

Industrial Engineering and Operations Research

Overview

The Department of Industrial Engineering and Operations Research (IEOR) educates students to become highly skilled in the quantitative modeling and analysis of a broad array of systems-level decision problems, such as:

- Economic efficiency, productivity, and quality
- The collection and analysis of data using a database and decision-support tools; the comprehensive modeling of uncertainty
- The development and creative use of analytical and computational methods for solving these problems

Students obtain the broader skills, background, and knowledge necessary to be effective professionals in a rapidly-changing global economy. The department's mission includes creating knowledge that advances the state of the art in optimization, stochastic modeling and simulation, and the application of these tools to important societal systems.

IEOR students and faculty members are actively engaged in a variety of research projects that have made and continue to make important contributions to both the theory and practice of operations research and industrial engineering. Some of the research areas represented in the IEOR department are the analysis of algorithms, automation and robotics, combinatorics and integer programming, convex optimization, financial engineering, inventory theory, risk analysis, robust optimization, queueing theory, supply chain management, scheduling, and simulation.

Undergraduate Programs

Industrial Engineering and Operations Research (<https://guide.berkeley.edu/archive/2024-25/undergraduate/degree-programs/industrial-engineering-operations-research/>): BS (offered through the College of Engineering), Minor

Operations Research and Management Science (<https://guide.berkeley.edu/archive/2024-25/undergraduate/degree-programs/operations-research-management-science/>): BA (offered through the College of Letters and Science)

Graduate Programs

Industrial Engineering and Operations Research (<https://guide.berkeley.edu/archive/2024-25/graduate/degree-programs/industrial-engineering/>): MSA, MEng, MS, and PhD

Industrial Engineering and Operations Research

IND ENG 10 Computer Programming for Analytics 4 Units

Terms offered: Not yet offered

An introduction to computer programming focused on developing foundational skills that can be used for implementing analytics methodologies and software. Programming concepts that will be introduced include: control statements, functions, sequences, dictionaries and sets, vectorization, strings, files and exceptions, object-oriented programming, recursion, search, sort, and databases. Applications of these concepts towards simulation analytics and optimization analytics will also be introduced. There are several homeworks and small-scale programming projects.

Objectives & Outcomes

- Course Objectives:**
1. Learn how to structure the flow and control of basic software programs
 2. Learn how to use different programming data structures
 3. Learn how to read, save, and manage files in software programs
 4. Learn how to use the object-oriented programming paradigm in structuring software programs
 5. Learn how to use basic computer science algorithms for recursion, search, and sort
 6. Learn how to create, extract and insert information using relational databases
 7. Learn how to apply programming concepts for simulation and optimization analytics

Rules & Requirements

Prerequisites: MATH 51 (co-requisite) and ENGIN 7 (can be taken concurrently)

Credit Restrictions: Students will receive no credit for IND ENG 10 after completing COMPSCI 61A, COMPSCI 61AS, DATA C88C, or DATA C8.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 24 Freshman Seminars 1 Unit

Terms offered: Fall 2017, Fall 2016, Fall 2015

The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.

Objectives & Outcomes

Course Objectives: Provide an introduction to the field of Industrial Engineering and Operations Research through a series of lectures.

Student Learning Outcomes: Learn more about Industrial Engineering and Operations Research.

Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 66 A Bivariate Introduction to IE and OR 3 Units

Terms offered: Fall 2016

This Freshman-level Introductory course will provide an intuitive overview of the fundamental problems addressed and methods in the fields of Industrial Engineering and Operations Research including Constrained Optimization, Human Factors, Data Analytics, Queues and Chains, and Linear Programming. The course will focus on two-dimensional, i.e., bivariate, examples where the problems and methods are amenable to visualization and geometric intuition. The course will discuss applications such as dieting, scheduling, and transportation. This course will not require pre-requisites and will present the core concepts in a self-contained manner that is accessible to Freshmen to provide the foundation for future coursework.

Objectives & Outcomes

Course Objectives: •

Provide a broad survey of the important topics in IE and OR, and develop intuition about problems, algorithms, and abstractions using bivariate examples (2D).

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Describe different mathematical abstractions used in IEOR (e.g., graphs, queues, Markov chains), and how to use these abstractions to model real-world problems.

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Introduce students to the data analysis process including: developing a hypothesis, acquiring data, processing the data, testing the hypothesis, and presenting results.

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Provide students with concrete examples of how the mathematical tools from the class apply to real problems such as dieting, scheduling, and transportation.

Rules & Requirements

Credit Restrictions: Course restricted to Freshman students.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Goldberg

IND ENG 98 Supervised Group Study and Research 1 - 3 Units

Terms offered: Spring 2019, Fall 2015, Spring 2015

Supervised group study and research by lower division students.

Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of directed group study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

IND ENG 99 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Prior to 2007

Supervised independent study for lower division students.

Rules & Requirements

Prerequisites: Freshman or sophomore standing and consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:

8 weeks - 1.5-7.5 hours of independent study per week

10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

IND ENG 115 Industrial and Commercial Data Systems 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Design and implementation of databases, with an emphasis on industrial and commercial applications. Relational algebra, SQL, normalization.

Students work in teams with local companies on a database design project. WWW design and queries.

Rules & Requirements

Prerequisites: Upper division standing

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Goldberg

IND ENG 120 Principles of Engineering Economics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Economic analysis for engineering decision making: Capital flows, effect of time and interest rate. Different methods of evaluation of alternatives. Minimum-cost life and replacement analysis. Depreciation and taxes.

Uncertainty; preference under risk; decision analysis. Capital sources and their effects. Economic studies. Formerly Engineering 120.

Rules & Requirements

Credit Restrictions: Students will receive 2 units for 120 after taking Civil Engineering 167. Students will not receive credit after taking Engineering 120.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 4 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Adler

IND ENG 130 Methods of Manufacturing Improvement 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Analytical techniques for the improvement of manufacturing performance along the dimensions of productivity, quality, customer service, and throughput. Techniques for yield analysis, process control, inspection sampling, equipment efficiency analysis, cycle time reduction, and on-time delivery improvement. Applications on semiconductor manufacturing or other industrial settings.

Rules & Requirements

Prerequisites: IND ENG 172, MATH 54, or STAT 134 (STAT 134 may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Leachman

IND ENG 135 Applied Data Science with Venture Applications 3 Units

Terms offered: Spring 2023, Spring 2022, Fall 2021

This highly-applied course surveys a variety of key of concepts and tools that are useful for designing and building applications that process data signals of information. The course introduces modern open source, computer programming tools, libraries, and code samples that can be used to implement data applications. The mathematical concepts highlighted in this course include filtering, prediction, classification, decision-making, Markov chains, LTI systems, spectral analysis, and frameworks for learning from data. Each math concept is linked to implementation using Python using libraries for math array functions (NumPy), manipulation of tables (Pandas), long term storage (SQL, JSON, CSV files), natural language (NLTK), and ML frameworks.

Objectives & Outcomes

Student Learning Outcomes: Students will be able to design and build data sample application systems that can interpret and use data for a wide range of real life applications across many disciplines and industries; implement these concepts within applications with modern open source CS tools. understand relevant mathematical concepts that are used in systems that process data;

Rules & Requirements

Prerequisites: Prerequisites include the ability to write code in Python, and a probability or statistics course. This course is ideal for students who have taken COMPSCI C8 / DATA C8 / INFO C8 / STAT C8

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Sidhu

IND ENG 142 Introduction to Machine Learning and Data Analytics 3 Units

Terms offered: Fall 2023, Spring 2023, Fall 2022

This course introduces students to key techniques in machine learning and data analytics through a diverse set of examples using real datasets from domains such as e-commerce, healthcare, social media, sports, the Internet, and more. Through these examples, exercises in R, and a comprehensive team project, students will gain experience understanding and applying techniques such as linear regression, logistic regression, classification and regression trees, random forests, boosting, text mining, data cleaning and manipulation, data visualization, network analysis, time series modeling, clustering, principal component analysis, regularization, and large-scale learning.

Objectives & Outcomes

Course Objectives: 1.

To expose students to a variety of statistical learning methods, all of which are relevant in useful in wide range of disciplines and applications.

2.
To carefully present the statistical and computational assumptions, trade-offs, and intuition underlying each method discussed so that students will be trained to determine which techniques are most appropriate for a given problem.

3.
Through a series of real-world examples, students will learn to identify opportunities to leverage the capabilities of data analytics and will see how data analytics can provide a competitive edge for companies.

4.
To train students in how to actually apply each method that is discussed in class, through a series of labs and programming exercises.

5.
For students to gain some project-based practical data science experience, which involves identifying a relevant problem to be solved or question to be answered, gathering and cleaning data, and applying analytical techniques.

6.
To introduce students to advanced topics that are important to the successful application of machine learning methods in practice, include how methods for prediction are integrated with optimization models and modern optimization techniques for large-scale learning problems.

Rules & Requirements

Prerequisites: IEOR 165 or equivalent course in statistics. Prior exposure to optimization is helpful but not strictly necessary. Some programming experience/literacy is expected

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Grigas, Paul

IND ENG 142A Introduction to Machine Learning and Data Analytics 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course introduces students to key techniques in machine learning and data analytics through a diverse set of examples using real datasets from domains such as e-commerce, healthcare, social media, finance, the Internet, and more. Through these examples, conceptual exercises, data analysis exercises in Python, and a comprehensive team project, students will gain experience understanding and applying techniques such as linear regression, logistic regression, classification and regression trees, random forests, boosting, text mining, data cleaning and manipulation, data visualization, time series modeling, clustering, principal component analysis, regularization, and large-scale learning with neural networks.

Rules & Requirements

Prerequisites: IND ENG 165 and IND ENG 172 or equivalent courses in probability and statistics. Prior exposure to optimization (either IND ENG 160 or IND ENG 162 or equivalent). Some programming experience/literacy is expected

Credit Restrictions: Students will receive no credit for IND ENG 142A after completing IND ENG 142, IND ENG 242, IND ENG 242A, COMPSCI 189, COMPSCI 289, or STAT 154. A deficient grade in IND ENG 142A may be removed by taking IND ENG 142.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Grigas, Paul

IND ENG 142B Machine Learning and Data Analytics II 4 Units

Terms offered: Spring 2025, Spring 2024

Following IEOR 142A/242A, this course further introduces students to essential methodologies and recent trends in machine learning and data analytics. The course will bridge theoretical foundations with applied data analytics by using examples and real datasets from domains such as e-commerce, social media, finance, and more. Students will gain experience with various data analytics packages in Python and will deliver a comprehensive team project. Topics include: deep learning, time series and survival analysis, end-to-end learning, causal inference, reinforcement learning, and ethics, fairness and safety in artificial intelligence.

Rules & Requirements

Prerequisites: IndEng 142A or IndEng 242A or equivalent introductory machine learning class. Familiarity with the Python programming language

Credit Restrictions: Students will receive no credit for IND ENG 142B after completing IND ENG 242B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

IND ENG 145 Fundamentals of Revenue Management 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Revenue management (RM) is the decision science of efficiently selling a fixed supply of various goods and services when the demand is heterogeneous and uncertain. This undergraduate course will focus on fundamental models and algorithms for RM. Broad usefulness of concepts will be demonstrated through applications in airline reservation systems, retail, advertising, e-commerce and school-student assignments.

Rules & Requirements

Prerequisites: IndEng 162, IndEng 169 and either IndEng 173 Or IndEng 172 (or equivalent introductory courses in mathematical programming and probability). Familiarity with algorithm design and mathematical maturity recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Udwani

IND ENG 150 Production Systems Analysis 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2020

Quantitative models for operational and tactical decision making in production systems, including production planning, inventory control, forecasting, and scheduling.

Rules & Requirements

Prerequisites: IND ENG 160, IND ENG 173, IND ENG 162, IND ENG 165, and ENGIN 120

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Yano

IND ENG 151 Service Operations Design and Analysis 3 Units

Terms offered: Spring 2025, Fall 2022, Fall 2021

This course is concerned with improving processes and designing facilities for service businesses such as banks, health care organizations, telephone call centers, restaurants, and transportation providers. Major topics in the course include design of service processes, layout and location of service facilities, demand forecasting, demand management, employee scheduling, service quality management, and capacity planning.

Rules & Requirements

Prerequisites: IND ENG 162, IND ENG 173, and a course in statistics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 153 Logistics Network Design and Supply Chain Management 3 Units

Terms offered: Fall 2025, Fall 2024, Spring 2024

We will focus primarily on both quantitative and qualitative issues which arise in the integrated design and management of the entire logistics network. Models and solution techniques for facility location and logistics network design will be considered. In addition, qualitative issues in distribution network structuring, centralized versus decentralized network control, variability in the supply chain, strategic partnerships, and product design for logistics will be considered through discussions and cases.

Rules & Requirements

Prerequisites: IND ENG 160, IND ENG 162 or senior standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Kaminsky

IND ENG 156 Healthcare Analytics 3 Units

Terms offered: Spring 2025, Spring 2024

With the growing complexity of providing healthcare, it is increasingly important to design and manage health systems using engineering and analytics perspectives. This course will cover topics related to healthcare analytics, including: optimizing chronic disease management, designing matching markets for health systems, developing predictive analytics models, and managing resource utilization.

Rules & Requirements

Prerequisites: Courses in mathematical modeling (such as IND ENG 160 and IND ENG 172) and computer programming (such as CS C8 or CS 61A) are recommended

Credit Restrictions: Students will receive no credit for IND ENG 156 after completing IND ENG 256.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Aswani

IND ENG 160 Nonlinear and Discrete Optimization 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course introduces unconstrained and constrained optimization with continuous and discrete domains. Convex sets and convex functions; local optimality; KKT conditions; Lagrangian duality; steepest descent and Newton's method. Modeling with integer variables; branch-and-bound method; cutting planes. Models on production/inventory planning, logistics, portfolio optimization, factor modeling, classification with support vector machines.

Rules & Requirements

Prerequisites: MATH 53 and MATH 54

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Atamturk

IND ENG 162 Linear Programming and Network Flows 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course addresses modeling and algorithms for optimization of linear constrained optimization problems. The simplex method; theorems of duality; complementary slackness. Applications in production planning and resource allocation. Graph and network problems as linear programs with integer solutions. Algorithms for selected network flow problems. Transportation and logistics problems. Dynamic programming and its role in applications to shortest paths, project management and equipment replacement.

Rules & Requirements

Prerequisites: MATH 53 and MATH 54

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Hochbaum

IND ENG 164 Introduction to Optimization Modeling 3 Units

Terms offered: Spring 2025, Spring 2024

Designed for students from any science/engineering major, this upper-division course will introduce students to optimization models, and train them to use software tools to model and solve optimization problems. The main goal is to develop proficiency in common optimization modeling languages, and learn how to integrate them with underlying optimization solvers. Students will work primarily on modeling exercises, which will develop confidence in modeling and solve optimization methods using software packages, and will require some programming. Review of linear and nonlinear optimization models, including optimization problems with discrete decision variables. Applications to practical problems from engineering and data science.

Objectives & Outcomes

Course Objectives: •

To introduce students to the core concepts of optimization

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To train them in the art and science of using software tools to model and solve optimization problems.

Rules & Requirements

Prerequisites: No prerequisites except some Python programming skills, which can be met by COMPSCI C8 (or any other Python-based course)

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 165 Engineering Statistics, Quality Control, and Forecasting 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course will introduce students to basic statistical techniques such as parameter estimation, hypothesis testing, regression analysis, analysis of variance. Applications in forecasting and quality control.

Rules & Requirements

Prerequisites: IND ENG 172, or STAT 134, or an equivalent course in probability theory

Credit Restrictions: Students will receive no credit for IND ENG 165 after completing STAT 135.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 166 Decision Analytics 3 Units

Terms offered: Spring 2025, Fall 2023, Spring 2022

Introductory course on the theory and applications of decision analysis. Elective course that provides a systematic evaluation of decision-making problems under uncertainty. Emphasis on the formulation, analysis, and use of decision-making techniques in engineering, operations research and systems analysis. Includes formulation of risk problems and probabilistic risk assessments. Graphical methods and computer software using event trees, decision trees, and influence diagrams that focus on model design.

Rules & Requirements

Prerequisites: IND ENG 172 or STAT 134

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Oren, Righter

IND ENG 169 Integer Optimization 3 Units

Terms offered: Spring 2022, Spring 2021, Fall 2020

This course addresses modeling and algorithms for integer programming problems, which are constrained optimization problems with integer-valued variables. Flexibility of integer optimization formulations; if-then constraints, fixed-costs, etc. Branch and Bound; Cutting plane methods; polyhedral theory. Applications in production planning, resource allocation, power generation, network design. Alternate formulations for integer optimization: strength of Linear Programming relaxations. Algorithms for integer optimization problems. Specialized strategies by integer programming solvers.

Objectives & Outcomes

Course Objectives: •

Enable the students to recognize when problems can be modeled as integer optimization problems.

- Familiarize students in leading methodologies for solving integer optimization problems, and techniques in these methodologies.
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To acquire skills in the best modeling approach that is suitable to the practical problem at hand.

- To train students in modeling of integer optimization problems;
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To train the students in the selection of appropriate techniques to be used for integer optimization problems.

Rules & Requirements

Prerequisites: MATH 53, MATH 54, and background in Python and programming

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Rajan

IND ENG 170 Industrial Design and Human Factors 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course surveys topics related to the design of products and interfaces ranging from alarm clocks, cell phones, and dashboards to logos, presentations, and web sites. Design of such systems requires familiarity with human factors and ergonomics, including the physics and perception of color, sound, and touch, as well as familiarity with case studies and contemporary practices in interface design and usability testing. Students will solve a series of design problems individually and in teams.

Rules & Requirements

Prerequisites: Upper division standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Goldberg

IND ENG 171 Berkeley Changemaker: Ethical and Effective Entrepreneurship in High Tech 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course emphasizes the three Berkeley Changemaker pillars of critical thinking, effective communication, and productive collaboration. It combines critical examination of entrepreneurial challenges with strategic, ethical, and leadership theories. It develops verbal and collaborative leadership skills, through flipped classroom and intense case discussions, a team project, and a formal final presentation of the project. The case discussions in particular will develop effective listening, real-time analysis, and verbal leadership skills. The project will challenge you to analyze a current or historical ethical challenge in a high technology industry, or analyze the ethical implications of your own entrepreneurial plans.

Objectives & Outcomes

Student Learning Outcomes: Students who fully engage with this class will strengthen their in-the-moment abilities to listen, learn, analyze, and convince. They will size up high tech business and entrepreneurial opportunities with new perspectives, both strategic and ethical. They will gain practice in applying strategic and ethical frameworks to entrepreneurship and business decisions in high technology. They will learn how to understand and build upon criticism in real-time, and lead discussions on contentious issues towards productive, inclusive, and mutually beneficial outcomes. They will become an entrepreneur who not only sees how innovation can solve society's problems, but can furthermore convince and lead others in accomplishing and implementing a solution.

Rules & Requirements

Prerequisites: Upper division standing

Credit Restrictions: Students will receive no credit for IND ENG 171 after completing UGBA 105.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 8 weeks - 6 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Fleming

IND ENG 172 Probability and Risk Analysis for Engineers 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This is an introductory course in probability designed to develop a good understanding of uncertain phenomena and the mathematical tools used to model and analyze it. Applications will be given in such areas as reliability theory, risk theory, inventory theory, financial models, and computer science, among others. This course is a probability course and cannot be used to fulfill any engineering unit or elective requirements.

Objectives & Outcomes

Course Objectives: Students will learn how to model random phenomena and learn about a variety of areas where it is important to estimate the likelihood of uncertain events. Students will also learn how to use computer simulation to replicate and analyze these events.

Rules & Requirements

Prerequisites: MATH 51, MATH 52, and MATH 53

Credit Restrictions: Students will receive no credit for IND ENG 172 after completing STAT 134, or STAT C140.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 173 Introduction to Stochastic Processes 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This is an introductory course in stochastic models. It builds upon a basic course in probability theory and extends the concept of a single random variable into collections of random variables known as stochastic processes. The course focuses on discrete-time Markov chains, Poisson process, continuous-time Markov chains, and renewal theory. It also discusses applications to queueing theory, risk analysis and reliability theory. Along with the theory, the course covers stochastic simulation techniques that will allow students to go beyond the models and applications discussed in the course.

Objectives & Outcomes

Course Objectives: Students will learn how to model random phenomena that evolves over time, as well as the simulation techniques that enable the replication of such problems using a computer. By discussing various applications in science and engineering, students will be able to model many real world problems where uncertainty plays an important role.

Rules & Requirements

Prerequisites: Students should have taken a probability course, such as STAT 134 or IND ENG 172, and should have programming experience in Matlab or Python

Credit Restrictions: Students will receive no credit for Ind Eng 173 after taking Ind Eng 161.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

IND ENG 174 Simulation for Enterprise-Scale Systems 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Introductory course on design, programming, and statistical analysis of simulation methods and tools for enterprise-scale systems such as traffic and computer networks, health-care and financial systems, and factories. Topics include the types of problems that can be solved by such methods. Programming material includes the theory behind random variable generation for a variety of common variables. Advanced techniques such as variance reduction, simulation optimization, or meta-modeling are considered. Student teams implement an enterprise-scale simulation in a semester-length design project.

Objectives & Outcomes

Course Objectives: •

Exposure students to state-of-art advanced simulation techniques. •

Note: the course is a mixture of modeling art, analytical science, and computational technology.

- Have students communicate their ideas and solutions effectively in written reports.
- Insure students become familiar with the fundamental similarities and differences among simulation software packages.
- Introduce students to modern techniques for developing computer simulations of stochastic discrete-event models and experimenting with such models to better design and operate dynamic systems.
- Introduce the different technologies used to develop simulation models and simulator products in order to become critical consumers of simulation study results.
- Teach strengths and weaknesses of different approaches for a foundation for selecting methodologies.
- Teach students how to model random processes and experiment with simulated systems.

Rules & Requirements

Prerequisites: IND ENG 165; IND ENG 173; IND ENG 172 or STAT 134

Credit Restrictions: Students will receive no credit for IND ENG 174 after completing IND ENG 131. A deficient grade in IND ENG 174 may be removed by taking IND ENG 131.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Zheng

IND ENG 180 Senior Project 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Application of systems analysis and industrial engineering to the analysis, planning, and/or design of industrial, service, and government systems. Consideration of technical and economic aspects of equipment and process design. Students work in teams under faculty supervision.

Topics vary yearly.

Rules & Requirements

Prerequisites: 160, 162, 165, 173, Engineering 120, and three other Industrial Engineering and Operations Research electives

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 6 hours of fieldwork per week

Summer: 10 weeks - 3 hours of lecture and 9 hours of fieldwork per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

IND ENG 190B Advanced Topics in Industrial Engineering and Operations Research: Entrepreneurial Marketing and Finance 1 - 4 Units

Terms offered: Fall 2017, Spring 2014, Fall 2013

The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of seminar per week

Summer:

8 weeks - 1.5-7.5 hours of seminar per week

10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 190C Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2020, Fall 2019, Spring 2019

The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of seminar per week

Summer:

8 weeks - 1.5-7.5 hours of seminar per week

10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 190D Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2017, Fall 2014, Spring 2014

The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of seminar per week

Summer:

8 weeks - 1.5-7.5 hours of seminar per week

10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 190F Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2013, Spring 2012, Spring 2011

The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of seminar per week

Summer:

8 weeks - 1.5-7.5 hours of seminar per week

10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 190G Advanced Topics in Industrial Engineering and Operations Research 1 - 4 Units

Terms offered: Spring 2020, Fall 2019, Spring 2019

The 190 series cannot be used to fulfill any engineering requirement (engineering units, courses, technical electives, or otherwise).

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of seminar per week

Summer:

8 weeks - 1.5-7.5 hours of seminar per week

10 weeks - 1.5-6 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

IND ENG 190H Cases in Global Innovation 1 Unit

Terms offered: Fall 2021, Spring 2011

This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in globalizing a company, product, or service. Over the duration of this course, students will examine case studies of early, mid-stage, and large-scale enterprises as they seek to start a new venture, introduce a new product or service, or capitalize on global economic trends to enhance their existing business. The course content exposes students interested in internationally oriented careers to the strategic thinking involved in international engagement and expansion. Cases will include both U.S. companies seeking to enter emerging markets and emerging market companies looking to expand within their own nations or into markets in developed nations. The course is focused around intensive study of actual business situations through rigorous case-study analysis.

Rules & Requirements

Prerequisites: Junior or Senior standing

Hours & Format

Fall and/or spring: 8 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

IND ENG 190I Cases in Global Innovation: China 1 Unit

Terms offered: Prior to 2007

This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in globalizing a company product or service, with a focus on China. Over the duration of this course, students will examine case studies of foreign companies seeking to start a new venture, introduce a new product or service to the China market, or domestic Chinese companies seeking to adapt a U.S. or western business model to the China market. The course content exposes students interested in internationally oriented careers to the strategic thinking involved in international engagement and expansion and the particularities of the China market and their contrast with the U.S. market. The course is focused around intensive study of actual business situations through rigorous case-study analysis and the course size is limited to 30.

Rules & Requirements

Prerequisites: Junior or senior standing. Recommended, but not required to be taken after or along with Engineering 198

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/
Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Sidhu

IND ENG 190K Cases in Global Innovation: South Asia 1 Unit

Terms offered: Prior to 2007

This course is designed primarily for upper-level undergraduate and graduate students interested in examining the major challenges and success factors entrepreneurs and innovators face in conducting business, globalizing a company product or service, or investing in South Asia. Over the duration of this course, students will examine case studies of foreign companies seeking to start a new venture, introduce a new product or service to the South Asian market, or South Asian companies seeking to adapt a U.S or western business model. The course will put this into the larger context of the political, economic, and social climate in several South Asian countries and explore the constraints to doing business, as well as the policy changes that have allowed for a more conducive business environment.

Rules & Requirements

Prerequisites: Junior or senior standing. Recommended but not required to be taken after or along with Engineering 198

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Sidhu

IND ENG H196A Operations Research and Management Science Honors Thesis 3 Units

Terms offered: Fall 2022

Individual study and research for at least one academic year on a special problem approved by a member of the faculty; preparation of the thesis on broader aspects of this work.

Rules & Requirements

Prerequisites: Open only to students in the honors program

Credit Restrictions: Course may be repeated for credit with consent of instructor.

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

IND ENG H196B Operations Research and Management Science Honors Thesis 3 Units

Terms offered: Prior to 2007

Individual study and research for at least one academic year on a special problem approved by a member of the faculty; preparation of the thesis on broader aspects of this work.

Rules & Requirements

Prerequisites: Open only to students in the honors program

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

IND ENG 197 Undergraduate Field Research in Industrial Engineering 1 - 12 Units

Terms offered: Fall 2024, Spring 2023, Fall 2022

Students work on a field project under the supervision of a faculty member. Course does not satisfy unit or residence requirements for bachelor's degree.

Rules & Requirements

Prerequisites: Completion of two semesters of coursework

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-12 hours of fieldwork per week

Summer:

6 weeks - 2.5-30 hours of fieldwork per week

8 weeks - 1.5-22.5 hours of fieldwork per week

10 weeks - 1.5-18 hours of fieldwork per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

IND ENG 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Spring 2024

Group studies of selected topics. Semester course unit value and contact hours will have a one-to-one ratio.

Rules & Requirements

Prerequisites: Senior standing in Engineering

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

IND ENG 199 Supervised Independent Study 1 - 4 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020

Supervised independent study. Enrollment restrictions apply.

Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Course may be repeated for a maximum of four units per semester.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:

6 weeks - 2.5-10 hours of independent study per week

8 weeks - 2-7.5 hours of independent study per week

10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

IND ENG 210 Python for Analytics 3 Units

Terms offered: Not yet offered

This introductory course provides students with sufficient background in Python programming language

for use in analytics applications as well as potentially conducting

research in the area. The course is

designed to prepare students for the applied analytics problems and projects they will encounter in

advanced analytics courses. It will start with basic programming topics using Python and cover

using powerful Python packages such as Numpy, Scipy, Pandas, and Matplotlib that are essential for

descriptive, predictive, and prescriptive analytics. Students will work on group projects along with

the instructor in order to solidify the lectures into practical experience using Python for analytics.

Objectives & Outcomes

Student Learning Outcomes: LEARNING GOALS

Upon completion of the course students will have learned how to:

use Python and core scienti

ic packages to solve complex analytics problems;

develop custom Python scripts and functions to perform analytic computations;

visualize analytic results in graphical form;

understand the array of mathematical toolkits provided by the Python packages covered.

Hours & Format

Fall and/or spring: 2 weeks - 15 hours of lecture and 10 hours of laboratory per week

Summer: 2 weeks - 15 hours of lecture and 10 hours of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Aswani, Grigas, Pirutinsky

IND ENG 215 Analysis and Design of Databases 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Advanced topics in information management, focusing on design of relational databases, querying, and normalization. New issues raised by the World Wide Web. Research projects on current topics in information technology.

Rules & Requirements

Prerequisites: Graduate standing

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Goldberg

IND ENG 220 Economics and Dynamics of Production 3 Units

Terms offered: Spring 2017, Spring 2016, Spring 2015

Analysis of the capacity and efficiency of production systems. Development of analytical tools for improving efficiency, customer service, and profitability of production environments. Design and development of effective industrial production planning systems. Modelling principles are illustrated by reviewing actual large-scale planning systems successfully implemented for naval ship overhaul and for semiconductor manufacturing.

Rules & Requirements

Prerequisites: 262A (may be taken concurrently), Mathematics 104 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Leachman

IND ENG 221 Introduction to Financial Engineering 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

A course on financial concepts useful for engineers that will cover, among other topics, those of interest rates, present values, arbitrage, geometric Brownian motion, options pricing, & portfolio optimization. The Black-Scholes option-pricing formula will be derived and studied. Stochastic simulation ideas will be introduced and used to obtain the risk-neutral geometric Brownian motion values for certain types of Asian, barrier, and lookback options. Portfolio optimization problems will be considered both from a mean-variance and from a utility function point of view. Methods for evaluating real options will be presented. The use of mathematical optimization models as a framework for analyzing financial engineering problems will be shown.

Rules & Requirements

Prerequisites: 162 or 262A, course in probability, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Adler, Oren, Ross

IND ENG 222 Financial Engineering Systems I 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Introductory graduate level course, focusing on applications of operations research techniques, e.g., probability, statistics, and optimization, to financial engineering. The course starts with a quick review of 221, including no-arbitrage theory, complete market, risk-neutral pricing, and hedging in discrete model, as well as basic probability and statistical tools. It then covers Brownian motion, martingales, and Ito's calculus, and deals with risk-neutral pricing in continuous time models. Standard topics include Girsanov transformation, martingale representation theorem, Feynman-Kac formula, and American and exotic option pricings. Simulation techniques will be discussed at the end of the semester, and MATLAB (or C or S-Plus) will be used for computation.

Rules & Requirements

Prerequisites: 221 or equivalent; 172 or Statistics 134 or a one-semester probability course

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Guo

IND ENG 223 Financial Engineering Systems II 3 Units

Terms offered: Spring 2024, Spring 2023, Fall 2022

Advanced graduate course for Ph.D. students interested in pursuing a professional/research career in financial engineering. The course will start with a quick review of 222: the basics of Brownian motion, martingales, Ito's calculus, risk-neutral pricing in continuous time models. It then covers rigorously and in depth the most fundamental probability concepts for financial engineers, including stochastic integral, stochastic differential equations, and semi-martingales. The second half of the course will discuss the most recent topics in financial engineering, such as credit risk and analysis, risk measures and portfolio optimization, and liquidity risk and models.

Rules & Requirements

Prerequisites: 222 or equivalent; 173 or 263A or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Guo

IND ENG 224 Portfolio and Risk Analytics 3 Units

Terms offered: Spring 2019, Spring 2018

The course aims to train students in hands-on statistical, optimization, and data analytics for quantitative portfolio and risk management. In addition, the course will introduce elements of financial markets and asset classes. The emphasis will be on computational methods such as variants of GARCH, Black-Litterman, conic optimization, Monte Carlo simulation for risk and optimization, factor modeling. Students will undertake computational assignments and a group project. They will also manage hypothetical portfolios throughout the course.

Rules & Requirements

Prerequisites: A basic understanding of statistics and optimization, as well as fluency in a programming, language is required

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Alper Atamturk

IND ENG C227A Introduction to Convex Optimization 4 Units

Terms offered: Prior to 2007

The course covers some convex optimization theory and algorithms, and describes various applications arising in engineering design, machine learning and statistics, finance, and operations research. The course includes laboratory assignments, which consist of hands-on experience.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: El Ghaoui, Wainwright

Formerly known as: Electrical Engineering C227A/Industrial Engin and Oper Research C227A

Also listed as: EL ENG C227T

IND ENG C227B Convex Optimization and Approximation 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020, Spring 2019, Spring 2018, Spring 2017

Convex optimization as a systematic approximation tool for hard decision problems. Approximations of combinatorial optimization problems, of stochastic programming problems, of robust optimization problems (i.e., with optimization problems with unknown but bounded data), of optimal control problems. Quality estimates of the resulting approximation. Applications in robust engineering design, statistics, control, finance, data mining, operations research.

Rules & Requirements

Prerequisites: 227A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: El Ghaoui

Also listed as: EL ENG C227C

IND ENG 230 Economics of Supply Chains 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course is geared towards understanding operational, strategic, and tactical aspects of supply chain management. Topics covered are from a broad range that includes demand modeling, inventory management, facility location as well as process flexibility, contracting, and auctions. Important models (both centralized and decentralized) for understanding the design, operation, and evaluation of supply chains will be discussed with the goal of developing a holistic understanding of supply chain management. Students will be exposed to the key concepts through a mixture of foundational theory and case studies from a variety of businesses. The course is intended for graduate students at the Masters level looking for a concrete introduction

Rules & Requirements

Prerequisites: Basics Optimization and Probability (IndEng 240, IndEng 241, or equivalent)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Udwani

IND ENG 231 Introduction to Data Modeling, Statistics, and System Simulation 3 Units

Terms offered: Spring 2025, Fall 2023, Spring 2023

This course uses simulation models for analyzing and optimizing systems where the underlying processes and/or parameters are not fully known, but data may be available, sampled, or artificially generated. Monte Carlo simulations are used in a weekly laboratory to model systems that may be too complex to approximate accurately with deterministic, stationary, or static models; and to measure the robustness of predictions and manage risks in decisions based on data-driven models.

Objectives & Outcomes

Course Objectives: Students will understand the similarities and differences in methods for simulating the dynamics of complex, stochastic systems and apply these to model real systems. Special techniques for experimenting with computer simulations and analyzing the results will be used to understand the trade-offs in risk and performance in the presence of uncertainty.

Rules & Requirements

Prerequisites: 262A, 263A or equivalents and some programming experience

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Schruben, Guo, Lim

IND ENG 235 Applied Data Science with Venture Applications 3 Units

Terms offered: Spring 2023, Spring 2022, Fall 2021

This is an advanced project course in data science that offers a "maker" and/or "innovation" viewpoint. The course is focused first on developing an open-ended-real world project relating to data science. Related concepts of computer science tools and theoretical concepts are covered to support the project. These concepts include filtering, prediction, classification, LTI systems, and spectral analysis. After reviewing each concept, we explore implementing it in Python using libraries for math array functions, manipulation of tables, data architectures, natural language, and ML frameworks.

Rules & Requirements

Prerequisites: Prerequisites include: ability to write code in Python, and a probability or statistics course

Hours & Format

Fall and/or spring:

15 weeks - 3 hours of lecture per week

15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Sidhu

IND ENG 240 Optimization Analytics 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Computing technology has advanced to the point that commonly available tools can be used to solve practical decision problems and optimize real-world systems quickly and efficiently. This course will focus on the understanding and use of such tools, to model and solve complex real-world business problems, to analyze the impact of changing data and relaxing assumptions on these decisions, and to understand the risks associated with particular decisions and outcomes.

Rules & Requirements

Prerequisites: Basic analysis and linear algebra, and basic computer skills and experience

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 241 Risk Modeling, Simulation, and Data Analysis 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This is a Masters of Engineering course, in which students will develop a fundamental understanding of how randomness and uncertainty are root causes of risk in modern enterprises. The technical material will be presented in the context of engineering team system design and operations decisions.

Rules & Requirements

Prerequisites: Basic notions of probability, statistics, and some programming and spreadsheet analysis experience

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 242A Machine Learning and Data Analytics 4 Units

Terms offered: Fall 2025, Fall 2024, Spring 2024

This course applies foundational concepts in programming, databases, machine learning, and statistical modeling to answer questions from business and social science. The goal is for students to develop the experience and intuition to gather and build new datasets and answer substantive questions.

Rules & Requirements

Prerequisites: Prerequisites include working knowledge of a programming language (preferably Python), database language (preferably SQL), a statistical package (preferably R), and an understanding of basic linear and non-linear statistical models. Prior exposure to machine learning is helpful, though this will be covered in the predictive analytics and theory course

Credit Restrictions: Students will receive no credit for IND ENG 242A after completing IND ENG 142.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Grigas

Formerly known as: Industrial Engin and Oper Research 242

IND ENG 242B Machine Learning and Data Analytics II 4 Units

Terms offered: Spring 2025, Spring 2024

Following IEOR 142A/242A, this course further introduces students to essential methodologies and recent trends in machine learning and data analytics. The course will bridge theoretical foundations with applied data analytics by using examples and real datasets from domains such as e-commerce, social media, finance, and more. Students will gain experience with various data analytics packages in Python and will deliver a comprehensive team project. Topics include: deep learning, time series and survival analysis, end-to-end learning, causal inference, reinforcement learning, and ethics, fairness and safety in artificial intelligence.

Rules & Requirements

Prerequisites: IndEng 142A or IndEng 242A or equivalent introductory machine learning class. Familiarity with the Python programming language

Credit Restrictions: Students will receive no credit for IND ENG 242B after completing IND ENG 142B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 243 Analytics Lab 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

A project course to provide hands-on experience in end-to-end analytics development from exploratory analytics to systems analytics in an industry context, including communication of recommendations. Students will work in teams on projects and build solutions to business/industry challenges using Python packages such as Pandas, NumPy, Matplotlib, scikit-learn, Bokeh, and relevant optimization and simulation software.

Objectives & Outcomes

Student Learning Outcomes: Learning goals include technical communication and project presentation.

Rules & Requirements

Prerequisites: IEOR 240 Optimization Analytics, IEOR 241 Risk Modeling & Simulation Analytics, IEOR 242 Applications in Data Analysis. Familiarity with the Python programming language is also expected

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Aswani, Grigas

IND ENG 245 Fundamentals of Revenue Management 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course will introduce students to the science of engineering demand given a fixed supply of various goods and services when the customer base is heterogeneous and uncertain (a.k.a. Revenue Management). This requires an understanding of customer choice behaviour, different pricing and allocation strategies, and mechanisms for customer and seller interaction. The course will focus on introducing students to (i) Models that capture the key dynamics of these problems and (ii) Algorithmic ideas that turn these models into actionable decisions. The broad usefulness of concepts covered will be demonstrated through several applications such as in airline reservation systems, retail, advertising, e-commerce as well as non-profit applications.

Rules & Requirements

Prerequisites: INDENG 240 and INDENG 241 or equivalent

Credit Restrictions: Students will receive no credit for IND ENG 245 after completing IND ENG 145.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Udwani

IND ENG 248 Supply Chain Innovation, Strategy, and Analytics 3 Units

Terms offered: Fall 2013

This course introduces you to the field of supply chain management through a series of lectures and case studies that emphasize innovative concepts in supply chain management that have proven to be beneficial for a good number of adopters. Innovations that we will discuss include collaborative forecasting, social media, online procurement, and technologies such as RFID.

Rules & Requirements

Prerequisites: Introductory course on Production and Inventory Control or Operations Management

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 250 Introduction to Production Planning and Logistics Models 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This will be an introductory first-year graduate course covering fundamental models in production planning and logistics. Models, algorithms, and analytical techniques for inventory control, production scheduling, production planning, facility location and logistics network design, vehicle routing, and demand forecasting will be discussed.

Rules & Requirements

Prerequisites: 262A and 263A taken concurrently

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Kaminsky

IND ENG 251 Facilities Design and Logistics 3 Units

Terms offered: Fall 2012, Spring 2005, Spring 2004

Design and analysis of models and algorithms for facility location, vehicle routing, and facility layout problems. Emphasis will be placed on both the use of computers and the theoretical analysis of models and algorithms.

Rules & Requirements

Prerequisites: 262A, and either 172 or Statistics 134

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Kaminsky

IND ENG 252 Service Operations Management 3 Units

Terms offered: Spring 2021, Spring 2014, Spring 2013

This course focuses on the design of service businesses such as commercial banks, hospitals, airline companies, call centers, restaurants, Internet auction websites, and information providers. The material covered in the course includes internet auctions, procurement, service facility location, service quality management, capacity planning, airline ticket pricing, financial plan design, pricing of digital goods, call center management, service competition, revenue management in queueing systems, information intermediaries, and health care. The goal of the instructors is to equip the students with sufficient technical background to be able to do research in this area.

Rules & Requirements

Prerequisites: Students who have not advanced to M.S., M.S./Ph.D., or Ph.D. levels or are not in the Industrial Engineering and Operations Research Department must consult with the instructor before taking this course for credit

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Shen, Chen

IND ENG 253 Supply Chain Operation and Management 3 Units

Terms offered: Spring 2013, Spring 2012, Spring 2011

Supply chain analysis is the study of quantitative models that characterize various economic trade-offs in the supply chain. The field has made significant strides on both theoretical and practical fronts. On the theoretical front, supply chain analysis inspires new research ventures that blend operations research, game theory, and microeconomics. These ventures result in an unprecedented amalgamation of prescriptive, descriptive, and predictive models characteristic of each subfield. On the practical front, supply chain analysis offers solid foundations for strategic positioning, policy setting, and decision making.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Shen

IND ENG C253 Supply Chain and Logistics Management 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Supply chain analysis is the study of quantitative models that characterize various economic trade-offs in the supply chain. The field has made significant strides on both theoretical and practical fronts. On the theoretical front, supply chain analysis inspires new research ventures that blend operations research, game theory, and microeconomics. These ventures result in an unprecedented amalgamation of prescriptive, descriptive, and predictive models characteristic of each subfield. On the practical front, supply chain analysis offers solid foundations for strategic positioning, policy setting, and decision making.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Shen

Also listed as: CIV ENG C258

IND ENG 254 Production and Inventory Systems 3 Units

Terms offered: Spring 2014, Fall 2011, Fall 2009

Mathematical and computer methods for design, planning, scheduling, and control in manufacturing and distribution systems.

Rules & Requirements

Prerequisites: 262A or 150; 263A or 173 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 255 Frontiers in Revenue Management 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course is targeted at understanding RM problems in the booming environment of online platforms and marketplaces with applications ranging from online advertising to ride-sharing markets. The main focus is on design and analysis of models and algorithms for matching, pricing, incentivizing, and personalizing on such platforms. Sample topics include, but are not limited to, resource allocation and pricing under uncertain sequential demand, mechanism design, discrete choice models, static and dynamic assortment optimization, real-time recommendations, spatial supply response and supply re-balancing in bike/ride sharing systems.

Rules & Requirements

Prerequisites: IndEng 262A and IndEng 263A (or equivalent coursework) IndEng 264 and IndEng 269 recommended but not required

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Udwani

IND ENG 256 Healthcare Analytics 3 Units

Terms offered: Spring 2025, Spring 2024

With the growing complexity of providing healthcare, it is increasingly important to design and manage health systems using engineering and analytics perspectives. This course will cover topics related to healthcare analytics, including: optimizing chronic disease management, designing matching markets for health systems, developing predictive analytics models, and managing resource utilization.

Rules & Requirements

Prerequisites: Courses in mathematical modeling (such as IND ENG 160 and IND ENG 172) and computer programming (such as CS C8 or CS 61A) are recommended

Credit Restrictions: Students will receive no credit for IND ENG 256 after completing IND ENG 156.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Aswani

IND ENG 258 Control and Optimization for Power Systems 3 Units

Terms offered: Spring 2019, Spring 2017

One of the grand challenges of this century is the modernization of electrical power networks. This graduate-level course provides a fundamental understanding of the mathematics behind the operation of power grids.

Objectives & Outcomes

Course Objectives:

Students will understand the operation of power networks from a control and optimization perspective. They will learn how mathematical tools and computational methods are used for the design, modeling, planning, and real-time operation of power grids. They will also learn about the interaction between operation and electricity market.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Lavaei

IND ENG 261 Experimenting with Simulated Systems 3 Units

Terms offered: Spring 2009, Spring 2007, Spring 2006

This course will introduce graduate and upper division undergraduate students to modern methods for simulating discrete event models of complex stochastic systems. About a third of the course will be devoted to system modeling, with the remaining two-thirds concentrating on simulation experimental design and analysis.

Rules & Requirements

Prerequisites: 165 or equivalent statistics course, and some computer programming background

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Ross, Schruben, Shanthikumar

IND ENG 262A Mathematical Programming I 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Basic graduate course in linear programming and introduction to network flows and non-linear programming. Formulation and model building.

The simplex method and its variants. Duality theory. Sensitivity analysis, parametric programming, convergence (theoretical and practical).

Polynomial time algorithms. Introduction to network flows models.

Optimality conditions for non linear optimization problems.

Rules & Requirements

Prerequisites: Mathematics 110

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Adler, Oren

IND ENG 262B Mathematical Programming II 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Basic first year graduate course in optimization of non-linear programs. Formulation and model building. Theory of optimization for constrained

and unconstrained problems. Study of algorithms for non-linear optimization with emphasis on design considerations and performance evaluation.

Rules & Requirements

Prerequisites: Math 110 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Adler, Oren

IND ENG 263A Applied Stochastic Process I 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Conditional Expectation. Poisson and general point process and renewal theory. Renewal reward processes with application to inventory, congestion, and replacement models. Discrete and continuous time Markov chains; with applications to various stochastic systems--such as queueing systems, inventory models and reliability systems.

Rules & Requirements

Prerequisites: Industrial Engineering

172, or Statistics 134 or Statistics 200A. Probability background with Industrial Engineering 173 or equivalent is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Righter

IND ENG 263B Applied Stochastic Process II 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Continuous time Markov chains. The reversed chain concept in continuous time Markov chains with applications of queueing theory.

Semi-Markov processes with emphasis on application. Brownian Motion.

Random walks with applications. Introduction to Martinjales.

Rules & Requirements

Prerequisites: 263A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Righter

IND ENG 264 Computational Optimization 3 Units

Terms offered: Spring 2017, Spring 2016, Spring 2015

This course is on computational methods for the solution of large-scale optimization problems. The focus is on converting the theory of optimization into effective computational techniques. Course topics include an introduction to polyhedral theory, cutting plane methods, relaxation, decomposition and heuristic approaches for large-scale optimization problems.

Rules & Requirements

Prerequisites: 262A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Atamturk

IND ENG 265 Learning and Optimization 3 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021

This course will cover topics related to the interplay between optimization and statistical learning. The first part of the course will cover statistical modeling procedures that can be defined as the minimizer of a suitable optimization problem. The second part of the course will discuss the formulation and numerical implementation of learning-based model predictive control (LBMPC), which is a method for robust adaptive optimization that can use machine learning to provide the adaptation. The last part of the course will deal with inverse decision-making problems, which are problems where an agent's decisions are observed and used to infer properties about the agent.

Rules & Requirements

Prerequisites: Course on optimization (Industrial Engineering 162 or equivalent); course on statistics or stochastic processes (Industrial Engineering 165 or equivalent) Industrial Engin and Oper Research 165

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Aswani

IND ENG 266 Network Flows and Graphs 3 Units

Terms offered: Fall 2025, Fall 2024, Spring 2024

Survey of solution techniques and problems that have formulations in terms of flows in networks. Max-flow min-cut theorem. Minimum cost flows. Multiterminal and multicommodity flows. Relationship with linear programming, transportation problems, electrical networks and critical path scheduling.

Rules & Requirements

Prerequisites: 262A (may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Adler, Hochbaum

IND ENG 267 Queueing Theory 3 Units

Terms offered: Spring 2025, Spring 2022, Spring 2016

The result " $L = (\lambda w)$ " and other conservation laws. Elementary queueing models; comparing single- and multiple-server queues. PASTA. Work. Markovian queues; product form results. Overflow models. Embedded Markov chains. Random walks and the GI/G/1 queues. Work conservation; priorities. Bounds and approximations.

Rules & Requirements

Prerequisites: IND ENG 263A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 268 Applied Dynamic Programming 3 Units

Terms offered: Fall 2024, Fall 2021, Spring 2018

Dynamic programming formulation of deterministic decision process problems, analytical and computational methods of solution, application to problems of equipment replacement, resource allocation, scheduling, search and routing. Brief introduction to decision making under risk and uncertainty.

Rules & Requirements

Prerequisites: Mathematics 51

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Dreyfus

IND ENG 269 Integer Programming and Combinatorial Optimization 3 Units

Terms offered: Spring 2020, Spring 2010, Spring 2009

The course deals with discrete optimization problems and their complexity. These topics include complexity analysis of algorithms and its drawbacks; solving a system of linear integer equations and inequalities; strongly polynomial algorithms, network flow problems (including matching and branching); polyhedral optimization; branch and bound and lagrangean relaxation.

Rules & Requirements

Prerequisites: 262A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructor: Hochbaum

IND ENG 270 Current Readings in Innovation 3 Units

Terms offered: Fall 2015, Fall 2014

This seminar and discussion class aims to survey current and classic research on innovation and help doctoral students formulate their research designs. Readings are drawn from economics, organizations, and other social sciences, and engineering and in particular, data science research on analyzing large data sets. Students develop research designs and present each week and formally for their final. A written paper is also required. Authors join us, physically or virtually.

Rules & Requirements

Prerequisites: Background: upper level standing or graduate student, any school

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

Instructors: Fleming, Lee

IND ENG 280 Systems Analysis and Design Project 3 Units

Terms offered: Spring 2011, Spring 2010, Spring 2009

A project course for students interested in applications of operations research and engineering methods. One or more systems, which may be public or in the private sector, will be selected for detailed analysis and re-designed by student groups.

Rules & Requirements

Prerequisites: 262A, 263A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 288 Automation Science and Engineering 3 Units

Terms offered: Prior to 2007

Automation is a central aspect of contemporary industrial engineering that combines sensors, actuators, and computing to monitor and perform operations. It is applied to a broad range of applications from manufacturing to transportation to healthcare. This course provides an introduction to analysis, models, algorithms, research, and practical skills in the field and includes a laboratory component where students will learn and apply basic skills in computer programming and interfacing of sensors and motors that will culminate in a team design project.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 290 Special Topics in Industrial Engineering and Operation Research 2 - 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Lectures and appropriate assignments on fundamental or applied topics of current interest in industrial engineering and operations research.

Rules & Requirements

Prerequisites: Upper level standing or graduate student

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-3 hours of lecture per week

Summer:

6 weeks - 5-7.5 hours of lecture per week

10 weeks - 3-4.5 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 290A Dynamic Production Theory and Planning Models 3 Units

Terms offered: Spring 2014, Fall 2008, Spring 2008

Development of dynamic activity analysis models for production planning and scheduling. Relationship to theory of production, inventory theory and hierarchical organization of production management.

Rules & Requirements

Prerequisites: 220 and 254

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 290G Advanced Mathematical Programming 3 Units

Terms offered: Spring 2017, Spring 2014, Spring 2011

Selected topics in mathematical programming. The actual subjects covered may include: Convex analysis, duality theory, complementary pivot theory, fixed point theory, optimization by vector space methods, advanced topics in nonlinear algorithms, complexity of mathematical programming algorithms (including linear programming).

Rules & Requirements

Prerequisites: 262A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 290R Topics in Risk Theory 3 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014

Seminar on selected topics from financial and technological risk theory, such as risk modeling, attitudes towards risk and utility theory, portfolio management, gambling and speculation, insurance and other risk-sharing arrangements, stochastic models of risk generation and run off, risk reserves, Bayesian forecasting and credibility approximations, influence diagrams, decision trees. Topics will vary from year to year.

Rules & Requirements

Prerequisites: IND ENG 263A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Letter grade.

IND ENG 298 Group Studies, Seminars, or Group Research 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Advanced seminars in industrial engineering and operations research.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of colloquium per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: The grading option will be decided by the instructor when the class is offered.

IND ENG 299 Individual Study or Research 1 - 12 Units

Terms offered: Fall 2023, Summer 2023 Second 6 Week Session, Fall 2019

Individual investigation of advanced industrial engineering problems.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3-36 hours of independent study per week

Summer:

6 weeks - 7.5-40 hours of independent study per week

8 weeks - 6-40 hours of independent study per week

10 weeks - 4.5-40 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

IND ENG 375 GSI Proseminar on Teaching Engineering 2 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course provides basic training for graduate student instructors (GSIs). Discussion, practice, and review of fundamentals, issues, and best practices in teaching for any engineering course. Topics include: preparing a syllabus; public speaking and coping with language barriers; creating effective slides and exams; differing student learning styles; grading; encouraging diversity, equity, and inclusion; ethics; dealing with conflict and misconduct; and other topics relevant to serving as an effective teaching assistant.

Objectives & Outcomes

Course Objectives: 2. Organize concepts and objectives covered in an engineering course.

3. Design activities and discussions to promote learning and provide practice in course concepts and objectives.

4. Integrate verbal and visual methods of conveying engineering concepts and practices in the classroom and in discussions.

5. Practice fair and helpful evaluation of student work.

After completion of the course, GSIs will be able to perform the following course-related tasks:

1. Understand the University policies and procedures on academic integrity and ethics.

Rules & Requirements

Prerequisites: Graduate Standing or ASE (Academic Student Employee) Status

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Goldberg

IND ENG 601 Individual Study for Master's Students 1 - 12 Units

Terms offered: Fall 2010, Fall 2008, Spring 2008

Individual study for the comprehensive in consultation with the field adviser. Units may not be used to meet either unit or residence requirements for a master's degree.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer: 8 weeks - 6-68 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

IND ENG 602 Individual Study for Doctoral Students 1 - 12 Units

Terms offered: Fall 2010, Spring 2008, Fall 2007

Individual study in consultation with the major field adviser, intended to provide an opportunity for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D. (and other doctoral degrees). May not be used for unit or residence requirements for the doctoral degree.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer: 8 weeks - 6-68 hours of independent study per week

Additional Details

Subject/Course Level: Industrial Engin and Oper Research/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.