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:2500 Engineering Economy  3 s.h.

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:3700 and ENGR:2760.

ISE:3350 Process Engineering  4 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 MSCI:9100 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.

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

ISE:4113 Control of Mechanical Engineering Systems  
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 
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  
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 ENGR:2760. Same as ME:4116.

ISE:4172 Big Data Analytics  
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 MSCI:9100 
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  
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  
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  
Projects involving product and related operational system 
design in an industrial or service organization; associated 
enentrepreneurial 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  
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  
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  
Recent advances and research in industrial engineering 
presented by guest lecturers, faculty, students. Requirements: 
gradiuate standing.

ISE:5420 Automated Vehicle Systems  
Overview of vehicle technologies (HAV) and advanced driver 
safety systems (ADAS) including a historical perspective, 
testing, policy and regulation, algorithm design, and human 

ISE:5520 Renewable Energy  
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  
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 

ISE:5650 Mechatronics Engineering for Smart Device Design  
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 
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.

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.

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:6232 Advanced Computer-Aided Design and Manufacturing 3 s.h.
In-depth study of CAD and manufacturing (CAD/CAM); review of CAD/CAM, computer graphics, NURBS modeling (curves/surfaces, solid modeling, design data exchange); computational geometry for product development, heterogeneous object modeling, rapid prototyping (RP) and layered manufacturing, computer-aided path planning, CAD applications (computer-aided tissue engineering, biomedical imaging and processing, biomanufacturing); related lab projects and assignments. Requirements: knowledge of one programming language (C, C++, C#, VB, or Java).

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:6720 Nonlinear Optimization 3 s.h.
Mathematical models, theory, algorithms for constrained and unconstrained nonlinear optimization; optimality conditions and aspects of duality theory; applications of nonlinear optimization in data analytics and machine learning.

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:6810 Advanced Topics on Additive Manufacturing**  3 s.h.
Review of critical challenges facing 3-D printing; emphasis on techniques and practical experience in developing novel additive manufacturing processes and applications; topics include 3-D 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.

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