

ISE-INDUSTRIAL AND SYSTEMS ENGINEERING

ISE 2303 Design and Manufacturing Process 3 Credit Hours

(Crosslisted with AME 2303) Prerequisite: AME 2113 or CEES 2113 or ENGR 2113. Mechanical and physical properties of engineering materials. Introduction to design concepts, manufacturing processes and equipment used in engineering. (Sp)

ISE 2311 Computer Aided Design and Graphics Laboratory for Industrial Engineers 1 Credit Hour

Corequisite: 2303. Provides students with a basic understanding of technical graphics communication and computer-aided design for industrial engineering applications. By using computer-aided design/drafting software, SolidWorks/autoCAD, students will learn basic principles of engineering graphics and geometric modeling to assist in design problem visualization and planning. (Sp)

ISE 2823 Enterprise Engineering 3 Credit Hours

Introduction to the industrial engineering role as enterprise system integrator. Systems concepts, modeling and analysis; integrated product/service and operational process design; productivity and quality improvement; computer technology insertion; project, operations, and global supply chain management. (F)

ISE 2913 Introduction to Python for Analytics and Engineering 3 Credit Hours

Prerequisite: CS 1323 or equivalent, or special permission. This course serves as a fundamental introduction to programming using Python, with a particular focus on applications in the fields of analytics and engineering. Python has become cornerstone language in these disciplines due to its versatility, simplicity, and extensive library support. Students will learn the essential of Python programming, laying a strong foundation for more advance topics in data analytics. (Sp)

ISE 2960 Directed Reading 1-3 Credit Hours

Directed Reading. 1 To 3 Hours. Prerequisite: Engineering 1112; Permission Of The Department; Special Permission Card Required. May Be Repeated; Maximum Credit Three Hours. Individual Project Studies For University College Students In Industrial Engineering. (F)

ISE 3293 Applied Engineering Statistics 3 Credit Hours

Prerequisite: MATH 2433 or MATH 2924. Introduction to probability, one and higher dimensional random variates, function of random variables, expectation, discrete and continuous distributions, sampling and descriptive statistics, parameter estimation, use of statistical packages. (F, Sp)

ISE 3304 Design and Manufacturing II 4 Credit Hours

Prerequisite: 2303, 2311, Civil Engineering and Environmental Science 2153 (or concurrent enrollment) Or Aerospace and Mechanical Engineering 3143 (or concurrent enrollment). Dimensioning and tolerancing; tolerances-type, design and specification; assembly and fit design; tolerance standards, process planning-precedence representation in machining, operation and machine sequencing; jigs and fixtures-design and analysis; time and cost estimation for machining; automation; process/system integration. Laboratory (F)

ISE 3440 Mentored Research Experience 3 Credit Hours

0 to 3 hours. Prerequisites: ENGL 1113 or equivalent, and permission of instructor. May be repeated; maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

ISE 3813 Statistical Computing 3 Credit Hours

Prerequisite: ISE 2913 and Math 3333. This course provides an introduction to statistical computing using the R programming language. R is a powerful tool for statistical analysis, data visualization, and data manipulation. Students will learn how to perform statistical computations and data analysis using R, making it a valuable skill for careers in analytics and engineering. (F)

ISE 3913 Introduction to Machine Learning and Data Analytics 3 Credit Hours

Prerequisite: ISE 2913 or C S 1323 or special permission. This course provides a foundational understanding of machine learning and data analytics within the context of engineering and complex systems. Students will learn key concepts and techniques, including data preprocessing, anomaly detection, regression, classification, and time series analysis. The course emphasizes practical applications of machine learning and analytics and their significance in various industries. (Sp)

ISE 3960 Honors Reading (HONORS) 1-3 Credit Hours

1 to 3 Hours. Prerequisite: Admission to Honors Program. May be repeated; maximum credit six hours. Consists of topics designated by the instructor in keeping with the Student's major program. Covers materials not usually presented in the regular courses. (F, Sp, Su)

ISE 3970 Honors Seminar 1-3 Credit Hours

1 to 3 hours. Prerequisite: admission to Honors program. May be repeated; maximum credit six hours. Projects covered will vary. Deals with concepts not usually presented in regular coursework. (Irreg.)

ISE 3980 Honors Research (HONORS) 1-3 Credit Hours

1 to 3 hours. Prerequisite: Admission to Honors Program. May be repeated; maximum credit six hours. Will provide an opportunity for the gifted Honors candidate to work at a special project in the student's field. (F, Sp, Su)

ISE 3990 Special Topics 1-3 Credit Hours

1 to 3 hours. Directed study for undergraduates. (F, Sp, Su)

ISE 4113 Spreadsheet Dec Support Sys 3 Credit Hours

Prerequisite: I E/ISE 4623 or concurrent enrollment, and CS 1313 or CS 1321 or CS 1323 or CS 1324, or permission of instructor. Covers all aspects of spreadsheet-based software functionality that are relevant to decision-making. Microsoft Excel is used as the subject tool. Students will learn advanced functions of Excel that are available through the spreadsheet interface, the Visual Basic language and its integration with the spreadsheet environment, principles of decision-support systems studied in a variety of applications, including facility layout, and warehousing. (F)

ISE G4223 Fundamentals of Engineering Economy 3 Credit Hours

Prerequisite: MATH 2423 or 2924 or permission of the department. Development and use of time value of money interest formulas. Inflation considerations and bond problems. Bases for comparison of alternatives, present worth, annual worth, rate of return and savings-investment ratio methods. Decision-making among independent, dependent, capital-constrained and un-equal lived projects. Depreciation methods and their effect on corporate income taxes, leading to after-tax cash flow analysis. Benefit-cost and cost effectiveness analysis. (Sp)

ISE 4281 Engineering Co-Op Program 1 Credit Hour

(Crosslisted with AME, CH E, CEES, C S, EPHY, ECE and BME 4281) Prerequisite: Departmental permission and junior standing. May be repeated; maximum credit 6 hours. The Co-Op program provides students an opportunity to enhance their education via career exploration in related professional work experiences. Course assignments help students articulate their experiences by completing journals; mid-term paper; final paper and/or final presentation. Faculty receive an evaluation from the student's Co-Op supervisor who monitors performance. Faculty collaborate with the Co-Op supervisor to ensure student success. (F, Sp, Su)

ISE 4302 Systems Thinking 2 Credit Hours

Systems thinking is a way of making sense of the world's complexity by studying whole systems and studying the relationships both among systems and among the integral part of the system. As systems engineering problems are typically complex and often embedded in complex contexts, determining effective solutions can be difficult. Systems thinking is based on systems theory and systems sciences. (Sp)

ISE G4333 Production Systems/Operations 3 Credit Hours

Prerequisite: ISE 2823 and ISE 4623, or permission of instructor. Operations-oriented topics for production systems. Supply chain process (tactical planning, operational scheduling and sequencing, management and planning, and demand promising). Customer service process; E-Business and information technology applications for production systems. (F)

ISE 4383 Systems Evaluation 3 Credit Hours

(Slashlisted with ISE 5383) Prerequisite: ISE 4223, ISE 4563, and ISE 4633. Focuses on the development and evaluation of alternate system and process designs. Development of system goals, requirements, and performance measures; ranking of alternatives and decision analysis techniques. Review and development of trade studies. Applications in facility layout, maintenance, supply chain, and other contexts. No student may earn credit for both 4383 and 5383. (F)

ISE 4393 Capstone Design Project 3 Credit Hours

Prerequisite: ISE 4333 or ISE 3913, ISE 4383, ISE 4663, and ISE 4853. Restricted to graduating Industrial & Systems Engineering students; to be taken in the last semester. Current problems drawn from production and service organizations will be presented by personnel from these organizations. Students will solve these problems under the guidance of their instructor, using industrial engineering methodology. (F, Sp) [V].

ISE 4553 Data-Driven Decision Making I 3 Credit Hours

(Slashlisted with ISE 5553) Prerequisite: ISE 3293. Fundamentals of statistical models for describing engineering systems and processes. Analysis of variance, multiple regression, logistic regression, time series, clustering. Emphasis is placed on decision making. No student may earn credit for both 4553 And 5553. (F)

ISE 4563 Quality & Reliability Engineering 3 Credit Hours

(Slashlisted with ISE 5563) Prerequisite: ISE 3293 and ISE 4553. The use of statistical methods for quality control and improvement in product and process environments, as well as introductory applied probability for component and system reliability. Topics include philosophies of quality management, control chart theory and application, process capability, and performance metrics of reliability. Focus is given to decision making in engineering systems. No student may earn credit for both 4563 and 5563. (Sp)

ISE 4623 Deterministic Systems Models 3 Credit Hours

Prerequisite: I E/ISE 2823. Problem solving using analytical models: theory, methodology, and application. Topics include linear programming, simplex algorithm and sensitivity analysis, integer programming, and dynamic programming. Practical applications in transportation networks, project management and scheduling, deterministic inventory models, decision making, and systems integration. Solution methods using computer software. (F)

ISE 4633 Probabilistic Systems Models 3 Credit Hours

Prerequisite: I E 3293 or ISE 3293 AND I E 4623 or ISE 4623. Problem solving using stochastic models: theory, methodology, and application. Topics include probability distributions, Poisson processes, Markov chains and Markov decision processes, queuing theory, and Monte Carlo simulation. Practical applications in probabilistic inventory models, maintenance activities, decision making, and systems integration. Solution methods using computer software. (Sp)

ISE 4663 Systems Analysis Using Simulation 3 Credit Hours

(Slashlisted with ISE 5663) Prerequisite: ISE 3293 or ISE 5013 or DSA 5013. Implements the science of systems analysis through the use of simulation modeling and statistical analysis; inclusive of time study analysis for performing input modeling tasks. Laboratory. No student may earn credit for both 4663 and 5663. (F)

ISE G4804 Ergonomics in Systems Design 4 Credit Hours

Prerequisite: junior standing or permission of instructor. Human-systems integration, considering the impacts of the physical structure, the information flow, and the environmental conditions on human performance. Students learn how to design, evaluate and improve systems from the perspective of the human(s) working in and impacted by the system. (Sp)

ISE 4853 Data-Driven Decision Making II 3 Credit Hours

(Slashlisted with ISE 5853) Prerequisite: ISE 4553 and ISE 4804 or ISE 3913. Experimental methodology for empirical decision making. Includes the development of empirical hypotheses, designs, performance criteria, and analyses. Techniques for empirical reporting. The measurement of human performance is typically the vehicle used for students in this course. No student may earn credit for both 4853 and 5853. (F)

ISE 4913 Advanced Machine Learning and Data Analytics 3 Credit Hours

Prerequisite: ISE 3913. This advanced course builds upon the foundation established in the introductory course, delving deeper into machine learning and data analytics. Students will explore advanced machine learning algorithms, deep learning, natural language processing, reinforcement learning, big data analytics, and specialized topics like Generative Adversarial Networks (GANs). Ethical considerations, societal implications, and future trends are integral components of the course. (F)

- ISE 4960 Directed Readings 1-4 Credit Hours**
1 to 4 hours. Prerequisite: good standing in University; permission of instructor and dean. May be repeated; maximum credit four hours. Designed for upper-division students who need opportunity to study a specific problem in greater depth than formal course content permits. (Irreg.)
- ISE 4970 Special Topics/Seminar 1-3 Credit Hours**
1 to 3 hours. Prerequisite: permission of instructor. May be repeated with change of content; maximum credit twelve hours. Special topics in the various fields of industrial engineering – data analysis, engineering financial analysis, human factors, manufacturing, operations research, production, simulation, sustainability, systems. (Irreg.)
- ISE 4990 Special Studies 1-3 Credit Hours**
1 to 3 hours. Prerequisite: senior standing. May be repeated once; maximum credit six hours. Directed study for undergraduates. (F, Sp, Su)
- ISE 5013 Fundamentals of Engineering Statistical Analysis 3 Credit Hours**
(Crosslisted with DSA 5013) Prerequisite: graduate standing. Introduction to probability, expectation, discrete and continuous distributions, sampling and descriptive statistics, parameter estimation, and statistical tests to aid decision making. The student will learn analysis techniques for verification of systems parameters. (F, Sp)
- ISE 5023 Systems Optimization 3 Credit Hours**
Prerequisite: graduate standing. Introduction to basic systems models and their solution with modern computer packages. Emphasis on modeling, computer solution, and sensitivity analysis with limited reference to model theory and development of algorithmic methods. (F)
- ISE 5033 Systems Engineering 3 Credit Hours**
Prerequisite: graduate standing. The complexities of systems, design, sustainment, and modernization in the context of systems engineering. (Irreg.)
- ISE 5103 Intelligent Data Analytics 3 Credit Hours**
(Crosslisted with DSA 5103) Prerequisite: graduate standing or permission of instructor; ISE 3293 or ISE 5013; CS 1313 or CS 1323. In our society, data is rapidly increasing in volume, velocity, and variety. At the same time computing power and the sophistication of data analysis techniques are increasing. However, even with the expanding capabilities, businesses and organizations often find themselves "data rich, but information poor." Intelligent Data Analysis is a holistic approach to addressing real-world data intensive problems that integrates human intuition with data analysis tools to best draw out meaningful insights. To this end, the course has four underlying themes: defining the Problem, understanding and coping with Data, selecting and using appropriate Analytical Tools, and discovering and communicating the Insight. Techniques covered include data cleansing and pre-processing, exploratory analysis and visualization, dimension reduction, linear and logistic regression, decision trees, and clustering. This course will introduce students to a powerful open source statistical programming language (R) and include extensive hands-on data analysis and team projects. (F)
- ISE 5113 Advanced Analytics and Metaheuristics 3 Credit Hours**
(Crosslisted with DSA 5113) Prerequisite: ISE 5013, graduate standing or permission of Instructor. Explores advanced techniques for addressing complex optimization problems. Focus is on formulating mathematical models and developing problem solving strategies using methods in the context of Data Science and Analytics. Topics include continuous and combinatorial optimization with an emphasis on both traditional and modern heuristic techniques. (Sp)
- ISE 5123 Software Tools-Dec Support 3 Credit Hours**
Prerequisite: Computer Science 1313 or 1323, or permission of instructor. Covers an integrated set of software tools that is used in development of a wide variety of decision models and support systems. Students will learn Python programming language and several of its major libraries. Applications will be developed in data extraction and processing, and development of statistical, simulation, and optimization models. (Irreg.)
- ISE 5133 Energy Analytics 3 Credit Hours**
(Crosslisted with DSA 5133) Prerequisite: Graduate standing or permission of instructor. In today's data-driven world, the ability to extract knowledge and create successful future energy projections is critical for the energy sectors. In this regard, data science body of knowledge promises a strong set of analytical tools that can be used for demand/supply forecasting and price prediction. This course aims at teaching the students the fundamentals of data analysis and interpretation. (F)
- ISE 5293 Cost Engineering 3 Credit Hours**
(Crosslisted with ELM 5293) Prerequisite: Graduate standing. This course will discuss the application of scientific principles and techniques to problems of cost estimating, cost control, business planning, profitability analysis, project management, and planning and scheduling. It will provide an understanding of both the tools and models that can be used throughout the design, development, and support phases, and examine the trade-offs between system performance and life-cycle cost. (Su)
- ISE 5373 Intro to Additive Manufacturing 3 Credit Hours**
Prerequisite: Graduate standing or permission of instructor. Students will be exposed to Additive Manufacturing (AM, also 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing) in a holistic but highly technical manner. Topics include an overview of relevant AM technologies and their importance in many branches of industry (i.e., medical, aerospace, automotive, etc.), as well as the field's origins, growth, and future directions. (Sp)
- ISE 5383 Systems Evaluation 3 Credit Hours**
(Slashlisted with ISE 4383) Prerequisite: permission of department. Focuses on the development and evaluation of alternate system and process designs. Development of system goals, requirements, and performance measures; ranking of alternatives and decision analysis techniques. Review and development of trade studies. Applications in facility layout, maintenance, supply chain, and other contexts. (F) No student may earn credit for both 4383 and 5383.
- ISE 5503 Healthcare Analytics 3 Credit Hours**
(Crosslisted with DSA 5503) Prerequisite: Graduate Standing and ISE 3293 or DSA/ISE 5013. This course gives an overview of the primary concepts and methods towards developing artificial intelligence (AI)-enabled healthcare systems. We will focus on foundational methods in machine learning and data analytics for prediction and pattern recognition, and apply them to specific areas in medicine and healthcare including, but not limited to, disease diagnosis, patient treatments and their outcomes prediction. (Sp)
- ISE 5543 Decision Analysis 3 Credit Hours**
(Crosslisted with ELM 5543) Prerequisite: Graduate standing. This course provides the fundamentals of decision analysis and explores how analyzing risk can be incorporated into good decision making. Normative approaches to making decisions when uncertainty exists are central to this course. Topics covered include structuring decision problems, developing alternatives, single and multiple objectives, utility theory, risk tolerance, data-driven and subjective probability, and psychological pitfalls. (F)

- ISE 5553 Data-Driven Decision Making I 3 Credit Hours**
(Slashlisted with ISE 4553) Prerequisite: ISE 3293 or ISE 5013. Fundamentals of statistical models for describing engineering systems and processes. Analysis of variance, multiple regression, logistic regression, time series, clustering. Emphasis is placed on decision making. No student may earn credit for both 4553 and 5553. (F)
- ISE 5563 Quality & Reliability Engineering 3 Credit Hours**
(Slashlisted with ISE 4563) Prerequisite: ISE 3293 or ISE 5013 and ISE 4553 or ISE 5553. The use of statistical methods for quality control and improvement in product and process environments, as well as introductory applied probability for component and system reliability. Topics include philosophies of quality management, control chart theory and application, process capability, and performance metrics of reliability. Focus is given to decision making in engineering systems. No student may earn credit for both 4563 and 5563. (Sp)
- ISE 5613 Multicriteria Optimization 3 Credit Hours**
Prerequisite: 4623. Survey of developments and applications of theory and methods pertinent to decision making under conflicting criteria. Goal programming and interactive methods for multicriteria mathematical programming will be emphasized with applications. (Irreg.)
- ISE 5633 Supply Chain Mgt & Transport 3 Credit Hours**
Prerequisite: graduate standing or by permission. Introduces transportation and supply chain concepts along with the important issues in supply chain system design and operation. Students learn how to formulate and analyze systems models for supply chain systems using information technology skills and decision support systems. (Irreg.)
- ISE 5643 Engineering Optimization 3 Credit Hours**
Prerequisite: ISE 4623 or permission. Basic computational tools for solving nonlinear unconstrained and constrained optimization problems arising in engineering practice. Emphasis is on models and methods applicable to problems in engineering design, process operations, control, production planning, manufacturing and management. (Irreg.)
- ISE 5663 Systems Analysis Using Simulation 3 Credit Hours**
(Slashlisted with ISE 4663) Prerequisite: Graduate standing, and ISE 3293 or ISE 5013 or DSA 5013. Implements the science of systems analysis through the use of simulation modeling and statistical analysis, including time study analysis for performing input modeling tasks. No student may earn credit for both 4663 and 5663. (F)
- ISE 5693 Simulation Modeling and Analysis 3 Credit Hours**
Prerequisite: Graduate standing; ISE 3293 or ISE 5013. This course is an advanced study of simulation methodology. Emphasis will be given to modeling of discrete event systems. Provides theoretical and practical experience in building and running computer simulation models of industrial systems. Teaches statistical methods for analyzing the output from a simulation. (Sp)
- ISE 5713 Engineering Project Management 3 Credit Hours**
Prerequisite: ISE 3293 or ISE 5013 or permission of instructor. Review of the various technical and managerial aspects of project management. Introduction to extensions of CPM and PERT. Specific topics include network development and analysis, precedence constraints, resource allocation, time-cost trade-off, heuristics, criticality index, computer applications, design and analysis of engineering projects, and optimization techniques for project scheduling. (Irreg.)
- ISE 5743 Mgt of Engineering Function 3 Credit Hours**
Prerequisite: 2823 or graduate standing. Explores major concepts of engineering management and how to apply these concepts in managing the engineering function in an enterprise. Intensive analysis of the specialized problems of engineering organizations which include technical human power. Procedures and design for the control of engineering projects. Specific examples and cases of management problems and experiences are used. A research project is required that involves at least one of the functions of engineering management. (Irreg.)
- ISE 5753 Organization Systems 3 Credit Hours**
Prerequisite: graduate standing or permission. The organization is examined as a complex of subsystems to accomplish production or service objectives. Individuals as members of the subsystems are examined as human factor elements in contributing to the analysis of effectiveness and efficiency of systems. Organizations are viewed from a macro standpoint with emphasis on engineering organizations. Current trends and cases are reviewed with case presentations required. A research project evaluating and organization is required from an engineering management viewpoint. (Irreg.)
- ISE 5763 Project Management Methods 3 Credit Hours**
Prerequisite: Graduate standing and ISE 3293 or ISE 5013. This course provides the fundamentals of project management. Projects are temporary, unique endeavors that produce a product, service, or result. Organizations in both the public and private sectors use projects to achieve strategic objectives. Projects have distinct start and end dates, and so have a life cycle. We will examine life cycle through project selection, team organization, execution, and closure. (Su)
- ISE 5773 Systems Requirements and Architecting 3 Credit Hours**
(Crosslisted with ELM 5773) Prerequisite: Graduate standing. This course provides the fundamentals of systems engineering by offering an overview of the discipline and then focusing on the management of system requirements and developing how a system will meet them. We will discuss the definition of systems, the system development life cycle, and the systems engineering method. Topics include Detail design, requirement analysis and decomposition, and system architecting. (F)
- ISE 5783 Project Leadership 3 Credit Hours**
Prerequisite: Graduate standing in ISE or DSA. This course is designed to help everyone improve their ability to lead when in formal leadership roles and when in roles where influence is needed to achieve high-performing teams. This course is to prepare students to exercise leadership as influencers when in not in formal leadership roles, and to be able to excel as leaders. (F)
- ISE 5813 Advanced Human Factors and Ergonomics 3 Credit Hours**
Prerequisite: ISE 4804 and graduate standing. Analysis, design, and evaluation of human behaviors and decision-making processes in simple and complex systems. Integration of human factors, human computer interaction, and systems engineering. (Sp)
- ISE 5823 Exercise Physiology 3 Credit Hours**
(Crosslisted with HES 5823) Prerequisite: 4824; Zoology 3104 or 3133; Physiology 5016 or 5019; or permission. Advanced study of physiological responses, regulatory mechanisms and adaptations of human performance and health; factors affecting performance and health; and training and evaluative techniques. (F)

- ISE 5853 Data-Driven Decision Making II 3 Credit Hours**
 (Slashlisted with 4853) Prerequisite: 4553 and 4804. Experimental methodology for empirical investigation. Includes the development and measurement of empirical hypotheses, designs, performance criteria, and analyses. Techniques for empirical reporting. The measurement of human performance is typically the vehicle used for students in this course. No student may earn credit for both 4853 and 5853. (F)
- ISE 5893 Models Based Systems Engineering 3 Credit Hours**
 Prerequisite: graduate standing. Models Based System Engineering (MBSE) is concerned with the application of modeling and simulation techniques to the design, analysis, verification, and validation of complex systems throughout their lifecycle. Students will be exposed to principles, processes and tools necessary to develop and manage model-based representations of complex systems, enabling a holistic and integrated approach to systems engineering. (Sp)
- ISE 5960 Directed Readings 1-3 Credit Hours**
 1 to 3 hours. Prerequisite: graduate standing and permission of department. May be repeated; maximum credit twelve hours. Directed readings and/or literature reviews under the direction of a faculty member. (F, Sp, Su)
- ISE 5970 Seminar-Industrial Engineering 1-3 Credit Hours**
 1 to 3 hours. Prerequisite: graduate standing or permission. May be repeated with change of content; maximum credit 12 hours. Special topics in the various fields of industrial engineering, engineering, economy, operations research, ergonomics, production, manufacturing, simulation, engineering statistics and computer systems. (Irreg.)
- ISE 5980 Research for Master's Thesis 2-9 Credit Hours**
 Variable enrollment, two to nine hours; maximum credit applicable toward degree, six hours. (F, Sp, Su)
- ISE 5990 Special Studies 1-4 Credit Hours**
 1 to 4 hours. Prerequisite: senior standing, permission. May be repeated; maximum credit six hours. (F, Sp, Su)
- ISE 6623 Nonlinear Programming 3 Credit Hours**
 Prerequisite: Graduate standing and ISE 4623. Theory and computational aspects of nonlinear optimization problems. Topics include: applications and problem formulation, convexity, Kuhn-Tucker conditions, duality, quadratic programming, unconstrained optimization techniques, direct search method, penalty function, optimization methods, feasible direction methods, separable programming, geometric programming. (Irreg.)
- ISE 6960 Directed Readings 1-3 Credit Hours**
 1 to 3 hours. Prerequisite: graduate standing or permission of instructor. May be repeated; maximum credit six hours. Directed readings and/or literature review under the direction of a faculty member. (Irreg.)
- ISE 6970 Special Topics/Seminar 1-3 Credit Hours**
 1 to 3 hours. Prerequisite: graduate standing or permission of instructor. May be repeated; maximum credit 12 hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or research and field projects. (Irreg.)
- ISE 6980 Research for Doctoral Dissertation 2-16 Credit Hours**
 2 to 16 hours. Prerequisite: Graduate standing and permission of instructor; may be repeated. Directed research culminating in the completion of the doctoral dissertation. (F, Sp, Su)
- ISE 6990 Special Studies 1-9 Credit Hours**
 1 to 9 hours. Prerequisite: Graduate standing. May be repeated with change of content; maximum credit 9 hours. Special problems in the various fields of industrial and systems engineering. Special studies in data analytics, systems modeling and design, computational optimization, logistics and supply chain management, human-system integration, engineering education, advanced manufacturing, or biomedical manufacturing. In addition, students may need information relating to problem-specific disciplines such as weather, energy, sustainability, and psychology. (F, Sp, Su)