

INDUSTRIAL AND SYSTEMS ENGINEERING (ISE)

ISE 102. Introduction to Project Management and Work Design Systems. 3 Credit Hours.

This introductory course is designed to expose high school students to Industrial and Systems engineering. The course will introduce Project Management and it will be woven throughout the 3-week course culminating in a final project presentation. All students enrolled in this course will gain experience in problem solving, engineering design, computer applications, and hands-on activities. The course content includes topics on work design, methods analysis, time studies, human factors engineering, and project management. The students will be provided with an understanding and some hands-on experience on topics relative to the discipline of industrial and systems engineering. The laboratory and field trip experiences will enhance the classroom experience and provide an insight to the depth and breadth of the discipline. Summer Scholar Students only.

Requisite: Summer Scholars/ UM Academy only.

Components: LEC.

Grading: GRD.

Typically Offered: Summer.

ISE 201. Work Design Systems. 3 Credit Hours.

This course will show the design of improved methods for doing work based on effective human effort. Time standardization of productive operations by work measurement, predetermined time systems, and activity sampling are discussed. Labor estimation techniques will be discussed. Tools and charts for methods analysis are discussed and the use of Microsoft Visio and Microsoft Excel is emphasized and reviewed.

Prerequisite: EGN 123 or ISE 112.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 224. Python for Engineers. 3 Credit Hours.

Programming plays an important role in engineering. This course aims to establish the foundations for basic programming with focus on python. It comprehensively discusses the fundamental topics in programming, such as Data types, Variables, Iterators, Control flows, Functions, Modules, Class, Objects, and Object-Oriented Design.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 280. Fundamentals of Financial Engineering. 3 Credit Hours.

Course Description: This course introduces the basic principles of financial engineering to students in the College of Engineering. It concentrates on the description of different financial products. Basic mathematical and engineering principles are applied to the study of financial instruments. Financial tools are explained in a practical manner. The course focuses on how financial tools are created and how the tools work together to achieve specific goals. Applications are illustrated using real-world examples. Main financial products covered are Equities, Bonds, and Currencies. Cash flows covered include spot, options, and forwards and futures. Credit products covered are collateralized debt obligations, special purpose vehicles, and credit default swaps. Portfolio creation, portfolio construction, and strategy development are studied. The course gives a primer on analyzing financial statements (balance sheet, income statement, and cash flow statement), bonds, corporate valuations, stock trading fundamentals (fundamental analysis, technical analysis, algorithmic trading), mergers and acquisitions (tender offers, hostile takeovers, leveraged buyouts), stock repurchases, options valuation, futures, commodities, mutual and index funds, hedge funds, currency exchange, risk analysis, real estate investing, and portfolio balancing and optimization.

Requisite: Sophomore Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 310. Introduction to Engineering Probability. 3 Credit Hours.

Axioms of probability, discrete and continuous random variables, probability density functions, cumulative distribution function, expectation, conditioning, independence, functions of random variables, multiple random variables, sums of random variables, introduction to statistical analysis, estimation, and hypothesis testing. Cross-listed with EEN 310.

Prerequisite: MTH 162 or MTH 172 and Requisite: Junior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 311. Applied Probability and Statistics. 3 Credit Hours.

This course covers fundamental probability concepts, random variables, mathematical expectation, discrete and continuous probability distributions, sampling distributions, point and interval estimation, hypothesis testing, and simple linear regression and correlation. The use of Minitab, a statistical software application, is emphasized. Examples are drawn from various disciplines.

Prerequisite: MTH 162 or MTH 172.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 312. Foundations of Data Analysis. 3 Credit Hours.

This course aims to establish a solid background for data analysis. It covers fundamental topics, such as Data Properties, Estimation, Hypothesis and Testing, Regression and Classification, Design of Experiments, and Clustering, to establish the foundations of data analysis. This course not only builds up the theoretical knowledge but also relies on useful computer software (e.g., EXCEL, Minitab, and R) to enable the capability to handle large-scale problems.

Prerequisite: ISE 310 or ECE 310 or ISE 311 or MAS 311 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 351. Safety and Ethics in Engineering. 3 Credit Hours.

This course will address basic principles of accident prevention and safety engineering approaches to the design of facilities, manufacturing processes and organizational systems. Ethical decision making and analysis will be explored as a function of designing organizational safety plans. It also includes the analysis and design of safety procedures and accident control procedures in industry.

Requisite: Junior Status or Permission of Instructor.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 363. Project Management for Engineers. 3 Credit Hours.

This course guides students through fundamental project management concepts and behavioral skills needed to successfully launch, lead, and realize benefits from projects in profit and nonprofit organizations. In this course, students explore project management with a practical, hands-on approach through case studies and class exercises. In addition, you will participate in a project as a project manager and as a resource.

Requisite: Junior Status or Permission of Instructor.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 372. Emerging Technologies and the Creation of Technological Innovations. 3 Credit Hours.

A variety of emerging technologies will be discussed (nanotechnology, energy technologies, information technologies, biotechnologies, etc). The process of utilization in innovations will be covered.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 380. Engineering Economic Analysis. 3 Credit Hours.

This course will explore engineering economy fundamentals. Interest and money-time relationship, methods of making economic decisions, risk and uncertainty, and sensitivity analysis. In addition, analysis will include selections among multiple alternatives, depreciation, after tax analysis, benefit-cost analysis, replacement studies, cost analysis techniques.

Prerequisite: MTH 162 or MTH 172.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 399. Internship. 1-3 Credit Hours.

Practical application of classroom theory through employment with firms offering positions consistent with the student's field of study. Note: Only available to Foote Fellows to be used as one of their free electives.

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 406. Computer-Aided Manufacturing. 3 Credit Hours.

A comprehensive view of manufacturing with a focus on design, automation, and the use of computers in manufacturing. The topics include computer-aided design, communications, programmable logic controllers, CNC machining, industrial robots, process planning, and computer-integrated manufacturing. Laboratory projects are an integral part of the course.

Prerequisite: CHM 121 or CHM 151 and PHY 221.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 407. Product Design for Manufacturing. 3 Credit Hours.

The different phases of engineering design process. Guided Iteration Methodology for product design. Topics include design for manufacturing (DFM), best practices of product realization, solid modeling using SolidWorks, quality in design, issues in patents, liability and ethics. Engineering design specifications, evaluation methods for design alternatives.

Prerequisite: ISE 406.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 441. Operations Research and Optimization Methods. 3 Credit Hours.

Introduction to principles and techniques used for optimal decision-making through mathematical modeling and analysis. Main topics include mathematical modeling/programming, linear programming, integer programming, network optimization, and dynamic programming. The application focus of the course will be on engineering and business problems.

Prerequisite: MTH 210.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 442. Stochastic Modeling and Decision Making. 3 Credit Hours.

This course introduces fundamental probability models and decision-making tools for systems subject to uncertainty. Course topics include a brief review of probability concepts, Markov chains, Poisson processes and queueing theory, decision analysis, and dynamic programming. Applications will be drawn from queueing systems, reliability and quality engineering, inventory management, transportation and assignment problems, and finance. Some software may be used (e.g., Excel and MATLAB) to illustrate concepts.

Prerequisites: ISE 310 or ECE 310 or ISE 311 or MAS 311 and ISE 441.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 465. Inventory and Supply Chain Management. 3 Credit Hours.

This course consists of production and inventory management techniques such as forecasting methods, inventory control subject to both known and uncertain demand, aggregate planning, introduction to scheduling, materials requirement planning (MRP), and an introduction to quantitative modeling of supply chain management systems.

Prerequisite: ISE 310 or ECE 310 or ISE 311 or MAS 311 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 494. Senior Design Project. 3 Credit Hours.

This course includes the integration of Industrial and Systems Engineering principles and techniques in the design and improvement of production and service systems. Included in the course is a culminating design experience with the preparation of a project proposal, data collection, analysis, comprehensive final report, and formal presentations to stakeholders.

Prerequisite: ISE 547. And Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 501. Manufacturing Analysis and Design I. 3 Credit Hours.

Analysis of Production Systems stressing diagnosis of problems associated with work measurement, manufacturing methodologies, and their interaction with cost factors.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 502. Manufacturing Analysis and Design II. 3 Credit Hours.

Analysis of production systems stressing diagnosis of problems of quality and production control, utilizing quantitative techniques and analytical methods.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 505. Robotics. 3 Credit Hours.

Fundamentals of robotics including kinematics and dynamics, trajectory planning, sensors and actuators, robotic vision, and case studies. Building your own robot is an integral part of hands-on laboratory exercises. Matlab controltoolbox and image analysis toolbox will be extensively used for design and analysis.

Prerequisite: ISE 406.

Components: LEC.

Grading: GRD.

Typically Offered: Spring Even Years.

ISE 507. Design of Manufacturing Systems. 3 Credit Hours.

State-of-the-art techniques and tools relevant to the design, analysis, and control of modern manufacturing systems. Topics include modeling of manufacturing systems, tools for manufacturing system analysis, manufacturing system planning and scheduling, and lean manufacturing systems.

Prerequisite: ISE 465.

Components: LEC.

Grading: GRD.

Typically Offered: Spring Odd Years.

ISE 509. Automated Assembly. 3 Credit Hours.

Fundamentals of automated assembly including parts transfer systems and feeders, parts orientation and grasping techniques, product design for automated assembly (DFA), assembly robots, and performance and economics of assembly systems.

Prerequisite: ISE 406.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 512. Quality Management Systems. 3 Credit Hours.

This course addresses the concepts, theories, tools and methodologies employed in the management and improvement of quality. The course examines many of the advance topics in statistical quality control including control charts, process capability studies, acceptance sampling and Quality Function Deployment (QFD). Also covered in the course are Lean Six Sigma methodology, tools and concepts.

Prerequisite: ISE 311 or MAS 311 or ISE 312 or MAS 312 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 513. Quality Management in Service Organizations. 3 Credit Hours.

Course examines the issues of quality and productivity management in the service sector. Topics covered include the development and use of questionnaires, service industry applications of quality such as in banking, insurance, healthcare, transportation, government, public utilities, and retail trade.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 516. Introduction to Applied Data Analytics. 3 Credit Hours.

This course focuses on some of the most commonly-used data analytics models and covers the basics of data analytics using the open source software R (which is one of the fastest growing open source software platforms). Specific course topics include Data Preprocessing and Cleaning, Fundamentals of R (for basic data analytics tasks), Regression Analysis, Discriminant Analysis & Classification, Segmentation/Clustering, Model Tuning/Selection, Performance Measurement in Data Analytics, and Decision Making with Data. This course provides hands-on skills to engineering graduate students with performing statistical data analysis and decision-making utilizing common types of data sets.

Prerequisite: ISE 442 And ISE 312.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 517. Reinforcement Learning and Decision Making Under Uncertainty. 3 Credit Hours.

This selective course gives a firm foundation to reinforcement learning (RL) and decision theory from mainly a statistical perspective. We start with a discussion of utility theory to learn how preferences can be represented and modeled for decision making. We first model simple decision problems as multi-armed bandit problems and discuss several approaches to evaluate feedback. We will then model decision problems as Markov decision processes (MDPs), and discuss their solutions via dynamic programming and filtering algorithms. Finally, we introduce different types of reinforcement learning algorithms and discuss their applications in financial management, health-care, next generation networks, system operation and environmental engineering. We conclude the course with a discussion of advanced RL solutions, such as meta learning, inverse RL, multi-agent RL, and other open topics in RL, with the goal of introducing the RL generalization that can adapt and apply to various real-world scenarios. An emphasis on algorithms and applications will be a key part of this course.

Pre-requisite: ISE 224 or CSC 115 and ISE 442.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 524. Systems Intelligence with Software Applications. 3 Credit Hours.

Theory and application of designing decision support systems using Microsoft Excel VBA. Topics include studying of advanced excel techniques, designing efficient graphical user interfaces using Visual Basic for Applications. Optimizing the development process workflow. Accessing data sources provided by different database engines. Optimizing the final code.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 547. Simulation Modeling and Systems Analysis. 3 Credit Hours.

The objective of this course is to develop student's ability to model real systems and carry out effective and successful analysis of these systems using discrete event simulation. In this course, students will learn the basic concepts and algorithms of modeling and analysis. Students will get familiar with (1) formulating an appropriate simulation model for a system, (2) implementing the model as a computer program, and (3) evaluating the output of the model. Theoretical topics include random variable generation, model verification and validation, statistical input and output analysis

Prerequisites: ISE 442.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 548. Games and Decision Making. 3 Credit Hours.

This course covers fundamentals of decision theory and game theory. The course is research oriented and a significant part of the grading will be based on students' research. Topics include optimization with multiple variables, constrained optimization, Lagrange relaxation, utility theory, decision making under uncertainty, simultaneous move (Nash) games, sequential decision making, sequential (Stackelberg) games, games with imperfect information, contracting and coordination, and bargaining. This course is composed of lectures, in-class discussions and problem solving, homework assignments, and research paper assignments.

Prerequisite: ISE 310. And ISE 441.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 554. Applied Computational Biomechanics. 3 Credit Hours.

Students will become familiarized with current tools in the field of computational biomechanics for applications in ergonomics, sports performance, simulations of occupational activities and human movement in general. Through the presentation of case studies and the completion of assignments, students will gain hands-on experience on full-body simulation environments (e.g., OpenSim), biomechanically oriented finite elements packages (e.g., FEBio), and software for reconstruction of human anatomy from medical images (Seg3D).

Prerequisite: ISE 557. Or BME 375.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 557. Ergonomics and Human Factors Engineering. 3 Credit Hours.

The study of human capacities and limitations with emphasis on human performance in system design. Topics include design of displays and controls, workload, job design, human information processing, anthropometry, workplace design, biomechanics, task analysis, and research techniques in human factors engineering. Lecture, 3 hours.

Prerequisite: ISE 312 or MAS 312.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 568. Facilities Planning and Logistics. 3 Credit Hours.

This course focuses on the analysis and design of production and service facilities, including materials handling, facilities layout, warehouse and distribution systems, as well as logistics and supply chain.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 570. Engineering Management. 3 Credit Hours.

This course teaches the numerical techniques of management science for engineering problems. It covers a variety of solutions to practical problems using Microsoft Excel, Matlab and other solvers. This is a hands-on course utilizing practical examples that require the use of a number of methods but focuses not only on finding the optimal solution but analyzing the result in a manner that allows us to understand the sensitivity of the solution to different parameters. The course also includes the use of financial ratios and analysis.

Prerequisite: ISE 311 or MAS 311 or ISE 312 or MAS 312.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 571. Engineering Entrepreneurship. 3 Credit Hours.

This course teaches an integrated strategy framework for entrepreneurs. The course will explore various strategies and how to position a startup group against competition in an advantageous manner. In addition, you will learn tools for analyzing ongoing ventures to improve the competitive edge. The final project will emphasize the structured approach to strategy selection and evaluating alternatives.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 572. Management of Technological Innovation. 3 Credit Hours.

Engineering, Science and Management Principles contributing to the development of a successful framework for Managing technology with an organization, nationally or internationally. The process of technological innovations, technological planning and forecasting, and socio-economic changes. Prerequisite: Senior or graduate standing.

Requisite: Senior Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 580. Principles of Financial Engineering I. 3 Credit Hours.

Course Description: This course introduces the basic principles of financial engineering to students in the College of Engineering. It concentrates on the engineering methods of financial engineering. Methods, models, and analysis learned by students in subjects like stochastic models, simulation, optimization, probability, and statistics, are applied to the study of financial instruments. Financial tools are explained in a practical manner. The course focuses on how to create financial tools and how the tools work together to achieve specific goals. Applications are illustrated using real-world examples. Main financial products covered are Equities, Bonds, and Currencies. Cash flows covered include spot, options, and forwards and futures. Credit products covered are collateralized debt obligations, special purpose vehicles, and credit default swaps. Portfolio creation, portfolio construction, and strategy development are studied. The course gives a primer on analyzing financial statements (balance sheet, income statement, and cash flow statement), bonds, corporate valuations, stock trading fundamentals (fundamental analysis, technical analysis, algorithmic trading), mergers and acquisitions (tender offers, hostile takeovers, leveraged buyouts), stock repurchases, options valuation, futures, commodities, mutual and index funds, hedge funds, currency exchange, risk analysis, real estate investing, and portfolio balancing and optimization.

ISE 380.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 581. Principles of Financial Engineering II. 3 Credit Hours.

This course introduces the basic principles of financial engineering to students in the College of Engineering. It concentrates on the engineering methods of financial engineering. Methods, models, and analysis learned by students in subjects like stochastic models, simulation, optimization, probability, and statistics, are applied to the study of financial instruments. Financial tools are explained in a practical manner. The course focuses on how to create financial tools and how the tools work together to achieve specific goals. Applications are illustrated using real-world examples. Main financial products covered are Equities, Bonds, and Currencies. Cash flows covered include spot, options, and forwards and futures. Credit products covered are collateralized debt obligations, special purpose vehicles, and credit default swaps. Portfolio creation, portfolio construction, and strategy development are studied. The course gives a primer on analyzing financial statements (balance sheet, income statement, and cash flow statement), bonds, corporate valuations, stock trading fundamentals (fundamental analysis, technical analysis, algorithmic trading), mergers and acquisitions (tender offers, hostile takeovers, leveraged buyouts), stock repurchases, options valuation, futures, commodities, mutual and index funds, hedge funds, currency exchange, risk analysis, real estate investing, and portfolio balancing and optimization.

ISE 580.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 590. Special Topics in Industrial Engineering. 1-3 Credit Hours.

Sub-titles describing the topics are shown in parentheses in the class schedule, following the title "Special Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 595. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 596. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 599. Cooperative Education. 1 Credit Hour.

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 601. Manufacturing Analysis and Design I. 3 Credit Hours.

Analysis of Production Systems stressing diagnosis of problems associated with work measurement, manufacturing methodologies, and their interaction with cost factors.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 602. Manufacturing Analysis and Design II. 3 Credit Hours.

Analysis of production systems stressing diagnosis of problems of quality and production control, utilizing quantitative techniques and analytical methods.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 605. Robotics. 3 Credit Hours.

Fundamentals of robotics including kinematics and dynamics, trajectory planning, sensors and actuators, robotic vision, and case studies. Building your own robot is an integral part of hands-on laboratory exercises. Matlab controltoolbox and image analysis toolbox will be extensively used for design and analysis.

Components: LEC.

Grading: GRD.

Typically Offered: Spring Even Years.

ISE 607. Design of Manufacturing Systems. 3 Credit Hours.

State-of-the-art techniques and tools relevant to the design, analysis, and control of modern manufacturing systems. Topics include modeling of manufacturing systems, tools for manufacturing system analysis, manufacturing system planning and scheduling, and lean manufacturing systems.

Requisite: Graduate Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring Odd Years.

ISE 612. Quality Management Systems. 3 Credit Hours.

This course addresses the concepts, theories, tools and methodologies employed in the management and improvement of quality. The course examines many of the advance topics in statistical quality control including control charts and process capability studies, acceptance sampling, as well as Quality Function Deployment (QFD) and introduction to reliability. Also covered in the course are Lean Six Sigma methodology, tools and concepts.

Prerequisite: ISE 311 or MAS 311 or ISE 312 or MAS 312 or equivalent.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 613. Quality Management in Service Organizations. 3 Credit Hours.

Course examines the issues of quality and productivity management in the service sector. Topics covered include the development and use of questionnaires, service industry applications of quality such as in banking, insurance, healthcare, transportation, government, public utilities, and retail trade.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 616. Introduction to Applied Data Analytics. 3 Credit Hours.

This course focuses on some of the most commonly-used data analytics models and covers the basics of data analytics using the open source software R (which is one of the fastest growing open source software platforms). Specific course topics include Data Preprocessing and Cleaning, Fundamentals of R (for basic data analytics tasks), Regression Analysis, Discriminant Analysis & Classification, Segmentation/Clustering, Model Tuning/Selection, Performance Measurement in Data Analytics, and Decision Making with Data. This course provides hands-on skills to engineering graduate students with performing statistical data analysis and decision-making utilizing common types of data sets.

Prerequisite: ISE 442 And ISE 312.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 617. Reinforcement Learning and Decision Making Under Uncertainty. 3 Credit Hours.

This selective course gives a firm foundation to reinforcement learning (RL) and decision theory from mainly a statistical perspective. We start with a discussion of utility theory to learn how preferences can be represented and modeled for decision making. We first model simple decision problems as multi-armed bandit problems and discuss several approaches to evaluate feedback. We will then model decision problems as Markov decision processes (MDPs), and discuss their solutions via dynamic programming and filtering algorithms. Finally, we introduce different types of reinforcement learning algorithms and discuss their applications in financial management, health-care, next generation networks, system operation and environmental engineering. We conclude the course with a discussion of advanced RL solutions, such as meta learning, inverse RL, multi-agent RL, and other open topics in RL, with the goal of introducing the RL generalization that can adapt and apply to various real-world scenarios. An emphasis on algorithms and applications will be a key part of this course.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 624. Systems Intelligence with Software Applications. 3 Credit Hours.

Theory and application of designing decision support systems using Microsoft Excel VBA. Topics include studying of advanced excel techniques, designing efficient graphical user interfaces using Visual Basic for Applications. Optimizing the development process workflow. Accessing data sources provided by different database engines. Optimizing the final code.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 647. Simulation Modeling and Systems Analysis. 3 Credit Hours.

The objective of this course is to develop student's ability to model real systems and carry out effective and successful analysis of these systems using discrete event simulation. In this course, students will learn the basic concepts and algorithms of modeling and analysis. Students will get familiar with (1) formulating an appropriate simulation model for a system, (2) implementing the model as a computer program, and (3) evaluating the output of the model. Theoretical topics include random variable generation, model verification and validation, statistical input and output analysis.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 648. Games and Decision Making. 3 Credit Hours.

This course covers fundamentals of decision theory and game theory. The course is research oriented and a significant part of the grading will be based on students' research. Topics include optimization with multiple variables, constrained optimization, Lagrange relaxation, utility theory, decision making under uncertainty, simultaneous move (Nash) games, sequential decision making, sequential (Stackelberg) games, games with imperfect information, contracting and coordination, and bargaining. This course is composed of lectures, in-class discussions and problem solving, homework assignments, and research paper assignments.

Prerequisite: ISE 310. And ISE 441.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 654. Applied Computational Biomechanics. 3 Credit Hours.

Students will become familiarized with current tools in the field of computational biomechanics for applications in ergonomics, sports performance, simulations of occupational activities and human movement in general. Through the presentation of case studies and the completion of assignments, students will gain hands-on experience on full-body simulation environments (e.g., OpenSim), biomechanically oriented finite elements packages (e.g., FEBio), and software for reconstruction of human anatomy from medical images (Seg3D).

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 657. Ergonomics and Human Factors Engineering. 3 Credit Hours.

The study of human capacities and limitations with emphasis on human performance in system design. Topics include design of displays and controls, workload, job design, human information processing, anthropometry, workplace design, biomechanics, task analysis, and research techniques in human factors engineering. Lecture, 3 hours.

Requisite: Graduate Standing.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 668. Facilities Planning and Logistics. 3 Credit Hours.

This course focuses on the analysis and design of production and service facilities, including materials handling, facilities layout, warehouse and distribution systems, as well as logistics and supply chain.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 670. Engineering Management. 3 Credit Hours.

Integrating engineering discipline into the social and economic considerations of managing systems. Tools and techniques used by engineering managers including engineering project life cycle, role playing, communication, decision-making in engineering management, and managing change in engineering organizations are discussed.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 671. Engineering Entrepreneurship. 3 Credit Hours.

The conversion of technological know-how and engineering theories into business enterprises. The role of technology in creating wealth, connecting technology with market, the role and characteristics of entrepreneurs, starting a business and the business plan, innovation, industrial and service organizations, and the new business environment.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 672. Management of Technological Innovation. 3 Credit Hours.

Engineering, Science and Management Principles contributing to the development of a successful framework for Managing technology with an organization, nationally or internationally. The process of technological innovations, technological planning and forecasting, and socio-economic changes. Prerequisite: Senior or graduate standing.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 680. Principles of Financial Engineering I. 3 Credit Hours.

This course introduces the basic principles of financial engineering to students in the College of Engineering. It concentrates on the engineering methods of financial engineering. Methods, models, and analysis learned by students in subjects like stochastic models, simulation, optimization, probability, and statistics, are applied to the study of financial instruments. Financial tools are explained in a practical manner. The course focuses on how to create financial tools and how the tools work together to achieve specific goals. Applications are illustrated using real-world examples. Main financial products covered are Equities, Bonds, and Currencies. Cash flows covered include spot, options, and forwards and futures. Credit products covered are collateralized debt obligations, special purpose vehicles, and credit default swaps. Portfolio creation, portfolio construction, and strategy development are studied. The course gives a primer on analyzing financial statements (balance sheet, income statement, and cash flow statement), bonds, corporate valuations, stock trading fundamentals (fundamental analysis, technical analysis, algorithmic trading), mergers and acquisitions (tender offers, hostile takeovers, leveraged buyouts), stock repurchases, options valuation, futures, commodities, mutual and index funds, hedge funds, currency exchange, risk analysis, real estate investing, and portfolio balancing and optimization.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 681. Principles of Financial Engineering II. 3 Credit Hours.

This course introduces the basic principles of financial engineering to students in the College of Engineering. It concentrates on the engineering methods of financial engineering. Methods, models, and analysis learned by students in subjects like stochastic models, simulation, optimization, probability, and statistics, are applied to the study of financial instruments. Financial tools are explained in a practical manner. The course focuses on how to create financial tools and how the tools work together to achieve specific goals. Applications are illustrated using real-world examples. Main financial products covered are Equities, Bonds, and Currencies. Cash flows covered include spot, options, and forwards and futures. Credit products covered are collateralized debt obligations, special purpose vehicles, and credit default swaps. Portfolio creation, portfolio construction, and strategy development are studied. The course gives a primer on analyzing financial statements (balance sheet, income statement, and cash flow statement), bonds, corporate valuations, stock trading fundamentals (fundamental analysis, technical analysis, algorithmic trading), mergers and acquisitions (tender offers, hostile takeovers, leveraged buyouts), stock repurchases, options valuation, futures, commodities, mutual and index funds, hedge funds, currency exchange, risk analysis, real estate investing, and portfolio balancing and optimization.

ISE 580.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 690. Special Topics in Industrial Engineering. 3 Credit Hours.

Sub-titles describing the topics are shown in parentheses in the class schedule, following the title "Special Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 694. Master's Capstone Design Project. 3 Credit Hours.

A capstone design project for students in the five-year BSIE/MSIE program. Integration of Industrial Engineering principles and techniques in the design and improvement of production and service systems is emphasized. Offered for students in this program only.

Components: LEC.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 695. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 696. Special Problems. 1-3 Credit Hours.

Project course introducing methods of research through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 699. Cooperative Education. 1 Credit Hour.

Practical application of classroom theory through alternating semester or summer employment with industries offering positions consistent with the student's field of study. Course may be repeated. Periodic reports and conferences are required.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 703. Graduate Research Seminar. 1 Credit Hour.

Attendance and active participation in a designated semester seminar series.

Requisite: Must be a registered Doctoral student.

Components: SEM.

Grading: SUS.

Typically Offered: Fall & Summer.

ISE 704. Graduate Teaching. 1-3 Credit Hours.

Teaching or assisting in a course with a substantial level of instructional responsibility. Only open to doctoral students.

Requisite: Must be a registered Doctoral student.

Components: EXP.

Grading: SUS.

Typically Offered: Fall & Summer.

ISE 712. Design of Experiments. 3 Credit Hours.

Design and analysis of experiments, randomized blocks, Latin Squares, factorials, multiple correlation and regression, and application to response surfaces are discussed. 3 hours.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 713. Applied Regression Analysis. 3 Credit Hours.

Theory and applications of regression based models. Focus will be on empirical model building, estimation, inference and prediction with emphasis on interpretation of results and understanding model assumptions. Key Topics will be linear regression, panel data and time series analysis.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 715. Quality Through Planned Experimentation. 3 Credit Hours.

Sequential experimentation and guidance on how to build the sequence and use graphical methods to ascertain how much the planned changes contribute to the variation in the data. Experimentation is presented as a system in the context of a model to improve quality and integrate statistical process control (SPC) with methods of design. Examples presented contain problems often encountered in actual experimentation in a manufacturing or a service facility. Not open to students with credit in IEN 712.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 716. Advanced Quality Control. 3 Credit Hours.

Advanced topics in variables and attributes acceptance sampling and control charting. Statistical and economical design of control chart and sampling plan, sampling design and analysis with inspection and measurement errors, product liability prevention, value engineering, quality costs, Metrology, military standards, quality manuals, customer and vendor relations, and total quality control concepts are discussed.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 742. Linear Programming and Extensions. 3 Credit Hours.

Formulation, solution, postoptimality analysis of linear programming problems; revised simplex, parametric programming, decomposition of large-scale systems. Use of computer packages. Introduction to integer programming, network flows, and nonlinear programming applications.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 745. Advanced Stochastic Processes. 3 Credit Hours.

This course provides a foundation in stochastic processes for modeling systems subject to uncertainty. Fundamental probability models and important proofs and derivations will be covered to equip students with depth in theory. Throughout the course, engineering applications will be presented to provide motivation for the models and to illustrate how the models are used to inform optimal decision-making under uncertainty. Applications will include queueing systems, reliability engineering, inventory management, healthcare decision support, financial engineering, and games. Some programming (e.g., MATLAB, Python, or R) will be utilized in-class to illustrate concepts and will be required for homework assignments. Homework will include a mixture of theory, problem solving, applications, and case studies.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 747. Data Driven Multi-paradigm Simulation Systems. 3 Credit Hours.

The goal of this course to familiarize the students with current research problems in the simulation field including 1) various modeling paradigms (discrete event, system dynamics, agent-based approach, O-O modeling, Petri-net), 2) modeling enhancement in discrete event simulation, 3) standards, methods, techniques, and cyber-infrastructures (web services and grid computing) enabling distributed simulation, 4) algorithms for partitioning a large scale simulation into smaller pieces, and 5) real-time simulation and simulation based control. If time permits, the course will also cover 6) simulation optimization techniques using search algorithms and 7) deadlock detection and resolution in simulation. This course will help graduate students identify potential research topics in simulation principles for the application areas in design and control for complex data driven systems.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 757. Ergonomics and Occupational Biomechanics. 3 Credit Hours.

Effects of human factors in the improvement of performance of systems. Human capacities, capabilities, and limitations as derived from anatomical, physiological, and psychological principles are applied to the design of tools and equipment. Incorporation of all factors into systems design to achieve better system performance is emphasized

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 758. Ergonomics and Special Populations. 3 Credit Hours.

Ergonomic issues relevant to design for older adults and special populations such as the handicapped. Primary emphasis is placed on work environments, transportation and communication systems, and home environments. Topics include cognitive and physiological characteristics of special populations, workplace design, job and equipment design, rehabilitation engineering, clinical ergonomics, and legislation such as the ADA. Lecture, 3 hours.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 760. Productivity Measurement and Evaluation. 3 Credit Hours.

Basic concepts. Productivity measurement approaches at international, national, industry, and company levels. Latest measurement models for manufacturing companies. Relationships between total and partial productivities, profit and total productivity. Productivity evaluation: theory and methodology.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 761. Engineering Cost Management. 3 Credit Hours.

Issues of cost management, including activity based costing of engineering projects. A detailed study of how to separate, identify, understand and manage the major activities performed, and how these activities relate to customer needs. Overall view of costs associated with products, processes, and customers.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 763. Project Management Techniques. 3 Credit Hours.

Techniques and Tools in Project Management. Use of network flow techniques including PERT/CPM, planning, systems concepts, time management, conflicts, cost and resource control, tradeoff analysis.

Components: LEC.

Grading: GRD.

Typically Offered: Fall.

ISE 764. Supply Chain Management. 3 Credit Hours.

Supply Chain Management focuses on the flow of products, information, and money throughout the supply chain. An overview of issues, opportunities, tools, and approaches is provided. Emphasis is placed on business processes, system dynamics, control, design and re-engineering, and on the relationship between the supply chain and the company's strategic position relative to its clients and its competition. The dimensions of inter-corporate relationships with partners, including decision-making, incentives, and risk are also covered.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 765. Advanced Production Systems. 3 Credit Hours.

Quantitative, heuristic and computer methods applied to problems of production planning, work force balancing and capacity expansion. Sequencing and scheduling models. Advanced Material Requirements Planning (MRP II). Just In Time production systems (JIT). Master Production Scheduling (MPS). Optimize Production Technology (OPT). KANBAN production planning system. Learning curve theory. Advanced forecasting and time-series analysis.

Components: LEC.

Grading: GRD.

Typically Offered: Spring.

ISE 772. Strategic Management of Technological Innovation.. 3 Credit Hours.

Advanced topics in the management of technology emphasizing the relationship between technology and competitiveness in the global marketplace. Technology development in the U.S., Japan, and Europe, industrial R & D, strategic technological planning, and conditions for successful implementations. Case studies are used with individual and group assignments. Prerequisite: IEN 572 - Management of Technology or permission of Instructor.

Components: LEC.

Grading: GRD.

Typically Offered: Offered by Announcement Only.

ISE 792. Professional Communications Skills for Engineering Grad Students. 0 Credit Hours.

This course covers fundamental areas in professional communication for Engineering graduate students. Topic areas include: presenting research at conferences, writing manuscripts for publication, preparing the dissertation, the PhD comprehensive exams, effective teaching and mentoring, and obtaining positions in academia. Through interactive workshops, in-class exercises, brief presentations and assignments, students will have an opportunity to practice and strengthen necessary communication skills, developing collaborations, and developing effective presentation skills.

Components: LEC.

Grading: SUS.

Typically Offered: Offered by Announcement Only.

ISE 794. Master's Project. 3 Credit Hours.

A capstone project for M.S. students in the non-thesis option.

Components: THI.

Grading: GRD.

Typically Offered: Fall & Spring.

ISE 795. Special Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation of current problems. Offered by special arrangement only.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 796. Special Problems. 1-3 Credit Hours.

Research and/or design projects through an individual investigation. of current problems. Offered by special arrangement only.

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 799. Advanced Topics. 1-3 Credit Hours.

Subject matter offerings based upon student demand and availability of faculty. Subtitles describing the topics to be offered will be shown in parentheses in the printed class schedule, following the title "Advanced Topics".

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 810. Master's Thesis. 1-6 Credit Hours.

The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ISE 820. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in IEN 710 (usually six credits). Credit not granted. May be regarded as full time residence.

Components: THI.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 825. Continuous Registration--Master's Study. 1 Credit Hour.

To establish residence for non-thesis master's students who are preparing for major examinations. Credit not granted. Regarded as full time residence.

Components: LEC.

Grading: GRD.

Typically Offered: Fall, Spring, & Summer.

ISE 830. Pre-Candidacy Doctoral Dissertation. 1-12 Credit Hours.

Doctoral dissertation credits taken prior to Ph.D. student's candidacy. The student will enroll for credit as determined by his/her advisor. Not more than 12 hours of IEN 730 may be taken in a regular semester, nor more than six in a summer session.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ISE 840. Post-Candidacy Doctoral Dissertation. 1-12 Credit Hours.

Doctoral dissertation credits taken after Ph.D. student has been admitted to candidacy. The student will enroll for credit as determined by his/her advisor. Not more than 12 credits in IEN 740 may be taken in a regular semester, nor more than six credits in a summer session.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.

ISE 850. Research in Residence. 1 Credit Hour.

Used to establish research in residence for the Ph.D. and D.A., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

Components: THI.

Grading: SUS.

Typically Offered: Fall, Spring, & Summer.