

# Industrial and Systems Engineering Courses (ISE)

## ISE Courses

This is a list of courses with the subject code ISE. For more information, see Industrial and Systems Engineering (College of Engineering) in the catalog.

- 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 processes; computer graphics using Creo for CAD/CAM; typical industrial processes, including machining, casting, forming; prototype fabrication using additive manufacturing techniques; next generation manufacturing and design tools; laboratory exercises and projects. Topics include engineering design, computer graphics, computer-aided design, engineering materials, traditional and non-traditional manufacturing techniques, numerically controlled machine tools, additive manufacturing and process planning.
- 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: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, and selection; interpretation and presentation of analysis results; simple and multiple linear regression; logistic regression; ANOVA; polynomial regression; tree models; bootstrapping; hands-on data analysis with computer software. Prerequisites: STAT:2020 or STAT:2010 or STAT:3120. Same as DATA:3200, 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: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 or ISE:2360. 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: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: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:5310 Advanced Computational Design and Manufacturing** 3 s.h.  
Provides understanding and practical experience in application of computational techniques to solve design and manufacturing problems; introduction to underlying concepts behind 3D geometry representations, algorithms, and underlying mathematical foundations essential to solving a wide variety of problems in computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE); hands-on computational skills working on team-based course projects. Requirements: knowledge of basic C/C++ programming concepts.
- ISE:5350 Logistics Engineering and Management** 3 s.h.  
Introduction to the methods and applications of data-driven approaches in logistics management; key components of logistics management and the application of data science to each; combination of lectures with hands-on exercises to practice data science techniques in real logistics management scenarios.
- ISE:5380 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: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.
- 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:5740 Design and Analysis of Computer Experiments** 3 s.h.  
Introduction to basic concepts of computer experiments; differences between computer and physical experiments; three technical contents including parametric and nonparametric prediction/inference models for computer experiments, space filling design for computer experiments, and criterion-based experiment design. Requirements: coding capability in at least one popular software (e.g., R, MATLAB, Python). Recommendations: STAT:4540, BAIS:9100 or MBA:8150, ISE:6790, or coding capability in R, MATLAB, or Python.
- ISE:5810 Advanced 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 indirect processes.

**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 MS Thesis****arr.**

Experimental and/or analytical investigation of an approved topic for partial fulfillment of requirements for MS 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. Same as NURS:6900.

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

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