Industrial Engineering (IE)

IE 1990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 2310. Introduction to Industrial Engineering. 4 Hours.
Provides an overview of the history of industrial engineering and of the most common methods that industrial engineers use to solve problems and design efficient processes. The emphasis is on how these methods are used to study, improve, and/or optimize a product or process. Topics include work design, ergonomic design, engineering statistics, quality engineering, engineering economics, project management, and process optimization. Also discusses the design of the production processes, facilities, and material handling systems. Studies applications in manufacturing, product design, and service industries. Laboratory experiments and written reports are required.

IE 2311. Recitation for IE 2310. 0 Hours.
Provides small group demonstration and hands-on labs for IE 2310.

IE 2990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 3412. Engineering Probability and Statistics. 4 Hours.
Presents probability theory axiomatically, with emphasis on sample space presentation of continuous and discrete random variables. Covers descriptive statistics, expected value of random variables, covariance and correlation, sampling distribution, and point and interval estimations. Introduces hypothesis testing including tests for means, variances, and proportions.

IE 3420. Computers and Information Systems. 4 Hours.
Examines the design and implementation of computer-based information systems. Presents the techniques of the development life cycle of these systems. Introduces the students to available Web tools that are relevant to the use, design, development, and implementation of information systems in the context of the Internet and World Wide Web. Emphasizes the use and applications of information systems in engineering including design and manufacturing. Topics include the value of information, information and decision making, tools of system analysis and design, basic and advanced HTML, and JavaScript.

IE 3425. Engineering Database Systems. 4 Hours.
Examines the representation of data and its creation and management in engineering enterprises. Discusses the client/server model of database access. Presents the fundamentals of data modeling and management, data mining and warehousing, multitier applications, and the use of the SQL query language. Emphasizes the use and applications of database systems in engineering including design and manufacturing. Topics include design schema of tables, records and fields of databases, SQL statements, security issues, and the use of a scripting language such as Perl or Visual Basic.

IE 3426. Recitation for IE 3425. 0 Hours.
Provides small group demonstration and problem solving for IE 3425.

IE 3430. Object Oriented Engineering Applications. 4 Hours.
Examines the object-oriented programming (OOP) paradigm and its use in engineering applications, computations, and problem solving. Presents object-oriented concepts that are used to build these applications. Covers the basics of Java and how to use it in object-oriented engineering programming. Topics include objects, Java programs, GUIs, client/server engineering applications, database access, and problem solving.

IE 3990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 4510. Simulation Modeling and Analysis. 4 Hours.
Covers process model design and development, validation, and experimentation for discrete-event simulation models. Topics include problem formulation, data collection and analysis, random-variable generation, model development, scenario experimentation, statistical analysis of output, and resultant decision management. Utilizes a major industry-standard simulation software application with animation capabilities. Requires prior completion of IE 3412, MATH 3081, or equivalent.

IE 4512. Engineering Economy. 4 Hours.
Introduces students to economic modeling and analysis techniques for selecting alternatives from potential solutions to an engineering problem. Presents basic methods of economic comparison such as present worth, annual worth, rate of return, and benefit/cost techniques. Studies effects of taxes on investment analysis. Also covers decision tree analysis and statistical decision techniques.

IE 4515. Operations Research. 4 Hours.
Introduces deterministic models including linear programming; duality and postoptimality analysis; transportation and assignment problems; and network flow problems such as the shortest path, minimum spanning tree, and maximum flow.

IE 4516. Quality Assurance. 4 Hours.
Reviews the distributions and statistical approximations commonly applied in statistical quality control methods. Introduces analysis of variance and simple linear regression. Covers basic principles to state-of-the-art concepts and application of statistical process control and design. Applies principles to a variety of products. Topics include product quality measures and controls, Shewhart control charts, quality cost, Pareto analysis, discrete and variable sampling, and military standards in quality control.

IE 4520. Stochastic Modeling. 4 Hours.
Covers the analytical development and solution to stochastic models in operations research. Topics include Markov chains, queuing theory, and dynamic programming.

IE 4522. Human Machine Systems. 4 Hours.
Emphasizes human sensory/motor performance, information processing capabilities, learning, memory, and skilled-task performance. Topics include an introduction to the experiment as a source of knowledge of human performance characteristics; vision, visual performance, visual display design; audition, noise, hearing damage, auditory signals; principles of somesthesis; information processing; signal detection; aging effects; and system development. Environments and equipment are subjected to usability tests that take into account principles of human-computer interaction and human anthropometric characteristics. Laboratory experiences include experimental design, data collection and analysis, and laboratory reports generation.

IE 4523. Lab for IE 4522. 1 Hour.
Accompanies IE 4522. Covers topics from the course through various activities.

IE 4525. Logistics and Supply Chain Management. 4 Hours.
Introduces the analysis, design, control, and operation of logistics and supply chain management systems. Includes the integration of supply chain components, logistics information systems, forecasting, production scheduling, inventory management, transportation and warehousing, and facility location planning.

IE 4530. Manufacturing Systems and Techniques. 4 Hours.
Focuses on manufacturing and design and their impact on each other. Covers the basics of design-manufacturing integration, manufacturing systems, manufacturing processes and techniques, manufacturing automation, and production planning and control. Topics include concurrent engineering, design for assembly, design for manufacturability, rapid prototyping, mechanical tolerancing, bill of materials, group technology, computer-aided process planning, NC part programming, programmable logic controllers, flexible manufacturing systems, computer-integrated manufacturing, and just-in-time philosophy. Topics also include traditional manufacturing processes such as casting, forming, machining, welding, molding, and particulate processing, and nontraditional manufacturing processes such as electrical discharge machining, laser machining, and water-jet machining. Students are required to conduct manufacturing-related experiments in the manufacturing lab to gain hands-on experience.

IE 4531. Lab for IE 4530. 1 Hour.
Accompanies IE 4530. Covers topics from the course through various activities.

IE 4600. Systems Design for Sustainability. 4 Hours.
Covers the fundamental process of designing and building systems, from systems identification to the entire systems life cycle. Discusses sustainability, functionality, and capability of systems with respect to systems' objectives. Presents factors affecting systems design, operation, and sustainability. Focusing on design of sustainable systems and improvement of systems, encompasses communications, defense, logistics, manufacturing, transportation, and others. Discusses concept and preliminary design phases to detail, production, and operation phases of design. Seeks to provide the concepts, methodologies, models, and tools needed to understand and implement a total life-cycle approach to systems analysis. Includes different categories of systems, various applications of analytical methods, and related problems and cases. Students who do not meet course prerequisites may seek permission of instructor.

IE 4615. Expert Systems and Neural Networks. 4 Hours.
Covers the theory and applications of expert systems and neural networks in engineering. Topics include knowledge representation (semantic networks, frames, production rules, and logic systems), problem-solving methods (heuristic search algorithms, forward and backward chaining, constraint handling, truth, and maintenance), approximate reasoning methods (Bayesian, Dempster-Shafer, fuzzy logic, and certainty factors), and expert system shells. Reviews background material on important neural network architectures such as feed-forward neural networks, Kohonen's feature maps, radial basis function networks, and adaptive resonance theory networks. Discusses neural network applications in several areas including group technology; part family formation; manufacturing systems design, process, and machine tool monitoring and diagnosis; system identification and control; and product inspection.

IE 4625. Facilities Planning and Material Handling. 4 Hours.
Explores engineering tools, techniques, and concepts for the design of facilities. The term facility is defined broadly. Industrial plants, schools, hospitals, or places in which things are produced or services are provided to a customer are all considered facilities. Provide students with a broad but practical understanding of the facilities planning and design process. The critical nature of material handling is discussed and approaches to designing optimal handling systems are examined. The tools of operations, research, statistical methods, and software applications are the focus of the problem-solving activities.

IE 4699. Special Topics in Industrial Engineering. 4 Hours.
Focuses on advanced industrial engineering project agreed upon between the student and instructor. May be repeated without limit.

IE 4710. Industrial Engineering Research 1. 4 Hours.
Focuses on scientific research in industrial engineering agreed upon between the student and instructor. May be repeated without limit.

IE 4711. Industrial Engineering Research 2. 4 Hours.
Focuses on in-depth scientific research in industrial engineering agreed upon between the student and instructor. May be repeated without limit.

IE 4970. Junior/Senior Honors Project 1. 4 Hours.
Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. Combined with Junior/Senior Project 2 or college-defined equivalent for 8-credit honors project. May be repeated without limit.

IE 4971. Junior/Senior Honors Project 2. 4 Hours.
Focuses on second semester of in-depth project in which a student conducts research or produces a product related to the student's major field. May be repeated without limit.

IE 4990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 4991. Research. 4 Hours.
Offers an opportunity to conduct research under faculty supervision.

IE 4992. Directed Study. 1-4 Hours.
Offers theoretical or experimental work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

IE 4993. Independent Study. 1-4 Hours.
Offers theoretical or experimental work under individual faculty supervision. May be repeated without limit.

IE 4994. Internship. 4 Hours.
Offers students an opportunity for internship work. May be repeated without limit.

IE 4996. Experiential Education Directed Study. 4 Hours.
Draws upon the student's approved experiential activity and integrates it with study in the academic major. Restricted to those students who are using the course to fulfill their experiential education requirement. May be repeated without limit.

IE 5374. Special Topics in Industrial Engineering. 4 Hours.
Offers topics of current interest in industrial engineering. May be repeated up to two times.

IE 5400. Healthcare Systems Modeling and Analysis. 4 Hours.
Discusses the key functions of healthcare operations management, such as patient and process flow, process improvement, facility layout, staffing and scheduling, capacity planning, and resource allocation. Focuses on analysis, design, management, and control of health systems and processes that are necessary to provide clinical care. The applications of systems engineering methods, such as optimization, simulation, and queuing models, are discussed through papers and case studies in different care settings (e.g., hospitals, emergency departments, surgery departments, and outpatient clinics) for different diseases (e.g. diabetes, cancer, mental health, cardiovascular disease). Uses spreadsheet tools to model and solve simulation and optimization problems. Requires equivalent course work if prerequisites are not met.

IE 5500. Systems Engineering in Public Programs. 4 Hours.
Introduces the design, development, analysis, and application of mathematical modeling for addressing public programs and societal needs. Systems engineering and mathematical models form the basis for decision making in both public and private applications. Focusing on societal applications, offers students an opportunity to discover how to incorporate public objectives and characteristics of large systems in the development of models and policies. Examines applications in the operation of public programs (e.g., public health systems, government programs) and public safety (e.g., security, emergency preparedness, and disaster response). Modeling techniques include game theory, data envelopment analysis, cost-benefit analysis, simulation, differential equations, and stochastic optimization. Requires equivalent course work if prerequisites are not met.

IE 5617. Lean Concepts and Applications. 4 Hours.
Designed to give students an understanding of the fundamentals of lean thinking and train them in applying this knowledge to practical problems. Uses case studies from different disciplines to help students learn lean principles and develop skills to implement them in practice. Covers theory and applications of lean six sigma, in which lean focuses on waste reduction while six sigma strives to eliminate defects. A knowledge-driven and customer-focused approach to creating value, lean thinking calls for process changes to eliminate waste, shorten product delivery time, improve product quality, and curtail costs. Key tenants of lean thinking are value, value stream, flow, pull, and perfection. Lean thinking is imperative for organizations aspiring to stay competitive by creating and delivering products in less time while improving customer satisfaction.

IE 5620. Mass Customization. 4 Hours.
Provides students with conceptual understanding and implementation strategies of mass customization (MC). MC is both a business and production paradigm where a company provides the customers with goods and services that suit their individual needs but does so with the efficiency and costs of mass production. MC is important in many sectors including computers, automotive, healthcare, banking, insurance, and tourism. It is based on principles of industrial engineering, mechanical engineering, management science, and marketing. Topics include typology of mass-customized production systems, manufacturing processes for MC, information needs of MC, customer focus, marketing issues, technology enablers, implementation methods, and case studies. Methodology includes lectures, case discussions, plant visits, guest lectures, and a term project. Cross-disciplinary activities, particularly between engineering and business students, are encouraged wherever possible.

IE 5630. Biosensor and Human Behavior Measurement. 4 Hours.
Emphasizes the measurement of human behavior in complex human-machine interaction. Topics include introduction of complex human-machine interactions; research methods in complex human-machine interactions; various kinds of human psychophysiological signals/cues, including physiological cues, facial expressions, eye-gaze movement, head movement, contextual cues; human cues and behavior relationship; transducers and measurement for these human cues/signals; basic principles of biosensors; general classification of biosensors; current technologies for building biosensors; conventional transducers and new technologies including micro-/nanotechnology; general systematic design process for biosensors; application of biosensors to understand human behavior in human-machine interactions. Also introduces the latest relevant research advancements in sensor fusion, affective computing, and emotion recognition.

IE 5640. Data Mining for Engineering Applications. 4 Hours.
Introduces data mining concepts and statistics/machine learning techniques for analyzing and discovering knowledge from large data sets that occur in engineering domains such as manufacturing, healthcare, sustainability, and energy. Topics include data reduction, data exploration, data visualization, concept description, mining association rules, classification, prediction, and clustering. Discusses data mining case studies that are drawn from manufacturing, retail, healthcare, biomedical, telecommunication, and other sectors.

IE 5976. Directed Study. 1-4 Hours.
Offers theoretical or experimental work under the direction of members of the department on a chosen topic. Course content depends on instructor. May be repeated without limit.

IE 5978. Independent Study. 1-4 Hours.
Offers theoretical or experimental work under individual faculty supervision. May be repeated without limit.

IE 5984. Research. 1-4 Hours.
Offers an opportunity to conduct research under faculty supervision. May be repeated without limit.

IE 6200. Engineering Probability and Statistics. 4 Hours.
Studies fundamental concepts of probability. Topics include events, sample space, and discrete and continuous random variables; density functions, mass functions, cumulative probability distributions, and moment generating functions; expectation of random variables; common discrete and continuous probability distributions including binomial, Poisson, geometric, uniform, exponential, and normal; multivariate probability distributions, covariance, and independence of random variables; sampling and descriptive statistics; and parameter estimation, confidence intervals, and hypothesis testing. Also introduces analysis of variance. Requires knowledge of multivariate calculus.

IE 6300. Manufacturing Methods and Processes. 4 Hours.
Focuses on manufacturing and its relationship to design and computers. Examines the relationship between design and various aspects of manufacturing. Covers manufacturing systems, manufacturing processes, bill of materials, group technology, mechanical tolerancing, QC, SPC, QPC, TQM, process planning and CAPP, NC part programming, supply chain management, production scheduling, JIT, lean manufacturing, flexible manufacturing systems, CIM cells, and manufacturing control via, say, programmable logic controllers.

IE 6962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 6964. Co-op Work Experience. 0 Hours.
Provides eligible students with an opportunity for work experience. May be repeated without limit.

IE 6965. Co-op Work Experience Abroad. 0 Hours.
Provides eligible students with an opportunity for work experience abroad. May be repeated without limit.

IE 7200. Supply Chain Engineering. 4 Hours.
Presents modern quantitative techniques for designing, analyzing, managing, and improving supply chains using deterministic and probabilistic models. Topics include a macro view of supply chains, demand forecasting, aggregate planning, sequencing and scheduling, inventory analysis and control, materials requirement planning, pricing and revenue management, contracts decisions, transportation decisions, location and distribution decisions, supplier selection methods, and global supply chains.

IE 7215. Simulation Analysis. 4 Hours.
Covers elementary queueing models, simulation and modeling, simulation model design, a survey of simulation languages with one language covered in detail, input data analysis and distribution fitting, model verification and validation, output analysis and transient/steady-state response, terminating/nonterminating systems, model experimentation and optimization, random number/random variate generation, and variance reduction techniques.

IE 7255. Manufacturing Processes. 4 Hours.
Covers the structures of metals, polymers, and ceramics and their manufacturing processes. Manufacturing processes include casting, forming, machining, welding, molding, and particulate processing. Discusses nontraditional manufacturing processes including electrical discharge machining, laser machining, and water jet machining. Also covers manufacturing processes for the electronics industry, such as processing integrated circuits, and electronic assembly and packaging.

IE 7270. Intelligent Manufacturing. 4 Hours.
Covers several advanced and contemporary topics in manufacturing. Includes applications of computational methods including experts systems, neural networks, and multiagents in manufacturing. Discusses the methods related to distributed and Web-enabled manufacturing.

IE 7275. Data Mining in Engineering. 4 Hours.
Covers the theory and applications of data mining in engineering. Reviews fundamentals and key concepts of data mining, discusses important data mining techniques, and presents algorithms for implementing these techniques. Specifically covers data mining techniques for data preprocessing, association rule extraction, classification, prediction, clustering, and complex data exploration. Discusses data mining applications in several areas, including manufacturing, healthcare, medicine, business, and other service sectors. Students who do not meet course prerequisites may seek permission of instructor.

IE 7280. Statistical Methods in Engineering. 4 Hours.
Discusses statistical models for analysis and prediction of random phenomena. Topics include review of descriptive statistics and hypothesis testing, linear models, both regression and ANOVA. Introduces design of experiments. Covers experiments with single and multiple factors of interest, and considers experiments with high-order experimental restrictions.

IE 7285. Statistical Quality Control. 4 Hours.
Designed to study the fundamental concepts of quality planning and improvements. Studies analysis and application of modern statistical process control methods including cusum, EWMA, multivariate, and modified control charts. Covers inspection error and design of sampling plans. Topics include software quality assurance, and study of the concepts of Deming, Ishikawa, Feigenbum, and Taguchi's approach in quality planning, organization, and improvement.

IE 7290. Reliability Analysis and Risk Assessment. 4 Hours.
Studies principles of the methods of risk assessment and reliability analysis including fault trees, decision trees, and reliability block diagrams. Discusses classical, Bayesian, and median rank methods for analysis of components and systems reliability. Presents various factors that determine the stress and strength of components and their impact on system reliability. Uses practical applications, examples, and problems to cover a broad range of engineering fields, such as mechanical, electrical, industrial, computer, structures, and automatic control systems.

IE 7315. Human Factors Engineering. 4 Hours.
Offers students an opportunity to acquire the necessary knowledge and skills to recognize and analyze existing or potential human factors problems and to identify, design, and possibly implement feasible solutions. Includes introduction to human factors and ergonomics; engineering anthropometry and biomechanics; physiology related to human factors and workstation design; cognition and information processing; decision making, attention, and workload; human error and accidents; human-machine interface design; controls and displays; and human factors applications in transportation, aerospace, consumer product design, and so forth.

IE 7374. Special Topics in Industrial Engineering. 4 Hours.
Offers topics of interest to the staff member conducting this class for advanced study. May be repeated without limit.

IE 7440. Industrial Engineering Leadership Challenge Project 1. 4 Hours.
Offers students an opportunity to develop and present a plan for the demonstration of a marketable technology product or prototype with an industrial-engineering focus. Constitutes the first half of a thesis-scale project in technology commercialization. Requires work/training with a sponsoring organization or employer to improve a process or develop a project that is of significant value to the organization and demonstrates a quantifiable market impact while enhancing the student's technological and engineering depth and fostering the student's leadership development.

IE 7442. Industrial Engineering Leadership Challenge Project 2. 4 Hours.
Continues IE 7440, further developing a thesis-scale project in technology commercialization. Offers students an opportunity to demonstrate their development of a marketable technology product or prototype with an industrial engineering focus and produce a written documentary report on the project to the satisfaction of an advising committee. Requires work/training with a sponsoring organization or employer to improve a process or develop a project that is of significant value to the organization and demonstrates a quantifiable market impact while enhancing the student's technological and engineering depth and fostering the student's leadership development.

IE 7615. Neural Networks in Engineering. 4 Hours.
Covers the theory and applications of neural networks in engineering. Reviews basics of machine learning, discusses important neural network architectures, and presents neural network training methods and algorithms. The specific neural network models covered in this course include feedforward neural networks, radial basis function networks, support vector machines, self-organizing feature maps, and recurrent networks. Discusses neural network applications in several areas including manufacturing, healthcare, medicine, business, and diagnostics and prognostics.

IE 7945. Master's Project. 4 Hours.
Offers theoretical or experimental work under individual faculty supervision.

IE 7962. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

IE 7978. Independent Study. 1-4 Hours.
Offers theoretical or experimental work under individual faculty supervision. An independent study must be petitioned and approved by the academic advisor. The petition must clearly state the reason for taking the course; a brief description of goals; as well as the expected outcomes, deliverables, and grading scheme. Master's degree students in thesis or project options are not eligible to take independent study.

IE 7990. Thesis. 1-8 Hours.
Offers analytical and/or experimental work conducted under the direction of the faculty in fulfillment of the requirements for the degree. Requires first-year students to attend a graduate seminar program that introduces the students to the methods of choosing a research topic, conducting research, and preparing a thesis. Requires successful completion of the seminar program. May be repeated without limit.

IE 7994. Thesis Continuation—Part Time. 0 Hours.
Continues thesis work conducted under the supervision of a departmental faculty member. May be repeated without limit.

IE 7996. Thesis Continuation. 0 Hours.
Continues thesis work conducted under the supervision of a departmental faculty member.

IE 8960. Candidacy Preparation—Doctoral. 0 Hours.
Offers students an opportunity to prepare for the PhD qualifying exam under faculty supervision. Intended for students who have completed all required PhD course work and have not yet achieved PhD candidacy; students who have not completed all required PhD course work are not allowed to register for this course. May be repeated once.

IE 8964. Co-op Work Experience. 0 Hours.
Provides eligible students with an opportunity for work experience. May be repeated without limit.

IE 8986. Research. 0 Hours.
Offers students an opportunity to conduct full-time research under faculty supervision. May be repeated without limit.

IE 9000. PhD Candidacy Achieved. 0 Hours.
Indicates successful completion of program requirements for PhD candidacy.

IE 9986. Research. 0 Hours.
Offers students an opportunity to conduct full-time research under faculty supervision. May be repeated without limit.

IE 9990. Dissertation. 0 Hours.
Offers dissertation supervision under individual faculty supervision. May be taken twice for course credit. May be repeated once.

IE 9996. Dissertation Continuation. 0 Hours.
Offers continuing dissertation supervision under individual faculty supervision. May be repeated without limit.