

# UNDERGRADUATE HANDBOOK FOR ENVIRONMENTAL ENGINEERING

## MISSION STATEMENT

- Educate the next generation of environmental engineering professionals and assist in the education of other engineers and environmental scientists;
- Discover and develop new knowledge in environmental engineering;
- Share cutting edge research and new information and ideas through the scientific media and outreach programs.

These efforts will be conducted in the context of a world-class university bringing benefits to our students, the nation and global society.

## PROGRAM EDUCATIONAL OBJECTIVES

The educational goals for the Environmental Engineering major are consistent with those of the College of Engineering and Cornell University. We are committed to providing an excellent undergraduate engineering program in a nurturing learning environment so that our graduates acquire knowledge and develop the needed skills for successful professional careers.

### **The Educational Objectives of the Environmental Engineering Major are to**

1. Produce graduates who pursue careers in Environmental Engineering based on a background in mathematics, physical and life sciences, liberal studies and engineering.
2. Produce graduates who pursue advanced degrees in engineering and related professional fields.
3. Produce graduates who assume leadership positions and contribute to solutions of societal problems involving environmental systems.

**This degree program is co-sponsored by the Department of Biological and Environmental Engineering (in the College of Agriculture and Life Sciences and the College of Engineering) and the School of Civil and Environmental Engineering (in the College of Engineering).**

**2009-2010**

Cornell University is an equal opportunity, affirmative action educator.

Photo courtesy of Larry Geohring, Instructor of BEE 4270.

## INTRODUCTION

The Department of Biological and Environmental Engineering (BEE) in the College of Agriculture and Life Sciences (CAL S) and the College of Engineering (CoE) and the School of Civil and Environmental Engineering (CEE) in the College of Engineering (CoE) jointly offer a B.S. degree program in Environmental Engineering. This handbook presents a description of the undergraduate program and the curricular requirements for this degree.

We welcome your interest in our program, whether that interest is as a prospective or continuing student, alumnus or as a prospective employer of our students.

For more information, visit our website at: <http://www.bee.cornell.edu/cals/bee/degree-programs/undergraduate/ugrad-enveng.cfm> or <http://www.cee.cornell.edu/undergraduate-programs/environmental-engineering-major/index.cfm>

If you have questions about this major, you may contact:

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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 requirement at any time.

It is the policy of Cornell University to actively support equality of educational 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 maintenance of affirmative action programs that will assure the continuation of such equal 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 (coordinator for women's services) at the Office of Workforce Diversity, Equity and Life Quality, Cornell University, 160 Day Hall, Ithaca, NY 14853-2801; Phone: (607) 255-3976.

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 by writing the Office of Workforce Diversity, Equity and Life Quality, Cornell University, 160 Day Hall, Ithaca, NY 14853-2801; Phone: (607) 255-3976. Other questions or requests for special assistance can also be directed to that office.

## **WHAT IS ENVIRONMENTAL ENGINEERING?**

We live at a time when no part of the natural environment is untouched by human activities. Although we have made great strides in addressing many of the natural resources and environmental problems caused by human activities, growth in the world population and rising standards of living continue to stress the natural environment and generate a spectrum of environmental problems that need to be addressed. Environmental engineers are called upon to understand, arrange, and manipulate the biological, chemical, ecological, economic, hydrological, physical, and social processes that take place in our environment in an effort to balance our material needs with the desire for sustainable environmental quality.

At Cornell University, research and teaching activities related to environmental engineering are found in many of the traditional engineering fields. For example undergraduate majors in Biological Engineering and in Civil Engineering are offered by the Department of Biological and Environmental Engineering (BEE) and by the School of Civil and Environmental Engineering (CEE), respectively. BEE offers a concentration in Bioenvironmental Engineering and CEE offers a focus in Environmental Engineering. The major leading to a B.S. degree in Environmental Engineering is discussed in this handbook. The Environmental Engineering major is structured to provide students with appropriate background in the physical, chemical and biological sciences together with the mathematical, planning, analysis and design tools necessary to address complex environmental engineering concerns. The graduate and research programs in BEE and CEE focus on water and wastewater treatment processes, fate and transport of contaminants in natural aquatic systems, design and management of environmental and water resource systems, environmental fluid mechanics, and hydraulics and hydrology.

The collaborative BEE/CEE major in Environmental Engineering is supported by excellent teaching and research facilities including: laboratories for the analysis of water chemistry, physical/chemical/biological processes, biochemistry and microbiology. Cornell University is also the home of the Cornell Theory Center, the New York State Center for Advanced Technology in Biotechnology, and the Center for a Sustainable Future which oversees and supports many interdisciplinary environmental research programs. The wide variety of teaching and research activities, the world-class research facilities and the interdisciplinary centers at Cornell University provide students with excellent opportunities for study and research in Environmental Engineering.

## PROGRAM DETAILS

There are two administrative pathways Cornell students may use to complete the Environmental Engineering major. They may matriculate in the College of Engineering and affiliate with the Environmental Engineering major in either the BEE or CEE department, or they may matriculate in the College of Agriculture and Life Sciences and major in Environmental Engineering in the BEE department. The curriculum and degree requirements are almost the same for all students in the Environmental Engineering major regardless of the administrative pathway a student selects. Faculty advisors are assigned to each undergraduate at the time they formally enter the major.

### **Affiliation (College of Engineering Enrolled Students)**

Students who matriculate in the College of Engineering (CoE) may affiliate with the Environmental Engineering major in their second year of study. (Transfer students entering the CoE typically affiliate with their major program at the time of transfer.) Affiliated students pay endowed tuition and complete all Environmental Engineering requirements while enrolled in the engineering college.

### **Joint Program (College of Agriculture and Life Sciences Enrolled Students)**

Students who enroll in the College of Agriculture and Life Sciences (CALs) as freshmen majoring in Environmental Engineering complete a joint degree program with the College of Engineering. In the joint degree program, students register in CALs for their freshman and sophomore years and then are registered jointly with CALs and CoE for their junior and senior years (the registration process in years 3 and 4 is facilitated by the BEE department administration). The primary college in the junior year is CALs and in the senior year, the students' primary college is the College of Engineering. Starting with the freshman class entering in Fall 2007 (the graduating class of 2011), students in the joint degree program will pay state contract college tuition all four years of their program. Students in the joint degree program who matriculated as freshman prior to Fall 2007, or transfer students who will graduate before 2011, will pay endowed tuition for their last two semesters according to the information published in previous handbooks.

Oversight of the Environmental Engineering major is provided by a program committee of faculty from both BEE and CEE.

## **WHAT DO OUR GRADUATES DO?**

Many graduates from the Environmental Engineering major continue their education at the finest graduate schools around the world. They pursue Master of Engineering (M. Eng.), Master of Science (M.S.), or Doctoral (Ph.D.) programs in various related engineering disciplines, or they sometimes complement their engineering degrees with a Master of Business Administration (MBA) or Doctor of Law (LLD) degree. Because of the requirements for coursework in biology and chemistry, the undergraduate major in Environmental Engineering is also an excellent choice for students interested in medical school.

Career opportunities for Environmental Engineering graduates cover the spectrum of private industry, public agencies, educational institutions, and graduate and professional programs in engineering, science, medicine, and law. In recent years graduates have pursued careers in engineering consulting, management and business, and international development.

# **ENVIRONMENTAL ENGINEERING MAJOR**

## **DEGREE REQUIREMENTS**

# ENVIRONMENTAL ENGINEERING MAJOR

## DEGREE REQUIREMENTS

A student earning a Bachelor of Science degree in the Environmental Engineering major must complete the following academic requirements, which apply to students matriculating in the fall semester of 2009 or later. A minimum of 126 credit hours is required.

Group	Subject Matter	Credit Hours
1.....	<b>Mathematics</b> ..... (1910, 1920, 2930, 2940) All math courses in this sequence must be completed with a grade of C- or better.	16
2.....	<b>Chemistry</b> ..... General Chemistry (2090, 2070 or 2150) Organic Chemistry (1570 recommended or 3570)	7
3.....	<b>Physics</b> ..... Calculus-based physics (1112, 2213 or 2217)	8
4.....	<b>Computer Programming</b> ..... Intro to Computing (CS 1110, CS 1112 or BEE 1510 and CS 1130 or CS 1132)	5
5.....	<b>Biological Sciences</b> ..... Introductory Biology (BIOG 1101/1103, 1102/1104, 1105, 1106, 1107, 1108, 1109, or 1110) <sup>a</sup>	3-4
6.....	<b>Written Expression</b> ..... First Year Writing Seminars	6
7.....	<b>Engineering Distribution and Field Courses</b> (all must be taken for letter grade)..... <i>Introduction to Engineering</i> ENGR XXXX (3 credits) (ENGR 1130 is recommended) <sup>b</sup> , or The BEE Experience - BEE 1200 [required for students matriculating in CALS] (1 credit) <i>Engineering Distribution Courses</i> <sup>a</sup> Engineering for a Sustainable Society - ENGRD/BEE 2510 (3 credits) ENGRD XXXX - (ENGRD 2020, 2210, or 3200 are recommended) (3-4 credits) <i>Environmental Engineering Core Courses</i> Mechanics of Solids <sup>a</sup> - ENGRD 2020 (4 credits) Engineering Computation - CEE/ENGRD 3200 (3 credits) or Thermodynamics - ENGRD 2210 (3 credits) <sup>a</sup> Uncertainty Analysis in Engineering - CEE 3040 (4 credits) <sup>a, c</sup> Engineering Management - BEE 4890 or CEE 3230 (3 or 4 credits) Fluid Mechanics - CEE 3310 (4 credits) Earth Science (select one course) - EAS 2200, EAS 2680, EAS 3030, or CSS 3650 (3 or 4 credits) Environmental Quality Engineering - CEE 3510 (3 credits) Microbiology for Environmental Engineering - CEE 4510 (3 credits) <sup>d</sup> Engineering Laboratory (select one course) - BEE 4270, CEE 4530, CEE 4370, or CEE 6580 (3 or 4 credits) Environmental Systems Analysis - BEE 4750 (3 credits) Environmental Engineering Design Electives (9 credits) (see list of approved courses on page 12, at least one course from the list of Capstone Design) Environmental Engineering Major-Approved Electives (6 credits) (see list of approved courses on page 12) Other Environmental Engineering Electives to bring total category to 57 credits. These will generally consist of technical engineering courses at 2000 level or above from BEE or College of Engineering. A maximum of 4 credits of BEE 4970-4990 or CEE 3090, 4010 may be used in this category. Technical Writing Course. Approved technical communication courses are listed in the <i>Courses of Study</i> , College of Engineering section. BEE 4730 or BEE 4890 are on the approved list. <sup>e</sup>	57

**DEGREE REQUIREMENTS (CONTINUED)**

<b>Group</b>	<b>Subject Matter</b>	<b>Credit Hours</b>
8.....	<b>Liberal Studies</b> (6 courses)..... Liberal Studies courses are listed in the <i>Courses of Study</i> , College of Engineering section. At least six courses must be completed, including at least three of the six categories: 1. Cultural Analysis (CA) 2. Historical Analysis (HA) 3. Literature and the Arts (LA) 4. Knowledge, Cognition, and Moral Reasoning (KCM) 5. Social & Behavioral Analysis (SBA) 6. Foreign Language (not literature) <i>At least 2 courses must be 2000 level or higher.</i>	18
9.....	<b>Approved Electives</b> ..... These courses are selected by the student with approval of the Faculty Advisor.	6
<b>TOTAL MINIMUM .....</b>		<b>126</b>

<sup>a</sup>Students taking BIOG 1101/1103, 1105, 1107, or ENGRD 2020, 2210, 3200, 2700, or CEE 3040 as a second engineering distribution must take an additional major-approved elective.

<sup>b</sup>BEE 1510 and BEE 1200 together (5 credits) satisfy the ENGRI requirement for CALS matriculated first-year students. Students using BEE 1510 and BEE 1200 to satisfy the ENGRI requirement must make up the 2 credit difference with engineering coursework.

<sup>c</sup>ENGRD 2700 will be accepted (by petition) to substitute for CEE 3040 if taken prior to affiliation with the Environmental Engineering Major, or if necessary because of scheduling conflicts caused by Co-op or Study Abroad.

<sup>d</sup>Students may take BIOMI 2900 in place of CEE 4510.

<sup>e</sup>Students meeting the technical communications requirement with a course that fulfills another requirement (e.g. Liberal Studies, Major-Approved Elective), may use it to satisfy both requirements.

**Physical Education**

Two semesters of physical education are required. All students must pass a swim test prior to graduation. Transfer students are exempted from one semester of PE for each full-time semester they transfer into Cornell.

**Special Courses**

Courses such as PHYS 1012 do not count toward graduation requirements. Academic Excellence Workshops (ENGRG 1091, 1092, 1093 and 1094) may not be used as Engineering Electives, but may be used as Approved Electives (area 9).

**Additional program information is provided in the College of Engineering section of the *Courses of Study* and in the College of Engineering *Undergraduate Handbook*.**

## ENVIRONMENTAL ENGINEERING MAJOR CHECKLIST

	<i>Min. Credit Hours</i>	<i>√ When Done</i>
MATH 1910	4	<input type="checkbox"/>
MATH 1920	4	<input type="checkbox"/>
MATH 2930	4	<input type="checkbox"/>
MATH 2940	4	<input type="checkbox"/>
CHEM 2090 (2070 or 2150)	4	<input type="checkbox"/>
CHEM 1570 (or 3570)	3	<input type="checkbox"/>
PHYS 1112	4	<input type="checkbox"/>
PHYS 2213 (or 2217)	4	<input type="checkbox"/>
CS 1110, 1112 or BEE 1510 and CS 1130 or CS 1132	5	<input type="checkbox"/>
BIOG 110X (BIOG 1101/1103, 1102/1104, 1105, 1106, 1107, 1108, 1109, or 1110)	3/4	<input type="checkbox"/>
First-Year Writing Seminar 1 <sup>a</sup>	3	<input type="checkbox"/>
First-Year Writing Seminar 2 <sup>a</sup>	3	<input type="checkbox"/>
Liberal Studies Distribution - 6 courses (18-credit minimum) <sup>b</sup>	18	
Lib. Studies 1		<input type="checkbox"/>
Lib. Studies 2		<input type="checkbox"/>
Lib. Studies 3		<input type="checkbox"/>
Lib. Studies 4		<input type="checkbox"/>
Lib. Studies 5		<input type="checkbox"/>
Lib. Studies 6		<input type="checkbox"/>
Approved Elective (2 courses; 6-credit minimum)		
Approved Elective 1	3	<input type="checkbox"/>
Approved Elective 2	3	<input type="checkbox"/>
Physical Education (2 semesters) and swim test		<input type="checkbox"/>
Required Major Courses (57-credit minimum) <sup>c</sup>		
Intro. to Engr. (ENGRI 1XXX) <sup>d</sup> or BEE 1200 <sup>e</sup>	3/1	<input type="checkbox"/>
Engr. Dist. 1: ENGRD/BEE 2510 (required)	3	<input type="checkbox"/>
Engr. Dist. 2: ENGRD XXXX	3	<input type="checkbox"/>
ENGRD 2020 <sup>f</sup>	4	<input type="checkbox"/>
ENGRD 3200 or 2210 <sup>f</sup>	3	<input type="checkbox"/>
CEE 3040 <sup>g</sup>	4	<input type="checkbox"/>
CEE 3230 or BEE 4890	3/4	<input type="checkbox"/>
CEE 3310	4	<input type="checkbox"/>
Earth Science (EAS 2200, EAS 2680, EAS 3030, or CSS 3650)	3	<input type="checkbox"/>
CEE 3510	3	<input type="checkbox"/>
CEE 4510 <sup>h</sup>	3	<input type="checkbox"/>
Laboratory Course (CEE 4530, BEE 4270, CEE 4370, or CEE 6580)	3	<input type="checkbox"/>
BEE 4750	3	<input type="checkbox"/>
Design Elective 1 (Capstone Course <sup>i</sup> )	3	<input type="checkbox"/>
Design Elective 2 <sup>i</sup>	3	<input type="checkbox"/>
Design Elective 3 <sup>i</sup>	3	<input type="checkbox"/>
Major-Approved Elective 1	3	<input type="checkbox"/>
Major-Approved Elective 2	3	<input type="checkbox"/>
Engineering Electives to meet 57 credits	0-3	<input type="checkbox"/>
Total Required Credits	126 min	
Additional Elective Courses (0 credits min., no max.)		
Technical Writing Course <sup>a</sup>		<input type="checkbox"/>

<sup>a</sup>In addition to the first-year writing seminars, a technical writing course must be taken. An approved COMM or ENGRC course, or BEE 4730 or BEE 4890 will satisfy this requirement. Students meeting the technical communications requirement with a course that fulfills another requirement (e.g. Liberal Studies, Major-Approved Elective), may use it to satisfy both requirements.

<sup>b</sup>Six courses must be chosen from at least three of the following six groups: 1. Cultural Analysis (CA), 2. Historical Analysis (HA), 3. Literature and the Arts (LA), 4. Knowledge, Cognition, and Moral Reasoning (KCM), 5. Social and Behavioral Analysis (SBA), 6. Foreign Languages (not literature courses). At least two of the six courses must be at 2000-level or higher.

<sup>c</sup>9 credits of electives are determined by Major approval. To ensure breadth of engineering studies, Major programs also will include 9 hours of courses outside the Major. This group of courses may be comprised of ENGRD 2020, one engineering distribution or elective, and/or a CEE or BEE Major course outside the Major disciplinary area.

<sup>d</sup>ENGRI 1130 is recommended.

<sup>e</sup>BEE 1510 and BEE 1200 together (5 credits) satisfy the ENGRI requirement for CALS matriculated first-year students. Students using BEE 1510 and BEE 1200 to satisfy the ENGRI requirement must make up the 2-credit difference with engineering coursework.

<sup>f</sup>Students electing to use this course as a second engineering distribution must take an additional Major-approved elective.

<sup>g</sup>ENGRD 2700 may be accepted (by petition) to substitute for CEE 3040 if taken prior to affiliation with the Environmental Engineering Major, or if necessary because of scheduling conflicts caused by Co-op or Study Abroad. Students must make up the 1 credit.

<sup>h</sup>Students may take BIOMI 2900, Introduction to Microbiology, in place of CEE 4510.

<sup>i</sup>A list of approved Capstone Courses can be found on page 12 of this handbook.

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## DESIGN AND MAJOR APPROVED ELECTIVES

A total of 5 Design Electives and Major-Approved Electives must be selected from among the courses in the list below. At least three of these five courses must be Design Electives. At least one of the design electives must be a capstone design elective.

### Capstone Design Electives

- BEE 4730 Watershed Engineering (4 cr, Fall)
- BEE 4740 Water and Landscape Engineering Applications (3 cr, Spring)
- BEE 4870 Sustainable Energy Systems (3 cr, Fall)
- CEE 4350 Coastal Engineering (4 cr, Spring)
- CEE 4540 Sustainable Small-Scale Water Supplies (3 cr, Fall)

### Design Electives

- BEE 4760 Solid Waste Engineering (3 cr, Spring)
- CEE 3320 Hydraulic Engineering (4 cr, Spring)
- CEE 4360 Case Studies in Environmental Fluid Mechanics (4 cr, Spring)
- CEE 4440 Environmental Site and Remediation Engineering (3 cr, Spring, Next Offered 2011-2012)
- CEE 4520 Water Supply Engineering (3 cr, Fall, Next Offered 2010-2011)
- CEE 4550 AguaClara: Sustainable Water Supply Project (3 cr, Fall, Spring)
- CEE 6370 Experimental Methods in Fluid Mechanics (4 cr, Spring, Next Offered 2010-2011)

### Major-Approved Electives

- BEE 3299 Sustainable Development: A Web-Based Course (3 cr, Spring, Summer)
- BEE 3710 Physical Hydrology for Ecosystems (3 cr, Spring, Next Offered 2010-2011)
- BEE 4010 Renewable Energy Systems (4 cr, Spring)
- BEE 4710 Introduction to Groundwater (EAS 4710, 3 cr, Spring, Next Offered 2010-2011)
- BEE 4800 Our Changing Atmosphere: Global Change and Atmospheric Chemistry (EAS 4800, 3 cr, Fall)
- BEE 6510 Bioremediation: Engineering Organisms to Clean Up the Environment (3 cr, Spring, Next Offered 2010-2011)
- BEE 6710 Analysis of the Flow of Water and Chemicals in Soils (3 cr, Fall, Next Offered 2010-2011)
- CEE 3410 Introduction to Geotechnical Engineering and Analysis (4 cr, Spring)
- CEE 4110 Environmental Information Science (CSS 4110, 3 cr, Spring)
- CEE 4320 Hydrology (3 cr, Spring)
- CEE 4370 Experimental Methods in Fluid Mechanics (3 cr, Spring)
- CEE 4920 Engineers for a Sustainable World (3 cr, Fall)
- CEE 5970 Risk Analysis and Management (TOX 5970, 3 cr, Spring)
- CEE 6000 Numerical Methods for Engineers (3 cr, Fall, Next Offered 2010-2011)
- CEE 6100 Remote Sensing Fundamentals (CSS 6100, 3 cr, Fall)
- CEE 6200 Water Resources Systems Engineering (3 cr, Spring)
- CEE 6230 Environmental Quality Systems Engineering (3 cr, Fall, Next Offered 2010-2011)
- CEE 6300 Spectral Methods for Incompressible Fluid Flows (3 cr, Spring, Offered on Demand)
- CEE 6330 Flow in Porous Media and Groundwater (3 cr, Fall)
- CEE 6530 Water Chemistry (3 cr, Fall)

## **DESIGN AND MAJOR APPROVED ELECTIVES (CONTINUED)**

### **Major-Approved Electives**

CEE 6540 Aquatic Chemistry (3 cr, Spring, Next Offered 2011-2012)

CEE 6550 Transport, Mixing and Transformation in the Environment (3 cr, Fall)

CEE 6560 Physical/Chemical Processes (3 cr, Fall)

CEE 6570 Biological Processes (3 cr, Spring)

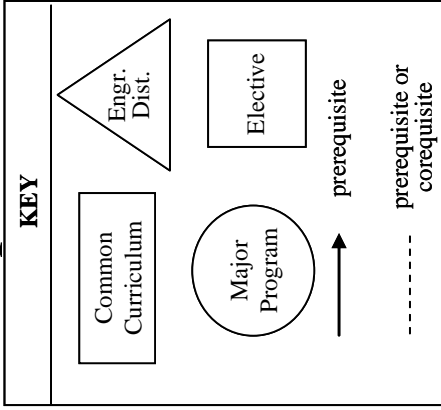
CEE 6580 Biodegradation and Biocatalysis (3 cr, Spring, Next Offered 2010-2011)

CHEME 6610 Air Pollution Control (3 cr, Spring)

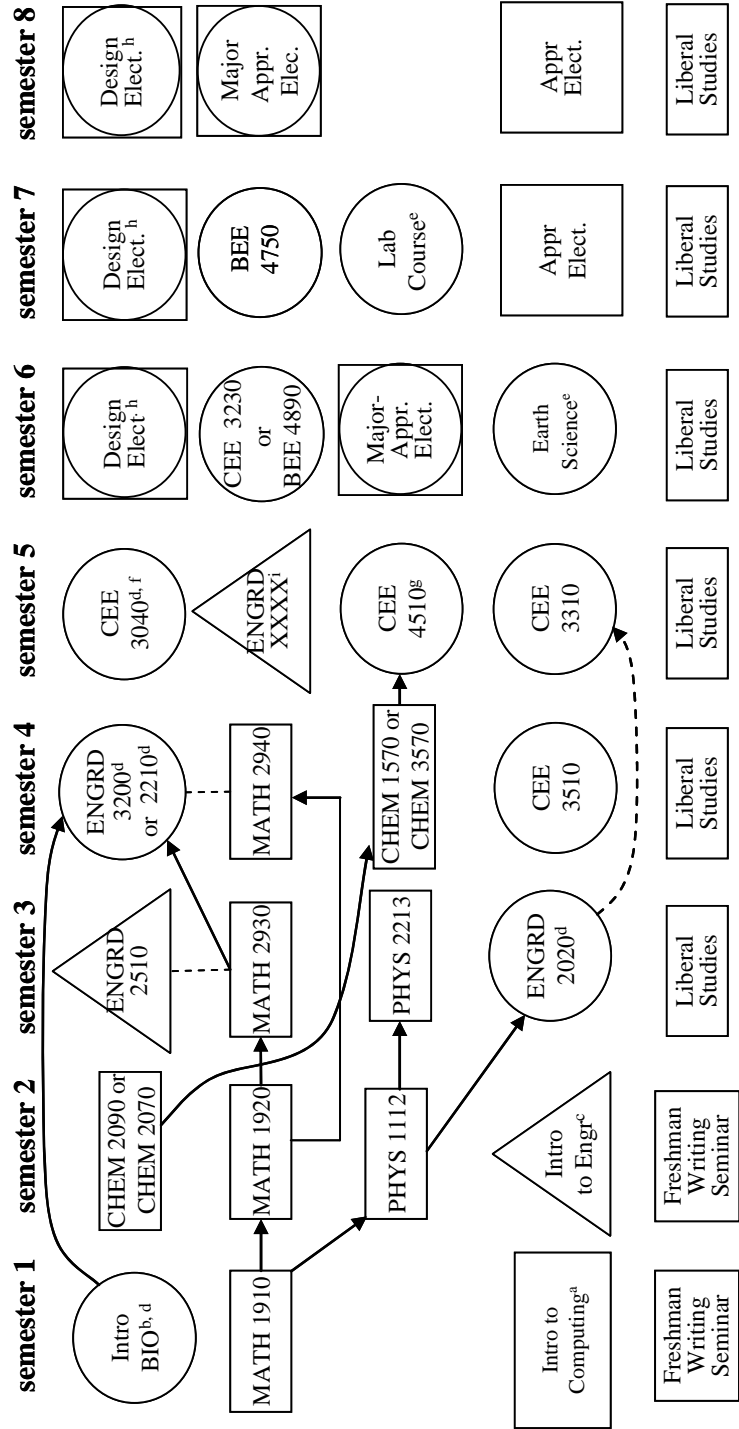
EAS 4570 Atmospheric Air Pollution (3 cr, Fall)

MAE 6480 Air Quality & Atmospheric Chemistry (EAS 6480, 3 cr, Fall)

# Environmental Engineering Major (EnvE) Roadmap



<sup>a</sup> CS 1110, 1112 or BEE 1510 and CS 1130 or CS 1132.  
<sup>b</sup> Students choose from BIOG 1101/1103(F), 1102/1104 (S), 1105(F), 1106 (S), 1107(SU), 1108(SU), 1109(F) or 1110(S).  
<sup>c</sup> ENGR 1130 is recommended. For CALS students, BEE 1200 together with BEE 1510 satisfies the Intro to Computer Programming and the Intro to Engineering requirement.  
<sup>d</sup> Students electing to use this course as a 2<sup>nd</sup> engineering distribution course must take an additional Major-Approved Elective. Note: some Intro to Biology courses do not count as an engineering distribution course.  
<sup>e</sup> Students may choose from a list that is found on page 12 of this handbook.  
<sup>f</sup> ENGRD 2700 will be accepted (by petition) to substitute for CEE 3040 if taken prior to affiliation in the major or if necessary because of scheduling conflicts caused by co-op or study abroad programs.  
<sup>g</sup> Students may take BIOMI 2900 in place of CEE 4510.  
<sup>h</sup> At least one design course from the list of Capstone Design Courses.  
<sup>i</sup> Students may substitute for a Major approved elective if using courses with footnote d as a second distribution.  
 Note: Students must also take a course that meets the technical communications requirement. Students meeting the technical communications requirement with a course that fulfills another requirement will have met both requirements.



**STUDENT PROGRAM PROGRESS FORM**

The progress of each student toward completion of degree requirements is charted on a Program Progress Form. An example report appears on the following page. Courses that have been completed are shown in their appropriate categories on this form. Students are encouraged to examine their Program Progress Form and to report errors and desired adjustments to the Undergraduate Coordinator in either 207 Riley-Robb Hall (BEE) or 221 Hollister Hall (CEE). It is important that the record be complete and accurate, because it is used to determine a student's eligibility for graduation.

**ENVIRONMENTAL ENGINEERING PROGRAM PROGRESS FORM**  
 (Applies to students matriculating in the Fall Semester of 2009 or later)

Name \_\_\_\_\_ Email: \_\_\_\_\_ Advisor: \_\_\_\_\_  
 CU ID \_\_\_\_\_ Last Revised: \_\_\_\_\_  
 2nd Major: \_\_\_\_\_ Minor: \_\_\_\_\_ Antic. Grad Date: \_\_\_\_\_

COURSE	#	CR	GRADE	TERM	COMMENTS
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**1) Math, Chemistry, Physics, Computing, Biology (39 credits)**

MATH	1910	4	_____	_____	_____
MATH	1920	4	_____	_____	_____
MATH	2930	4	_____	_____	_____
MATH	2940	4	_____	_____	_____
CHEM	2090, 2070 or 2150	4	_____	_____	_____
CHEM	1570 or 3570	3	_____	_____	_____
PHYS	1112	4	_____	_____	_____
PHYS	2213 or 2217	4	_____	_____	_____
CS	1110, 1112 or BEE 151	4	_____	_____	_____
CS	1130 or 1132	1	_____	_____	_____
BIOG	11XX	3	_____	_____	_____

**2) Engineering Distribution & Major Courses -- all letter grade (42 credits)**

ENGR1	1XXX	3	_____	_____	or BEE 1200 (1 credit)
ENGRD	2510	3	_____	_____	BEE 2510
ENGRD	XXXX	3	_____	_____	_____
ENGRD	2020	4	_____	_____	_____
CEE	3510	3	_____	_____	_____
CEE	3040	4	_____	_____	_____
CEE	3310	4	_____	_____	_____
CEE	3200 or ENGRD 2210	3	_____	_____	_____
BEE	4890 or CEE 3230	3	_____	_____	_____
CEE	4510	3	_____	_____	_____
BEE	4750	3	_____	_____	_____
Lab course		3	_____	_____	(BEE 4270, CEE 4530, 4370 or 6580)
Earth Science		3	_____	_____	(EAS 2200, 2680, 3030, or CSS 3650)

**3) Design Courses & Major-Approved Electives (See approved List; 15 credits)**

	3	_____	_____	_____	Design Course - Capstone
	3	_____	_____	_____	Design Course
	3	_____	_____	_____	Design Course
	3	_____	_____	_____	M-A Elective
	3	_____	_____	_____	M-A Elective

**4) Courses to Bring Total Env Program Credits in Section 2 & 3 to 57 Because of Substitutions**

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

**5) Freshman Writing Seminars (6 credits)**

	3	_____	_____	_____	_____
	3	_____	_____	_____	_____



## ENGINEERING MINORS

Environmental Engineering majors may choose to complete one or more of the Engineering Minors offered in the College of Engineering. Most students can complete a minor within their Environmental Engineering program in 8 semesters provided they work closely with their faculty advisor to carefully plan and schedule their courses. Completion of a minor is noted on the final Cornell transcript as official recognition of academic achievement above and beyond the student's Bachelor of Science degree requirements. The Minor in Environmental Engineering offered by BEE and CEE is NOT available to Environmental Engineering majors.

Engineering Minors are listed below along with the sponsoring department or school. Details of each minor along with the requirements and procedures for completing it are given in the Engineering Undergraduate Handbook available on-line at: <http://www.engineering.cornell.edu/student-services/academic-advising/engineering-handbook/index.cfm>

<b>Minors</b>	Aerospace Engineering (MAE)
	Applied Mathematics (TAM)
	Biological Engineering (BEE)
	Biomedical Engineering (BME)
	Business for Engineering Students (AEM; offered by CALS)
	Civil Infrastructure (CEE)
	Computer Science (CS)
	Electrical and Computer Engineering (ECE)
	Engineering Management (CEE)
	Engineering Statistics (ORIE)
	Environmental Engineering (BEE/CEE)
	Game Design (CS)
	Industrial Systems and Information Science Technology (ORIE)
	Information Science (CIS)
	Materials Science and Engineering (MSE)
	Mechanical Engineering (MAE)
	Operations Research and Management Science (ORIE)
	Science of Earth Systems (SES)

## HONORS PROGRAM

The environmental engineering honors program consists of at least nine credits beyond the minimum required for graduation in the environmental engineering major. These nine credits shall be drawn from one or more of the following categories with at least 3 credit hours in the first category:

1. A significant research experience or honors project under the direct supervision of a Environmental Engineering faculty member using BEE 4991-4992: BEE Honors Research or CEE 4000: Senior Honors Thesis (1 to 6 credits per semester). A significant written report or senior honors thesis must be submitted as part of this component. Letter grade only.
2. A significant teaching experience under the direct supervision of a faculty member or as part of a regularly recognized course in the College of Engineering (i.e., Undergraduate Engineering Teaching, BEE 4980 or CEE 4010 [1 to 4 credits per semester]).
3. Advanced or graduate courses at the 4000 level or above.

No research, independent study, or teaching for which the student is paid may be counted toward the honors program.

*Eligibility:* students must enter with and maintain a cumulative GPA equal or greater than 3.50.

*Application:* students must apply no later than the beginning of the first semester of their senior year but are encouraged to apply as early as the first semester of their junior year. All honors program students must be in the program for at least two semesters before graduation.

### *Note – Latin Honors*

- Cum laude is awarded to all engineering students with an overall GPA  $>3.50$ . Cum laude is also awarded to all engineering students who received a semester GPA  $>3.50$  in each of the last four semesters of attendance at Cornell; in each of these semesters, at least 12 letter-grade credits must be taken with no failing, unsatisfactory, missing, or incomplete grades. If the student is an Engineering Co-op student, then the Engineering Co-op summer term will count as one of the last four. Students who were approved for prorated tuition in their final semester will be awarded cum laude if they received a semester GPA  $>3.50$  in their last semester and meet the conditions above in the prior four semesters.
- Magna cum laude is awarded to all engineering students with a GPA  $> 3.75$  (based on all credits taken at Cornell).
- Summa cum laude is awarded to all engineering students with a GPA  $> 4.0$  (based on all credits taken at Cornell).
- All GPA calculations are minimums and are not rounded.

# SELECTED ENVIRONMENTAL ENGINEERING COURSE DESCRIPTIONS

**BEE 1200      The BEE Experience**  
Spring            1 credit  
M. F. Walter  
Letter grade only. Requirement for CALS BEE freshman. Not required for students who have completed ENGRG 1050. Prerequisite: BEE majors or permission of instructor. Lec T 1:25-2:15.

Forum covering the career opportunities for engineering students and the activities and curricula that lead to these opportunities. A series of seminars are given by practicing engineers, Cornell faculty members, alumni, staff from the Cornell Career Offices, and students. Students develop their undergraduate course plans; complete a web search assignment to locate jobs and internships, and select future courses to meet their academic objectives and career goals.

**BEE 1510      Introduction to Computer Programming**  
Fall                4 credits  
C. L. Anderson  
Letter grade only. Limited to 18 students per lab and rec. No previous programming experience assumed. Pre- or corequisite: MATH 1910 or equivalent. Lec M W F 11:15-12:05; Lab W R 12:20-2:15, 2:30-4:25.

Introduction to computer programming and concepts of problem analysis, algorithm development and data structure in an engineering context. The structured programming language MATLAB is used, implemented on interactive personal computers, and applied to problems of interest in biological and environmental engineering.

**BEE 2510      Engineering for a Sustainable Society (ENGRD 2510)**  
Fall                3 credits  
B. A. Ahner  
Letter grade only. Pre- or corequisite: MATH 2930. Lec T R 10:10-11:25.

Case studies of contemporary environmental issues including pollutant distribution in natural systems, air quality, hazardous waste management and sustainable development. Emphasis is on the application of math, physics and engineering sciences to solve energy and mass

balances in environmental sciences. Introduces students to the basic chemistry, ecology, biology, ethics and environmental legislation relevant to the particular environmental problem. BEE students must complete either BEE 2510 or BEE 2600 according to their academic plan. BEE students who complete both BEE 2510 and BEE 2600 receive engineering credit for only one of these courses.

**BEE 3299      Sustainable Development: A Web-Based Course**  
Spring, Summer 3 credits  
M.F. Walter, N. R. Scott  
S-U or Letter grade. Prerequisite: at least sophomore standing.

Sustainable development is the dominant economic, environmental and social issue of the 21st century. This course develops the concepts of sustainable development as an evolutionary process, demanding the integration of the physical sciences and engineering with the biological and social sciences for design of systems. Topics include the nature of ecosystems, global processes, sustainable communities, and industrial ecology, renewable energy and life cycle analysis.

**[BEE 3710      Physical Hydrology for Ecosystems (Offered alternate years)]**  
Spring            3 credits  
M. T. Walter  
Letter grade only. Prerequisite: MATH 1920 or permission of instructor. Lec T R 9:05-9:55; Lab R 2:30-4:25. (Next Offered 2010-2011.)

This is an introduction to physical hydrology with an emphasis on roles and interactions between hydrological processes and, ecological, biogeochemical, and human systems. <http://hive.bee.cornell.edu/faculty/walter/BEE371Index.htm>

**BEE 4010      Renewable Energy Systems**  
Spring            4 credits  
L. D. Albright  
Letter grade only. Prerequisite: college physics. Lec T R 10:10-11:25.

Introduces energy systems with emphasis on quantifying costs and designing/optimizing renewable energy systems to convert environmental inputs into useful forms of energy. Covers solar energy, small-scale hydropower, wind, bio-conversion processes, and house energy balances. Focuses on the technologies and small-scale system design, not policy issues. Use of spreadsheets is extensive.

**BEE 4270 Water Measurement and Analysis Methods**

Fall 3 credits

L. D. Geohring, T. S. Steenhuis

Letter grade only. Satisfies BE and EnvE laboratory experience requirement. Prerequisites: fluids or hydrology course and MATH 1910. Lec T 9:05-9:55; Lab T 1:25-4:25.

Get wet and muddy learning how to monitor and characterize water and soil management problems in the natural environment. This is a field based lab course that integrates science and engineering technologies, using various measurement equipment and analytical techniques to quantify water flow and quality parameters in surface and subsurface environments. Measurement accuracy, water sampling quality assurance protocols, and interpretation of watershed contaminants are addressed.

**[BEE 4710 Introduction to Groundwater (EAS 4710; offered alternate years)**

Spring 3 credits

L. M. Cathles, M. T. Walter, T. S. Steenhuis

S-U or Letter grade. Prerequisites: MATH 2930, fluid mechanics or hydrology course. Lec T R 10:10-11:25, Field Trip. (Next Offered 2010-2011.)

Intermediate-level study of aquifer geology, groundwater flow, and related design factors. Includes description and properties of natural aquifers, groundwater hydraulics, soil water, and solute transport.]

**BEE 4730 Watershed Engineering**

Fall 4 credits

M. T. Walter

Letter grade only. Satisfies BE and EnvE capstone design requirement. Satisfies College of Engineering technical writing requirement. Satisfies BE laboratory experience requirement. Prerequisite: CEE 3310 or hydrology course. Lec T R 10:10-11:00; Disc R 1:25-4:25.

This course teaches basic design and analysis as practiced for water control and nonpoint source pollution prevention. We will discuss the origins of design approaches including their theoretical bases but this is not a theory course. Most of the course is dedicated to practicing applied design. Assignments are generally representative of real-life engineering problems and will involve as much hands-on experience as possible. Some example topics include risk analysis, water conveyance, nonpoint source pollution control, stream restoration, stormwater management, and erosion control.

**BEE 4740 Water and Landscape Engineering Applications**

Spring 3 credits

L. D. Geohring, T. S. Steenhuis

Letter grade only. Satisfies BE and EnvE capstone design requirement. Prerequisite: fluids or hydrology course or permission of instructor. Lec M W F 12:20-1:10.

This course will focus on how water moves in soil and the implications for design of drainage and irrigation systems in the landscape. The course addresses aspects of soil physics, flow in porous media, water quality and water supply or disposal in regard to drainage and irrigation applications. Emphasis is on problem solving of actual situations, and a major site-design project is required.

**BEE 4750 Environmental Systems Analysis**

Fall 3 credits

D. A. Haith

Letter grade only. Prerequisite: computer programming and 1 year of calculus. Lec T R 11:40-12:55.

Applications of mathematical modeling, simulation, and optimization to environmental-quality management. Fate and transport models for contaminants in air, water, and soil. Optimization methods (search techniques, linear programming) to evaluate alternatives for solid-waste management and water and air pollution control. Introduction to hydrologic simulation (runoff and streamflow). Software packages for watershed analyses of point and nonpoint source water pollution.

**BEE 4760 Solid Waste Engineering**

Spring 3 credits

D. A. Haith

Letter grade only. Prerequisite: one semester of physics and chemistry. Lec T R 11:40-12:55.

Planning and design of processes and facilities for management of municipal solid wastes. Source characterization and reduction; collection and transport systems; waste-to-energy combustion; sanitary landfills composting; recycling and materials recovery facilities; and hazardous waste management. Emphasizes quantitative analyses.

**BEE 4800 Our Changing Atmosphere: Global Change and Atmospheric Chemistry (EAS 4800)**

Fall 3 credits

P. G. Hess

S/U or Letter grade. Prerequisites: CHEM 2090, MATH 1920, PHYS 1112 or equivalent, or permission of instructor. Lec M W F 12:20-1:10.

This course investigates the science behind changes in our atmospheres composition and its relation to global change. We will examine the chemistry and physics that determines atmospheric composition on global scales including the effects of biogeochemistry and atmospheric photochemistry.

**BEE 4870 Sustainable Energy Systems**

Fall 3 credits

L. Angenent

Letter grade only. Satisfies BE and EnvE capstone design requirement. Intended for upper-level undergraduates and graduate students. Prerequisites: BEE 2220 or an equivalent thermodynamics course. Lec T R 9:05-9:55; Lab W 1:25-4:25.

Offers a systems approach to understanding renewable energy systems (solar, wind, and biomass) and their conversion processes, from various aspects of biology, physics, engineering, environmental impacts, economics, and sustainable development.

**BEE 4890 Entrepreneurial Management for Engineers**

Fall 4 credits

M. B. Timmons

Letter grade only. Satisfies College of Engineering technical writing requirement. Prerequisite: junior standing, ENGRD 2700 or CEE 3040 or equivalent highly recommended. No on is allowed to add the course after 2<sup>nd</sup> week. Lec R 1:25-3:20; Lab M 1:25-2:15 or 7:30-8:20PM; Sec M 2:30-3:20 or 8:35-9:25 PM.

The course focuses on how to start a new company centered on engineering or biological technologies. Course objectives include coverage of: entrepreneurship principles, fund raising, negotiation, financial calculations (internal rate of return, time value of money, proforma statements); legal structures of businesses; project management; and to develop an awareness of issues related to professional ethics; and technical writing and communication. Majority of work done in teams including a complete business plan that is presented to angel investors. Business plans must require less than \$100K in startup funding and may result in actual investment by the angel investor group.

**BEE 4940 Special Topics in Biological and Environmental Engineering**

Fall, Spring 4 credits (maximum)

Staff

S-U or Letter grade.

The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Course offered under this number will be approved by the department curriculum committee, and the same course will not be offered twice under this number. Each 4940 has a unique course ID for enrollment.

**BEE 4970 Individual Study in Biological and Environmental Engineering**

Fall, Spring 1-4 credits

Staff

Letter grade only. Prerequisites: written permission of instructor and adequate ability and training for work proposed; normally reserved for seniors in upper two-fifths of their class. Students from all colleges must register with an Independent Study Form (available in 207 Riley-Robb Hall). See department office for course ID specific to your project advisor.

Special work in any area of Biological and Environmental Engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

**BEE 4980 Undergraduate Teaching**

Fall, Spring 1-4 credits

Staff

Letter grade only. Prerequisite: written permission of instructor. Students from all colleges must register with an Independent Study Form (available in 207 Riley-Robb Hall). See department office for course ID specific to your project advisor.

The student assists in teaching a Biological and Environmental Engineering course appropriate to his/her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses objectives and techniques with the faculty member in charge of the course.

**BEE 4990 Undergraduate Research**

Fall, Spring 1-4 credits

Staff

Letter grade only. Prerequisites: normally reserved for seniors in upper two-fifths of their class; adequate training for work proposed; written permission of instructor. Students from all colleges must register with an

Independent Study Form (available in 207 Riley-Robb Hall). See department office for course ID specific to your project advisor.

Research in any area of Biological and Environmental Engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.

### **BEE 4991-4992 BEE Honors Research**

Fall and Spring 1-6 variable credits

Staff

Letter grade only. Prerequisites: enrollment in BEE research honors program. Students must be eligible for Latin honors and complete honors program application by 3rd week of the Fall semester, senior year.

Intended for students pursuing the research honors program in BEE.

### **5330 Engineering Professionalism**

Spring 1 or 2 credits\*

M. B. Timmons, J. R. Stedinger, other Engineering Faculty S/U or Letter grade. Prerequisite: graduate student with accredited engineering degree or senior who will graduate with accredited engineering degree. Must register to take Fundamentals of Engineering Exam.\*\* Lec only 1<sup>st</sup> 10 weeks of semester. Lec W 7:30-10:30.

Presentations address engineering professionalism and ethics, and provide preparation for the general NY FE Examination taught in a team-based format. The second-credit ethics portion emphasizes the engineer's professional responsibilities for the health and welfare of the public and the guiding principles for a professional engineer. Case histories on engineering ethics will be examined and students will write their own personal statement addressing integrity. Homework addresses FE exam preparation, and students complete the formal comprehensive review of engineering subjects associated with the Fundamentals of Engineering Exam. \*One credit option includes FE review only.

\*\*Students must file their NY FE Exam application by either November 1 of the previous year or by May 1 of the spring semester to be enrolled in BEE 5330. The FE exam registration and sitting fees total \$205 and are paid to the NY State Education Department and the testing service, not to Cornell. The NY FE Exam is offered in April and October, the April exam may be taken at Cornell and other NY locations, the October exam is not offered at Cornell.

### **[BEE 6510 Bioremediation: Engineering Organisms to Clean Up the Environment**

Spring 3 credits

B. A. Ahner

Letter grade only. Prerequisites: BIOMI 2900 or BIOBM 3310 or permission of instructor. Lec T R 10:10-11:00. (Next Offered 2010-2011.)

Through lectures and current literature, students evaluate the benefits as well as the current obstacles to effective bioremediation, includes examples of genetically engineered organisms.]

### **BEE 6550 Thermodynamics & its Applications (Offered alternate years)**

Fall 3 credits

J-Y. Parlange

Letter grade only. Prerequisite: MATH 2930 or equivalent; for undergraduates, permission of instructor. Lec R 2:30-4:25.

Thermodynamics and its applications to problems in engineering and agriculture. Topics include basic concepts (equilibrium, entropy, processes, systems, potentials, stability, phase transitions) and applications (soil and water processes, dilute solutions, electromagnetism, surface phenomena, heat and mass transport, structure of organizations.)

### **[BEE 6710 Analysis of the Flow of Water and Chemicals in Soils (Offered alternate years)**

Fall 3 credits

J-Y. Parlange

Letter grade only. Prerequisites: four calculus courses and fluid mechanics course; for undergraduates, permission of instructor. Lec W 2:30-4:25, first meeting, (future times to be decided at first meeting). (Next Offered 2010-2011.)

Describes the chemical and water flows on a soil surface, in the vadose zone, and through the aquifer. Discusses current analytical, semi-analytical and computer-based techniques.]

**BEE 6720 Drainage (Offered alternate years)**  
 Spring 4 credits  
 T. S. Steenhuis, L. D. Geohring  
 Letter grade only. Prerequisites: BEE 4710 or BEE 4730.  
 Lec M W F 12:20-1:10; Lab T 1:25-4:25.

Discusses the theory of water and solute flow in aquifers, hill slopes, and the vadose zone as it relates to artificial drainage. Critically reviews drainage design as it relates to agricultural land, landfills, and land application sites. Examines the importance of preferential flow and matrix flow on water quality of drainage waters. Laboratories provide hands-on experience with measuring soil parameters and for actual drainage design.

**BEE 7540 The Right to Water**  
 Spring 3 credits  
 T. S. Steenhuis, G. Holst\_Warhaft, et al.  
 S-U or Letter grade. Prerequisite: graduate standing or permission of instructors. Lec W 2:30-4:25.

The course addresses the crisis of water in the Mediterranean region, through case studies situated in watershed basins, especially the Nile. It focuses on attitudes, conflicts, and relationships of local people and nations toward water, expressed in culture, environmental laws and watershed management practices.

**BEE 7710 Soil & Water Engineering Seminar**  
 Fall, Spring 1 credit  
 T. S. Steenhuis, J-Y. Parlange, M. F. Walter, M. T. Walter.  
 S-U grade only. Prerequisite: graduate standing or permission of instructor. Sem F 2:30-3:30.

Study and discussion of research or design procedures related to selected topics in watershed management, erosion control, hydrology, colloid transport and water quality.

**CEE 1130 Sustainable Design for Appledore Island (ENGRI 1130)**  
 Spring 3 credits  
 J. J. Bisogni  
 S-U or Letter grade. Note: Students must register under ENGRI 1130. Lec M W F 9:05-9:55.

Students learn how to design: reservoirs to provide water during droughts, aqueducts to transport water, and water treatment plants to prevent waterborne diseases. The course includes field trips, building a computer-controlled miniature water treatment plant, and exploring new technologies for making safe drinking water.

**CEE 2550 AguaClara: Sustainable Water Supply Project**  
 Fall, Spring 3 credits  
 M. L. Weber-Shirk  
 Letter grade only. Lec T R 1:25-2:40.

For description see CEE 4550.

**CEE 3040 Uncertainty Analysis in Engineering**  
 Fall 4 credits  
 J. R. Stedinger  
 S-U or Letter grade. Prerequisites: first-year calculus. Lec M W F 12:20-1:10, Sec 1 W 1:25-2:15, Sec 2 R 10:10-11:00, Sec 3 R 1:25-2:15, Sec 4 R 2:30-3:20, Sec 5 W 2:30-3:20.

Introduction to probability theory and statistical techniques, with examples from civil, environmental, biological, and related disciplines. Covers data presentation, commonly used probability distributions describing natural phenomena and material properties, parameter estimation, confidence intervals, hypothesis testing, simple linear regression, and nonparametric statistics. Examples include structural reliability, windspeed/flood distributions, pollutant concentrations, and models of vehicle arrivals.

**CEE 3200 Engineering Computation (ENGRD 3200)**  
 Spring 3 credits  
 C. P. Diamessis  
 S-U or Letter grade. Prerequisites: CS 1112 and MATH 2930. Corequisite: MATH 2940. Recommended: completion of MATH 2940. Lec 1 T R 10:10-11:00, Sec 1 F 10:10-11:00, Sec 2 11:15-12:05, Sec 3 12:20-1:10, Sec 4 1:25-2:15, Sec 5 2:30-3:20.

Introduction to numerical methods, computational mathematics, and probability and statistics. Development of programming and graphics proficiency with MATLAB and spreadsheets. Topics include: Taylor-series approximations, numerical errors, condition numbers, operation counts, convergence, and stability, probability distributions, hypothesis testing. Included are numerical methods for solving engineering problems that entail roots of functions, simultaneous linear equations, statistics, regression, interpolation, numerical differentiation and integration, and solution of ordinary and partial differential equations, including an introduction to finite difference methods. Applications are drawn from different areas of engineering. A group project uses these methods on a realistic engineering problem.

**CEE 3230      Engineering Economics and Management (ENGRG 3230)**

Spring, Summer Co-op    3 credits

F. Vanek

Letter grade only. Note: Primarily for Juniors and Seniors. Lec M W 10:10-11:00; Lab F 9:05-9:55, 10:10-11:00, 11:15-12:05.

Introduction to Engineering and business economics and to project management. Intended to give students a working knowledge of money management and how to make economic comparisons of alternative engineering designs or projects. The impact of inflation, taxation, depreciation, financial planning, economic optimization, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems.

**CEE 3310      Fluid Mechanics**

Fall                            3 credits

E. A. Cowen

Letter grade only. Prerequisite or corequisite: ENGRD 2020. Lec M W F 10:10-11:00; Lab R 12:20-1:10, 1:25-2:15, F 1:25-2:15.

Covers hydrostatics, the basic equations of incompressible fluid flow, potential flow and dynamic pressure forces, viscous flow and shear forces, steady pipe flow, turbulence, dimensional analysis, laminar and turbulence boundary layer, flows around obstacles, and open-channel flow. Includes small-group laboratory assignments.

**[CEE 3320      Hydraulic Engineering**

Spring                        3 credits

P. L. Liu

Letter grade only. Prerequisite: CEE 3310. Lec T R 10:10-11:25. (Next Offered 2011-2012.)

Application of fluid-mechanical principles to problems of engineering practice and design: hydraulic machinery, open-channels, and river engineering. Lectures supplemented by laboratory work and a design project.]

**CEE 3510      Environmental Quality Engineering**

Spring                        3 credits

Staff

Letter grade only. Lec M W F 11:15-12:05.

Introduction to engineering aspects of environmental quality control. Quality parameters, criteria, and standards for water and wastewater. Elementary analysis pertaining to the modeling of pollutant reactions in natural systems, and introduction to design of unit processes for wastewater treatment.

**CEE 4110      Remote Sensing: Resource Inventory Methods**

Spring                        3 credits

A. Lembo

Letter grade only. Lec M W F 9:05-9:55; Lab M 1:25-4:25, R 1:25-4:25.

Survey of resource inventory methods applied to field-based studies of environmental systems. Laboratory emphasizes using maps, spatial databases, global positioning systems, and aerospace imagery to discriminate, measure, inventory, and monitor environmental resources.

**CEE 4320      Hydrology**

Spring                        3 credits

W. H. Brutsaert

Letter grade only. Prerequisite: CEE 3301. Lec M W F 9:05-9:55. Note: Intended for undergraduates. Lec concurrent with CEE 6320.

Introduction to hydrology as a description of the water cycle and the role of water in the natural environment, and other issues for environmental engineers. (See description for CEE 6320.)

**[CEE 4350      Coastal Engineering**

Spring                        4 credits

Staff

Letter grade only. Prerequisite: CEE 3310. Satisfies EnvE capstone design requirement.

Covers the following topics: review of hydrodynamics; small-amplitude wave theory; wave statistics; wave-structure interactions; coastal processes.]

**[CEE 4360      Case Studies in Environmental Fluid Mechanics**

Spring                        4 credits

E. A. Cowen

Letter grade only. Prerequisite: CEE 3310 or equivalent.

An introduction to fundamental fluid mechanics and transport processes of the environment through laboratory - and field - based studies (Cayuga Lake, and Fall, Six-Mile, Cascadilla Creeks) and case studies. Topics include surface and internal wave dynamics, sediment and nutrient/contaminant transport, and interfacial transfer. Lectures are based on laboratory/field projects. Course includes a design project.]

**CEE 4370 Experimental Methods in Fluid Dynamics**  
 Spring 3 credits  
 E. A. Cowen  
 Letter grade only. Pre or corequisites: CEE 3310 or equivalent and CEE 3040 or equivalent. (Next Offered 2010-2011.)

Introduction to experimental data collection and analysis, in particular as they pertain to fluid flows. Covers computer-based experimental control, analog and digital data acquisition, discrete sampling theory, digital signal processing, and uncertainty analysis. Also covers analog transducers, acoustic and laser Doppler velocimetry, full-field (2-D) quantitative imaging techniques. Includes laboratory experiments.

**[CEE 4440 Environmental Site and Remediation Engineering]**  
 Spring 3 credits  
 T. D. O'Rourke  
 Letter grade only. Prerequisite: CEE 3410 or equivalent or permission of instructor. (Next Offered 2011-2012.)

Covers principles of hydrogeology, contaminant migration, and remediation technologies related to geotechnical and environmental engineering. Emphasizes environmental site assessment, site feasibility studies, selection of remediation procedures, and engineered landfills. Design problems are based on real projects and involve visits from practicing engineers.]

**[CEE 4510 Microbiology for Environmental Engineering]**  
 Fall 3 credits  
 R. E. Richardson  
 Letter grade only. Prerequisites: two semesters of college chemistry; organic chemistry or permission of instructor. Lec M W F 11:15-12:05. (Next Offered 2010-2011.)

Introduction to the fundamental aspects of microbiology and biochemistry that are pertinent to environmental engineering and science. Provides an overview of the characteristics of bacteria, Archaea, unicellular Eukaryotes (protozoa, algae, fungi), and viruses. Includes discussions of cell structure, bioenergetics and metabolism, and microbial genetics. Focus is then applied to topics pertinent to environmental engineering: pathogens; disease and immunity; environmental influences on microorganisms; roles of microbes in the carbon, nitrogen, and sulfur cycles; enzymes; molecular microbiology; and microbial ecology. This is an introductory course and is inappropriate for those who have taken BIOMI 290 or equivalent.]

**[CEE 4520 Water Supply Engineering]**  
 Fall 3 credits  
 J. J. Bisogni  
 Letter grade only. Prerequisite: CEE 3510. Lec T R 8:40-9:55. (Not Offered 2010-2011.)

Analysis of contemporary threats to human health from water supplies. Covers criteria and standards for potable-water quality; water-quality control theory; design of water supply facilities.]

**CEE 4530 Lab Research in Environmental Engineering**  
 Fall 3 credits  
 Staff  
 Letter grade only. Prerequisite: CEE 3510 or permission of instructor. Lec MF 11:25-2:15; Lab W 1:25-4:25.

Laboratory investigations of reactor flow characteristics; acid rain/lake chemistry; contaminated soil-site assessment and remediation; and wastewater treatment. Design of laboratory experiments, data analysis, computerized process control, and model development are emphasized.

**CEE 4540 Sustainable Small-Scale Water Supplies**  
 Fall 3 credits  
 M. L. Weber-Shirk  
 Letter grade only. Satisfies EnvE capstone design requirement. Lec MWF 11:15-12:05.

This course covers the design and analysis of small-scale drinking water supply systems. We explore the technical, economic, and social constraints that form the sustainable space-i.e., the set of viable technologies that could be adopted progressively to improve the availability and quality of water. Students work in teams to design water supply and treatment systems.

**CEE 4550 AguaClara: Sustainable Water Supply Project**  
 Fall, Spring 3 credits  
 M. L. Weber-Shirk  
 Letter grade only. Lec T R 1:25-2:40.

Student teams conduct research, build working models, design full-scale prototypes, create design algorithms, and create educational materials for technology transfer to improve water drinking water quality in Honduras. For more information see <http://aguaclara.cee.cornell.edu>

**CEE 4920 Engineers for a Sustainable World: Engineering in International Development**

Fall 3 credits

F. Vanek, P. Doing

Letter grade only. Prerequisite: Senior or Graduate Standing; Juniors need permission of instructor. Lec T R 10:10-11:00, Lab 1 M 7:30-9:25PM, Lab 2 1:25-3:25.

Engineering-based group service projects offer real-life engineering research and design experience, from problem formulation through implementation. They may be international or local, and may relate to any kind of engineering. Students work on interdisciplinary teams with a project supervisor and a partner community organization. Course readings and a writing assignment cover the relationship between engineering and international development, the philosophy and politics of technology, and ethics in engineering practice.

**CEE 5970 Risk Analysis and Management (TOX 5970)**

Spring 3 credits

J. R. Stedinger

S-U or Letter grade. Prerequisite introduction to probability and statistics (e.g., CEE 3040, ENGRD 2700, ILSRT 2100, BTRY 3010, or AEM 2100); two semesters of calculus; senior or graduate standing or permission of instructor. Lec M W F 10:10-11:00.

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 6000 Numerical Methods for Engineers**

Fall 3 credits

P. J. Diamessis

Letter grade only. Lec M W 2:55-4:10. (Next Offered 2010-2011.)

The primary focus is algorithm implementation within the context of engineering applications (spanning fluid and solid/fracture mechanics and beyond). Student projects will include parallel implementation using resources at the Theory Center. Course topics will include: Sources of error and error propagation, eigenvalue/eigenvector computation, solution of linear systems via direct or iterative methods and issues of parallel implementation, least squares approximation of lab/simulation data,

solution of non-linear equations, interpolation in one and two dimensions, fast Fourier transforms (serial vs. parallel) and wavelets.]

**CEE 6020 Environmental Seminar**

Fall 1 credit

Staff

Letter grade only. Lec R 4:30-5:30.

Presents topics for current interest.

**CEE 6021 Seminar-Environmental and Water Resources Systems Analysis**

Spring 1 credit

C. A. Shoemaker and J. R. Stedinger

S-U grade only. Prerequisite: permission of instructor. Sec R 4:30-5:30.

Graduate students and faculty members informal lectures on various topics related to ongoing research in environmental or water resources systems planning and analysis.

**CEE 6051 Seminar-Environmental Quality Engineering**

Spring 1 credit

J. M. Gossett

S-U grade only. Prerequisite: graduate students in Environmental Engineering. Sec M 4:45-6:00PM.

Presentation and discussion of current research in Environmental Engineering

**CEE 6100 Remote Sensing Fundamentals (CSS 6100)**

Fall 3 credits

W. D. Philpot

Letter grade only. Lec MW 11:15-12:05; Lab F 11:15-12:05; F 12:20-1:10.

Introduction to the equipment and methods used in obtaining information about earth resources and the environment from aircraft or satellite. Coverage includes sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design.

**CEE 6210 Stochastic Hydrology**

Fall 3 credits

J. R. Stedinger

Letter grade only. Prerequisites: CEE 3040 or permission of instructor. (Offered on Demand.)

Course exams statistical, time series and stochastic optimization methods used to address water resources planning and management problems involving uncertainty objectives and hydrologic inputs. Statistical issues include: maximum likelihood and moments estimators; censored data sets and historical information; probability plotting; Bayesian inference; regionalization methods; ARMA models; multivariate stochastic stream flow models; stochastic simulation; and stochastic reservoir-operation optimization models.

**[CEE 6230 Environmental Quality Systems Engineering]**

Fall 3 credits

C. A. Shoemaker

Letter grade only. Prerequisites: MATH 2940, optimization, and graduate standing or permission of instructor. (Next Offered 2010-2011.)

Application of optimization, simulation methods, and uncertainty analysis to the prevention and remediation of pollution. Case studies include: regional waste and wastewater treatment, restoration of dissolved oxygen levels in rivers, and reclamation of contaminated groundwater. Application use linear programming, integer, dynamic, nonlinear programming, and sensitivity analysis.]

**[CEE 6300 Spectral Methods for Incompressible Fluid Flows]**

Spring 3 credits

P. J. Diamessis

Letter grade only. Lec M W 10:10-11:50. (Offered on Demand. Please contact the professor if interested in taking this course.)

Higher order spatial discretization schemes (spectral and compact-finite difference). One-dimensional non-linear partial differential equations (Burgers eqn., Korteweg-DeVries eqn. and Shallow Water eqns.) and implications for environmental fluid flow simulations. Two-dimensional problems and fast iterative solvers. Numerical solution of the incompressible Navier-Stokes equations in an environmental/geophysical context. Advanced topics may include: Introduction to turbulence subgrid scale modeling in stratified/rotating flow, free surface flow modeling and representation of complex topography.]

**CEE 6310 Computational Simulation of Flow and Transport in the Environment**

Spring 3 credits

Staff

Letter grade only. Prerequisites: MATH 2940 or equivalent, ENGRD 3200 or experience in numerical methods and programming, and elementary fluid mechanics. Lec T R 10:10-11:25.

Covers fundamental equations of saturated and unsaturated flow in porous media; flow in fractured media; numerical modeling of transport in porous media; diffusion and advective diffusion in one, two, and three dimensions; anisotropy; and additional terms for reactive substances. Teaches various numerical methods including finite difference, finite elements, and boundary elements.

**CEE 6320 Hydrology**

Spring 3 credits

W. H. Brutsaert

Letter grade only. Prerequisite: CEE 3310. Lec M W F 9:05-9:55.

Introduction to hydrology as a description of the water cycle and the role of water in the natural environment, and other issues for environmental engineers and scientists. Covers: physical and statistical prediction methods for design related to hydrologic processes; hydrometeorology and evaporation; infiltration and base flow; surface runoff and channel routing; linear and nonlinear hydrologic systems; and storage routing and unit hydrograph methods

**CEE 6330 Flow in Porous Media and Groundwater**

Spring 3 credits

W. H. Brutsaert

Letter grade only. Prerequisite: CEE 3310. Lec M W F 11:15-12:05. Please contact professor if interested in this course.

Fluid mechanics and equations of single-phase and multiphase flow; methods of solution. Applications involve aquifer hydraulics, pumping wells; drought flows; infiltration, groundwater recharge; land subsidence; seawater intrusion, miscible displacement; and transient seepage in unsaturated materials.

**[CEE 6340 Boundary Layer Meteorology]**

Fall 3 credits

W. H. Brutsaert

Letter grade only. Prerequisite: CEE 3310 or permission of instructor. Please contact professor if interested in this course. Not Offered Fall 09.

Physical processes in the lower atmospheric environment: turbulent transport in the atmospheric boundary layer, surface-air interaction, disturbed boundary layers, radiation. Applications include sensible and latent heat transfer from lakes, plant canopy flow and evapotranspiration, turbulent diffusion from chimneys and cooling towers, and related design issues].

**[CEE 6350 Small and Finite Amplitude Water Waves**

Spring 3 credits

P. L. Liu

Letter grade only. (Offered on Demand. Please contact the professor if interested in taking this course.)

Reviews linear and nonlinear theories of ocean waves. Discusses the applicability of different wave theories to engineering problems.]

**CEE 6360 Environmental Fluid Mechanics**

Spring 3 credits

E. A. Cowen

Letter grade only. Lec M W 1:25-2:40. (Offered on Demand. Please contact the professor if interested in taking this course.)

Covers analytic and modeling perspectives of environmental flows; mechanics of layered and continuously stratified fluids: internal waves, density currents, baroclinic motions, and turbulence; jets and plumes and their behavior in the environment; turbulent diffusion, shear flow dispersion, and wave-induced mixing processes; and applications to mixing processes in rivers, lakes, estuaries, and the coastal ocean.

**[CEE 6370 Experimental Methods in Fluid Dynamics (M&AE 6272)**

Spring 4 credits

E. A. Cowen

Letter grade only. Pre or corequisite: CEE 3310 or equivalent and CEE 3040 or equivalent. (Next Offered 2010-2011.)

Introduction to experimental data collection and analysis, in particular as they pertain to fluid flows. Covers computer-based experimental control, analog and digital data acquisition, discrete sampling theory, digital signal processing, uncertainty analysis. Also covers analog transducers, acoustic and laser Doppler velocimetry, full-field (2-D) quantitative imaging techniques. Includes laboratory experiments and a project.]

**CEE 6030 Seminar Environmental Fluid Mechanics/Hydrology**

Spring 1 credit

Staff

S-U grade only. Requirement for graduate students majoring in hydraulics or hydraulic engineering. Open to undergraduates and graduates. Sec R 4:30-5:30.

Topics of current interest in fluid mechanics, hydraulic engineering, and hydrology.

**CEE 6035 Special Topics in Hydraulics**

On-Demand 1-6 credits

Staff

Special topics in fluid mechanics, hydraulic engineering, or hydrology.

**CEE 6530 Water Chemistry for Environmental Engineering**

Fall 3 credits

J. M. Gossett

Letter grade only. Prerequisite: one semester of college chemistry or permission of instructor. Lec M W F 10:10-11:00.

Covers principles of chemistry applicable to the understanding, design, and control of water and wastewater treatment processes and to reactions in receiving waters. Topics include chemical thermodynamics, reaction kinetics, acid-base equilibria, mineral precipitation/dissolution, and electrochemistry. Focuses on the mathematical description of chemical reactions relevant to engineered processes and natural systems, and the numerical or graphical solution of these problems.

**[CEE 6540 Aquatic Chemistry**

Spring 3 credits

J. J. Bisogni

Letter grade only. Prerequisite: CEE 6530 or CHEM 2870-2880. (Next Offered 2011-2012.)

Applies concepts of chemical equilibria to natural aquatic systems. Topics include acid-base reactions, buffer systems, mineral precipitation, coordination and redox reactions, Eh-pH diagrams adsorption phenomena, humic acid chemistry, and chemical-equilibria computational techniques. In-depth coverage of topics covered in CEE 6530.]

**CEE 6550      Transport, Mixing, and Transformation in the Environment**

Fall                      3 credits

Staff

Letter grade only. Prerequisite: CEE 3310. Lec T R 10:10-11:25.

Application of fluid mechanics to problems of transport, mixing, and transformation in the water environment. Introduction to advective, diffuse, and dispersive processes in the environment. Boundary interactions: air-water and sediment-water processes. Introduction to chemical and biochemical transformation processes. Applications to transport, mixing, and transformation in rivers, lakes, and coastal waters.

**CEE 6560      Physical/Chemical Process**

Fall                      3 credits

J. J. Bisogni

Letter grade only. Pre or corequisites: CEE 6530 or permission of instructor. Lec M W F 9:05-9:55.

Theoretical and engineering aspects of chemical and physical phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes and to their transformation in the environment. Analysis and design of treatment processes and systems.

**CEE 6570      Biological Processes**

Spring                    3 credits

J. M. Gossett

Letter grade only. Prerequisites: introductory microbiology and CEE 6560, or permission of instructor. Lec M W F 11:15-12:05.

Theoretical and engineering aspects of biological phenomena and processes applicable to the removal of impurities from water, wastewater, and industrial wastes and to their transformation in the environment. Bioenergetics analysis, stoichiometry, biokinetic, and design of biological treatment process.

**[CEE 6580      Biodegradation and Biocatalysis**

Spring                    3 credits

R. E. Richardson

Letter grade only. Prerequisites: CEE 4510 or BIOMI 2900 or equivalent; CEE 3510 or CHEME 3900 or permission of instructor. Lec T 1:25-2:40; Lab R 1:25-4:30. (Next Offered 2010-2011.)

Students explore the use of microbes in biodegradation and biocatalysis as well as the molecular techniques (i.e., analysis of DNA, RNA, and proteins) commonly used in these applications. Lectures cover enzyme classes and

kinetics, selective isolation of organisms with desired bioconversion capabilities, effects of environmental parameters and cell-to-cell communication on gene expression, methods in microbial molecular biology, and contemporary case studies in biodegradation and biocatalysis. Laboratory sessions give students hands-on experience in molecular and analytical methods. Student teams design and then construct a bioreactor employing their own environmental isolates that degrade a selected contaminant or produce a desired compound.]

**CSS 3650      Environmental Chemistry: Soil, Air, and Water**

Spring                    3 credits

M. B. McBride

Letter grade only. Prerequisites: CHEM 2070-2080 or CHEM 1560. Lec MWF 10:10-11:00.

Overview of the chemistry of the biosphere and biogeochemical processes that control the fluxes, concentrations, and bioavailability of essential elements and pollutants in soil, air, and water. Gives particular attention to soil's function as a filter for contaminants. Describes the history of environmental contamination by xenobiotics and heavy metals, with emphasis on behavior and properties of pollutants that pose the greatest risk to human and ecological health.

**EAS 2200      The Earth System**

Fall, Spring            4 credits

W. M. White and A. Moore

Letter grade only. Prerequisites: MATH 1110/1910. Lec TR 10:10-11:25; Lab R 2:00-4:25.

An integrated introduction to the earth system stressing the biological, chemical, geological, and physical interactions among the atmosphere, ocean, and solid earth. Topics covered will include biogeochemical cycles, climate dynamics, and the evolution of the atmosphere, biosphere, cryosphere (ice), hydrosphere (oceans and inland waters), and lithosphere (solid earth).

**EAS 2680      Climate and Global Warming (PBS)**

Spring                    3 credits

A. T. DeGaetano

S-U or Letter grade. Prerequisite: basic college math. Lec MWF 10:10-11:00.

Familiarizes students from a range of disciplines with such contemporary issues in climatology as global warming and El Niño. Introduces the natural greenhouse effect, past climates, observed and projected climate changes and impacts. Also covers natural climate variations (e.g., El Niño) and their consequences and predictability. Readings focus on recent scientific findings to climate change.

**EAS 3030      Introduction to Biogeochemistry (also  
NTRES 3030)**

Fall              4 credits

J. Yavitt

Letter grade only. Prerequisites: CHEM 2070 or equivalent, MATH 1120, plus a course in biology and/or geology. Lec TR 12:20-1:10; Dis1: M 2:00-4:25; Dis2: R 2:00-4:25.

Control and function of the Earth's global biogeochemical cycles. Begins with a review of the basic inorganic and organic chemistry of biologically significant elements, and then considers the biogeochemical cycling of carbon, nutrients, and metals that take place in soil, sediments, rivers, and the oceans. Topics include weathering, acid-base chemistry, biological redox processes, nutrient cycling, trace gas fluxes, bio-active metals, the use of isotopic tracers, controls on atmospheric carbon dioxide, and mathematical models. Interactions between global biogeochemical cycles and other components of the Earth system are discussed.

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## **BEE AND CEE FACULTY AFFILIATED WITH ENVE UNDERGRADUATE MAJOR AND THEIR INTERESTS**

**Beth A. Ahner (BEE)**

Biogeochemistry of trace metals in aquatic ecosystems and soil, plant-based biomediation., plant and algae-based production of raw materials and energy.

**Louis D. Albright (BEE)**

Energy conservation and management, indoor environment quality, sustainable food production systems, and renewable energy systems analysis and design.

**C. Lindsay Anderson (BEE)**

Renewable energy systems and integration with existing markets and power systems. Mathematical modeling and systems simulation.

**Largus T. Angenent.(BEE)**

Conversion of wastewater and agricultural wastes into bioenergy with nondefined mixed cultures.

**Antje J. Baeumner (BEE)**

Biosensors and microfluidic systems for clinical diagnostics, food safety and environmental protection.

**James J. Bisogni, Jr. (CEE)**

Environmental engineering, biological wastewater treatment processes, aquatic chemistry, remediation of acid lakes.

**Wilfried H. Brutsaert (CEE)**

Hydrology, land-atmosphere interactions, hydraulics, groundwater flow.

**Edwin A. Cowen (CEE)**

Environmental fluid mechanics, wave hydrodynamics, coupled air-water transfer processes, mixing and transport processes in the environment, experimental methods.

**Peter J. Diamessis (CEE)**

Environmental fluid mechanics, hydrodynamics of the coastal/open ocean and lakes, turbulence modeling, hydrodynamic instability theory, spectral methods in scientific and engineering computation, high performance parallel scientific computing.

**Richard I. Dick (CEE, Emeritus)**

Water and wastewater treatment, residue management, sludge treatment/disposal

**H. Oliver Gao (CEE)**

Environment/energy and transportation systems, transportation energy consumption and emissions inventory estimation and impact analysis, statistical and mathematical modeling.

**Kifle G. Gebremedhin (BEE)**

Timber engineering and mechanics, engineering livestock thermal environments, and modeling from bio-energetics to population dynamics of single or multiple species of animals for a sustainable ecosystem in terms of energy (feed and water) budget.

**Larry D. Geohring (BEE)**

Hydrologic and hydraulic applications to soil and water resources management, soil and water conservation engineering, fate and transport processes of nutrients and other potential agricultural pollutants.

**James M. Gossett (CEE)**

Water and waste treatment, microbiological phenomena and processes, treatment of contaminated groundwater.

**Douglas A. Haith (BEE)**

Environmental systems analysis, nonpoint source pollution, solid waste management, watershed modeling, environmental impacts of pesticides.

**Peter G. Hess (BEE)**

Understanding how anthropogenic and natural processes affect the chemical composition of the atmosphere. The composition of the atmosphere affects air quality and the response of the climate system to global change. The coupling between atmospheric chemistry and climate and in predicting future changes.

**William J. Jewell (BEE, Emeritus)**

Ecological engineering, biological and chemical mechanisms of pollution control and energy generation.

**Leonard W. Lion (CEE)**

Aquatic chemistry, biogeochemical fate of toxic pollutants, interfacial reactions of pollutants in aqueous systems.

**Philip L-F. Liu (CEE)**

Fluid mechanics, water wave dynamics, coastal oceanography and engineering, tsunami dynamics and numerical methods

**Daniel P. Loucks (CEE)**

Environmental and water resource systems planning and management modeling, and predicting the impacts of water management on ecosystems.

**Thomas D. O'Rourke (CEE)**

Geotechnical and geoenvironmental engineering, environmental site remediation, water supply performance during extreme events.

**Jean-Yves Parlange (BEE)**

Analysis of infiltration, surface runoff, denitrification and solute transport, groundwater movement, erosion and sediment transport, and watershed models.

**William D. Philpot (CEE)**

Remote sensing, digital image processing, radiative transfer.

**Ruth E. Richardson (CEE)**

Microbiology of water and soil systems, molecular techniques, fate and transport of contaminants.

**Norman R. Scott (BEE)**

Bioengineering, sustainable development, bio-fuels, renewable energy, recycling, energy conservation, and managed ecosystems.

**Christine A. Shoemaker (CEE)**

Modeling groundwater contamination and remediation, pesticide source reduction, optimization algorithms, supercomputing.

**Jery R. Stedinger (CEE)**

Stochastic hydrology, water resource systems operations and planning, risk analysis.

**Tammo S. Steenhuis (BEE)**

Management of soil and water resources, fate of agricultural toxics and nutrients.

**Michael B. Timmons (BEE)**

Aquaculture, water quality and management systems, biological filtration.

**Larry P. Walker (BEE)**

Processes for utilization of enzymes, microorganisms, and plants, enzymatic hydrolysis of polysaccharides, and high-solids aerobic decomposition (i.e., composting).

**Michael F. Walter (BEE)**

International development, sustainable development, ecological engineering and water management.

**M. Todd Walter (BEE)**

Ecohydrology, hydrological controls on environmental transport, and watershed modeling.

**Monroe L. Weber-Shirk (CEE)**

Sustainable drinking water treatment (global applications).

## WHAT TO EXPECT FROM YOUR FACULTY ADVISOR

Each Environmental Engineering student is assigned a faculty advisor. The primary role of the advisor is to guide you through your academic program and to assist with questions or problems you may have along the way. You will pre-register for each semester's classes in the middle of the previous semester using the Student Center (Just the Facts). You should plan on meeting with your faculty advisor early in the pre-enrollment process to discuss your progress and course selections. Advisors do not select your courses for you and you are responsible for meeting all graduation requirements. (The program does track your progress and alert you of your progress toward graduation in each semester of the junior and senior year.)

Your advisor will also enjoy getting to know you and will appreciate hearing about your successes in academics and in life. Your advisor will talk with you about career plans, provide letters of recommendation and assist you with applying to graduate or professional schools if this is what you want to do next. Faculty advisors help students applying for internships, study abroad, and provide advice as you look for summer jobs and undergraduate research. Therefore, you are encouraged to make opportunities to visit with your advisor at times other than during the scramble of pre-enrollment.

Everyone (especially students) at Cornell is busy juggling different responsibilities and activities. The following suggestions will allow you to maximize the help your advisor can offer with regard to your academics. If you follow them, you will get the most out of your relationship with your advisor.

- **Plan ahead!** Schedule routine appointments ahead of time.
- When you need to see your **Environmental Engineering advisor**, use E-mail to **schedule an appointment in advance** and indicate why you wish to meet. If your advisor is unavailable or **if you are experiencing an emergency**, in BEE contact Brenda Marchewka (255-2173; bls19) or Professor Walter (255-3161; mfw2) and in CEE contact Nadine Porter (255-3412, ndp5) or Professor Philpot (255-0801, wdp2) They will work with you and bring your advisor into the loop as quickly as possible.
- **Be prepared to think about the big picture.** Your future plans may change, but it helps both you and your advisor to see in the beginning where you think you are headed.
- **Always have a copy of your schedule** or a list of courses with you when you meet with your advisor to discuss pre-enroll.
- Make a **list of questions and concerns** that you want to discuss with your advisor before you meet so you remember everything that is important.
- **Share good news and personal accomplishments** with your advisor. This helps them get to know you and gives you another good reason to say hello.

If you have questions about your academic focus or decide to make some changes in the direction of your education, you may change faculty advisors (or majors) if your interests shift. To change advisors in BEE or CEE, contact Professor Walter or Professor Philpot to discuss your situation. Contact the Counseling and Advising Office in Roberts Hall at 255-2257 if you are seeking a new major in CALS. Contact the College of Engineering Advising Office in Olin Hall at 255-7414 if you are seeking to transfer to a different Engineering field. Environmental Engineering Advisors are knowledgeable about other majors in both colleges, and will talk with you even if you feel you might want to change majors. Our interest is in your education and what is best for you!

## STUDENT SUPPORT SERVICES

Having problems managing your workload or your time? Have you been sleeping more but still feel tired all the time? Having problems getting out of bed and getting motivated? Each year, many students in the College and the University find that they are having problems academically, socially, and/or personally. Deciding how you respond to these obstacles can profoundly affect your level of success at Cornell.

Cornell offers several resources to help students who are having problems academically:

### **Behrman Biology Advising Center**

8am-4:30pm Monday-Thursday, 8am-4pm Friday; 216 Stimson Hall  
Tel: 607.255.5233; Fax: 607.255.0669; Email: [bioadvising@cornell.edu](mailto:bioadvising@cornell.edu)  
[www.bio.cornell.edu/advising/](http://www.bio.cornell.edu/advising/)

### **Engineering Advising Office**

8am-4:30pm Monday-Friday; 167 Olin Hall  
Tel: 607.255.7414; Fax: 607.255.9297; Email: [adv\\_engineering@cornell.edu](mailto:adv_engineering@cornell.edu)  
<http://www.engineering.cornell.edu/student-services/academic-advising/index.cfm>

### **Learning Strategies Center**

8:30am-4:30pm Monday-Thursday, 8:30am-4pm Friday; 420 Computing and Communications Center (CCC)  
Tel: 607.255.6310; Email: [jcb13@cornell.edu](mailto:jcb13@cornell.edu)  
<http://www.clt.cornell.edu/campus/learn/learn.html>

### **Math Support Center**

Open during Academic Year – see web site for specific hours; 256 Malott Hall  
Tel: 607.255.4658; Email: [cmw18@cornell.edu](mailto:cmw18@cornell.edu)  
<http://www.math.cornell.edu/Courses/FSM/support.html>

### **Writing Workshop**

8:30am-5pm Monday-Friday – call for an appointment; 174 Rockefeller Hall  
Tel: 607.255.6349; Fax: 607.255.4010; Email: [thc33@cornell.edu](mailto:thc33@cornell.edu)  
[http://www.arts.cornell.edu/knight\\_institute/walkin/walkin.htm](http://www.arts.cornell.edu/knight_institute/walkin/walkin.htm)

### **Minority & Women's Programs in Engineering**

8am-4:30pm; 146 Olin Hall  
Tel: 607.255.6403; Fax: 607.255.2834; Email: [dpeng@cornell.edu](mailto:dpeng@cornell.edu)  
<http://www.engineering.cornell.edu/diversity/office-diversity-programs/index.cfm>

## MENTAL WELLNESS SUPPORT

Sometimes obstacles aren't rooted in study habits but in medical or psychological problems. These range from low iron or blood sugar to depression or anxiety. For many students this is the first time they are living away from home and are responsible for their own well-being. Although many people see you each day and may genuinely care about you, no one is making sure that you are eating well, getting regular exercise, and are healthy. Indeed, it is less likely that people will recognize if you're facing some minor or major emotional problem, especially if you are living off-campus. It is important that you care for yourself, and ask for help and direction from your Resident Advisor, faculty advisor, or other campus or community office/agency.

Cornell offers mental wellness support to students through the following services, among others:

**CAPS (Counseling and Psychological Services)** at Gannett: Cornell University Health Services; Tel: 607.255.5155; Email: [gannett@cornell.edu](mailto:gannett@cornell.edu)  
[www.gannett.cornell.edu/CAPS/default.html](http://www.gannett.cornell.edu/CAPS/default.html)

CAPS has noted a trend that engineering students tend to wait a long time before they seek assistance. This behavior results from the—usually mistaken—belief that the problem solving skills of engineers extend to emotional and psychological issues. Failure to seek help usually ends up putting the student in more academic and personal risk. If you are really stressed, tired all the time, having trouble getting yourself to class, not able to complete assignments on time, confused about life in general, sad, anxious, or just want someone to talk to so you can decompress, contact CAPS. Oftentimes just talking with a trained professional can help you feel better. Note: each student is limited to 12 individual counseling sessions per year, this is not long-term counseling.

**EARS (Empathy, Assistance, and Referral Service)**; Tel: 607.255.3277  
<http://www.gannett.cornell.edu/counseling-support/EARS.html>  
Free and confidential.

### General Medical Problems

Gannett Health Center; Tel: 607.255.5155; Email: [gannett@cornell.edu](mailto:gannett@cornell.edu)  
<http://www.gannett.cornell.edu>

If you've had a lingering health concern, please have it checked out. Even minor illnesses can detract from your overall enjoyment of 'the college experience'.

## PROFESSIONAL REGISTRATION

Engineers are licensed (after examination and if they also have suitable experience) to practice engineering in each state of the U.S. While not required for all Environmental Engineering jobs, registration is important for environmental engineers because they are responsible for public safety in much of their work. Most states and communities require that a registered engineer give final approval to all plans and specifications for engineering projects. Students can take the first step toward getting a Professional Engineering (PE) license while still a senior at Cornell. Students are eligible during their last term to take Part A of the nationwide examination, the "Fundamentals of Engineering (FE) Examination." Successful completion earns the title "Intern Engineer" (often also called "Engineer-in-Training"). Because Part A emphasizes fundamental knowledge gained in engineering distribution courses and core courses, there is a comparative advantage in taking this exam during your last term. **Please be sure to have BEE or CEE notified of your exam results so we receive the feedback we need to document the success of our graduates.** Success or failure in this examination has no bearing on your academic standing at Cornell.

The Part A exam is held at Cornell University in the Spring and at other locations in New York for the Fall exam. Application forms to apply for the Part A exam are available on-line at: [www.op.nysed.gov/peforms.htm](http://www.op.nysed.gov/peforms.htm) and in the Undergraduate Programs Office in 223 Carpenter Hall, or in the Undergraduate Program Office in 221 Hollister Hall. In 1999, the State of New York Education Department contracted with an independent examination vendor to administer the exam and handle related activities. Because of this you are required to first apply for licensure and then you will be sent information regarding testing including application deadlines. Historically application deadlines have been Nov. 1<sup>st</sup> for the April exam, and May 1<sup>st</sup> for the October exam. There is a \$70.00 licensing fee for Part A of the exam.

Part B of the examination may be taken after four years for engineering students who have suitable engineering experience after passing Part A. Successful completion of Part B will give you the title "Professional Engineer" in the state where you took the Part B exam. With some exceptions registration in other states may usually be obtained by reciprocity rather than taking another exam.

Details about the professional licensure application process is available on-line at <http://www.op.nysed.gov/pe.htm>

## GRADUATE EDUCATION

It's not too early to consider additional study beyond your bachelor's degree. For students who wish to continue their graduate program at Cornell, there are several options, as described below, leading to a Master of Engineering, and Master of Business Administration, and Master of Science or a Doctor of Philosophy.

### MASTER OF ENGINEERING

B.S. degree holders in engineering from Cornell who have a grade point average of 2.7 are generally eligible for admission to the three Master of Engineering programs outlined below. However, each application is evaluated individually, and BEE and CEE faculty reserve the right to make a final admission decisions. To apply visit: [www.gradschool.cornell.edu](http://www.gradschool.cornell.edu).

Cornell students who are between one and eight credits short of their engineering baccalaureate degree may initiate their Master of Engineering program as "Early Admit students." Early Admit students complete their Bachelors degree and spend at least one full time semester enrolled in the graduate school prior to the conferral of their Master of Engineering Degree. Early Admit students are classified as undergraduate students and pay undergraduate tuition during their Early Admit semester.

All MEng students must register for a minimum of one semester in the Graduate School. When enrolled in the graduate school, BEE Master of Engineering students advised by a member of the BEE graduate major, are charged statutory graduate tuition.

#### *1. MASTER OF ENGINEERING (BIOLOGICAL AND ENVIRONMENTAL ENGINEERING) PROGRAM*

The Master of Engineering (MEng) program is primarily intended for those who have a Bachelors degree or equivalent in an engineering or closely related science field from a college or university of recognized standing. Students in the MEng program must have a BEE advisor who is a member of the graduate faculty, and must satisfactorily complete a curriculum approved by that advisor which satisfies the degree requirements of the graduate major.

#### *2. MASTER OF ENGINEERING (CIVIL AND ENVIRONMENTAL ENGINEERING) PROGRAM*

A report prepared by a task force of the American Society for Engineering Education (ASEE) recommended that baccalaureate students who plan to pursue careers in engineering practice be encouraged to complete, on a full-time basis, an advanced degree program focused upon engineering practice. Our School has long believed that the four-year B.S. program is too limited to prepare young engineers for the rigors of engineering practice and to provide them with sufficient meaningful, significant, design experience. CEE's solution to this problem has been the fifth-year Master of Engineering Program in Civil and Environmental Engineering or Engineering Management. Professionally-oriented, the Master of Engineering (Civil) degree programs are particularly popular graduate degrees for CEE seniors and represents the fifth year of an integrated five-year Civil Engineering program leading to a Master of Engineering degree.

The Master of Engineering degree is a course work and project-oriented program. It is normally completed in two semesters of (civil) intensive study. Thirty credit hours consisting of course work in major and supporting areas and a project are required.

Master of Engineering students in Environmental Engineering may focus their studies in one of the following subject areas: environmental processes, environmental fluid mechanics and hydrology, and environmental and water resource systems engineering. For the M.Eng. program in Environmental Engineering, each program typically consists of course work in a subject area and supporting areas as well as a project.

### *3. MASTER OF ENGINEERING (ENGINEERING MANAGEMENT) PROGRAM*

The M.Eng. program in engineering management is aimed at engineers who want to stay in a technical environment, but focus on managerial roles. Students learn to identify problems, formulate and analyze models to understand these problems, and interpret the results of analyses for managerial action. Past projects in the management area have included the development of an integrated forecasting and production planning package for a large manufacturing organization, the design of a telecommunications tower, and the re-engineering of a service operation to increase the quality of the service and reduce costs.

A student's program of study is designed individually in consultation with an academic adviser and then submitted to the Chair of the Engineering Management Program for approval. Graduates of this program are in demand by environmental engineering consulting firms, management consultants, industrial companies, and other organizations that focus on the efficient management of projects and technical systems. The School of Civil and Environmental Engineering cooperates with the Johnson Graduate School of Management in a joint program leading to both master of engineering and master of business administration degrees.

### **COOPERATIVE PROGRAMS WITH THE JOHNSON GRADUATE SCHOOL OF MANAGEMENT**

There are several special programs that allow a student to earn a degree from the Engineering College and the Johnson Graduate School of Management in less time than if the degrees were pursued sequentially. Here we describe two programs that start with a Cornell Engineering B.S. degree, and one that considers a joint MEng. Degree from the Engineering College with an M.B.A. from the Johnson School.

#### *JOINT B.S./M.ENG. (ENVIRONMENTAL) /M.B.A. AND JOINT B.S./M.B.A.*

Two special programs make it possible for students to earn degrees from both a bachelors degree from the College of Engineering and an M.B.A. from Johnson Graduate School of Management. One program, completed in five years, leads to a B.S. degree in engineering and a Master of Business Administration (M.B.A.) degree. The other program, which takes six years, earns three degrees: the B.S. in engineering, the Master of Engineering (M.Eng.), and the M.B.A.

Both programs require taking a specific set of courses at the undergraduate level; these curricula allow for a shortening of the combined programs by one academic year. Information about the specific requirements for each area is available from the appropriate undergraduate major coordinator and graduate program coordinator. The curriculum must include nine core courses required for the M.B.A. or allowed substitutes. See the *Engineering Undergraduate Handbook*.

Students who decide to pursue either of these programs should take the GMAT exam, which is required by the Johnson School of Management, in March of their junior year (or earlier).

The joint B.S./M.Eng. (Environmental) /M.B.A. program is very attractive in that both Masters degrees are received within two years after the B.S. This program must be initiated in the junior year. This special program requires early planning so those electives taken during the junior and senior year can be used to meet requirements of the M.B.A. degree. By March 1 of the sixth term of enrollment, a student must apply for admission to the M.B.A. program through the Johnson Graduate School of Management. Application to the M.Eng. program should take place by February 1 in the student's senior year at Cornell. Students are encouraged to go to Engineering Advising and the Johnson School for more information.

#### *JOINT M.ENG./M.B.A. PROGRAM*

For those interested in both the M.Eng. and M.B.A. degrees, but who do not participate in the six-year joint program described above, an alternative opportunity is the five-semester joint program. Application to this program can begin as late as the first few weeks of enrollment in the M.Eng. program. The five-semester program is open to students with B.S. degrees from Cornell or elsewhere.

#### **MASTER OF SCIENCE AND PH.D. PROGRAMS**

Some students pursue a research-oriented Master of Science (M.S.) program either here or elsewhere. An increasing percentage of our students continue on to the Ph.D. for careers in research, teaching, or consulting. A Ph.D. degree can be pursued after earning a M.S. or an M.Eng. degree. Some students prefer to take a job immediately after receiving the B.S. and then return for graduate study a few years later. Ask your advisor, professors, or the BEE or CEE Director of Graduate Studies for information about graduate study.

## **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 implies that the work is the student's own. Outside assistance should be acknowledged, and the student's academic position truthfully reported. In addition, Cornell students have the right to expect academic integrity from each of their peers. It is plagiarism for anyone to represent another person's work as his or her 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 state clearly what is expected, and that students understand what authorship citations an instructor expects. To become better acquainted with academic integrity responsibilities, each student should read the Code of Academic Integrity. A copy may be obtained from the Engineering Advising Office, 167 Olin Hall, or from the Dean of the Faculty, 315 Day Hall. Also available on the web at: <http://cuinfo.cornell.edu/Academic/AIC.html>

## **FREEDOM FROM SEXUAL HARASSMENT**

The College feels it is essential for the well being of the University community that every individual be treated with respect. Sexual harassment and sexist comments are incompatible with this goal.

Unwelcome sexual advances, requests for sexual favors, or other verbal or physical contact or written communication of a sexual nature is sexual harassment when any of the following occurs:

1. Submission to such conduct is made either explicitly or implicitly a term or condition of employment or academic standing; or
2. Submission to or rejection of such conduct is used as the basis for employment or academic decisions affecting the individual; or
3. Such conduct has the purpose or effect of unreasonably interfering with an individual's work, academic performance, or participation in extracurricular activities; or creating an intimidating, hostile, or offensive working or learning environment.

Any student, staff employee, or faculty member who believes she/he has been victimized by sexual harassment is encouraged to promptly contact the Office of Workforce Diversity, Equity and Life Quality at (607) 255-3976, or the University Ombudsman at (607) 255-4321 in 118 Stimson Hall, 8:30am-4:30pm Monday-Friday or other times by appointment.

# **NOTES**

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