Cornell University

School of Operations Research and Information Engineering

Master of Engineering Student Handbook
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I. ORIE AT CORNELL

A. Introduction

The faculty of 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 program in Operations Research and Information Engineering (ORIE). It is intended to help you gain an understanding of the field of operations research at Cornell, the expectations and requirements of the Master of Engineering (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 instilled within the fields of optimization, probability, stochastic processes, statistics, and simulation. The areas of application for these tools are virtually limitless, but ORIE students generally apply their knowledge to the design, operation, and improvement of business systems.
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 engaging them in client-sponsored project work with real data, deadlines, and deliverables. Regardless of their respective concentrations, 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.

Seven concentrations and minors* are currently associated with the MEng degree program in ORIE. Each is designed to meet certain educational objectives. The concentrations and minors currently affiliated with the MEng in ORIE are as follows:

- 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

All of these concentrations and minors share a common set of base requirements, including a minimum number of course credit hours, core and distribution courses, and participation in an approved engineering design project. 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.

Regardless of concentration, 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, each student must have already taken and successfully completed:

1. A standard **engineering calculus sequence**, including linear algebra (with eigenvalues and eigenvectors), and vector calculus.

2. A basic **engineering probability and statistics course** equivalent to ENGRD 2700. Cornell’s description of this course is as follows:

   *Basic Engineering Probability and Statistics* (ENGRD 2700, 3 credits). Prerequisite: first year calculus.

   *This course should give students a working knowledge of basic probability and statistics as they apply to engineering work. Computer analysis data and simulation are emphasized. Topics include random variables, probability distributions, expectation, testing, experimental design, quality control and regression.*

3. An **intermediate-level computer programming course** in a language such as C, C++, Java, or MATLAB that includes the following topics: program organization, user interfaces, abstract data structures, functional recursion (functions or procedures that call themselves recursively), algorithm analysis and implementation. At Cornell, the appropriate course is:

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

   *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. Java is the principal programming language.*

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 Appendix C for a summary chart.) 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. Students may consult the online course catalog at www.cornell.edu/academics/courses.cfm for course details and descriptions.

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 9160. (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 technical can be counted toward the 30-credit-hour requirement. Most ORIE courses numbered 3000 or above qualify, with the exceptions of ORIE 3800, ORIE 3120, ORIE 3150 and ORIE 4990. 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. 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 B.S. degree usually count toward this requirement, but they do not apply toward the 30-credit-hour 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, and ORIE 4990. See Appendix B. For students who were ORIE undergraduate majors at Cornell, ORIE elective courses taken as an undergraduate in excess of the credits required for the B.S. degree usually count toward this requirement, but they do not apply toward the 30-credit-hour requirement.

e. Complete a minimum of 10 credit hours each semester toward the MEng degree. Please note that students may not count more than 20 credit hours toward the MEng degree in any semester.

f. Complete a minimum of 22 credit hours exclusive of courses in the Johnson Graduate School of Management and the School of Hotel Administration. Exception: This does not apply to students in the Strategic Operations concentration.

g. 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 from 201 Rhodes Hall, or on the ORIE web site: http://www.orie.cornell.edu/academics/master/resources/forms.cfm. All courses that count toward the MEng degree must be on a student’s study plan, and they 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 (but not both), or ORIE 5370
   - ORIE 5500
   - ORIE 5580 (replaced with ORIE 5581 and ORIE 5582 for Financial Engineering students)
   - ORIE 5510

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. In order to petition for a course waiver, the student must submit a completed Course Waiver Petition Form, along with any supporting documentation that details the course(s) previously taken. The form is available from 201 Rhodes Hall or at: http://www.orie.cornell.edu/academics/master/resources/forms.cfm.

c. Complete ORIE 9100 (fall and spring) with a passing grade (S). Exceptions: ORIE 9100 in the spring is waived for students in the SO concentration. Students in the Financial Engineering concentration
must take 2 colloquium credits from among ORIE 9100 (1 cr. each fall, spring), and ORIE 9160 (1 or 2 crs. offered at CFEM), with at least 1 credit in ORIE 9160.

d. Complete ORIE 5110 with a grade of C- or better. Exceptions: ORIE 5110 is waived for students in the Financial Engineering concentration and for students who have taken (or are currently taking) ORIE 5100.

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:

<table>
<thead>
<tr>
<th>Fall Semester:</th>
<th>Scheduled Hours:</th>
<th>Enrolled Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOR, IT, DA — ORIE 5980*</td>
<td>1</td>
<td>5 (R grade)**</td>
</tr>
<tr>
<td>Sys. Engr. Minor — ORIE 5940</td>
<td>3</td>
<td>3 (Letter grade)</td>
</tr>
<tr>
<td>Mfg. &amp; IE — ORIE 5910</td>
<td>2</td>
<td>5 (R grade)**</td>
</tr>
<tr>
<td>SO — (spring only)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>FE (fall only) — ORIE 5961***</td>
<td>5</td>
<td>5 (Letter grade)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Semester:</th>
<th>Scheduled Hours:</th>
<th>Enrolled Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOR, IT, DA — ORIE 5981*</td>
<td>4</td>
<td>5 (Letter grade)</td>
</tr>
<tr>
<td>Sys. Engr. Minor — ORIE 5940</td>
<td>3</td>
<td>3 (Letter grade)</td>
</tr>
<tr>
<td>Mfg. &amp; IE — ORIE 5911</td>
<td>3</td>
<td>5 (Letter grade)</td>
</tr>
<tr>
<td>SO — NBA6500, etc.</td>
<td>16</td>
<td>16 (Letter grade)</td>
</tr>
</tbody>
</table>

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 19-25.

* Cornell undergraduates starting the MEng program in the spring semester 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 5961 in their 2nd 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 Applied Operations Research Concentration has no specific elective requirements other than those implied by the base 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.

Students in DA must take two approved courses in Statistical Data Analysis, at least one of which must be an ORIE or STSCI course, one approved course in Database/Spreadsheet Technology, and one approved course in Marketing and Pricing Strategy. The currently approved courses for each of these areas are listed below. Other suitable courses may be substituted by petition.
Statistical Data Analysis (2 courses with a minimum total of 5.5 crs) one of which must be in ORIE or STSCI):

- ORIE 4740 Statistical Data Mining
- STSCI 4740 Data Mining and Machine Learning, Spring 4 crs
- ORIE 5550 Applied Time Series Analysis, Spring 3 crs
- ORIE 5640 Statistics for Financial Engineering, Spring 4 crs
- ORIE 4710 Applied Linear Statistical Models/ORIE 4711 Experimental Design, Spring 2 crs/Spring 2 crs (Note: this pair counts as a single course) (not offered 2014-15)
- NBA 6390 Data-driven Marketing, Fall 1.5 crs (letter grade only, no S/U)
- 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

Database/Spreadsheet Technology (1 course):

- CS 3300 Data-driven Web Applications, Spring 3 crs
- CS 4300 Information Retrieval, Fall, 3 crs
- CS 4302 Web Information Systems, Spring 3 crs
- CS 5780 Machine Learning, Fall, 4 crs
- CS 5320 Introduction to Database Systems, Fall 3 crs
- HADM 6010 Data Driven Analytics, Fall 3 crs
- ORIE 4820 Spreadsheet-Based Modeling and Data Analysis, Spring 3 crs
- STSCI 4500 Databases and Statistical Computing, Spring 4 crs

Marketing and Pricing Strategy (1 course):

- CS 5540 Computational Techniques for Analyzing Clinical Data, Spring 3 crs
- HADM 6050 Yield Management, Fall 3 crs
- NBA 6220 Marketing Strategy, Fall 3 crs
- NBA 6930 Strategy and Tactics of Pricing, Fall 3 crs
- ORIE 4154 Revenue Management, Spring 3 crs

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

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 Financial Engineering 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++. Note that 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 Program Office 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.
3-Semester Financial Engineering Program

Any proposed deviations from the requirements listed below require written permission from the Director of MEng Studies in the School of ORIE.

### Prerequisites

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Cr.Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob &amp; Stat sequence (ENGRD 2700 and ORIE 5500, or equivalent)</td>
<td>3 and 4</td>
</tr>
<tr>
<td>Stochastic Processes (ORIE 5510 or equivalent, recommended)</td>
<td>4</td>
</tr>
<tr>
<td>Computers and Programming (CS 2110)</td>
<td>4</td>
</tr>
<tr>
<td>Basic Finance course (online course or self study)*</td>
<td></td>
</tr>
</tbody>
</table>

### First Term (fall)

The following courses are required:

- 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 Derivatives (NBA 5550) 3
- Operations Research I: Optimization I (ORIE 5300) 4
- Monte Carlo Simulation (ORIE 5581) 2
- Enterprise Engineering Colloquium (ORIE 9100) (Optional—refer to footnote)† 1

### Second Term (spring)

The following courses are required:

- Financial Engineering with Stochastic Calculus II (ORIE 5610) or Credit Risk (ORIE 5620) 3-4
  - Quantitative Methods of Financial Risk Mgmt. (ORIE 5650) ** 3-4
- Statistics for Financial Engineering (ORIE 5640) or Time Series Analysis (ORIE 5550)** 3-4
- Topics in Linear Optimization (ORIE 5311) or Optimization II (ORIE 5310) or 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) ) (Optional—refer to footnote)† 1

### Summer Term

- Internship

### Third Term (fall) at Cornell Financial Engineering Manhattan (CFEM)

The following courses are required:

- Applied Financial Engr – Project Course (ORIE 5961) 5
- Computational Methods in Finance (ORIE 5630) 3
- Seminar in Financial Engineering (ORIE 9160)† 1-2

In addition, students must take a minimum of 6 credit hours from the following electives, of which 2 credit hours must be in ORIE courses taught at CFEM:

- Comprehensive Financial Statement Analysis (NBA 5061) (Fall) 3
- International Finance (NBA 5540) (Fall) 3
- Advanced Investment Strategies (NBA 6450) (Fall) 1.5
- Equity Derivatives and Related Products (NBA 6940) (Fall) 3
- Statistical Data Mining I (ORIE 4740) (Spring) 4
  - Data Mining and Machine Learning (STSCI 4740) (Fall) 4
- Applied Linear Statistical Models (ORIE 4710) (not offered 2014-15) 2
  - Linear Models with Matrices (STSCI 4030) (Fall) 4
- Introduction to Game Theory (ORIE 4350) (Spring) 4
- Multivariate Analysis (STSCI 4100) (Spring) 4
- Bond Mathematics and Mortgage-Backed Securities (ORIE 5660) (CFEM) 3
- Special Topics in Financial Engineering (ORIE 5912, ORIE 5913, ORIE 5914, ORIE 5915) (CFEM) 2-6

† A minimum of 2 colloquium credits are required from among the following options, with at least 1 credit in ORIE 9160: ORIE 9100 (1 cr. fall or spring), ORIE 9160 (1 or 2 crs offered at CFEM).

* 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, one course will count as FE elective credits.

*** If ORIE 5370 is taken, one credit of the three will count as a FE elective credit.

Note: Students in the FE concentration are exempt from taking Case Studies (ORIE 5110).
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 take four approved elective courses, 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 the list of other approved IT electives. The currently approved IT elective courses are listed below by area. Other suitable courses may be substituted by petition.

Technology and Infrastructure (at least 1 course):
- ORIE 4800 Information Technology, 4 crs (not offered 2014-15)
- CS 3410 Computer Systems Organization and Programming, Spring 4 crs
- CS 5300 The Architecture of Large-Scale Information Systems, Spring 4 crs
- CS 5320 Introduction to Database Systems, Fall 3 crs
- ECE 4450 Computer Networks and Telecommunications, Fall 4 crs
- ECE 5660 Fundamentals of Networks, Spring 4 crs

Information Economics and Strategy (at least 1 course):
- ORIE 3800 Information Systems and Analysis**, Spring, 4 crs
- HADM 7720 Information Systems Management, 3 crs
- INFO 4400 Advanced Human-Computer Interaction Design, Spring 3 crs
- NBA 6010 Electronic Commerce, Spring 3 crs
- ECE 5830 Introduction to Technical Management, Fall 3 crs

** ORIE 3800 may be taken ONLY by 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, Fall 4 crs
- CS 5150 Software Engineering, Fall 4 crs
- CS 5412 Cloud Computing
- SysEng 5300/5310 Systems Engineering & Six Sigma for Design and Operation of Reliable Systems
Other Approved IT electives:

- ORIE 4820 Spreadsheet-Based Modeling and Data Analysis, Spring 3 crs
- ORIE 4850 Applications of Operations Research and Game Theory to Information Technology, 3 crs (not offered 2014-15)
- ORIE 5126 Supply Chain Management, Spring 4 crs
- ORIE 5130 Service System Modeling and Design, 3 crs (not offered 2014-15)
- CS 3300 Data-driven Web Applications, Spring 3 crs
- CS 4300 Information Retrieval, Fall 3 crs

Students with good undergraduate preparation in operations research can complete the IT concentration in two semesters. Others may need three semesters to complete the IT concentration due to the fact that certain courses have 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 \textit{at most two} of these courses towards the satisfaction of the MEng IT concentration requirements (although no academic credit will be given towards the MEng degree).

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.

E. Manufacturing and Industrial Engineering Concentration

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

The Manufacturing and Industrial Engineering 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 Manufacturing and Industrial Engineering Design Project (ORIE 5910 and ORIE 5911) fulfills the ORIE MEng project requirement.
Manufacturing and Industrial Engineering Concentration
Requirements

Note: Subject to change. The 2014-15 requirements will be available at the ORIE MEng Orientation in August.

1. Manufacturing Focus Courses
   The following courses are required elements of the curriculum for the Manufacturing and Industrial Engineering Concentration. Any deletions or substitutions require the written approval of the Program Coordinator prior to the semester in which the substitution or deletion is sought.
   - ORIE 5100 Design of Manufacturing Systems (Fall, 4 credits)
   - NBA 5530 Accounting and Financial Decision Making (Spring, 3 credits)
     or NBA 5020 Managerial Cost Accounting (Fall, Spring, 3 credits)
   - ORIE 5910 Manufacturing Project (Fall, 2 credits)
   - ORIE 5911 Manufacturing Project (Spring, 3 credits)
   - ORIE 9100 Enterprise Engineering Colloquium (required Fall and spring, 1 credit each)

2. 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.

Select three courses (or more) from:
   - A&EP 6620 Micro/Nano-fabrication and Processing (Spring, 3 credits)
   - A&EP 6630 Nanobiotechnology (Fall, 3 credits)
   - CEE 5900 Project Management (Fall and Spring, 4 credits)
   - CEE 5930 Engineering Management Methods (Fall, 4 credits)
   - ECE 4320 MicroElectro Mechanical Systems (MEMS) (Spring, 4 credits)
   - ECE 5830 Introduction to Technical Management (Fall, 3 credits)
   - NBA 6120 Disruptive Technologies (Fall, 2 credits)
   - NBA 6410 Supply Chain Management (Spring, 4 credits)
   - NCC 5580 Managing Operations (Spring, 3 credits)
   - ORIE 5122 Inventory Management (Fall, 3 credits)
   - ORIE 5126 Supply Chain Management (Spring, 4 credits)
   - ORIE 5140 Model Based Systems Engineering (Fall, 4 credits)
   - SYSEN 5300 Systems Engineering Design (Fall, 3 credits)
3. Manufacturing and Industrial Engineering 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, John Callister.

**Manufacturing and Industrial Engineering Concentration students in ORIE 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.**

Students in the Manufacturing and Industrial Engineering Concentration must fulfill the requirements for the Master of Engineering degree and the Manufacturing and Industrial Engineering Concentration. This concentration requires five courses (ORIE 5100, NBA 5530, and 3 electives) to satisfy the Technology and Industry Breadth. If a student has already taken one or more ORIE core course, then it may be possible to complete the Manufacturing and Industrial Engineering Concentration in one academic year. Otherwise, it will take an additional semester to finish both the MEng degree and the Manufacturing and Industrial Engineering Concentration.

Applicants 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.

F. Strategic Operations Concentration (SO)

The keystone of the Strategic Operations Concentration (SO) is the Strategic Operations Immersion (SOI) course offered by the Johnson Graduate School of Management. This 16-credit-hour intensive “supercourse” 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 and faculty from the College of Engineering, the Johnson Graduate School of Management, and the School of Industrial and Labor Relations participate. For scheduling reasons, students taking the SO concentration frequently need to spend an extra summer at Cornell in order to complete the ORIE MEng degree requirements. 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.**
Instruction in the SO 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.

Exclusive of the Strategic Operations Immersion course, students concentrating in SO may not count more than 3 credit hours in JGSM or HADM courses toward their MEng degree. The Strategic Operations Immersion course contributes a total of 5 credit hours toward the 12 credit hours to be taken in the School of ORIE (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 summer.

The ORIE MEng Project requirement can be fulfilled within the framework of the SO Immersion semester. The manner in which this is done may vary from year to year. Frequently, 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 credits)
- System Analysis, Behavior and Optim. (ORIE 5142, Spring, 3 credits)
- Project Management (CEE 5900, Fall or Spring, 4 credits)
- Systems Engineering Project (ORIE 5940, Fall and Spring, 5-8 credits 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), the BRAIN: Autonomous Underwater Vehicle (http://www.engineering.cornell.edu/academics/undergraduate/special_programs/student_teams/teams/cuauv.cfm), and the Robot World Cup Soccer Games (http://www.cis.cornell.edu/boom/2005/ProjectArchive/robocup/). 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. Accelerated MBA Program

The Johnson Graduate School of Management (JGSM) offers a special Accelerated 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.

AMBA 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, AMBA 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 Accelerated 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 a short break to gain 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 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 first semester in which they are enrolled in the early admission program, and they must receive their bachelor's degrees before registering as MEng students the following semester. Please note 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 and the Graduate School financial aid office in Caldwell Hall.

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 (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 the student must successfully complete 10 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 Representative, 201 Rhodes Hall. Students should contact their advisors by the middle of the first week of classes for advice on course selection and planning.

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. Note that 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 ORIE courses, 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. 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 may 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 Graduate School at Bartels Hall and pick up registration materials. All courses (except JGSM courses) will be available for on-line enrollment starting the first week of 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 (http://cuinfo.cornell.edu/Academic/AIC.html) for Cornell Community. The definition of academic integrity as it appears in the Policy Notebook (which governs) is as follows:

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.)

D. **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:

i. Respect for the privacy of other users' information, even when that information is not securely protected.
ii. 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.

iii. Respect for the finite capacity of the system and limitation of use so as not to interfere unreasonably with the activity of other users.

iv. Respect for the procedures established to manage the use of the system.

E. 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.

F. 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.

The general procedure to be followed in cases of violations of academic integrity is as follows (more extensive details are found at http://cuinfo.cornell.edu/Academic/AIC.html):

1. The faculty member may summon the student to an interview, called a Primary Hearing, but this is not mandatory. At the primary hearing there must be a third party, appointed by the School, present to witness the proceedings. If the faculty member finds the charge supported, he or she may impose a penalty of a failing grade in all or part of the course. A finding of guilt is to be reported to the student's college.

In the School of Operations Research and Information Engineering, the penalty for violations of academic integrity is automatic failure of the course involved, unless the faculty member determines that there are mitigating circumstances and chooses to impose a lesser penalty. Courses failed because of such violations may not be dropped.

Violations of academic integrity will be reported to the student's college, which will maintain a record, and may recommend a review by the Dean in cases of repeated violations by a student.
2. The case may be heard by the Academic Integrity Hearing Board of the College of Engineering if:

   a. the student wishes to appeal the findings of the primary hearing on one of three grounds - lack of due process, excessively harsh penalty, or contested judgment of the faculty member; or
   b. the faculty member wishes to impose a 
      
      harsher penalty than failure of the course; or
   c. the faculty member wishes to omit the primary hearing; or
   d. the Dean summons the student because of repeated violations.

The Hearing Board may clear the student, affirm the penalty imposed by the faculty member, or impose a harsher penalty including recording the violation on the student's transcript, suspension, or expulsion.
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 three 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 higher status because of their advanced training and experience.

Tuition and fees for the ORIE MEng program are those associated with Graduate School Endowed Professional Degrees, as listed at: http://bursar.cornell.edu. Tuition and fees for the 2014-2015 academic year are $47,505 (or $23,525 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

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 already 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 $5,867.
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 and the Graduate School financial aid office in Caldwell Hall.


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/](http://studentemployment.cornell.edu/). We recommend that Master of Engineering students work no more than 10 hours per week, on average, while enrolled as a full-time student.
VI. UNIVERSITY RESOURCES

A. Career Services

The Engineering Career Services Office (201 Carpenter Hall; http://www.engineering.cornell.edu/resources/career_services/) has an extensive on-campus recruiting program, in which more than 250 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. Many students do not have well developed job seeking skills. Visit this office often, and take advantage of the extensive opportunities it offers to enhance your skills and to make contact with employers. Both the Engineering Career Services Office and the University Career Services Office (103 Barnes Hall) have special programs on how to approach the job market, preparation of resumes, how to take interviews, etc. Announcements on these lectures and meetings will be posted online.

Each year, the Engineering Career Services Office 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, please refer to:


Counseling and Psychological Services, 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 Activities Office website for group listings and information: http://sao.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/IIE** - The *Institute for Operations Research and the Management Sciences* is the national professional organization for Operations Research. The *Institute of Industrial Engineers* is the national professional organization of Industrial Engineers. Student chapters of INFORMS and IIE serve 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 a very active joint INFORMS/IIE 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 and IIE organizations offer career-related information, including job postings, and other valuable resources.

- **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.*

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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
   - NBA 6430, Managerial Spreadsheet Modeling
   - ORIE 3120, Industrial Data and Systems Analysis
   - ORIE 3800 Information Systems and Analysis
   - ORIE 3150, Financial and Managerial Accounting
   - ORIE 4152, Entrepreneurship for Engineers
   - ORIE 4990, Teaching in ORIE
   - Generally speaking, only courses numbered 4000 or above 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 Cost Accounting (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
   - NBA 6940, Equity Derivatives and Related Products
   - ORIE 9100, Applied ORIE Colloquium
   - DA concentration only:
     - NBA 6220, Marketing Strategy
     - 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 and by the Department of Mathematics. Note the exceptions listed in parts A and B above. In particular, ORIE 9100 ORIE and ORIE 9160 are not allowed. Some popular choices from fields other than ORIE are listed below. Petitions are required for non-ORIE courses that are not on this list.
- CEE 5290, Heuristic Methods for Optimization
- CEE 5970, Risk Analysis and Management
- CEE 6230, Environmental Quality Systems Engr.
- CEE 4630, Future Transportation, Technology and Systems
- CEE 4640, Transportation Systems Design
- CS 5150, Software Engineering
- CS 5320, Intro to Database Systems
- CS 5780, Machine Learning
- Econ 3140, Econometrics, or Econ 3120, Applied Econometrics
- Econ 6200, Econometrics II
- HADM 6050, Yield Management
- HADM 6290, Investment Analysis and Portfolio Management
- MSE 5420, Flexible Electronics
- MAE 4170, Intro. to Robotics
- 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.
COURSES USED TO SATISFY THE REQUIREMENT OF 12 CREDIT HOURS OF SCHOOL OF ORIE COURSES

<table>
<thead>
<tr>
<th>Fall 2014 Courses (cr.hrs.)</th>
<th>Spring 2015 Courses (cr.hrs.)</th>
<th>Courses Not Offered Acad.Yr. 2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIE 4350(4) Intro. to Game Theory</td>
<td>ORIE 4154(3) Revenue Management</td>
<td>ORIE 4320(4) Nonlinear Optimization</td>
</tr>
<tr>
<td>ORIE 4600(3) Intro. to FE (for non-FE's)</td>
<td>ORIE 4740(4) Statistical Data Mining</td>
<td>ORIE 4330(4) Discrete Models</td>
</tr>
<tr>
<td>ORIE 4630(3) O.R. Tools for FE (for non-FE's)</td>
<td>ORIE 4820(3) Spreadsheet Based Modeling/Data Analysis</td>
<td>ORIE 4360(3) Math. Exam. of Fair Representation</td>
</tr>
<tr>
<td>ORIE 5100(4) Design of Manu. Systems</td>
<td>ORIE 5126(3) Principles of Supply Chain Management</td>
<td>ORIE 4540(3) Extreme Value Analysis...</td>
</tr>
<tr>
<td>ORIE 5110(1) Case Studies</td>
<td>ORIE 5128(2) Apps of OR to Health Systems</td>
<td>ORIE 4710(2) Applied Linear Models</td>
</tr>
<tr>
<td>ORIE 5140(4) Model Based Systems Engr</td>
<td>ORIE 5142(3) Systems Analysis, Behavior, &amp; Optim.</td>
<td>ORIE 4711(2) Experimental Design</td>
</tr>
<tr>
<td>ORIE 5300(4) ORI: Optimization</td>
<td>ORIE 5150(4) Econ. Analysis of Engr. Systems</td>
<td>ORIE 4800(4) Information Tech. for OR&amp;IE</td>
</tr>
<tr>
<td>ORIE 5500(4) Engr. Probability &amp; Statistics II</td>
<td>ORIE 5311(2) Topics in Linear Optimization**</td>
<td>ORIE 4850(3) App. of OR &amp; Game Theory</td>
</tr>
<tr>
<td>ORIE 5581(2) Monte Carlo Simul. (for FE's)</td>
<td>ORIE 5510(4) Intro. to Engr Stochastic Proc. I</td>
<td>ORIE 5122(3) Inventory Management</td>
</tr>
<tr>
<td>ORIE 5600(4) Fin.Engr.with Stoch. Calc.I</td>
<td>ORIE 5550(4) Applied Time Series Analysis</td>
<td>ORIE 5127(2) OR Apps in Supply Chain Mgmt</td>
</tr>
<tr>
<td>ORIE 5582(2) Monte Carlo Methods in FE (for FE's)</td>
<td>ORIE 5620(4) Monte Carlo Methods in FE (for FE's)</td>
<td>ORIE 5130(3) Service System Modelling &amp; Design</td>
</tr>
<tr>
<td>Courses offered at CFEM (NYC) only</td>
<td>ORIE 5620(4) Compu. Methos in Finance</td>
<td>ORIE 5520(4) Intro. to Engr. Stoch. Proc. II</td>
</tr>
<tr>
<td>ORIE 5660(3) Bond Math</td>
<td>ORIE 5640(4) Statistics for Financial Engineering</td>
<td>ORIE 5661(2) Intro. to US Bond Markets</td>
</tr>
<tr>
<td>ORIE 5912(2) Special Topics in FE</td>
<td>ORIE 5913(2) Special Topics in FE II</td>
<td>ORIE 5770(3) Quality Control</td>
</tr>
<tr>
<td>ORIE 5914(2) Special Topics in FE III</td>
<td>ORIE 5915(2) Special Topics in FE IV</td>
<td></td>
</tr>
</tbody>
</table>

**ORIE 5311 does not count if student is taking (or has taken) ORIE 3310/5310.**

ORIE 4990, ORIE 9100, ORIE 9160, ORIE 5940, ORIE 5910/5911, ORIE 5980/5981, ORIE 5960, ORIE 5961 do not count toward the 12 cr. hr. requirement in ORIE courses.

ORIE 5190/5191 (Independent Study / Selected Topics in Applied OR) **counts with approval of advisor.**

Strategic Operations Concentration (SO) **counts** 5 credit hours.

Note: 1) MEng students must obtain prior approval from the instructor to enroll in 6000 level ORIE courses.

2) Students may receive credit for ORIE 4600 or ORIE 5600, but not both.
**APPENDIX C.**
Short Guide to OR&IE MEng Requirements

**TECHNICAL**
At least 30 hours including at least 22 hours outside JGSM

- 3000+ level OR&IE courses (not 3800, 3120, 3150).
- Courses in Appendix A Table B.
- 5961 Applied Financial Engineering 5
- Strategic Operations Concentration 10 of the 16 hours

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

- Courses in Appendix A Table C.
- Most 4000+ level Engineering College courses.
- Cornell ORIE U/G: Tech electives in excess of 18 hrs.
- 5980/5981 MEng Project 5
- 5940 Sys.Engr. Project 6
- Strategic Operations Concentration 10 of the 16 hours

**ORIE CONTENT**
At least 12 hours

- 4000+ Level OR&IE Courses (but not 4990, 5940, 5910/5911, 5961, 5980/5981, 9100, 9160)
- Cornell ORIE U/G: OR electives in excess of 9 hrs
- Strategic Operations Concentration 5 of the 16 hrs

**ORIE BASICS**

- 5110 Case Studies 1
- 5300 OR I - 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) (but not both), or 5370 Optimization Modeling in Finance (3crs).

** 3300, 3310, 3500, 3510, 5100, 4580 suffice if taken as an undergraduate.