The Master of Industrial Engineering degree is a graduate degree program administered by the George R. Brown School of Engineering, with the participation of the Rice University Departments of Mechanical Engineering and Statistics, and the Rice Center for Operations Research.

The program is designed to explore modern industrial systems, which arise in fields such as manufacturing, services, supply chain management, energy, transportation and healthcare. Analyzing and optimizing their performance is very challenging; for example, the number of ways that Federal Express can route its vehicles vastly exceeds the number of atoms in the universe. These analyses are crucial, their financial impact typically exceeds the profit margins in many industries, such as transportation and retailing.

To meet these challenges, the Master of Industrial Engineering degree emphasizes improving the quality and reliability of complex systems. It provides students with a deep set of analytical and engineering skills to make data-driven decision needed in every major economic sector. Graduates will help industry, governments, and non-profits improve efficiency in changing and uncertain environments.

Industrial Engineering does not currently offer an academic program at the undergraduate level.

**Master’s Program**
- Master of Industrial Engineering (MIE) Degree (https://ga.rice.edu/programs-study/departments-programs/engineering/industrial-engineering/industrial-engineering-mie/#outcomestext)

**Coordinated Program**
- Master of Industrial Engineering (MIE) Degree / Master of Business Administration (MBA) Degree (https://ga.rice.edu/programs-study/departments-programs/engineering/industrial-engineering/business-administration-mba-industrial-engineering-mie/#outcomestext)

**Directors**
Andrew J. Schaefer
Eylem Tekin

**Professors**
Michael D. Byrne, Psychological Sciences
Patricia DeLucia, Psychological Sciences
Fathi Ghorbel, Mechanical Engineering
Illya V. Hicks, Computational & Applied Mathematics
C. Fred Higgs III, Mechanical Engineering
Marcia K. O’Malley, Mechanical Engineering
Amit Pazgal, Business
Eduardo Salas, Psychological Sciences
Andrew J. Schaefer, Computational & Applied Mathematics
Laura Schaefer, Mechanical Engineering
Pol D. Spanos, Mechanical Engineering
Richard A. Tapia, Computational & Applied Mathematics
Yin Zhang, Computational & Applied Mathematics

**Associate Professors**
Leonardo Dueñas-Osorio, Civil and Environmental Engineering
Philip A. Ernst, Statistics
Philip T. Kortum, Psychological Sciences

**Assistant Professors**
Matthew Brake, Mechanical Engineering
Pedram Hassanzadeh, Mechanical Engineering
Joseph Huchette, Computational and Applied Mathematics
Santiago Segarra, Electrical and Computer Engineering

**Assistant Teaching Professor**
Eleazar Marquez, Mechanical Engineering

**Professor in the Practice**
John Dobelman, Statistics

**Lecturer**
Eylem Tekin, Industrial Engineering

**Industrial Engineering (INDE)**

INDE 501 - FUNDAMENTALS OF INDUSTRIAL ENGINEERING
Short Title: FUND INDUSTRIAL ENGINEERING
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to fundamental tools in industrial engineering. Topics include productivity analysis, material handling, logistics, design of experiments, quality control, location theory, warehouse design, supply chain management and scheduling. Instructor Permission Required.
INDE 509 - INTRODUCTION TO HUMAN FACTORS ENGINEERING
Short Title: INTRO TO HUMAN FACTORS ENG
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): INDE 501
Description: Analysis and design of engineering systems considering human characteristics and limitations. Design of control, displays, tools, workstations and groups. Human factors research methods. Instructor Permission Required.

INDE 511 - GRAPH ALGORITHMS
Short Title: GRAPH ALGORITHMS
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Graph Algorithms in Operations Research. Topics include: spanning trees, graph search algorithms, shortest path problems, worst case time complexity analysis, computational complexity, dominating set problems, vertex and edge cover problems, python implementations, and other problems in graph optimization. Instructor Permission Required. Recommended Prerequisite(s): INDE 545 or CAAM 378

INDE 543 - MANUFACTURING PROCESSES AND SYSTEMS
Short Title: MANUFACTURING PROC AND SYS
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): INDE 501
Description: Fundamentals of manufacturing processes and systems. Topics include machining, casting, 2D printing, material flow, capacities, bottlenecks, and just-in-time systems. Simulation and optimization of various manufacturing systems. Trade-offs among various processes. Instructor Permission Required.

INDE 545 - PRESCRIPTIVE ANALYTICS
Short Title: PRESCRIPTIVE ANALYTICS
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: A survey of methods for combining mathematical models and large data sets to produce optimal decisions. Topics include decision analysis, dynamic programs, mathematical programs and various heuristics. Instructor Permission Required.

INDE 546 - COMPUTATIONAL PRESCRIPTIVE ANALYTICS
Short Title: COMP PRESCRIPTIVE ANALYTICS
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): INDE 545
Description: A continuation of INDE 545 that focuses on computational approaches to prescriptive analytics. Topics include decomposition approaches to large-scale optimization, modeling languages, decision analysis and discrete-event simulation software. Emphasis will be placed on using relevant software on practical problems. Instructor Permission Required.

INDE 561 - SUPPLY CHAIN MANAGEMENT
Short Title: SUPPLY CHAIN MANAGEMENT
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): INDE 545
Description: Supply chain management is the integrated management of the flow of materials, products, services, and cash from the suppliers all the way to the customers and from the customers back to the suppliers. Due to the complex nature of today's supply chains, effective management of these flows is a challenging task. This course aims to familiarize students with the concepts and models that are useful in designing and managing effective and efficient supply chains. Topics include facility location and distribution models, forecasting, sales & operations planning, supply chain coordination, inventory management, transportation, supplier selection, pricing & revenue management, and sustainability in supply chains. Instructor Permission Required.

INDE 562 - INTRODUCTION TO CONTINUOUS OPTIMIZATION
Short Title: INTRO TO CONTINUOUS OPT
Department: Industrial Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: An introduction to the formulation of unconstrained and constrained optimization models, and their numerical implementations to problems in science and engineering. Emphasis on Newton-type and interior-point methodologies. Instructor Permission Required. Recommended Prerequisite(s): INDE 545 or CAAM 378
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Short Title</th>
<th>Department</th>
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<th>Restrictions</th>
<th>Credit Hours</th>
<th>Course Type</th>
<th>Grade Mode</th>
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<th>Short Title</th>
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<tbody>
<tr>
<td>INDE 567</td>
<td>Optimization Methods in Finance</td>
<td>OPT METHODS IN FINANCE</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>3</td>
<td>Lecture</td>
<td>Standard Letter</td>
<td>Industrial Engineering</td>
<td>INDE 567</td>
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<tr>
<td>INDE 571</td>
<td>Probability and Statistical Inference</td>
<td>PROB &amp; STATISTICAL INFER</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>3</td>
<td>Lecture</td>
<td>Standard Letter</td>
<td>Industrial Engineering</td>
<td>INDE 571</td>
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<tr>
<td>INDE 572</td>
<td>Stochastic Processes and Simulation</td>
<td>STOCH PROCESSES &amp; SIMULATION</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>3</td>
<td>Lecture</td>
<td>Standard Letter</td>
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<td>INDE 573</td>
<td>Discrete-Event Simulation</td>
<td>DISCRETE-EVENT SIMULATION</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>3</td>
<td>Lecture</td>
<td>Standard Letter</td>
<td>Industrial Engineering</td>
<td>INDE 573</td>
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<td>INDE 577</td>
<td>Data Science and Machine Learning</td>
<td>DATA SCI &amp; MACHINE LEARNING</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>3</td>
<td>Lecture</td>
<td>Standard Letter</td>
<td>Industrial Engineering</td>
<td>INDE 577</td>
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<tr>
<td>INDE 590</td>
<td>Master's in Industrial Engineering Capstone Experience</td>
<td>MIE CAPSTONE EXPERIENCE</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>1</td>
<td>Research</td>
<td>Standard Letter</td>
<td>Industrial Engineering</td>
<td>INDE 590</td>
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<tr>
<td>INDE 597</td>
<td>Special Topics</td>
<td>SPECIAL TOPICS</td>
<td>Industrial Engineering</td>
<td>Graduate</td>
<td>Enrollment is limited to Graduate level students.</td>
<td>1-4</td>
<td>Seminar, Lecture, Laboratory, Internship/Practicum</td>
<td>Research</td>
<td>Industrial Engineering</td>
<td>INDE 597</td>
</tr>
</tbody>
</table>

Description:
- INDE 567: Fundamentals of financial optimization. Asset-liability management, arbitrage and asset pricing, mean-variance models, portfolio optimization. This course covers models and algorithms for solving linear, quadratic, integer, and stochastic optimization models encountered in financial and data science applications. Department Permission Required. Recommended Prerequisite(s): INDE 545
- INDE 571: Topics include probability, random variables, probability distributions, transformations, moment generating functions, common families of distributions, independence, sampling and convergence, basics of estimation theory, hypothesis testing, Bayesian inference, ANOVA, regression. Introduction to statistical software. Department Permission Required.
- INDE 572: Topics include Markov chains, renewal processes, queueing theory, statistical quality control, discrete-event simulation, random number generators, Monte Carlo methods, resampling methods, Markov Chain Monte Carlo, importance sampling and simulation based estimation for stochastic processes.
- INDE 573:Simulation of discrete-event dynamic systems. Topics include introduction to simulation models; modeling with Simio, a comprehensive simulation package with animation capabilities; statistical aspects such as input and output analysis, random variate generation, variance reduction techniques; optimization via simulation. Department Permission Required.
- INDE 577: Fundamentals of data science and machine learning. Topics include: introduction to scikit-learn, Keras and tensorflow2, linear and logistic regression, clustering, support vector machines, random forest trees, neural networks, deep learning, natural language processing. Instructor Permission Required. Recommended Prerequisite(s): Three semesters of calculus recommended. A background in some programming language would be extremely useful.
- INDE 590: MIE students are required to write a field report related to one of the required core courses in the curriculum. Students should coordinate this with the INDE 590 instructor/capstone director, prepare a report relevant to the course material, and present it in class. Instructor Permission Required.
- INDE 597: Offered for research credit. Department Permission Required. Repeatable for Credit.
- INDE 590: Enrollment is limited to Graduate or Visiting Graduate level students.

Notes:
- Department Permission Required. Repeatable for Credit.
- Topics and credit hours may vary each semester. Enrollment is limited to Graduate level students.
- Topics and credit hours may vary each semester. Spring 2020: This course introduces the theory and practice of revenue management and dynamic pricing, with a focus on application areas such as the airline industry and online advertisements. Topics include state-of-the-art revenue optimization algorithms (single-leg revenue management (RM), network RM, booking limits, bid price control, overbooking), auctions, market analytics, offer optimization, and forecasting and estimation from data. Instructor Permission Required. Repeatable for Credit.

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Description and Code Legend

Note: Internally, the university uses the following descriptions, codes, and abbreviations for this academic program. The following is a quick reference:

Course Catalog/Schedule
• Course offerings/subject code: INDE

Program Description and Code
• Industrial Engineering: INDE

Graduate Degree Description and Code
• Master of Industrial Engineering: MIE

Graduate Degree Program Description and Code
• Degree Program in Industrial Engineering: INDE

CIP Code and Description
• INDE Major/Program: CIP Code/Title: 14.3701 - Operations Research

1 Classification of Instructional Programs (CIP) 2020 Codes and Descriptions from the National Center for Education Statistics: https://nces.ed.gov/ipeds/cipcode/