

# Industrial and Systems Engineering Courses (ISE)

This is a list of all industrial and systems engineering courses. For more information, see Industrial and Systems Engineering.

**ISE:0000 Industrial Engineering Internship/Co-op 0 s.h.**  
Industrial engineering students participating in the Cooperative Education Program register in this course during work assignment periods; registration provides a record of participation in the program on the student's permanent record. Requirements: admission to Cooperative Education Program.

**ISE:1000 First-Year Seminar 0-1 s.h.**  
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

**ISE:2000 Industrial Engineering Sophomore Seminar 0 s.h.**  
Curriculum and profession; ethics and professionalism in classroom and workplace. Requirements: sophomore or transfer standing in engineering.

**ISE:2360 Design for Manufacturing 3 s.h.**  
Fundamentals of design, engineering graphics, and manufacturing processing; computer graphics using Pro/ENGINEER for CAD and CAM; typical industrial processes, including casting, welding, machining, forming; laboratory exercises and projects. Corequisites: ENGR:2720.

**ISE:2500 Engineering Economy 3 s.h.**  
Basic concepts of engineering economy: time value of money, cash flow equivalence, depreciation, tax considerations, continuous cash flows, cost accounting overview; main analysis techniques—present worth, uniform annual cost, rate of return, benefit/cost ratio, replacement and break-even analysis. Corequisites: STAT:2020.

**ISE:3000 Professional Seminar: Industrial Engineering 0 s.h.**  
Professional aspects of industrial engineering presented through lectures and discussions by guest speakers, field trips, films, panel discussions. Requirements: junior standing.

**ISE:3149 Information Visualization 3 s.h.**  
Instruments for reasoning about quantitative information; analyzing and communicating statistical information; main typologies of data graphics (data-maps, time-series, space-time narrative, relational diagrams, graphs and methods for dimensionality reduction); language for discussing data visualizations combined with knowledge of human perception of visual objects; how to visualize information effectively by using statistical methods, knowledge of human perception, and basics of data graphics. Prerequisites: STAT:2020.

**ISE:3300 Manufacturing Systems 3 s.h.**  
Manufacturing and logistics systems, supply chain management, MRP/ERP systems, lean manufacturing, concurrent engineering, value stream mapping and six sigma. Offered spring semesters. Prerequisites: ISE:2360 and ISE:3700.

**ISE:3350 Process Engineering 3 s.h.**  
Methodologies, algorithms, and tools for processing modeling, analysis, and reengineering; modeling issues in product and component design, product and process modularity, quality, reliability, and agility. Prerequisites: ISE:3700.

**ISE:3400 Human Factors 3 s.h.**  
Design of human-machine systems; development of optimum work environments by applying principles of behavioral science and basic knowledge of human capacities and limits. Offered fall semesters. Prerequisites: PSY:1001.

**ISE:3450 Ergonomics 3 s.h.**  
Ergonomic design of jobs and products in an industrial and consumer market setting; principles of good design, examples of poor design; consequences of poor job and product design; principles of work sampling, usability studies, performance rating, sizing and planning of workstations, hand tool design, ergonomic design in transportation; related group project.

**ISE:3500 Information Systems Design 3 s.h.**  
Structure and design of computer-based information systems; concepts of information systems, decision making; computer hardware, software, data structures; methods for determining system requirements; designing, implementing, evaluating, managing information systems; applied projects. Prerequisites: ENGR:1300.

**ISE:3600 Quality Control 3 s.h.**  
Basic techniques of statistical quality control; application of control charts for process control variables; design of inspection plans and industrial experimentation; modern management aspects of quality assurance systems. Offered fall semesters. Prerequisites: STAT:2020 or BAIS:9100 or (STAT:3100 and STAT:3101 and STAT:3200). Same as CEE:3142, STAT:3620.

**ISE:3610 Stochastic Modeling 3 s.h.**  
Fundamental probabilistic models and applications of industrial engineering; overview of probability and distributions, stochastic processes and Markov chains, queuing theory, inventory theory, decision theory under uncertainty, and elements of risk management. Prerequisites: STAT:2020. Corequisites: ISE:3700.

**ISE:3660 Data Analytics with R 3 s.h.**  
Basics of data analytics and data mining; how to implement a variety of popular data mining methods in R to tackle business and engineering problems; focus on process of turning raw data into intelligent decisions and algorithms commonly used to build predictive models and find relevant patterns in data. Prerequisites: STAT:2020.

**ISE:3700 Operations Research 3 s.h.**  
Operations research models and applications; emphasis on deterministic model (linear programming, duality). Offered fall semesters. Prerequisites: MATH:2550. Corequisites: STAT:2020.

**ISE:3750 Digital Systems Simulation 3 s.h.**  
Simulation modeling and analysis; emphasis on construction of models, interpretation of modeling results; input and output analysis; hands-on usage of ARENA simulation software, manufacturing, health care, and service. Offered spring semesters. Prerequisites: ISE:3610 and ISE:3700.

**ISE:3760 Applied Linear Regression 3 s.h.**  
Regression analysis with focus on applications; model formulation, checking, selection; interpretation and presentation of analysis results; simple and multiple linear regression; logistic regression; ANOVA; hands-on data analysis with computer software. Prerequisites: STAT:2020 or STAT:2010 or STAT:3120. Same as IGPI:3200, STAT:3200.

**ISE:3998 Individual Investigations: Industrial Engineering****arr.**

Independent projects in industrial engineering for undergraduate students, including laboratory study, an engineering design project, analysis and simulation of an engineering system, computer software development, CAD/CAM applications, or research.

**ISE:4113 Control of Mechanical Engineering Systems****3 s.h.**

How to model simple engineering systems, apply time and frequency domain analysis techniques, and design control systems; application of these techniques using MATLAB; writing differential equations describing engineering systems and determine time domain response to a wide range of inputs; use of state-variable equations to model engineering systems and determine their time response to a wide range of inputs; describe advantages of feedback control; analyze performance of control systems; determine stability of control systems using Root-Locus, Bode, and Nyquist methods; design feedback control systems using frequency domain and state-variable methods. Prerequisites: MATH:2550 and MATH:2560 and ENGR:2710. Same as ME:4113.

**ISE:4116 Manufacturing Processes Simulations and Automation****3 s.h.**

Material processing, metal cutting theories, forming, micro/nano fabrication, programmable logic controller, computer numerical controllers, discrete control system, DC and AC servo motors, Command generation. Prerequisites: ME:2300. Same as ME:4116.

**ISE:4172 Big Data Analytics****3 s.h.**

Principles of data mining and machine learning in context of big data; basic data mining principles and methods—pattern discovery, clustering, ordering, analysis of different types of data (sets and sequences); machine learning topics including supervised and unsupervised learning, tuning model complexity, dimensionality reduction, nonparametric methods, comparing and combining algorithms; applications of these methods; development of analytical techniques to cope with challenging and real "big data" problems; introduction to MapReduce, Hadoop, and GPU computing tools (Cuda and OpenCL). Prerequisites: STAT:2020 or BAIS:9100. Requirements: basic programming skills in C, C++, Java, or Python; knowledge of Matlab, Octave, or R; and knowledge of a word processor. Recommendations: ISE:3760 and CS:4400 and CS:3330 and MATH:2550.

**ISE:4175 Safety Engineering****3 s.h.**

Systems safety principles and methods, occupational safety, product safety and liability, accident investigation and prevention methods and analysis, hazard analysis, and standards and regulations.

**ISE:4550 Wind Power Management****3 s.h.**

Principles of wind power production, wind turbine design, wind park location and design, turbine and wind park control, predictive modeling, integration of wind power with a grid.

**ISE:4600 Industrial Engineering Design Project****1-4 s.h.**

Projects involving product and related operational system design in an industrial or service organization; associated entrepreneurial or intrapreneurial planning. Corequisites: ISE:2500 and ISE:3300 and ISE:3350 and ISE:3400 and ISE:3450 and ISE:3500 and ISE:3600 and ISE:3750, if not taken as prerequisites. Requirements: completion of all ISE coursework.

**ISE:4620 Design of Experiments for Quality Improvement****3 s.h.**

Development of skills necessary to efficiently and effectively design and analyze experiments for quality improvement; topics include experiment planning, design, and statistical analysis of the results; experimentation is beneficial in all phases of industrial processes including new product design, process development, and manufacturing process improvement; students develop successful experiments that can lead to reduced development lead time, enhanced process performance, and improved product quality. Prerequisites: STAT:2020. Requirements: junior (third year) standing.

**ISE:4900 Introduction to Six Sigma****3 s.h.**

Six Sigma techniques for the DMAIC cycle (Define, Measure, Analyze, Improve, Control); what is needed for data collection (process inputs and outputs, measurement tools), conduct analysis (hypothesis testing, process capability studies), and conduct process improvement studies (design of experiments, response surface methodology); overview of Six Sigma, process and project management skills; application of the DMAIC model to a real-life improvement projection (a "learn-by-doing" approach). Prerequisites: ISE:3600.

**ISE:5000 Graduate Seminar: Industrial Engineering****1 s.h.**

Recent advances and research in industrial engineering presented by guest lecturers, faculty, students. Requirements: graduate standing.

**ISE:5420 Automated Vehicle Systems****3 s.h.**

Overview of vehicle technologies (HAV) and advanced driver assistance systems (ADAS) including a historical perspective, testing, policy and regulation, algorithm design, and human factors. Recommendations: ISE:3400.

**ISE:5520 Renewable Energy****3 s.h.**

Introduction to different sources of renewable energy generation including wind, solar, fuel cells, and bioenergy; design of energy solutions for different stand-alone applications (i.e., factories, data centers, hospitals) and system-wide solutions powering transportation systems, cities, or states; application-specific topics such as energy storage, control of energy generators, operations and maintenance, performance optimization, equipment health monitoring, predictive engineering, and integration of renewable energy with a grid.

**ISE:5620 Design of Experiments****3 s.h.**

Principles and methods of statistical design of experiments for product and process improvement; students develop skills necessary for planning, analysis, and optimization of experimental data, which can be applied across various fields of research including engineering, medicine, and the physical sciences. Prerequisites: STAT:2020.

**ISE:5650 Mechatronics Engineering for Smart Device Design****3 s.h.**

Introduction to basic mechatronics system components and design principles using mechatronics to meet functionality requirements of products, processes, and systems; lab-oriented assignments and team-based projects presented with innovative case studies in diverse application domains; labs require students to use a micro-controller kit to finish hardware development assignments; for students who plan to have a career in areas such as product development, robotics, design and manufacturing automation, technology management and innovations. Prerequisites: ENGR:2120 and (ISE:2360 or ENGR:2760).

- ISE:5730 Digital Industry** 3 s.h.  
Modeling methodologies, analysis, and optimization of digital enterprise models; autonomous building of models from data stores; introduction to different application-as-a-service models embedded in edge, fog, and cloud architectures and solutions; science of process modeling and analysis illustrated with case studies. Prerequisites: ISE:3700.
- ISE:5860 Health Informatics** 3 s.h.  
Technological tools that support health care administration, management, and decision making. Same as HMP:5370, IGPI:5200, MED:5300, SLIS:5900.
- ISE:5995 Contemporary Topics in Industrial Engineering** arr.  
New topics or areas of study not offered in other industrial engineering courses; topics based on faculty/student interest.
- ISE:5998 Individual Investigations: Industrial Engineering** arr.  
Individual projects for industrial engineering graduate students: laboratory study, engineering design, analysis and simulation of an engineering system, computer software development, research. Requirements: graduate standing.
- ISE:5999 Research: Industrial Engineering M.S. Thesis** arr.  
Experimental and/or analytical investigation of an approved topic for partial fulfillment of requirements for M.S. with thesis in industrial engineering. Requirements: graduate standing.
- ISE:6211 Human Factors in Healthcare Systems** 3 s.h.  
Solving human factors problems in health care work systems; cognitive systems engineering, interface design, health care productivity, patient safety; specific research including decision making, information transfer, and communication; discrete event and dynamic systems simulation modeling; human computer interaction; health information technology/systems; usability; business models of organizational, technical, and social elements of health care systems.
- ISE:6220 Cognitive Engineering** 3 s.h.  
Cognitive engineering principles; decision making and judgment; distributed cognition; cognitive work; human system interaction; cognitive work analysis; situated action and ecological models; mental models and representation; cognitive engineering methods and applications.
- ISE:6300 Innovation Science and Studies** 3 s.h.  
Innovative typology and sources, classical innovation models, measuring innovation, innovation discovery from data, evolutionary computation in innovation, innovation life cycle.
- ISE:6350 Computational Intelligence** 3 s.h.  
Concepts, models, algorithms, and tools for development of intelligent systems; data mining, expert systems, neural networks for engineering, medical and systems applications. Prerequisites: ISE:3700. Same as NURS:6900.
- ISE:6380 Deep Learning** 3 s.h.  
Basic principles of deep neural networks for various engineering applications; skill sets to design and implement deep learning algorithm for engineering applications; essential topics of deep learning for its practical use and exploring diverse methods and architectures for different types of applications.
- ISE:6410 Research Methods in Human Factors Engineering** 3 s.h.  
Logic and methods for research and for analysis and evaluation of complex human-machine systems; advanced techniques for enhancement of human interaction with advanced information technology; emphasis on cognitive task analysis techniques for innovative design, understanding of how technology affects safety, performance, user acceptance.
- ISE:6420 Human/Computer Interaction** 3 s.h.  
Development of projects using human factors principles in the design of computer interfaces.
- ISE:6450 Human Factors in Aviation** 3 s.h.  
Measuring, modeling, and optimizing human visual performance; display design for optimal legibility, research in visibility, legibility, conspicuity, and camouflage; visibility model development.
- ISE:6460 The Design of Virtual Environments** 3 s.h.  
Development of techniques for designing and creating three-dimensional representations of information for simulation, scientific visualization, and engineering; emphasis on human factors issues, software.
- ISE:6480 Unmanned Aircraft Systems** 3 s.h.  
Applications and research in unmanned aircraft systems (UAS) with focus on engineering aspects; new era of aviation and how UAS are fast emerging as a disruptive technology in aviation; applications ranging from film production, photography, precision agriculture, remote sensing, and infrastructure inspections to military applications; problem space of UAS from a variety of angles including engineering controls design, data links, UAS types, human factors, regulatory aspects.
- ISE:6600 Linear Programming** 3 s.h.  
Mathematical programming models; linear and integer programming, transportation models, large-scale linear programming, network flow models, convex separable programming. Requirements: calculus and linear algebra. Same as BAIS:6600, IGPI:6600.
- ISE:6650 Human Analytics and Behavioral Operations** 3 s.h.  
Introduction to several quantitative applications related to determining workforce size, skills-sets, and multifunctionality in service and manufacturing systems, based on measurable quality and productivity performance at the intersection of human factors engineering and production planning; modeling and solving problems in a context of speed and accuracy trade-off; models include learning, forgetting, teamwork, fatigue, procrastination, and individual difference measures.
- ISE:6750 Stochastic Optimization** 3 s.h.  
General tools and approaches used in decision making under uncertainties; modeling of uncertainties and risk, changes that uncertainties bring to the decision process, difficulties of incorporating uncertainties into optimization models, common techniques for solving stochastic problems.
- ISE:6760 Pattern Recognition for Financial Data** 3 s.h.  
Modeling and harvesting useful information and patterns for financial data; topics include basic concepts of financial data, financial data visualization, modeling and forecasting of financial time series, seasonal models, volatility models, value at risk, principal component analysis, and factor models.

**ISE:6780 Financial Engineering and Optimization 3 s.h.**

Quantitative methods of modeling various financial instruments (i.e., stocks, options, futures) and tools for measurement and control of risks inherent to financial markets; fundamentals of interest rates; options and futures contract valuation, including weather and energy derivatives; risk management and portfolio optimization; emphasis on modeling and solution techniques based on optimization and simulation approaches traditional to industrial engineering and operations research. Recommendations: basic knowledge of probability and statistics, numerical methods, and optimization.

**ISE:6790 Advanced Data Analytics and Informatics 3 s.h.**

Advanced analytics techniques (i.e., linear mixed effects model, Gaussian process model, Bayesian analytics); team project on selected data analytics topics from Kaggle using real industrial data for performance demonstration; emphasis on understanding methodology and technology applications; application of each analytics technique on various industrial data context. Recommendations: STAT:4540 or MBA:8150; working knowledge of important discrete and continuous distributions, joint distributions, linear regression, random process, hypotheses testing, and analysis of variance; and programming capability in any language (e.g., Matlab, R, Python).

**ISE:6810 Advanced Topics on Additive Manufacturing 3 s.h.**

Review of critical challenges facing 3D printing; emphasis on techniques and practical experience in developing novel additive manufacturing processes and applications; topics include 3D content creation and preparation, CAD systems for additive manufacturing, additive manufacturing processes, fabrication speed and improvements, rapid tooling and indirective processes.

**ISE:7995 Advanced Topics: Industrial Engineering arr.**

Discussion of current literature in industrial engineering.

**ISE:7998 Special Topics in Industrial Engineering arr.****ISE:7999 Research: Industrial Engineering Ph.D. Dissertation arr.**

Experimental and/or analytical investigation of an approved topic for partial fulfillment of requirements for Ph.D. in industrial engineering.