MECHANICAL AND INDUSTRIAL ENGINEERING

(330) 941-3016

Moser Hall, Room 2510

The Mechanical and Industrial Engineering program is dedicated to furthering the missions and objectives of the university and the College of Science, Technology, Engineering, and Mathematics. We focus on providing an opportunity for quality education in mechanical engineering and industrial and systems engineering while offering professional service to local and regional industry and to the public. The program is committed to providing its students with a broad, general education and an up-to-date technological curriculum in a four-year undergraduate program. It also offers an application-oriented evening Master of Science in Engineering program to practicing engineers and recent engineering graduates. An online Master of Engineering Management is also available.

Professor

S. Cory Brozina, Ph.D., Assistant Professor

Kyosung Choo, Ph.D., Associate Professor

Seok Gi Lee, Ph.D., Assistant Professor

Zefeng Lyu, Ph.D., Assistant Professor

Hazel Marie, Ph.D., Professor

Stefan Moldovan, Ph.D., Assistant Professor

Alexander H. Pesch, Ph.D., Assistant Professor

Jae Joong Ryu, Ph.D., Associate Professor

Elvin B. Shields, Ph.D., Professor

Virgil C. Solomon, Ph.D., Professor

Bharat Yelamanchi, Ph.D., Assistant Professor

Lecturer

Ali Alelaiw, M.S., Lecturer

Eric Haake, M.A., Lecturer

Sharmin N. Mithy, M.S., Lecturer

Mark Sindelar, Ph.D., Lecturer

Anthony Viviano, M.S., Senior Lecturer

Majors

- Industrial and Systems Engineering Program (https://catalog.ysu.edu/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-mechanical-industrial/industrial-systems-engineering-program/)
- Mechanical Engineering Program (https://catalog.ysu.edu/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-mechanical-industrial/mechanical-engineering-program/)

Minors

- Minor in Industrial and Systems Engineering (https://catalog.ysu.edu/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-mechanical-industrial/minor-industrial-systems-engineering/)
- Minor in Mechanical Engineering (https://catalog.ysu.edu/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-mechanical-industrial-mechanical-engineering-minor/)
- Minor in Manufacturing Engineering (https://catalog.ysu.edu/undergraduate/colleges-programs/college-science-technology-engineering-mathematics/department-mechanical-industrial-manufacturing-engineering-minor/)

Mechanical Engineering

MECH 1500   Drawing Fundamentals   3 s.h.
Visualization of objects for engineering communication. Freehand sketching, orthographic projection, multiview drawing, auxiliary views, sectional views, and dimensioning.
Prereq.: High school geometry or equivalent.

MECH 1501   Engineering Communication with CAD   3 s.h.
Computer-aided drawing for engineering communication. 2D multiview drawings, 3D modeling including wire frame, solid, and surface models. Final design project using these tools is required. Two hours lecture, three hours laboratory per week.
Prereq.: MECH 1500 or equivalent.

MECH 1560   Engineering Communication with CAD   2 s.h.
Commercially available software typically used in engineering practice will be used to develop traditional 2D engineering drawings and 3D solid models representing engineering components and systems. Teams of students will complete an engineering design project. One hour lecture and three hours laboratory per week.
Prereq.: ENGR 1550.

MECH 2603   Thermodynamics 1   3 s.h.
Thermodynamic properties of gases and vapors, and their relationships in energy transformations. The First and Second Laws of thermodynamics. Introduction to thermodynamic cycles and efficiencies of power and refrigeration systems.
Prereq.: MATH 1572, CHEM 1515.

MECH 2606   Engineering Materials   3 s.h.
Properties and uses of engineering materials, manufacturing processes, including heat treatments and forming operations. Introduction to mechanical testing methods. Listed also as MTEN 2606.
Prereq.: MATH 1571 or MATH 1585H.

MECH 2606L   Engineering Materials Laboratory   1 s.h.
Experiments design to introduce the students to the basics of engineering materials investigation, instrumentation, data collection and analysis, and reporting. Topics include microstructural and crystallographic investigations, mechanical behavior of solids subjected to static and dynamic axial, flexural, and torsional stresses, diffusion experiments, and phase diagram construction.
Prereq.: C or better in one of MATH 1571, MATH 1571H, MATH 1571E, or MATH 1585H.
Prereq. or Coreq.: MECH 2606.

MECH 2620   Statics and Dynamics   3 s.h.
Principles of engineering mechanics as applied to statics and dynamics, Vector applications to forces and moments; centroid and center of gravity; static equilibrium. Kinematics of particles; Newton's laws; work-energy; and impulse momentum techniques using vector approach,.
Prereq.: MATH 1572 and PHYS 2610 or concurrent.

MECH 2641   Dynamics   3 s.h.
Kinematics of particles and rigid bodies. Newton's laws of motion, work-energy, and impulse momentum techniques applied to particle and rigid body motion using a vector approach.
Prereq.: CEEN 2601.

MECH 3704   Thermodynamics 2   3 s.h.
Power and refrigeration cycles, relations among thermodynamic properties, properties of non-reacting gas mixtures and solutions, chemical reactions and combustion processes, psychrometry and air conditioning principles, and more advanced topics on renewable energy.
Prereq.: MECH 2603 .

MECH 3708   Dynamic Systems Modeling   3 s.h.
Mathematical modeling of linear mechanical, electrical, thermal, fluid, and mixed systems. State space variables. Frequency response. Computer simulation using modern computer tools. Three hours lecture per week.
Prereq.: C or better in MECH 2641, ECEN 2614, and MATH 3705.
Coreq.: MECH 3708L.

MECH 3708L   Dynamic Systems Modeling Laboratory   1 s.h.
Mathematical modeling of linear mechanical, electrical, thermal, fluid, and mixed systems. State space variables. Frequency response. Computer simulation using modern computer tools. Three laboratory hours per week.
Prereq.: C or better in MECH 2641, ECEN 2614, and MATH 3705.
Coreq.: MECH 3708.

MECH 3720   Fluid Dynamics   3 s.h.
Physical properties of fluids. Governing equations of fluid dynamics; forces on bodies due to incompressible fluid motion. Dimensional analysis and similitude. Analysis of energy losses in pipe flows. Concept of the viscous boundary layer.
Prereq.: MECH 2603; MECH 2641; MATH 3705.

MECH 3720L   Fluid Dynamics Laboratory   1 s.h.
Introduction to equipment, data acquisition, and techniques for measurement and computation of fluid flows in engineering applications. Effective technical communication skills, analysis and interpretation of data in teams are emphasized.
Prereq.: MECH 3720.

MECH 3725   Heat Transfer 1   3 s.h.
Fundamentals of heat transfer by conduction, convection, and radiation. Heat transfer by combined modes.
Prereq.: MECH 3720 or concurrent.

MECH 3742   Kinematics of Machines   3 s.h.
Position, velocity, and acceleration analysis of mechanisms. Design of link and cam mechanisms to perform desired machine functions. Graphical, analytical, and commercial software applications.
Prereq.: MECH 2641, ENGR 1560 and MECH 1560.

MECH 3751   Stress and Strain Analysis 1   3 s.h.
Analysis of internal forces, stresses, strains, and deflections in three dimensions. Dynamic loading including impact and fatigue. Theories of failure and energy methods. Must be taken concurrently with MECH 3751L.
Prereq.: CEEN 2602, MECH 2606.

MECH 3751L   Stress and Strain Analysis 1 Laboratory   1 s.h.
Transmission and reflection photoelasticity. State and dynamic strain gage applications using computer-aided data acquisition. Three hours laboratory per week. Concurrent with: MECH 3751.

MECH 3762   Design of Machine Elements   3 s.h.
Application of fundamental engineering principles to the design of various elements found in machines. Elements include connections, shafts, keys, couplings, springs, gears, belts, chains, bearings, clutches, brakes, screws, etc. Must be taken concurrently with MECH 3762L.
Prereq.: MECH 2641 and MECH 3751.

MECH 3762L   Design of Machine Elements Laboratory   1 s.h.
Practical design problems incorporating analysis, material selection, and sizing of machine components utilizing the computer. Three hours laboratory per week. Must be taken concurrently with MECH 3762.

MECH 4800   Special Topics   3 s.h.
Special topics and new developments in mechanical engineering. Subject matter, credit hours, and special prerequisites are announced in advance of each offering. May be repeated to a maximum of 8 s.h. with different content.
Prereq.: Junior standing in Mechanical Engineering, or consent of instructor.

MECH 4808   Mechanical Systems Design 1   2 s.h.
Detailed design of a mechanical engineering system utilizing expertise expected of a new graduate in an industry setting. Design methodology, case studies, oral presentations, and written reports prepare the student to function as part of a design team on a capstone project. MECH 4809 must be taken at the next offering after completing 4808. Grading in MECH 4808 is Traditional/PR. Two hours lecture per week.
Prereq.: MECH 3708, MECH 3725, MECH 3742, and MECH 3762.
Gen Ed: Capstone 2024.

MECH 4808L   Mechanical Systems Design Laboratory   1 s.h.
Supplemental activities related to MECH 4808, such as discussion and seminars on industry practices and standards, computer software applications, experimental verification, etc. Three hours laboratory per week. Must be taken concurrently with MECH 4808.
Gen Ed: Capstone 2024.

MECH 4809   Mechanical Systems Design 2   3 s.h.
Detailed design of a mechanical engineering system utilizing expertise expected of a new graduate in an industry setting. Design methodology, case studies, oral presentations, and written reports prepare the student to function as part of a design team on a capstone project. MECH 4809 must be taken at the next offering after completing 4808. Three hours lecture per week.
Prereq.: MECH 4808.
Gen Ed: Capstone 2024.

MECH 4809L   Mechanical Systems Design Laboratory 2   1 s.h.
Supplemental activities related to MECH 4808 and MECH 4809, such as discussions and seminars on industry practices and standards, computer software applications, experimental verifications, etc. Three hours laboratory per week. MECH 4808L must be taken concurrently with MECH 4808 and MECH 4809L must be taken concurrently with MECH 4809.

MECH 4823   Heating, Ventilation, and Air Conditioning   3 s.h.
Design of heating and air conditioning systems for residential, commercial, and industrial complexes. Human comfort, psychometries, and environmental issues. Computer simulation of heating and cooling load for steady-state and transient conditions. Selection of controls and equipment.
Prereq.: MECH 3725.

MECH 4825L   Heat Transfer and Thermodynamics Laboratory   1 s.h.
Experiments involving basic measurement techniques, power and refrigeration cycles, heat transfer, heat exchangers, and energy systems. Three hours laboratory per week.
Prereq.: MECH 3720, MECH 3725.

MECH 4835   Thermal Fluid Applications   3 s.h.
Application of the principles of thermodynamics, fluid dynamics, and heat transfer to design. Design, analysis and computer simulation of thermal fluid systems and components.
Prereq.: MECH 3725.

MECH 5811   Solar Engineering   3 s.h.
Radiational characteristics of solar energy, glass materials and selective coatings. Analysis of flat plate collectors, concentrators, and thermal storage. System simulation and economic analysis for optimization of basic solar systems.
Prereq.: PHYS 2611, MECH 3725 or consent of chairperson.

MECH 5820   Turbulence   3 s.h.
Physics of turbulence in thermal-fluid engineering systems; statistical descriptions, energy cascade and scales of turbulent motion. Modeling and simulation of turbulent flows. Examples of turbulence in mixing layers, combustion, and wall-bounded flows.
Prereq.: MECH 3720 or PHYS 3705 or CHEN 3786 (or equivalent).

MECH 5825   Heat Transfer 2   3 s.h.
Advanced topics in heat transfer. Multi-dimensional conduction, free convection, phase change heat transfer and thermal radiation. Integration of analytical, numerical, and computational methods into design projects.
Prereq.: MECH 3708 and MECH 3725.

MECH 5836   Fluid Power and Control   3 s.h.
Theory of prime movers, turbomachinery, and control systems. Modeling of hydraulic and pneumatic systems and components. Hydraulic fluids, pumps, cylinders, valves, motors, compressors, and actuators. Hydraulic and pneumatic circuit applications and control.
Prereq.: MECH 3725.

MECH 5842   Kinetics of Machines   3 s.h.
Three dimensional kinematics and dynamics of machines. Dynamic analysis and design; balancing of machines.
Prereq.: MECH 3742.

MECH 5852   Stress and Strain Analysis 2   3 s.h.
Continuation of MECH 3751. Introduction to applied elasticity theory including plane stress and strain and stress functions. Plastic and creep behavior of materials. Introduction to instability. Emphasis on design applications.
Prereq.: MECH 3751, MECH 3751L, MATH 3705.

MECH 5872   Engineering Acoustics   3 s.h.
The nature of sound and its propagation; analysis and control of sound and noise production in mechanical equipment; transmission and absorption of sound in engineering materials, ultrasonics, structural acoustics, base measurements, and equipment.
Prereq.: MECH 3708.

MECH 5881   Mechanical Vibrations   3 s.h.
Introduction to mechanical vibrations: single and multi-degree of freedom systems, free and forced vibrations, impedance and modal analysis including applications.
Prereq.: MECH 3708.

MECH 5881L   Mechanical Vibrations Laboratory   1 s.h.
Introduction to vibrations measurements. Experiments with mechanical systems, computer simulation of vibration systems. Experimental determination of component models and parameters. Three hours laboratory per week.
Prereq.: MECH 5881.

MECH 5884   Finite Element Analysis   3 s.h.
Fundamental principles of finite element analysis with emphasis on applications to design in areas of stress analysis, vibrations, and heat transfer. Use of commercial software.
Prereq.: MECH 3708, MECH 3725, MECH 3751.

MECH 5885   Computational Fluid Dynamics   4 s.h.
Understand finite differential and finite volumes methods used in CFD. Understand the need for various turbulence models and how to choose them. Become proficient at disseminating the results form a CFD software. Three hours lecture and three hours laboratory per week.
Prereq.: MECH 3720 and MECH 3725.

MECH 5892   Control of Mechanical Systems   3 s.h.
Introduction to theory of feedback and control. Performance and stability of linear systems. Design of feedback control systems. Practical application and introduction to state-space methods. Two hours lecture and three hours laboratory per week.
Prereq.: MECH 3708.

Industrial Engineering

ISEN 1560   Principles of Industrial & Systems Engineering   3 s.h.
An introduction to creative thought processes and analytical tools that are used to develop human usable systems within industrial engineering.
Prereq.: ENGR 1550.

ISEN 2610   Engineering Statistics   3 s.h.
Applications of data collection and analysis techniques to engineering problems. Techniques for data structuring, data modeling, parameter estimation, and design of experiments utilizing engineering data.
Prereq.: C or better in one of MATH 1570 or MATH 1571 or MATH 1571H or MATH 1585H, C or better in either ENGR 1550 or ENGR 1550H.

ISEN 2616   Systems Analysis and Design   3 s.h.
Analysis and design of systems. Decomposition of large systems into subsystems. Analysis, modeling, and design of subsystems. Integration of subsystems.
Prereq.: MATH 1571 or MATH 1571H or MATH 1585H.
Coreq.: ENGR 1560 or ENGR 1560H.

ISEN 2620   IE Applied Statistics   3 s.h.
The course is an introduction to the basic concepts and methods of applied statistics.
The course is an introduction to the basic concepts and methods of applied statistics. **Prereq.:** ISEN 2610.

ISEN 2624   Engineering Economy   3 s.h.
The analysis and evaluation of factors that affect the economic success of engineering projects. Topics include interest, depreciation, cost classification, comparison of alternatives, make-buy decisions, replacement models and after-tax analysis.
Prereq.: C or better in one of MATH 1570 or MATH 1571 or MATH 1571H or MATH 1585H.
Prereq. or Coreq.: ENGR 1560 or ENGR 1560H.

ISEN 3720   Statistical Quality Control   3 s.h.
Concepts of data-based quality control techniques. Intermediate design of experiments as an off-line quality control technique using ANOVA techniques. Process control chart construction and applications as on-line quality control techniques. Basics of acceptance sampling systems and standards.
Prereq.: ISEN 2610 or equivalent.

ISEN 3723   Manufacturing Processes   3 s.h.
Introduction to properties and uses of engineering materials. Introduction to mechanical testing methods, metrology, tolerances, testing and inspection; semi-finished product manufacturing; macro-processing (forming, casting, powder metallurgy, metal working, composite fabrication); joining; nontraditional manufacturing processes; and surface processing.
Prereq.: MATH 1572, MECH 1560.

ISEN 3723L   Manufacturing Processes Lab   1 s.h.
This lab is an introduction to a variety of manufacturing processes. This course divided into formative, subtractive, and additive manufacturing concepts and practices through a series of introductory tutorial labs and a term-long design and fabrication project. Processes covered include CAD design, metallurgy, metrology, 3D printing, casting, forming, welding, and inspection. A selection of additional processes will be available should students upon availability. These include investment casting, injection molding, and destructive and non-destructive tests.
Prereq.: MECH 1560.
Prereq. or Coreq.: ISEN 3723 or MFG 3723.

ISEN 3727   Simulation of Industrial Engineering Systems   3 s.h.
Techniques for the digital simulation of industrial engineering systems which can be represented via discrete event models. The generation of random variables, shaping of probability distributions, model structuring, model verification, and the simulation of inventory, queuing, and quality control systems in a high-level structured programming language. A special-purpose simulation language for expanding the class of problems which can be economically modeled.
Prereq.: ISEN 2610, ISEN 2616.

ISEN 3730   Materials Handling and Facilities Planning   3 s.h.
The course focuses on operational facility planning through comprehensive layout design. Considerations include product flow, space and activity relationships, workforce requirements, and material handling. Topics include flow analysis, facility location, group technology and layout, just-in-time, material handling equipment such as AGV, motion and time studies, and work sampling.
Prereq.: ISEN 2616.

ISEN 3736   Methods Engineering   2 s.h.
Techniques for analysis of task performance, the use of process charts, and various methods of work simplification, human-machine relation analysis. Theory and practice of time study and other methods of measuring and establishing performance level and productivity.
Prereq.: ISEN 3710 or equivalent.

ISEN 3736L   Methods Engineering Laboratory   1 s.h.
Practice in analyzing and recording tasks. Determination of time standards and productivity requirements. Analysis and evaluation of actual plant operations. Taken concurrently with ISEN 3736. Three hours laboratory per week.

ISEN 3740   Prod Planning and Supply Chain   3 s.h.
This course introduces the issues underlying the design and operation of traditional and current supply chains, focusing on the logistics of the material and information movement inside manufacturing and service networks.
Prereq.: ISEN 2610 and ISEN 3730.
Prereq. or Coreq.: ISEN 2616.

ISEN 3745   Accounting for Engineers   3 s.h.
Review of labor and material costing systems. Introduction to cost accounting systems. Practice in development of forecasting and estimating systems. Process, operation and product costing systems. Elements of financial accounting systems that affect engineering decisions.
Prereq.: ISEN 3724 or equivalent.

ISEN 4810   Special Topics   3 s.h.
Special topics and new developments in Industrial Engineering. Subject matter, credit hours, and special prerequisites to be announced in advance of each offering.
Prereq.: senior standing in Industrial Engineering or consent of instructor.

ISEN 4821   Capstone Design 1   3 s.h.
The application of engineering techniques to the analysis, design, layout, and justification of manufacturing and service facilities. Subjects covered include, equipment selection, process flow, and material flow. The system design involves field investigation, acquisition and analysis of data, use of computer-aided facilities planning and design software, preparation of drawings, and writing a final report.
Prereq.: ISEN 3723, ISEN 3720, ISEN 3727, and DATX 5801.
Coreq.: ISEN 5801.
Gen Ed: Capstone 2024.

ISEN 4822   Capstone Design 2   3 s.h.
This course will focus on project management and completing the two-semester design project with industry. Project analyses will be highlighted by both written and oral communication of design outcomes.
Prereq.: ISEN 4821 (C or better).
Gen Ed: Capstone 2024.

ISEN 5801   Operations Research 1   3 s.h.
Formulation and solution of engineering problems using linear programming. Model formulation, the primal, dual, and transportation simplex methods, duality theory, and sensitivity analysis.
Prereq.: MATH 2673.

ISEN 5811L   Manufacturing Practices I Laboratory   1 s.h.
Experimental analysis of manufacturing processes. Process control and data acquisition. Experimental design applied to processes including polymer processes, casting, machining, and joining. Three hours laboratory.
Prereq. or Coreq.: ISEN 3723.

ISEN 5812L   Manufacturing Practices 2 Laboratory   1 s.h.
Experimental analysis of advanced manufacturing techniques. Advanced sensing and controlling technologies. Real-time monitoring, metrology, and data acquisition. Numerically controlled (NC) machines and programming. Net-shape and additive manufacturing.
Prereq. or Coreq.: ISEN 5823.

ISEN 5820   Advanced Quality for Engineers   3 s.h.
Applications and practices of quality control in industry. Engineering and administrative aspects of quality control programs, process control, and acceptance sampling. Application of quantitative methods to the design and evaluation of engineered products, processes, and systems.
Prereq.: ISEN 3720.

ISEN 5823   Automation   3 s.h.
Principles and applications of sensing, actuation and control. Emphasis on hydraulic and pneumatic systems. Industrial process controllers, sensors and machine vision. Design and cost considerations for industrial automation applications.
Prereq.: MECH 2641, ECEN 2614 or consent of instructor.

ISEN 5825   Advanced Engineering Economy   3 s.h.
An extension of the topics in engineering economy. Analysis of rationale and norm of decision making, risk and uncertainty models, utility theory, measurement of productivity, and advanced project comparison methods.
Prereq.: ISEN 2624.

ISEN 5830   Human Factors Engineering   3 s.h.
Various aspects of human factors in the design of human-machine systems and environments. Study of human sensory, perceptual, mental, psychomotor, and other characteristics; techniques of measuring human capabilities, limitations, safety, comfort, and productivity.
Prereq.: MATH 2673.

ISEN 5850   Operations Research 2   3 s.h.
Formulation and solution of industrial engineering problems using operational research models. Topics include queuing models and the specialization of linear models to equipment replacement, project planning, assignment, and transshipment problems.
Prereq.: ISEN 5801.

ISEN 5880   Management of Technology   3 s.h.
The course discusses major topics in management of technology and innovations. Dynamics of technology innovation, sources of technology innovations, corporate technology strategy, collaboration and intellectual property, structures and process for innovations, idea generation, commercialization of technology and innovations, and market entry.
Prereq.: Senior standing or consent of instructor.

ISEN 5881   Competitive Manufacturing Management   3 s.h.
Basic principles of manufacturing competitiveness. The role of engineers in promoting competitiveness. Discussion of new technologies used in modern manufacturing management including, continuous improvement, waste elimination, JIT, lean production systems, setup time reduction, equipment maintenance/improvement, total quality management, and supply chain management.
Prereq.: ISEN 3723 or consent of instructor.