineering – Refrigeration
3 hrs.
Mechanical vapor compression refrigeration cycles; refrigerants; absorption refrigeration; miscellaneous refrigeration processes; cryogenics; semester design project. Prerequisite: ME 301.

ME 536 Industrial Pollution Prevention
3 hrs.
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.

ME 537 Building Energy Management
3 hrs.
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.

ME 540 Advanced Mechanical Vibrations
3 hrs.
Principles of vibrations in one or more degrees of freedom; application to machine members. Prerequisite: ME 341; MTH 224.

ME 542 Kinematic Synthesis of Linkages
3 hrs.
Design of planar and spatial linkage mechanisms to satisfy input-output motion requirements: rigid-body motion of the coupler for finitely-separated positions; coordination of shaft rotations; coupler-point path problems. Prerequisites: ME 344; MTH 202, 224.

ME 544 Mechanical Systems Analysis
3 hrs.
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.

ME 547 Fluid Power Control Systems
3 hrs.
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. Prerequisites: ME 301, ME 308.

ME 548 Optimization of Mechanical Systems
3 hrs.
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.

ME 549 Microprocessor Interfacing in Mechanical Systems
3 hrs.
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." Prerequisites: ME 303; EE 328; proficiency in at least one computer language; or consent of instructor.

ME 554 Fracture of Solids
3 hrs.
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. Prerequisites: ME 354 and CE 301.

ME 556 Mechanics of Composite Materials
3 hrs.
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 301.

ME 560 Principles of Robotic Programming
3 hrs.
Programming of industrial robotic manipulators with external inputs, tactile sensing, and vision sensing. A design project is required. Cross-listed as IME 560. Prerequisites: graduate or senior standing in engineering or computer science.

ME 562 Analysis and Design of Robotic Systems
3 hrs.
Underlying theories of robotic systems; implications for engineering design. Kinematic, dynamic, and control analysis of robotic arms; robotic systems design. Plant visits to observe robots in action; hands-on experience using open-loop and closed-loop robots. Prerequisites: ME 344, 304, 441; EE 328; or consent of department.

ME 573 Methods of Engineering Analysis
3 hrs.
Application of principles of analog and digital computers and numerical methods to solve mechanical engineering problems. Prerequisites: ME 341; MTH 202, 224.

ME 577 Finite Element Methods in Engineering
3 hrs.
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.

ME 591 Topics in Mechanical Engineering
1-3 hrs.
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.