INDUSTRIAL AND SYSTEMS ENGINEERING

EGN 5949 Practicum/Internship/Cooperative Work Experience 1-6 Credits, Max 6 Credits
Grading Scheme: S/U
Practical cooperative engineering work under approved industrial and faculty supervision.
Prerequisite: graduate student.

EGN 6640 Entrepreneurship for Engineers 3 Credits
Grading Scheme: Letter Grade
Introduction to entrepreneurship, idea generating and feasibility analysis, and business planning. Lectures, case studies, student-led discussions, team business plans, and investor presentations.

EGN 6913 Engineering Graduate Research 0-3 Credits, Max 12 Credits
Grading Scheme: S/U
Course will provide the student with supervised research in a laboratory setting.

EIN 5249 Human Factors in System Design 3 Credits
Grading Scheme: Letter Grade
This course will provide an understanding of concepts and methods in human factors and applications to human-machine system design. We will consider the system design implications of human cognitive and physical capabilities and limitations in perception, memory, decision-making and motor-control.

EIN 5501 Health Systems Engineering Models and Methods 3 Credits
Grading Scheme: Letter Grade
Introduction to the application of systems engineering and data analytics methods to healthcare systems. Exploration of common problems of decision-making and optimization in healthcare including scheduling and capacity planning. Examination of health policy, data analysis, and information technology unique to healthcare. Investigation of lean, six sigma and continuous improvement.
Prerequisite: Knowledge of object-oriented programming, statistics, simulation and linear programming at the undergraduate level.

EIN 6176 Advanced Quality Management and Engineering for Business Processes 3 Credits
Grading Scheme: Letter Grade
Philosophy of continuous improvement and methodology for applying team problem solving to manufacturing and service industries. Hands-on application of basic statistical quality tools; introduction to quality function deployment; concurrent engineering; business process reengineering; process analysis; benchmarking. Team project.
Prerequisite: introductory statistics or consent of instructor.

EIN 6212 Loss Assessment and Control 3 Credits
Grading Scheme: Letter Grade
This course will provide advanced coverage of risk assessment and management methods in the context of systems safety engineering. It will cover different types of hazard exposure, (chemical, fire, radiation, asbestos, lead, hazardous waste). Risk measurement and mitigation strategies will be identified for each hazard along with emergency response operations.
Prerequisite: EIN 6215 with a minimum grade of C.

EIN 6215 System Safety Engineering 3 Credits
Grading Scheme: Letter Grade
This course will focus on identification and recognition of potential safety hazards as well as the concept of risk assessment. Various systems safety methodologies will be explored together with applications to hazard analysis and control. Industrial case studies will be referenced to illustrate the usefulness of system safety techniques.
Prerequisite: EIN 6216, or instructor approval for undergraduate students.

EIN 6216 Occupational Safety Engineering 3 Credits
Grading Scheme: Letter Grade
Topics covered include safety history and litigation, accident causation, safety organizations and agencies, approaches to occupational safety and risk management, product defects and safety program development; product liability; consumer product safety commission, hazard communication standard, workers' compensation, OSHA safety standards and codes and OSHA record keeping, common occupational hazards.
Prerequisite: Basic probability and Electricity at the undergraduate level.

EIN 6357 Advanced Engineering Economy 3 Credits
Grading Scheme: Letter Grade
Economic analysis of capital expenditure decisions. Financial mathematics and microeconomics. Decision under risk and uncertainty. Game theory and utility theory.
Prerequisite: STA 4321.

EIN 6422 Manufacturing Management 3 Credits
Grading Scheme: Letter Grade
Variety and importance of management decisions. Total quality management, just-in time manufacturing, concurrent engineering, material requirements planning, production scheduling, and inventory control.
Prerequisite: ESI 6314 and undergraduate probability and statistics.

EIN 6510 Principles of Manufacturing Systems Engineering 3 Credits
Grading Scheme: Letter Grade
Introduction to modern manufacturing systems. Components of product and process design, computer-integrated manufacturing and automation. Current areas of development and research.
Prerequisite: calculus through differential equations.

EIN 6905 Special Problems 1-6 Credits, Max 15 Credits
Grading Scheme: Letter Grade
Laboratory, lecture, field work, or conferences.

EIN 6910 Supervised Research 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Supervised Research

EIN 6918 Graduate Seminar 1 Credit, Max 15 Credits
Grading Scheme: S/U
Graduate Seminar

EIN 6940 Supervised Teaching 1-5 Credits, Max 5 Credits
Grading Scheme: S/U
Supervised Teaching

EIN 6971 Research for Master's Thesis 1-15 Credits
Grading Scheme: S/U
Research for Master's Thesis

EIN 7933 Special Problems 1-6 Credits, Max 12 Credits
Grading Scheme: Letter Grade
Laboratory, lecture, field work, or conferences.

EIN 7979 Advanced Research 1-12 Credits
Grading Scheme: S/U
Research for doctoral students before admission to candidacy. Designed for students with a master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

EIN 7980 Research for Doctoral Dissertation 1-15 Credits
Grading Scheme: S/U
Research for Doctoral Dissertation

ESI 5471 Optimization for Financial Engineering 3 Credits
Grading Scheme: Letter Grade
Introduces optimization theories and methods to support the practice of financial engineering. The course will cover the use methodologies from mathematical programming in financial decision-making and their applications to portfolio and asset management. It will also involve building optimization models based on financial market data and risk assessment using optimization modeling languages.

ESI 5613 Data Analytics for ISE 3 Credits
Grading Scheme: Letter Grade
Provides an understanding of the skills necessary for managing and analyzing data. The concepts that will be covered in this class include python basics, exploratory data analysis, data manipulation, data cleaning, data wrangling, and machine learning. All the technical skills will be motivated by different examples involving data.

ESI 5687 Machine Learning for Financial Risk Management 4 Credits
Grading Scheme: Letter Grade
Explores how machine learning changes the practice of risk management and financial engineering. Covers the best practices for model selection and construction for big financial data, including regression and classification techniques, and deep learning with applications to forecasting financial time series.

ESI 6314 Deterministic Methods in Operations Research 4 Credits
Grading Scheme: Letter Grade
Introduction to basic models and their solution with modern computer packages. Emphasis on modeling, computer solution, and sensitivity analysis with minimal reference to model theory and development of algorithmic methods.
Prerequisite: calculus through differential equations, knowledge of linear algebra, and experience using mainframes or PCs.

ESI 6323 Models for Supply Chain Management 3 Credits
Grading Scheme: Letter Grade
Essential elements including controlling and coordinating activities such as order processing, purchasing, material storage and handling, production scheduling, packaging, transportation, and setting customer service standards.
Prerequisite: prior course work in linear programming, probability, and stochastic processes.

ESI 6325 Applied Probability Methods in Engineering 3 Credits
Grading Scheme: Letter Grade
Applied probability theory and statistics, reliability engineering, quality control, robust design, forecasting, Markov processes, and queuing theory.
Prerequisite: calculus, differential equations, undergraduate probability, and statistics.

ESI 6341 Intro to Stochastic Optimization 3 Credits
Grading Scheme: Letter Grade
Introduction to Stochastic Optimization is intended as a first introductory course for graduate students in such fields as engineering, operations research, statistics, mathematics, and business administration (in particular, finance or management science). 3 credits.
Prerequisite: Basic knowledge of calculus, statistics and linear programming.

ESI 6346 Decision Making under Uncertainty 3 Credits
Grading Scheme: Letter Grade
Introduction to the use of quantitative models for decision-making in environments where uncertainty is present. Focuses on fundamentals of probability simulation, Markov chains, queuing analysis, decision trees and dynamic programing.
Prerequisite: ESI6314 Deterministic Methods for Operations Research, andStudents should have had a course in probability/statistics at the undergraduate level.

ESI 6352 Financial Optimization Case Studies 3 Credits
Grading Scheme: Letter Grade
Quantitative analysis of financial systems. Optimization case studies in finance and risk management. Statistical analysis of risk management and financial systems. Portfolio optimization: Value-at-Risk (quantile), Conditional Value-at-Risk (Expected Shortfall), Drawdown, Hedging. Calibration of distribution and application to CDO pricing.
Prerequisite: There are no formal prerequisites for the course. The course requires knowledge of basic statistical concepts (probability distributions, linear regression). Familiarity with optimization (linear programming). Familiarity with high level programming languages, which can be used for data analysis (e.g., with MATLAB or R).

ESI 6417 Linear Programming and Network Optimization 3 Credits
Grading Scheme: Letter Grade
Formulation and solution techniques for network flow and linear programming problems. Algorithms for network optimization. The simplex method, theory and computation. Duality theory, sensitivity analysis.
Prerequisite: Linear algebra and basic theory of optimization.

ESI 6420 Fundamentals of Mathematical Programming 3 Credits
Grading Scheme: Letter Grade
Introducing mathematical programming with an emphasis on classical optimization concepts, models and solution techniques. Focus on convex analysis (convex sets, separation theorems, convex functions), optimality conditions (Fritz-John Karush-Kuhn-Tucker), Lagrangian duality and iterative solution methods 9gradient, conjugate gradients barrier methods.
Prerequisite: Mathematical background, ability to proof mathematical statements and ability to write simple codes with Matlab or C.

ESI 6448 Discrete Optimization Theory 3 Credits
Grading Scheme: Letter Grade
Modeling with integer variables; enumeration and cutting plane methods; decomposition algorithms; branch and bound methods; computational complexity and software issues; special combinatorial optimization problems; parallel algorithms for integer programming.
Prerequisite: linear programming and nonlinear optimization or equivalent.

ESI 6492 Global Optimization 3 Credits
Grading Scheme: Letter Grade
Properties of nonconvex functions, convex envelopes, and duality. Complexity issues, applications of global optimization and software issues. Algorithms for quadratic programming. Concave minimization, Lipschitz optimization, and nonconvex network flow problems.
Prerequisite: linear and nonlinear programming.

ESI 6529 Digital Simulation Techniques 3 Credits
Grading Scheme: Letter Grade
Computer programming aspects of digital simulation. Deterministic simulation; stochastic simulation. Use of simulation languages.
Prerequisite: computer programming and probability theory.

ESI 6546 Stochastic Modeling and Analysis 3 Credits
Grading Scheme: Letter Grade
Stochastic processes, with emphasis on model building and probalistic reasoning. Review of elementary probability theory. Poisson process and renewal theory. Discrete and continuous time Markov chains. Brownian motions, random walks, and martingales. Applications in queuing, reliability, inventory theory, logistics, and finance.
Prerequisite: STA 6326.

ESI 6552 Systems Architecture 3 Credits
Grading Scheme: Letter Grade
Foundations for developing and evaluating architectures for systems of systems. Process for generating functional, physical, and operational architecture from a top-level operations concept.
Prerequisite: calculus, linear algebra, basic statistics.

ESI 6553 Systems Design 3 Credits
Grading Scheme: Letter Grade
Broad introduction to systems engineering and the structured approaches needed to design complex systems. Emphasizes formulation of systems problems and approaches to their solution. Introduces basic mathematical techniques for dealing with systems design.
Prerequisite: calculus, linear algebra, basics of statistics.

ESI 6555 Systems Management 3 Credits
Grading Scheme: Letter Grade
Introduction to the concepts of systems and the role of systems engineering in their development. Basic framework for planning and assessing system development, and how systems analysis methods and techniques are integrated into systems engineering processes.
Prerequisite: calculus, linear algebra, basics of statistics.

ESI 6616 Data Analytics for System Monitoring 3 Credits
Grading Scheme: Letter Grade
Focuses on advanced data analytics techniques for modeling, monitoring, diagnosis, and quality improvement of industrial processes. The techniques introduced have wide applications in manufacturing, health care, service industry applications, and human factors.
Prerequisite: Basic probability and statistics.

ESI 6617 High-Dimensional Data Analytics 3 Credits
Grading Scheme: Letter Grade
Covers techniques in high-dimensional data analytics that are particularly beneficial to industrial applications, including manufacturing, agricultural, and healthcare systems. It focuses on the analysis of functional data (e.g., spatial or temporal data), multi-channel data, and structured images and point clouds.
Prerequisite: ESI 6325 with a minimum grade of C or ESI 6420 with a minimum grade of C.

FIN 5490 Stochastic Calculus in Financial Engineering 4 Credits
Grading Scheme: Letter Grade
Introduces students to the basic ideas and methods of stochastic calculus and its applications in finance, which are essential for the practice of quantitative finance and risk management. Covers arbitrage and risk-neutral pricing in a discrete-time setting, continuous-time models using Brownian motion, Markov processes, stochastic integral, stochastic differential equations, Ito's formula, change of measure, martingales, and applications to option pricing.
Prerequisite: FIN 6537.

FIN 5776 Numerical Methods in Financial Engineering 4 Credits
Grading Scheme: Letter Grade
Presents the basic numerical and simulation techniques for the pricing of derivative securities. The material includes numerical methods commonly used in financial engineering, including random number generation, stochastic processes, statistics, and differential equations. Applications of each topic will be presented along the course through case studies with real market data.
Prerequisite: FIN 5778. In addition, basic knowledge of differential equations, probability and statistics, computer programming (any language) and exposure to the topics of stocks, bonds, and options is a prerequisite.

FIN 5778 Introduction to Financial Technology 3 Credits
Grading Scheme: Letter Grade
Explores the impacts of financial technology in our day to day lives. Students will learn the technology behind payments, credit, lending and asset management, as well as applications of blockchain technology for investments and financial transactions. The course will provide an overview of the FinTech industry, decentralized finance and major applications of the blockchain. Topics on privacy, security and regulation of FinTech will be covered.

FIN 6951 Master's Project in Financial Engineering 3 Credits
Grading Scheme: Letter Grade
Capstone event in the Financial Engineering curriculum. Students develop an indepth analysis on a financial engineering topic under the supervision of the course instructor. The effort culminates in a written project report and a presentation to the class.
Prerequisite: ESI 6352, FIN 5776, and ESI 5471.