The rules and regulations stated in this handbook are for information only and in no way constitute a contract between the student and Cornell University. The University reserves the right to change any regulations or requirements at any time.

It is the policy of Cornell University actively to support equality of education and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age, or handicap. The University is committed to the maintenance of affirmative-action programs that will assure the continuation of such equality of opportunity. Sexual harassment is an act of discrimination and, as such, will not be tolerated. Inquiries concerning the application of Title IX may be referred to Cornell’s Title IX coordinator at the Office Workforce Diversity, Equity and Life Quality, 160 Day Hall, Ithaca, New York 14853-2801.
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SECTION 1 - INTRODUCTION

Welcome to Cornell University and, in particular, to the College of Engineering, and the Engineering Management Program. We hope your year here will be both an academically rich and personally rewarding experience. This handbook has been prepared to simplify the orientation and registration process of new candidates for the Master of Engineering degree in Engineering Management, and help them develop their academic program. Additional information can be obtained from the graduate program office in 219 Hollister.

1.1 The Engineering Management Program

The Engineering Management program has a strong educational tradition. Since its inception in 1988, the program has attracted students with bachelor’s degrees in all of the various engineering fields. Mechanical, biomedical, civil, electrical, computer science, industrial/operations research, chemical, applied and engineering physics, and environmental engineering students have all participated in the program. We have more than 800 alumni who hold important positions in engineering, product management, finance, consulting, research and development, manufacturing, sales, education, construction management, and government in the U.S. and around the world.

The Engineering Management program is housed in Hollister Hall, which is also home to the School of Civil & Environmental Engineering. Appendix A lists the Engineering Management program faculty and their particular specializations.

The three key individuals responsible who manage the Engineering Management program are

Director, Master of Engineering Program in Engineering Management: Patrick Reed, 211 Hollister, pmr82@cornell.edu

Program Manager, Engineering Management Program: Lisa Gerber, 215 Hollister Ave, 607-255-8315, lmg297@cornell.edu

Program Coordinator: Tania Sharpsteen, 215A Hollister, 255-3553, tms235@cornell.edu

Other individuals involved in the administration of the degree include:

Director, School of Civil & Environ. Engr.: Linda Nozick, 220 Hollister; 255-3690
Director of Administration: Joe Rowe, 220 Hollister, 255-0549
Administrative Assistant: Jeannette Little, 220 Hollister Hall, 255-3690

Support Staff:
Administrative Assistant: Beth Korson, 220 Hollister, 255-2542
Finance Specialist: Stacey Shirk, 220 Hollister, 255-3684
Accounts Coordinator: Megan Keene, 220 Hollister, 255-6192
Facilities Coordinator: Paul Charles, B56 Hollister, 351-3210
IT: Cameron Willkens, B55 Hollister
Communications: Charissa King-O’Brien, 220 Hollister
1.2 The Master of Engineering (M.Eng.) Degree in Engineering Management

The Master of Engineering degree is a coursework and project-oriented program. It requires thirty (30) credit hours consisting of coursework in major and supporting areas, and a project. This generally corresponds to 9 regular courses. In addition, it requires two, one-credit seminars (Professional and Leadership Development Series in the Fall and Project Management Seminar in the Spring), for a total of 32 credits minimum to graduate. The Master of Engineering degree can be completed in two semesters of intensive study, or in three semesters for students who want to include extra electives, make up deficiencies, or need time to adjust to study that departs significantly from their undergraduate experience. Students opting for the three semester program must meet the university requirement of 12 credits minimum per semester.

This program is aimed at engineers who want to be leaders in a technical environment and who want to advance into managerial roles. The dominant organizational structure in engineering firms to accomplish engineering-based work is the project team. The core business of a project team is to organize themselves to use technology and engineering skills to meet the needs of a customer. That customer may be another engineering group within the same company, an external customer (either an individual or another company) or the general public. To develop skills to operate effectively in this environment, the course work and the project address the following focus areas: leading people, advancing your business, and disrupting your field. Given the importance of engineering skills within the project team, this program also requires students to continue to build technical depth in the engineering domain that holds particular interest to them.

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<th>LEAD PEOPLE</th>
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Specifically, students learn to identify problems, analyze data, and formulate models to understand these problems, and interpret the results of analyses for managerial action. Identifying problems often requires managing data, and transforming data into information. Such data and information can be used as the basis for modeling, and the models generate insights that help us to understand problems and identify opportunities. A foundation of making good managerial decisions is the thread: data → information → models → decisions. Managers also need to communicate the results of such analyses.
to their supervisors, to customers, and to other stakeholders who are concerned with decisions and take part in the decision making process.

The business context of the issues and decisions with which students will deal is important, and the program mixes courses from the Engineering College with courses from the Cornell Johnson College of Business and the School of Industrial and Labor Relations to provide that larger context.

Management responsibilities in a technical environment (and increasingly in many business environments) are often focused on projects, where a combination of resources (people, equipment, money, etc.) must be brought together to achieve a specific outcome within both schedule and budget constraints. This importance of projects is reflected in this program through a strong focus on project management – the combination of “people skills” and “technical skills” necessary to make projects successful.

By the end of your Engineering Management degree, you will also develop strong competencies in the following areas:

Because the program is designed to appeal to students from different disciplinary backgrounds, and who are aiming at different career paths, the core tools taught in the program are augmented by a set of track specialization courses that allow students to develop expertise in particular application areas. More detail on how these various program elements are reflected in specific curricular requirements are found in Appendix E.

For some students (especially those whose career interests focus on engineering companies), the Master of Engineering degree in Engineering Management can be viewed as an effective alternative to an MBA degree because it is focused on the mix of technical skills and project management skills that are valued highly in many technical environments. However, for some other students, the combination of the M.Eng. degree and an MBA is attractive, and Cornell offers a joint program between the Engineering College and the Johnson School of Business leading to both degrees (usually after a total of five semesters). Additional details on this joint M.Eng./MBA program are provided in Appendix B.

1.2.1 Preparation

Students from all fields of engineering are welcome in the Master of Engineering program in Engineering Management. The core elements of the program do not require specific knowledge from any particular engineering discipline. However, in keeping with the data → information → models → decisions thread described above, we require that all entering students will have a basic background in probability and statistics. This is generally satisfied by a one-semester undergraduate class that many engineering programs require. At Cornell, the typical courses used by undergraduates to satisfy this requirement are ENGRD 2700, CEE 3040 or ECE 3100. Appendix C describes the material that you should understand to meet this background requirement and to do well in the program.

If you have not had a course in probability and statistics as an undergraduate, you may arrange to take such a course over the summer preceding enrollment as an M.Eng. student, or you will have to take such a course (as an overload) during the first semester of your M.Eng. program. The credits for this
course do not count toward the 30 credits required to complete the degree. We strongly encourage students to satisfy this preparation requirement prior to entering the program because it is used in Fall courses, particularly the required course ENMGT 5930.

1.2.2 Major Program Requirements

**Required Courses:**
- ENMGT 5900 - Project Management (Fall or Spring, 4 credits)
- ENMGT 5910 - Engineering Management Project (Fall or Spring, 4 credits) *
- ENMGT 5930 - Data Analytics for Engineering Managers (Fall, 4 credits)
- ENMGT 5940 - Economics and Finance for Engineering Management (Fall, 4 credits)
- ENMGT 6090 - Professional Development and Leadership Series (Fall, 1 credit, non-graded)
- ENMGT 6091 - Project Management Seminar (Spring, 1 credit, non-graded)

*One out of two of the following:*
- ENMGT 5970 – Risk Analysis and Management (Spring, 3 credits), or
- ENMGT 5980 - Introduction to Decision Analysis (Fall, 3 credits)

*ENMGT 5910 may only be taken in the second semester of your program (or third semester for a three-semester program).*

**One course (minimum 3 credits) in individual and/or organizational behavior** (many students take NCC 5530 – Marketing Management; NCC 5540 – Mgmt. and Leading in Organizations; NBA 6630 – Managerial Decision Making; or ILROB 5200 – Organizational Behavior & Analysis; other courses are also possible.)

**9 credits (minimum) of track specialization elective courses** (see Appendix E)

**Meeting the minimum 3-credit requirement:** The program requires that courses chosen to satisfy the finance/accounting and behavior requirements are for a minimum of 3 credits each. You cannot take a half-semester (e.g., 1.5- or 2-credit course) to meet this requirement, even if you meet the overall 30-credit requirement for the degree elsewhere. However, in other colleges instructors sometimes divide a 3-credit course into two 1.5-credit segments, in which case you can meet the 3-credit requirement as long as you take both segments. For the Track Specialization requirement, you are allowed to take courses 1.5-credits or higher.

Appendix E provides the proposal form that must be completed by each student, listing the courses that will be used to satisfy degree requirements.

Appendix F provides course descriptions for the required courses and the most popular choices of courses in accounting/finance and organizational behavior.

The information provided should help you make decisions, but we encourage you to seek guidance from your advisor and other faculty members. An important aspect of the M.Eng. program is interaction between each student and his/her faculty advisor. Your advisor will work with you to develop a program consistent with your career goals and the intent of the M.Eng. program. Also feel free to reach out to the Executive Director as well.
Enrolling in the M.Eng. program in Engineering Management will take relatively little time for most of you. You will find the process a little more informal than undergraduate registration, with more freedom to change courses easily during the first three weeks of classes of each semester. The major steps in the process are described in the following sections.

2.1 Assignment of Advisor

You will have an advisor to help you design a program of study and generally to assist you during your stay at Cornell. Advisor assignments are made prior to you beginning your M.Eng. program. You may also request to change your advisor to another Engineering Management faculty member with the permission of the faculty member whom you would like to serve as your new advisor.

The engineering management student cohort will discuss course requirements with Engineering Management faculty as a group at the orientation at the beginning of the semester. Thereafter, you should set up an appointment with your advisor, and take responsibility for registering for all required courses by the add/drop deadline. Additionally, you are responsible for submitting your completed M.Eng proposal form to the Graduate Field Assistant by the deadline date once your advisor has approved and signed off on your proposal form. You are responsible for any changes to your proposal (for example, any changes made to your courses at any time during your program).

2.2 Course Registration

Graduate students must register for courses online by logging into you Student Center with your NetID*. You can begin registering for classes for the Fall term at 8:00am on Tuesday, August 20, 2019. Courses may be added online until 11:59pm on Thursday, September 12th. They may be dropped online (without a petition) until 11:59pm on Thursday, October 24th.

Pre-enrollment for the Spring 2020 courses begins at 7:00am on Wednesday, October 30th and ends at 4:30pm on Friday, November 1st.

For any additional courses to be added for the Spring 2020 semester after the pre-enrollment dates, you can begin registering for courses for the Spring term on Tuesday, January 14, 2020 at 8:00am. They may be dropped online (without a petition) until Tuesday, February 4, 2020 at 11:59pm.

Any changes in your course registration after the deadlines (i.e., adds/drops, credit hour changes) requires submission of a Course Enrollment Petition to the Engineering Registrar’s office within the College of Engineering. The petition must be signed by both your advisor and the instructor of the course. Please note that petitions are not automatically approved.

*NetID: You should have received your NetID and information from Cornell Information Technologies (CIT) over the summer. If you did not, please contact the CIT Office at HelpDesk@cornell.edu. Please be sure to check your Cornell e-mail regularly.

2.3 Planning Your M.Eng. Program

Please study the pertinent material in this handbook for both required courses and appropriate elective courses before seeing your advisor. It would be worthwhile to spend some time with the online course catalog (https://classes.cornell.edu/browse/roster/FA19) to identify possible courses for both the Fall and Spring terms (the Spring roster will be available by mid-October). In addition, students will want to
consult the course listing in the Johnson School of Business, the School of Industrial and Labor Relations, and various other departments within engineering.

Program planning is done with the aid of the M.Eng. Proposal Form for Engineering Management (see Appendix E). You will fill this form out with the help of your advisor, who must also sign the form showing his/her approval of your program. Extra proposal forms can be obtained from the Graduate Field Coordinator.

A maximum of two credit hours graded on an S/U basis, such as seminar or their equivalent, may be included provided they are participatory in nature.

2.4 Approval of Your Course Program

After a “final” program of courses for the entire year is agreed upon with your advisor, please submit your Proposal Form to the Graduate Field Assistant by **Friday, September 13th** for the Fall, 2019 term and **Friday, February 7th, 2020** for the Spring, 2019 term. It will then be forwarded to the Director of the Engineering Management Program for final approval. A copy of the approved program is returned to both you and your faculty advisor. Original forms stay on file with the Graduate Field Assistant.

2.5 Filing Your Course Program

You have approximately three (3) weeks (until Thursday, September 12, 2019) to enroll online for Fall 2019 classes. This time period allows you to sit in on an extra course or two, if you wish, for a couple of weeks to assist you in making up your mind about your exact program for the term.

2.6 Program Changes

Students often propose changes to their program at the start of their second semester that reflect changes in interests and/or course availability. All changes to your approved M.Eng. program must take the form of a revised proposal. Revised proposal forms must also be approved by your advisor and the Engineering Management Director.

It is important that any changes in your program be approved promptly because the current version of your proposal form that is on file serves as a check list for determining compliance with graduation requirements.

2.7 Petitions

Cornell University has a long-standing tradition of considering petitions from students relative to special situations or circumstances that could justify exceptions to the normal rules or requirements. Petitions are considered by the Engineering Management Director. While we are not encouraging use of the petition route to get around requirements, we do want to point out the existence of this process. It gives everyone the opportunity of stating his/her case for special consideration, and therefore it is a very important part of the operational procedures for students attending Cornell University.

2.8 Financial Aid and Work Obligation

Financial aid administered by the College or School can be in the form of fellowships or half-time assistantships. If you have the latter, you will be given eight hours per week of teaching assistant-related duties. MEng students typically serve as graders, prepare class materials, etc. The faculty generally make assistantship assignments during the first two weeks of classes.
2.9 Grade Requirements

The College requires a minimum grade point average of 2.50 for graduation from the Master of Engineering program. Students who are admitted on a Provisional Basis must achieve a 3.00 average during their first term in the M.Eng. program in order to continue in the second term. Typical graduate student grade point averages are much higher than this. At Cornell, decimal grade points are assigned to grades with (+) or (-), i.e., A+ = 4.3, A = 4, A- = 3.7, B+ = 3.3, etc.

A grade of less than C- in a course will result in no credit being granted toward satisfaction of the 30-hour minimum requirement. However, these courses are included in calculating grade point averages.

2.10 Office Space, etc.

The Engineering Management students have space allocated in 404 Hollister. This space includes:
- Individual study carrels (first come first serve on a daily basis)
- Group study areas
- Sixteen computer workstations (first come first serve on a daily basis)
- Thirty-two individual lockers for storage of books, etc.
- Storage areas above study carrels and computer workstations (first come first serve on a daily basis)
- Laptop charging table
- Printers (available via wireless access from your laptops or directly from the work stations)

We do not recommend leaving valuable items in the lockers or storage space above the workstations as there is no way to lock them.

Entrance into the M.Eng. office is via your ID card. Your ID will also open outside doors to Hollister Hall and the Graduate Student lounge in Hollister Hall.

2.11 Job Placement

We are confident that the background you receive in your M.Eng. program in Engineering Management will be of great assistance to you in the job market. Employers have always been enthusiastic about Cornell graduates with M.Eng. degrees in Engineering Management. Based on our review of recent alums, the following five career pathways are the most common among our graduates. That being said, we see our students pursue a number of successful career pathways outside of these below.

Figure 1: Example career path trajectories of Engineering Management graduates
During the Engineering Management Professional Development and Leadership series, we will work together with you to set you up for success for your career search.

Also please feel free to reach out to Andrea Ippolito, Executive Director of the Engineering Management Program, to discuss your career goals as well.

SECTION 3 - PROFESSIONAL CONDUCT and SPECIAL NEEDS

3.1 Academic Integrity and Plagiarism

Absolute integrity is expected of every Cornell student in all academic undertakings. Integrity entails a firm adherence to values most essential to an academic community, including honesty with respect to the intellectual efforts of oneself and others. Both students and faculty at Cornell assume the responsibility of maintaining and furthering these values. However, a Cornell student’s submission of work for academic credit indicates that the work is their own. All outside assistance should be acknowledged, and the student’s academic position should be reported truthfully at all times. In addition, Cornell students have the right to expect academic integrity from each of their peers. It is plagiarism for anyone to represent another’s work as their own. As stated in the University Code of Academic Integrity, “The maintenance of an atmosphere of academic honor ... is the responsibility of the student and faculty ...”

Gray areas sometimes exist when students study and work together. It is important that faculty make clear what is expected and that students understand what authorship citations an instructor expects. To become better acquainted with academic integrity responsibilities, each student should have a copy of the Policy Notebook for Students, Faculty and Staff (available in the Dean of Student’s Office). Also, a copy of the “University Code of Academic Integrity” is included in the Handbook of Engineering Students available from the Engineering College’s Office of Admissions and Undergraduate Programs located near the north entrance of Hollister Hall.

3.2 Persons with Special Needs

Cornell University is committed to assisting those persons with disabilities who have special needs. A brochure describing services for persons with disabilities may be obtained from the Office of Equal Opportunity, Cornell University, 234 Day Hall, Ithaca, New York 14853-2801. Other questions or requests for special assistance also should be directed to that office.

APPENDIX A: ENGINEERING MANAGEMENT PROGRAM FACULTY AND THEIR INTERESTS

Ricardo A. Daziano, Assistant Professor (Ph.D. Université Laval): pro-environmental preferences, sustainable travel behavior, renewable energy, environmentally-friendly energy sources.

Huaizhu "Oliver" Gao, Associate Professor (Ph.D. California/Davis): systems engineering, statistical modeling, transportation and air quality.

Andrea Ippolito, Lecturer: Engineering Management, entrepreneurship, innovation, product management, healthcare systems.
Robert Newman, Senior Lecturer: Engineering Management, business development, organizational and team development, engineering management, emotional intelligence, entrepreneurship.
Linda K. Nozick, Professor (Ph.D. Pennsylvania): Systems engineering, transportation and logistics, engineering management.

Patrick M. Reed, Professor (Ph.D. Illinois): Environmental and water resources systems; multiobjective planning and management, evolutionary computation; high-performance computing; uncertainty in decision making.

Samitha Samaranayake, Assistant Professor (Ph.D. University of California, Berkeley): Systems engineering and transportation

Jery R. Stedinger, Professor (NAE, Ph.D. Harvard): Stochastic hydrology; water resource systems planning and operations; risk analysis and management.

Francis M. Vanek, Senior Lecturer (Ph.D. Pennsylvania): Energy, environment, and transportation.

APPENDIX B: FIVE SEMESTER M.ENG./MBA PROGRAM

What is it?
A joint venture between the College of Engineering and the Johnson Graduate School of Management (JGSM) that allows students to acquire a Master of Engineering degree and an MBA degree in 5 semesters (usually based on Fall admission to the M.Eng. program). The dual-degree program consists of 75 credit hours, 30 of which comprise the regular two-semester M.Eng. program. For those admitted to the MBA program, the JGSM allows some (occasionally all) of these M.Eng. credits to be transferred to the MBA program, usually resulting in saving one semester’s time over taking the M.Eng. and MBA degree programs separately.

What are the requirements?
Applicants must have already earned a baccalaureate degree in engineering, applied science, or equivalent from Cornell or elsewhere and be accepted for admission or presently enrolled in the M.Eng. program. The two programs require separate application forms and review processes, and materials submitted to one program are not available to the other. The JGSM places great emphasis on relevant work experience, and this will be taken into consideration when evaluating applications. All requirements of the Master of Engineering program are to be completed. No credit toward the M.Eng. degree is allowed for coursework done outside Cornell. All requirements of the Master of Business Administration curriculum are to be completed. Coursework done outside Cornell normally will not be credited toward the MBA degree.

Please review the following steps if you are interested in this program, (the following dates are based on Fall enrollment):

a. If you have been admitted to or are attending the M.Eng. program, formally apply to the Johnson Graduate School of Management by the second semester of your M.Eng. program at the latest. You must fill out a separate JGSM application form and pay their application fee. You should also notify your M.Eng. advisor of your intention to do the MBA program so your advisor can take this into consideration when planning your M.Eng. program schedule.
b. If you have not already done so, apply to take the GMAT or GRE (either acceptable) and is required by JGSM. January of your M.Eng. year is your last possible test date. Have the scores directed to JGSM.

If you are admitted to the JGSM, your Master of Engineering degree will be awarded when all requirements of that degree are completed (usually after 2 semesters), and the Master of Business Administration degree will be awarded when all requirements of that degree are completed (usually after 3 more semesters). The two degrees cannot be awarded simultaneously.

In general, financial aid is not awarded to those doing the MBA portion of the program except through the Knight Joint Degree Scholarship Program, which has very strict requirements. Information and an application to the Scholarship Program is available on the web at:

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

Questions about this Scholarship Program should be directed to the Office of Research and Graduate Studies, engr_grad@cornell.edu.

**APPENDIX C: MASTERS IN PUBLIC ADMINISTRATION (M.P.A.) FROM THE CORNELL INSTITUTE FOR PUBLIC AFFAIRS (CIPA)**

After the award of the M. Eng. degree, Engineering Management students who aspire to a leadership or management position in formulating, implementing or evaluating public policies can benefit from a program that offers an accelerated path to a Masters in Public Administration (M.P.A.) from the Cornell Institute for Public Affairs (CIPA). CIPA offers a flexible and challenging two-year program of graduate professional studies in public affairs that prepares degree recipients for careers in public affairs, public administration, and public policy.

Concentration areas offered in CIPA include Environmental Policy; Science, Technology and Infrastructure Policy; Economic and Financial Policy; International Development; and Public and Nonprofit Management.

The two degree programs (MEng and M.P.A.) have separate admission processes; so you may apply to the Accelerated M.P.A. program upon completion of your first semester in the M.Eng program. The M.Eng students who possess an M.Eng. can obtain the M.P.A. degree in three additional semesters. Applicants should plan on meeting with the CIPA Director of Graduate Studies to discuss which M.Eng credits would be transferable for the MPA program.

Please contact the C.I.P.A. Office at 607-255-8018 or cipa@cornell.edu to set up an appointment. More information is available on the CIPA website at http://www.cipa.cornell.edu.

**APPENDIX D: PREREQUISITE SKILLS IN PROBABILITY AND STATISTICS**

Engineering Management requires that an engineer deal with variation, variability and uncertainty. Illustrative issues of concern include estimates of the time to complete tasks in project planning and scheduling; the prices for goods and services; the demand for goods and services; and the performance of a range of systems and other forces that effect an organization. Thus Engineering Management students need to know how to use the language of probability to describe variability and
uncertainty, and to help resolve the challenges faced by their organization. They need to understand how statistical concepts help them resolve what information can be extracted from available data, and how to determine and describe the precision of estimated quantities.

Our Engineering Management courses provide examples of these issues, and reinforce and advance these skills. But we depend upon all the Engineering Management students to begin the program with a basic understanding of probability and statistics, consistent with what would be included in an undergraduate treatment of the subject. Specific concepts and ideas students should have when entering the program include the basic concepts and methods of probability, along with an understanding of the idea of statistical estimation, construction of confidence intervals, hypothesis testing, and linear regression analysis. If the student does not complete a course with this material prior to entering, they will be required to take a course while in the program. This course will require additional course work beyond the 30 credit hours required, and may delay completion of the program.

Specifically we expect the following. [For clarification we provide references to sections in Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th edition, Duxbury, Belmont, CA, 2015. See also http://allpsych.com/stats/index.html]

1. Students should know the 3 basic axioms for probability. [Devore §2.1-2.2]
   \{ P(A) \geq 0; \ P(S) = 1; \ \text{for A and B disjoint, } P[A \cup B] = P[A] + P[B] \}

2. Students should know how to calculate the probability of events consisting of unions [A \cup B ], intersections [A \cap B ], and complements [A' = S – A ], of events of known probability. They should be able to use the Total Probability Theorem and Bayes Theorem to calculate probabilities and conditional probabilities of different events [P(A|B) = P(A \cap B)/P(B) ]. [Devore §2.2-2.5]

3. Students should know definitions of the cumulative distribution function (cdf) F_X(x) and probability density function (pdf) f_X(x) for continuous univariate random variables; the properties of each; and how to use these functions to calculate the probabilities for events such as P{ a \leq X \leq b }. [Devore §4.1-4.2]

4. Students should know the definitions and properties of the mean \mu, variance \sigma^2, and correlations r; how to compute the univariate “moments” given a pdf; and how to compute the mean and variance for linear functions and linear combinations of random variables. [Devore §5.1-5.2, 5.5]

5. Students should know the some properties of a Normal distribution, the form of the pdf, and how to calculate quantiles and the probability of events such as a \leq X \leq b for X \sim N [\mu, \sigma^2]. Students should be able to state the Central Limit Theorem and know when it applies. [Devore §4.3, 5.4]

6. Students should know the mean, variance and probability mass function for the discrete binomial and the Poisson distributions, and be able to use those relationships to compute probabilities for a range of events. [Devore §3.1-3.4, 3.6]

7. Students should know the concept of an estimator, and the sampling properties of the sample mean \bar{X} for a set of data. [Devore §5.4, 6.1-6.2]

8. Students should know how to construct confidence intervals for the mean of a Normal distribution with small samples. [Devore §7.1-7.3]
9. Students know how to structure a statistical decision problem as a choice between two hypotheses and how that choice relates to probabilities of type I (denoted $\alpha$) and II (denoted $\beta$) errors; students should know how to perform a simple one-sample or two-sample t test. [Devore §8.1-8.2]

10. Students should know why statisticians sometimes summarize results by a $P$-value, as well as what a $P$-value is, and how to calculate it. [Devore §8.4]

11. Students should understand the form of and assumptions employed with the basic linear model $Y= \alpha + \beta x + \epsilon$, with independent additive normal errors $\epsilon$. [Devore §12.1]

12. Students should be able to calculate least-squares estimators of the two coefficients $\alpha$ and $\beta$, and construct hypothesis tests on the parameters. Students should know the definition of $R^2$, what it represents, and how to calculate it. Students should know the definition and meaning of the correlation coefficient, and be able to calculate its estimator $r$. [Devore §12.2-12.5]

APPENDIX E: Program Requirements, Link to Proposal Form for M.Eng. Degree in Engineering Management, and Track Specialization Electives

Below is the link to the EM Proposal form that you must complete and add to your Cornell Box folder that you recently received access to for advisor approval. Please note that any changes made to your proposal form must be approved by your advisor along with an updated copy of your proposal form.

EM Proposal form 2019-20

2 One course in individual and/or organizational behavior is required.

Suggested courses include:

- ENGMT 5000 Entrepreneurship and Private Equity
- ENMG 6000 Entrepreneurship for Scientists and Engineers
- ENMG 6020 Managing a Culture of Innovation
- HADM 6110 Negotiations in the Hospitality Industry
- ILROB 5200 Organizational Behavior & Analysis (Note: Must be admitted in person by prof)
- NBA 5150 Leadership Theory and Practice (Note: This is an intensive, 1-week course that meets before the semester starts, so if you choose to take it you would need to make travel plans accordingly. We highly recommend you take it in the Fall semester because the Spring semester typically is very popular and has a wait list).
- NBA 6090 Digital Marketing
- NBA 6200 Marketing Research
- NBA 6540 Power and Politics in Organizations (Note: You must take both the first and second 7-week sections of this course to meet the 3-credit requirement)
- NBA 6620 Product Marketing Insights
- NBA 6630 Managerial Decision Making
- NCC 5530 Marketing Management
- NCC 5540 Management & Organizations
- PADM 5570 Corporate Responsibility
9-credits in Engineering Management Track Specialization elective courses are required
Each student’s program must include at least 9-credits worth of electives selected to provide a track area of specialization. Students can combine two 1.5 or higher credit behavior courses, as long as they meet or exceed 3 credits. We have put together six track areas of specialization below tied to common career paths of Engineering Management degree graduates. Any 5000 or 6000-level College of Engineering non-seminar technical 3 credits or higher course is acceptable. Courses outside of the College of Engineering and not listed below must be approved by the Director of the Engineering Management program via a course petition. The course petition must include a detailed syllabus of the technical content to be covered. You are also welcome to mix and match courses from different headings or choose courses aligned with your own interests to best serve your professional goals.

Figure 2: Track areas of specialization for electives

You will need to get your specialization track and classes approved by your faculty advisor.

Some additional things to think about when selecting your specialization track electives:
1. Make sure to comb through the course catalog because it is constantly getting updated with new courses or courses are being iterated upon/removed.
2. Make sure to check the prerequisites. If you don’t have the prerequisites, make sure that you have the permission of the instructor, which you can get by emailing them. Also don’t be afraid to show up on the first day of classes too (along with emailing them).
3. Many Johnson school courses are only 1.5 credits, which allows you to take more, but make sure that you meet the requirement of 9 credits worth of specialization electives.
4. Make sure to double check when courses are offered because many courses are only offered in the Fall or Spring, but not both.
5. For your specialization electives, courses should be above the 5000 level, which means that they are at the graduate level. 4000 level engineering courses may be acceptable if there is no course on the same topic at a higher level; ask your advisor.
6. You can mix and match across track specializations or build your own track!

The breakdown of the pre-approved electives for each track are below. Please note that course offerings change from semester to semester.

**Consulting**
CEE 5970 Risk Analysis & Management (If not used as a core course)
CEE 6640 Microeconomics of Discrete Choice
ENMGT 5960 Negotiations and Contracts for Engineering Management
ENMGT 5980 Intro to Decision Analysis (If not used as a core course)
NBA 5000  Intermediate Accounting
NBA 5020  Managerial Accounting and Reporting
NBA 5061  Comprehensive Financial Statement Analysis
NBA 5090  Advanced Financial Statement Analysis (1.5 credits)
NBA 5110  Financial Modeling (1.5 credits)
NBA 5120  Applied Portfolio Management (1.5 credits)
NBA 5130  International Finance Cases (1.5 credits)
NBA 5140  Ethics and Corporate Culture (1.5 credits)
NBA 5200  Retail Operations (1.5 credits)
NBA 5245  Introduction to Macroeconomics
NBA 5270  Applied Economic Analysis
NBA 5305  Entrepreneurial Finance (1.5 credits)
NBA 5420  Investment and Portfolio Management
NBA 5260  Leaders in Emerging Markets (1 credit)
NBA 5360  Investment Banking Essentials (1.5 credits)
NBA 5550  Fixed Income Securities and Interest Rate Options
NBA 5911  Risk Management in Emerging Markets
NBA 5980  Behavioral Finance (1.5 credits)
NBA 6090  Digital Marketing (1.5 credits)
NBA 6200  Marketing Research
NBA 6220  Marketing Strategy (1.5 credits)
NBA 6250  International Marketing (1.5 credits)
NBA 6390  Data-Driven Marketing (1.5 credits)
NBA 6430  Managerial Spreadsheet Modeling (1.5 credits)
NBA 6560  Valuation Principles (1.5 credits)
NBA 6630  Managerial Decision Making
NBA 6650  Strategic Management of Technology and Innovation
NBA 6730  Derivatives Securities Part I (1.5 credits)
NBA 6740  Derivatives Securities Part II (1.5 credits)
NBA 6780  Advanced Private Equity - Negotiations and Structuring (2 credits)
NBA 6410  Supply Chain Management
NBA 6820  Negotiation 1: Negotiation Essentials (1.5 credits)
NBA 6880  Financial Distress, Bankruptcy and Restructuring (1.5 credits)
NBA 6930  Strategy and Tactics of Pricing (1.5 credits)
NCC 5000  Financial Accounting (2.5 credits, if not using for Finance requirement)
NCC 5530  Marketing Management (if not using for Org Behavior requirement)
NCC 5560  Managerial Finance (if did not take already for finance requirement)
NCC 5580  Managing Operations
PADM 5755  Infrastructure financing

Product Management and Entrepreneurship
AEM 6385  Entrepreneurial Strategy
AEM 6395  Technology Strategy
ENMGT 5070  Entrepreneurship for Engineers and Scientists
ENMGT 5920  Product Management
ENMGT 6020  Managing a Culture of Innovation and Entrepreneurship
ENMGT 5960  Negotiations and Contracts for Engineering Management
HADM 6130  Entrepreneurial Management
HADM 6211  Entrepreneurial Finance
HADM 6800  Law for Entrepreneurs
LAW 6335  Emerging Growth Companies and Venture Capital Financing
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<td>NBA 5100</td>
<td>Social Entrepreneurship (1.5 credits)</td>
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<td>Design and Innovation (1.5 credits)</td>
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<tr>
<td>NBA 5305</td>
<td>Entrepreneurial Finance (1.5 credits)</td>
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<td>NBA 5590</td>
<td>The Venture Capital Industry and Private Equity Markets (0.5 credits)</td>
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<td>NBA 5630</td>
<td>The IPO &amp; Mergers &amp; Acquisitions Process</td>
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<td>NBA 6029</td>
<td>Leading Agile Innovation (1.5 credits)</td>
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<td>NBA 6090</td>
<td>Digital Marketing (1.5 credits)</td>
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<td>NBA 6230</td>
<td>eLab</td>
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<td>NBA 6390</td>
<td>Data-Driven Marketing (1.5 credits)</td>
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<td>NBA 6560</td>
<td>Valuation Principles (1.5 credits)</td>
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<td>Entrepreneurial Marketing (1.5 credits)</td>
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<td>Product Marketing Insights</td>
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<td>Strategic Management of Technology and Innovation</td>
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<td>NBA 6820</td>
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<td>NBA 6930</td>
<td>Strategy and Tactics of Pricing (1.5 credits)</td>
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<td><strong>Real Estate and Construction Management</strong></td>
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<tr>
<td>CEE 5950</td>
<td>Construction Planning and Operations</td>
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<tr>
<td>CEE 6730</td>
<td>Design of Concrete Structures</td>
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<tr>
<td>CRP 5320</td>
<td>Real Estate Development Process I (1.5 credits each, must take part II)</td>
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<tr>
<td>CRP 5321</td>
<td>Real Estate Development Process II (1.5 credits each, must take part I first)</td>
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<tr>
<td>CRP 5560</td>
<td>Creating the Built Environment</td>
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<tr>
<td>CRP 5530</td>
<td>Concepts and Methods of Land Use Planning</td>
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<tr>
<td>CRP 5590</td>
<td>Legal Aspects of Land Use Planning</td>
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<tr>
<td>ENMGT 5960</td>
<td>Negotiations and Contracts for Engineering Management</td>
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<td>HADM 6200</td>
<td>Principles of Real Estate</td>
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<td>HADM 6211</td>
<td>Entrepreneurial finance</td>
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<td>Real Estate Finance and Investments</td>
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<td>HADM 6500</td>
<td>Sustainable Development</td>
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<td>HADM 6570</td>
<td>Project Mgt for Real Estate Development</td>
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<tr>
<td>HADM 6580</td>
<td>Advanced project management for real estate development</td>
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<td>PADM 5755</td>
<td>Infrastructure financing</td>
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<tr>
<td>SYSEN 5740</td>
<td>Design Thinking for Complex Systems</td>
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<td><strong>Engineering Leadership</strong></td>
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<td><strong>General</strong></td>
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<td>ENMGT 5960</td>
<td>Negotiations and Contracts for Engineering Management</td>
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<tr>
<td>HADM 6155</td>
<td>Women in Leadership</td>
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<td>HADM 6835</td>
<td>Leading and Managing Teams</td>
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<tr>
<td>ILRHR 7451</td>
<td>Leadership Assessment for Managers</td>
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<tr>
<td>NBA 5150</td>
<td>Leadership Theory and Practice (take in Fall)</td>
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<tr>
<td>NBA 6410</td>
<td>Supply Chain Management</td>
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<tr>
<td>NBA 6630</td>
<td>Managerial Decision Making</td>
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<tr>
<td>NBA 6650</td>
<td>Strategic Management of Technology and Innovation</td>
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<tr>
<td>NBA 6700</td>
<td>Leadership, Ethics and Organizations (1.5 credits)</td>
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<tr>
<td>NBA 6820</td>
<td>Negotiation 1: Negotiation Essentials (1.5 credits)</td>
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<tr>
<td>NCC 5580</td>
<td>Managing Operations</td>
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<tr>
<td>ORIE 5100</td>
<td>Design of Manufacturing Systems</td>
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<tr>
<td>ORIE 5122</td>
<td>Inventory Management</td>
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<tr>
<td>ORIE 5140</td>
<td>Model based systems engineering</td>
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</tbody>
</table>
ORIE 5300  Optimization I
ORIE 5380  Optimization Methods
ORIE 5580  Simulation Modeling and Analysis
ORIE 5581  Monte Carlo Simulation
ORIE 6741  Bayesian Machine Learning

Healthcare/Biomedical
BME 5310  Machine Learning with Biomedical Data
BME 5390  Biomedical Materials & Devices for Human Body Repair
BME 6210  Engineering Principles for Drug Delivery
BME 6650  Principles of Tissue Engineering
BME 7310  Advanced Biomedical Engineering Analysis of Biological Systems

Analytics
This is a popular track to do if you are interested in supply chain management too.
CEE 5970  Risk Analysis & Management (If not used as a core course)
CEE 6000  Numerical Techniques for Engineers
CEE 6620  Networks
CRP 5080  Introduction to Geographic Information Systems for planners
CS 5320  Introduction to Database Systems
CS 5150  Software Engineering
CS 5320  Introduction to Database Systems
CS 5780  Machine Learning
ENMGT 5980  Intro to Decision Analysis (If not used as a core course)
FDSC 4210  Food Engineering Principles (this is a popular course for students interested in Food Product Supply Chain Management)
INFO 5306  Crowdsourcing and Human Computation
INFO 6113  Technology and Law Colloquium
INFO 6120  Ubiquitous Computing
INFO 6220  Networks II
INFO 6260  Networks, Crowds, and Markets
INFO 6420  Human Robot Interaction - Research and Design
M&AE 4780  Feedback Control Systems
NBA 5301  Intermediate Design and Programming for Web
NBA 6010  Electronic Commerce
NBA 6340  Customer Strategy and Analytics (1.5 credits)
NBA 6390  Data-Driven Marketing (1.5 credits)
NBA 6410  Supply Chain Management
NBA 6430  Managerial Spreadsheet Modeling (1.5 credits)
NBA 6550  Introduction to Statistical Programming and SQL (1.5 credits)
NBA 6920  Advanced Data Analytics Applications and Methods (1.5 credits)
NCC 5530  Marketing Management
NCC 5580  Managing Operations
ORIE 5100  Design of Manufacturing Systems
ORIE 5122  Inventory Management
ORIE 5126  Principles of Supply Chain Management
SYSEN 5200  Systems Analysis Behavior and Optimization
SYSEN 5220  Systems Dynamics
SYSEN 5240  Search and Optimization with Metaheuristics
SYSEN 5300  Systems Engineering and Six Sigma for the Design and Operation of Reliable Systems
SYSEN 5400  Theory and Practice of Systems Architecture
SYSEN 5500  Systems Modeling Language: Fundamentals and Practice
SYSEN 5740  Design Thinking for Complex Systems
SYSEN 5940  Creativity and Innovation within Systems Engineering
SYSEN 6410  Multiobjective Systems Engineering Under Uncertainty
SYSEN 6880  Industrial Big Data Analytics and Machine Learning
SYSEN 5200  Systems Dynamics
SYSEN 5300  Systems Engineering and Six Sigma for the Design and Operation of Rel Syst
SYSEN 5400  Design & Operation of Rel Systs Theory & practice of systems architecture
SYSEN 5400  Theory and Practice of Systems Architecture

**Sustainability and Renewable Energy**
A&EP 4840  Controlled Fusion
AEP 5500  Physics of Renewable Energy
BEE 4010  Renewable Energy Systems
BEE 4750  Environmental Systems Analysis
BEE 4870  Sustainable bioenergy systems
CEE 6530  Water Chemistry for Environmental Engineering
CEE 6550  Transport, Mixing and Transformation in the Environment
CEE 6560  Physical/Chemical Processes
CEE 6570  Biological Processes
CEE 6930  Public Systems Modeling
CEE 6200  Water Resource Systems Engineering
ChemE 6610  Air Pollution Control
ChemE 6640  Energy Economics
ChemE 6650  Energy Engineering
ChemE 6610  Air Pollution Control Manufacturing Management
ChemE 6660  Analysis of Sustainable Energy Systems
ECE 4510  Electric Power Systems I
ECE 4520  Electric Power Systems II
MAE 5010  Future Energy Systems
MAE 5020  Wind Power
MAE 5430  Combustion processes
MSE 5150  Structures & materials for sustainable energy systems
MSE 5330  Materials for energy production, storage, conversion, and distribution

**APPENDIX F: 2019-20 COURSES OF STUDY FOR ENMGT 59XX SERIES AND OTHER KEY COURSES**

**CEE Courses**

**ENMGT 5900: Project Management**
Fall & Spring, 4 credits. Prerequisite: permission of instructor.

Core graduate course in project management for people who will manage technical or engineering projects. Focuses both on the “technical” tools of project management (e.g., methods for planning, scheduling, and control) and the “human” side (e.g., forming a project team, managing performance, resolving conflicts), with somewhat greater emphasis on the latter.

**ENMGT 5910: Engineering Management Project**
Fall and Spring, 4 credits. Prerequisite: permission of instructor.
As Engineering Managers, you need to embrace both technical and business skills to tackle complex, sociotechnical challenges, while staying on top of the current pace of technological change. In this Engineering Management project course, we are bridging from your coursework to your role as an engineering manager. To get there, you will practice the tools, themes, and techniques learned in your Engineering Management coursework through the scaffolding of a large project. In ENMGT 5910, you will work in teams to participate in a project in collaboration with an industry partner. You will perform an intensive evaluation of some mixture of the technological and management aspects of a major engineering project or system, conducted with a team of students. This project typically incorporates some combination of economic and financial analysis, integration of components into a large-scale system, or technology feasibility.

**ENMGT 5920 Product Management**
Spring, 3 credits.
Product Management is one of the fastest growing careers in engineering and technology-based industries. In this course, you will learn the foundations of product management including (i) preparing for success as a product manager, (ii) identifying and targeting customer needs, (iii) prioritizing your project needs, and (iv) designing, developing, and deploying your product across the product life cycle. Using skills developed through course lectures and discussions, you will complete in a project where you will practice the sprint model utilized in most product teams. This course is for students interested in pursuing a career as a product manager in engineering or technology-based companies, learning about the product management competency, or working in a non-traditional tech setting to apply these skills on complex systems.

**ENMGT 5930: Engineering Management Methods: Data, Information, and Modeling**
Fall, 4 credits. Prerequisites: CEE 3040 or equivalent.
Methods for managing data and transforming data into information. Modeling as a means to synthesize information into knowledge that can form the basis for decisions and actions. Application of statistical methods and optimization to managerial problems in project design, scheduling, operations, forecasting, and resource allocation.

**ENMGT 5940: Economics and Finance for Engineering Management**
Fall, 4 credits.
An engineering case based exploration of economic models and methods used in analyses, comparisons, and decision making by engineers and engineering teams. Emphasis will be placed not only on the important calculations, but on understanding, communicating and recording their findings, related assumptions, risks, external considerations and situational awareness.

**ENMGT 5960 Negotiations and Contracts for Engineering Management**
Spring, 3 credits.
An exploration of Negotiation types, skills, and tactics relevant to Engineers and Engineering Managers, and a study in contract types, details, and clauses common to engineering fields. Studies will include human factors and behavior in negotiations, understanding and managing the end game, and legal terminology engineers should know.

**ENMGT 5970: Risk Analysis and Management**
Spring, 3 credits. Prerequisite: introduction to probability and statistics (e.g. CEE 3040, ENGRD 2700, ILRST 2100, or AEM 2100); two semesters of calculus; senior or graduate standing, or permission of instructor. J.R. Stedinger.
Develops a working knowledge of risk terminology and reliability engineering, analytic tools and models used to analyze environmental and technological risks, and social and psychological risk issues. Discussions address life risks in the United States historical accidents, natural hazards, threat assessment, transportation risks, industrial accidents, waste incineration, air pollution modeling, public health, regulatory policy, risk communication, and risk management.

**ENMGT 5980: Introduction to Decision Analysis**  
Fall, 3 credits. Prerequisite: introduction to probability and statistics course such as CEE 3040, ENGRD 2700, ILRST 2100, BTRY 3010, or AEM 2100. Enrollment is limited to: seniors and graduate students; or permission of instructor.

Framework to structure the way we think about decision situations that are complicated by uncertainty, complexity, and competing objectives. Specific decision analysis concepts and tools, such as decision trees, sensitivity analysis, value of information, and utility theory. Applications to all areas of engineering and life. Includes a group project to analyze a real-world decision.

**ENMGT 6020 Managing a Culture of Innovation**  
Fall, 3 credits.  
Innovation is not just ideas, but getting ideas to measurable impact for your customers or employees. While the word “innovation” is pervasive throughout engineering and business, developing and managing a culture of innovation has only been mastered by few organizations. In fact, no company has remained on the Dow Jones Industrial Average since its inception. Why? Because implementing a culture of innovation is very difficult and is mired by a lack of understanding of proven innovation strategies, competencies, and tools. In this course, you will learn a systematic approach for developing and managing a culture of innovation. You will learn how to develop an innovation strategy to better meet your organizations goals and customer needs. In addition, we will take time to dive into innovation competencies, such as design thinking, lean start-up, and making, along with learn several innovation tools including hackathons, open innovation challenges and competitions, and corporate venture arms. Lastly, we will discuss how to implement and scale your innovation strategies to deliver impact for your customers and organization.

**ENMGT 6090: Professional Development and Leadership Series**  
In the Professional and Leadership Development Course, Engineering Management Master of Engineering students will identify the goals for their career and engage in several career development support services, such as networking, interviewing, resume and cover letter writing, and negotiation workshops. In addition, they will engage in a leadership development series to help them further build their engineering management and leadership competencies. Through a variety of tools, one-on-one coaching, workshops, events, and other resources, this course will help students develop and practice critical career management skills, along with build their confidence to find a career opportunity best suited to their interests and needs.

**ENMGT 6091: Project Management Seminar**  
Weekly seminar aimed at M.Eng. students, in particular in the engineering management program. Weekly speaker will come from different engineering applications and discuss insights into project management.

Appendix G: Course resources

Please note that courses listed may not be available every Fall and Spring. Please be sure to check with University Class Roster for the most up to date course listing:  
[https://classes.cornell.edu/browse/roster/FA19](https://classes.cornell.edu/browse/roster/FA19).