

INDUSTRIAL ENGINEERING

<https://ien.coe.miami.edu/index.html>

Dept. Code: IEN

Overview

Industrial Engineering combines science and technical knowledge with human sciences to design, plan, and analyze systems that involve people, materials, money, energy, equipment, and other resources. Industrial engineers work with personnel in research and development, accounting, engineers in other disciplines, maintenance, human resources, and production to increase organizational productivity, improve quality, reduce health care costs, conserve energy, develop public transportation systems, and improve industrial safety conditions. Industrial engineering distinguishes itself from other engineering professions because it has applications in manufacturing, service, commercial, and governmental activities. It is the major branch of engineering concerned not only with technology, but with people, making industrial engineers a prime source of management talent.

Through consultation with his/her academic advisor, a student is assisted in choosing electives which will prepare him/her for a degree of specialization compatible with his/her future goals. The available concentrations are Engineering Management and Manufacturing. Specific courses required in each concentration are described in Degree Programs Section.

The Department of Industrial Engineering offers graduate programs leading to the:

- Master of Science in Industrial Engineering
- Master of Science in Environmental Health and Safety
- MSIE/MBA Weekend Executive Program (in conjunction with the School of Business)
- Master of Science in Management of Technology (in conjunction with the School of Business)

The Department also offers:

- a Ph.D. program in Ergonomics
- a Ph.D. in Industrial Engineering.

For further information, see the Bulletin of the Graduate School (<http://bulletin.miami.edu/graduate-academic-programs/engineering/industrial-engineering/>).

Bachelor of Science in Industrial Engineering

The curriculum includes required courses in mathematics and the physical sciences that ensure a firm scientific background while advanced departmental courses provide specialization. Required courses in the people and society - humanities and arts give students the social, ethical and ecological awareness needed in their profession. The courses are designed with the prerequisite structure in mind so that students have to draw from previously acquired knowledge to successfully complete upper level course requirements.

The engineering design experience is interwoven in the curriculum throughout the students' four years of study.

- Starting with IEN 111 **Introduction to Engineering I** and IEN 112 **Introduction to Engineering II**, an introduction to Engineering graphics, Auto CAD, MATLAB, C++, advanced Excel and Access are given.
- The students then move on to take IEN 201 **Methods Analysis and Work Measurement** where they perform work measurement projects in industry, write reports, and make oral presentations to management. In the Spring of their Junior year, the students take IEN 363 **Project Management for Engineers** and they are exposed to techniques and tools in project management such as use of network flow and MS Project.
- Students take IEN 361 **Industrial Cost Analysis** and IEN 380 **Engineering Economy** where they become aware of the impact of productivity on the economic and social well-being of industry and countries. The students are also introduced to basic models of decision making such as the formulation and evaluation of an economic strategy.
- IEN 406 **Computer-Aided Manufacturing** introduces the students to product design in manufacturing and modern concepts of CAD/CAM/Automation.
- IEN 441 **Deterministic Models in Operations Research** focuses on the formulation of linear programming problems and solutions by the simplex method. Related topics include sensitivity analysis, duality theory and network programming. Engineering applications are emphasized.
- IEN 442 **Stochastic Models in Operations Research** focuses on basic concepts and techniques of random processes that are used to develop models for a variety of engineering and managerial problems. Topics include the Poisson Process, Markov chains, renewal theory, queuing models, and reliability.
- IEN 465 **Production and Inventory Control** provides a thorough treatment of modern production and inventory management policies, and their ramifications on supply chain management.
- Theory and applications of decision support systems in industrial engineering are covered in IEN 524 **Decision Support Systems in IE**. The topics include the study of model-based data-based, knowledge-based, and communication-based decision support systems.

- In IEN 557 **Ergonomics and Human Factors Engineering** both laboratory projects and real-world projects are designed, discussed, and conducted.
- Industry based projects are embedded into several other courses such as IEN 512 **Statistical Quality Control and Quality Management**, IEN 547 **Computer Simulation Systems**, and IEN 568 **Materials Handling and Facilities Planning**.
- IEN 494 **Senior Project** is a capstone project course where the students pool all of their knowledge and previous design experience into one major project integrating all components of the curriculum together. These projects are usually industry-based. Students prepare written and oral presentations. These presentations are made before top management or engineers of the organization where the projects were conducted in the presence of the faculty representatives from the department.

Real world projects are an integral part of most junior and senior level courses. In these courses, communication is emphasized through requirements for oral presentation and written technical reports. This experience provides the graduates with valuable industrial experience and communications skills while studying at the University of Miami.

The teaching laboratories meet current program needs and are constantly being improved. Equipment and experiments are geared to provide instruction in the areas of production system design, work methods and measurement, human factors engineering, manufacturing processes, computer applications in industrial engineering and operations research.

Advanced Writing and Communication Skills: Industrial Engineering students satisfy the University's Advanced Writing and Communication Skills requirement by completing a set of classroom courses, laboratory courses and design courses where they learn effective oral, graphical and technical writing skills. Industrial Engineering students acquire Advanced Writing and Communication skills in the following core courses:

- IEN 111 Introduction to Engineering I
- IEN 201 Methods Analysis and Work Measurement
- IEN 351 Industrial Safety Engineering
- IEN 363 Project Management for Engineers
- IEN 380 Engineering Economy
- IEN 494 Senior Project
- IEN 512 Statistical Quality Control and Quality Management
- IEN 547 Computer Simulation Systems
- IEN 557 Ergonomics and Human Factors Engineering
- IEN 568 Materials Handling and Facilities Planning

Industrial Engineering Concentrations

- Engineering Management Concentration
- Manufacturing Engineering Concentration
- Pre-Medical Concentration

Five-Year Bachelor of Science in Industrial Engineering and Master of Science in Industrial Engineering (Five-Year BSIE/MSIE Program)

This program is specifically designed for those students who want to pursue their graduate study as soon as they complete their undergraduate study in Industrial Engineering. The special conditions for this Five-Year BSIE/MSIE Program are as follows:

1. The student must declare his/her intent to participate before the end of the Junior year by submitting an official application to the department graduate committee for admission into the MSIE portion of the program. Exceptions to this rule must be approved by the department faculty.
2. A student wishing to withdraw from the Five-Year Program without the MSIE degree must complete all the requirements for the BSIE program, including the IEN 494 Senior Project in order to get his/her BSIE degree.
3. To qualify for the MSIE degree, the student must meet all the pertinent Graduate School requirements, including an acceptable score on the GRE (Graduate Record Examination) and a minimum of 3.0 GPA.
4. The student is awarded both the BSIE and MSIE degrees at the end of the fifth year when all undergraduate and graduate requirements are satisfied.

Dual B.S./M.S. Degrees in Industrial Engineering

- B.S./M.S. in Industrial Engineering - Five Year Dual Degree (<http://bulletin.miami.edu/undergraduate-academic-programs/engineering/industrial-engineering/five-year-bachelor-science-industrial-engineering-master-science-industrial-engineering-bsie-msie/>)

IEN 111. Introduction to Engineering I. 3 Credit Hours.

Use of engineering tools and computer techniques for problem solving, data acquisition, analysis, presentation, software design, and computer aided drafting. Development of design skills through several design and building competitions. Introduction to professional ethics, intellectual property, ethics, intellectual property rights, and an introduction to use of MATLAB, AutoCAD, and programming in C++.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 112. Introduction to Engineering II. 2 Credit Hours.

Continuation of IEN 111. An overview of Industrial Engineering concepts and issues important to the design and operation of industrial and service systems. Students will learn the use of software tools developed to enhance the Industrial Engineer's ability such as database management, high level programming languages, electronic spreadsheets, and computer graphics.

Prerequisite: IEN 111.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 201. Methods Analysis and Work Measurement. 3 Credit Hours.

Design of improved methods for doing work based on effective human effort. Time standardization of productive operations by work measurement, predetermined time systems, and activity sampling are discussed. Tools and charts for methods analysis are discussed and use of Microsoft Vision is emphasized and reviewed.

Prerequisite: IEN 112.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 306. Manufacturing Processes. 3 Credit Hours.

Basic and applied sciences in processing of materials. Effects of processing on the manufactured parts, selection of processing methods, and their relation with material properties. Contemporary and non-traditional processes used in manufacturing are also covered.

Prerequisite: CHM 121 or CHM 151 and PHY 221.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 310. Introduction to Engineering Probability. 3 Credit Hours.

Axioms of probability, discrete and continuous random variables, probability density functions, cumulative distribution function, expectation, conditioning, independence, functions of random variables, multiple random variables, sums of random variables, introduction to statistical analysis, estimation, and hypothesis testing. Cross-listed with EEN 310.

Prerequisite: MTH 162 and Requisite: Junior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 311. Applied Probability and Statistics. 3 Credit Hours.

This course covers fundamental probability concepts, random variables, mathematical expectation, discrete and continuous probability distributions, sampling distributions, point and interval estimation, hypothesis testing, and simple linear regression and correlation. The use of Minitab, a statistical software application, is emphasized. Examples are drawn from various disciplines.

Prerequisite: MTH 162.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 312. Applied Statistical Methods. 3 Credit Hours.

Linear regression, multiple regression, analysis of variance, and design of experiments are discussed. Cross-listed with MAS 312.

Prerequisite: IEN 310 or ECE 310 or IEN 311 or MAS 311 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 351. Industrial Safety Engineering. 3 Credit Hours.

Basic principles of accident prevention and safety engineering approach to the design of mechanical equipment, facilities, and manufacturing processes. Analysis and design of fire prevention procedures and accident control procedures in industry are included.

Requisite: Junior Status or Permission of Instructor.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 360. Productivity Engineering. 3 Credit Hours.

Definitions and scope of productivity engineering and management. The productivity cycle. Productivity measurement, evaluation, improvement—discussion and examples. Productivity planning and improvement through the application of industrial and systems engineering techniques.

Discussion of individual techniques with examples. Application potential of the course in real life situations.

Prerequisite: MTH 162.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 361. Industrial Cost Analysis. 3 Credit Hours.

Analysis of financial statements and cost factors in manufacturing and service systems. Cost accounting methods, job order costing and process costing approaches. Deterministic and probabilistic estimates of cost.

Prerequisite: MTH 162. And IEN 201.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 363. Project Management for Engineers. 3 Credit Hours.

This course will help students develop a basic understanding of the key concepts, theories, tools, and methodologies of project management.

Students will be introduced to the different phases of managing projects from conception to termination with particular emphasis on planning, scheduling, resource allocation, monitoring and control. The course will utilize a case-study-based approach in analyzing the techniques and methods of project management.

Requisite: Junior Status or Permission of Instructor.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 372. Emerging Technologies and the Creation of Technological Innovations. 3 Credit Hours.

A variety of emerging technologies will be discussed (nanotechnology, energy technologies, information technologies, biotechnologies, etc). The process of utilization in innovations will be covered.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 380. Engineering Economy. 3 Credit Hours.

Engineering Economy Fundamentals. Interest and money-time relationship, methods of making economic decisions, risk and uncertainty, sensitivity analysis, selections among multiple alternatives, depreciation, benefit-cost analysis, replacement studies, minimum cost analysis, and related topics.

Prerequisite: MTH 162.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 399. Internship. 1 Credit Hour.

Practical application of classroom theory through employment with firms offering positions consistent with the student's field of study. Course may be repeated.

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

IEN 406. Computer-Aided Manufacturing. 3 Credit Hours.

A comprehensive view of manufacturing with a focus on design, automation, and the use of computers in manufacturing. The topics include computer-aided design, communications, programmable logic controllers, CNC machining, industrial robots, process planning, and computer-integrated manufacturing. Laboratory projects are an integral part of the course.

Prerequisite: CHM 121 or CHM 151 and PHY 221.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 407. Product Design for Manufacturing. 3 Credit Hours.

The different phases of engineering design process. Guided Iteration Methodology for product design. Topics include design for manufacturing (DFM), best practices of product realization, solid modeling using SolidWorks, quality in design, issues in patents, liability and ethics. Engineering design specifications, evaluation methods for design alternatives.

Prerequisite: IEN 406.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 441. Deterministic Models in Operations Research. 3 Credit Hours.

Introduction to deterministic mathematical models with applications to operational problems. Topics include the methodology of operations research, mathematical programming, game theory, network flow-theory, and dynamic programming. Cross-listed with MAS 441.

Prerequisite: MTH 210.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 442. Stochastic Models in Operations Research. 3 Credit Hours.

Probabilistic models in operations research. Topics include probabilistic inventory models, queuing theory, Markov chains, and probabilistic dynamic programming. Cross-listed with MAS 442.

Prerequisites: IEN 310 or ECE 310 or IEN 311 or MAS 311 and IEN 441 or MAS 441.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 465. Production and Inventory Control. 3 Credit Hours.

Production and inventory management techniques such as forecasting methods, inventory control subject to both known and uncertain demand, aggregate planning, introduction to scheduling, materials requirement planning (MRP), just-in-time (JIT) manufacturing, and introduction to scheduling are covered.

Prerequisite: IEN 310 or ECE 310 or IEN 311 or MAS 311 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 494. Senior Project. 3 Credit Hours.

Integration of Industrial Engineering principles and techniques in the design and improvement of production and service systems. Course includes preparation of project proposal, data collection, analysis, reporting, and formal presentations.

Prerequisite: IEN 547. And Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 501. Manufacturing Analysis and Design I. 3 Credit Hours.

Analysis of Production Systems stressing diagnosis of problems associated with work measurement, manufacturing methodologies, and their interaction with cost factors.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 502. Manufacturing Analysis and Design II. 3 Credit Hours.

Analysis of production systems stressing diagnosis of problems of quality and production control, utilizing quantitative techniques and analytical methods.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 505. Robotics. 3 Credit Hours.

Fundamentals of robotics including kinematics and dynamics, trajectory planning, sensors and actuators, robotic vision, and case studies. Building your own robot is an integral part of hands-on laboratory exercises. Matlab controltoolbox and image analysis toolbox will be extensively used for design and analysis.

Prerequisite: IEN 406.

Components: LEC.

Grading: GRD.

IEN 507. Design of Manufacturing Systems. 3 Credit Hours.

State-of-the-art techniques and tools relevant to the design, analysis, and control of modern manufacturing systems. Topics include modeling of manufacturing systems, tools for manufacturing system analysis, manufacturing system planning and scheduling, and lean manufacturing systems.

Prerequisite: IEN 465.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 509. Automated Assembly. 3 Credit Hours.

Fundamentals of automated assembly including parts transfer systems and feeders, parts orientation and grasping techniques, product design for automated assembly (DFA), assembly robots, and performance and economics of assembly systems.

Prerequisite: IEN 406.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 512. Statistical Quality Control and Quality Management. 3 Credit Hours.

This course addresses the concepts, theories, tools and methodologies employed in the management and improvement of quality. The course examines many of the advance topics in statistical quality control including control charts and process capability studies, acceptance sampling, as well as Quality Function Deployment (QFD) and introduction to reliability. Also covered in the course are Lean Six Sigma methodology, tools and concepts.

Prerequisite: IEN 311 or MAS 311 or IEN 312 or MAS 312 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 513. Quality Management in Service Organizations. 3 Credit Hours.

Course examines the issues of quality and productivity management in the service sector. Topics covered include the development and use of questionnaires, service industry applications of quality such as in banking, insurance, healthcare, transportation, government, public utilities, and retail trade.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 516. Introduction to Applied Data Analytics. 3 Credit Hours.

This course focuses on some of the most commonly-used data analytics models and covers the basics of data analytics using the open source software R (which is one of the fastest growing open source software platforms). Specific course topics include Data Preprocessing and Cleaning, Fundamentals of R (for basic data analytics tasks), Regression Analysis, Discriminant Analysis & Classification, Segmentation/Clustering, Model Tuning/Selection, Performance Measurement in Data Analytics, and Decision Making with Data. This course provides hands-on skills to engineering graduate students with performing statistical data analysis and decision-making utilizing common types of data sets.

Prerequisite: IEN 442 And IEN 312.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 524. Decision Support Systems in Industrial Engineering. 3 Credit Hours.

Theory and application of decision support systems in industrial engineering. Topics include the study of model-based, data-based, knowledge-based, and communication-based decision support systems. Emphasis is placed on the selection process of the appropriate systems for various decision problems in industrial environments.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 547. Computer Simulation Systems. 3 Credit Hours.

Computer simulation and the development of simulation models. Application of discrete and continuous system simulation languages to systems studies is also included.

Prerequisites: IEN 442 or MAS 442.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

IEN 548. Games and Decision Making. 3 Credit Hours.

This course covers fundamentals of decision theory and game theory. The course is research oriented and a significant part of the grading will be based on students' research. Topics include optimization with multiple variables, constrained optimization, Lagrange relaxation, utility theory, decision making under uncertainty, simultaneous move (Nash) games, sequential decision making, sequential (Stackelberg) games, games with imperfect information, contracting and coordination, and bargaining. This course is composed of lectures, in-class discussions and problem solving, homework assignments, and research paper assignments.

Prerequisite: IEN 310. And IEN 441.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 554. Applied Computational Biomechanics. 3 Credit Hours.

Students will become familiarized with current tools in the field of computational biomechanics for applications in ergonomics, sports performance, simulations of occupational activities and human movement in general. Through the presentation of case studies and the completion of assignments, students will gain hands-on experience on full-body simulation environments (e.g., OpenSim), biomechanically oriented finite elements packages (e.g., FEBio), and software for reconstruction of human anatomy from medical images (Seg3D).

Prerequisite: IEN 557. Or BME 375.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 557. Ergonomics and Human Factors Engineering. 3 Credit Hours.

The study of human capacities and limitations with emphasis on human performance in system design. Topics include design of displays and controls, workload, job design, human information processing, anthropometry, workplace design, biomechanics, task analysis, and research techniques in human factors engineering. Lecture, 3 hours.

Prerequisite: IEN 312 or MAS 312.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 568. Materials Handling and Facilities Planning. 3 Credit Hours.

Analysis and design of production and service facilities, emphasis on material handling requirements. Capacity requirements, facility location, layout, storage systems and warehousing are discussed.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 570. Engineering Management. 3 Credit Hours.

Integrating engineering discipline into the social and economic considerations of managing systems. Tools and techniques used by engineering managers including engineering project life cycle, role playing, communication, decision-making in engineering management, and managing change in engineering organizations are discussed.

Prerequisite: IEN 311 or MAS 311 or IEN 312 or MAS 312.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 571. Engineering Entrepreneurship. 3 Credit Hours.

The conversion of technological know-how and engineering theories into business enterprises. The role of technology in creating wealth, connecting technology with market, the role and characteristics of entrepreneurs, starting a business and the business plan, innovation, industrial and service organizations, and the new business environment.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 572. Management of Technological Innovation. 3 Credit Hours.

Engineering, Science and Management Principles contributing to the development of a successful framework for Managing technology with an organization, nationally or internationally. The process of technological innovations, technological planning and forecasting, and socio-economic changes. Prerequisite: Senior or graduate standing.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

IEN 590. Special Topics in Industrial Engineering. 1-3 Credit Hours.

Sub-titles describing the topics are shown in parentheses in the class schedule, following the title "Special Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

IEN 594. Master's Capstone Design Project. 0-3 Credit Hours.

A capstone design project for students in the five-year BSIE/MSIE program. Integration of Industrial Engineering principles and techniques in the design and improvement of production and service systems is emphasized. Offered for students in this program only.

Prerequisite: IEN 547. Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

IEN 595. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

IEN 596. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

IEN 599. Cooperative Education. 1 Credit Hour.

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.