

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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TABLE OF CONTENTS

I.	ORIE AT CORNELL	
	A. Introduction.....	2
	B. Brief History of the School.....	2
	C. Overview of the Master of Engineering Program.....	2
II.	MASTER OF ENGINEERING PROGRAM REQUIREMENTS	
	A. Prerequisites	4
	B. General Curriculum Requirements.....	4
	1. Credit Hours	5
	2. Courses	6
	3. Engineering Design Project.....	8
	C. Other Requirements	8
	1. Good Academic Standing.....	8
	2. Professional Development for Spring Admits.....	9
	3. MEng and CFEM Exit Surveys.....	9
III.	CONCENTRATION AND MINOR REQUIREMENTS	
	A. Applied Operations Research Concentration.....	10
	B. Data Analytics Concentration.....	10
	C. Financial Engineering Concentration.....	11
	D. Information Technology Concentration.....	13
	E. Manufacturing and Industrial Engineering Concentration	14
	F. Strategic Operations Concentration.....	16
	G. Systems Engineering Minor.....	17
	H. One-Year MBA Program.....	18
IV.	POLICIES AND PROCEDURES	
	A. Academic Advisors.....	19
	B. Registration and Add/Drop Deadlines.....	19
	C. Petitioning.....	19
	D. Extramural and Transfer Credits.....	19
	E. Conduct.....	19
	F. Academic Integrity	20
	G. Early Admission for Cornell Undergraduates.....	23
	H. Three Semester Degree Option.....	23
V.	FINANCIAL AID	
	A. Merit-Based Financial Aid.....	24
	B. Need-Based Financial Aid	25
	C. Employment Opportunities	25
VI.	UNIVERSITY RESOURCES	
	A. Career Services.....	26
	B. Health and Counseling Services	26
	C. Student Organizations.....	26
	APPENDICES	
	A. Popular Electives Offered by other Departments	
	B. ORIE MEng General Curriculum Requirements	

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, statistics, and simulation. The application areas for these tools are virtually limitless, but ORIE students generally apply their knowledge to the design, operation, and improvement of business systems.

All students in the ORIE MEng program 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. Details for each 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 client-sponsored project work with real data, deadlines, and deliverables. Regardless of their concentrations, ORIE MEng students are expected to play major roles in all aspects of their projects, including formulating and analyzing the problem, managing the client relationship, monitoring the project timeline and milestones, and delivering the final results.

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

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

II. MASTER OF ENGINEERING PROGRAM REQUIREMENTS

A. Prerequisites

Before beginning the Master of Engineering program in ORIE, all ORIE MEng students must provide 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 courses MATH 1910, MATH 1920, and MATH 2940.
2. An introductory **engineering probability and statistics course** similar in content and rigor to Cornell course ENGRD 2700.
3. An **intermediate-level computer programming course** in a general programming language such as C, C++, Java, or Python, similar in content and rigor to Cornell course 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.

ENGRD 2700 and ENGRD 2110 are offered 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.

Please note that the certain concentrations have additional prerequisites. See Section III for details. Prerequisite course work that was completed more than five years prior to the start of the MEng program must be retaken or reinforced in an approved manner.

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 seminar courses (e.g., ORIE 9100 and ORIE 5210), which must be taken S/U. A maximum of 2 credit hours of S/U seminar courses may be applied towards the 30-credit-hour requirement. Only courses that have direct professional relevance and are suitably technical can be counted toward the 30-credit-hour requirement. Most courses taught in the College of Engineering that are numbered 4000 or above qualify, as well as several technical courses from other Cornell schools and colleges. Appendix A contains a list of popular courses that have met this requirement in the past, as well as a list of courses that *do not* meet this requirement. **Courses not listed 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 add deadline has passed.
- c. Complete a minimum of 19 letter-graded credit hours in Technical Engineering courses as part of the 30 credit hours of technical coursework. Appendix A contains a list of courses that have met this requirement in the past. Courses not listed in Appendix A will be allowed by petition only.
- d. Complete a minimum of 12 letter-graded ORIE credit hours as part of the 19 credit hours of Technical Engineering coursework, but exclusive of the MEng project, colloquium courses, and ORIE 4152 and ORIE 4990 (which are disallowed for MEng credit). For students who were ORIE undergraduate majors at Cornell, up to 3 allowable ORIE elective credits that were taken in excess of the credits required for the BS degree may count toward this requirement and the Technical Engineering credit requirement, but they do not apply toward the 30-credit-hour requirement. Students must indicate the use of such excess credits on their study plan.
- e. 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.
- f. Complete a minimum of 22 credit hours that count toward the MEng degree exclusive of Johnson School, HADM, and AEM courses. Exception: Students in the Strategic Operations concentration may count up to 15 credit hours taken as part of the Johnson immersion toward the MEng degree, provided the courses qualify as technical.

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. This form is available in Rhodes 201 and at: <http://www.orie.cornell.edu/academics/master/resources/forms.cfm>. The study plan must be approved and signed by the student's academic advisor. Note that ***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:
 - 9 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 (e.g., as a Cornell undergraduate) do not count towards satisfying ORIE Core requirements. In addition, courses a student takes 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 4154 – Revenue Optimization and Marketplace Design (S 3 cr)
- ORIE 4320 – Nonlinear Optimization (F 4 cr)
- ORIE 4330 – Discrete Models (F 4 cr)
- ORIE 4350 – Intro to Game Theory (F 4 cr)
- ORIE 4820 – Spreadsheet-Based Modeling and Data Analysis (S 3 cr)
- ORIE 5122 – Inventory Management (S 3 cr)
- **ORIE 5300 – Optimization I (F 4 cr)**
- ORIE 5310 – Optimization II (S 4 cr)
- ORIE 5311 – Topics in Linear Optimization (S 2 cr)
- ORIE 5370 – Optimization Modeling in Finance (S 3 cr)
- (With Approval) ORIE 63XX courses

Stochastic Modeling Courses:

- ORIE 4154 – Revenue Optimization and Marketplace Design (S 3 cr)
- ORIE 4600 – Intro to Financial Engineering (F 3 cr)*
- ORIE 4630 – OR Tools for Financial Engineering (F 3 cr)*
- ORIE 5122 – Inventory Management (S 3 cr)
- ORIE 5130 – Service System Modeling and Design (S 3 cr)
- **ORIE 5500 – Prob and Stat II (F 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 5510 – Stochastic Processes (S 4 cr)*
- ORIE 5520 – Intro to Engineering Stochastic Processes II (F 4 cr)
- ORIE 5600 – Financial Engineering with Stochastic Calculus I (F 4 cr)
- ORIE 5610 – Financial Engineering with Stochastic Calculus II (S 4 cr)
- ORIE 5620 – Credit Risk: Modeling, Valuation, and Mgmt (S 3 cr)
- ORIE 5650 – Quantitative Methods of Financial Risk Mgmt (S 3 cr)
- (With Approval) ORIE 65XX courses

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)
- (With Approval) ORIE 67XX courses
- CS 5780 – Machine Learning for Intelligent Systems (S 4 cr)
- CS 5786 – Machine Learning for Data Science (F 4 cr)
- STSCI 4030 – Linear Models with Matrices (F 4 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)

* *Disallowed for MEng credit for Financial Engineering students*

^ *Disallowed for ORIE Core credit for Data Analytics students*

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

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 specific project course to satisfy the MEng project requirement.

In all other cases, students should enroll in project courses each semester according to the table below. 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 client organization. Full commitment, participation, and teamwork are expected of all students.

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

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 to work on their MEng projects. Spring semester classes usually begin between January 21-27.

* 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 2nd 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. To attain good standing, a student must:

- a. Carry a course load that enables him or her to complete the MEng Program without unnecessary delay;
- b. Achieve a grade point average (GPA) of 2.50 or better in each semester;
- c. Achieve a cumulative GPA of 2.50 or better across all courses satisfying requirements of the MEng degree, and
- d. 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 student's immediate termination from the MEng program at the discretion of the MEng Program Director. Students who fail to attain good academic standing for two consecutive semesters typically will be asked to leave the MEng program.

2. 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 that contributes to his or her professional development during the summer and/or fall following admission. Completing a summer project or internship that has been approved by the student's academic advisor or the MEng Program Director will satisfy this requirement.

3. 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.

The AOR concentration has no specific elective requirements, giving students the opportunity to pursue a broad variety of interests within the general requirements 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

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).

Students who have not completed a two-semester probability and statistics prerequisite sequence may need three semesters to complete the DA concentration due to elective course prerequisite requirements (and/or enrollment limits) and because of the timing and sequence of course offerings.

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.

In addition to satisfying the ORIE Core requirements, students in DA must complete three approved elective courses for at least 9 credit hours in total. The three courses must be comprised of two additional courses from the Data Science and Statistical Modeling category in Section II.B.2.b, plus one course from the Additional DA Electives list on the next page. The last of these may be substituted by petition with a suitable course not listed. 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 4840 – Algorithms for Markets (S 4 cr)
- CS 5320 – Introduction to Database Systems (F,S 3 cr)
- CS 5540 – Computational Techniques for Analyzing Clinical Data (S 3 cr)
- HADM 6010 – Data Driven Analytics (F 3 cr)
- HADM 6050 – Revenue Management (S 3 cr)
- HADM 6075 – Web Scraping & Data Mining for Hospitality Dec Making (F 3 cr)
- HADM 6230 – Real Estate Statistical Modeling (F 1.5 cr)
- INFO 5100 – Visual Data Analytics for the Web (S 3 cr)
- NBA 6200 – Marketing Research (S 3 cr)
- NBA 6390 – Data-driven Marketing (S 1 cr)
- NBA 6930 – Strategy and Tactics of Pricing (F 3 cr)
- ORIE 4820 – Spreadsheet-Based Modeling and Data Analysis (S 3 cr)
- STSCI 4060 – Python Programming and its Applications in Statistics (S 3 cr)
- STSCI 4140 – Applied Design (S 4 cr)
- STSCI 4100 – Multivariate Analysis (S 4 cr)
- STSCI 4110 – Categorical Data (S 4 cr)
- STSCI 4120 – Nonparametric Inference and Sequential Analysis (F 4 cr)
- STSCI 4500 – Databases and Statistical Computing (S 4 cr)
- STSCI 5065 – Big Data Management and Analysis (S 3 cr)

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 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).

C. Financial Engineering ConcentrationAdditional 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).*
- *An introductory finance course. Courses in economics and accounting are not acceptable substitutes.*
- *Strongly recommended: A course in differential equations, similar in content and rigor to Cornell course MATH 2930.*
- *Strongly recommended: A course in stochastic processes, similar in content and rigor to Cornell course ORIE 3510.*
- *Strongly recommended: 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.

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 – Investments and Portfolio Analysis (S 3 cr)
- NBA 5510 – Emerging Markets Finance (S 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 6450 – Advanced Investment Strategies (F 3 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)*
- ORIE 5253 – Special Topics in FE II (F 2 cr)*
- ORIE 5254 – Special Topics in FE III (F 2 cr)*
- ORIE 5255 – Special Topics in FE IV (F 2 cr)*

**Courses are taught by finance professionals affiliated with CFEM. Topics vary from year to year. Recent examples include: Quantitative Portfolio Management, Topics in Asset Management, Equity Market Micro Structure, Trading and Arbitraging Volatility Surface.*

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 in acknowledgment of this. The Dean's Certificate requirements for JGSM 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.

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.

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 4800 – Information Technology (F 4 cr) (not offered 2017-18)
- ORIE 5142 – Systems Analysis Behavior and Optimization (S 3 cr)
- CS 3410 – Computer Systems Organization and Programming (S 4 cr)
- CS 5320 – Introduction to Database Systems (F,S 3 cr)
- CS 5414 – Distributed Computing Principles (F 4 cr)
- ECE 4450 – Computer Networks and Telecommunications (F 4 cr)
- ECE 4800 – Optimal System Analysis and Design (F 4 cr)
- ECE 5660 – Fundamentals of Networks (S 4 cr)
- INFO 5300 – Architecture of Large-Scale Information Systems (S 4 cr)
- SYSEN 5400 – Theory and Practice of Systems Architecture (F 3 cr)

Information Economics and Strategy (at least 1 course):

- ORIE 4154 – Revenue Optimization and Marketplace Design (S 3 cr)
- ORIE 5150 – Economic Analysis of Engineering Systems (S 3 cr)
- CS 4852 – Networks II: Market Design (S 3 cr)
- CS 5780 – Machine Learning for Intelligent Systems (S 4 cr)
- HADM 6050 – Revenue Management (S 3 cr)
- INFO 4400 – Advanced Human-Computer Interaction Design (S 3 cr)
- INFO 6230 – Games, Economic Behavior, and the Internet (F 3 cr)
- NBA 6005 – Technology Strategy for a Sustainable World (F 1.5 cr)
- NBA 6010 – Electronic Commerce (S 3 cr)
- ORIE 3800 – Information Systems and Analysis* (S 4 cr)

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

Managing IT Implementation (at least 1 course):

- ORIE 5140 – Model Based Systems Engineering (F 3 cr)
- CEE 5900 – Project Management (F,S 4 cr)
- CS 5150 – Software Engineering (F 4 cr)
- CS 5412 – Cloud Computing (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)
- INFO 4301 – Ethics in New Media, Technology, and Communication (S 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 two courses of at most 6 credits towards the satisfaction of the MEng IT concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

E. Manufacturing and Industrial Engineering Concentration

Additional prerequisites: None

The Manufacturing and Industrial Engineering concentration (MIE) is coordinated by the Center for Manufacturing Enterprise, working cooperatively with the

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

In addition to satisfying the ORIE Core requirements, students in MIE must complete Manufacturing Focus courses and three MIE Elective courses from those listed below. Any changes or substitutions require written approval of the Program Coordinator prior to the semester in which the substitution or change is sought.

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 5122 – Inventory Management (F 4 cr)
- NBA 5530 – Accounting and Financial Decision Making (S 3 cr)
or NBA 5020 – Managerial Accounting and Reporting (F,S 3 cr)
- ORIE 9100 – Enterprise Engineering Colloquium (F and S 1 cr each)

MIE Electives (at least 3 courses):

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.

- AEP 6620 – Micro/Nano-fabrication and Processing (F 3 cr)
- AEP 6630 – Nanobiotechnology (F 3 cr)
- CEE 5900 – Project Management (F,S 4 cr)
- CEE 5930 – Engineering Management Methods (F 4 cr)
or ECE 5830 – Introduction to Technical Management (F 3 cr)
- ECE 4320 – Integrated Micro Sensors and Actuators (S 4 cr)
- NBA 6120 – Disruptive Technologies (F 2 cr)
- NBA 6410 – Supply Chain Management (S 3 cr)
or both NBA 6410/6420 – Supply Chain Analytics/Strategy (S 1.5 cr each)
- NCC 5580 – Managing Operations (S 3 cr)
- ORIE 5140 – Model Based Systems Engineering (F 4 cr)
- ORIE 5150 – Economic Analysis of Engineering Systems (S 4 cr)
- SYSEN 5300 – Systems Engineering and Six Sigma for the Design and Operations of Reliable Systems (F 3-4 cr)

The MEng project for MIE students is completed as the course sequence ORIE 5910 and ORIE 5911. This cross-disciplinary group design project is

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

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 towards the satisfaction of the MIE concentration requirements (although no academic credit will be given towards the MEng degree for these previously taken courses).

F. Strategic Operations Concentration (SO)

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

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

Instruction in the Strategic Operations Immersion is primarily project and 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.

The required component of the Strategic Operations Immersion for ORIE MEng students entails 9-12 credit hours across 3-4 courses, typically consisting of Operations Management, Supply Chain Management, Management Cases, and the SSO Practicum. In addition, students choose elective courses from an approved list to bring their total course load up to 15 credit hours or more. Approved SO elective course options vary from year to year.

Note that unless they intend to extend their MEng degree study to three semesters, SO students should plan to complete the ORIE Core requirements during the fall semester. The ORIE 9100 (spring only) colloquium requirement is waived for students in the Strategic Operations concentration. **If a student does not perform satisfactorily during the fall semester, permission to continue in the SO concentration may be rescinded.**

Exclusive of the Strategic Operations Immersion, students concentrating in SO may not count more than 3 credit hours in JGSM, HADM, or AEM courses toward their MEng degree. Completing the Strategic Operations Immersion (with 15 or more technical credit hours) contributes a total of 3 credit hours toward the general ORIE credit hour requirement (see Section II.B.1.d), and a total of 7 credit hours toward the Technical Engineering requirement (see Section II.B.1.c).

The ORIE MEng project requirement is typically fulfilled within the framework of the Strategic Operations Immersion semester. In most cases, substantial team-based work products that are already required components of the SO curriculum can be used to satisfy the ORIE MEng project requirement. However, ORIE MEng students should be aware that additional requirements and/or restrictions may be placed on the work products in question in order for them to satisfy the ORIE MEng project requirement. Additional requirements, if any, 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.

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,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 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,

and the BRAIN: Autonomous Underwater Vehicle

http://www.engineering.cornell.edu/academics/undergraduate/special_programs/student_teams/teams/cuauv.cfm. Projects have also included nontraditional

topics such as the design of financial products. All of these projects address system design, analysis, integration, implementation, and participation in competitions, by student-managed design teams.

H. One-Year MBA Program

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

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

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

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

IV. POLICIES AND PROCEDURES

A. Academic Advisors

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

B. Registration and Add/Drop Deadlines

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

C. Petitioning

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

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 they satisfy ORIE MEng degree requirements and have not been applied toward another degree. 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 may be counted (provided the student registers for two semesters as a full-time ORIE MEng student before completing the program).

E. 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.

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*. Below we repeat in full the Principle of academic integrity and the Guidelines for Students. The general procedure to be followed in cases of 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. If an eligible early admit student expects to complete the remaining undergraduate credits during the *spring* semester, that student must submit an application for the 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 as appropriate toward the MEng degree. Each course taken during the early admit semester may count towards either the bachelor's degree or the master's 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.

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

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 such cases, the School of ORIE will allow a MEng student to pursue a third semester of study, provided that certain conditions are met.

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

V. FINANCIAL AID

The decision to attend graduate school is an investment in your future that will pay off both financially and with enhanced career opportunities. Over the past several years, not only has the ORIE MEng starting salary been \$10,000-\$12,000 higher on average than the 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 Professional Degrees (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 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 http://www.engineering.cornell.edu/academics/graduate/financial_aid/meng/scholarship.cfm.

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 Basic 9-month TA Stipend for full-time PhD TAs, which may be found at: <http://gradschool.cornell.edu/costs-funding/stipend-rates>. (GTS positions are typically 7.5 hrs per week, while full-time PhD TAs are 15 hours 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: <http://gradschool.cornell.edu>. Please note, however, that most of these fellowships are reserved for research degree students (i.e., MS, PhD), not MEng.

B. Need-Based Financial Aid

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

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

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 online GEM-related materials neglect to mention MEng, but MEng degree candidates *are* eligible for GEM Fellowships.

C. Employment Opportunities

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

VI. UNIVERSITY RESOURCES

A. Career Services

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

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

B. Health and Counseling Services

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

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

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).
- **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).

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

Acknowledgements

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APPENDIX A. Popular Electives Offered by other Departments

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

- All courses numbered at the 3000 level or below, except as noted and by petition in special circumstances
- Foreign languages, oral and written communication, the humanities, etc.
- BEE 4750, Environmental Systems Analysis
- CEE 5930, Engineering Management Methods (except as noted for MIE)
- ENGRG 6780, TA Training
- NBA 6430, Managerial Spreadsheet Modeling
- ORIE 4152, Entrepreneurship for Engineers
- ORIE 4990, Teaching in ORIE

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

- CEE 5900, Project Management
- CEE 5940, Economic Methods for Engineering and Management
- CEE 5980, Introduction to Decision Analysis
- HADM 6010, Data Driven Analytics
- NBA 5020, Managerial Accounting and Reporting (Only admissible for students with no courses in either accounting or engineering finance.)
- NBA 5061, Comprehensive Financial Statement Analysis
- NBA 5070, Entrepreneurship for Scientists and Engineers
- NBA 5400, Advanced Corporate Finance (or HADM 6260)
- NBA 5510, Emerging Markets Finance
- NBA 5530, Accounting and Financial Decision Making
- NBA 5540, International Finance
- NBA 5550, Fixed Income Securities and Interest-Rate Options
- NBA 5980, Behavioral Finance
- NBA 6010, Electronic Commerce
- NBA 6060, Evaluating Capital Investment Projects
- NBA 6390, Data-Driven Marketing (for letter grade only, no S/U)
- NBA 6420, Supply Chain Strategy
- NBA 6450, Advanced Investment Strategies
- 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
- SYSEN 5720, The Art of Innovation: A Hands On Approach
- NBA 6930, Strategy and Tactics of Pricing

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

- Most technical courses numbered 4000 or above that are offered by the College of Engineering, Computer Science, Statistical Sciences, and the Department of Mathematics. Exceptions apply. A sample of popular choices from fields other than ORIE are listed below. Petitions are required for non-ORIE courses that are not on this list.
- CEE 4630, Future Transportation, Technology and Systems
- CEE 4640, Transportation Systems Design
- CEE 5970, Risk Analysis and Management
- CEE 6230, Environmental Quality Systems Engr.
- CS 5150, Software Engineering
- CS 5320, Intro to Database Systems
- CS 5780, Machine Learning for Intelligent Systems
- CS 5786, Machine Learning for Data Science
- ECON 3140, Econometrics, or Econ 3120, Applied Econometrics
- ECON 6200, Econometrics II
- HADM 6050, Yield Management
- HADM 6290, Investment Analysis and Portfolio Management
- NBA 5240, Macroeconomics and International Trade
- NBA 5420, Investments and Portfolio Analysis
- 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. ORIE MEng General Curriculum Requirements

MEng Student Handbook text governs, if at variance

TECHNICAL
30+ credit hours including
22+ outside of JGSM, HADM, AEM
that consist of:

- TECHNICAL ENGINEERING credit hours
- Courses in Appendix A Table B
- Approved colloquium courses (ORIE 9100, ORIE 5210)
- Strategic Operations immersion counts as:
MIN(15, qualifying “TECH” hours taken as part of SSO)

TECHNICAL ENGINEERING
19+ credit hours
that may also include:

- ORIE and ORIE CORE credit hours
- Courses in Appendix A Table C
- Most 4000+ level Engineering College courses
- ORIE Project courses (5220, 5910/1, 5940, 5980/1), all of which are 5+ credit hours in total
- Strategic Operations immersion counts as 7 “TECH ENG” hours

ORIE
12+ ORIE credit hours
that consist of:

- ORIE CORE courses with ORIE course number
- Project Prep (ORIE 5110)
- 4000+ Level ORIE courses *excluding* project and colloquium courses and ORIE 4152, ORIE 4990
- Strategic Operations immersion counts as 3 “ORIE” hours

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

- 9+ 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