

# Cornell University

Applied OR

Data Analytics

Financial  
Engineering

Information  
Technology

Manufacturing &  
Industrial  
Engineering

Strategic  
Operations

Systems  
Engineering

# School of Operations Research and Information Engineering

## Master of Engineering Student Handbook

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## **I. ORIE AT CORNELL**

### **A. Introduction**

Welcome to Cornell! This handbook is a guide to the Master of Engineering (MEng) program in Operations Research and Information Engineering (ORIE). The sections that follow outline 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. We look forward to getting to know you and are confident that you will have a challenging and rewarding educational experience!

### **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 is highly valued in the marketplace and continues to be an attractive option for well-prepared undergraduates in Operations Research, Industrial Engineering, Computer Science, Information Science, Mathematics, Finance, Statistics, and many other quantitative disciplines.

The main objectives of the ORIE MEng program at Cornell are to advance the breadth and depth of our students' technical knowledge and to provide them 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, simulation, statistics, and data science. 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 must fulfill a set of general curriculum requirements (detailed in Section II), including a minimum number of credit hours in various types of courses, course requirements (including ORIE Core,

colloquium, and project preparation courses), and participation in a capstone engineering design project.

Seven concentrations and minors\* are currently associated with the ORIE MEng program:

- 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

Each concentration and minor is designed to meet certain educational objectives and has corresponding elective requirements that must be met *in addition to* the general requirements. Students in the Financial Engineering concentration also have the option of completing the Financial Data Science (FDS) Certificate as part of their studies. Details for each concentration and the FDS Certificate 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 provides an intensive learning experience that is fundamentally different from the completion of a traditional individual Masters' thesis. It is intended to prepare students for the professional arena by having them engage in project work with organizational partners that involves real data, deadlines, and deliverables. ORIE MEng students are expected to play major roles in all aspects of their projects, including formulating and analyzing the problem, managing the partner 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 sequence of course offerings 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 some students are admitted to the ORIE MEng program in the spring semester, spring admission is typically limited to well-prepared applicants who are already at Cornell and have been able to participate in professional development and 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 certificate or transcript verification that they have successfully completed the following coursework at a degree granting institution:

1. A standard **engineering calculus sequence**, including linear algebra (with eigenvalues and eigenvectors), and vector calculus, similar in content and rigor to Cornell's MATH 1910, MATH 1920, and MATH 2940.
2. An introductory **engineering probability and statistics course**, covering fundamental theory, and similar in content and rigor to Cornell's ENGRD 2700.
3. An **intermediate-level computer programming course** in a general programming language such as C++, Java, or Python, similar in content and rigor to Cornell's ENGRD 2110. Courses that entail programming applications, but where programming is not the primary focus are not acceptable substitutes. Courses in statistical modeling languages, such as R and SAS, are not acceptable substitutes by themselves.

ENGRD 2700 and ENGRD 2110 are offered each semester and also during the summer at Cornell. Information is available at the Summer Session Office, B20 Day Hall, (607) 255-4987, or at [www.sce.cornell.edu](http://www.sce.cornell.edu). Prerequisite course work completed more than five years prior to the start of the MEng program must be retaken or reinforced in an approved manner.

Please note that the certain concentrations have additional prerequisites. See Section III for details. Failure to satisfy program prerequisites will jeopardize a student's academic standing at Cornell and may result in a mandatory concentration change or (in extreme cases) a leave of absence until all prerequisites are met.

### **B. General Curriculum Requirements**

This section details the credit hour, course, and project requirements each student must fulfill to receive the Master of Engineering degree in ORIE. A diagram summarizing these requirements can be found in Appendix B.

Students should consult the ORIE MEng program office (201 Rhodes) to confirm that their specific course selections meet the general requirements. Although academic 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.***

Current course offerings and descriptions may be found at: <http://courses.cornell.edu/>. **Certain courses may not be offered every year.**

## 1. Credit Hours

Every ORIE MEng student must:

- a. Register as a full-time MEng student for two or more semesters. To be considered full-time, federal rules stipulate that a student must be enrolled in at least 12 credit-bearing hours. Exceptions: Industrial Partnership Program students and Cornell University employees in the Employee Degree Program may enroll part time. Cornell undergraduates in the Early Admission program must register as full-time MEng students for at least one semester following their Early Admit semester (see section IV.G for details).
- 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 the seminar and professional practicum courses (ORIE 9100, ORIE 9115, ORIE 5210, and ORIE 5215), which must be taken S/U. A maximum of 2 credit hours of S/U 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 numbered 4000 or above qualify, as do several technical courses from other Cornell schools and colleges. Appendix A lists popular courses that meet this requirement, courses that require special petition approval, and courses that *do not* meet this requirement. **Courses not described as approved or listed as approved in Appendix A will be allowed by petition only.** Petitions must be approved by the student's academic advisor and the MEng Program Director before the course add deadline.
- c. Complete a minimum of 9 letter-graded ORIE credit hours as part of the 30 credit hours of technical coursework, not including the MEng project, colloquium/professional practicum courses, independent study courses, or any ORIE courses explicitly disallowed in Appendix A (e.g., ORIE 4152, ORIE 4990).
- d. Complete at least 10 credit hours that count toward the MEng degree in each of the first two semesters the student is enrolled, and no more than 20 credit hours in any semester. The maximum is dictated by College of Engineering policy. 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.
- e. Complete a minimum of 22 credit hours that count toward the MEng degree exclusive of Cornell SC Johnson College of Business courses and courses deemed as equivalent. That is, ORIE MEng students may count at most 8 credit hours of approved Cornell Business courses (or equivalent) toward the MEng degree. This limit applies to all courses offered by Johnson, Dyson, and the Hotel School, as well as courses specified in Appendix A.C as counting towards this limit. Exception: Strategic Operations concentrators may count up to 15 credit hours of approved Cornell Business courses (or equivalent) toward the MEng degree.

## 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 detailing all courses in which the student is enrolled or intends to enroll for that term. Study plan templates are available in 201 Rhodes Hall and at: <https://www.orie.cornell.edu/orie/programs/meng-degree-ithaca/meng-resources>. The study plan must be approved and signed by the student's academic advisor. **Certain courses may not be offered every year.**
- b. Fulfill ORIE Core requirements. These consist of successfully completing 12 or more letter-graded credit hours among the courses listed in this section, including:
  - 8 or more credit hours in ORIE courses;
  - 3 or more credit hours at the 5000-level or above; and
  - 3 or more credit hours in each of the following categories:
    - Optimization Modeling
    - Stochastic Modeling
    - Data Science and Statistical Modeling

Approved courses for each of the categories are given below. Although certain courses appear in multiple categories, a student may count a course towards at most one of the categories. Courses that a student has taken prior to enrolling in the ORIE MEng program do not count towards satisfying ORIE Core requirements, except as noted below and in section IV.D. In addition, courses taken to count towards the ORIE Core requirements may not be “double-counted” towards concentration-specific requirements unless the concentration explicitly allows it.

**Note that ORIE 5300 is a prerequisite for most courses in the Optimization Modeling category, and ORIE 5500 is a prerequisite for most courses in the Stochastic Modeling category and the Data Science and Statistical Modeling category. Students lacking these foundational courses are strongly advised to take them prior to (or concurrently with) others in those categories.**

### Optimization Modeling Courses:

- ORIE 4140 – Mathematical Modeling of Operational Systems (F 2 cr)
- ORIE 4350 – Intro to Game Theory (F 4 cr)
- ORIE 5100 – Design of Manufacturing Systems (F 4 cr)
- ORIE 5126 – Principles of Supply Chain Management (S 4 cr)
- **ORIE 5300 – Optimization I (F 4 cr)**
- ORIE 5310 – Optimization II (S 4 cr)
- ORIE 5370 – Optimization Modeling in Finance (S 3 cr)
- ORIE 63XX courses (ONLY with Instructor and Advisor Approval)
- MATH 3610 – Mathematical Modeling (F 4 cr)
- MATH 4260 – Numerical Analysis: Linear & Nonlinear Problems (S 4 cr)
- SYSEN 6800 – Computational Optimization (F 4 cr)

### Stochastic Modeling Courses:

- ORIE 4600 – Intro to Financial Engineering (S 3 cr)\*
- ORIE 4630 – OR Tools for Financial Engineering (F 3 cr)\*\*
- ORIE 5100 – Design of Manufacturing Systems (F 4 cr)
- ORIE 5126 – Principles of Supply Chain Management (S 4 cr)
- ORIE 5130 – Service System Modeling and Design (F 3 cr)
- **ORIE 5500 – Engineering Prob and Stat II (F 4 cr)\*^**
- ORIE 5510 – Intro to Engineering Stochastic Processes I (S 4 cr)\*\*\*
- ORIE 5580 – Simulation Modeling and Analysis (F 4 cr)
- ORIE 5581 – Monte Carlo Simulation (F 2 cr)
- ORIE 5582 – Monte Carlo Methods in FE (S 2 cr)
- ORIE 5600 – Financial Engineering with Stochastic Calculus I (F 4 cr)
- ORIE 65XX courses (ONLY with Instructor and Advisor Approval)
- ECE 4110 – Random Signals in Comm. and Signal Processing (F 4 cr)
- ECE 4271 – Evolutionary Processes, Algorithms, Games (S 3 cr)

### Data Science and Statistical Modeling Courses:

- ORIE 4630 – OR Tools for Financial Engineering (F 3 cr)\*\*
- ORIE 4740 – Statistical Data Mining I (S 4 cr)
- ORIE 4741 – Learning with Big Messy Data (F 4 cr)
- ORIE 4742 – Information Theory, Probabilistic Modeling, & Deep Learning with Scientific & Financial Applications (S 3 cr)
- ORIE 5550 – Applied Time Series Analysis (S 4 cr)
- ORIE 5640 – Statistics for Financial Engineering (S 4 cr)
- ORIE 67XX courses (ONLY with Instructor and Advisor Approval)
- CS 5780 – Machine Learning for Intelligent Systems (F 4 cr)
- CS 5786 – Machine Learning for Data Science (S 4 cr)
- ECE 5412 – Bayesian Estimation and Stochastic Optimization (S 3 cr)
- STSCI 4090 – Theory of Statistics (F,S 4 cr)\*^
- STSCI 4740 – Data Mining and Machine Learning (F 4 cr)
- STSCI 4780 – Bayesian Data Analysis: Principles and Practice (S 4 cr)
- STSCI 5030 – Linear Models with Matrices (F 4 cr)
- SYSEN 6880 – Industrial Big Data Analytics & Machine Learning (S 4 cr)

\* Disallowed for MEng credit for FE concentrators

^ Disallowed for MEng credit for Data Analytics concentrators

\*\* Disallowed for DSSM Core for FE concentrators (OK for Stoch Core/general ORIE credit)

\*\*\* Disallowed for Stoch Core for FE concentrators (OK for general ORIE credit)

**Eligibility to waive one ORIE Core area:** Students who have previously completed six or more letter-graded credits of ORIE Core course work in a particular area, three or more of which must be in ORIE courses (e.g., a Cornell undergraduate who has already taken the ORIE 3300/3310 sequence) may elect to waive that area. A student may waive at most one of the ORIE Core areas and must indicate on his or her study plan the previously completed courses being used to satisfy the waiver requirement. (The credit hours from these previously taken courses do not count as credit hours towards the MEng degree.) Students opting to waive an ORIE Core area must still complete 8 or more letter-graded credit hours among the allowed courses in the Core category lists, including:

- 6 or more credit hours in ORIE courses;
- 3 or more credit hours at the 5000-level or above; and
- 3 or more credit hours in each of the two remaining categories.

In addition, students opting to waive an ORIE Core area are still subject to all of the credit hour requirements detailed in section II.B.1 and all of the concentration requirements detailed in section III.

- c. Earn 1 colloquium credit with a passing grade (S). Students in the Financial Engineering concentration must complete ORIE 5210 during the CFEM semester. All other ORIE MEng students must complete ORIE 9100 during the fall semester (or an approved substitute).
- d. Earn 1 professional practicum credit with a passing grade (S). Students in the Financial Engineering concentration must complete ORIE 5215 during the first fall semester. All other ORIE MEng students must complete ORIE 9115 during the fall semester. Spring admits to the ORIE MEng program who did not take ORIE 5215 or ORIE 9115 during the previous fall semester must work with their academic advisors and the MEng Director to devise a suitable plan to satisfy this requirement.
- e. Successfully complete the project preparation course ORIE 5110 or ORIE 5100 during the fall semester. Exception: This requirement is waived for students in the Financial Engineering concentration.
- f. Resolve any incomplete course grade within one semester of the submission of the incomplete.

### 3. Engineering Design Project

Each ORIE Master of Engineering student must successfully complete an approved team-based engineering design project. MEng projects typically have industrial, financial, or government-related organizations as partners 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.

Students in the Strategic Operations (SO) concentration undertake team-based project work as part of their holistic immersion experience and do not enroll in a separate project course to satisfy the MEng project requirement.

In all other cases, students should enroll in project courses each semester according to the following tables. A final written report must be submitted and signed by the faculty project advisor(s), and a final oral presentation must be made to the partner organization. Full commitment, participation, and teamwork are expected of all students.

<u>Fall Semester:</u>	<u>Effective Credit 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)**
FE (CFEM) — ORIE 5220***	5	5 (Letter grade)
<u>Spring Semester:</u>	<u>Effective Credit 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)

**Students enrolled in ORIE 5980/5981 are required to return to Cornell at least two full weeks before spring semester classes begin to work on their MEng projects. Spring semester classes begin between January 20-27.**

\* *Cornell undergraduates starting the MEng program in the spring semester and concentrating in AOR, DA, or IT should enroll in ORIE 5980 the preceding fall.*

\*\* *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 during their 2<sup>nd</sup> fall semester at CFEM.*

## C. Other Requirements

This section outlines other requirements each student must fulfill to receive the Master of Engineering degree in ORIE.

### 1. Good Academic Standing

ORIE MEng students are expected to maintain good academic standing throughout their degree program and must achieve it to graduate. To attain good standing, an ORIE MEng student must:

- Satisfy all prerequisites prior to beginning the program, as described in section II.A;
- Carry a course load that enables him or her to complete the program without unnecessary delay;
- Achieve a grade point average (GPA) of 2.50 or better in each semester;
- Achieve a cumulative GPA of 2.50 or better across all courses satisfying the requirements of the MEng degree, and
- Attain a C- or better in every graded course taken.

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 grade lower 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 cumulative GPA of 2.50 or better for graduation from the Master of Engineering program.

Students who fail to maintain good academic 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 mandatory leave of absence from the MEng program at the discretion of the MEng Program Director. This includes students who enter the ORIE MEng program with prerequisite deficiencies and subsequently fail to attain good academic standing during the first term. Students who fail to attain good academic standing for two consecutive semesters typically will be asked to withdraw from the MEng program.

## **2. MEng and CFEM Exit Surveys**

Every MEng student nearing the completion of his or her degree is required to complete the mandatory MEng Exit Survey administered by the College of Engineering. This survey must be completed in order for a student to receive his or her MEng degree. ORIE MEng students will also be given the opportunity to meet with the MEng Program Director or the CFEM Director for a brief exit interview. Interviews will be scheduled towards the end of each semester, and students will be notified of available time slots ahead of time.

In addition to the MEng Exit Survey, students in the Financial Engineering concentration must complete the CFEM Exit Survey administered by CFEM towards the end of their second fall semester. Like the MEng Exit Survey, the CFEM Exit Survey is mandatory and must be completed in order for a student to receive his or her MEng degree

### **III. CONCENTRATION AND MINOR REQUIREMENTS**

This section outlines additional prerequisites and course requirements for each concentration and minor associated with the ORIE MEng program. Upon enrolling in a concentration, students must provide certificate or transcript verification that they have successfully completed the necessary prerequisite coursework at a degree granting institution. In creating their study plans, students should note that ***certain courses may not be offered every year.***

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

*Additional prerequisites: None*

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 appropriate for students with undergraduate degrees in ORIE who want to increase the breadth of their exposure to operations research and its applications, as well as for those with undergraduate degrees in other fields who want to gain a solid foundation in the theory and practice of OR.

AOR concentrators must complete 12+ letter-graded credit hours of approved ORIE-labeled coursework, excluding project, practicum, colloquium, and independent study courses. Any ORIE courses taken to satisfy ORIE Core requirements may also be counted towards the concentration requirement. (Hence, for AOR concentrators, the general curriculum requirement specified in section II.B.1.c is effectively raised from 9 ORIE credit hours to 12 ORIE credit hours.) The MEng project for AOR students is completed as the course sequence ORIE 5980 and ORIE 5981.

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

*Additional prerequisites: A two-semester sequence of calculus-based probability and statistics theory, similar in content and rigor to Cornell courses ENGRD 2700 and ORIE 3500. Courses in which probability and statistical methods are used, but where theory is not the primary focus are not acceptable substitutes, nor are professional exam credentials (e.g., CFA, FRM).*

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. Students admitted to the DA concentration who have not completed the prerequisites will be assigned to the AOR concentration until the prerequisites are met. Students may need three semesters to complete the DA concentration due to elective course prerequisites, enrollment limits, and/or the timing and sequence of course offerings.

In addition to satisfying the ORIE Core requirements, students in DA must complete three or more approved elective courses for at least 9 credit hours in total. The three courses must be comprised of one or more additional courses from the Data Science and Statistical Modeling category in section II.B.2.b, and one or more courses from the Additional DA Electives list that follows, with no more

than 3 credit hours from College of Business (or equivalent) courses. This structure is designed to ensure that DA students gain a solid foundation that spans statistical theory, data technology, and data-driven analysis and strategy.

Additional DA Electives:

- CS 4700 – Foundations of Artificial Intelligence (F,S 3 cr)
- CS 4775 – Computational Genetics and Genomics (F 4 cr)
- CS 4787 – Principles of Large-Scale Machine Learning Systems (S 4 cr)
- CS 5320 – Introduction to Database Systems (F 3 cr)
- CS 5740 – Natural Language Processing (F 4 cr)
- HADM 6030 – Quality Systems and Processes (S 3 cr)
- HADM 6050 – Revenue Management (F 3 cr)
- INFO 5100 – Visual Data Analytics for the Web (S 3 cr)
- NBA 6200 – Marketing Research (S 3 cr)
- NBA 6390 – Data-driven Marketing (F 1.5 cr)
- NBA 6920 – Machine Learning Applications in Business\* (S 1.5 cr)
- NBA 6930 – Strategy and Tactics of Pricing (F 1.5 cr)
- ORIE 4820 – Spreadsheet-Based Modeling and Data Analysis (S 3 cr)
- ORIE 5270 – Big Data Technologies (S 2 cr)
- STSCI 4060 – Python Programming and its Applications in Statistics (S 3 cr)
- STSCI 4100 – Multivariate Analysis (S 4 cr)
- STSCI 4110 – Categorical Data (S 4 cr)
- STSCI 4140 – Applied Design (S 4 cr)
- STSCI 4270 – Intro to Survival Analysis (F 4 cr)
- STSCI 4520 – Statistical Computing (S 4 cr)
- STSCI 5065 – Big Data Management and Analysis (S 3 cr)

*\*With MEng Director Approval only. Student may not receive credit for this and any other ML course, including but not limited to ORIE 474x, STSCI 4740, CS 478x/578x, SYSEN 6880.*

The MEng project for DA students is completed as the course sequence ORIE 5980 and ORIE 5981. One or more of the ORIE 5980/5981 projects will have a strong data analytics component, and to the extent possible, DA students will be given preference for these projects when assignments are made.

Cornell undergraduates who have successfully completed DA elective courses as part of their undergraduate studies and who have not waived the Data Science and Statistical Modeling category of the ORIE Core may count at most 3 credits towards the satisfaction of the DA concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses). Data analytics concentrators who choose to waive the Data Science and Statistical Modeling category of the ORIE Core may not apply undergraduate credits towards concentration requirements.

## C. Financial Engineering Concentration

### Additional prerequisites:

- *A two-semester (or three-quarter) sequence of calculus-based probability and statistics and/or stochastic processes, similar in content and rigor to Cornell courses ENGRD 2700 plus (ORIE 3500 or ORIE 3510). Courses in which probability and statistical methods are used, but where theory is not the primary focus are not acceptable substitutes, nor are professional exam credentials (e.g., CFA, FRM).*
- *An introductory finance course. Courses in economics and accounting are not acceptable substitutes.*
- Strongly recommended:
  - *A course in differential equations, similar to Cornell course MATH 2930.*
  - *Proficiency with C++ and/or Python.*

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 general requirements for the MEng degree. Exception: FE students who have not had Stochastic Processes before may take ORIE 5510 for general ORIE credit, but it will not count as ORIE Core credit.

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 trade financial instruments. As such, the concentration enables students to gain deep and broad knowledge of financial markets and investment strategies and innovations. FE is specifically designed to be a three-semester concentration (Fall-Spring-Fall), with the third semester taking place at Cornell Financial Engineering Manhattan (CFEM) in New York City.

In addition to satisfying the ORIE Core requirements, students in FE must complete 12 or more letter-graded credit hours from the Financial Applications Electives list below, 6 or more of which must be earned in CFEM courses numbered ORIE 52XX. The MEng project for FE students is completed as the course ORIE 5220 during the CFEM term.

### Financial Applications Electives:

- NBA 5061 – Comprehensive Financial Statement Analysis (F 3 cr)
- NBA 5420 – Investment and Portfolio Management (S 3 cr)
- NBA 5430 – Financial Markets and Institutions (F 3 cr)
- NBA 5450 – The Search for Alpha (F 1.5 cr)
- NBA 5540 – International Finance (F 3 cr)
- NBA 5550 – Fixed-Income Securities and Interest-Rate Options (F 3 cr)
- NBA 5980 – Behavioral Finance (S 1.5 cr)
- NBA 6060 – Evaluating Capital Investment Projects (S 1.5 cr)

- NBA 6560 – Valuation Principles (S 1.5 cr)
- NBA 6730 – Derivatives Securities, Part I (F 1.5 cr)
- NBA 6740 – Derivatives Securities, Part II (F 1.5 cr)
- ORIE 5230 – Quantitative Trading Strategies (F 3 cr)
- ORIE 5240 – Bond Math and Mortgage-Backed Securities (F 3 cr)
- ORIE 5252 – Special Topics in FE I (F 2 cr)<sup>†</sup>
- ORIE 5253 – Special Topics in FE II (F 2 cr)<sup>†</sup>
- ORIE 5254 – Special Topics in FE III (F 2 cr)<sup>†</sup>
- ORIE 5255 – Special Topics in FE IV (F 2 cr)<sup>†</sup>
- ORIE 5256 – Special Topics in FE V (F 2 cr)<sup>†</sup>

<sup>†</sup>*Courses taught by finance professionals affiliated with CFEM. Topics vary from year to year.*

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. Cornell undergraduates who have successfully completed FE elective courses as part of their undergraduate studies may count at most 3 credits towards the satisfaction of the FE concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

Students who successfully complete the FE concentration will receive a Dean's Certificate in Financial Engineering. The Dean's Certificate requirements for Johnson students, who are eligible to pursue the credential outside of the FE concentration, may be obtained from the ORIE graduate office in 201 Rhodes Hall.

**Financial Data Science (FDS) Certificate:** FE concentrators interested in data science may complement their studies with the FDS Certificate by fulfilling the requirements listed below. All courses must be successfully completed for letter-graded credit (audits and S/U are not acceptable). The FDS framework is designed to enable students to add value to an organization immediately by cultivating critical skills in big data collection, manipulation, storage, and access, as well as machine learning theory, and algorithm implementation and evaluation.

**Financial Data Science Certificate (all are required):**

- At least one of the following courses\*:
  - ORIE 4740 – Statistical Data Mining I (S 4 cr)
  - ORIE 4741 – Learning with Big Messy Data (F 4 cr)
  - ORIE 4742 – Information Theory, Probabilistic Modeling, & Deep Learning with Scientific & Financial Applications (S 3 cr)
  - CS 5780 – Machine Learning for Intelligent Systems (F 4 cr)
  - CS 5786 – Machine Learning for Data Science (S 4 cr)
  - STSCI 4740 – Data Mining and Machine Learning (F 4 cr)
- ORIE 5270 – Big Data Technologies (S 2 cr)
- ORIE 5256 – Special Topics in FE V (F 2 cr at CFEM)\*\*
- Must complete an FDS-eligible project for ORIE 5220 (F 5 cr at CFEM)
- Special Workshop(s) (non-credit-bearing at CFEM)

\* *May also be counted towards ORIE and ORIE Core requirements, as appropriate.*

\*\* *FDS-oriented elective. May also be counted towards ORIE and Financial Applications Electives.*

## D. Information Technology Concentration

Additional prerequisites: None

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.

In addition to satisfying the ORIE Core requirements, 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 the Additional IT Electives listed below. Other suitable courses may be substituted by petition. A course listed in multiple areas can be used to count for at most one area.

If a student takes one or more IT elective courses to satisfy a portion of the ORIE Core requirements, one of these courses may count towards satisfaction of the IT concentration requirements as well. Note that a student may need an additional semester to finish both ORIE MEng degree requirements and IT concentration requirements.

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

- ORIE 5142 – Systems Analysis Behavior and Optimization (S 3 cr)
- CS 3410 – Computer Systems Organization and Programming (F 4 cr)
- CS 4420 – Computer Architecture (F 4 cr)
- CS 5114 – Network Programming Languages (F 4 cr)
- CS 5320 – Introduction to Database Systems (F,S 3 cr)
- CS 5412 – Cloud Computing (S 4 cr)
- CS 5414 – Distributed Computing Principles (F 4 cr)
- CS 5430 – System Security (S 4 cr)
- ECE 4450 – Computer Networks and Telecommunications (S 4 cr)
- ECE 5660 – Fundamentals of Networks (S 4 cr)
- SYSEN 5400 – Theory and Practice of Systems Architecture (F 3 cr)

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

- ORIE 4350 – Intro to Game Theory (F 4 cr)
- CS 4852 – Networks II: Market Design (S 3 cr)
- CS 5780 – Machine Learning for Intelligent Systems (F 4 cr)
- HADM 6050 – Revenue Management (F 3 cr)
- INFO 5355 – Human Computer Interaction Design (F 4 cr)
- INFO 4400 – Advanced Human-Computer Interaction Design (S 3 cr)
- NBA 6010 – Electronic Business (S 3 cr)

**Managing IT Implementation (at least 1 course):**

- ORIE 5140 – Model Based Systems Engineering (F 3 cr)
- CEE 5900 – Project Management (F,S 4 cr)
- CS 5150 – Software Engineering (S 4 cr)
- CS 5152 – Open-Source Software Engineering (F 4 cr)
- CS 5412 – Cloud Computing (S 4 cr)
- CS 5430 – System Security (S 4 cr)
- ECE 5830 – Introduction to Technical Management (F 3 cr)
- SYSEN 5300 – Systems Engineering and Six Sigma for the Design and Operation of Reliable Systems (S 3-4 cr)

**Additional IT Electives:**

- ORIE 4820 – Spreadsheet-Based Modeling and Data Analysis (S 3 cr)
- ORIE 5126 – Supply Chain Management (S 4 cr)
- CS 3152 – Introduction to Computer Game Architecture (S 4 cr)
- CS 3300 – Data-driven Web Applications (S 3 cr)
- CS 4300 – Language and Information (S 3 cr)
- CS 4700 – Foundations of Artificial Intelligence (F 3 cr)

The MEng project for IT students is completed as the course sequence ORIE 5980 and ORIE 5981. One or more of the ORIE 5980/5981 projects will have a strong IT component, and to the extent possible, IT students will be given preference for these projects when assignments are made.

Cornell undergraduates who have successfully completed IT elective courses as part of their undergraduate studies may count at most one course towards the satisfaction of the MEng IT concentration requirements (although no academic credit will be given towards the MEng degree for courses previously taken). IT concentrators who choose to waive a category of the ORIE Core may not apply the same undergraduate courses or credits towards concentration requirements.

**E. Manufacturing and Industrial Engineering Concentration****Additional prerequisites: None**

The Manufacturing and Industrial Engineering concentration (MIE) prepares students to use their operations research skills to improve manufacturing environments and associated processes across the supply chain network. This concentration covers aspects of design, production, and distribution of goods and services, as well as fundamentals of modern manufacturing technology including computer-aided 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.

In addition to satisfying the ORIE Core requirements, students in MIE must complete Manufacturing Focus courses and 9 or more letter-graded credit hours from the MIE Electives list that follows. Any changes or substitutions require prior written approval from the MEng Director.

If a student takes one or more of the Manufacturing Focus or MIE Elective courses to satisfy a portion of the ORIE Core requirements, these courses may count towards satisfaction of the MIE concentration requirements as well. Note that a student may need an additional semester to finish both ORIE MEng degree requirements and MIE concentration requirements.

Manufacturing Focus (all are required):

- ORIE 5100 – Design of Manufacturing Systems (F 4 cr)
- NBA 5530 – Accounting and Financial Decision Making (S 3 cr)  
  or NBA 5020 – Managerial Accounting and Reporting (S 3 cr)
- ORIE 9100 – Enterprise Engineering Colloquium (F 1 cr)

MIE Electives (at least 9 credit hours):

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 or allowed.

- CEE 5900 – Project Management (F,S 4 cr)
- CEE 5930 – Data Analytics for Engineering Managers (F 4 cr)  
  or ECE 5830 – Introduction to Technical Management (F 3 cr)
- ECE 4320 – Integrated Micro Sensors and Actuators (S 4 cr)
- MAE 5200/5210 – Dimensional Tolerancing in Mechanical Design (S 1 or 2 cr)
- MAE 5250 – Computer-Aided Manufacture\* (F 1 cr)
- MAE 5260 – Design for Manufacture and Assembly (S 1 cr)
- MAE 5270 – Design Failure Modes and Effects Analysis (F 1 cr)
- NBA 6100 – Applied Operations Strategy (F 1.5 cr)
- NBA 6410/6420 – Supply Chain Strategy/Supply Chain Analytics (S 1.5/1.5 cr)
- ORIE 4140 – Mathematical Modeling of Operational Systems (F 2 cr)
- ORIE 5126 – Principles of Supply Chain Management (S 4 cr)
- ORIE 5140 – Model Based Systems Engineering (F 4 cr)
- SYSEN 5300 – Systems Engineering and Six Sigma for the Design and Operations of Reliable Systems (F 3-4 cr)

*\*Since MAE 5250 is offered S/U only, it cannot count toward the 30-credit-hour requirement for the MEng degree, but it will count toward MIE concentration requirements.*

The MEng project for MIE students is completed as the course sequence ORIE 5910 and ORIE 5911. This cross-disciplinary group design project frequently centers on a major manufactured product, including the design of a system for the product's manufacture or distribution. 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.

Cornell undergraduates who have successfully completed Manufacturing Focus and/or MIE Elective courses as part of their undergraduate studies may count at most two of these courses of at most 6 credits towards the satisfaction of the MIE concentration requirements (although no academic credit will be given

towards the MEng degree for these previously taken courses). However, MIE concentrators who choose to waive a category of the ORIE Core may not apply the same undergraduate courses or credits towards concentration requirements.

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

*Additional prerequisites: Strong background in operations research and/or relevant professional experience.*

The keystone of the Strategic Operations concentration (commonly called the Semester in Strategic Operations or SSO) is the Strategic Operations Immersion offered by the Johnson School. This intensive “supercourse” occupies the majority of the spring semester and provides a comprehensive treatment of how business and operations strategies are aligned and executed for success, including product design, logistics, quality control, corporate organization, employee organization and compensation, marketing, and globalization. Graduate students from the College of Engineering, the Johnson School, and the School of Industrial and Labor Relations participate.

SSO instruction is primarily project and case oriented, based more on interactive discussion than lecture. The course material is integrated with company site visits and team-based project work with industry partners. The ORIE MEng project requirement is fulfilled within the context of the SSO framework.

The required component of SSO for ORIE MEng students entails 9 credit hours across 3 courses, typically consisting of Operations Management (2.5 cr), Management Cases (2 cr), and the SSO Practicum (4.5 cr). In addition, students may enroll in courses from an approved SSO elective list, or they may enroll in a limited number of credit hours outside of SSO, provided that the outside courses do not have scheduled classes on Fridays, since it is essential to avoid conflicts with site visits and other mandatory SSO activities. Approved SSO elective course options vary from year to year.

In order to complete MEng requirements in two semesters, SSO students should plan to fulfill the majority of the ORIE Core requirements during the fall semester. (Note that ORIE 5126 is typically offered as an approved SSO elective in the spring and may be counted towards ORIE Core requirements.) Students concentrating in SSO may not count more than 15 credit hours in College of Business courses (or equivalents) towards their MEng degree, including all business courses taken as part of SSO. **If a student does not perform satisfactorily during the fall semester, permission to continue in the SSO concentration may be rescinded.**

## 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.

In addition to satisfying the ORIE Core requirements, students in the Systems Engineering minor must complete the three Systems Engineering Minor courses listed below.

### Systems Engineering Minor (all are required):

- ORIE 5140 – Model Based Systems Engineering (F 4 cr)
- ORIE 5142 – System Analysis, Behavior and Optimization (S 3 cr)
- CEE 5900 – Project Management (F or S 4 cr)

The MEng project for Systems Engineering students is completed as the course ORIE 5940, taken in both fall and spring semesters for 5-8 credits total. The project course is central to the Systems Engineering Minor. Unlike project courses for other ORIE concentrations, the Systems Engineering project course spans two full semesters and requires a significant time commitment from students throughout the year. Most team projects encompass system design, analysis, integration, implementation, and participation in competitions.

## H. One-Year MBA Program

The Johnson School offers a special One-Year MBA program for students who have already 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 an accelerated version of the MBA core courses. They then join the second-year MBA class in the fall, participate fully in the regular academic-year program, and receive their MBA degree in May. For students who plan to pursue the MEng/MBA degrees sequentially, 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). In either case, students must apply and be admitted to Johnson as a separate process from their MEng admission. For more information on the MEng/MBA, including the opportunity to apply for the valuable Lester B. Knight Scholarship, see:

<https://www.johnson.cornell.edu/programs/full-time-mba/dual-degree-programs/meng-mba/> and

<https://www.engineering.cornell.edu/admissions/graduate-admissions/admissions-meng-students/knight-scholarship-program>.

## **IV. POLICIES AND PROCEDURES**

### **A. Academic Advisors**

Each MEng student will be assigned an academic advisor just prior to the start of the Fall semester. Students should contact their advisors during the first week of classes (but not before) for advice on course selection and study plan approval.

### **B. Registration and Course Enrollment**

As an ORIE MEng student, you are required to register every semester in order to gain access to campus resources. To qualify as a registered student, you must:

- Complete course enrollment;
- Settle all financial accounts, including the current semester tuition;
- Satisfy New York State and university health requirements; and
- Clear any and all holds from the College of Engineering, the Graduate School, the Judicial Administrator, Cornell Health, and the Bursar's Office.

You can check your registration status and view your holds by visiting Student Center at: <http://studentcenter.cornell.edu/>. Upon arriving to campus, students should check in with the Graduate Student Services Coordinator in 201 Rhodes Hall to ensure that ORIE has all necessary documentation.

In general, all Bursar holds must be cleared before a student will be allowed to enroll in classes. Course enrollment for the fall semester begins in mid-August for MEng students. See <https://registrar.cornell.edu/calendar/2019-2020> for the complete timeline of course enrollment and add/drop deadlines for the academic year. Note that certain courses may not be available for enrollment until the semester begins.

### **C. Petitions**

Cornell has a long history of allowing students to submit petitions for modifications to certain rules and policies when the circumstances warrant exceptions. Depending on the type of request being made, there are different entities that are authorized to review and approve (or deny) MEng student petitions. All petition forms are available in the Graduate Student Service Coordinator's office in 201 Rhodes Hall. For requests involving:

- Exceptions to ORIE MEng curriculum requirements (e.g., course substitutions), students should use a general ORIE petition form and must obtain signatures from the MEng Director and/or their academic advisor. Submit the completed petition to 201 Rhodes Hall.
- Course enrollment (e.g., credit overloads, late adds or drops), students should use the appropriate add/drop form or College of Engineering petition form and must obtain signatures from the MEng Director and their academic advisor. Depending on the circumstance, instructor approval may also be required. Submit the completed petition to the Engineering Registrar in 170 Rhodes Hall.
- Exceptions to general MEng degree requirements, policies, or procedures, or to appeal an appealable field decision, the student must submit a written

petition request to the MEng Board of Directors via the office of the Associate Dean of MEng Programs ([engr-meng@cornell.edu](mailto:engr-meng@cornell.edu)).

- Program extensions, there is a special program extension request form that the student must complete and submit to 201 Rhodes Hall to initiate this process. Please note that program extension is a multi-step process that involves several administrative units, including the School of ORIE, the Engineering Registrar, and (for international students) the Office of Global Learning. See section IV.H for more information.

#### **D. Extramural and Transfer Credits**

Prior to matriculation into the ORIE MEng program and after the bachelor's degree is awarded, a maximum of 9 Cornell credit hours can be applied toward the ORIE MEng degree, provided these credits satisfy ORIE MEng degree requirements and have not been applied toward any other degree or credential. No other transfer credits are accepted by ORIE.

After matriculation into the ORIE MEng program, any extramural Cornell credit hours that satisfy MEng degree requirements and have not been applied toward another degree or credential may be counted (provided the student registers for two semesters as a full-time ORIE MEng student before completing the program).

#### **E. Conduct**

Cornell University is committed to providing a safe, inclusive, and respectful learning, living, and working environment for its students, faculty, and staff members. If you have any questions or concerns about incidents involving potential sexual harassment, assault, gender discrimination, or other related forms of violence, please visit the Sexual Harassment and Assault – Response and Education (SHARE) website at <http://www.share.cornell.edu/>. This site offers information about SHARE partners who provide services, support, reporting options, education, and advocacy.

Every MEng student is expected to exhibit courteous, professional, and honest behavior in all aspects of his or her role as a Cornell student, including but not limited to all communications with faculty, staff, alumni, recruiters, project partners, and fellow students, whether online or in person. Moreover, MEng students are 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 extreme cases, a student may be required to withdraw from the MEng program.

#### **F. 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*. MEng students are subject to these policies and procedures. Below we repeat in full the Principle of academic integrity

and the Guidelines for Students. The general procedure to be followed in cases of suspected violations of academic integrity may be found at: <http://cuinfo.cornell.edu/aic.cfm>.

### Principle

*Absolute integrity is expected of every Cornell student in all academic undertakings. Integrity entails a firm adherence to a set of values, and the values most essential to an academic community are grounded on the concept of honesty with respect to the intellectual efforts of oneself and others. Academic integrity is expected not only in formal coursework situations, but in all University relationships and interactions connected to the educational process, including the use of University resources. While both students and faculty of Cornell assume the responsibility of maintaining and furthering these values, this document is concerned specifically with the conduct of students.*

*A Cornell student's submission of work for academic credit indicates that the work is the student's own. All outside assistance should be acknowledged, and the student's academic position truthfully reported at all times. In addition, Cornell students have a right to expect academic integrity from each of their peers.*

### 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.)

#### *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:

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.

#### *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.

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

For students who are undergraduates at Cornell University, there is a provision for earning credit toward the Master of Engineering degree during the final semester in which the bachelor's degree is completed. This is called early admission.

In order to qualify for early admission during the final undergraduate semester, a student must need 8 or fewer credit hours to complete his or her bachelor's degree, including any special designations, and they must complete the bachelor's degree by the end of that term (i.e., the "early admit semester"). Students must apply for early admission to the MEng program at least one semester PRIOR to the early admit semester.

For instance, if an eligible early admit student expects to complete his or her remaining undergraduate credits during the *spring* semester, then that student must apply to the ORIE MEng program by September 15 of the previous fall. If the student expects to complete the remaining undergraduate credits during the *fall* semester, then the student must submit an application for the MEng program by December 1 of the previous fall.

If the application for early admission is approved, the student registers as an undergraduate during the early admit semester but may count credits toward the MEng degree as appropriate. Each course taken during the early admit semester may count towards either the bachelor's degree or the MEng degree, but not both. Early admit students must register as MEng students in the term(s) following the early admit semester. 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.

## H. 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 most cases, the School of ORIE will allow a MEng student to pursue a third semester of study, provided that they follow the extension request process outlined on the associated petition form and submit all necessary documentation prior to the stated deadline, which is typically set to the Friday before Spring Break.

Any ORIE MEng student who extends his or her graduate program to a third semester is subject to additional academic requirements and costs, as detailed below. *You must accept responsibility for meeting these additional requirements and costs as a condition of having your Extension Request approved.*

### Academic Requirements for Program Extensions:

You must satisfy the following academic requirements during your extended semester of study:

- You must successfully complete a minimum of 12 credit hours of letter-graded or S/U coursework, including 6 or more letter-graded credit hours that can count toward the ORIE MEng degree, and of these 6 letter-graded credit hours, 3 or more must be in approved ORIE courses.
- By the end of the extended semester you must have achieved a total of at least 36 technical credit hours that count toward the ORIE MEng degree, replacing the standard requirement of 30 credit hours. (Note that you may enroll in Cornell College of Business courses during the extended semester; however, the standard requirement that no more than 8 credit hours total of College of Business courses can count towards the ORIE MEng degree remains in place.)
- You may enroll in at most one class using the AUDIT grading option.

Not meeting these academic requirements during your extended semester may result in you not graduating from the MEng program and (if you are an international student) may place your visa status in jeopardy.

### Costs associated with an Additional Semester of MEng Study:

MEng students who request Program Extensions are not eligible for pro-rated tuition and should expect to pay for a full additional semester of study, including tuition and fees, living expenses, and student health insurance. If you are an international student, financial certification may be required as part of the I-20 extension process.

## **V. FINANCIAL AID**

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

The current tuition and fees for the ORIE MEng program may be found at: <https://www.dfa.cornell.edu/bursar/students-parents/tuition-rates-fees>. See the Master's Degree (Tier 1) entry. 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 and the College of Engineering, 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 partial tuition fellowships and Graduate Teaching Specialist (GTS) positions. Research assistantships are not available for MEng students. For information on the Knight Scholarship, a College of Engineering Scholarship program for students who are also interested in pursuing both the MEng and MBA degrees, see <https://www.engineering.cornell.edu/admissions/graduate-admissions/admissions-meng-students/knight-scholarship-program>.

All applicants to the ORIE MEng program are considered for merit-based financial aid as part of the admissions process. Fellowships and GTS positions are awarded on a discretionary basis, with many GTS positions for spring classes determined late in the fall semester. GTS award decisions take into account a student's academic background and 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 is prorated to pay  $\frac{1}{4}$  of the Standard 9-month TA Stipend for full-time PhD TAs, which may be found at: <http://gradschool.cornell.edu/costs-funding/stipend-rates>. Most GTS positions typically require an average of 7.5 hrs per week.

If you were (or are) an undergraduate student at Cornell, 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: <https://gradschool.cornell.edu/financial-support/fellowships/>. 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 federally or privately funded loan programs (which are not administered through the School of ORIE). Cornell currently participates in two federally funded programs: the William D. Ford Direct Loan and the Federal Graduate PLUS loan. These programs are available to U.S. citizens and permanent residents who are matriculated toward the degree. See <http://gradschool.cornell.edu/costs-and-funding/loans> for more information.

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. Note that some online GEM-related materials neglect to mention MEng, but MEng degree candidates *are* eligible for GEM Fellowships. For more information, visit:

<https://www.engineering.cornell.edu/engdiversity/current-students/graduate-students/diversity-fellowship-programs>.

## **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. Non-work study positions are listed by the Office of Student Employment, 203 Day Hall; <http://studentemployment.cornell.edu/>. We strongly recommend that Master of Engineering students work no more than 10 hours per week, on average, while enrolled.

## **VI. UNIVERSITY RESOURCES**

### **A. Career Services**

Both the Cornell Engineering Career Center (201 Carpenter Hall) and the University Career Services Office (103 Barnes Hall) offer special programming for MEng students on how to approach the job search, resume preparation, interview preparation, etc. (See <https://www.engineering.cornell.edu/students/graduate-students/mengmps-students/career-resources-mengmps-students> for details.) These offices also run an extensive on-campus recruiting program, in which hundreds of companies participate each year.

Plan to visit the Cornell Engineering Career Center during the first week of classes, and take advantage of the extensive opportunities available to enhance your job search skills and to make contact with employers. Upcoming sessions and workshops will be posted online. You should plan to prepare for recruiting early since interviewing begins during the second or third week of the fall semester.

### **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:

- CornellHealth Center, 110 Ho Plaza, <https://health.cornell.edu/> (607-255-5155)
- Cornell Fitness Centers, 319 Helen Newman Hall, <https://recreation.athletics.cornell.edu/fitness> (607-254-5232)
- Counseling and Psychological Services, <https://health.cornell.edu/services/counseling-psychiatry> (607-255-5155)

### **C. Student Organizations**

There are hundreds 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 other 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. Cornell has an active INFORMS chapter, and 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 professionals 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. More information about activities and events hosted by Cornell's very active SWE chapter can be found at: [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.*

## **APPENDIX A. Course Eligibility for the ORIE MEng Degree**

Most technical courses at Cornell offered by the College of Engineering, Computing and Information Science, and the Department of Mathematics that are numbered 4000 or above, and taken for letter-graded credit, will be allowed to count toward the ORIE Master of Engineering degree. However, exceptions apply. Please refer to the lists below for details.

### **A. Courses that are NOT allowed to count toward the ORIE MEng degree**

- All courses numbered at the 3000 level or below, except as noted elsewhere in Handbook
- All ENGR C, ENGR D, ENGR G courses
- All College of Business courses not listed in sections B or C and/or not approved by petition
- Any course outside of Engineering, CIS, and Math not listed in section C and/or not approved by petition
- MATH 4030, History of Mathematics
- ORIE 4990, Teaching in ORIE (and all similar teaching courses)

### **B. Popular College of Business courses that can count toward the MEng degree (must be taken for letter-graded credit)**

- HADM 6030, Quality Systems and Processes
- HADM 6050, Revenue Management
- HADM 6145, Developing Service Based Business Models and Plans
- HADM 6250, Securitization and Structured Financial Products
- HADM 6280, Real Estate Finance and Investments
- HADM 6235, Intermediate Corporate Finance  
xor NBA 5580, Corporate Financial Policy
- NBA 5061, Comprehensive Financial Statement Analysis
- NBA 5070, Entrepreneurship for Scientists and Engineers
- NBA 5330, Management Cases (for SSO students)  
xor NBA 5810, Management Cases
- NBA 5420, Investment and Portfolio Management
- NBA 5430, Financial Markets and Institutions
- NBA 5450, The Search for Alpha
- NBA 5530, Accounting and Financial Decision Making
- NBA 5540, International Finance
- NBA 5550, Fixed Income Securities and Interest-Rate Options
- NBA 5690, Management Consulting Essentials
- NBA 5980, Behavioral Finance
- NBA 6010, Electronic Business
- NBA 6060, Evaluating Capital Investment Projects
- NBA 6100, Applied Operations Strategy
- NBA 6120, Disruptive Technologies
- NBA 6200, Marketing Research
- NBA 6390, Data-Driven Marketing

- NBA 6410, Supply Chain Strategy
- NBA 6420, Supply Chain Analytics
- NBA 6560, Valuation Principles
- NBA 6650, The Strategic Management of Technology and Innovation
- NBA 6730, Derivatives Securities, Part I
- NBA 6740, Derivatives Securities, Part II
- NBA 6930, Strategy and Tactics of Pricing

**C. Courses that may be approved to count toward the MEng degree on a case-by-case basis (but must be approved by petition and must be taken for letter-graded credit)**

- AEM 6030, Risk Management and Optimization
- AEM 6061, Risk Simulation and Monte Carlo Methods
- BEE 4750, Environmental Systems Analysis
- BEE 4890, Entrepreneurial Management for Engineers\*
- BEE 4891, Social Entrepreneurship for Engineers\*
- Any BTRY 4000+ course that is not cross-listed with STSCI\*\*
- CEE/ENMGT 5930, Data Analytics for Engineering Managers
- CEE/ENMGT 5970, Risk Analysis and Management
- CEE/ENMGT 5980, Introduction to Decision Analysis
- ECE 5830, Introduction to Technical Management\*
- ECON 6200, Econometrics II
- ENMGT 5920, Product Management\*
- ENMGT 6000, Entrepreneurship for Scientists and Engineers\*
- Any INFO 4000+ course that is not cross-listed with CS\*\*
- NBA 4120, Equity Investment Research and Analysis
- NBA 5020, Managerial Accounting and Reporting
- NBA 6040, Finance and Ethics
- ORIE 4152, Entrepreneurship for Engineers\* (does not count as ORIE-labeled credit)
- STSCI 4950, Statistical Consulting
- STSCI 4951, Advanced Statistical Consulting
- SYSEN 5740, Design Thinking for Complex Systems

\* If approved, course credits will count toward the College of Business 8-credit limit

\*\* No petition required for BTRY and INFO courses listed as concentration electives

## **APPENDIX B. ORIE MEng General Curriculum Requirements**

MEng Student Handbook text governs, if at variance

### **TECHNICAL 30+ credit hours that consist of:**

- ORIE and ORIE CORE courses
- ORIE MEng Project (ORIE 5220, 5910/1, 5940, or 5980/1), all of which are 5+ credit hours in total
- Colloquium course (ORIE 9100 or ORIE 5210)
- Practicum course (ORIE 9115 or ORIE 5215)
- Approved concentration elective courses
- Courses in Appendix A.B
- Petition-approved courses in Appendix A.C
- At most 8 credit hours from the College of Business or equivalent (15 credit hours for SSO concentrators)

### **ORIE 9+ ORIE credit hours that consist of:**

- ORIE-labeled ORIE CORE courses
- Project Prep (ORIE 5110 or ORIE 5100)
- Other 4000+ level ORIE courses *excluding* project, colloquium, independent study, and ORIE courses disallowed for ORIE or MEng credit

### **ORIE CORE 12+ credit hours from approved course lists that must include:**

- 8+ ORIE credit hours with 3+ at 5000-level
- 3+ credit hours in Optimization Modeling
- 3+ credit hours of Stochastic Modeling
- 3+ credit hours in Data Science and Statistical Modeling