

IE - INDUSTRIAL ENGINEERING

IE Class Schedule (<https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/IE/>)

Courses

IE 199 Undergraduate Open Seminar credit: 1 to 5 Hours. (<https://courses.illinois.edu/schedule/terms/IE/199/>)

May be repeated.

IE 297 Independent Study credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/297/>)

Individual investigations of any phase of Industrial Engineering. May be repeated in separate terms. Prerequisite: Consent of instructor.

IE 300 Analysis of Data credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/300/>)

Nature of probabilistic models for observed data; discrete and continuous distribution function models; inferences on universe parameters based on sample values; control charts, acceptance sampling, and measurement theory. Credit is not given towards graduation for both IE 300 and CEE 202; credit is also not given towards graduation for both IE 300 and BIOE 310. Prerequisite: MATH 241.

IE 310 Deterministic Models in Optimization credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/310/>)

Linear Optimization - Simplex method, duality, and sensitivity analysis, Transportation and Assignment Problems, Network Optimization Models, Dynamic Programming, Nonlinear optimization, and Discrete optimization. Credit is not given for both IE 310 and CEE 201. Prerequisite: Credit or concurrent registration in MATH 257 or MATH 415.

IE 311 Operations Research Lab credit: 1 Hour. (<https://courses.illinois.edu/schedule/terms/IE/311/>)

Applications of OR models with the use of software tools. Prerequisite: Concurrent registration in IE 310.

IE 330 Industrial Quality Control credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/330/>)

Contemporary concepts and methods for quality and productivity design and improvement; philosophies of Deming, Taguchi, and others leading the quality management and engineering movement; Shewhart's methods for statistical process control; process capability analysis; statistical methods for tolerance assessment; process control methods employing attribute data; design of experiments, concepts, and methods. Prerequisite: IE 300.

IE 340 Human Factors credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/340/>)

Introduction to human factors, ergonomics, engineering psychology, history of ergonomics, human-machine relations, displays and controls, human-computer interaction, industrial and aviation systems, physiology of work and anthropometrics, cognitive ergonomics, human reliability, human as manual controller, human-machine systems design, prototyping, professional practice and ethics, laboratory exercises. Same as PSYC 358. Prerequisite: PSYC 100, PSYC 103, or consent of instructor.

IE 360 Facilities Planning and Design credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/360/>)

Facility planning, plant layout design, and materials handling analysis; determination of facilities requirements, site selection, materials flow, use of analytical and computerized techniques including simulation, and applications to areas such as manufacturing, warehousing, and office planning. Prerequisite: Credit or concurrent enrollment in IE 310.

IE 361 Production Planning & Control credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/361/>)

Scope of production systems and activities involved in their design, establishment, management, operation, and maintenance; mathematical and computer models for planning and control of facilities, human resources, projects, products, material, and information in production systems. Prerequisite: IE 310.

IE 370 Stochastic Processes and Applications credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/370/>)

Introduction to stochastic processes with applications in decision-making under uncertainty. Topics include newsvendor problem, discrete-time Markov chain (including classification of states, stationary distribution, absorbing states), Poisson processes (including time-homogenous, time-nonhomogeneous, thinning Poisson), continuous-time Markov chain (including Markov property, generator matrix, stationary distribution), queuing theory (including M/M/k queue, open Jackson network), and Markov decision processes (including finite-horizon models, infinite-horizon models). Prerequisite: IE 300 and IE 310.

IE 371 Simulation Modeling with Applications for Industrial Engineering credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/371/>)

Use of discrete-event simulation in the modeling and analysis of complex systems subject to uncertainty. At the end of the course, the students should be able to develop simulation models of complex, real-life systems; design simulation experiments; analyze and interpret the results of the simulation; and effectively organize and present simulation-based projects. The main part of the class will be spent on the development of simulation models using software such as Arena by Rockwell. Other topics of the course also include input modeling, selecting distributions, generating random variables, sensitivity analysis, simulation optimization, and reporting and analyzing simulation outputs. Prerequisite: IE 300 and IE 310. Restricted to Junior and Senior Standing.

IE 397 Independent Study credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/397/>)

Individual investigations or studies of any phase of Industrial Engineering. May be repeated in separate terms. Prerequisite: Consent of instructor.

IE 398 Special Topics credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/398/>)

Subject offerings of new and developing areas of knowledge in industrial engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

IE 400 Design & Anlys of Experiments credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/400/>)

Concepts and methods of design of experiments for quality design, improvement and control. Simple comparative experiments, including concepts of randomization and blocking, and analysis of variance techniques; factorial and fractional factorial designs; Taguchi's concepts and methods; second-order designs; response surface methodology. Engineering applications and case studies. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: IE 300.

IE 405 Computing for ISE credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/405/>)

This course will introduce students to algorithm design, computer programming in C++, and database SQL queries. It will provide the fundamental methods, concepts and principles of these topics to give students enough breadth to use these techniques in their jobs and to prepare them to pursue advanced topics in these areas. There will be weekly programming assignments to implement algorithms and SQL covered in the class. 3 undergraduate hours. 4 graduate hours. Prerequisite: CS 101 or equivalent.

IE 410 Advanced Topics in Stochastic Processes & Applications credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/410/>)

Modeling and analysis of stochastic processes. Transient and steady-state behavior of continuous-time Markov chains; renewal processes; models of queuing systems (birth-and-death models, embedded-Markov-chain models, queuing networks); reliability models; inventory models. Familiarity with discrete-time Markov chains, Poisson processes, and birth-and-death processes is assumed. Same as CS 481. 3 undergraduate hours. 4 graduate hours. Prerequisite: IE 310.

IE 411 Optimization of Large Systems credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/411/>)

Practical methods of optimization of large-scale linear systems including extreme point algorithms, duality theory, parametric linear programming, generalized upper bounding technique, price-directive and resource-directive decomposition techniques, Lagrangian duality, Karmarkar's algorithm, applications in engineering systems, and use of state-of-the-art computer codes. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: IE 310 and MATH 257 or MATH 415.

IE 412 OR Models for Mfg Systems credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/412/>)

Operations research techniques applied to problems in manufacturing and distribution. Single and multi-stage lot sizing problems, scheduling and sequencing problems, and performance evaluation of manufacturing systems. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: IE 310.

IE 413 Simulation credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/413/>)

Use of discrete-event simulation in modeling and analysis of complex systems. Data structures and event-list management; verification and validation of simulation models; input modeling, including selection of probability distributions and random variate generation; statistical analysis of output data. Same as CS 482. 3 undergraduate hours. 4 graduate hours. Prerequisite: CS 101 and IE 310.

IE 420 Financial Engineering credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/420/>)

Introduction to the theory and practice of financial engineering: basics of derivative securities and risk management; Markowitz portfolio theory and capital asset pricing model; interest rate and bonds; forward and futures contracts, hedging using futures contracts; option contracts and arbitrage relationship; binomial model, no-arbitrage pricing, risk-neutral pricing, and American options pricing; Brownian motion, Black-Scholes-Merton model, delta hedging, Greek letters, implied volatility, and volatility smile. 3 undergraduate hours. 4 graduate hours. Prerequisite: IE 300.

IE 421 High Frequency Trading Technology credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/421/>)

Teaches students both the core concepts and underlying mechanics of, step by step, message by message, bit for bit, exactly how trillions of dollars in notional value are automatically traded daily around the globe, whether it is stocks, bonds, options, futures, currencies, crypto, etc. High Frequency Trading will provide students with an exciting introduction both to the modern world of automated finance and to many exciting technologies that power it. Where does the "actual" real-time price of a particular asset come from at any point in time? How exactly is it being calculated and by who or what? Is there even a single price or are there multiple, and are any of those prices actually correct? Just how fast can modern traders process market data or execute trades and how do they accomplish this? 4 undergraduate hours. 4 graduate hours. Credit is not given if student received credit in IE 498/598 Electronic Trading or IE 498/598 High Frequency Trading. Prerequisite: Should have an understanding of programming and data structures and be proficient in coding in at least one programming language (typically python, C/C++, java, javascript, etc). Students who have taken CS 225 would have the requisite knowledge, but it is not required students have taken this course.

IE 430 Economic Found of Quality Syst credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/430/>)

Total quality systems for planning, developing, and manufacturing world-class products. Economic foundations of total quality. Product value, cost, pricing, environmental quality, activity-based costing, design for assembly, organization structure, lead time, innovation, Taguchi methods, simulation-based significance testing, Strategic Quality Deployment, statistical process control, and conjoint analysis. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: IE 300.

IE 431 Design for Six Sigma credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/IE/431/>)

Quality Engineering principles and the Six Sigma Define-Measure-Analyze-Improve-Control (DMAIC) process. Application of concepts and methods of statistical process control, designed experiments, and measurement systems analysis to cases of quality and productivity improvement; application of the fundamentals of quality engineering and the Six Sigma to areas of produce development, service enterprise, and manufacturing processes. 3 undergraduate hours. 3 graduate hours. Prerequisite: IE 300.

IE 434 Deep Learning: Mathematics and Applications credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/434/>)

Mathematical foundations of deep learning and applications to topical examples. Understanding of mathematical formulations of building blocks of machine learning. Design of deep learning algorithms for practical applications. Examples will be drawn from real datasets, and implementations will involve PyTorch. 3 undergraduate hours. 4 graduate hours. Credit is not given for IE 434 and IE 534. Prerequisite: IE 300(or equivalent), MATH 231, MATH 415, CS 101.

IE 441 Work and Organization Design credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/441/>)

In Work and Organization Design, we will learn about models and theories of work and organization design. By the end of the class you will be able to distinguish between good and bad jobs, including important characteristics of organizations, based on empiric evidence. This class will also provide tools and skills to analyze and redesign jobs to make bad jobs into good ones. We will discuss various implementation strategies to intelligently apply redesigns, which improves their success. 3 undergraduate hours. 4 graduate hours. Prerequisite: IE 340 or consent of instructor.

IE 445 Human Performance and Cognition in Context credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/445/>) Same as EPSY 456 and PSYC 456. See EPSY 456.

IE 497 Independent Study credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/497/>) Independent study of advanced problems related to industrial engineering. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated. Prerequisite: Consent of instructor.

IE 498 Special Topics credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/498/>) Subject offerings of new and developing areas of knowledge in industrial engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated in the same or separate terms if topics vary to a maximum of 9 hours.

IE 510 Applied Nonlinear Programming credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/510/>) Optimization of nonlinear systems; survey of classical methods and concepts such as the Lagrangian method, the Jacobian method, and Kuhn-Tucker conditions; modern algorithms; numerical methods for digital computers; applications in engineering design; use of state-of-the-art computer codes. Prerequisite: IE 310.

IE 511 Integer Programming credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/511/>) Optimization of linear systems over discrete decision domains. Topics to be covered include Modeling, Polyhedral theory, Integral Polyhedra, Totally Unimodular Matrices, Total Dual Integrality, Computational Complexity, Cutting plane method, Branch and Bound method, and Lagrangian Dual. Structured integer programs involving Matchings, Knapsack, Cuts and Matroids will be studied as applications. 4 graduate hours. No professional credit. Prerequisite: IE 411 or MATH 482.

IE 513 Optimal System Design credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/513/>) This course is designed to address the fundamental mathematical theories for complex engineering system (product) design optimization in multidisciplinary environment. The course starts with the basics of nonlinear programming (continuous optimization), then expands to the area of multidisciplinary design optimization (MDO) in depth. Analytical Target Cascading (ATC) - a well-established hierarchical optimization method - is covered in-depth with assignments in written and programming forms. After a successful completion of the course, the students will be able to model and solve basic MDO problems and apply MDO in a research-based semester project. Prior experience in coding (in Matlab or similar) will be helpful but not required. 4 graduate hours. No professional credit. Prerequisite: IE 310.

IE 514 Optimization Methods for Large-Scale, Network-Based Systems credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/514/>) The course will cover topics related to optimization over large-scale networks. We will look at data-driven methodologies by which very large-scale optimization problems, primarily integer programs, can be solved. We will consider motivations from application areas such as airline scheduling, vehicle routing, and communications. Topics covered include shortest paths; multi-commodity flows; decomposition techniques; Lagrangean relaxation; set-covering and set-partitioning problems (with special characteristics); column generation and branch-and-price and cut; composite variables; large-scale neighborhood search techniques; modeling robustness and uncertainty; stochastic modeling in large-scale integer programs; data-driven optimization. The course will include real-world modeling examples from applications including vehicle routing, freight logistics, and airline schedule planning. 4 graduate hours. No professional credit. Prerequisite: IE 411 or the equivalent.

IE 516 Pricing and Revenue Management credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/516/>) Focuses on the theory and practice of pricing optimization and revenue management. Topics that will be covered include: Quantity-based revenue management; Demand estimation, forecasting, and learning; Dynamic pricing; Assortment optimization. 4 graduate hours. No professional credit. Prerequisite: IE 410, IE 411.

IE 517 Machine Learning in Finance Lab credit: 2 Hours. (<https://courses.illinois.edu/schedule/terms/IE/517/>) Machine Learning includes the design and the study of algorithms that can learn from experience, improve their performance and make predictions. This course is designed specifically and exclusively for MSFE first semester students. It features rigorous coding exercises in Python and acts as preparation for later courses. Students will learn the concepts behind different supervised machine learning algorithms and implement them in Python using advanced packages; pandas, NumPy, and scikit-learn. All the data for this course features unique real-world financial datasets. 2 graduate hours. No professional credit.

IE 518 Queueing Systems credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/518/>) An introduction to queueing systems and their applications in engineering. Topics include both classical single-stage models and queueing networks. Students will learn how to apply key ideas and methods of queueing theory, such as: Markov processes, embedded Markov chains, PASTA property, reversibility, productform stationary distributions, stochastic stability, asymptotic analysis. 4 graduate hours. No professional credit. Prerequisite: IE 410 or an equivalent graduate stochastic processes course.

IE 519 Combinatorial Optimization credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/519/>) The course will cover a series of topics in combinatorial optimization. The emphasis will be on polyhedral theory, structural results and their applications to designing algorithms. Specific topics to be covered include: Matchings, b-matchings, T-joins, T-cuts, Arborescences, Branchings, Matroids, Matroid Intersection, Polymatroids, Submodular Functions, Directed Cuts, Multi-flows. Same as CS 586. 4 graduate hours. No professional credit. Prerequisite: Familiarity with linear programs (IE 411 or equivalent), Algorithms (CS 374 or equivalent), and Graph Theory (MATH 412 or equivalent).

IE 521 Convex Optimization credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/521/>)

Finite dimensional convex optimization problems; characterization of optimal solutions; iterative algorithms for differentiable and nondifferentiable problems; distributed optimization algorithms; robust problems and solutions; applications of convex optimization models. 4 graduate hours. No professional credit. Prerequisite: ECE 490 or IE 411; MATH 416; MATH 444.

IE 522 Statistical Methods in Finance credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/522/>)

Statistical tools that are fundamental for financial modeling, analyzing financial data and further studies in financial engineering. Topics include summary statistics, statistical plots, point estimation, accuracy and precision, confidence interval, Monte Carlo simulation, maximum likelihood estimation, normal mixture, resampling, hypothesis testing, simple linear regression, multiple linear regression, variable selection, regression diagnostics, autocorrelation, moving average models, filtering, autoregressive models, ARIMA, forecasting, and selected additional topics. Implementations are done using R. 4 graduate hours. No professional credit. Credit is not given for both IE 522 and GE 524. Prerequisite: IE 300 and MATH 461.

IE 523 Financial Computing credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/523/>)

Review of C++ programming: structures, classes, I/O, C++ standard libraries, Recursion. Linear Algebra tools and MILP solvers in C++. Computational aspects of probability, statistics and simulation in C++. Methods: Root-finding, Taylor's Expansion, FFTs, Dynamic Programming, Monte Carlo Methods. Financial computing case studies in C++. 4 graduate hours. No professional credit. Prerequisite: CS 225.

IE 524 Optimization in Finance credit: 2 Hours. (<https://courses.illinois.edu/schedule/terms/IE/524/>)

Basic optimization models, theory and methods for financial engineering including linear, quadratic, nonlinear, dynamic integer, and stochastic programming; applications to portfolio selection, index fund tracking, asset management, arbitrage detection, option pricing and risk management; optimization software for classes of optimization problems. Projects requiring building optimization models based on financial market data and solutions using optimization solvers. 2 graduate hours. No professional credit. May be repeated in the same or separate semesters if topics vary to a maximum of 4 hours. Prerequisite: FIN 500 and MATH 257 or equivalent.

IE 525 Stochastic Calculus & Numerical Models in Finance credit: 2 Hours. (<https://courses.illinois.edu/schedule/terms/IE/525/>)

Basic theory of stochastic differential equations and numerical techniques for their analysis with applications to financial modeling. Brownian motion, martingales, stochastic integration, Ito's formula, stochastic differential equations, partial differential equations, simulation methods for derivatives pricing, finite-difference techniques for Black-Scholes equations and options pricing, Monte Carlo methods, variance reduction techniques, and sensitivity calculations. 2 graduate hours. No professional credit. May be repeated if topics vary to a maximum of 4 hours. Prerequisite: IE 523.

IE 527 MSFE Professional Development credit: 0 Hours. (<https://courses.illinois.edu/schedule/terms/IE/527/>)

Preparing MSFE students for successful careers in financial engineering. Topics include financial engineering career paths, MSFE concentrations and electives, preparing resumes and cover letters, interview procedures and preparation, networking, and job offer and salary negotiation. Lectures will be supplemented with seminars given by MSFE alumni, MSFE practicum project sponsors, and practitioners. They will give insights on financial markets, employment opportunities, market trends, internship and full-time job searching, and much more. 0 graduate hours. No professional credit. Approved for S/U grading only. May be repeated in separate terms. Prerequisite: Restricted to MS: Financial Engineering Students only.

IE 529 Stats of Big Data & Clustering credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/529/>)

Covers various foundational topics in data science. Parametric and non-parametric methods. Hypothesis testing; Regression; Classification; Dimension reduction; and Regularization. Unsupervised and semi-supervised learning, along with a few case studies. 4 graduate hours. No professional credit. Prerequisite: MATH 416 and IE 300 or equivalent. All ISE graduate students and students enrolled in the Master of Science in Advanced Analytics (MSAA) are eligible to take the course.

IE 531 Algorithms for Data Analytics credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/531/>)

This course will introduce the student to a set of algorithms for data analytics which include: hashing, indexes, caching; algorithms for structured datasets; streaming data modes; PageRank algorithms for market-basket models; clustering algorithms; and case studies. 4 graduate hours. No professional credit. Prerequisite: IE 411, CS 225. ISE graduate students and students enrolled in the Master of Science in Advanced Analytics (MCAA) are eligible to take the course.

IE 532 Analysis of Network Data credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/532/>)

This course will focus on statistical aspects analyzing network data. It will review illustrative problems relating to aggregation of information, decision-making, and inference tasks over various graphical models and networks. 4 graduate hours. No professional credit. Prerequisite: MATH 412. ISE graduate students and students enrolled in the Master of Science in Advanced Analytics (MCAA) are eligible to take the course.

IE 533 Big Graphs and Social Networks credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/533/>)

This course will cover the fundamentals of graph theory and network optimization. It will focus on algorithmic challenges associated with big graphs and intertwine the Hadoop Framework for solving example problems like shortest paths, link analysis, graph association and inexact graph matching. Applications in social network analysis will include study of network types, random graph models, exact and approximate computation of centrality measure, finding high value individuals, community detection, diffusion processes and cascading models, and influence maximization. 4 graduate hours. No professional credit. Prerequisite: MATH 213, IE 300, IE 411. ISE graduate students and students enrolled in the Master of Science in Advanced Analytics (MCAA) are eligible to take the course.

IE 534 Deep Learning credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/534/>)

Provides an introduction to neural networks and recent advances in deep learning. Topics include training and implementation of neural networks, convolution neural networks, recurrent neural networks (LSTM and gated recurrent), residual networks, reinforcement learning, and Q-learning with neural networks. A part of the course will especially focus on recent work in deep reinforcement learning. The course will also cover deep learning libraries (e.g., Chainer, Tensorflow) and how to train neural networks using GPUs and GPU clusters. Same as CS 547. 4 graduate hours. No professional credit. Credit is not given for both IE 534 and IE 434. Prerequisite: CS 446 or equivalent. Graduate students only.

IE 546 Human Factors in Health Care Engineering Systems credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/546/>)

Provides an overview of research that applies theories and methods from human factors and cognitive science to analyze the sources of these problems and to develop and evaluate design and training interventions to help providers and patients successfully navigate health care systems. An introduction to problems and accidents in health care related to human factors is followed by an overview of concepts and methods from the fields of human factors and cognitive science. Same as EPSY 546. 4 graduate hours. No professional credit.

IE 547 Healthcare Operations and Systems credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/547/>)

Delivers an introduction of healthcare systems and strategic issues in their operations, and a background of healthcare, health systems, hospitals and elements of care centers. The course blends quantitative and qualitative material, modeling and practical perspectives, and includes demand management, forecasting methods, workforce planning, inventory and materials planning, supply chain management in healthcare, process improvement and patient flow, facility design and planning, and operations scheduling. Financial performance and metrics, as well as case studies and project work will be included. 4 graduate hours. No professional credit. Prerequisite: The student should have a Bachelors Degree in Industrial Engineering, Operations Management, or closely related disciplines. Specifically, they should have: (1) Basic Calculus sequence (Calc I, II and III at UIUC these are MATH 220, MATH 231, and MATH 241; MATH 234 can also be used); (2) Elementary Probability and Statistics (IE 300 or STAT 400, MATH 463 or equivalent); (3) Notions or Linear Algebra (MATH 415) and preference for Linear Programming (IE 310/IE 311). Priority will be given to students enrolled in the Healthcare Engineering Systems Concentration of M.Eng. degree program.

IE 583 MSFE Practicum Project credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/583/>)

Application of mathematical, statistical, computing, machine learning and data analytics tools to a real life financial engineering team project sponsored by the industry. Projects in each semester are different and may require different skill sets. Regular meetings with the sponsor required. 4 graduate hours. No professional credit. May be repeated in separate terms for a total of 8 hours. Prerequisite: IE 522, FIN 500, and MSFE program approval. Restricted to MS: Financial Engineering Students only.

IE 590 Seminar credit: 0 Hours. (<https://courses.illinois.edu/schedule/terms/IE/590/>)

Presentation and discussion of significant developments in industrial engineering. Approved for S/U grading only. May be repeated.

IE 597 Independent Study credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/597/>)

Independent study of advanced problems related to industrial engineering. May be repeated in the same or separate terms if topics vary to a maximum of 12 hours. Prerequisite: Consent of instructor.

IE 598 Special Topics credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/IE/598/>)

Subject offerings of new and developing areas of knowledge in industrial engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 graduate hours. No professional credit. Approved for Letter and S/U grading. May be repeated in the same or separate terms if topics vary.

IE 599 Thesis Research credit: 0 to 16 Hours. (<https://courses.illinois.edu/schedule/terms/IE/599/>)

Approved for S/U grading only. May be repeated.