

INDUSTRIAL AND SYSTEMS ENGINEERING

Our Website (<http://www.ise.vt.edu>)

Overview

The mission of the Grado Department of Industrial and Systems Engineering is to:

- Prepare undergraduate and graduate students for life-long success and leadership in the profession, in industry, and in higher education;
- Conduct and disseminate research that advances knowledge; and
- Serve the profession, industry, and society.

Industrial and systems engineering is one of the most diverse fields in engineering. ISE is concerned with the design, improvement, and installation of integrated work systems of people, materials, equipment and technology, processes, information, and capital. The industrial engineer is concerned with creating value and improving performance of integrated systems, whether that involves improving quality and productivity, reducing costs and non-value adding activities, improving customer satisfaction, or improving worker safety.

The applications for industrial engineering capabilities include industry, government, and service organizations. Graduates of the ISE program at Virginia Tech work in manufacturing facilities, distribution warehouses, hospitals, airlines, railroads, banks, amusement parks, the military, federal government, and management consulting firms. The boundaries of where ISEs make contributions are limitless.

The mission of the ISE Undergraduate Program is to prepare industrial and systems engineering students to create value for organizations, the profession, and society. We achieve this mission by recruiting, retaining, and educating high quality and diverse students and by creating a rigorous and collegial environment enabling students to learn industrial engineering methods and tools, built upon a foundation of mathematical, physical, and engineering sciences, and to apply them in any global organizational setting. Students are able to achieve academic and professional success through opportunities to participate in various educational experiences, to develop capabilities as future leaders, and to embark on a lifelong journey of professional development and learning.

Program Educational Objectives and Student Outcomes

The ISE faculty, with input from our external Advisory Board, employers, and students, have defined the following Program Educational Objectives (PEOs) and Student Outcomes for our Undergraduate Program. PEOs are statements that describe the expected accomplishments of ISE graduates within 3-5 years after graduation. Student Outcomes are statements that describe what students are expected to know and be able to do at the time of graduation.

Program Educational Objectives: Within 3-5 years of graduation, ISE alumni will have:

- Created value by applying industrial and systems engineering methods, via critical thinking, to design/redesign integrated systems/processes through the identification, creation, and implementation of sustainable solutions.

- Provided technical or administrative leadership.
- Pursued professional development and knowledge enhancement via graduate study, continuing education, company training or rotation programs, etc., in order to enhance knowledge in existing areas or learn about emerging trends in industrial and systems engineering.
- Communicated effectively with different audiences and stakeholders, both in-person and online, using written, oral, and visual media.
- Worked effectively and inclusively in teams having attributes such as varying organizational backgrounds, positions, geographic locations, and demographic compositions.
- Served the profession, community, and society as exemplified by our motto *Ut Prosim* (That I May Serve).

Student Outcomes: At the time of graduation, ISE students will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The Industrial and Systems Engineering program at Virginia Tech is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (<http://www.abet.org>).

Curriculum

The BSISE curriculum (ISE Undergraduate Program) encompasses coursework addressing the technical, organizational, human, and economic elements of work systems. Our aim is to provide graduates with the knowledge and capabilities to enable them to successfully pursue careers in industrial engineering or to continue on to graduate study.

ISE emphasizes instruction in fundamental engineering principles based on the physical sciences, engineering sciences, mathematics, and statistics. These principles are applied in practical design experiences throughout the undergraduate curriculum.

Coursework in the physical and chemical sciences and mathematics provides a solid background for basic engineering science courses, which in turn support courses in industrial engineering. Industrial engineering courses are focused in the areas of operations research, manufacturing systems, human factors and ergonomics, and management systems. In each of these areas, modern computing and software tools support analysis and design activities. Electives provide students with the opportunity to explore other areas of engineering, as well as cultural,

societal and creative experiences, which makes for well-rounded, diverse, and globally-aware engineers.

Students gain valuable hands-on experience in multiple areas of the BSISE curriculum via state-of-the-art laboratory facilities. These include the ISE Senior Design Center (computer support and other resource material for student design projects), the Harris Manufacturing Processes Laboratories (conventional and numerically-controlled machine tools, robotics and automation equipment, and welding and foundry facilities), and the Human Factors Work Measurement and Methods Engineering Laboratory (equipment for in-class exercises and experiments in work measurement, motion economy and time study, psychophysics, human audition and vision, and work station design).

The capstone experience in the ISE Undergraduate Program is ISE 4005 Project Management and Systems Design-ISE 4006 Project Management and Systems Design Project Management & System Design (also referred to as "Senior Design"). The two-course sequence involves students working in project teams with external company sponsors to solve real-world problems. This provides ISE students with engineering project experience that develops not only their capabilities in applying ISE tools and techniques, but technical and professional skills such as teamwork, communication, project management, and life-long learning skills as well. Student project teams present their findings at the annual Senior Design Symposium, which is attended by company sponsors and the ISE Advisory Board.

Many ISE students participate in Undergraduate Research to help satisfy elective requirements in the curriculum. The opportunity to work more closely with ISE faculty members, in some cases on a one-on-one basis, can provide more in-depth development of particular ISE capabilities and a more-enriching educational experience.

The ISE program also provides students with the opportunity to pursue minors, such as a Business Minor, Green Engineering Minor, or Statistics Minor. Specific information about minors available to ISE students can be found in the ISE Undergraduate Student Handbook and the ISE website. Students and employers alike are seeing the benefits of these minors for adding value to the ISE major.

The ISE department participates in the Cooperative Education & Internship Program, in which qualified students may alternate semesters of study with semesters of professional co-op employment or internships. Students are encouraged to pursue these experiences before they graduate to make them more competitive in the work force. Students are also encouraged to participate in career fairs and job interviews on and off campus.

The ISE department also provides students with many significant scholarship opportunities at the undergraduate and graduate levels to encourage and acknowledge high academic performance and achievements. The department also maintains bilateral student exchange agreements with international universities, where students can take ISE courses, which will transfer back to their BSISE. Students may also select other universities at which to perform a study abroad semester.

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Graduate programs leading to the M.S. and Ph.D. are offered (see Graduate Catalog). The graduate programs include concentrations in manufacturing systems engineering, human factors engineering and ergonomics, operations research, and management and systems engineering. The ISE Department also coordinates on- and off-campus master's degree programs in systems engineering (M.S.) and engineering administration (M.E.A.). The department also offers the accelerated undergraduate/graduate program for students interested in pursuing their Master's degree in ISE. More information is available on the ISE Department website.

Program Requirements

The graduation requirements in effect during the academic year of admission to Virginia Tech apply. Requirements for graduation are listed on checksheets. Students must satisfactorily complete all requirements and university obligations for degree completion. The university reserves the right to modify requirements in a degree program.

Please visit the University Registrar's website at <https://www.registrar.vt.edu/graduation-multi-brief/checksheets.html> for degree requirements.

Students are strongly encouraged to meet with one of the ISE Academic Advisors to discuss the BSISE curriculum.

- Industrial and Systems Engineering Major (<https://catalog.vt.edu/undergraduate/college-engineering/industrial-systems-engineering/industrial-systems-engineering-bs/>)

Head and Professor: E.M. Van Aken

Associate Department Head and Undergraduate Program Director: J.P. Shewchuk

Assistant Head and Graduate Program Director: M.A. Nussbaum

Charles O. Gordon Professor: G.D. Taylor, Jr.

John Grado Professor: J.G. Casali

Hal G. Prillaman Professor: M.A. Nussbaum

Paul T. Norton Professor: S.C. Sarin

Ralph H. Bogle Professor: B.M. Kleiner

John Lawrence Professor: K.P. Triantis

Professors: P. A. Belling, J.G. Casali, B.M. Kleiner, Z.J. Kong, M.L. Madigan, M.A. Nussbaum⁶, S.C. Sarin, G.D. Taylor Jr., K.P. Triantis, K.L. Tsui, and E.M. Van Aken

Associate Professors: M. Bansal, X. Chen, D.E. Dickerson, K.P. Ellis^{2,3,4}, J.L. Gabbard, N. Ghaffarzadegan, M. Jeon, R. Jin, B. Johnson, S.G.

Klauer, A. L'Afflitto, N. Lau, P.K. Rao, J.P. Shewchuk, and E.B. Toy

Assistant Professors: R. Hildebrand, N. Hosseinichimeh, S. Lim, R.N.C. Patrick, T.G. Topcu, S. Tunc, X. Yue, and H. Zhong

Collegiate Associate Professor: N. Cherbaka

Collegiate Assistant Professor: J. Godfrey, C.S. Kwaramba, W.P.V. Nguyen, and L. Savage

Instructor: K.E. Carper

Faculty Affiliates: P. Agee, T. Cody, X. Deng, Y. Hong, A. Leonessa, J. Moreland, M. Perez, N. Roofigari-Esfahan, S. Trent, G. Vining, and W. Woodal

Adjunct Faculty: M. Deegan, J. Geraghty, G. Keller, K. Lee, M. Muscatello, and W. Vaneman

Professors Emeritus: M.P. Deisenroth, W.J. Fabrycky, K.H.E. Kroemer, H.A. Kurstedt, D. L. Price, H.D. Sherali, H.L. Snyder, and W.G. Sullivan

Associate Professors Emeritus: P. Ghare, P.T. Kemmerling P. Koelling, J.A. Nachlas, and R.E. Taylor

Academic Advisors: J.Kerstiens and P. Van Curen

Undergraduate Course Descriptions (ISE)

ISE 2004 - Introduction to Industrial and Systems Engineering (1 credit)

Introduction to the Industrial and Systems Engineering profession through exposure to problems, principles, and practice. Systems thinking, critical thinking, and contemporary issues in industrial and systems engineering. Introduction to the ISE Department, focusing on faculty and research areas. Importance of ethics and professionalism. Academic planning for the BSISE degree.

Instructional Contact Hours: (1 Lec, 1 Crd)

ISE 2014 - Engineering Economy (2 credits)

Concepts and techniques of analysis for evaluating the value of products/services, projects, and systems in relation to their cost. Economic and cost concepts, calculating economic equivalence, comparison of alternatives, purchase versus lease decisions, financial risk evaluation, cash flow sensitivity analysis, and after-tax analysis.

Instructional Contact Hours: (2 Lec, 2 Crd)

ISE 2024 - Probability Foundations for Industrial and Systems Engineers (3 credits)

Introduction to the mathematical foundations of probability theory for industrial engineers. Understanding of probability as a model for real phenomena, with applications of probability in an industrial engineering context. Review of set theory, counting (permutations and combinations), definition of probability axioms, sample spaces, random variables, independence, probability distribution functions, probability mass or density functions, expectations, moment-generating functions, joint and conditional random vectors and distributions, and distributions of functions of random variables, central limit theorem.

Prerequisite(s): MATH 2204 or MATH 2204H

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 2034 - Data Management for Industrial and Systems Engineers (3 credits)

Investigation of data modeling, storage, acquisition, and utilization in industrial and systems engineering. Development of effective spreadsheet applications. Design and implementation of relational databases via entity-relationship modeling, relational schema, normalization, and queries. Structured query language (SQL) fundamentals and SQL relational databases. Overview of non-relational databases, Big Data, and Data Analytics. All topics covered within the context of typical industrial and systems engineering problems.

Prerequisite(s): CS 1044 or CS 1064 or CS 1114 or ECE 1574

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 2214 - Manufacturing Processes Laboratory (1 credit)

Laboratory exercises and experimentation in manufacturing processes. Emphasis on using production machines and equipment to make products using multiple manufacturing processes, coupled with inspection per engineering drawings. Processes include assembly, casting, machining, forming, welding, and non-traditional machining, performed manually and/or via computer programming. Also covers basic shop floor operation and documents used for monitoring and controlling part production.

Instructional Contact Hours: (3 Lab, 1 Crd)

ISE 2404 - Deterministic Operations Research I (3 credits)

Deterministic operations research modeling concepts; linear programming modeling, assumptions, algorithms, modeling languages, and optimization software; duality and sensitivity analysis with economic interpretation; network models (formulations and algorithms), including transportation problems, assignment problems, shortest path problems, maximum flow problems, minimum cost network flow problems, minimal spanning tree problems. A C- or better required in MATH 1114 or MATH 2114.

Prerequisite(s): MATH 1114 or MATH 2114

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 2974 - Independent Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ISE 2984 - Special Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ISE 2994 - Undergraduate Research (1-19 credits)

Instructional Contact Hours: Variable credit course

ISE 3004 - Industrial Cost Control (3 credits)

Introduction to basic accounting concepts and operating characteristics of accounting systems. Principles of financial, cost and activity-based accounting, design of accounting systems, techniques of analysis, and cost control. Emphasis on interpretation of accounting for decision-analysis, including the benefits of limitations of accounting information.

Prerequisite(s): ISE 2014

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3034 - Technical Communication for Engineers (3 credits)

Fundamentals of effective technical writing. Structure, presentation, and utility of common engineering documents: laboratory reports, technical reports, proposals, progress reports, and project reports. Practice in writing common engineering documents, both individually and collaboratively. Strategies and practice for effective oral technical presentations, both individually and group-based. Ethical and legal considerations in technical writing and oral technical presentations. All topics covered within the context of typical engineering problems and practice.

Prerequisite(s): ENGL 1106

Pathway Concept Area(s): 1A Discourse Advanced, 10 Ethical Reasoning

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3204 - Manufacturing Processes (3 credits)

Survey of manufacturing processes including casting, forming, machining, welding, joining, and nontraditional processes such as electrical-discharge machining. Basic manufacturing materials and their properties, structure of metals, metal deformation and heat treatment. Mathematical modeling of common manufacturing processes; process planning and the effect of plans on cost; impact of product design on manufacturability and assemblability. Recent trends in manufacturing, sustainable manufacturing. Also includes topics in inspection and testing, computer-aided manufacturing, and numerical control.

Prerequisite(s): ENGE 1216 or ENGE 1414

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3214 - Facilities Planning and Logistics (3 credits)

Theory, concepts, and methods for designing and analyzing facilities and material flow in manufacturing, storage, and distribution environments. Topic areas include material handling systems, facility layout, facility location, warehousing, distribution, logistics, and transportation. C- or better in ISE 2014, 2404, and 3414.

Prerequisite(s): ISE 2014 and ISE 2404

Corequisite(s): ISE 3414

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3414 - Probabilistic Operations Research (3 credits)

This course introduces probability models used to investigate the behavior and performance of manufacturing and service systems under conditions of uncertainty. Major topics include probability, conditioning, elementary counting processes, and Markov chains and Markov processes. Emphasis is on the use of these tools to model queues, inventories, process behavior, and equipment reliability. C- or better required in STAT 4105, MATH 2224 or 2204, MATH 2214 or 2214H, and ISE 2004.

Prerequisite(s): ISE 2004 and ISE 2024 and (MATH 2204 or MATH 2204H or MATH 2406H) and (MATH 2214 or MATH 2214H) and (CS 1044 or CS 1064 or CS 1114 or ECE 1574)

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3424 - Discrete-Event Computer Simulation (3 credits)

Analysis and design of work systems through static and dynamic simulation. Topics include an introduction to systems analysis and modeling, simulation optimization, model development and testing, and problem analysis through simulation. C- or better required in ISE 3414 and STAT 4105.

Prerequisite(s): ISE 3414

Instructional Contact Hours: (2 Lec, 3 Lab, 3 Crd)

ISE 3434 - Deterministic Operations Research II (3 credits)

Advanced concepts in deterministic operations research, including theory of complexity, integer programming, advanced linear programming techniques, nonlinear programming, dynamic programming. Covers modeling languages and optimization software for integer programming and nonlinear programming problems. Grade of C- or better required in ISE 2004, 2404 and MATH 2204 or 2224.

Prerequisite(s): ISE 2404 and (MATH 2224 or MATH 2204) and ISE 2004

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3614 - Human Factors Engineering and Ergonomics (3 credits)

Investigation of human factors, ergonomics, and work measurement engineering, with emphasis on a systems approach toward workplace and machine design. Discussion of basic human factors research, discipline-specific ethics, design/evaluation methods for industrial and artificial intelligence (AI) systems including human machine interactions, human information processing, visual and auditory processes, design of display and control, effects of environmental stressors on humans, visualization and sonification of large datasets, human factors role in the design of machine learning and AI applications.

Prerequisite(s): ISE 2004

Corequisite(s): ISE 2024

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 3624 - Industrial Ergonomics (3 credits)

Introduction to ergonomics and work measurement with an emphasis on people at work. Discussion of methods for work measurement, ergonomic assessment, and evaluation, with major topics including productivity and performance, manual materials handling, work-related musculoskeletal disorders, safety, training and legal issues. C- or better required in ISE 3614.

Prerequisite(s): ISE 3614 and ESM 2104

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4004 - Theory of Organization (3 credits)

A theory of cooperative behavior in formal organizations, including the structure and elements of formal organizations. The executive process and the nature of executive responsibility also are examined.

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4005 - Project Management and Systems Design (2 credits)

Capstone design experience for ISE majors. 4005: Structured systems engineering and project management methods and tools to plan, manage, and execute technical industrial and systems engineering projects. Students work in teams to apply industrial and systems engineering and project management tools to define and analyze a real-world problem and communicate results effectively. 4006: Designing, implementing, and evaluating work system solutions, all via students working in teams. Communication of solutions to various project stakeholders.

Prerequisite(s): ISE 2034 and ISE 2214 and ISE 3034 and ISE 3214 and ISE 3424 and ISE 3624 and ISE 4204

Corequisite(s): ISE 4404

Instructional Contact Hours: (2 Lec, 2 Crd)

ISE 4006 - Project Management and Systems Design (2 credits)

Capstone design experience for ISE majors. 4005: Structured systems engineering and project management methods and tools to plan, manage, and execute technical industrial and systems engineering projects. Students work in teams to apply industrial and systems engineering and project management tools to define and analyze a real-world problem and communicate results effectively. 4006: Designing, implementing, and evaluating work system solutions, all via students working in teams. Communication of solutions to various project stakeholders.

Prerequisite(s): ISE 4005

Instructional Contact Hours: (2 Lec, 2 Crd)

ISE 4015 - Management Systems Theory, Applications, and Design (3 credits)

Systems approach to management, domains of responsibility, structured and synergistic management tools, management system model, contextual frameworks, information portrayal, automation objectives model, evaluation, shared information processing, information modeling. A management process for definition, measurement, evaluation and control, the organization as an information processor, corporate culture, scoping agreements, schemas and management elements, structured design.

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4204 - Production Planning and Inventory Control (3 credits)

Planning and control of operations in both manufacturing and service industries. Management and utilization of resources to support cost effective products and services. Principles, models, and techniques used for production planning and inventory control.

Prerequisite(s): ISE 2404 and ISE 3414 and STAT 4706

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4214 - Lean Manufacturing (3 credits)

Overview of Lean Manufacturing principles, theory, methods, and techniques in modern manufacturing enterprises. Lean philosophy and basic concepts, master production scheduling and production smoothing, assembly line sequencing, setup time reduction, U-shaped line balancing/operation, machine arrangement, kanban, automation, and value stream mapping. Investigation and discussion of lean manufacturing case studies. C- or better required in ISE 4204.

Prerequisite(s): ISE 4204

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4264 - Industrial Automation (3 credits)

Survey of various technologies employed in industrial automation, with emphasis on industrial applications of robotics, machine vision and learning, and programmable controllers. Introductory robot motion modeling, investigation into problems in Computer- Aided Design (CAD)/Computer-Aided Manufacturing (CAM) integration. Examination of components commonly employed in automation systems, their aggregation, and related production process design.

Prerequisite(s): ISE 2204 or ISE 2214

Instructional Contact Hours: (2 Lec, 3 Lab, 3 Crd)

ISE 4304 - Global Issues in Industrial Management (3 credits)

Industrial management topics of current interest explored from a global perspective. Current domestic and international challenges resulting from a global marketplace and the proliferation of information and technology. Industrial management and organizational performance, total quality management, business process re-engineering, leadership, organizational change, role of communication and information, and ethics. Examination and comparison across international boundaries.

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4404 - Statistical Quality Control (3 credits)

Application of statistical methods and probability models to the monitoring and control of product quality. Techniques for acceptance sampling by variables and attributes are presented. Shewhart control charts for both classes of quality characteristics are examined in depth. The motivation for each method, its theoretical development, and its application are presented. The focus is upon developing an ability to design effective quality control procedures. C- or better required in ISE 3414, STAT 4105, and STAT 4706.

Prerequisite(s): ISE 3414 and STAT 4706

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4414 - Industrial Quality Control (3 credits)

Implementation of statistical quality control techniques in an industrial setting. Development and analysis of cost models for use in the design of optimal quality control plans. Also included are new techniques, advanced quality control models, and an examination of the role of industrial statistics in the overall product quality assurance function. C- or better required in ISE 4404.

Prerequisite(s): ISE 4404

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4424 - Logistics Engineering (3 credits)

Introduction to the key issues in the integrated support of a product or process. Synthesis of topics from earlier studies to provide a cohesive approach to their applications. Logistics engineering provides a survey of product support issues and methods of resolving them within the context of the overall production activity. C- or better required in ISE 3414.

Prerequisite(s): ISE 3414

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4434 - Supply Chain and Operations Engineering (3 credits)

Mathematical models, algorithms, and tools to support the design/redesign and management of supply chain systems. Resiliency, reliability, efficiency, and effectiveness of supply chains; collaboration and coordination among the different decision-makers in supply chains; impact of new developments on supply chain engineering, including the growth of the internet and e-commerce, the need to build suitable and environmentally-friendly supply chains. Mathematical modeling and system-wide optimization of the entire supply chain system under certainty.

Prerequisite(s): ISE 2404 and ISE 3414

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4624 - Work Physiology (3 credits)

Anthropometry, skeletal system, biomechanics, sensorimotor control, muscles, respiration, circulation, metabolism, climate. Ergonomic design of task, equipment, and environment. C- or better required in 3624.

Prerequisite(s): ISE 3624

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4644 - Risk and Hazard Control (3 credits)

Introduction to the fields of risk assessment, risk and hazard control, safety management, process safety, and system safety engineering through exposure to problems, principles, and practice. Integrated systems approach to problem solving. Industrial accident and disaster case study analysis and review of contemporary issues. Review of risk analysis and control techniques and overview of global regulations and guidelines for process, industrial, and occupational safety. C- or better required in ISE 3614.

Prerequisite(s): ISE 3614

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4654 - Principles of Industrial Hygiene (3 credits)

Introduction to the foundations of the field of Industrial Hygiene, that discipline devoted to the anticipation, recognition, measurement, evaluation, and control of occupational health hazards. Includes biological (e.g. microbial agents, allergens), chemical (e.g. solvents, carcinogens, dusts), and physical (e.g. radiation, temperature) hazards. Overview of control of health hazards, such as personal protective equipment, administrative controls, and engineering controls. Will involve lecture and participatory case-study activities. Will provide ample opportunity for hands-on use of monitoring equipment, protective equipment and controls testing devices.

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4804 - System Dynamics Modeling of Industrial Systems (3 credits)

Computer-aided approach to analyze and make better decisions in complex industrial systems. Systems thinking and causal loop modeling of complexity over time. Interconnectivity of industrial systems, production, and service. Stock-flow diagrams. Systems modeling of product development and market adoption. Simulation of dynamic problems arising in complex systems. Systems modeling and simulation-based decision analysis to improve performance in service and manufacturing.

Instructional Contact Hours: (3 Lec, 3 Crd)

ISE 4974 - Independent Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ISE 4984 - Special Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ISE 4984A - Special Study (1-19 credits)

Pathway Concept Area(s): 1A Discourse Advanced

Instructional Contact Hours: Variable credit course

ISE 4994 - Undergraduate Research (1-19 credits)

Instructional Contact Hours: Variable credit course