Industrial and Systems Engineering (ISE)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

ISE 0818. Tackling Global Problems with Systems Thinking. 3 Credit Hours.
Poverty, climate change, wealth inequality, environmental concerns - these are some of the most pressing issues in societies worldwide. Although leaders have the best intentions of improving these social woes, many of the solutions offered are often just band-aids or worse, they exacerbate the problem. Ever wonder how you can create real, lasting change? Uncovering the root causes of these problems provides insight into how and why global problems came to be and what the best course of action is to mitigate or erase them and prevent their re-occurrence. Though this is no small task, once the underlying constructs are known, we can begin to develop more useful and sustainable solutions. Throughout this course you will discover the true causes of a messy societal issue and build an interactive framework for studying it that can be used in any global society. You will see the differences that exist for the same issue in different societies and understand the important role society and globalization plays in the development and remedy of the issues. For instance, what are the driving factors of homelessness in Manila and Philadelphia or sex trafficking in India and China? All of these places have a societal, political, educational and economic system. What are the differences between them, how do they interact with each other, what is the major driving force and how has globalization affected each differently? Identifying these factors can help to make impactful, long-lasting solutions to systemic global problems. Systems thinking is a holistic method of making sense of complicated problems such as these by looking at the interactions of its parts, including identifying viable solutions and avoiding unintended consequences. Gain deeper insight into the interactions of the types of global problems that plague societies and simultaneously develop a systems mindset. Note: This course fulfills the GenEd Global/World Society (GG) requirement.

Course Attributes: GG, SF

Repeatability: This course may not be repeated for additional credits.

ISE 2101. Applied Statistical Methods for Industrial and System Engineers. 3 Credit Hours.
Statistical analysis techniques and their applications in the field of industrial and systems engineering are presented. Topics include the statistical measures describing data, frequency distributions, probability distributions, sampling parameter estimation, hypothesis testing, regression analyses, and analyses of variance. Special emphasis on their application to field of industrial and systems engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1951 (may be taken concurrently), MATH 1031 (may be taken concurrently), 'Y' in MA07, 'Y' in MATW, or 'Y' in METW)

ISE 2102. Manufacturing Systems Design. 3 Credit Hours.
Introduction to the theory and practice of manufacturing and production processes. Topics to be covered include introduction to various manufacturing processes, fundamentals of lean manufacturing principles, operations analysis, work flow, assembly lines, logistics and service operations. Students will be exposed to the contemporary techniques used to design and analyze manufacturing systems for economic manufacture of products. Note: Prior to Fall 2024, this course was titled "Production Process Design and Laboratory"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 1117 or MEE 1117)

ISE 2103. Operations Research I. 3 Credit Hours.
This first course in Operations Research will cover an introduction to linear decision models, linear programming, network optimization and algorithms to solve complex engineering decision problems. Topics include model formulation, simplex method, sensitivity analysis and duality. Focus will be on optimization software implementation. Note: Prior to Fall 2024, this course was titled "Deterministic Models in Operations Research"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), or 'Y' in METW) and ENGR 1102 (may be taken concurrently)

ISE 2111. Emerging Technologies in Industrial and Systems Engineering I. 2 Credit Hours.
The first course in a series of three courses, this course introduces students to concepts in emerging technology applications in industrial and systems engineering. Focus will be on the introduction to various emerging technologies such as automation, data analysis, machine learning/artificial intelligence and their relation to manufacturing and service system design. It will provide students with the opportunity to apply their skills by conceiving, designing and programming a smart device.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ((ISE 2101 (may be taken concurrently) and ISE 2102 (may be taken concurrently)), (ISE 2101 (may be taken concurrently) and ISE 2103 (may be taken concurrently)), or (ISE 2102 (may be taken concurrently) and ISE 2103 (may be taken concurrently)))

ISE 3101. Quality Control and Process Improvement. 3 Credit Hours.
Methods used to achieve higher product quality, to prevent defects, to locate chronic sources of trouble, to measure process capability, and to use inspection data to regulate manufacturing processes are emphasized. Preparation of statistical control charts and selection of suitable sampling plans. Topics include review of probability distributions, control chart principles, control charts for variables (X, R charts), control charts for attributes (p, c, u charts), specifications and tolerances, fundamentals of acceptance sampling, acceptance sampling by attributes, special attribute sampling procedures, reliability, graphic methods for quality control, and TQM and ISO standards. Note: Prior to Fall 2024, this course was titled "Product Quality Assurance"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101.

ISE 3102. Operations Research II. 3 Credit Hours.
Modeling and analysis of engineering optimization problems using techniques from mathematical programming. Topics include integer programming, multicriteria optimization, stochastic programming, and nonlinear programming using an appropriate software. Emphasis is placed on the engineering applications of non-linear models. Note: Prior to Fall 2024, this course was titled "Stochastic Models in Operations Research"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2103.

ISE 3103. Systems Thinking and Modeling. 3 Credit Hours.
Utilizing a systems thinking approach in engineering design and development is necessary to understand the connections and dependencies that exist within the system. This course introduces the concept of systems thinking and computer modeling via system dynamics. Computer modeling can aid in understanding the complex feedback dynamics possible emergent behavior which can be found in the human, technological and organization systems. In addition, policy interventions and their effect on the behavior and structure of the system will also be addressed.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101 and (MATH 2041, MATH 2941, MATH 3041, MATH 3941, or 'Y' in METW)

ISE 3105. Data Analytics and Visualization in ISE. 3 Credit Hours.
This course is an introduction to data analytics and visualization with applications in industrial and systems engineering. The course covers an introduction to fundamental terminology and concepts related to engineering data analytics, how to ask the right questions, and other analytical skills needed to make effective, data-driven engineering decisions. The course will solve engineering problems faced in modern industrial settings and cover software skills like spreadsheet basics/standard query language (SQL) basics, Python and/or R programming for data analysis and programming. Engineering applications in areas such as manufacturing, logistics and healthcare will be used. In addition, the relationship between data analytics and data science will be discussed by having a brief introduction to predictive modeling using Python/R and its role in engineering applications.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101.

ISE 3111. Emerging Technologies in Industrial and Systems Engineering II. 2 Credit Hours.
The second course in a series of three courses, this course builds upon foundational knowledge learned in manufacturing and systems design and extends it into practice utilizing emerging technologies. Students will learn how the different technologies are combined in an industrial setting, the systems integration that is required and gain additional practice in the design, implementation and integration of a smart system. Focus will be on the data collection and visualization from connected devices.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2111, ISE 3101 (may be taken concurrently), ISE 3102 (may be taken concurrently), and (ISE 3103 (may be taken concurrently), ISE 3105 (may be taken concurrently), or ISE 4107 (may be taken concurrently))

ISE 3185. Industrial and Systems Engineering Internship Experience. 1 to 3 Credit Hour.
The course provides industrial and systems engineering experience in an engineering service, industrial, or research setting. The internship should allow the student to apply knowledge learned, build upon that knowledge and assess outcomes.

Repeatability: This course may be repeated for additional credit.

ISE 3202. Industrial and Systems Engineering Laboratory. 2 Credit Hours.
This course will allow students to experience various areas of contemporary production and manufacturing. Focus is through exposure to laboratory exercises and computer simulations to study major manufacturing processes, production designs and design for manufacturing and assembly.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2102.

ISE 4101. Human Factors (Ergonomics). 3 Credit Hours.
This course covers Human-machine systems analysis. The study of workplace layout, measurement of employee efficiency and productivity, criteria for tool and fixture design or selection, industrial fatigue, environmental influences on performance including the effects of illumination, noise, vibration, thermal, and other atmospheric factors. The basic ideas of industrial hygiene; the impact of OSHA; and special techniques for experimenting with human subjects, via demonstrations and supervised experiments are explored. Additional topics include human factor definitions, human factor research methodologies, human information processing, visual presentation - static and dynamic information, auditory and other displays; speech communication, motor skills, human control systems, data entry devices, physical work and manual materials handling, applied anthropometry, workplace environment; illumination and atmospheric conditions, noise, vibration and motion, human error, accidents and warnings, and usability and human-computer interaction.

Repeatability: This course may not be repeated for additional credits.

ISE 4102. Systems Simulation and Modeling. 3 Credit Hours.
Introduction to the application of simulation modeling for the analysis of complex industrial and manufacturing service systems. Examples are chosen from real-life situations such as warehousing, material handling, robotics, transportation, and hospital emergency rooms. Verification/validation as well as statistical analysis of both input/output data are introduced. Topics include verification and validation, calibration of models, face validity, validity of assumptions, Turing/Delphi test, comparison and evaluation of alternative systems, simulation examples, queueing systems, inventory systems, object oriented programming, ARENA simulation software, random number generation, Input modeling and Output analysis, confidence intervals, and variance reduction. Note: Prior to Fall 2024, this course was titled "Industrial Simulation"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2103.

ISE 4104. Inventory and Manufacturing Control. 3 Credit Hours.
This course introduces the study of the components and functioning of integrated production, planning, and control systems; forecasting, aggregate planning, scheduling, and recent models of production and inventory control for optimizing continuous and intermittent manufacturing operations. MRP basics and introduction to using a computer to apply scheduling models will be covered. Topics include functional modules in the control of a manufacturing organization, forecasting methods, aggregate planning and master scheduling, linear programming based methods, capacity requirements planning; machine scheduling, job sequencing and line balancing; job shop and flow shop models; material requirements planning and just-in-time production control. Note: Prior to Fall 2024, this course was titled "Production Planning and Control"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2103 (may be taken concurrently)

ISE 4105. Facility Planning. 3 Credit Hours.
This course will study strategic planning of production facilities including location, planning, design and maintenance. Emphasis on production systems, machine selection, automation, material handling, storage and warehousing, quality, retrofitting and preventative maintenance.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101, ISE 2102, and ISE 2103.

ISE 4106. Service Systems Engineering. 3 Credit Hours.
Services play a vital role in modern economies. In many economies they surpass their manufacturing counterparts in terms of contribution to the Gross Domestic Product, yet they cannot be handled in the exact same manner. The fundamentals of this sector as an engineering field will be discussed as well as the operations of service systems as a customer-centric environment. Topics will include service quality, strategies, operations, electronic services, queueing, service supply chains and managing service projects. Various projects will be handled during the course of the semester focusing on various aspects of the service industry.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101 and ISE 4104.

ISE 4107. Systems Lifecycle Engineering and Management. 3 Credit Hours.
Complex system development requires both hard and soft skills to address the challenges in modern engineering. Systems engineering includes human, organization and technical variables that all must be considered in complex system development. This course will cover the foundations of systems science and systems thinking, as well as an overview of the methodology that systems engineers use to bring these systems to fruition. Topics in the methodology that will be covered include identification of needs, requirements development, design and design integration, verification and validation as well as tools used to perform these functions such as technical management, lifecycle costing and risk analysis and management. This course will show the breadth of knowledge that is required of a systems engineer to address engineering challenges. Note: Prior to Fall 2024, this course was titled "Systems Engineering Fundamentals"; students who received credit for this title will not receive additional credits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2101 and ISE 3103.

ISE 4108. Supply Chain Engineering. 3 Credit Hours.
Companies are continuously working towards aligning their operations with effective supply chain solutions. This course will cover the theory, principles and implications of supply chain engineering and is intended to provide students with an understanding of the strategic and tactical elements of supply chains. Focus will be on the application and development of mathematical modeling tools to solve these problems such as facility location, deterministic and stochastic inventory management, aggregate planning, the bullwhip effect, disruptions, vehicle routing and contracting. The class is both theoretical and practical and will include case studies, journal articles and relevant research.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 2103.

ISE 4111. Emerging Technologies in Industrial and Systems Engineering III. 2 Credit Hours.
The third course in a series of three courses, this course builds upon knowledge learned throughout the ISE curriculum and extends it into practice utilizing emerging technologies. This course will explore advanced topics in emerging technologies used in industrial applications such as machine learning and artificial intelligence. Students will use advanced analytical methods to learn how to improve and optimize systems for better and faster decision-making.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ISE 3111 and ((ISE 4102 (may be taken concurrently) and ISE 4105 (may be taken concurrently)), (ISE 4102 (may be taken concurrently) and ISE 4108 (may be taken concurrently)), or (ISE 4105 (may be taken concurrently) and ISE 4108 (may be taken concurrently)))

ISE 4176. Industrial and Systems Engineering Senior Design Project I. 3 Credit Hours.
Your undergraduate career culminates with the Senior Design Project and integrates the Industrial and Systems engineering concepts with a major design experience. Through this experience you will demonstrate your skills for managing and executing a design project in a team setting. Skills you will need include problem identification, constraint specification, alternative analysis selection, design development, analysis and recommendations. In addition, you will have practice learning how to manage impediments that arise in the project development. Through this culminating experience you will integrate knowledge and further your technical, critical thinking, writing and teamwork skills.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ENGR 2196 and Complete 2 of the following: ISE 3102, ISE 3103, and ISE 4104.

ISE 5101. Probability and Statistics for Industrial and Systems Engineering. 1.5 Credit Hour.
The course provides fundamental topics in probability and statistical inference. Topics include probability, Bayes Theorem, discrete and continuous variables and their distributions and point estimation.

Repeatability: This course may not be repeated for additional credits.

ISE 5102. Data Analytics for Engineers. 1.5 Credit Hour.
The course discusses topics in statistical inference such as hypothesis testing for one and two and multi-sample experiments as well as regression via statistical software such as R. Additional topics in non-parametric statistics may be covered if time permits.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in ISE 5101 (may be taken concurrently)

ISE 5111. Introduction to Linear Optimization. 1.5 Credit Hour.
This course focuses on mathematical programming of engineering problems. Topics include linear programming formulation, simplex method, sensitivity and duality.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in ISE 5101 (may be taken concurrently)

ISE 5112. Advanced Optimization Models in Engineering. 1.5 Credit Hour.
This course focuses on advanced topics in mathematical programming of engineering problems. Topics include non-linear programming, binary and integer programming and optimality conditions.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in ISE 5111 (may be taken concurrently)

ISE 5116. Engineering Decision Analysis. 1.5 Credit Hour.
This course focuses on the art and science of decision-making in engineering. It presents the theory and modeling techniques which incorporate risk and uncertainty. Topics include foundations of decision analysis, simulation and sensitivity.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in ISE 5101 (may be taken concurrently)

ISE 5118. Multi-Attribute Engineering Decision Analysis. 1.5 Credit Hour.
This course continues more advanced topics on the art and science of decision-making in engineering for multi-objective problems. Particular focus is paid to utility theory, value, Bayesian models and risk assessment as part of the decision-making activity.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in ISE 5116 (may be taken concurrently)