

# Cornell University

## School of Operations Research and Information Engineering

Applied OR

Data Analytics

Financial  
Engineering

Information  
Technology

Manufacturing

Strategic  
Operations

Systems  
Engineering

## Master of Engineering Student Handbook

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## TABLE OF CONTENTS

I.	ORIE AT CORNELL	
	A. Introduction.....	2
	B. Brief History of the School.....	2
	C. Overview of the Master of Engineering Program.....	2
II.	MASTER OF ENGINEERING PROGRAM REQUIREMENTS	
	A. Prerequisites .....	4
	B. General Requirements .....	4
	1. Credit Hours .....	5
	2. Courses .....	6
	3. Engineering Design Project.....	7
	4. Professional Development for Spring Admits.....	7
III.	CONCENTRATIONS AND MINORS	
	A. Applied OR Concentration.....	8
	B. Data Analytics Concentration.....	8
	C. Financial Engineering Concentration.....	10
	D. Information Technology Concentration.....	12
	E. Manufacturing and Industrial Engineering Concentration .....	13
	F. Strategic Operations Concentration.....	15
	G. Systems Engineering Minor.....	16
	H. One-Year MBA Program.....	16
IV.	POLICIES AND PROCEDURES	
	A. Early Admission for Cornell Undergraduates.....	18
	B. Three Semester Degree Option.....	18
	C. Academic Advisors.....	19
	D. Good Standing Status.....	19
	E. Extramural and Transfer Credits.....	19
	F. Petitioning.....	20
	G. Registration and Add/Drop Deadlines.....	20
	H. Conduct.....	20
	I. Exit Interviews.....	20
	J. Academic Integrity .....	20
V.	FINANCIAL AID	
	A. Merit-Based Financial Aid.....	24
	B. Need-Based Financial Aid .....	25
	C. Employment Opportunities .....	25
VI.	UNIVERSITY RESOURCES	
	A. Career Services.....	26
	B. Health and Counseling Services .....	26
	C. Student Organizations.....	26
	APPENDICES	
	A. Popular Electives Offered by other Departments	
	B. Diagram of General ORIE MEng Requirements	

## **I. ORIE AT CORNELL**

### **A. Introduction**

The School of Operations Research and Information Engineering welcomes you to Cornell. We look forward to getting to know you and are confident that you will have a challenging and rewarding educational experience.

This handbook has been designed as a guide to the Master of Engineering (MEng) program in Operations Research and Information Engineering (ORIE). It outlines the expectations and requirements of the MEng program, the courses and concentrations offered, various policies and procedures, and support resources that are available to you.

### **B. Brief History of the School**

Operations Research and Information Engineering has a long history at Cornell. Industrial Engineering courses were first taught in 1895, through the Sibley School of Mechanical Engineering. Operations Research courses were introduced in 1955. In 1961, the Department of Industrial Engineering and Administration and the graduate field of Industrial Engineering and Operations Research were established. In 1965, the undergraduate program in all engineering disciplines was changed from five years to four years. The Master of Engineering program was established in the same year to give those students who desired a five-year program in ORIE the opportunity to pursue one.

Since then, the School of ORIE and the MEng program have flourished. Our world-renowned faculty has doubled in size, and many new courses and concentrations have been added.

### **C. Overview of the Master of Engineering Program**

As a two- or three-semester professional degree program, the ORIE MEng has become highly valued in the marketplace and continues to be an attractive option for well-prepared undergraduates in Operations Research, Industrial Engineering, Mathematics, Finance, and many other quantitative disciplines.

The main objectives of every MEng program at Cornell are to advance the breadth and depth of our students' technical knowledge and to provide students with opportunities to synthesize and apply this knowledge in a real-world environment. In ORIE, the technical tools of primary importance are mathematical modeling and the application of quantitative techniques embodied in the fields of optimization, probability, stochastic processes, statistics, and simulation. The application areas for these tools are virtually limitless, but ORIE students generally apply their knowledge to the design, operation, and improvement of business systems.

All students in the ORIE MEng program are required to fulfill a set of general requirements (detailed in Section II), including a minimum number of course credit hours, core and distribution courses, and participation in an approved engineering design project.

Seven concentrations and minors\* are currently associated with the ORIE MEng program. Each is designed to meet certain educational objectives:

- Applied Operations Research Concentration (AOR)
- Data Analytics Concentration (DA)
- Financial Engineering Concentration (FE)
- Information Technology Concentration (IT)
- Manufacturing and Industrial Engineering Concentration (MIE)
- Strategic Operations Concentration (SO)
- Systems Engineering Minor

The specific courses that are required in order for a student to complete a particular concentration or minor may vary depending on his or her background. Detailed requirements for each concentration and minor are given in Section III.

The capstone component of the ORIE MEng program is the team-based engineering design project, which all students complete with the guidance of a Cornell faculty advisor. The MEng project is fundamentally and purposefully different from traditional coursework and the process of completing an individual Masters' thesis. It is intended to prepare students for the professional arena by having them engage in client-sponsored project work with real data, deadlines, and deliverables. Regardless of their concentrations within ORIE, students are expected to play major roles in all aspects of their projects, including formulating and analyzing the problem, managing the client relationship, monitoring the project timeline and milestones, and delivering the final results.

The ORIE MEng program is designed to begin in the fall semester. For a variety of reasons, including the sequencing of offered courses and the timeline for project activities, completing the MEng program in the traditional fall-spring or fall-spring-fall semester sequence is strongly encouraged. Although students are occasionally admitted to the MEng program in the spring semester, spring admission is typically limited to applicants who are already at Cornell and have been able to participate in project start-up activities that take place during the fall semester.

*\*The primary difference between concentrations and minors is that concentrations have requirements designed specifically for ORIE students, while minors have requirements that allow for participants from other disciplines (i.e., outside of ORIE).*

## **II. MASTER OF ENGINEERING PROGRAM REQUIREMENTS**

### **A. Prerequisites\***

Before beginning the Master of Engineering program in ORIE, all ORIE MEng students must provide verification that they have successfully completed:

1. A standard **engineering calculus sequence**, including linear algebra (with eigenvalues and eigenvectors), and vector calculus.
2. An introductory **engineering probability and statistics course** equivalent to Cornell's ENGRD 2700:

***Basic Engineering Probability and Statistics*** (ENGRD 2700, 3 credits).  
*Prerequisites: two-semester calculus sequence, linear algebra.*

*Gives students a working knowledge of basic probability and statistics and their application to engineering. Includes computer analysis of data and simulation. Topics include random variables, probability distributions, expectation, estimation, testing, experimental design, quality control, and regression.*

3. An **intermediate-level computer programming course** in a language such as C, C++, Java, or MATLAB equivalent to Cornell's ENGRD 2110:

***Object Oriented Programming and Data Structures*** (ENGRD 2110 / CS 2110. 3 credits). *Prerequisite: CS 1110 or equivalent.*

*Intermediate programming in a high-level language and introduction to computer science. Topics include program structure and organization, object-oriented programming (classes, objects, types, sub-typing), graphical user interfaces, algorithm analysis (asymptotic complexity, big O notation), recursion, data structures (lists, trees, stacks, queues, heaps, search trees, hash tables, graphs), simple graph algorithms.*

ENGRD 2700 and ENGRD 2110 are offered in each semester and also during the summer at Cornell. Information may be obtained from the Summer Session Office, B20 Day Hall, (607) 255-4987, or at [www.sce.cornell.edu](http://www.sce.cornell.edu).

*\*The Financial Engineering concentration has additional prerequisites. See Section III.C for details.*

### **B. General Requirements**

This section outlines the credit hour, course, and project requirements each student must fulfill in order to receive the Master of Engineering degree in ORIE. (See <http://courses.cornell.edu> for current course offerings and descriptions.) Students should consult the ORIE MEng program office (201 Rhodes) to confirm that their specific course selections fulfill these requirements. Although faculty advisors will assist students in course selection, ***it is ultimately the student's responsibility to plan his or her course of study and to ensure that all degree requirements are satisfied.***

## 1. Credit Hours

Every ORIE MEng student must:

- a. Register as a full-time MEng student for two or more semesters. Exceptions: Cornell University employees in the Employee Degree Program, students enrolled in the Industrial Partnership Program, and Cornell undergraduates in the Early Admission program.
- b. Complete a minimum of 30 credit hours of approved technical coursework, all of which must be taken for letter grades, with the exceptions of ORIE 9100 and ORIE 5210. (These seminar courses must be taken S/U.) A maximum of 2 credit hours of S/U seminar courses may be applied towards the 30-credit-hour requirement. Only courses that have direct professional relevance and are suitably technical can be counted toward the 30-credit-hour requirement. Most courses taught in the College of Engineering that are numbered 4000 or above qualify, as well as several technical courses from other Cornell schools and colleges. Appendix A contains a list of popular courses that have been allowed in the past. Courses not listed in Appendix A will be allowed by petition only. Petitions must be approved by the student's advisor and the MEng Program Director before the add deadline has passed.
- c. Complete a minimum of 19 letter-graded credit hours in Technical Engineering courses. Most courses taught in the College of Engineering that are numbered 4000 or above qualify, along with a selected number of courses from other Cornell schools and colleges. Appendix A contains a list of popular courses that have been allowed in the past. Courses not listed in Appendix A are allowed by petition only. Petitions must be approved by the student's advisor and the MEng Program Director before the add deadline has passed. For students who were ORIE undergraduate majors at Cornell, ORIE elective courses taken as an undergraduate in excess of the credits required for the BS degree usually count toward this requirement, but they do not apply toward the 30-credit-hour requirement. A maximum of 6 excess credit hours can be applied toward the Technical Engineering requirement. If applicable, students must indicate this information on their study plan.
- d. Complete a minimum of 12 letter-graded credit hours in the School of ORIE, exclusive of the MEng project. See <http://courses.cornell.edu/> for current course offerings. For students who were ORIE undergraduate majors at Cornell, ORIE elective courses taken as an undergraduate in excess of the credits required for the BS degree usually count toward this requirement, but they do not apply toward the 30-credit-hour requirement. (ORIE 4990 does not count.) A maximum of 6 excess credit hours can be applied toward the 12-credit-hour ORIE course requirement.
- e. Complete at least 12 credit hours each semester the student is enrolled and at least 10 credit hours that count toward the MEng degree in the first and second semesters the student is enrolled. By College policy, a student may not count more than 20 credit hours in any semester toward his or her MEng degree. ORIE MEng students may not remain enrolled in more than

20 credit hours beyond the fourth full week of classes without a petition that is approved by the student's advisor and the MEng Program Director.

- f. Complete a minimum of 22 credit hours that count toward the MEng degree *exclusive* of Johnson School, HADM, and AEM courses. Exception: This does not apply to students in the Strategic Operations concentration.
- g. Attain a minimum GPA across all courses that satisfy the requirements of the MEng degree.
- h. Resolve any incomplete grade within one semester of the submission of the incomplete.

## 2. Courses

Every ORIE MEng student must:

- a. File a Study Plan with the Graduate Student Services Coordinator in 201 Rhodes Hall at the beginning of each semester. This form is available at: <http://www.orie.cornell.edu/academics/master/resources/forms.cfm> and in 201 Rhodes Hall. All courses that count toward the MEng degree must be listed on the study plan, and the entire course plan must be approved by the student's faculty advisor.
- b. Waive or complete the following courses with a grade of C- or better:
  - ORIE 5300
  - ORIE 5310 or ORIE 5311 or ORIE 5370
  - ORIE 5500 (non-FE students)
  - ORIE 5580 (ORIE 5581 and ORIE 5582 for FE students)
  - ORIE 5510 (non-FE students)

A student may petition to waive a required core course if he or she has successfully completed an equivalent course for a letter grade at an accredited academic institution within the six-year period prior to his or her matriculation in the ORIE MEng program. To do so, the student must submit a completed Course Waiver Petition Form, along with any supporting documentation. The form is available in 201 Rhodes Hall and online at: <http://www.orie.cornell.edu/academics/master/resources/forms.cfm>. For a Financial Engineering student who has taken ORIE 4580 as an undergraduate at Cornell, ORIE 5581 is waived, but ORIE 5582 is required.

- c. Earn 2 colloquium credits with a passing grade (S). Students in the Financial Engineering concentration may earn colloquium credits from among ORIE 9100 (1 cr. each fall, spring) and ORIE 5210 (1 or 2 credits offered at CFEM), with at least 1 credit in ORIE 5210. All other ORIE MEng students must complete ORIE 9100 (or an approved substitute) in the fall and spring semesters. Exception: ORIE 9100 in the spring is waived for students in the Strategic Operations concentration.
- d. Complete ORIE 5110 or ORIE 5100 (or an approved substitute) with a grade of C- or better. Both courses may be taken for credit. Exception: This requirement is waived for students in the Financial Engineering concentration.

### 3. Engineering Design Project

Each ORIE Master of Engineering student must complete an approved team-based engineering design project. MEng projects typically have industrial, financial, or government organizations as clients and/or sponsors. The format and timeline for MEng projects varies by concentration or minor, as does the manner in which students are assigned to project teams. The specific goals and expectations for MEng projects will be presented prior to team assignment. In all cases, a final written report must be submitted and signed by the faculty advisor, and a final oral presentation must be made to the client organization before the project requirement is considered fulfilled. Full commitment and participation are expected from all project team members.

The project courses in which students should enroll each semester are listed in the table below, by concentration or minor:

<u>Fall Semester :</u>	<u>Scheduled Hours:</u>	<u>Enrolled Credit Hours:</u>
AOR, IT, DA — ORIE 5980*	1	5 (R grade)**
Sys.Engr. Minor — ORIE 5940	3	3 (Letter grade)
Mfg. & IE — ORIE 5910	2	5 (R grade)**
SO — (spring only)	--	--
FE (CFEM fall only) — ORIE 5220***	5	5 (Letter grade)
<u>Spring Semester:</u>	<u>Scheduled Hours:</u>	<u>Enrolled Credit Hours:</u>
AOR, IT, DA — ORIE 5981*	4	5 (Letter grade)
Sys.Engr. Minor — ORIE 5940	3	3 (Letter grade)
Mfg. & IE — ORIE 5911	3	5 (Letter grade)
SO — NBA 6500, etc.	14.5+	14.5+ (Letter grades)

**Students enrolled in ORIE 5981 in the spring semester are required to return to Cornell at least two full weeks before spring semester classes begin and are required to spend that time working on their MEng projects. Spring semester classes usually begin between January 21-27.**

\* Cornell undergraduates starting the MEng program in the spring semester should enroll in ORIE 5980 the preceding fall if they are doing a fall/spring project sequence.

\*\* An R in the fall semester implies a year-long course with a letter grade given only at the end of the spring semester — only spring semester enrolled credit hours count.

\*\*\* Financial Engineering students enroll in ORIE 5220 in their 2<sup>nd</sup> fall semester.

### 4. Professional Development for Spring Admits

Any spring admit to the ORIE MEng program who was not a registered Cornell student in the previous fall semester must engage in meaningful project work in the summer and/or fall following admission that contributes to his or her professional development. Completing a summer project or internship that has been approved by the student's advisor or the MEng Program Director will satisfy this requirement.

### **III. Concentrations and Minors**

This section outlines the specific requirements of each concentration and minor currently associated with the Master of Engineering degree in ORIE.

#### **A. Applied Operations Research Concentration**

The Applied Operations Research concentration (AOR) is the most general of the concentrations and allows the most flexibility with respect to elective courses. The AOR concentration is most appropriate for students with undergraduate degrees in ORIE who want to increase the depth and breadth of their exposure to operations research and its applications, and for those with undergraduate degrees in other fields who want to gain a solid foundation in the theory and practice of OR.

The AOR concentration has no specific elective requirements beyond those implied by the general credit hour requirements for ORIE courses (12 cr hrs), Technical Engineering courses (19 cr hrs), and overall technical content (30 cr hrs). This gives AOR students the opportunity to pursue a variety of interests within the overall structure of the degree program. The MEng project for AOR students is completed as the course sequence ORIE 5980 and ORIE 5981.

#### **B. Data Analytics Concentration**

The Data Analytics concentration (DA) focuses on the theory and tools needed to make fact-based, data-driven decisions associated with the development, pricing, promotion, and distribution of ideas, goods, and services. The required course work for this concentration consists of three complementary areas that are collectively essential for effective data analysis and data-driven decision making.

Students in DA must complete four approved elective courses for at least 12 credit hours in total. The four courses must be comprised of two courses in Statistical Data Analysis, (at least one of which must be in ORIE, CS, or STSCI), one course in Data Technology, and one course in Data-Driven Decisions and Strategy. The currently approved courses for each of these areas are listed on the following page. Other suitable courses may be substituted by petition.

Students who have already completed ORIE 5500 usually can finish the DA concentration in two semesters. Others may need three semesters to complete the DA concentration due to certain courses having prerequisites (and/or enrollment limits) and because of the timing and sequence of course offerings. Cornell undergraduates who have successfully completed DA elective courses as part of their undergraduate studies may count at most two of these courses and at most 6 credits towards the satisfaction of the MEng DA concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

One or more of the ORIE 5980/5981 projects will have a strong data analysis component, and to the extent possible, DA students will be given preference to these projects when assignments are made.

Statistical Data Analysis (2 courses, one of which must be in ORIE, CS, or STSCI):

- ORIE 4740 Statistical Data Mining, Spring 4 crs  
or STSCI 4740 Data Mining and Machine Learning, Fall 4 crs
- ORIE 4741 Learning with Big Messy Data, Fall 4 crs
- ORIE 5550 Applied Time Series Analysis, Spring 4 crs
- ORIE 5640 Statistics for Financial Engineering, Spring 4 crs
- ORIE 4710 Applied Linear Statistical Models Spring 2 crs and  
ORIE 4711 Experimental Design or ORIE 4712 Regression, Spring 2 crs  
(not offered 2016-17)
- CS 4850 Mathematical Foundations for the Information Age, Spring 4 crs
- CS 5780 Machine Learning for Intelligent Systems, Spring 4 crs
- CS 5786 Machine Learning for Data Science, Fall 4 crs
- HADM 6230 Statistical Analysis of Real Estate Data, Fall 1.5 crs
- NBA 6200 Marketing Research, Spring 3 crs
- STSCI 4030 Linear Models with Matrices, Fall 4 crs
- STSCI 4100 Multivariate Analysis, Spring 4 crs
- STSCI 4110 Categorical Data, Spring 4 crs
- STSCI 4120 Nonparametric Inference & Sequential Analysis, Fall 4 crs
- STSCI 4270 Introduction to Survival Analysis, Fall 3 crs
- STSCI 4780 Bayesian Data Analysis: Principles and Practice, Spring 4 crs

Data Technology (1 course):

- ORIE 4820 Spreadsheet-Based Modeling and Data Analysis, Spring 3 crs
- CS 3300 Data-driven Web Applications, Spring 3 crs
- CS 4300 Language and Information, Fall, 3 crs
- CS 5320 Introduction to Database Systems, 3 crs
- INFO 5100 Visual Data Analytics for the Web, Spring 3 crs
- STSCI 4060 Python Programming and Applications in Statistics, Spring 2crs
- STSCI 4500 Databases and Statistical Computing, Spring 4 crs
- STSCI 5065 Big Data Management and Analysis, Spring 3 crs

Data-Driven Decisions and Strategy (1 course):

- ORIE 4154 Revenue Management, Spring 3 crs
- ORIE 4630 OR Tools for Financial Engineering, Fall 3 crs
- CS 5540 Computational Techniques for Analyzing Clinical Data, Spring 3crs
- HADM 6010 Data Driven Analytics, Fall 3 crs (not offered 2016-17)
- HADM 6050 Revenue Management, Spring 3 crs
- HADM 6075 Web Scraping and Data Mining for Hospitality Decision Making, Fall 3 crs (not offered 2016-17)
- NBA 6390 Data-driven Marketing, Spring 1 cr (letter grade only, no S/U)
- NBA 6930 Strategy and Tactics of Pricing, Fall 3 crs (not offered 2016-17)
- STSCI 4140 Applied Design, Spring 4 crs

### C. Financial Engineering Concentration

The Financial Engineering concentration (FE) prepares students for careers that involve the quantitative analysis and management of financial instruments and risk. Such jobs frequently involve: (1) mathematical modeling and analysis of stocks, bonds, options, currency exchange rates, and other structured products, (2) developing quantitative models to help corporations understand and manage their exposure to risk, and/or (3) implementing algorithms to monitor, price, and/or trade financial instruments. Unlike other concentrations, FE is specifically designed to be a three-semester program (Fall-Spring-Fall), with the third semester taking place at Cornell Financial Engineering Manhattan (CFEM) in New York City.

Students who successfully complete the FE concentration will receive a Dean's Certificate in acknowledgment of this. Eligibility for the Dean's Certificate is restricted to students registered in the Master of Engineering degree program or in the Johnson Graduate School of Management. Admission to the ORIE MEng Program (or the JGSM) does not guarantee admission to the FE concentration (or permission to pursue the Dean's Certificate). The requirements for the FE concentration are outlined on the following pages. A list of the Dean's Certificate requirements for JGSM students is available from the ORIE graduate office in 201 Rhodes Hall.

Because of the rigorous nature of the FE program, there are additional prerequisites for admission. Before entering the program, students must have already completed a two-semester course sequence in probability and statistics (ENGRD 2700 and ORIE 5500, or equivalent), and a basic course in finance. Other strongly recommended preparation includes a course in Stochastic Processes (ORIE 5510 or equivalent) and familiarity with C++. Courses completed to satisfy the prerequisites for the Financial Engineering concentration (at Cornell or elsewhere) do not count towards fulfilling any of the other credit hour requirements for the MEng degree.

In certain cases it may be possible for well-prepared Cornell ORIE undergraduates to complete the FE program in fewer than three semesters. Please consult the MEng Director for requirements and details. Note that Cornell undergraduates can waive up to 3 credit hours of FE elective coursework if a qualifying course was successfully completed as an undergraduate.

## Financial Engineering Required Curriculum

Any proposed deviations from the requirements listed below require written permission from the ORIE MEng Director.

<b><u>First Term (Fall)</u></b>	<b><u>Cr.Hrs.</u></b>
• Derivatives Securities, Part I (1/2 semester course) (NBA 6730)	1.5
• Derivatives Securities, Part II (1/2 semester course) (NBA 6740)	1.5
• Financial Engineering with Stochastic Calculus I (ORIE 5600)	4
• Fixed-Income Securities and Interest-Rate Options (NBA 5550)	3
• Optimization I (ORIE 5300)	4
• Monte Carlo Simulation (ORIE 5581)	2
• Enterprise Engineering Colloquium (ORIE 9100) ( <u>Optional</u> —see footnote) <sup>†</sup>	1

<b><u>Second Term (Spring)</u></b>	<b><u>Cr.Hrs.</u></b>
• Financial Engineering with Stochastic Calculus II (ORIE 5610) <u>or</u> Quantitative Methods of Financial Risk Mgmt. (ORIE 5650) <u>or</u> Credit Risk (ORIE 5620) (not offered 2016-17)**	3-4
• Statistics for Financial Engineering (ORIE 5640) <u>or</u> Time Series Analysis (ORIE 5550)**	3-4
• Topics in Linear Optimization (ORIE 5311) <u>or</u> Optimization II (ORIE 5310) <u>or</u> Optimization Modeling in Finance (ORIE 5370)***	2-4
• Monte Carlo Methods in Financial Engineering (ORIE 5582)	2
• Investments and Portfolio Analysis (NBA 5420)	3
• Enterprise Engineering Colloquium (ORIE 9100) ( <u>Optional</u> —see footnote) <sup>†</sup>	1

### **Summer Term**

- Internship

### **Third Term (Fall) at Cornell Financial Engineering Manhattan (CFEM)**

• Applied Financial Engr – Project Course (ORIE 5220)	5
• Quantitative Trading Strategies (ORIE 5230)	3
• Seminar in Financial Engineering (ORIE 5210) <sup>†</sup>	1-2

In addition, students must take a minimum of 6 FE elective credits, of which 2 credit hours must be in ORIE courses taught at CFEM. The following courses are pre-approved (others may be allowed by petition):

• Comprehensive Financial Statement Analysis (NBA 5061) (Fall)	3
• International Finance (NBA 5540) (Fall)	3
• Advanced Investment Strategies (NBA 6450) (Fall)	1.5
• Statistical Data Mining I (ORIE 4740) (Spring)	4
<u>or</u> Data Mining and Machine Learning (STSCI 4740) (Fall)	4
• Learning with Big Messy Data (ORIE 4741) (Fall)	4
• Multivariate Analysis (STSCI 4100) (Spring)	4
<u>or</u> Linear Models with Matrices (STSCI 4030) (Fall)	4
• Introduction to Game Theory (ORIE 4350) (Fall)	4
• Bond Mathematics and Mortgage-Backed Securities (ORIE 5240) (CFEM)	3
• Special Topics in Financial Engineering (ORIE 5252, ORIE 5253, ORIE 5254, ORIE 5255) (CFEM)	1.5 - 2

<sup>†</sup> 2 colloquium credits are required from among ORIE 9100 (1 cr. fall or spring) and ORIE 5210 (1 or 2 crs offered at CFEM), with at least 1 credit in ORIE 5210.

\* Courses offered by the Johnson Graduate School of Management require familiarity with core financial topics at the level of NCC 5560 (Managerial Finance). You should develop this familiarity by studying a text such as "Investments" by Bodie, Kane and Marcus (Chapters 1-3, 6-9, 12, 14-16, 18 and 20).

\*\* If two courses are taken in this group, one course may count toward FE elective credit.

\*\*\* If ORIE 5370 is taken to satisfy the spring term optimization requirement, one credit of the three will count toward FE elective credit.

## D. Information Technology Concentration

The Information Technology concentration (IT) prepares students to participate in the development, acquisition, and integration of information systems (particularly those embodying OR approaches) to ensure that strategic business needs are satisfied. Students who elect this concentration will be introduced to the essentials of information technology and ways to bring it to bear in enterprise environments to assist real decision making.

Students in IT must complete four approved elective courses for at least 12 credit hours in total, with at least one course in each of the following three areas: Technology and Infrastructure, Information Economics and Strategy, and Managing IT Implementation. The fourth course may be chosen from among these three areas, or from a list of other approved IT electives. The currently approved IT electives are listed below. Other suitable courses may be substituted by petition.

Students who are able to waive one or more of the core ORIE courses usually can complete the IT concentration in two semesters. Others may need three semesters due to certain courses having prerequisites (and/or enrollment limits) and because of the timing and sequence of course offerings. Note that Cornell undergraduates who have successfully completed IT elective courses as part of their undergraduate studies may count at most two of these courses and at most 6 credits towards the satisfaction of the MEng IT concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

One or more of the ORIE 5980/5981 projects will have a strong information technology component, and to the extent possible, IT students will be given preference to these projects when assignments are made.

### Technology and Infrastructure (at least 1 course):

- ORIE 4800 Information Technology, 4 crs (not offered 2016-17)
- ORIE 5142 Systems Analysis Behavior and Optimization, Spring 3 crs
- CS 3410 Computer Systems Organization and Programming, 4 crs
- CS 5320 Introduction to Database Systems, 3 crs
- CS 5414 Distributed Computing Principles, Fall 4 crs
- ECE 4450 Computer Networks and Telecommunications, Fall 4 crs
- ECE 4800 Optimal System Analysis and Design, Fall 4 crs
- ECE 5660 Fundamentals of Networks, Spring 4 crs
- INFO 5300 The Architecture of Large-Scale Information Systems, Spring 4 crs
- SYSEN 5400 Theory and Practice of Systems Architecture, Fall 3 crs

### Information Economics and Strategy (at least 1 course):

- ORIE 4154 Revenue Management, Spring 3 crs
- CS 4852 Networks II: Market Design, Spring 3 crs
- CS 5780 Machine Learning for Intelligent Systems, Spring 4 crs
- HADM 6050 Revenue Management, Spring 3 crs
- INFO 4400 Advanced Human-Computer Interaction Design, Spring 3 crs
- INFO 6230 Games, Economic Behavior, and the Internet, Fall 3 crs

- NBA 6005 Technology Strategy for a Sustainable World, Fall 1.5 crs
- NBA 6010 Electronic Commerce, Spring 3 crs
- ORIE 3800 Information Systems and Analysis\*\*, Spring, 4 crs

\*\* ORIE 3800 may be taken ONLY with permission of the MEng Director

Managing IT Implementation (at least 1 course):

- ORIE 5140 Model Based Systems Engineering, Fall 3 crs
- CEE 5900 Project Management, 4 crs
- CS 5150 Software Engineering, Fall 4 crs
- CS 5412 Cloud Computing, Spring 4 crs (not offered 2016-17)
- ECE 5830 Introduction to Technical Management, Fall 3 crs
- SYSEN 5300 Systems Engineering and Six Sigma for the Design and Operation of Reliable Systems, Spring 3-4 crs

Other Approved IT electives:

- ORIE 4820 Spreadsheet-Based Modeling and Data Analysis, Spring 3 crs
- ORIE 5126 Supply Chain Management, Spring 4 crs
- CS 3152 Introduction to Computer Game Architecture, Spring 4 crs
- CS 3300 Data-driven Web Applications, Spring 3 crs
- CS 4300 Language and Information, Spring 3 crs
- CS 4700 Foundations of Artificial Intelligence, Fall 3 crs
- INFO 4301 Ethics in New Media, Technology, and Communication, Spring 3 crs

## **E. Manufacturing and Industrial Engineering Concentration**

The Manufacturing and Industrial Engineering concentration (MIE) prepares students to use their operations research skills to great effect in manufacturing environments. This concentration covers all aspects of the design, production, and distribution of goods and services, as well as the fundamentals of modern manufacturing technology and the use of computers for design, analysis, and management of manufacturing processes. Students admitted to the MIE concentration are expected to have a working knowledge of probability and statistics as well as strong disciplinary credentials. Industrial experience is advantageous but not required.

Upon completing the program, students receive a certificate attesting to their area of expertise, as well as the MEng degree in ORIE. The MIE concentration provides, in effect, a second area of expertise, in manufacturing, to complement the expertise in ORIE.

The MIE concentration is coordinated by the CME (Center for Manufacturing Enterprise), working cooperatively with the participating fields and the Master of Engineering program. The requirements for this concentration are described on the pages that follow. The MIE design project (ORIE 5910 and ORIE 5911) fulfills the ORIE MEng project requirement.

In addition to the MIE design project, students in MIE must complete the manufacturing focus courses and three approved elective courses. If a student has already taken one or more of the ORIE MEng core courses, then it may be possible to complete the MIE concentration in one academic year. Otherwise, it may take an additional semester to finish both ORIE MEng degree requirements and MIE concentration requirements. Cornell undergraduates who have successfully completed MIE focus and/or elective courses as part of their undergraduate studies may count at most two of these courses towards the satisfaction of the MIE concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

### Manufacturing Focus Courses

The following courses are required elements of the MIE concentration curriculum. Any changes or substitutions require the written approval of the Program Coordinator prior to the semester in which the substitution or change is sought.

- ORIE 5100 Design of Manufacturing Systems (Fall, 4 crs) (not offered in 2016-17 – see Program Coordinator for alternatives)
- NBA 5530 Accounting and Financial Decision Making (Spring, 3 crs)  
or NBA 5020 Managerial Accounting and Reporting (Fall, Spring, 3 crs)
- ORIE 9100 Enterprise Engineering Colloquium (Fall and Spring, 1 cr each)

### Technology and Industry Breadth

Students should select at least three courses from the following list. Any deletions or substitutions require the written approval of the Program Coordinator prior to the semester in which the substitution or deletion is sought. Note that many of these courses have prerequisites. Students lacking those prerequisites can ask the instructor's permission to enroll in the class, but for certain subject areas this may not be advisable.

- AEP 6620 Micro/Nano-fabrication and Processing (Fall, 3 crs)
- AEP 6630 Nanobiotechnology (Fall, 3 crs)
- CEE 5900 Project Management (Fall and Spring, 4 crs)
- CEE 5930 Engineering Management Methods (Fall, 4 crs)
- ECE 4320 MicroElectro Mechanical Systems (MEMS) (Spring, 4 crs)
- ECE 5830 Introduction to Technical Management (Fall, 3 crs)
- NBA 6120 Disruptive Technologies (Fall, 2 crs)
- NBA 6410 Supply Chain Management Analytics (Spring, 1.5 crs)
- NCC 5580 Managing Operations (Spring, 3 crs)
- ORIE 5122 Inventory Management (3 crs) (not offered 2016-17)
- ORIE 5126 Supply Chain Management (4 crs) (not offered 2016-17)
- ORIE 5140 Model Based Systems Engineering (Fall, 4 crs)
- ORIE 5150 Economic Analysis of Engineering Systems (Spring, 4 crs) (not offered 2016-17)
- SYSEN 5300 Systems Engineering and Six Sigma for the Design and Operations of Reliable Systems (Spring, 3-4 crs)

### MIE Concentration Design Project

This cross-disciplinary group design project is centered on a major manufactured product, including the concurrent design of a system for the product's manufacture. Market needs, economics, financing, quality, life-cycle costs, distribution, and marketing are addressed as part of the product and manufacturing-system design. Supervision will be handled by faculty along with the interaction of cooperating industrial personnel. **Required project work will be done during the January intersession.** Most of the projects are supervised by CME's MEng Program Coordinator, Dr. John Callister.

MIE Concentration students register for the project using the course sequence ORIE 5910 and ORIE 5911. They will receive 5 credit hours in total for the year. An R is used in lieu of a grade for the fall semester of a year-long course, with a letter grade given at the end of the spring semester only.

### **F. Strategic Operations Concentration (SO)**

The keystone of the Strategic Operations concentration (SO) is the Strategic Operations Immersion offered by the Johnson Graduate School of Management. This intensive "supercourse" comprises at least 15 credit hours and occupies the entire spring semester. SO provides a comprehensive treatment of production management, including product design, logistics, quality control, corporate organization, employee organization and compensation, marketing, and globalization. Students from the College of Engineering, the Johnson School, and the School of Industrial and Labor Relations participate.

Instruction in the Strategic Operations Immersion is primarily project or case oriented, based more on discussion than lecture. Students participate in interdisciplinary teams with members from across the three different colleges. The course material is integrated with plant visits and project work with local industry. The four major topics of concentration are: the changing environment for product design (and redesign); rapid-response production systems; organization, management and compensation of the manufacturing team; and performance measurements.

Typically, a student must already have a strong background in operations research and/or relevant professional experience to be admitted to the SO concentration. **If a student does not perform satisfactorily during the fall semester, permission to continue in the SO concentration may be rescinded.**

Including the Strategic Operations Immersion, students concentrating in SO may not count more than 18 credit hours in JGSM, HADM, or AEM courses toward their MEng degree. Completing the Strategic Operations Immersion (with 15 or more credit hours) contributes a total of 5 credit hours toward the ORIE credit hour requirement (see Section II.B.1.d), and a total of 10 credit hours toward the Technical Engineering requirement (see Section II.B.1.c). The ORIE 9100 (spring only) and ORIE 5311 requirements are waived for students in the Strategic Operations concentration; however, ORIE 5510 is not waived. Since ORIE 5510 is not taught in the fall semester, SO students who have not already taken an equivalent course must take ORIE 5510 in the preceding or following summer.

The ORIE MEng Project requirement is typically fulfilled within the framework of the Strategic Operations Immersion semester. In most cases, a substantial team-based work product that is already a required component of one of the SO courses can be used to satisfy the ORIE MEng project requirement. ORIE MEng students should be aware, however, that additional requirements and/or restrictions may be placed on the work in question in order for it to satisfy the ORIE MEng project requirement. Any requirements that need to be fulfilled in order for work to count as the ORIE MEng project will be specified by the SO Immersion Director and/or the ORIE MEng program Director prior to the beginning of the SO Immersion.

### **G. Systems Engineering Minor**

The Systems Engineering Minor prepares students to meet the increasing need from industry for engineers who go beyond the expertise in a particular engineering discipline. Within this minor program, students with diverse interdisciplinary skills integrate engineering system components, ensure total system operability, and evaluate various economic forces in the marketplace.

The Systems Engineering Minor requires four courses, one of which is a 2-semester Systems Engineering project, which satisfies the ORIE MEng project requirement. These courses must be incorporated into a schedule that meets the other requirements for the MEng degree in ORIE:

- Model Based Systems Engineering (ORIE 5140, Fall 4 crs)
- System Analysis, Behavior and Optimization (ORIE 5142, Spring 3 crs)
- Project Management (CEE 5900, Fall or Spring, 4 crs)
- Systems Engineering Project (ORIE 5940, Fall and Spring, 5-8 crs total)

The project course is central to the Systems Engineering Minor. Unlike project courses associated with other ORIE concentrations, the Systems Engineering project course spans two full semesters and requires a significant time commitment from students throughout the year. Popular projects include: the FSAE Racecar Team

[http://www.engineering.cornell.edu/academics/undergraduate/special\\_programs/student\\_teams/teams/fsae.cfm](http://www.engineering.cornell.edu/academics/undergraduate/special_programs/student_teams/teams/fsae.cfm),

and the BRAIN: Autonomous Underwater Vehicle

[http://www.engineering.cornell.edu/academics/undergraduate/special\\_programs/student\\_teams/teams/cuauv.cfm](http://www.engineering.cornell.edu/academics/undergraduate/special_programs/student_teams/teams/cuauv.cfm). Projects have also included such nontraditional topics as the design of financial products. All of these projects address system design, analysis, integration, implementation, and participation in competitions, by student-managed design teams.

### **H. One-Year MBA Program**

The Johnson Graduate School of Management (JGSM) offers a special One-Year MBA program to selected students who have completed an advanced degree in a technical field. This intensive twelve-month program begins in late May, making it amenable to students who are able to complete their MEng degrees in the traditional fall-spring sequence.

One-Year MBA students spend the summer taking a special version of the MBA core courses that emphasizes their technical skills. Once the summer sequence has been completed, these students join the second-year MBA class in the fall, participate fully in the regular academic-year program, and receive their MBA degree in May. More information can be obtained from the JGSM Office of Admissions in Sage Hall. Students must apply and be admitted to the JGSM as a separate process from their MEng admission.

For students who plan to combine an MEng degree with the One-Year MBA, the Johnson School accepts applications and admits students into the program up to 18 months before the applicant enrolls in the Johnson School (potentially before the student begins the MEng degree program). However, the Johnson School rarely accepts applicants without significant work experience.

For MEng students who are interested in eventually pursuing an MBA, the Knight Scholarship Program offers a valuable financial aid opportunity. The principal objective of the Lester Knight Scholarship Program is to assist and encourage top students in the College of Engineering to earn their MEng degree and, after gaining professional work experience (usually two to three years), their MBA. Currently, students admitted to the MEng program and selected to receive the Knight Scholarship will be awarded \$20,000 towards tuition while enrolled in the MEng program. Knight Scholars admitted to the MBA program at the Johnson Graduate School of Management will receive another \$20,000 towards tuition while registered in the MBA program. For more information, please visit <http://www.engineering.cornell.edu/student-services/rgs/financial-aid/knightscholarship.cfm> or the Office of Research and Graduate Studies, 222 Carpenter Hall.

## **IV. POLICIES AND PROCEDURES**

### **A. Early Admission for Cornell Undergraduates**

For students who are undergraduates at Cornell University, there is a provision for starting the Master of Engineering degree before completing the bachelor's degree. This is called early admission.

In order to qualify for early admission in a given semester, a student must need 8 or fewer credit hours to complete his or her bachelor's degree, including any special designations, when the semester begins. If the application for early admission is approved, the student registers as an undergraduate student and begins work on the MEng degree during the final semester of completing the bachelor's degree. Each course taken during this semester counts towards either the bachelor's degree or the master's degree, but not both. Students are required to complete their undergraduate programs during the early admission semester, and they must receive their bachelor's degrees before registering as MEng students the following semester. Please note that most Cornell undergraduate financial aid automatically terminates upon completion of the baccalaureate degree. If applicable, please discuss this with your undergraduate financial aid counselor.

The College of Arts and Sciences enforces additional restrictions on Arts and Sciences undergraduates who are seeking early admission into the MEng program. Contact the College of Arts and Sciences for more information.

### **B. Three Semester Degree Option**

Like the MBA, MD, and JD degrees, the MEng is a professional degree with a planned program timeframe. Barring unforeseen emergencies, major illnesses, or other extreme circumstances, students are expected to complete their degree requirements on schedule. For most MEng students, this means finishing in two semesters (or three semesters for the FE concentration). As mentioned in Section III, however, it may be difficult for a student to complete the requirements for a particular concentration in two semesters because of gaps in his or her background and/or the sequence and timing of courses offered. In such cases, the School of ORIE will allow an MEng student to pursue a third semester of study, provided that certain conditions are met.

A student who wishes to pursue an unscheduled third semester of study in the ORIE MEng program must notify the Director of the ORIE MEng program prior to the start of his or her second semester. The student must devise a suitable plan of study for the third semester, and during the third semester the student must successfully complete 12 or more credit hours, 3 or more of which must be taken for a letter grade in approved ORIE courses. The student's study plan must be approved by his or her academic advisor and the MEng Director.

### **C. Academic Advisors**

An academic advisor will be assigned to each student at the beginning of the Fall semester by the Graduate Student Services Coordinator, 201 Rhodes Hall. Students should contact their advisors during the first week of classes for advice on course selection and planning, but not before.

### **D. Good Standing Status**

Cornell uses a grading system with (+) and (-) and assigns decimal grade points to grades as follows: A+ = 4.3, A = 4.0, A- = 3.7, B+ = 3.3, B = 3.0, B- = 2.7, C+ = 2.3, C = 2.0, C- = 1.7, D+ = 1.3, D = 1.0, D- = 0.7, F = 0. A student must receive a final grade of C- or better in all courses that are required by his or her concentration. A grade of less than C- in any course will result in no credit being granted for that course toward the MEng degree, although the grade will still be factored into the student's GPA. The College of Engineering requires a minimum cumulative grade point average of 2.50 for graduation from the Master of Engineering Program.

The School of ORIE reviews MEng student records at the end of each semester. To attain good standing, a student must: (1) carry a course load that enables him or her to complete the MEng Program without unnecessary delay, (2) achieve a semester grade point average of 2.50 or better, (3) achieve a grade point average of 2.50 or better across all courses that satisfy the requirements of the MEng degree, and (4) attain a C- or better in every graded course taken.

Students who do not attain good standing during a term will be notified of their status in writing and will be invited to meet with appropriate ORIE faculty to discuss the situation. Extremely poor performance – for instance, failing to meet two or more of the criteria required for good standing – may lead to a student's immediate termination from the MEng program at the discretion of the MEng Program Director. Students who fail to attain good standing for two consecutive semesters typically will be asked to leave the MEng program.

### **E. Extramural and Transfer Credits**

Prior to matriculation into the MEng program and after the bachelor's degree is awarded, a maximum of 9 Cornell credit hours can be applied toward the MEng degree, provided they satisfy MEng degree requirements and have not been applied toward another degree. No other transfer credits are accepted by ORIE. MEng courses taken to satisfy prerequisites for the Financial Engineering concentration do not count toward the 30-credit-hour requirement. After matriculation into the MEng program, any extramural Cornell credit hours that satisfy the MEng technical requirements and have not been applied toward another degree may be counted (provided the student is registered for two semesters as a full-time ORIE MEng student before completing the program).

## **F. Petitioning**

Cornell University has a long-standing tradition of considering petitions from students if special situations or circumstances justify exceptions to the normal rules or requirements. These petitions may include possible course substitutions, exemptions from required courses, and/or academic actions. Any petition from a student should first be presented to his or her academic advisor and the MEng Director. If the issue is not resolved to the satisfaction of the student, he or she may appeal directly to the College's Graduate Professional Programs Committee.

## **G. Registration and Add/Drop Deadlines**

Upon arriving to campus, students should officially check in with the College of Engineering and pick up registration materials. All courses (except JGSM courses) will be available for on-line enrollment starting in mid-August for six weeks. Courses may be dropped on-line through mid-October. Students will be notified of the add and drop deadlines each semester. Pre-enrollment information for the following semester will be sent to students during the course of the semester.

## **H. Conduct**

Every ORIE MEng student is expected to exhibit courteous, professional, and honest behavior in all dealings with faculty, staff, and other students. MEng students are also expected to complete all required administrative tasks in a timely fashion. Discourteous, negligent, or deceitful behavior may result in action being taken against the student in accordance with Cornell University policy. In severe cases, a student may be terminated from the MEng program at the discretion of the MEng Program Director.

## **I. Exit Surveys and Interviews**

Each student near the completion of his or her MEng degree will be required to complete an exit survey and will be given the opportunity to meet with the MEng Program Director for a brief exit interview. Interviews will be scheduled at the end of each semester, and students will be notified of available time slots ahead of time.

## **J. Academic Integrity**

The School of Operations Research and Information Engineering adheres to the policies and procedures of the University on academic integrity, as stated in the *Policy Notebook for Cornell Community*. The principle of academic integrity and the general procedure to be followed in cases of violations of academic integrity may be found at: <http://cuinfo.cornell.edu/aic.cfm>. Here we repeat in full the Guidelines for Students:

A. *General Responsibilities*

1. A student shall in no way misrepresent his or her work.
2. A student shall in no way fraudulently or unfairly advance his or her academic position.
3. A student shall refuse to be a party to another student's failure to maintain academic integrity.
4. A student shall not in any other manner violate the principle of academic integrity.

B. *Examples of Violations*

The following actions are examples of activities that violate the Code of Academic Integrity and subject their actors to proceedings under the Code. This is not a definitive list.

1. Knowingly representing the work of others as one's own.
2. Using, obtaining, or providing unauthorized assistance on examinations, papers, or any other academic work.
3. Fabricating data in support of laboratory or field work.
4. Forging a signature to certify completion of a course assignment or a recommendation to graduate school.
5. Unfairly advancing one's academic position by hoarding or damaging library materials.
6. Misrepresenting one's academic accomplishments.

C. *Specific Guidelines for Courses*

1. **Examinations.** During in-class examinations no student may use, give, or receive any assistance or information not given in the examination or by the proctor. No student may take an examination for another student. Between the time a take-home examination is distributed and the time it is submitted by the student for grading, the student may not consult with any persons other than the course professor and teaching assistants regarding the examination. The student is responsible for understanding the conditions under which the examination will be taken.
2. **Course Assignments.** Students are encouraged to discuss the content of a course among themselves and to help each other to master it, but no student should receive help in doing a course assignment that is meant to test what he or she can do without help from others. Representing another's work as one's own is plagiarism and a violation of this Code. If materials are taken from published sources the student must clearly and completely cite the source of such materials. Work submitted by a student and used by a faculty member in the determination of a grade in a course may not be submitted by that student in a second course, unless such submission is approved in advance by the faculty member in the second course. If a student is submitting all or part of the same work simultaneously for the determination of a grade in two or more

different courses, all faculty members in the courses involved must approve such submissions.

3. **Academic Misconduct.** A faculty member may impose a grade penalty for any misconduct in the classroom or examination room. Examples of academic misconduct include, but are not limited to, talking during an exam, bringing unauthorized materials into the exam room, and disruptive behavior in the classroom.
  - a. The faculty member must promptly notify the student of the reason for the imposition of a penalty for academic misconduct and the degree to which his or her grade will be affected.
  - b. Academic misconduct is not a violation of academic integrity. The student may, however, seek review by the Academic Integrity Hearing Board on the basis either that the finding of guilt is arbitrary and capricious or that the penalty for academic misconduct is excessive or inappropriate to the circumstances involved. ("Arbitrary and capricious" describes actions which have no sound basis in law, fact, or reason or are grounded solely in bad faith or personal desires. A determination is arbitrary and capricious only if it is one no reasonable mind could reach.)

### C. *Principles for Computer Use and Network Systems*

The use of computers and network systems in no way exempts students from the normal requirements of ethical behavior in the Cornell University community. Use of a computer and network system that is shared by many users imposes certain additional obligations. In particular, data, software and computer capacity have value and must be treated accordingly.

Although some rules are built into computer and network systems, such restrictions cannot limit completely what students can do. In any event students are responsible for their actions whether or not rules are built in, and whether or not they can circumvent them.

Standards of behavior include:

1. Respect for the privacy of other users' information, even when that information is not securely protected.
2. Respect for the ownership of proprietary software. For example, unauthorized copies of such software for one's own use, even when that software is not protected against copying is inappropriate.
3. Respect for the finite capacity of the system and limitation of use so as not to interfere unreasonably with the activity of other users.
4. Respect for the procedures established to manage the use of the system.

*D. Variances*

A faculty member is responsible for informing his or her students and teaching assistants of variances from this Code that apply to work in his or her course. These variances should be clearly stated in writing at the beginning of the course or activity to which they apply.

*E. Jurisdiction and Penalties*

The authority to determine whether a specific action shall be treated as a violation of the Code of Academic Integrity lies with the Academic Integrity Hearing Board. Those who violate the Code of Academic Integrity will be subject to penalties under this Code and may also be subject to penalties under state and federal laws.

In the School of Operations Research and Information Engineering, students are expected to exercise reasonable care to prevent their work from being copied or used by others. Students who knowingly facilitate the use of their work by others will be considered guilty of a violation of academic integrity.

## **V. FINANCIAL AID**

The decision to attend graduate school is an investment in your future that will pay off both financially and with enhanced career opportunities. Over the past several years, not only has the MEng starting salary been \$10,000-\$12,000 higher (on average) than the starting salary for our undergraduates, but Masters students often enter the professional arena with a higher status or an advanced trajectory because of their additional training and experience.

Tuition and fees for the ORIE MEng program are those associated with Graduate School Endowed Professional Degrees (Tier 1), as listed at: <http://bursar.cornell.edu>. Tuition and fees for the 2016-2017 academic year are \$50,712 (or \$25,356 per semester). Cornell offers a convenient installment plan to pay tuition and certain other bursar billed items. For more information, contact the Bursar's office, 260 Day Hall, 607-255-6413; <http://www.bursar.cornell.edu>.

Two types of financial assistance are available to MEng students: merit-based aid and need-based aid. Within the School of ORIE, only merit-based aid is awarded. Need-based aid for graduate students comes primarily from federally or privately funded loan programs. Each is described in more detail below.

### **A. Merit-Based Financial Aid**

In the School of ORIE, merit-based aid for MEng students comes in the form of fellowships and Graduate Teaching Specialist positions. Research assistantships are not generally available to MEng students. For information on the Knight Scholarship, a College of Engineering Scholarship program for students who are also interested in pursuing an MBA degree, see [http://www.engineering.cornell.edu/academics/graduate/financial\\_aid/meng/scholarship.cfm](http://www.engineering.cornell.edu/academics/graduate/financial_aid/meng/scholarship.cfm).

If you answered "Yes" to the merit-based aid question when you applied to the MEng program, then you were automatically considered for merit-based financial aid. However, even if you answered "No" to this question, or if you did not receive financial aid at the time you were offered admission to the MEng program, there may still be a possibility for you to earn a GTS award.

Graduate Teaching Specialist positions are awarded to MEng students on a discretionary basis. Although most GTS positions for the fall semester are awarded well before classes begin, there are frequently several openings for the spring semester. GTS award decisions are based on a student's academic accomplishments, maturity, communication skills, and other factors. If a student demonstrates outstanding performance along these lines during the fall semester, he or she should notify the Graduate Student Services Coordinator in Rhodes 201 that he or she wishes to be considered for a GTS position in the spring. Each semester-long GTS position pays about \$6,288.

If you were (or are) an undergraduate student at Cornell, then please be aware that most Cornell undergraduate student financial aid automatically terminates upon completion of the baccalaureate degree. We recommend you discuss this with your undergraduate financial aid counselor.

Cornell's Graduate School Financial Aid office maintains a Fellowship Notebook Web site listing grants and fellowships awarded by various government agencies, foundations, corporations, and private sponsors: <http://gradschool.cornell.edu>. Please note, however, that most of these fellowships are reserved for research degree students (i.e., MS, PhD), not MEng.

## **B. Need-Based Financial Aid**

Need-based aid for graduate students comes primarily from several federally or privately funded loan programs (which are not administered through the School of ORIE). Federal Direct Loans, and Federal Direct Graduate Plus Loans, provide the bulk of this form of support. With these loan sources, U.S. citizens and permanent residents can usually cover all legitimate educational expenses.

Cornell participates in the Federal Direct Loan and Supplemental Loan and other loan programs. Applications and more detailed information can be obtained from the Financial Aid office, 143 Caldwell Hall, Cornell University, or <http://gradschool.cornell.edu/costs-and-funding/loans>.

International students can visit Cornell's Financial Aid office for information and online listings on loans and fellowships: <http://gradschool.cornell.edu>.

GEM Engineering Fellowships provide opportunities for underrepresented ethnic minority students to obtain a master's degree in engineering through a program of paid summer internship and financial assistance. GEM fellowships pay tuition, fees, and a stipend per graduate academic year. U.S. citizenship is required. The application is obtainable from the Diversity Programs in Engineering, 146 Olin Hall, Cornell, and must be submitted by November 1: <http://www.engineering.cornell.edu/diversity/resources/financial.cfm>. Note that some GEM-related materials on the web neglect to mention MEng, but MEng degree candidates *are* eligible for GEM Fellowships.

## **C. Employment Opportunities**

Any student who can prove their identity and eligibility to work in the United States may earn extra money by taking one of the 3,500 non-work study jobs available on or off campus. You can choose any job that interests you. Non-work study positions are listed by the Office of Student Employment, 203 Day Hall; <http://studentemployment.cornell.edu/>. We recommend that Master of Engineering students work no more than 10 hours per week, on average, while enrolled.

## **VI. UNIVERSITY RESOURCES**

### **A. Career Services**

The Cornell Engineering Career Center (201 Carpenter Hall; [http://www.engineering.cornell.edu/resources/career\\_services/](http://www.engineering.cornell.edu/resources/career_services/)) has an extensive on-campus recruiting program, in which hundreds of companies participate each year. You should visit this office during the first week of classes. You will need to make recruiting preparations early since interview sign-ups usually begin during the second or third week of the semester. Visit this office often, and take advantage of the extensive opportunities it offers to enhance your job search skills and to make contact with employers. Both the Cornell Engineering Career Center and the University Career Services Office (103 Barnes Hall) offer special programs on how to approach the job search, preparation of resumes, how to interview, etc. Announcements on these lectures and meetings will be posted online.

Each year the Cornell Engineering Career Center publishes an informative recruiting handbook that explains the College of Engineering Recruiting Process in detail. With all of the career resources available on campus, the primary responsibility for managing your career preparation and job search remains with you. With a little self-determination, we are confident that you will succeed!

### **B. Health and Counseling Services**

The demands of the ORIE MEng program can make it difficult at times for students to maintain a healthy work-life balance. Nevertheless, getting sufficient sleep, maintaining a healthy diet, and exercising can make an enormous difference in your graduate school experience. For more information about available resources, please see the Graduate Student Services Coordinator in 201 Rhodes Hall, or visit:

- Gannett Health Center, 110 Ho Plaza, [www.gannett.cornell.edu](http://www.gannett.cornell.edu) (607-255-5155)
- Cornell Fitness Centers, 305 Helen Newman Hall, <http://cornellbigred.com/> (607-254-5232)
- Counseling and Psychological Services, [www.gannett.cornell.edu](http://www.gannett.cornell.edu) (607-255-5208)

### **C. Student Organizations**

There are many dozens of student clubs and organizations at Cornell for individuals with special professional or social interests. See the Cornell Student Organizations Office website for group listings and information: <http://orgsync.rso.cornell.edu/>

Three groups that may be of general interest to all ORIE MEng students are:

- **MSLC** - Each year, nominations are solicited from the ORIE MEng class for candidates to serve on the MEng Student Leadership Committee. The members of this committee organize social events and cultural outings, arrange for industry speakers, and collectively act as spokesperson(s) for the ORIE MEng class. If you are interested in being a member of the committee, please contact the MEng Program Director.
- **INFORMS** - The Institute for Operations Research and the Management Sciences is the national professional organization for Operations Research. The Cornell student chapter of INFORMS serves the purpose of introducing students to the professional aspects of the field, career opportunities, and a variety of social activities, i.e. intramural teams, an annual banquet, and semiannual picnics. Cornell has an active INFORMS chapter, which MEng students are welcome to join. Through guest speakers from industry, plant tours, seminars, and social activities, members benefit from the opportunity to meet other students and professional engineers and to learn about the latest developments and opportunities in ORIE. The national INFORMS organization offer career-related information, including job postings, and other valuable resources ([www.informs.org](http://www.informs.org)).
- **SWE** - The Society of Women Engineers is a professional, non-profit, educational service organization of undergraduate and graduate engineers and men and women with equivalent engineering experience. The objective of the Society is to encourage, assist, and inform young women, parents and counselors, and the general public of the qualifications and achievements of women engineers and of the opportunities open to them in engineering. Hosting the Northeast Regional Conference and conducting a conference for high school students are a few of the major activities undertaken in recent years by the very active Cornell chapter of SWE. The SWE mailing address is 162 Olin Hall ([www.swe.cornell.edu](http://www.swe.cornell.edu)).

*This handbook was written to provide information to Master of Engineering students in the School of Operations Research and Information Engineering. Your comments and suggestions are greatly appreciated.*

### **Acknowledgements**

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## APPENDIX A.

### **SOME POPULAR ELECTIVE COURSES FROM OTHER DEPARTMENTS**

#### **A. Courses that are NOT Allowed to count toward the 30-credit-hour requirement for the MEng degree**

- Foreign languages, oral and written communication, the humanities, etc.
- BEE 4750, Environmental Systems Analysis
- Engrg 6780, TA Training.
- CEE 5930, Engineering Management Methods (except as noted)
- NBA 6430, Managerial Spreadsheet Modeling
- ORIE 3120, Industrial Data and Systems Analysis
- ORIE 3800, Information Systems and Analysis (except as noted)
- ORIE 3150, Financial and Managerial Accounting
- ORIE 4152, Entrepreneurship for Engineers
- ORIE 4990, Teaching in ORIE
- Generally speaking, courses numbered 4000 or above in the College of Engineering are allowed. Petitions to have 3000 level courses count towards an MEng degree will be considered. 2000 level courses are never allowed.

#### **B. Popular courses that can count toward the 30-credit-hour requirement for the MEng degree, but NOT the 19-credit-hour Technical Engineering requirement**

- CEE 5900, Project Management
- CEE 5940, Economic Methods for Engineering and Management
- CEE 5980, Introduction to Decision Analysis
- HADM 6010, Data Driven Analytics
- NBA 5020, Managerial Accounting and Reporting (Only admissible for students with no courses in either accounting or engineering finance.)
- NBA 5070, Entrepreneurship for Scientists and Engineers
- NBA 5400, Advanced Corporate Finance (or HADM 6260)
- NBA 5530, Accounting and Financial Decision Making
- NBA 5540, International Finance
- NBA 5550, Fixed Income Securities and Interest-Rate Options
- NBA 6010, Electronic Commerce
- NBA 6390, Data-driven Marketing (for letter grade only, no S/U)
- NBA 6450, Advanced Investment Strategies
- NBA 6650, The Strategic Management of Technology and Innovation
- NBA 6730, Derivatives Securities, Part I
- NBA 6740, Derivatives Securities, Part II
- SYSEN 5720, The Art of Innovation: A Hands On Approach
- NBA 6930, Strategy and Tactics of Pricing

**C. Popular courses from fields other than ORIE that can count toward the 19-credit-hour Technical Engineering requirement**

- Most technical courses numbered 4000 or above that are offered by the College of Engineering, Computer Science, Statistical Sciences, and the Department of Mathematics. Exceptions apply. A sample of popular choices from fields other than ORIE are listed below. Petitions are required for non-ORIE courses that are not on this list.
- CEE 4630, Future Transportation, Technology and Systems
- CEE 4640, Transportation Systems Design
- CEE 5970, Risk Analysis and Management
- CEE 6230, Environmental Quality Systems Engr.
- CS 5150, Software Engineering
- CS 5320, Intro to Database Systems
- CS 5786, Machine Learning for Data Science
- Econ 3140, Econometrics, or Econ 3120, Applied Econometrics
- Econ 6200, Econometrics II
- HADM 6050, Yield Management
- HADM 6290, Investment Analysis and Portfolio Management
- NBA 5240, Macroeconomics and International Trade
- NBA 5420, Investment and Portfolio Management
- NBA 6120, Disruptive Technologies
- NBA 6200, Marketing Research
- NBA 6410, Supply Chain Management
- STSCI 4030, Linear Models with Matrices
- STSCI 4740, Data Mining and Machine Learning

**APPENDIX B.**

**General  
ORIE MEng  
Requirements**

**TECHNICAL**  
**At least 30 hours including  
at least 22 outside of Johnson  
School, HADM, and AEM courses**

MEng Student  
Handbook text  
governs, if at  
variance

Courses in Appendix A Table B.  
ORIE 9100 and/or ORIE 5210 Colloquia 2  
Strategic Operations Concentration All hours

**TECHNICAL ENGINEERING**  
**At least 19 hours of technical  
engineering content**

Courses in Appendix A Table C.  
Most 4000+ level Engineering College courses.  
5980/5981 MEng Project 5  
5940 Sys.Engr. Project 6  
5910/5911 Manufacturing Opt. Des. Proj. 5  
5961 Applied Financial Engineering 5  
Strategic Operations Concentration 10 hours

**ORIE CONTENT**  
**At least 12 hours**

4000+ Level OR&IE Courses  
(but not 4990, 5940, 5910/5911, 5961, 5980/5981,  
9100, 9160)  
Strategic Operations Concentration 5 hours

**ORIE BASICS\*\***

5110 Case Studies	1
5300 Optimization I	4
5500 Probability and Statistics II	4
5580 Simu. Modeling & Analysis	4
5510 Stochastic Processes I	4
5311* Topics in Lin. Opt.	2

\* or 5310 Optimization II (4crs), or 5370 Optimization Modeling in Finance (3crs).

\*\* 5100, 3300, 3500, 4580, 3510, 3310, respectively, suffice as substitutes.