

STUDENT HANDBOOK
Master of Engineering
Degree Program in
ENGINEERING MANAGEMENT
2009-2010



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SECTION 1 INTRODUCTION

Welcome to Cornell University and, in particular, to the College of Engineering. 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.

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, civil, electrical, computer science, industrial/operations research, chemical, applied and engineering physics, and environmental engineering students have all been well represented in the program. The engineering faculty who teach in the Engineering Management program and their particular specializations are listed in Appendix A. In addition, we have more than 600 alumni who hold important positions in engineering, construction, research and development, manufacturing, sales, education, consulting, 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. The faculty and other individuals responsible for administering the Engineering Management program include:

Director, School of Civil & Environ. Engr.: Philip Liu, 220 Hollister, 255-3690

Director of Administration: Joe Rowe, 220 Hollister, 255-0549

Administrative Assistant: Jeannette Little, 220 Hollister, 255-3690

Director of Graduate Studies: James J. Bisogni, Jr.

Chair, Master of Engineering Program in Engineering Management: Mark Turnquist

Graduate Program Coordinator: Tania Sharpsteen, 219 Hollister, 255-7560

Other Support Staff:

Administrative Assistant: Christine Day, 220 Hollister, 255-3438

Accounts Administrator: Debra Federation, 220 Hollister, 255-3684

Accounts Coordinator: Maureen Letteer, 220 Hollister, 255-6192

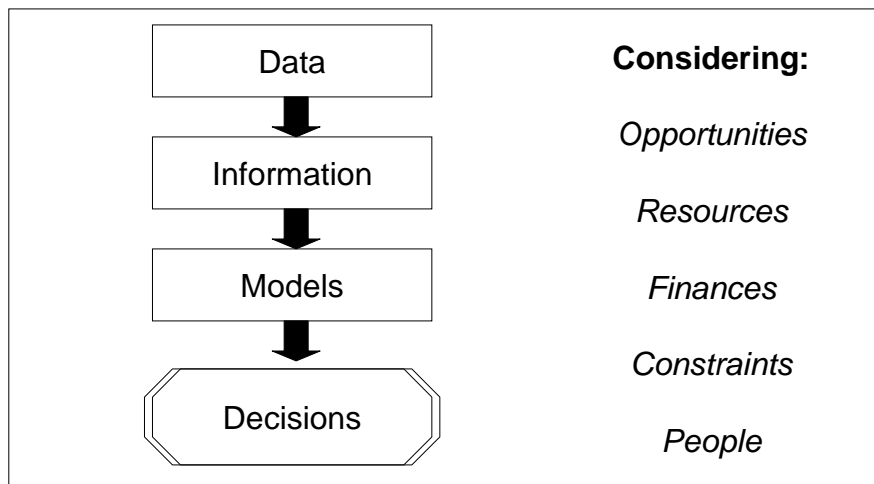
Building Coordinator: Paul Charles, B56 Hollister, 255-4201

1.2 The Master of Engineering 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. The Master of Engineering degree can be completed in two semesters of intensive study, but for some students a third semester may be necessary.

The program is aimed at engineers who want to operate in a technical environment, but who also want to advance in managerial roles. 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. Understanding is the foundation of making good managerial decisions. This thread: data → information → models → decisions underlies the structure and philosophy of the Engineering Management program at Cornell.

Engineering Management is a Problem-Solving, Project-Orientated Activity requiring both people skills and technical skills



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 Johnson Graduate School of Management 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.

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 specialization courses that allow students to develop expertise in particular application areas. Some students select these specialization courses to focus on a disciplinary specialty (e.g., wireless communications in Electrical and Computer Engineering, construction operations in Civil & Environmental Engineering, software engineering in Computer Science, etc.). Other students focus more on a functional specialty (real estate development, management consulting, energy systems, infrastructure management, etc.). More detail on how these various program elements are reflected in specific curricular requirements is in section 1.2.2.

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 Graduate School of Management 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 do assume 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 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.

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.

1.2.2 Major Program Requirements

Required Courses:

- CEE 5900 – Project Management (Fall, 4 credits)
- CEE 5910 – Engineering Management Project (Fall or Spring, 4 credits)
- CEE 5930 – Engineering Management Methods (Fall, 4 credits)
- CEE 5970 – Risk Analysis and Management (Spring, 3 credits)

One course in finance and/or accounting (many students take either NBA 5530 – Accounting and Financial Analysis for Engineers, ORIE 5150 – Economic Analysis of Engineering Systems, or NCC 5560 – Managerial Finance)

One course in individual and/or organizational behavior (many students take CEE 6900 – Creativity, Innovation and Leadership; NCC 5530 – Marketing Management; NCC 5540 – Mgmt. and Leading

in Organizations; NBA 6630 – Managerial Decision Making; NBA 6660 – Negotiations; or ILROB 5200 – Organizational Behavior & Analysis)

Three specialization courses in either a disciplinary or functional area.

A disciplinary specialization will usually be in the same field as your undergraduate degree. Functional specializations can vary widely. Appendix D provides examples of functional areas. *At least two of the three specialization courses must be technical in nature, and at least one of the three should be from Engineering.*

Appendix B provides course descriptions for the required courses and the most popular choices of courses in accounting/finance and organizational behavior. Appendix D provides the proposal form that must be completed by each student, listing the courses that will be used to satisfy degree requirements.

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.

SECTION 2 PLANNING and REGISTERING for the M.ENG. PROGRAM

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.

Upon arrival, please see the Graduate Program Coordinator (GPC) in 219 Hollister Hall. The Coordinator will provide you with up-to-date information, forms, the name of your advisor, and your office assignment.

2.1 Assignment of Advisor

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

You should set up an appointment with your advisor shortly after arriving on campus. Please do not wait until the last couple of days before classes begin. The beginning of the semester is busy for everyone, and your advisor may also be responsible for a number of undergraduate and other graduate students.

It is your responsibility to establish a relationship with your advisor who must approve the Engineering Management program you propose, as well as any changes you may propose.

2.2 University Registration

Note that graduate registration at Cornell is a two-stage process. First, you must enroll in the University and second, you must enroll in courses. The former is on a fixed schedule, while the latter is accomplished over the first three weeks of each semester.

New graduate students should register on Monday, August 24 at Bartels Hall, from 8:30 am to 3:00 pm. After August 24th, registration moves to the University Registrar's Office in B-7 Day Hall (8:00 am to 4:30 pm). Anyone who registers **after September 18th** will be charged a \$350 late fee. Every student must have an ID card and be registered with the University in order to enroll in courses.

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. E-mail messages are one of the most effective forms of communication. **Please check your e-mail regularly** in the event that your advisor, your professors, your colleagues, or the GPC need to get in contact with you.

Social Security Card Application: A representative of the Social Security Administration may be at Bartels Hall to help international students who are receiving any kind of financial support from Cornell apply for a U.S. Social Security Number (SSN). Bring your passport, visa documents, and a letter from the ISSO office. You may also apply for a SSN at the local SSA Office at 127 E. State Street. Once you obtain your SSN, take the card to the Graduate Program Coordinator and the University Registrar's Office, B-7 Day Hall, to update your Cornell record.

2.3 Course Registration

Graduate students must register for courses online. You will receive details about online course enrollment upon registering with the Graduate School. Courses may be **added** online until September 11th. They may be **dropped** online until October 7th.

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 Graduate School. The petition must be signed by both your advisor and the instructor of the course. Petitions are not automatically approved and, in fact, Graduate School personnel have indicated that they will be much stricter in approving petitions. Check *Just the Facts* often after your course schedule is online to verify that all information is correct, and do not wait until the last minute (2 days before classes end!) to submit a Course Enrollment Petition.

2.4 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 course catalog (in print or online) to identify possible courses for both the Fall and Spring terms. Engineering Management courses for Fall 2009 and Spring 2010 are listed in Appendix E. Appendix F lists a larger set of courses offered by Civil and Environmental Engineering that are appropriate for MEng students. There normally are a few changes in course offerings made after the catalog copy is prepared, and final correct information will be published online and posted by Departments. In addition, students will want to consult the course listing in the Johnson Graduate School of Management, 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 D). 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 GPC.

Except for seminars, which may be graded on an S/U basis, all courses that count towards the MEng degree must be taken for a letter grade (A-F). With approval of both your advisor and the Engineering Management Director, a maximum of two S/U-graded credit hours may be allowed, provided the seminars are “participatory” (requires more than just attending the class).

2.5 Approval of Your Course Program

After a “final” program of courses for the entire year is agreed upon with your advisor, please return the Proposal Form to the GPC by **September 18th**. 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 your faculty advisor. You may pick up a copy from your student mail folder in 220 Hollister. Original forms stay on file with the GPC.

2.6 Filing Your Course Program

You have approximately three (3) weeks (until September 11, 2009) to enroll online for Fall 2009 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.

2.7 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, and turned into the GPC.

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. Program changes made after the Fall term to take effect in the Spring term should be submitted by February 5, 2010.

2.8 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. Most petitions are considered by the Engineering Management Director; others must be submitted to the College Master of Engineering Committee for a decision. The College Committee may also review petitions that are submitted to the Engineering Management Director that are not resolved to the satisfaction of the student. 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.

2.9 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, hold office hours, prepare class materials, etc. The faculty generally make assistantship assignments during the first two weeks of classes.

2.10 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.

2.11 Facilities

Most of the facilities for the CEE School are housed in Hollister Hall, except for the large-scale infrastructure testing labs in the George Winter Lab (Thurston Hall). Each Master of Engineering student will have a workstation equipped with a computer in a room with other students. Additional computing facilities for all members of the Cornell community are located at numerous locations throughout the campus. Some of the closest sites for engineering students include Carpenter Hall (ACCEL on the 2nd floor), Upson Hall (B7), and Uris Library (Tower Room). The Engineering Library is in Carpenter Hall.

2.12 Room Assignments, Building Keys, and Mail Folders

Upon arrival, you will need to visit the GPC in 219 Hollister to get your office assignment. Entrance to the M.Eng. offices is via your ID card. Your ID will also open outside doors to Hollister Hall and all student lounges in Hollister Hall.

Each student will be provided a folder bearing his or her name in the graduate student mail file located in the Main Office (220 Hollister). You should check your folder frequently, not only for incoming mail, but also for messages from the Engineering Management Chair, your advisor, or other Cornell sources such as the Graduate School. This mail folder is provided for campus mail and notices; you should have your personal mail sent to your local residential address.

The bulletin board outside of the GPC's office is specifically for announcements relative to all graduate students and concentrations within CEE. You should get into the habit of checking the bulletin board on a regular basis. We try to keep it updated with program topics, seminar speaker announcements, Graduate School notices, and other important messages.

2.13 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.

The Engineering Co-op and Career Services Office (201 Carpenter Hall) offers an extensive recruitment program with many interviewers coming to campus each year. You should visit this office early in the fall term and take advantage of the excellent opportunities it offers. The University Career Services Office has a series of special lectures on how to approach the job market, how to prepare resumes, how to take interviews, etc. Announcements of these lectures and meetings will be posted throughout Hollister Hall.

Many opportunities also are available with private engineering companies, industries, and agencies that do not routinely interview on campuses because they are relatively small. Do not hesitate to ask faculty with whom you work for advice on jobs. Many of the faculty have excellent connections to professional firms and will be happy to pass along notices they receive about jobs or help you identify potential employers. Job listings and descriptions are also posted on CEE's website: www.cee.cornell.edu. There are many routes to explore in seeking the right engineering position; the key point to remember is that you must take the initiative.

2.14 Miscellaneous

The Graduate School will place a "hold" on your diploma if certification of your undergraduate degree has not been received (official final transcript showing date undergraduate degree was awarded). Holds will also be placed on your diploma if you have any outstanding debts with the university or have not returned library books. Please make sure Bursar charges and library fines are paid, all Graduate School paperwork has been processed, and all library books are returned at least one week before Commencement.

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

Paul G. Carr, Adjunct Associate Professor (Ph.D. Virginia Tech): construction engineering and management.

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

Kenneth C. Hover, P.E., Professor (Ph.D. Cornell): concrete design, construction, and materials behavior.

Daniel P. Loucks, NAE, Professor (Ph.D. Cornell): water resources and environmental management systems, interactive simulation modeling and decision support systems.

Linda K. Nozick, Professor (Ph.D. Pennsylvania): systems engineering, transportation and logistics, engineering management.

Christine A. Shoemaker, Professor (Ph.D. Southern California): water resource and water quality systems; watershed modeling; groundwater contamination; optimization algorithms.

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

Mark A. Turnquist, Professor (Ph.D. MIT): transportation systems planning, analysis, and design; manufacturing logistics; engineering management.

Francis M. Vanek, Visiting Lecturer (Ph.D. Pennsylvania): energy, environment, and transportation.

Frank J. Wayno, Adjunct Associate Professor (Ph.D. Princeton): engineering management, project management and organizational change.

APPENDIX B 5 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 (EM) 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.

If you are interested in this program, do the following (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, which is required by JGSM, using January of your M.Eng. year as 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 can not 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:

http://www.engineering.cornell.edu/student-services/orgspe/student-resources/fellowships-aid/upload/Knight_App.pdf

(requires Adobe Acrobat). Questions about this Scholarship Program should be directed to the Office of Research and Graduate Studies, 222 Carpenter Hall, Cornell University, Ithaca, New York 14853 (607-255-7413; enr_grad@cornell.edu)

APPENDIX C

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 EM 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 EM courses provide examples of these issues, and reinforce and advance these skills. But we depend upon all the EM 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*, 7th edition, Duxbury, Belmont, CA, 2008. See also <http://allpsych.com/stats/index.html>]

1. Students should know the 3 *basic axioms for probability*. [Devore §2.1-2.2]
{ $P(A) \geq 0$; $P(S) = 1$; 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 $[A^c = S - A]$, 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 μ , variance s^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 α) and II (denoted β) 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* $Y = \alpha + \beta x + \varepsilon$, with independent additive normal errors ε . [Devore §12.1]
12. Students should be able to calculate *least-squares estimators* of the two coefficients α and β , 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]

M.Eng. Proposal Form – **ENGINEERING MANAGEMENT**

Date: _____

NAME: _____ ADVISOR: _____

		Year	Year	
		20__	20__	
REQUIRED COURSES		Cr.	Fall	Spr.
		Comments		
CEE 5900	Project Management	4		
CEE 5910	Project	4		
CEE 5930	Engineering Management Methods	4		
CEE 5970	Risk Analysis and Management	3		

		Cr.	Fall	Spr.	Comments
FINANCE/ACCOUNTING ELECTIVE (1 required)¹					

		Cr.	Fall	Spr.	Comments
BEHAVIOR ELECTIVE (1 required)²					

		Cr.	Fall	Spr.	Comments
SPECIALIZATION ELECTIVES (3 required)³					

		Cr.	Fall	Spr.	Comments
SEMINARS (Indicate if Participatory or Non-Participatory)⁴					

		Cr.	Fall	Spr.	Comments
ALL OTHER COURSES					

Total Credits for all Fall & Spring Courses⁵ _____

TOTAL M.Eng. PROGRAM CREDIT HOURS: _____ (must equal or exceed 30)

APPROVALS: Advisor _____ EM Director _____

Date _____ Date _____

See Attached Notes. Updated proposals should identify what changes were made and why.

Notes:

¹ One course in Finance/Accounting is required. Suggested courses appropriate for a student's background in accounting and engineering economics are listed below.

<u>Student's Background</u>	<u>Suggested Courses</u>
No background in accounting	NBA 5530 – Finance & Accounting for Engineers (S)
Some accounting, but no engineering economics	ORIE 5150 – Economic Analysis of Engr. Systems (S)
Some background in both accounting and engineering economics	NCC 5560 – Managerial Finance (F/S)

² One course in individual and/or organizational behavior is required. Suggested courses include:

- CEE 6900 Creativity, Innovation and Leadership (Spring, 3 credits)
- NCC 5530 Marketing Management (Spring, 3 credits)
- NCC 5540 Management & Organizations (Spring, 3 credits)
- NBA 6630 Managerial Decision Making (Fall, 3 credits)
- NBA 6660 Negotiations (Fall/Spring, 3 credits)
- ILROB 5200 Organizational Behavior & Analysis (Fall/Spring, 3 credits)

³ Each student's program must include three electives selected to provide an area of specialization. *At least two of the three courses must be technical in nature and at least one of the three should be from Engineering.* The student has an option of selecting either a disciplinary specialization or a functional specialization.

Johnson School courses that may make sense as a technical specialization course include:

- NBA 5180 Data Mining for Marketing, Sales...
- NBA 5270 Applied Price Theory
- NBA 6000 Strategic Role of IT
- NBA 6010 Electronic Commerce
- NBA 6120 Disruptive Technologies
- NBA 6390 Data-Driven Marketing
- NBA 6410 Logistics and Manufacturing Strategy

Disciplinary specialization - The student can select three courses that form a natural extension to the technical work done in their undergraduate major, providing greater depth in that discipline. In most cases, these will be courses at the 500 or 600 level in the undergraduate major field. In some cases, courses in a related field will be most appropriate; for example, a student who was an undergraduate in electrical engineering might choose coursework in computer science or materials science. The student and their advisor are responsible for determining an appropriate selection of courses.

Functional specialization - Such a specialization will often involve courses selected from two, or even three, departments, but which focus on a particular area of application. The following illustrative functional specialization areas (with examples of appropriate courses for each) are intended to offer ideas that may be useful, but are not intended to be an exhaustive list of possibilities. The student and their advisor can create other options, subject to approval by the Director of the Engineering Management Program.

Decision Support and Systems Development

CEE 5240	Applied Systems Engineering I (F)
CEE 5252	Applied Systems Engineering II (S)
CEE 5290	Heuristic Methods for Optimization (F)
CRP 5080	Introduction to Geographic Information Systems (S)
CS 4302	Web Information Systems (S)
CS 4320	Introduction to Database Systems (F)
CS 5150	Software Engineering (S)
NBA 6000	The Strategic Role of Information Systems (S)
NBA 6010	Electronic Commerce (S)
NBA 6120	Disruptive Technologies (F)

Energy Systems Management

A&EP 4840	Controlled Fusion (S)
A&EP 6330	Nuclear Reactor Engineering (F)
ChE 6610	Air Pollution Control (S)
ECE 4510	Electric Power Systems I (F)
ECE 4520	Electric Power Systems II (S)
ECE 5510	Electric Systems Engineering & Economics (F)

Environmental Systems Management

CEE 5940	Economic Methods for Engineering & Management (F)
CEE 6200	Water Resource Systems Engineering (S)
CEE 6230	Environmental Quality Systems Engr. (not offered 04-05)
CEE 6550	Transport, Mixing and Transformation in the Environment (F)
ChE 6610	Air Pollution Control (S)

Manufacturing Management

NBA 6410	Business Logistics Management (S)
OR&IE 5100	Design of Manufacturing Systems (F)
OR&IE 5126	Supply Chain Management (S)
OR&IE 5120	Production Planning and Scheduling Theory and Practice (S)
OR&IE 5122	Inventory Management (F)
OR&IE 5770	Quality Control (F)

Property Development and Construction

CEE 5950	Construction Planning and Operations (F) [engineering specialization]
CEE 6750	Concrete Materials & Construction (S)
CRP 5320	Real Estate Development Process (F)
CRP 5330	Real Estate Marketing & Management (F)
CRP 5520	Land Use Planning (F)
CRP 5530	Land Use Regulations (S)
HADM 6620	Principles of Real Estate (F)
HADM 6628	Real Estate Finance and Investments (S)

Systems Engineering

CEE 5240	Applied Systems Engineering I (F)
CEE 5252	Applied Systems Engineering II (S)
CEE 6860	Civil Infrastructure Systems (S)
CEE 5290	Heuristic Methods for Optimization (F)
ECE 5510	Electric Power Systems Engineering & Economics (F)
M&AE 4780	Feedback Control Systems (S)
CS 5150	Software Engineering (S)
OR&IE 5100	Design of Manufacturing Systems (F)

Urban Infrastructure Management

CEE 6860	Civil Infrastructure Systems (S)
CEE 5940	Economic Methods for Engr. & Management (S)
CRP 5080	Introduction to Geographic Information Systems (S)
CRP 5520	Land Use Planning (F)
CRP 5530	Land Use Regulations (S)
CRP 6050	Urban Public Finance (F)
CRP 6320	Methods of Regional Science and Planning I (S)

⁴ Credit for seminars toward the MEng degree only count if the format of the seminar is “participatory” (i.e. requires more than attendance).

⁵ All courses you are taking should be listed whether or not they count in the MEng program. No more than 20 credits per semester (MEng and non-MEng) may be taken except by petition to the College Master of Engineering Committee.

APPENDIX E

2009-10 COURSES OF STUDY FOR CEE 59X SERIES AND OTHER KEY COURSES

CEE Courses

CEE 5240: Applied Systems Engineering

Fall, 3 credits. Prerequisites: senior or graduate standing in engineering field; concurrent or recent enrollment in group-based project with strong system design components approved by course instructor. A.R. George and R. Roundy.

Fundamental ideas of systems engineering and their application to design and development of various types of engineered systems. Defining system requirements, creating effective project teams, mathematical tools for systems analysis and control, testing and evaluation, economic considerations, and the system life cycle.

CEE 5900: Project Management

Fall, Spring, 4 credits. Prerequisite: permission of instructor. F. J. Wayno.

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.

CEE 5910: Engineering Management Project

Fall, Spring, 4 credits. Prerequisite: permission of instructor. Staff.

Intensive evaluation of the management aspects of a major engineering project or system. Most students work on a large group project in the area of project management, but students may also work singly or in small groups on an engineering management topic of special interest to them.

CEE 5930: Engineering Management Methods: Data, Information, and Modeling

Fall, 4 credits. Prerequisites: CEE 3040 or equivalent. M. A. Turnquist.

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.

CEE 5950: Construction Planning and Operations

Fall, 3 credits. P. G. Carr.

Covers the fundamentals of construction planning: organization of the work site; construction planning, scheduling, and cost estimating; bidding; temporary structures; contract documents and the relationships among owners, designers, contractors, suppliers, and developers.

CEE 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.

CEE 6900: Creativity, Innovation, and Leadership

Spring. 3 credits. Prerequisite or corequisite: CEE 5900 or permission of instructor. F.J. Wayno

Graduate course designed to help aspiring engineering managers to better understand individual creativity and organizational innovation and to develop the skills required to play a productive role in fostering both. Not incidentally, the course will also help students who take it to become more creative themselves. The course is highly participatory and has a flow that moves from the individual → to the group → to the organization, with theory, research results, and practical skills-development woven seamlessly together.

Finance/Accounting Courses

NBA 5530: Accounting and Financial Analysis for Engineers

Spring. 3 credits. Course intended for non-Johnson School students only. J. D'Souza

This course focuses on basic financial and managerial accounting and the economic and financial concepts that have a bearing on managerial decisions. The goals of the course are: 1) to give students a working knowledge of the accounting process and the value and limitations of the data that comes out of the accounting information system; 2) to familiarize students with key concepts in managerial accounting and the application of cost information to pricing and operating decisions; and 3) to promote an understanding of the use of economic theory in the evaluation of capital investment projects. The teaching methods consist of lectures and cases. Students are evaluated on the basis of exams.

NCC 5560: Managerial Finance

Fall, Spring. 3 credits. Course intended for non-Johnson School students only. Staff

An introduction to business finance through theory and case studies. Topics include stock and bond valuation, the capital-budgeting decision, portfolio theory, asset-pricing models, raising capital, capital structure, mergers and acquisitions, costs of capital, option pricing, and risk management. International applications are considered within each topic area. Letter grade only, based on exam, group case reports, homework and class participation.

ORIE 5150: Economic Analysis of Engineering Systems

Spring. 4 credits. Prerequisites: ORIE 3300 and ORIE 3150. Staff

Course topics include financial planning, including cash-flow analysis and inventory flow models; engineering economic analysis, including discounted cash flows and taxation effects; application of optimization techniques, as in equipment replacement or capacity expansion models, and issues in designing manufacturing systems. Includes a student group project.

Individual and Organizational Behavior Courses

NBA 6660: Negotiations

Fall, Spring. 3 credits. Staff

Judgment is the art and science of transforming perception into thought or opinion. Negotiation is the art

and science of securing agreements between two or more independent parties. The purpose of this course is to understand the theory and processes of negotiation as it is practiced in a variety of settings. This course is designed to complement the technical and diagnostic skills learned in other courses. A basic premise of the course is that while a manager needs analytical skills to develop optimal solutions to problems, a broad array of negotiation skills are needed for these solutions to be accepted and implemented. The course highlights the components of an effective negotiation and teaches students to analyze their own behavior in negotiations. The course is largely experimental, providing students with an opportunity to develop their skills by participating in negotiations and integrating their experiences with the principles presented in the assigned readings and course discussions.

NCC 5530: Marketing Management

Fall, Spring. 3 credits. Course intended for non-Johnson School students only. Staff

The course addresses controllable and uncontrollable marketing variables that managers in multi-product firms face in today's business environment. Topics include customer behavior, product planning, distribution, advertising and promotion, pricing, and competitive strategy.

NCC 5540: Management and Leading in Organizations

Fall, Spring. 3 credits. Course intended for non-Johnson School students only. Staff.

This course takes a resource-based approach to management by arguing that organizations should link their strategy to their internal resources and capabilities. This theme is developed by addressing: 1) the strategic value of internal resources and capabilities; 2) the role of human resources and organizational behavior in formulating and implementing strategy; and 3) the importance of structure and the design of organizations in formulating and implementing strategy. Included among the topics are how firms create sustainable competitive advantage through internal resources and capabilities; what the best practices are for managing people; what effects best practices have on attitudes and behaviors; why putting the customer first is not necessarily best practice from a resource-based perspective; why organizational culture is central to organizational effectiveness; why the formal organizational chart and structure of an organization are important; how organizations innovate; how organizations change through re-architecture and re-engineering; what firms gain and lose through pursuing core competencies; and what firms gain through strategic alliances and networks. The course makes extensive use of case materials.

APPENDIX F

OVERALL LIST OF SELECTED CEE COURSES: 2009-2010

[**Subject to change.** Course descriptions, including courses in other departments, are available at: <http://www.cornell.edu/academics/courses.cfm>]

FALL 2009

Master of Engineering Projects

CEE 5031	MEng Project: Environ. Fluid Mechanics & Hydrology
CEE 5041	MEng Project: Geotechnical Engineering
CEE 5051	MEng Project: Aquaclara: Sustainable H ₂ O Supply Project
CEE 5061	MEng Project: Transportation Systems Engineering
CEE 5071	MEng Project: Structural Engineering
CEE 5073	MEng Project: Civil Engineering Materials
CEE 5910	MEng Project: Engineering Management

Regular Courses

CEE 4510	Microbiology for Environmental Engineers
CEE 4530	Laboratory Research in Environmental Engineering
CEE 4540	Sustainable Small-Scale Water Supply
CEE 4630	Future Transportation, Technologies and Systems
CEE 4720	Introduction to Finite Element Methods
CEE 4770	Introduction to Composite Materials
CEE 4920	Engineers for a Sustainable World
CEE 5240	Applied Systems Engineering
CEE 5900	Project Management
CEE 5930	Engineering Management Methods: Data, Information, and Modeling
CEE 5950	Construction Planning & Operations
CEE 5980	Introduction to Decision Analysis
CEE 6100	Remote Sensing Fundamentals
CEE 6290	Advanced Numerical Methods for Engineers
CEE 6400	Foundation Engineering
CEE 6530	Water Chemistry for Environmental Engr.
CEE 6550	Transport, Mixing & Transformation in the Environment
CEE 6560	Physical/Chemical Processes
CEE 6620	Urban Transportation Network Design and Analysis
CEE 6710	Fundamentals of Structural Mechanics
CEE 6720	Introduction to Finite Element Methods
CEE 6730	Design of Concrete Structures
CEE 6930	Modeling Public Systems
CEE 7400	Engineering Behavior of Soils
CEE 7410	Rock Engineering
CEE 7700	Engineering Fracture Mechanics
CEE 7790	Advanced Behavior of Metal Structures

Seminars

CEE 6020 Seminar: Environment/Water Resource Systems
CEE 6060 Seminar: Transportation Systems Engineering
CEE 6070 Seminar: Civil Infrastructure (Structures/Geotech)

Special Topics and Other Courses

CEE 6015 Special Topics: Remote Sensing
CEE 6035 Special Topics: Hydraulics
CEE 6045 Special Topics: Geotechnical Engineering
CEE 6055 Special Topics: Environmental Engineering
CEE 6065 Special Topics: Transportation Systems Engineering
CEE 6075 Special Topics: Structural Engineering
CEE 6090 Special Topics: Environ. & Water Resource Systems
CEE 6095 Special Topics: Engineering Management

SPRING 2010

Master of Engineering Projects

CEE 5022	MEng Project: Environ. & Water Resource Systems Engr.
CEE 5032	MEng Project: Environ. Fluid Mechanics & Hydrology
CEE 5042	MEng Project: Geotechnical Engineering
CEE 5052	MEng Project: Aquaclara: Sustainable H ₂ O Supply Project
CEE 5062	MEng Project: Transportation Systems Engineering
CEE 5072	MEng Project: Structural Engineering
CEE 5074	MEng Project: Civil Engineering Materials
CEE 5920	MEng Project: Engineering Management

Regular Courses

CEE 4110	Remote Sensing: Resource Inventory Methods
CEE 4370	Experimental Methods in Fluid Mechanics
CEE 4410	Retaining Structures & Slopes
CEE 4640	Transportation Systems Design
CEE 4740	Design of Steel Structures
CEE 4781	LRFD-Based Engineering of Wood Structures
CEE 5252	Systems Analysis: Architecture, Behavior & Optimization
CEE 5900	Project Management
CEE 5970	Risk Analysis & Management
CEE 6150	Digital Image Processing
CEE 6200	Water Resources Systems Engineering
CEE 6300	Computational Fluid Dynamics for Environmental Flows
CEE 6310	Computational Simulation of Flow & Transport in the Environment
CEE 6320	Hydrology
CEE 6370	Environmental Methods in Fluid Dynamics
CEE 6410	Retaining Structures & Slopes
CEE 6570	Biological Processes
CEE 6580	Biodegradation and Biocatalysis
CEE 6650	Environment/Energy & Transportation Planning & Management
CEE 6750	Concrete Materials & Construction
CEE 6760	Advanced Composite Materials
CEE 6780	Structural Dynamics of Earthquake Engineering
CEE 6860	Civil Infrastructure Systems
CEE 6900	Creativity, Innovation & Leadership
CEE 7360	Turbulence & Turbulent Mixing in Environ. Stratified Flows
CEE 7450	Soil Dynamics
CEE 7750	Nonlinear Finite Element Analysis
CEE 7770	Computational Solid & Structural Mechanics

Seminars

CEE 6021	Seminar: Environment/Water Resource Systems
CEE 6030	Seminar: Environmental Fluid Mechanics & Hydrology
CEE 6051	Seminar: Environmental Quality Engineering
CEE 6060	Seminar: Transportation Systems Engineering

CEE 6070 Seminar: Civil Infrastructure
CEE 6080 Seminar: Engineering Systems & Management

Special Topics and Other Courses

CEE 6015 Special Topics: Remote Sensing
CEE 6035 Special Topics: Hydraulics
CEE 6045 Special Topics: Geotechnical Engineering
CEE 6055 Special Topics: Environmental Engineering
CEE 6065 Special Topics: Transportation Systems Engineering
CEE 6075 Special Topics: Structural Engineering
CEE 6090 Special Topics: Environ. & Water Resource Systems
CEE 6095 Special Topics: Engineering Management