Industrial and Systems Engineering (ISE)

Courses

ISE 100 Industrial Employment 0 Credits
Usually following the junior year, students in the industrial engineering curriculum are required to do a minimum of eight weeks of practical work, preferably in the field they plan to follow after graduation. A report is required. Must have sophomore standing.

ISE 111 Engineering Probability 3 Credits
Random variables, probability models and distributions. Poisson processes. Expected values and variance. Joint distributions, covariance and correlation.
Prerequisites: MATH 022 or MATH 096 or MATH 032 or MATH 052

ISE 112 Computer Graphics 1 Credit
Introduction to interactive graphics and construction of multiview representations in two and three dimensional space. Applications in industrial engineering. Must have sophomore standing in industrial engineering.

ISE 121 Applied Engineering Statistics 3 Credits
The application of statistical techniques to solve industrial problems. Regression and correlation, analysis of variance, quality control, and reliability.
Prerequisites: ISE 111 or MATH 231 or IE 111

ISE 131 Work Systems and Operations Management 3 Credits
Workermachine systems, work flow, assembly lines, logistics and service operations, and project management. Operations analysis, methods engineering, work measurement, lean production, and six sigma. Workplace ergonomics, plant layout design, and work management.
Prerequisites: ISE 111 or MATH 231 or IE 111
Can be taken Concurrently: ISE 111, MATH 231, IE 111

ISE 132 Work Systems Laboratory 1 Credit
Laboratory exercises, case studies, and projects in operations analysis, methods engineering, work measurement, and plant layout design.
Prerequisites: ISE 131 or IE 131
Can be taken Concurrently: ISE 131, IE 131

ISE 168 (EMC 168) Production Analysis 3 Credits
A course for students not majoring in industrial engineering. Engineering economy; application of quantitative methods to facilities analysis and planning, operations planning and control, work measurement, and scheduling.
Prerequisites: MATH 021 or MATH 031 or MATH 051 or MATH 075 or MATH 076

ISE 172 Algorithms in Systems Engineering 0,4 Credits
Use of computers to solve problems arising in systems engineering. Design and implementation of algorithms for systems modeling, systems design, systems analysis, and systems optimization. Computer systems, basic data structures, the design and implementation of efficient algorithms, and application of algorithms to the design and optimization of complex systems such as those arising in transportation, telecommunications, and manufacturing. Weekly laboratory with exercises and projects.
Prerequisites: CSE 004 or CSE 007 or CSE 017

ISE 215 Fundamentals of Modern Manufacturing 3 Credits
Manufacturing processes and systems. Metal machining and forming, polymer shape processes, powder metallurgy, assembly and electronics manufacturing. Introduction to automation, numerical control, and industrial robots.
Prerequisites: MAT 033

ISE 216 Manufacturing Laboratory 1 Credit
Laboratory exercises and experiments in manufacturing processes and systems.
Prerequisites: ISE 215 or IE 215
Can be taken Concurrently: ISE 215, IE 215

ISE 224 Information Systems Analysis and Design 3 Credits
An introduction to the technological as well as methodological aspects of computer information systems. Content of the course stresses basic knowledge in database systems. Database design and evaluation, query languages and software implementation. Students that take CSE 241 cannot receive credit for this course.

ISE 226 Engineering Economy and Decision Analysis 3 Credits
Economic analysis of engineering projects; interest rate factors, methods of evaluation, depreciation, replacement, breakeven analysis, aftertax analysis. decision-making under certainty and risk.
Prerequisites: ISE 111 or MATH 231 or IE 111
Can be taken Concurrently: ISE 111, MATH 231, IE 111

ISE 230 Introduction to Stochastic Models in Operations Research 3 Credits
Formulating, analyzing, and solving mathematical models of real-world problems in systems exhibiting stochastic (random) behavior. Discrete and continuous Markov chains, queueing theory, inventory control, Markov decision process. Applications typically include traffic flow, call centers, communication networks, service systems, and supply chains.
Prerequisites: ISE 111 or IE 111 or MATH 231

ISE 240 Introduction to Deterministic Optimization Models in Operations Research 3 Credits
Formulating, analyzing, and solving mathematical models of real-world problems in systems design and operations. A focus on deterministic optimization models having parameters that are known and fixed. Algorithmic approaches for linear, integer, and nonlinear problems. Solving optimization problems utilizing specialized software.
Prerequisites: MATH 205

ISE 251 Production and Inventory Control 3 Credits
Techniques used in the planning and control of production and inventory systems. Forecasting, inventory models, operations planning, and scheduling.
Prerequisites: ISE 121 and ISE 230 and ISE 240
Can be taken Concurrently: ISE 230, ISE 240

ISE 254 Senior Project 0,3 Credits
The use of industrial and systems engineering techniques to solve a major problem in either a manufacturing or service environment. Problems are sufficiently broad to require the design of a system. Human factors are considered in system design. Laboratory component provides significant industry exposure.
Prerequisites: ISE 226 or ISE 251
Can be taken Concurrently: ISE 226, ISE 251

ISE 255 Senior Thesis I 3 Credits
In-depth study of a research topic in industrial and systems engineering supervised by an Industrial and Systems Engineering department faculty member. Requires completion of a formal research proposal and a public presentation of the proposal at the end of the semester.

ISE 256 Senior Thesis II 3 Credits
Continued in-depth study of a research topic in industrial and systems engineering supervised by an Industrial and Systems Engineering department faculty member. Requires a formal thesis and public presentation of the results.
Prerequisites: ISE 255

ISE 275 Fundamentals of Web Applications 3 Credits
Introduction to web technologies required to support the development of client side and server side components of Internet based applications. Students will be exposed to the problems of design, implementation, and management by way of assigned readings, class discussion, and project implementation. Term project.
Prerequisites: ISE 224 or IE 224 or CSE 241
Can be taken Concurrently: ISE 224, IE 224, CSE 241

ISE 281 Leadership Project 1-3 Credits
Application of leadership principles through team projects with industry. Written report required.
Repeat Status: Course may be repeated.
Prerequisites: ISE 382 or IE 382

ISE 300 Apprentice Teaching 1-4 Credits

ISE 305 Simulation 0,3 Credits
Applications of discrete and continuous simulation techniques in modeling industrial systems. Simulation using a highlevel simulation language. Design of simulation experiments.
Prerequisites: ISE 121 or IE 121

ISE 316 Optimization Models and Applications 3 Credits
Modeling and analysis of operations research problems using techniques from mathematical programming. Linear programming, integer programming, multicriteria optimization, stochastic programming, and nonlinear programming using an algebraic modeling language.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240 or ISE 221 or IE 221 or ISE 222 or IE 222

ISE 319 Facilities Planning and Material Handling 3 Credits
Facilities planning including plant layout design and facility location. Material handling analysis including transport systems, storage systems, and automatic identification and data capture.
Prerequisites: ISE 131 or IE 131

ISE 320 Service Systems Engineering 3 Credits
Models and algorithms for reducing costs and improving customer service in service industries such as transportation, health care, retail, hospitality, education, and emergency services. Topics include facility location, resource allocation, inventory management, workforce planning, queuing analysis, call center management, and vehicle routing, with an emphasis on their applications in service industries. This course is an undergraduate version of ISE 420. Credit will not be given for both ISE 320 and ISE 420.
Prerequisites: ISE 230 and ISE 240
Can be taken Concurrently: ISE 230

ISE 321 Independent Study in Industrial & Systems Engineering 1-3 Credits
Experimental projects in selected fields of industrial engineering, approved by the instructor. A written report is required. Department permission required.
Repeat Status: Course may be repeated.

ISE 324 Industrial Automation and Robotics 3 Credits
Introduction to robotics technology and applications. Robot anatomy, controls, sensors, programming, work cell design, part handling, welding, and assembly. Laboratory exercises.
Prerequisites: (MECH 003 or MECH 002) and MATH 205

ISE 328 Engineering Statistics 3 Credits
Random variables, probability functions, expected values, statistical inference, hypothesis testing, regression and correlation, analysis of variance, introduction to design of experiments, and fundamentals of quality control. This course cannot be taken by IE undergraduates.
Prerequisites: MATH 023 or MATH 096

ISE 332 Product Quality 3 Credits
Introduction to engineering methods for monitoring, control, and improvement of quality. Statistical models of quality measurements, statistical process control, acceptance sampling, and quality management principles. Some laboratory exercises.
Prerequisites: ISE 121 or IE 121

ISE 334 Organizational Planning and Control 3 Credits
Design of organization and procedures for managing functions of industrial engineering. Analysis and design of resources planning and control, including introduction of change in manmachine systems; manpower management and wage administration. Must have junior standing.

ISE 339 Stochastic Models and Applications 3 Credits
Introduction to stochastic process modeling and analysis techniques and applications. Generalizations of the Poisson process; renewal theory and applications to inventory theory, queuing, and reliability; Brownian motion and stationary processes.
Prerequisites: ISE 220 or IE 220 or ISE 230 or IE 220

ISE 340 Production Engineering 3 Credits
Development of process plans for manufacturing of discrete parts. Emphasis on machining processes planning and design manufacturing interface. Economic analysis of process design alternatives. Concurrent engineering topics. Introduction to mechanization, automation, and flexible manufacturing systems. Fundamentals of group technology and cellular manufacturing Term project. Laboratory.
Prerequisites: ISE 215 or IE 215

ISE 341 Data Communication Systems Analysis and Design 3 Credits
An introduction to the hardware as well as performance evaluation of data communication networks. Emphasis on data transmission, encoding, data link control, communication networking techniques, and queuing/simulation analysis of network performance.
Prerequisites: (ISE 230 or IE 230) and (ISE 240 or IE 240)

ISE 347 Financial Optimization 3 Credits
Making optimal financial decisions under uncertainty. Financial topics include asset/liability management, option pricing and hedging, risk management and portfolio optimization. Optimization techniques covered include linear and nonlinear optimization, discrete optimization, dynamic programming and stochastic optimization. Emphasis on use of modeling languages and solvers in financial applications. Requires basic knowledge of linear optimization and probability. Credit will not be given for both ISE 347 and ISE 447.
Prerequisites: ISE 316

ISE 355 Optimization Algorithms and Sortware 3 Credits
Basic concepts of large families of optimization algorithms for both continuous and discrete optimization problems. Pros and cons of the various algorithms when applied to specific types of problems; information needed; whether local or global optimality can be expected. Participants practice with corresponding software tools to gain hands-on experience. Credit will not be given for both IE 355 and IE 455.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240

ISE 356 Introduction to Systems Engineering and Decision Analysis 3 Credits
Systems Engineering modeling techniques. Architectures for large scale systems design. Includes physical, functional, and operational architectures. Requirements engineering, interface and integration issues, graphical modeling techniques. Additional topics may include: decision analysis techniques for systems, uncertainty analysis, utility functions, multiattribute utility functions and analysis, influence diagrams, risk preference, Analytical Hierarchy and Node Processes in decision making.
Prerequisites: (ISE 220 or IE 220) or ((ISE 230 or IE 230) and (ISE 240 or IE 240),)

ISE 357 Introduction to Industrial Engineering Mathematics 3 Credits
A review of linear algebra and an introduction to quantitative analysis, manipulation of matrices, core concepts associated with systems oaf linear equations and linear optimization, algebraic and geometric models. The credits for this course cannot be applied to any undergraduate degree offered by the Industrial & Systems Engineering Department. Consent of department required.

ISE 358 Game Theory 3 Credits
A mathematical analysis of how people interact in strategic situations. Applications include strategic pricing, negotiations, voting, contracts and economic incentives, and environmental issues.
Prerequisites: MATH 021 or MATH 031 or MATH 051 or MATH 076

ISE 362 (MSE 362) Logistics and Supply Chain Management 3 Credits
Modeling and analysis of supply chain design, operations, and management. Analytical framework for logistics and supply chains, demand and supply planning, inventory control and warehouse management, transportation, logistics network design, supply chain coordination, and financial factors. Students complete case studies and a comprehensive final project.
Prerequisites: ((ISE 220 or IE 220) and (ISE 251 or IE 251),) or ((ISE 230 or IE 230) and (ISE 240 or IE 240),)

ISE 364 Introduction to Machine Learning 3 Credits
Techniques of applied machine learning rather than deep theory behind the algorithms and methods. Programming solutions for machine learning problems using a high-level programming language and associated machine learning libraries. Regression, clustering, principal component analysis, Bayesian methods, decision trees, random forests, support vector machines, and neural networks.
Prerequisites: CSE 003 or CSE 007 or CSE 002 or CSE 017

ISE 365 Applied Data Mining 3 Credits
Introduction to the data mining process including business problem understanding, data understanding and preparation, modeling and evaluation, and model deployment. Emphasis on hands-on data preparation and modeling using techniques from statistics, artificial intelligence, such as regression, decision trees, neural networks, and clustering. A number of application areas are explored. This course is an undergraduate version of IE 465. Credit will not be given for both IE 365 and IE 465.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 367 Mining of Large Datasets 3 Credits
Explores how large datasets are extracted and analyzed. Discusses suitable algorithms for high dimensional data, graphs, and machine learning. Introduces the use of modern distributed programming models for large-scale data processing. An undergraduate version of ISE 467, with assignments better geared towards undergraduate students. Credit will not be given for both ISE 367 and ISE 467.
Prerequisites: ISE 111 and CSE 002

ISE 372 Systems Engineering Design 3 Credits
Analysis, design, and implementation of solutions to problems in manufacturing and service sectors using information technology. Emphasis on problem identification and the evaluation of proposed solutions and implementations. Term Project.
Prerequisites: ((ISE 220 or IE 220) or ((ISE 230 or IE 230) and (ISE 240 or IE 240),),) and (ISE 275 or IE 275)

ISE 382 Leadership Development 3 Credits
Exploration and critical analysis of theories, principles, and processes of effective leadership. Managing diverse teams, communication, and ethics associated with leadership. Application of knowledge to personal and professional life through projects and team assignments.

ISE 401 Convex Analysis 3 Credits
Theory and applications of convex analysis, particularly as it relates to convex optimization and duality theory. Content of the course emphasizes rigorous mathematical analysis as well as geometric and visually intuitive viewpoints of convex objects and optimization problems.

ISE 402 Operations Research Models and Applications 3 Credits
Applied models in operations research, including models in supply chain management, energy, health care, disaster relief, and/or financial optimization. Models, theorems, algorithms, and skills for translating practical problems into mathematical ones.

ISE 403 Research Methods 3 Credits
Skills for conducting doctoral research. Topics include technical reading, technical writing, computing skills, literature review skills, and research ethics.

ISE 404 Simulation 0,3 Credits
Applications of discrete and continuous simulation techniques in modeling industrial systems. Simulation using a highlevel simulation language. Design of simulation experiments. This course is a version of IE 305 for graduate students, with research projects and advanced assignments.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 121

ISE 405 Industrial and Systems Engineering Special Topics 1-3 Credits
An intensive study of some field of industrial and systems engineering.
Repeat Status: Course may be repeated.

ISE 406 Fundamentals of Optimization 3 Credits
Introduction to theory and algorithms for linear, discrete, and convex mathematical optimization. Significant portion dedicated to linear optimization theory from both geometric and algebraic perspectives. Basic coverage of discrete optimization, including modeling techniques and algorithmic ideas for solving discrete optimization problems such as branch-and-bound and cutting planes. Basic introduction to convex optimization, including convex sets and functions, duality theory, and optimality conditions.

ISE 407 Numerical Methods and Scientific Computing 3 Credits
Topics in numerical methods, numerical analysis, and scientific computing including floating point arithmetic, conditioning and stability, data structures for scientific computing, analysis of algorithms, and direct and iterative methods for numerical linear algebra. Emphasis on efficient implementations in modern computing languages.

ISE 409 Time Series Analysis 3 Credits
Theory and applications of an approach to process modeling, analysis, prediction, and control based on an ordered sequence of observed data. Single or multiple time series are used to obtain scalar or vector difference/ differential equations describing a variety of physical and economic systems.

ISE 410 Design of Experiments 3 Credits
Experimental procedures for sorting out important causal variables, finding optimum conditions, continuously improving processes, and trouble shooting. Applications to laboratory, pilot plant and factory. Must have some statistical background and experimentation in prospect.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 411 Networks and Graphs 3 Credits
This course examines the theory and applications of networks and graphs. Content of the courses stresses on the modeling, analysis and computational issues of network and graph algorithms. Complexity theory, trees and arborescences, path algorithms, network flows, matching and assignment, primaldual algorithms, Eulerian and Hamiltonian walks and various applications of network models.
Prerequisites: ISE 406 or IE 406

ISE 412 Quantitative Models of Supply Chain Management 3 Credits
Analytical models for logistics and supply chain coordination. Modeling, analysis, and computational issues of production, transportation, and other planning and decision models. Logistics network configuration, risk pooling, stochastic decision-making, information propagation, supply chain contracting, and electronic commerce implication.
Prerequisites: ISE 316 or ISE 426

ISE 415 Optimization Under Uncertainty 3 Credits
Modeling, theory, solution algorithms, and applications of optimization models under uncertainty. Topics include stochastic, robust, and distributionally robust optimization techniques, including the mathematics of obtaining their associated deterministic equivalent optimization problems.

ISE 416 Dynamic Programming 3 Credits
This course is concerned with the dynamic programming approach to sequential decision making under uncertainty, exact solution algorithms, and approximate methods adapted to large-scale problems. Value iteration, policy iteration and lambda-policy iteration are introduced and analyzed using fixed-point theory. The linear optimization approach to dynamic programming is introduced. Special policy structures are studied. Algorithms based on sampling and on the use of linear approximation architectures are covered.
Prerequisites: ISE 316 or IE 316

ISE 417 Continuous Optimization 3 Credits
Theoretical principles underlying continuous (nonlinear) optimization problems and the numerical methods that are available to solve them. Topics include the steepest descent method, Newton's method for unconstrained optimization, necessary and sufficient optimality conditions, duality, line search and trust region methods for unconstrained optimization, derivative-free and quasi-Newton techniques, and other numerical methods relevant for solving continuous optimization problems.

ISE 418 Discrete Optimization 3 Credits
Theory, algorithms, and applications of discrete optimization. Focus on mathematical and algorithmic foundations with emphasis on techniques most successful in current software implementations, such as convexification and enumeration. Use of commercial and open source software and frameworks for solving discrete optimization problems will be discussed.

ISE 419 Planning and Scheduling in Manufacturing and Services 3 Credits
Models for the planning and scheduling of systems that produce goods or services. Resource allocation techniques utilizing static and dynamic scheduling methods and algorithms. Application areas include manufacturing and assembly systems, transportation system timetabling, project management, supply chains, and workforce scheduling.

ISE 424 Robotic Systems and Applications 3 Credits
Detailed analysis for robotic systems in manufacturing and service industries. Task planning and decomposition, motion trajectory analysis, conveyor tracking, error detection and recovery, end effector design, and systems integration.

ISE 426 Optimization Models and Applications 3 Credits
Modeling and analysis of operations research problems using techniques form mathematical programming. Linear programming, integer programming, multicriteria optimization, stochastic programming and nonlinear programming using an algebraic modeling language. This course is a version of IE 316 for graduate students, with research projects and advanced assignments. Closed to students who have taken IE 316.
Prerequisites: ISE 240 or IE 240

ISE 429 Probability and Stochastic Processes 3 Credits
Mathematical foundations of probability and stochastic processes for modeling and analyzing real-world phenomena. Modeling and analyzing systems that evolve over time, such as queueing systems. Topics include probabilistic models, fundamental theorems of probability, conditional probability, independence, random variables, distribution functions, laws of large numbers, martingales, Markov chains, Poisson processes, and Brownian motion.

ISE 430 Management Science Project 3 Credits
Analysis of a management problem and design of its solution incorporating management science techniques. An individual written report is required. Recommended to be taken in the last semester of the program.

ISE 431 Operations Research Special Topics 1-3 Credits
Extensive study of selected topics in techniques and models of operations research.
Repeat Status: Course may be repeated.

ISE 433 Manufacturing Engineering Special Topics 3 Credits
Extensive study of selected topics in the research and development of manufacturing engineering techniques.

ISE 437 Advanced Database Analysis and Design 3 Credits
Intensive treatment of design and application of modern database technology, including information modeling and logical design of databases. Emphasis on applications to the manufacturing environment.
Prerequisites: ISE 224 or IE 224

ISE 438 Advanced Data Communication Systems Analysis and Design 3 Credits
Study of technological development, operational algorithms and performance analysis in data networks. Emphasis on recent developments in communication technologies, modeling and simulation of largescale networks, routing models and algorithms, and flow control issues.

ISE 439 Queueing Systems 3 Credits
Queueing theory and analysis of manufacturing, distribution, telecommunications, and other systems subject to congestion. Design and analysis of queueing networks; approximation methods such as mean value analysis, uniformization, fluid and diffusion interpretations; numerical solution approaches.

ISE 441 Financial Engineering Projects 3 Credits
Analysis, design and implementation of solutions to problems in financial services using information technology, mathematical modeling, and other financial engineering techniques. Emphasis on realworld problem solving, problem definition, implementation and solution evaluation.

ISE 442 Manufacturing Management 3 Credits
Study of factors affecting the development of a manufacturing management philosophy; decision-making process in areas of organization, planning, and control of manufacturing. The principles and techniques of TQM, Deming and others; metrics, costs, benchmarking, quality circles, and continuous improvement. Influence of the social, technical, and economic environment upon manufacturing management decisions. Case studies.

ISE 443 (MSE 443) Automation and Production Systems 3 Credits
Principles and analysis of manual and automated production systems for discrete parts and products. Cellular manufacturing, flexible manufacturing systems, transfer lines, manual and automated assembly systems, and quality control systems.
Prerequisites: ISE 215 or IE 215

ISE 444 Optimization Methods in Machine Learning 3 Credits
Machine learning models and optimization methods that are used to apply these models in practice. Convex models. Gradient and subgradient methods and their stochastic counterparts. Limits and errors of learning, noise reduction, and nonconvex models. Other techniques and algorithms include acceleration, coordinate descent, alternating-direction methods, first-order constrained convex optimization methods, and second-order methods.

ISE 445 Assembly Processes and Systems 3 Credits
Joining processes including welding, brazing, soldering, and adhesive bonding. Mechanical assembly methods. Manual assembly lines and line balancing. Automated assembly. Product design considerations including Design for Assembly.

ISE 447 Financial Optimization 3 Credits
Making optimal financial decisions under uncertainty. Financial topics include asset/liability management, option pricing and hedging, risk management, and portfolio optimization. Optimization techniques covered include linear and nonlinear programming, integer programming, dynamic programming, and stochastic programming. Emphasis on use of modeling languages and solvers in financial applications. Requires basic knowledge of linear programming and probability. This course is a version of IE 347 for graduate students and requires advanced assignments. Credit will not be given for both IE 347 and IE 447.
Prerequisites: ISE 426 or IE 426 or ISE 316 or IE 316

ISE 455 Optimization Algorithms and Software 3 Credits
Basic concepts of large families of optimization algorithms for both continuous and discrete optimization problems. Pros and cons of the various algorithms when applied to specific types of problems; information needed; whether local or global optimality can be expected. Participants practice with corresponding software tools to gain hands-on experience. This course is a version of IE 355 for graduate students and requires advanced assignments. Credit will not be given for both IE 355 and IE 455.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240

ISE 456 Conic Optimization 3 Credits
Modeling, theory, solution algorithms, and applications of conic optimization. Topics include mathematics of conic optimization: second-order cones, semidefinite cones, conic duality, interior-point methods. Applications of conic optimization to combinatorial optimization and other areas of optimization are covered.

ISE 458 Topics in Game Theory 3 Credits
A mathematical analysis of how people interact in strategic situations. Topics include normalform and extensiveform representations of games, various types of equilibrium requirements, the existence and characterization of equilibria, and mechanism design. The analysis is applied to microeconomic problems including industrial organization, international trade, and finance. Must have two semesters of calculus.
Prerequisites: ECO 412 and ECO 413

ISE 460 Engineering Project 1-3 Credits
Intensive study of an area of industrial engineering with emphasis upon design and application. A written report is required.

ISE 461 Readings 1-3 Credits
Intensive study of some area of industrial engineering that is not covered in general courses.

ISE 465 Applied Data Mining 3 Credits
Introduction to the data mining process including business problem understanding, data understanding and preparation, modeling and evaluation, and model deployment. Emphasis on hands-on data preparation and modeling using techniques from statistics, artificial intelligence, such as regression, decision trees, neural networks, and clustering. A number of application areas are explored. This course is a graduate version of IE 365 possessing some advanced assignments. Credit will not be given for both IE 365 and IE 465.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 470 Introduction to Healthcare Systems 3 Credits
The state of Healthcare from economic, systems, quality, and historical perspectives. Components of the Healthcare system including, facilities, delivery and treatment systems, and personnel. System costs, reimbursement methods and financial aspects in Healthcare. Healthcare policy, laws and ethics. System performance measures including access, cost effectiveness and quality of care.

ISE 471 Quality and Process Improvement in Healthcare 3 Credits
The dimensions of Healthcare quality and their definitions, quality metrics, accreditation and other benchmarking and evaluation methods. Change management, project planning and team management. Continuous improvement tools including "lean", "six-sigma", and "TQM".

ISE 472 Financial Management in Healthcare 3 Credits
Engineering economics in Healthcare; value metrics (net present value, return on investment, etc.), cost-benefit analysis, capital projects and improvements. Accounting methods in Healthcare systems. Reimbursement methods, organizations, and alternatives. Financial strategy, planning, pricing and capital formation in "for", and "not for" profit settings.

ISE 473 Information Technology in Healthcare 3 Credits
Introduction to information systems in Healthcare. Components of the system; electronic medical records, patient monitoring and data collection (clinical information systems), ancillaries (lab, pharmacy, radiology), imaging and digital technology, financial, inventory and management information systems. Enterprise systems in Healthcare, IT driven cost, efficiency and treatment quality metrics. Data warehousing, sharing, mining, protection and privacy issues.

ISE 474 Healthcare Systems Engineering Capstone Project 3 Credits
A three credit hour "capstone" project to be completed in collaboration with industry partners and under the supervision of faculty. Students will work in small groups on projects in the Healthcare industry. The Professor of Practice is the general advisor for the capstone project course.

ISE 475 Healthcare Systems Project 1-3 Credits
Intensive study of an area of healthcare systems engineering with emphasis upon design and application. Written report is required.

ISE 482 Leadership Development 3 Credits
Exploration and critical analysis of theories, principles, and processes of effective leadership. Managing diverse teams, communication, and ethics associated with leadership. Application of knowledge to personal and professional life through projects and team assignments. Credit will not be given to a student for both ISE 382 and ISE 482.

ISE 490 Thesis 1-6 Credits

ISE 499 Dissertation 1-15 Credits