INDUSTRIAL AND SYSTEMS ENGINEERING

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Chairperson: Ratna Babu Chinnam
https://engineering.wayne.edu/industrial-systems

The industrial engineer is a broadly-trained integration engineer, concerned with enabling complex systems to function effectively. Managing the inventory of a production facility, for example, involves issues of production and stocking policy, manufacturing equipment, human resources, customer demand, and supplier relationships. The industrial engineer must understand the interaction of the components of a system, and coordinate the flow of materials and information to effectively manage the operation. The industrial engineer plays an important role in defining information needs and developing strategies for decision-making based on incomplete knowledge. However, the skills of the industrial engineer have much greater application than to traditional production environments. In a growing service sector of the economy including health care delivery, public safety, air transportation, and banking, for example, issues of resource management, scheduling, quality of service, and systems design are important.

Traditionally, the manufacturing engineer was responsible for developing the process capability to realize the output of design engineering. Today the boundary between design and manufacturing engineering is becoming blurred; both groups work together in teams to assure the soundness of design and production capability. The manufacturing engineer must have an understanding of the design process, but the manufacturing engineer's special expertise is the knowledge of the production process.

Today's production is computer-based and provides flexibility through computer control. The manufacturing engineer is responsible for designing and implementing the cells and production lines which become the basic units of manufacturing. Increasingly, such production units are becoming parts of an integrated factory system, not simply islands of automation. The manufacturing engineer must understand the multi-layered control architecture of the integrated factory, and the computer-based technologies which enable it.

The Department maintains laboratories in systems simulation, computer-aided manufacturing, human systems, and concurrent engineering design.

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- Industrial Engineering (B.S.) (https://bulletins.wayne.edu/undergraduate/college-engineering/industrial-systems-engineering/industrial-engineering-bs/)
- Industrial Engineering Minor (https://bulletins.wayne.edu/undergraduate/college-engineering/industrial-systems-engineering/industrial-engineering-minor/)

IE 1000 Industrial Engineering & Systems Thinking Cr. 3
This course introduces the fundamentals of industrial engineering and systems thinking through a hands-on, project-centric approach. Working in teams, students will develop a comprehensive solution for a chosen real-world scenario. Students will progress through key phases—from market research and stakeholder analysis to concept development, refinement, and the creation of an integrated operational plan—while integrating domain-specific challenges such as logistics, facility design, or energy production. Examples of project scenarios include a) foreign retailer planning to enter an emerging market; b) designing and setting up a new hospital in a community (addressing location, size, facilities design, supported specialties, etc.); and c) establishing an alternative energy production network (addressing market interest, energy mix, locations, production capacity, etc.). Offered Fall.
Restriction(s): Enrollment limited to students with a class of Freshman or Sophomore; enrollment limited to students in the College of Engineering, Liberal Arts & Sciences or School of Business.

IE 3120 Work Design Cr. 3
Role of the human as an element of the work environment. Traditional issues of work standards, productivity analysis and occupational safety are introduced. Examination of functional and organizational role of the worker; impact of emerging computer-based technologies on work design and implementation strategies is discussed. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 3450 Manufacturing Processes I Cr. 3
A study of the field of manufacturing processes from a mechanical engineering design standpoint. Topics include: processing of metals, polymers and ceramics, and computer-aided manufacturing. Offered Fall, Winter.
Prerequisites: BE 1500 with a minimum grade of C-, ME 2420 with a minimum grade of C-, BE 1300 with a minimum grade of C-, and BE 1310 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.
Fees: $25
Equivalent: ME 3450

IE 4250 Data Science and Analysis Cr. 3
This course is designed to explore the must-knows of data analysis and data science for engineering students. As data analysis focuses on processing and performing statistical analysis to solve problems for well-defined questions, data science complements it by fixating on unearthing answers to the questions that are not well-defined. This course not only covers how to perform descriptive statistics, design of experiment, and hypothesis testing for drawing conclusions, but also introduces how to apply machine learning and predictive analytics to extract critical information from the datasets. This course equips students with methods which are the key tools that enable engineers with descriptive as well as predictive methods to identify and deal with viability of measurements in stochastic environments. Offered Winter.
Prerequisite: BE 2100 with a minimum grade of C
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4260 Principles of Quality Control Cr. 3
Statistical quality control including process capability, control charts, and acceptance sampling procedures. Procedures for measurement of dimensional tolerance are introduced. Computer-based data collection and analysis. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4310 Production Control Cr. 3
The design of production planning and control systems. Materials management, forecasting, planning, scheduling of production systems, the planning and scheduling for large scale projects and introduction to the design of computerized materials management systems. Applications of operations research models to production control problems. Offered Winter.
Prerequisite: ENG 3050 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4330 Facilities Design Cr. 3
Design of manufacturing, warehouse and material handling facilities. Use of analytic and computer-aided methods in the facilities design process. Offered Winter.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4355 Product Engineering Cr. 3
Current principles and processes of product engineering. Use of integrated product engineering processes and methods. Offered Winter.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering.

IE 4420 Systems Simulation Cr. 3
Systems modeling and discrete event simulation. Methodology applied to analysis and design of a broad range of systems including both production and service systems. Computer assignments and a term project are required. Offered Yearly.
Prerequisites: BE 1200 with a minimum grade of C-, BE 2100 with a minimum grade of C, and (BE 1500 with a minimum grade of C- or BE 1600 with a minimum grade of C-)
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4560 Operations Research Cr. 3
An introduction to the philosophy of operations research. Formulation of linear programming models and their solution. Duality and sensitivity analysis. The transportation model. Introduction to probabilistic modeling and applications of queueing models. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C and MAT 2150 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4800 Engineering Design I: Project Management Cr. 2
Project selection, team building, and methodological preparation required for Engineering Design Project II. Offered Every Term.
Prerequisites: IE 3120 with a minimum grade of C-, IE 4250 with a minimum grade of C-, IE 4850 with a minimum grade of C-, and 2 of (IE 4420 with a minimum grade of C- (may be taken concurrently), IE 4330 with a minimum grade of C- (may be taken concurrently), or IE 4560 with a minimum grade of C- (may be taken concurrently))
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.

IE 4850 Engineering Economy Cr. 3
Economic analysis of engineering projects. Selection of appropriate financial parameters (e.g., interest rates) and methods of analysis for depreciation, tax considerations, and use of accounting data for comparison among investment options. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.
Equivalent: CE 4850

IE 4880 Engineering Design II Cr. 2
Intensive design experience defined and executed by the student. Requires synthesis and application of skills and knowledge gained in the program. Offered Winter, Spring/Summer.
Prerequisites: IE 4260 with a minimum grade of C- (may be taken concurrently), IE 4310 with a minimum grade of C- (may be taken concurrently), IE 4330 with a minimum grade of C- (may be taken concurrently), IE 4420 with a minimum grade of C- (may be taken concurrently), IE 4560 with a minimum grade of C- (may be taken concurrently), and IE 4800 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4990 Directed Study Cr. 1-4
Supervised study and instruction in a field selected by the student. Offered Intermittently.
Restriction(s): Enrollment limited to students with a class of Senior; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.
Repeatable for 4 Credits

IE 4991 Undergraduate Internship Cr. 1-2
The objective is to prepare students for roles in industrial and systems engineering by providing students with the opportunity to gain professional experience while engaging in rigorous classroom academics. Students who select this course can only perform work relevant to industrial engineering, therefore, some jobs may not be eligible for internship credit; the work must support the BSIE curriculum. Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Junior or Senior.
Repeatable for 3 Credits

IE 5490 Creative Problem Solving in Design and Manufacturing Cr. 3
Concepts of laws of natural development of engineering systems. Algorithm for inventive (creative) problem-solving (AIPS-85). Creative use of physical and geometrical effects in design of mechanical and manufacturing systems. Concepts of strength, stiffness, vibratory effects, reliability in mechanical design. Offered Yearly.
Equivalent: ME 5470, SYE 5470

IE 5995 Special Topics in Industrial Engineering Cr. 1-4
Special subject matter in industrial engineering. Topics to be announced in Schedule of Classes . Offered Intermittently.

IE 6000 Digital Automation Cr. 3
Fundamentals of digital control and logic; integration and automation solution technologies (barcode systems, vision systems, etc.); data acquisition. Offered Fall.

IE 6005 Automotive Engineering Statistics Cr. 3
Introduction to probability and statistics for engineering students: analysis of random component in problems, understanding probability and statistics, opportunities for application, analysis of data using statistical software. Offered for graduate credit only. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

IE 6010 IoT and Edge AI Programming Cr. 3
Learn sensor programming on an embedded device; use Wi-Fi, Bluetooth and MQTT to implement data streaming, remote control, and multi-device networking; explore the IoT data processing life cycle which includes capturing, cloud storage, and data analysis; develop and deploy machine learning models for use in mobile and edge computing environments. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6020 Digital Twinning and Immersive Modeling Cr. 3
This course presents an introduction to virtual and augmented reality (VR and AR) technologies, with an emphasis on designing and developing interactive virtual and augmented reality experiences. Learn the strengths and limitations of VR/AR technology and the need for consideration of human factors and cognitive issues. Beyond immersive technology, the course also covers Digital Twins, as a response to the increasing digitalization of product development, production, and products themselves. Offered Every Other Fall.

IE 6040 Simulation in Robotics Using ROS Cr. 3
Robotic systems are increasingly used for various tasks and applications. The applications include transportation safety, search and rescue, space exploration, and military operations, to name a few. ROS, the Robot Operating System, is an open-source framework used to direct the robots to perform tasks. ROS provides a software infrastructure for people who are interested in building and using robots. This framework is commonly used by people to share and collaborate on code and common ideas. Offered Winter.

IE 6125 Human Factors Engineering Cr. 3
Current methods and topics in engineering research on human capabilities and limitations as a system component. Advanced analysis, modeling and design of human-centered systems. Offered Winter.

IE 6210 Applied Engineering Statistics Cr. 3
An applied statistics course for students in engineering that will build upon introductory statistical knowledge. Students will learn to identify the phenomena they would like to study, design, and run experiments; collect data and analyze it by applying statistical tools such as multiple regression, ANOVA, and non-parametric statistical tools; and report on the statistical results and their implication to engineering phenomena. No credit for AGRADE undergraduates after taking IE 4250. Offered Fall, Winter.

IE 6220 Value Engineering Cr. 3
Resource management; systematic approach to solving problems and making decisions; forcing latent capabilities to be applied to challenging assumptions; application of unbiased logic techniques to produce superior results. Offered Spring/Summer.

IE 6240 Quality Management Systems Cr. 3
Design of quality management systems. Topics include: QFD, quality planning, business operating systems, TQM, standards, and auditing. Quality management tools such as PDCA and root case analysis. Offered Winter.

IE 6255 Quality Engineering Cr. 3
Quality Engineering means achieving quality by design, so this course covers several important methods in supporting engineering design activities. These methods include quality function deployment, axiomatic design, Theory of Inventive Problem Solving (TRIZ), Taguchi method (robust design) and tolerance design. Offered Fall, Winter.
Prerequisite: IE 6210 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6270 Engineering Experimental Design Cr. 3
The design of engineering experiments for manufacturing process analysis, human factors experimentation, societal systems analysis and life testing; basic experimental design models, blocking, factorial experiments, nested designs, covariance analysis, response surface analysis, estimation of effects. Offered Fall.
Prerequisite: IE 6210 with a minimum grade of C or IE 4250 with a minimum grade of C-

IE 6275 Reliability Estimation Cr. 3
The course is designed for graduate students specializing in quality engineering. These individuals play a significant role in designing and developing new products and manufacturing systems and processes. Topics include: reliability measures, failure distributions, reliability block diagrams, reliability estimation using exponential and Weibull distributions, sequential life testing, test planning, and Bayesian reliability. Offered Fall.
Prerequisite: IE 4250 with a minimum grade of C- or IE 6210 with a minimum grade of C

IE 6310 Lean Operations and Manufacturing Cr. 3
Fundamental theories and concepts in lean manufacturing, six-sigma, mistake proofing, problem solving, process management. Students develop competency in identifying causes and sources of waste in manufacturing, industrial, and business operations. Offered Fall, Winter.
Prerequisite: IE 4250 with a minimum grade of C- or IE 6210 with a minimum grade of C

IE 6315 Production and Service Systems Cr. 3
Fundamental theories and concepts in the design and operation of production systems for manufacturing and service organizations. Topics may include: Inventory Management, Production Planning (MRP, JIT, ERP), Factory Physics, Production Control, Introduction to Supply Chain Management Offered Winter.
Prerequisite: IE 6210 with a minimum grade of C

IE 6325 Supply Chain Management Cr. 3
Supply chain management and logistics is unique and, to some degree, represents a paradox because it is concerned with one of the oldest and also the most newly discovered activities of business. Supply chain system activities - communication, inventory management, warehousing, transportation, facility location, and production - have been performed since the start of commercial activity. It is difficult to visualize any product that could reach a customer without logistical support. Yet, it is only over the last decade that firms have started focusing on logistics and supply chain management as a source of competitive advantage. Logistics and supply chain management today represents a great challenge as well as a tremendous opportunity for most firms. Another term that has appeared in business jargon recently is demand chain. From our perspective, we will use the phrases logistics management, supply chain management, and demand chain management interchangeably. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6405 Integrated Product Development Cr. 3
Product development process: product architectures, concurrent engineering. Integration of marketing, design, and manufacturing functions for product development. How such processes are designed to account for various manufacturing and other business constraints to ensure that customer needs are met. Offered Fall.
Restriction(s): Enrollment limited to students in the College of Engineering.
Equivalent: AET 5600, EVE 5600

IE 6420 CAD/CAM Cr. 3
This course aims to provide students with an in-depth introduction to CAD/CAM and computer-aided process planning. Students will have the scientific foundations for understanding the issues and technologies of modern CAD/CAM and related design and modeling activities. The course covers the major topics of CAD/CAM by learning fundamental theory and modern CAD/CAM software. It will provide an integrated view of engineering so that students may gain a complete view of product design, modeling, and manufacturing. Offered Winter.

IE 6422 Flexible Manufacturing Systems Cr. 3
Flexible manufacturing systems are a highly automated group technology machine cell, consisting of a group of processing stations, interconnected by an automated material handling and storage system, and controlled by an integrated computer system. The analysis and design of flexible manufacturing systems will be covered, including: FMS control and communication architecture, FMS material handling architecture, flexibility analysis, and computer-integrated manufacturing (CIM). Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6425 Product Lifecycle Management and Sustainable Design Cr. 3
The aim of this class is to familiarize the current principles, practices, and applications of Product Lifecycle Management (PLM). The sustainable design of products and processes, as well as the early consideration of constraints and factors, are important in the successful development of competitive products. PLM is an integrated, information driven approach to all aspects of a products life from its design inception, through its manufacture, deployment and maintenance, culminating in its removal from service and final disposal. PLM technology plays a critical role in most modern industries including aerospace, automobile, and medical. Effective integration of PLM technologies into the product development process can put the industry at a competitive advantage to deliver innovative products. Offered Winter.

IE 6430 Computer Simulation Methods Cr. 3
The application of discrete, continuous and combined simulation methods to the solution of a variety of production and service systems problems. Computer simulation and a term project involving an application are required. No credit after IE 4420. Offered Fall, Winter.

IE 6435 Fundamentals of Sustainable Manufacturing Cr. 3
Sustainable manufacturing, as defined by the U.S.A. Department of Commerce, is “the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound.” This course is designed to introduce the fundamental concepts of sustainable manufacturing. While the focus will be on sustainable manufacturing, topics will also include connections of sustainable design, environmental sciences, and the social sciences with sustainable manufacturing. Offered Every Other Fall.

IE 6442 Facilities Design and Materials Flow Cr. 3
Presents the fundamental concepts, theory and procedures required for effective facilities design and planning. Includes models for determining plant size and time phasing; design of manufacturing, warehouse and material handling facilities; and use of analytic and computer-aided methods in the facilities design process. No credit after IE 4330. Offered Fall, Winter.

IE 6501 Healthcare Systems, Data Foundations & Interoperability Cr. 3
This gateway course introduces healthcare as a complex socio-technical system and prepares students to evaluate the data, workflows, stakeholders, incentives, and governance conditions that shape healthcare AI and analytics projects. Students learn how clinical, operational, claims, registry, public-health, and patient-generated data are created; how terminology and interoperability standards structure data exchange; and why data quality problems often reflect deeper system conditions rather than isolated technical defects. The course emphasizes systems thinking, stakeholder analysis, workflow mapping, human factors, data provenance, interoperability, and responsible use. Students complete a portfolio-ready Health System and Data Readiness Assessment for a selected healthcare domain, connecting system context, data flows, stakeholder needs, interoperability requirements, and AI-readiness risks. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6502 Applied Biostatistics, Study Design & Causal Thinking Cr. 3
This course develops the statistical, study-design, and causal reasoning skills needed to make credible claims from healthcare data. Students learn to distinguish descriptive, predictive, and causal questions; design observational analyses; identify common sources of bias; use regression and time-to-event methods appropriately; construct causal diagrams; and communicate uncertainty to clinical, operational, and public-health stakeholders. The course emphasizes judgment over rote computation: students learn when a model or association is insufficient, how confounding and selection processes arise in healthcare systems, and how to make transparent claims with appropriate limitations. The major portfolio artifact is a causal analysis memo with a reproducible notebook. Offered Every Term.
Prerequisite: IE 6501 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6503 Machine Learning for Clinical & Operational Prediction Cr. 3
This course teaches students to build, evaluate, document, and critique machine-learning models for clinical and operational healthcare prediction. The emphasis is not on maximizing a single benchmark metric, but on disciplined healthcare ML practice: careful problem framing, data splitting and leakage prevention, model development, calibration, threshold selection, temporal and external validation, subgroup performance, interpretability, drift, and model documentation. Students use reproducible workflows and create a portfolio-ready predictive model with a model card and subgroup evaluation. The course prepares students to participate responsibly in healthcare AI development and review, including situations where a model should not be deployed. Offered Every Term.
Prerequisite: IE 6502 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6504 Clinical NLP & Generative AI for Healthcare Cr. 3
This course prepares students to design, prototype, evaluate, and govern clinical natural language processing and generative AI workflows. Students work with clinical text use cases such as notes, discharge summaries, radiology/pathology reports, secure messages, and operational documentation. The course covers text preprocessing, classification, information extraction, embeddings, semantic retrieval, retrieval-augmented generation, prompt and context control, evaluation against labeled references, hallucination management, privacy risks, bias, human-in-the-loop review, and workflow fit. The course is intentionally evaluation-heavy: students learn to build useful prototypes while documenting limitations, safety controls, and governance requirements. Offered Every Term.
Prerequisite: IE 6501 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6505 Healthcare AI Implementation Studio Cr. 3
This capstone studio integrates the full lifecycle of responsible healthcare AI implementation: problem framing, stakeholder engagement, data governance, evidence and validation planning, workflow integration, risk management, monitoring, change management, and value communication. Students develop a deployment-ready package for a healthcare AI or analytics initiative. The course emphasizes judgment, not simply execution: students must determine whether AI is appropriate, what evidence is sufficient, who must be involved, how risks will be monitored, and how value will be demonstrated. The studio culminates in an executive-style defense before a review panel or instructor-designated audience. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6510 Information Systems for the Manufacturing Enterprise Cr. 3
Information systems are used to make organizations leaner and more integrated across the entire Manufacturing Enterprise. A suite of information systems is to provide an environment that allows an engineer to consider both product and manufacturing requirements throughout the design, development, manufacturing cycle, resulting in a single unified concurrent engineering process, an integral knowledge management process, and rapid response to market changes. This course will teach information technologies and applications in the manufacturing industry. Offered Fall.

IE 6520 Negotiating in an IE Environment Cr. 3
Analytic and interpersonal skills needed to negotiate effectively. Students integrate the analytic and interpersonal skills necessary to be an effective negotiator in a rapidly-changing technical environment. Offered for graduate credit only. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6530 Global Automotive Marketing Strategy Cr. 3
Over the course of the term, we will examine the various steps necessary in order to develop, design, and analyze a marketing plan. We will cover strategic issues of specific interest to the automotive industry. Offered Every Other Spr/Sum.
Restriction(s): Enrollment limited to students in the MS in Engineering Management program.

IE 6560 Deterministic Optimization Cr. 3
The primary goals are to develop the ability to formulate fairly complex optimization problems, provide an appreciation of the main classes of problems that are practically solvable, describe the available solution methods, and build an understanding of the qualitative properties of the solutions they provide. The class participant will develop skills in recognizing and formulating deterministic optimization models and gain an appreciation for the role of sensitivity analysis in analyzing a problem. Covers methods for quantifying the impact of specific constraints on the overall performance of the system. Application areas include production scheduling, product mix planning, manpower planning, routing and scheduling, financial planning, and prototype builds. Offered Fall, Winter.

IE 6570 Engineering Leadership and Management Cr. 3
This course is intended for students in the off-campus Engineering Management Master's Program. It provides students with a global perspective on engineering leadership. It investigates leadership at multiple levels - individual, organizational and societal - and it explores multiple contexts including different organizational cultures, countries and virtual teamwork. Topics covered include the leader's role in developing and changing organizational culture and leadership differences across cultures. Participants explore issues surrounding global leadership competencies such as leading virtually, the new ways of work, leading innovation, workforce diversity and ethics. They also assess their own cultural intelligence. Offered Yearly.

IE 6580 Engineering Financial Practice Cr. 3
Combines the central concepts of engineering financial and engineering managerial economics. Demonstrates, from an engineering financial perspective, how engineering decisions can impact the economic goals of the company. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6590 Engineering Leadership: Strategic Communications Cr. 3
Leaders in an engineering work environment face unique team and organizational communication challenges. Strong and precise communication is key to effective leadership and organizational efficiency. Participants in this course will engage in the practical and theoretical aspects of verbal and nonverbal communications in leadership and in the workplace. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6611 Fundamentals of Six Sigma Cr. 3
The attraction of Lean Six Sigma is obvious — designs that work, fewer defects and wastes in manufacturing, faster processes, lowered production costs, and greater customer satisfaction. With these pluses, it's no wonder the world's leading companies are adopting the Six Sigma approach to product development in ever-growing numbers. This comprehensive course covers the fundamental aspects of Lean and Six Sigma, Lean operation principles and tools, and the Six Sigma process improvement, that is Define-Measure-Analyze-Improve-Control (DMAIC). Offered Winter, Spring/Summer.

IE 6620 Lean Six Sigma Capstone Cr. 3
Covers extended aspects of Lean and Six Sigma, both the Six Sigma process improvement, that is, Define-Measure-Analyze-Improve-Control (DMAIC), and Lean operation principles and tools. The course also covers Design for Six Sigma and its utilization earlier in Product Development (PD). We extend the DMAIC process steps with DFSS's IDOV (Identify, Design, Optimize, Verify) process steps that cover the earlier PD phases. Offered Spring/Summer.
Prerequisite: IE 6611 with a minimum grade of B-
Restriction(s): Enrollment is limited to Graduate level students.

IE 6720 Engineering Risk and Decision Analysis Cr. 3
Structure, modeling and analysis of technical management decisions with emphasis on multiple objectives and trade-offs, and significant uncertainty. Explores barriers to rational decision making. Offered Fall, Spring/Summer.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6830 Management of Technology Change Cr. 3
Focuses on technology change and use of systems approach to plan for, manage and implement the diffusion and dynamics of product, process and business model innovation. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6840 Project Management Cr. 3
Provides an appreciation for the role and importance that project management has in delivering complex engineering projects on time, within budget, within performance specifications, and satisfying the customer. Reviews the fundamental content of the nine knowledge areas and five process groups included in the PMI's Project Management Body of Knowledge and how they apply to the general stages of a product development project with a look at some basic techniques and tools. Offered Winter.

IE 6850 Manufacturing Strategies Cr. 3
Manufacturing strategy is one aspect of a company's business strategy that also includes marketing, finance, and research and development. Each strategy development must coexist to achieve the company's goal, meet customer demands, and stay competitive. The objective of this course is to introduce and discusses key components of manufacturing strategy and how this fits within an overall business strategy. Offered Intermittently.

IE 6991 Industrial Internship Cr. 1-3
Offered Fall, Winter.
Repeatable for 99 Credits