

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

Prerequisite: Sophomore standing. 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 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 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 in I E/ISE 4623, Computer Science 1313 or C S 1323, or permission of instructor. Covers all aspects of spreadsheet-based software functionality that are relevant to supporting 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, warehousing, portfolio optimization, and various statistical inference problems. (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 4333 Production Systems/Operations 3 Credit Hours

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

ISE 4383 Systems Evaluation 3 Credit Hours

Prerequisite: I E/ISE 3304, I E/ISE 4223, I E/ISE 4563, I E/ISE 4633, I E/ISE 4804. 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)

- ISE 4393 Capstone Design Project** **3 Credit Hours**
Prerequisite: ISE 4333, 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 Simul** **3 Credit Hours**
Prerequisite: Engineering 3293 or 3293, 4633. 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 (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 5853) Prerequisite: 4553 and 4804. 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 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 5303 Computer-Aided Manufacturing 3 Credit Hours**
Prerequisite: 3304 or permission. The course introduces a general understanding of computer applications to machines and processes in manufacturing systems, numerical control principles, computer-assisted n/c programming (apt, g-codes) and rapid prototyping. Machining processes such as volume milling, trajectory milling, and surface milling will be taught using pro/manufacture. Rapid prototyping technologies such as the sla, sls, fdm and 3dp will be introduced. The course will also provide hands-on prototyping experience using the zcorp (tm) 3dp machine. (Irreg.)
- ISE 5313 Advanced Metal Cutting 3 Credit Hours**
Prerequisite: 3304 and permission of instructor. Theory of metal cutting or machining. Mechanics and dynamics of metal cutting are discussed with relevance to existing literature. The role of sensors in automation of machining is explored. Laboratory (Irreg.)
- ISE 5323 Advanced Productn Systems/Ops 3 Credit Hours**
Prerequisite: ISE 5013, ISE 4333, or by permission. Laws of factory physics that describe the basic behavior of discrete manufacturing systems. Limitations of traditional control approaches (i.e. MRP and DRP). Modern approaches to planning of material and capacity. Differences between push system and pull systems. Theory of constraints. The corrupting effect of variability on a manufacturing system. Operational performance measures. Industry-specific differences in business drivers and system behavior. (Irreg.)
- ISE 5343 Reliability in Engr Design 3 Credit Hours**
Prerequisite: Engineering 3293 or permission of instructor. Probabilistic reliability models for the lifetimes of manufactured components. Structure functions, system reliability calculations, lifetime distributions, models of dependence, parameter estimation, availability, maintainability, burn-in, preventive maintenance. Laboratory (Irreg.)
- ISE 5383 Systems Evaluation (Slashlisted with 4383) 3 Credit Hours**
Slashlisted with 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. No student may earn credit for both 4383 and 5383. (F)
- ISE 5393 Intro-CAD Tissue Engineering 3 Credit Hours**
Prerequisite: graduate standing or permission of instructor. Designed for graduate and senior undergraduate students in Engineering majors. Describes advanced computer-aided technology for medical implant design and tissue engineering applications. Topics include reverse engineering, biomodeling and layered manufacturing. Course content is delivered through lecture- and laboratory-based hands-on training. (Irreg.)
- ISE 5523 Applied Probabilistic Models 3 Credit Hours**
Prerequisite: 4633 or permission of instructor. Review of probability theory, random variables, discrete and continuous distributions, moment generating functions and conditional probability; introduction to Markov chains, Markov processes and renewal theory; applications to queuing theory, inventory systems and reliability models. (Irreg.)
- 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 5573 Stat Analysis-Simulatn Models 3 Credit Hours**
Prerequisite: 4663, and Engineering 3293; or permission. Probabilistic and statistical aspects in the design and analysis of stochastic simulations: random number generation, random variate generation, input modeling, output analysis (including time series models and spectral analysis), ranking and selection and variance reduction techniques. Laboratory (Irreg.)
- 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 5623 Linear Programming 3 Credit Hours**
Prerequisite: 4623. Introduction to set theory and vector spaces, convexity analysis, special matrices. Properties and solution methods of linear inequalities, Farkas' Lemma, optimality conditions, polyhedral sets and cones. Simplex method, theory of duality, simplex based algorithms, bounded variable and decomposition approaches, sensitivity and parametric analysis, geometrical interpretations, complementary pivot theory. (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: 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 5653 Engr Network Flow Analysis 3 Credit Hours**
Prerequisite: 5623. Modeling network flow problems, algorithms and computational analysis of networks. Topics include: graph theory, shortest path problems, network flow problems, computer applications. (Irreg.)
- ISE 5663 Simulation I 3 Credit Hours**
Prerequisite: 4663, Engineering 3293 or permission of instructor. Advanced network modeling, continuous modeling, discrete event modeling, animation. (Irreg.)

- ISE 5673 Simulation II** **3 Credit Hours**
Prerequisite: 5663. Advanced study of simulation methodology. Provides practical experience in building and running computer simulation models of industrial systems. Utilization of statistical techniques for analyzing the output from a simulation is also emphasized. Addresses discrete event simulation as well as animation. (Irreg.)
- 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 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 5843 Biomechanics** **3 Credit Hours**
Prerequisite: 4824 or HES 3843 or permission. Review of muscle, bone and joint structure and function. Review of kinematic and kinetic principles as applied to human movement. Analysis of human movements using film, anthropometric, dynamometer, force platform, electromyographic and performance techniques. Application of human movement analysis to ergonomics, sport and rehabilitation. (Irreg.)
- 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 5863 Product Usability** **3 Credit Hours**
Prerequisite: Graduate standing or permission of instructor. Theoretical and practical methods of analyzing usability, which include the use of questionnaires and surveys, experimentation, task analysis, and cognitive modeling. Students will learn to justify performing usability studies through cost/benefit analysis and increased customer satisfaction. By the end of the course, students should be able to analyze the usability of a product as well as design products that are more usable. Because of the relationship between usability and quality, the students will learn how to increase product quality. (Irreg.)
- 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: 5623. 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 6643 Integer Programming** **3 Credit Hours**
Prerequisite: 5623. An introduction to the applications and computational techniques available for solving integer programming problems. Topics include: branch and bound, cutting plane methods, Bender's partitioning algorithm, set covering and set partitioning algorithms and knapsack method. (Irreg.)
- ISE 6663 Advanced Simulation Topics** **3 Credit Hours**
Prerequisite: 5673, or permission of instructor. Advanced simulation topics; simulation language design; special purpose languages, continuous process simulation. (Irreg.)
- ISE 6673 Support Vector Machines** **3 Credit Hours**
Prerequisite: 5623, 5643 or by permission. Develops the foundation of kernel methods and support vector machines and their computer implementations. Applications include current problems in financial engineering and data analysis (including building statistical learning models, managing risk, and solution of large scale machine learning problems), weather prediction, and computational biology. (Irreg.)

ISE 6853 Human Factors-Computer Systems 3 Credit Hours

Prerequisite: 5813 or permission of instructor. Important factors involved in designing the human/computer interface based on established principles of ergonomics, existing guidelines and current research. Topics include: identifying user characteristics, code design, menus, interactive dialog procedures, graphical user interfaces, input and output devices, documentation, training and vdt workplace. Students may be required to make class presentations. (Sp)

ISE 6933 Special Topics 3 Credit Hours

Prerequisite: graduate standing or permission. May be repeated; maximum credit 12 hours. Evaluation and simulation of various industrial engineering systems emphasizing the system as an integrated structure. (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 Doctoral Dissertation 2-16 Credit Hours
(F, Sp, Su)**ISE 6990 Special Studies 1-6 Credit Hours**

1 to 6 hours. Prerequisite: graduate standing. May be repeated; maximum credit six 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. (F, Sp, Su)