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Mechanical Engineering and Energy Processes

The mission of the Department of Mechanical Engineering and Energy Processes is to provide high quality engineering education to students and equip them with lifelong learning skills, which allow them to adapt to a changing work environment throughout their careers. Also, the Department of Mechanical Engineering and Energy Processes supports faculty growth and development through research and creative activities because quality teaching and service to humanity and society cannot be achieved without such activities. Finally, the Department of Mechanical Engineering and Energy Processes supports the idea of service to department, college, university, professional societies and community as part of the mission. The undergraduate program in Mechanical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org. The department also offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees.

Bachelor of Science Degree in Mechanical Engineering

The fundamental goal of the undergraduate program in Mechanical Engineering is to offer a high-quality education for our students, designed to achieve the following Program Educational Objectives (PEOs), which describe what graduates are expected to attain within a few years of graduation:

1. Practice mechanical engineering in a global and societal context
2. Have skills needed for effective written and oral communication, collaboration, and innovation
3. Pursue advanced education or lifelong learning that support careers in a broad range of fields
4. Act in a professional and ethical manner, in their careers and communities

Also, the undergraduate program is designed to achieve the following Student Outcomes (SOs), which describe what students are expected to know and be able to do by the time of graduation:

1. The ability to apply knowledge of mathematics, science and engineering to problem solving
2. The ability to design and conduct experiments, as well as to analyze and interpret data
3. The ability to design a system, component, or process to meet desired needs within realistic constraints
4. The ability to function on multi-disciplinary teams
5. The ability to identify, formulate and solve engineering problems
6. An understanding of professional and ethical responsibility
7. The ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for and an ability to engage in life-long learning
10. Knowledge of contemporary issues
11. The ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Mechanical engineering is one of the broadest fields of engineering. Mechanical engineers learn measurement and instrumentation, computer-aided design, computer simulation, computer control, combustion and engine analysis. They learn to design thermal systems for mechanical and electrical
equipment including heating, ventilating, air conditioning and refrigeration. Students learn how to design and produce new materials for advanced engineering applications. Courses are also offered in subjects related to the chemical processes and environmental control industries. Graduates are highly sought after in a variety of industries such as automotive, aerospace and manufacturing.

**Bachelor of Science Degree in Mechanical Engineering, College of Engineering**

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td>Requirements for Major in Mechanical Engineering</td>
<td>(9)+85</td>
</tr>
<tr>
<td>Basic Science</td>
<td>(6)+4</td>
</tr>
<tr>
<td>CHEM 200, CHEM 201, CHEM 210</td>
<td>(3)+4</td>
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<tr>
<td>PHYS 205A, PHYS 205B, PHYS 255A, PHYS 255B</td>
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<tr>
<td>Mathematics Analysis</td>
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<tr>
<td>MATH 150, MATH 250, MATH 251, MATH 305</td>
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<td>ENGR 351</td>
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<tr>
<td>Required Engineering Courses</td>
<td>17</td>
</tr>
<tr>
<td>ENGR 222 or ENGR 296</td>
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<tr>
<td>ENGR 250, ENGR 261, ENGR 335, ENGR 350A, ENGR 370A</td>
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<tr>
<td>Required ME Courses</td>
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<tr>
<td>ME 102, ME 300, ME 302, ME 309, ME 312, ME 400, ME 401, ME 407, ME 411, ME 436, ME 472, ME 475, ME 495A, ME 495B</td>
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<td>Elective Engineering Courses</td>
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<td>Total</td>
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</table>

**Mechanical Engineering and Energy Processes Courses**


**ME300 - Engineering Thermodynamics I** 300-3 Engineering Thermodynamics I. Study of the basic principles of thermodynamics. Engineering analysis of physical systems based on the first and second laws. Properties of pure substance (ideal gas behavior, non-ideal gas behavior, and equations of states.)
Mixtures of ideal gases. Introduction to cycle analysis. Prerequisite: MATH 250, PHYS 205A with a grade of C or better.

**ME302 - Engineering Heat Transfer** 302-3 Engineering Heat Transfer. Fundamentals of heat transfer by conduction, convection and radiation. Applications of theory to engineering systems. Prerequisite: ME 300 and MATH 305; ENGR 370A or 370B concurrently.

**ME303 - Energy Impacts** 303-3 Energy: Uses and Cultural Impacts. Lectures, discussions, and class projects directed at understanding the role of energy, power, and related concepts in cultures in the past, the present, and the future. A review of current energy resources and use patterns and their impact on various cultures, as well as projections for new energy conservation techniques and the development of alternative energy technology and their cultural effects. An overview of worldwide energy needs, seeking to identify future limits on energy use attributable to environmental, economic, political, cultural, and other technological and evolutionary constraints. Prerequisite: Satisfactory completion of three hours of University Core Curriculum science requirements.

**ME309 - Mechanical Analysis & Design** 309-3 Mechanical Analysis and Design. The course covers kinematics and kinetics of interconnected bodies. Principles of kinematics and force analyses are applied to planar machinery. Vector loop approach is used to model mechanisms and numerical methods are employed in which a set of nonlinear equations are solved iteratively to find their displacement, velocity and acceleration. Limited coverage of design of mechanisms is presented. Prerequisite: ENGR 261; ENGR 222 or 296.

**ME312 - Materials Sci Fundamentals** 312-3 Materials Science Fundamentals. Sub-Microscopic Structure of solids, including electronic states, atomic and molecular, arrangement, structural imperfections and atomic diffusion, and their relationship to macro-mechanical properties. Prerequisites: PHYS 205A, MATH 250, CHEM 200, 201. Lab Supply fee: $8.

**ME392 - ME Co-Op Education** 392-1 to 6 Mechanical Engineering Cooperative Education. Supervised work experience in industry, government or professional organization. Students work with on-site supervisor and faculty advisor. Reports are required from the student and the employer. Hours do not count toward degree requirements. Mandatory Pass/Fail. Restricted to sophomore standing.

**ME393 - Internship in Mech Engr** 393-1 to 12 Internship in Mechanical Engineering. Credit for documented work experience as an intern in an engineering occupation or an engineering-related occupation. Work assignments must have been professional service in the mechanical engineering field. Hours do not count toward degree requirements. Mandatory Pass/Fail. Prerequisite: satisfactory completion of twelve hours of Engineering and/or Mechanical Engineering courses.

**ME400 - Engr Thermodynamics II** 400-3 Engineering Thermodynamics II. Combined first and second law analysis: Exergy analysis; Analysis of power and refrigeration cycles. Detailed treatment of gas and vapor cycles including gas and steam cycles; Thermodynamics of combustion and reaction of mixtures; Introduction to thermodynamic property relations, chemical and phase equilibrium. Prerequisite: ME 300.

**ME401 - Thermal Measurements Lab** 401-1 Thermal Measurements Laboratory. Study of basic measurements used in the thermal sciences. Calibration techniques for temperature and pressure sensors. Thermal measurements under transient and steady-state conditions. Applications include conduction, convection and radiation experiments. Uncertainty analysis. The handling and reduction of data. Prerequisite: ME 302.


**ME406 - Thermal Systems Design** 406-3 Thermal Systems Design. Applications of the principles of engineering analysis to the design of thermal systems. Coordination of such systems as heat exchangers, air conditioners, cogeneration cooling towers, and furnaces. Emphasis is placed on application of basic principles of heat transfer and fluid mechanics. Prerequisite: ME 302.
ME407 - Measurements & Controls 407-2 Mechanical Engineering Measurements and Controls. Laboratory to familiarize students with the use of instruments to measure time, distance, velocity, acceleration, strain, fluid flow and turbulence. Instruments include micrometers, laser distance meters, stroboscopes, oscilloscopes, incremental rotary encoder, LVDT, load cells accelerometers, analog/digital converters, pressure transducers, and related equipment. Application of control principles to mechanical engineering systems. Speed and position control using computer-based instrumentation. Pneumatic control temperature and flow sensing and control. Automatic control of servo systems. Process control and Programmable Logic Controller (PLC) applications. Not for graduate credit. Prerequisite: ME 436 or consent of instructor.

ME408 - Energy Conversion Systems 408-3 Energy Conversion Systems. Principles of advanced energy conversion systems; nuclear power plants, combined cycles, magnetohydromagnetics, cogeneration (electricity and process steam), and heat pumps. Constraints on design and use of energy conversion systems; energy resources, environmental effects, and economics. Prerequisite: ME 400.

ME410 - Applied Chemical Thermodynamics and Kinetics. Designed for students interested in chemical and environmental processes and materials science. Topics covered include application of the Second and Third Laws of Thermodynamics, solution theory, phase equilibria, sources and uses of thermodynamic data, classical reaction rate theory, kinetic mechanisms and the determination of rate-determining steps in chemical reactions. Prerequisite: CHEM 200, 201, ME 300 or consent of instructor.

ME411 - Manufacturing Methods for Engineering Materials. Overview of manufacturing processes with emphasis on the fabrication of materials from the processing and equipment viewpoint. This course presents a broad study of the many manufacturing processes utilized in the production of a wide variety of products and components. Insight into the multitude of processing factors which influence the practical design of manufactured parts to achieve the advantages of maximum economy, accuracy and automation in everyday production. Prerequisite: ME 312 and ENGR 350A.

ME415 - Engineering Acoustics 415-3 Engineering Acoustics. Principles of engineering acoustics and their applications to passive and active noise control techniques. Laboratory experience demonstrates techniques for control and reduction of noise. Prerequisite: ME 436. Special approval needed from the instructor.

ME416 - Air Pollution Control 416-3 Air Pollution Control. An overview of problems in air pollution likely to influence the Mechanical Engineer. Engineering control theory, procedure and equipment related to control of particulate, gaseous, and toxic air emissions. Restricted to senior standing and College of Engineering or consent of instructor.


ME422 - Applied Fluid Mechanics for ME 422-3 Applied Fluid Mechanics for Mechanical Engineers. Applications of fluid mechanics in internal and external flows. The mathematical basis for inviscid and viscous flows calculations is developed with application to pipe and duct flows; external flow about bodies; drag determination; turbomachinery; and reaction propulsion systems. Semester design project of a fluid mechanical system. Prerequisite: ME 300 and MATH 305; ENGR 370A or 370B concurrently.


ME446 - Energy Management 446-3 Energy Management. Fundamentals and various levels of analysis for energy management of commercial buildings and industrial processes and buildings. Use of energy management systems and economic evaluations are required in course projects. Prerequisite: ME 302.


ME451 - Advanced Dynamics 451-3 Advanced Dynamics. Three-dimensional kinematics and dynamics of particles and rigid bodies; Coordinates and reference frames; Rotations of rigid bodies; Euler angles; Newtonian mechanics; Work and energy; Generalized coordinates and degrees of freedom; Analytical mechanics with a focus on Lagrange’s equations; Hamilton’s principle for continuous elastic systems. Prerequisites: MATH 305 and ME 309 with a grade of C or better or graduate standing.

ME463 - Introduction to Ceramics 463-3 Introduction to Ceramics. Structure and physical properties, mechanical properties, processing and design of ceramics. Prerequisite: ME 312 or equivalent.

ME465 - Intro to Nanotechnology 465-3 Introduction to Nanotechnology. Survey of the rapidly developing fields of nanometer science and engineering. Impact on society; principles of self-assembly; production and properties of nano-materials; cell mechanism as a model for assemblers; nano-tools; and nano-systems are explored. Prerequisite: CHEM 210.

ME468 - Friction Science & Apps 468-3 Friction Science and Applications. Study of systems and materials used for friction applications with a focus on aerospace and ground transportation vehicles. Course covers theories and experimental methods regarding friction and wear, contact mechanics, friction materials, vibration and noise, thermal transport and thermo-elastic phenomena. The course approach uses a materials emphasis. Prerequisite: ME 312. Restricted to senior standing or consent of instructor.

ME470 - Mech System Vibrations 470-3 Mechanical System Vibrations. Linear vibration of mechanical systems; System modeling; Free and forced response of single degree of freedom systems; Lagrange’s equations; Multi-degree of freedom systems; Modal analysis for response calculations; Vibration of continuous sytems. Prerequisite: ENGR 261, ENGR 351, MATH 305.

ME472 - Materials Selection for Design 472-3 Materials Selection for Design. Interaction of material design process with material selection criteria. Comparison of materials properties, processes and fabrication. Project work includes design models, materials selection rationale, oral presentation of projects, construction of mock-up models, and theoretical design problems in the area of the student’s specialization, including materials selection considerations for biomaterials/biomedical applications. Prerequisite: ENGR 222 and ME 312.


ME477 - Fund Comp Aid Des & Manf 477-3 Fundamentals of Computer-Aided Design and Manufacturing. Introduction to the concepts of computer-aided design and manufacturing (CAD/CAM). Subjects include computer graphics, geometric modeling, engineering analysis with FEM, design optimization, computer numerical controls, project planning, and computer integrated manufacturing.
(CIM). Students are required to use computer packages for projects. Prerequisite: ME 475 or consent of instructor.

**ME478 - FEA in CAD** 478-3 Finite Element Analysis in CAD. Course to cover a multitude of topics in CAD/CAE with emphasis on finite element modeling and analysis. Overview of CAD/CAM/CAE; FEA software; FEA problems including trusses, beams, frames, thermal analysis, and fluid mechanics; design optimization; rapid prototyping. Students are required to use FEA software for homework assignments and a design project. Prerequisite: ME 302 and ME 475 or consent of instructor.

**ME480 - Computational Fluid Dynamics** 480-3 Computational Fluid Dynamics. Application of computational fluid dynamics techniques to the solution of problems in engineering heat transfer and fluid flow. Discretization techniques; stability analysis. Introduction to grid generation. Prerequisite: ENGR 351, ENGR 370A (or 370B concurrently); ME 302 or consent of instructor.

**ME485 - Cell & Molecular Biomechanics** 485-3 Cellular and Molecular Biomechanics. (Same as BME 485) Mechanics at the micron and nanoscale level relevant to living cells. Molecular forces, bond dynamics, force induced protein conformational changes. Structural basis of living cells; contractile forces; mechanics of the biomembranes, the nucleus, the cytoskeletal filaments- actin, microtubule, intermediate filaments. Active and passive rheology techniques; microrheological properties of the cytoskeleton. Active cellular processes such as cell adhesion, cell spreading, control of cell shape, and cell migration. Discussion on the experimental techniques including single molecule approaches to understand these key cellular processes. Discussion on theoretical models that predict these cellular processes and their limitations. Introductory concepts of mechanobiology will be discussed. Prerequisites: ENGR 350A or 350B with a minimum grade of C or better; or graduate standing.

**ME492 - Special Problems in Engr** 492-1 to 5 Special Problems in Engineering. Engineering topics and problems selected by either the instructor or the student with the approval of the instructor. Five hours maximum course credit. Not for graduate credit. Restricted to senior standing. Special approval needed from the instructor.

**ME493 - Materials in Energy** 493-3 Materials in Energy Applications. Materials are central to every energy technology. The course will provide information on high performance materials for alternative energy technologies and developing a fundamental understanding of their structure-property-performance relationships. It will include materials for fuel cells, lithium ion batteries, supercapacitors, photovoltaics, solar energy conversion, thermoelectrics, and hydrogen production and storage, catalysts for fuel conversion. Prerequisite: ME 312.

**ME495A - Mechanical Engr Design** 495A-3 Mechanical Engineering Design. Project development skills, feasibility and cost-benefit analysis, ethical issues, professionalism, preliminary design, identification of tasks, assignment of tasks to project team members, coordination of interdisciplinary team effort, development of final proposal, oral presentation of final proposal. Not for graduate credit. Prerequisite or concurrent enrollment in: ENGR 351; ME 400; one ME elective. Restricted to senior standing in ME.

**ME495B - Mechanical Engr Design** 495B-3 Mechanical Engineering Design. Development of the final design, hardware implementation of the final design (if the project warrants), documentation of all stages of design, project coordination, documentation of the testing and evaluating of the design, cost estimating, scheduling, and written, oral, and poster presentation of the final design. Not for graduate credit. Prerequisite: ME 495A (last semester).

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**Mechanical Engineering and Energy Processes Faculty**

Abrate, Serge, Professor, Ph.D., Purdue University, 1983.
Agrawal, Om P., Professor, Ph.D., University of Illinois at Chicago, 1984.
Chai, Tan, Assistant Professor, Ph.D., Ohio State University, 2013.
Chen, Juh W., Professor, Emeritus, Ph.D., University of Illinois, 1959.
Chowdhury, Farhan, Assistant Professor, Ph.D., University of Illinois at Urbana-Champaign, 2011.
Chu, Tsuchin, Professor, Ph.D., University of South Carolina, 1982.
Cooley, Christopher G., Assistant Professor, The Ohio State University, 2012.
Don, Jarlen, Professor, Ph.D., Ohio State University, 1982.
Esmaeili, Asghar, Professor, Ph.D., The University of Michigan, 1995.
Farhang, Kambiz, Professor, Ph.D., Purdue University, 1989.
Filip, Peter, Professor, Ph.D., Technical University, Ostrava, 1989.
Kent, Albert C., Professor, Emeritus, Ph.D., Kansas State University, 1968.
Koc, Rasit, Professor and Chair, Ph.D., University of Missouri-Rolla, 1989.
Mathias, James A., Associate Professor, Ph.D., Ohio State University, 2001.
Mondal, Kanchan, Professor, Ph.D., Southern Illinois University, 2001.
Nsofor, Emmanuel C., Professor, Ph.D., Mississippi State University, 1993.
O'Brien, William S., Associate Professor, Emeritus, Ph.D., West Virginia University, 1972.
Orthwein, William, Professor, Emeritus, Ph.D., University of Michigan, 1959.
Rajan, Suri, Professor, Emeritus, Ph.D., University of Illinois, 1970.
Suni, Ivar Ian, Professor, Ph.D., Harvard, 1992.
Tempelmeyer, Kenneth E., Professor, Emeritus, Ph.D., University of Tennessee, 1969.
Wiltowski, Tomasz, Professor, Ph.D., Institute of Catalysis and Surface Chemistry, 1982.
Wittmer, Dale E., Professor, Emeritus, Ph.D., University of Illinois, 1980.
Wright, Maurice, Professor, Emeritus, Ph.D., University of Wales, 1962.