

UNDERGRADUATE MANUAL ENVIRONMENTAL ENGINEERING

*DEPARTMENT OF CIVIL, STRUCTURAL AND
ENVIRONMENTAL ENGINEERING*

School of Engineering and Applied Sciences



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1. INTRODUCTION

1.1 PURPOSE OF THIS MANUAL

This manual has been designed as a general reference for enrolled undergraduate environmental engineering majors. An online version can be read or downloaded [here](#). Users of this manual should check the web site periodically for published errata. Students intending to pursue the BS civil engineering degree should consult the *Civil Engineering Undergraduate Manual*.

The guidance presented in this manual is based on the policies and procedures of the University at Buffalo (UB), the School of Engineering and Applied Sciences (SEAS), and the Department of Civil, Structural and Environmental Engineering (CSEE) as of September 1, 2007. The University reserves the right to modify the procedure and requirements outlined in this manual. Such modifications generally will not be considered as retroactive.

You must follow the procedures in place when you entered the major. Official UB policies are found in the [Undergraduate Catalog](#). Additional information may be found at the website of the [Office of Undergraduate Education](#) in SEAS (410 Bonner Hall). UB rules and regulations regarding student rights and responsibilities may be found at the website of the [Office of Judicial Affairs & Student Affairs](#).

In accordance with federal and state laws, no person in whatever relationship with the University at Buffalo shall be subject to discrimination on the basis of age, religion or creed, color, disability, national origin, race, ethnicity, sex or sexual orientation, or marital or veteran status.

1.2 OVERVIEW OF ENVIRONMENTAL ENGINEERING

Environmental engineers work at the interface of society and the environment, striving to protect both human and ecosystem health. Among the top priorities of the profession are energy and carbon management, the delivery of safe water to drink and clean air to breathe, and the restoration of water quality in the Great Lakes, the Hudson River and water bodies throughout the nation. Today, environmental engineers face issues that include the detection and treatment of new pollutants and pathogens, threats of terrorism to our nation's water supplies, global climate change, and the global cycling of pollutants. Because they often work in the public arena, environmental engineers require broad technical training and strong communication skills, and they usually must be licensed as professional engineers.

Graduates of the program are prepared for employment opportunities in 1) the development, design, and management of innovative and conventional treatment processes for water, wastewater, and hazardous wastes, and 2) modeling the fate and transport of contaminants and assessing their impact on environmental quality. Graduates of UB's undergraduate and graduate environmental and civil engineering programs have found employment:

- In *private practice* (consulting or industry), participating in the research, planning, design, construction and/or maintenance of public and commercial environmental facilities and projects such as environmental cleanups.
- In *public practice* (city, county, state, or federal agencies), participating in city/regional planning, the design and construction of public environmental facilities such as water/wastewater

treatment plants, and/or in developing and implementing environmental programs and regulations.

- At *colleges and universities*, training future engineers and conducting research to develop new and improved technologies.
- In *multidisciplinary settings*, combining environmental and civil engineering training with geology, economics, law, software engineering, architecture, and/or information technology.

Typical annual starting salaries for environmental engineers with a B.S. degree are in the \$45,000 to \$55,000 range. Factors influencing salary include, experience, specialization, computer skills and grade point average.

1.3 ENVIRONMENTAL ENGINEERING AT UB

THE DEPARTMENT

The Department of Civil, Structural and Environmental Engineering offers the only degree in environmental engineering within the State University of New York system. With 25 full-time faculty members, the Department has yearly research expenditures in the range of \$10 to \$15 million, and is the home of three major research centers. The integration of research with undergraduate teaching provides students with unique opportunities for state-of-the-science training.

The goals of the Department are expressed in its *Vision* and *Mission* statements:

VISION STATEMENT

Our vision is to be recognized as a prominent department in civil engineering in the United States and a premier department in civil engineering among public universities in the northeastern United States. Our vision is guided by principles of stability and flexibility. We will maintain our strength in the traditional areas of civil engineering, but we will be flexible and we will face the new challenges in our professional environment. We foresee the need for a continual reassessment and change of our teaching and research focus as we respond to the following trends: (a) advancements in technology, (b) multidisciplinary approach, (c) responsibility to society, and (d) accountability and efficiency.

MISSION STATEMENT

Civil, structural and environmental engineers contribute to the health, safety, and quality of life of society through the design, construction, and operation of public and private infrastructure. The mission of the Department of Civil, Structural and Environmental Engineering is to:

- *Educate students in fundamental concepts, critical thinking, technical skills and ethical principles as applied to engineering analysis and design,*
- *Serve the engineering profession and society through scholarship and innovative research, and*
- *Provide the local, national, and international communities with continuing educational opportunities, technical assistance, and intellectual resources.*

THE CURRICULUM

UB's environmental engineering program provides you with an integrated education in mathematics, basic sciences, English composition, ethics, humanities, fundamentals of environmental engineering, engineering design, and computer applications. A solid foundation is provided in the basics of environmental engineering with an emphasis on aqueous and soil systems. In-depth specialization is provided

through a choice of senior-year electives. While pursuing your BS degree, you also can gain valuable industrial experience through co-op and internship programs.

UB graduates with a BS degree in environmental engineering find employment with private consulting firms, industry, and government agencies. Many return immediately or within a few years to graduate school for advanced studies leading to a Master of Engineering (ME), Master of Science (MS) or Doctor of Philosophy (PhD) degree. Graduates of the program have the skills and most of the prerequisites to pursue further education in law, medicine, management, or other professional fields.

THE FACULTY

Instruction in the Department of Civil, Structural and Environmental Engineering is provided by 25 distinguished full-time faculty and approximately 10 adjunct faculty. All full-time faculty hold doctoral degrees, and many have earned national awards, including (among the current faculty): the *SUNY Chancellor's Awards for Excellence in Teaching* (3 recipients), the *National Science Foundation Presidential Young Investigator Award/Career Award* (4 recipients), the *Office of Naval Research Young Investigator Award*, the *SUNY Chancellor's Award for Excellence in Scholarship and Creative Activity*, the *SUNY Distinguished Professor* (2 at this rank), and the *New York State Society of Professional Engineers Engineering Educator of the Year Award*.

THE RESEARCH INFRASTRUCTURE

The Department of Civil, Structural and Environmental Engineering has active research programs in the areas of structural and earthquake engineering, environmental engineering, computational mechanics, and geotechnical engineering. These research programs include several nationally recognized multidisciplinary centers:

- **[The Great Lakes Program](#)** was established in 1985 to support efforts designed to protect and preserve the Great Lakes Ecosystem. This ecologically and economically important ecosystem is home to more than 40 million people in the United States and Canada. The mission of the Great Lakes Program is to coordinate the development, evaluation, and synthesis of scientific and technical knowledge on the Great Lakes Ecosystem in support of public education and policy formation.
- **[The Center for Integrated Waste Management](#)** (CIWM) was established at the University at Buffalo by New York State in 1987 to initiate and coordinate research and development in the area of toxic substances and hazardous wastes. The Center currently promotes the development and application of improved environmental technologies and management methods for 1) more effectively remediating past environmental contamination and promoting redevelopment of formerly contaminated properties, and 2) preventing, reducing, reusing, and recycling industrial and municipal waste streams. The Center provides assistance to communities, industries, businesses, public agencies, and non-profit organizations.
- **[MCEER](#)** is a national center of excellence dedicated to the discovery and development of new knowledge, tools and technologies that equip communities to become more disaster resilient in the face of earthquakes and other extreme events. MCEER accomplishes this through a system of multidisciplinary, multi-hazard research, education and outreach initiatives. Established in 1986 by the National Science Foundation (NSF), it was the country's first national center for earthquake engineering research.

In addition to the above Department-based Centers, environmental engineering students and faculty participate in the activities of several other UB research centers, including the *Center for Computational*

Research, the National Center for Geographic Information and Analysis, New York Sea Grant, and the Environment and Society Institute.

STUDENT ORGANIZATIONS

Environmental engineering students are afforded the opportunity to participate in many nationally-recognized professional organizations, including:

- Air and Waste Management Association (AWMA)
- American Society of Civil Engineers (ASCE)
- Associated General Contractors of America (AGC)
- Chi Epsilon, Civil Engineering Honor Society
- Engineers for a Sustainable World (ESW)
- National Society of Professional Engineers (NSPE)
- National Society of Black Engineers (NSBE)
- New York Water Environment Association (NYWEA)
- Society of Women Engineers (SWE)
- Society of Hispanic Professional Engineers (SHPE)
- Tau Beta Pi, Engineering Honor Society

Environmental engineering majors also participate in the UB Environment Engineering and Science Club (UBEESC).

PROFESSIONAL REGISTRATION

The UB environmental engineering program is designed to support eventual licensure as a Professional Engineer (PE). It is strongly recommended that all students consider professional registration as part of their career path.

Obtaining registration as a PE is a multi-step process that normally includes graduation with a BS degree from an ABET-accredited program. If you are within 20 credits of graduation, then you are eligible to take the Fundamentals of Engineering (FE) exam. Students graduating in May generally take the FE exam in April.

After graduation, the new engineer must accumulate a specified period of experience (usually 4 years) working under the supervision of a licensed PE. The final requirement for registration is the successful completion of the PE exam, which is administered on a state-by-state basis. In most states, completion of a Master's degree will reduce the required experience (e.g., from 4 to 3 years). More information about professional licensure is available from the [American Academy of Environmental Engineers](#), the [National Council of Engineering Examiners](#), and the [New York State Department of Education](#).

Although the FE exam can be taken at any point prior to applying for the PE license, most full-time UB engineering students take the exam in April of their senior year. (The test is also offered in October.) The registration deadlines for the April and October exams are normally in the preceding November and May, respectively. Exam dates for the next ten years may be found [here](#). April exams are typically offered in Rochester NY, while the October exams are given in Buffalo.

To assist with preparation for the FE exam, an evening review class is offered each year at UB by the Engineering Society of Buffalo. The course typically involves a weekly 3-hour review session for 23 weeks. Full-time UB students normally receive a 50 percent discount on the standard course fee.

For more information about the FE exam, contact the Director of Undergraduate Studies or visit the [in-formation page](#) maintained by the SEAS Office of Undergraduate Education.

2.1 PROGRESS TOWARDS GRADUATION

2.1 ADVISEMENT

You have a variety of resources for academic advisement. As you progress through the academic program, each member of your advisement team will play a different role, depending on your status and needs. Key advisement personnel are reviewed below and summarized in Table 1.

KEY ADVISEMENT PERSONNEL (SEE APPENDIX B FOR CONTACT INFORMATION)

Freshman Mentor

Engineering students entering UB as freshman are assigned a faculty mentor whose responsibility is to meet with the student on a voluntary basis during the freshman year. The primary role of the mentor is to provide general guidance and encouragement during the transition to college-level study, as well as information on engineering careers. In general, the mentor is not expected to provide specific advice regarding degree requirements. These functions are performed by other members of the advisement team. In the Department of Civil, Structural and Environmental Engineering, your freshman mentor normally continues as your faculty advisor.

Student Excellence Program Staff

The SEAS Office of Undergraduate Education operates a program called the Student Excellence Initiative. It is designed to assist students in developing good study habits and making an effective transition to engineering study at the University level. A number of voluntary programs are available, including group study session and tutoring in science, math, and basic engineering courses. Details are available [here](#).

Departmental Faculty Advisor

When you enrolled as an environmental engineering major, you were assigned an academic advisor who is a full-time member of the CSEE faculty (hereafter, your faculty advisor). A current list of faculty advisors is posted on the Departmental [website](#). If your name is not on the list, please contact the Undergraduate Studies Secretary to request the assignment of a faculty advisor. You may request a change in your assigned Departmental advisor at any time by contacting the Undergraduate Studies Secretary.

The role of the faculty advisor is to provide general guidance regarding the environmental engineering curriculum and career paths. Specific questions regarding nonstandard issues such as transfer credits, general education, and course substitutions will normally be directed to other appropriate members of the advisement team (see Table 1). Juniors and seniors are required to meet with their faculty advisor once each semester during the registration period. This is accomplished through forced-registration in CIE 340 and CIE 415.

Director of Undergraduate Studies

The CSEE Director of Undergraduate Studies is a faculty member who performs a variety of functions, including, but not limited to approval of upper level course transfers or substitutions, assistance to students with academic or registration problems, advisement of students in combined degree programs, and coordination of ABET accreditation activities. The Director of Undergraduate Studies also approves waivers for MAE 177. Students may request a meeting with the Director of Undergraduate Studies at any time.

Undergraduate Studies Secretary

The Undergraduate Studies secretary assists students with a variety of issues, including advisor assignments, forms, and forced registration.

SEAS Office of Undergraduate Education academic advisors

An academic advisor from the SEAS Office of Undergraduate Education (hereafter, an engineering advisor) is often the first student contact, usually as part of the orientation process. Meetings with an engineering advisor are generally recommended on a semester basis for the first two years and on an as-needed basis thereafter, usually upon student request.

In addition to providing general academic advice, the engineering advisors make decisions regarding transfer credit for basic math, science, and general engineering (EAS) courses, provide information on General Education requirements, and provide a final review to ensure that the student has met all degree requirements at the time of graduation. As you progress through your program of study, individual advisement is increasingly provided by the environmental engineering faculty advisor.

Table 1. Advisement Guide (see Appendix B for contact information)

If You Need Help With:	Contact
Elective choices, career opportunities	Faculty advisor
General education, transfer credits, DARS errors, degree audit	Engineering advisor
Academic integrity issues	Course instructor, Department Chair
Advisor list , forms, flowsheets, forced registration	Undergraduate Studies Secretary
MAE 177 exceptions, any other issues	Director of Undergraduate Studies

ADVISEMENT DOCUMENTS AND RESOURCES

Flowsheet

The Department maintains a flowsheet for tracking progress toward degree requirements for each student (see Appendix 1). (Official flowsheets are maintained by the SEAS Office of Undergraduate Education.) The flowsheet is updated on a semester basis and is referenced extensively by both the faculty and engineering advisors. A copy of your flowsheet may be obtained from the Undergraduate Studies Secretary.

DARS Reports

The Degree Audit Reporting System (DARS) Report is another guidance document to assist you on your path to graduation. Although unofficial, it provides useful information about unfulfilled graduation requirements. Students are encouraged to use DARS only for preliminary screening; any discrepancies should be brought to the attention of the Director of Undergraduate Studies and/or engineering advisor.

TAURUS

In general, acceptance of transfer credits is determined by the SEAS Office of Undergraduate Education in consultation with the Director of Undergraduate Studies. However, for colleges and universities within the SUNY system and other selected institutions, a large number of courses have been prescreened to establish articulation (equivalence) with UB courses. A searchable version of the articulation database (called [TAURUS](#)) is available.

KEY ADVISEMENT EVENTS

Initial advisement: freshman and new transfers

During the initial SEAS orientation, your educational background and prospective major were reviewed by an engineering advisor, and your registration into the appropriate classes for the first semester was processed. Where applicable, transfer and high school Advanced Placement (AP) credits were reviewed and recorded on your flowsheet. (Transfer students and freshmen requesting AP credit should forward their final transcript to the UB Admissions Office well in advance of the initial orientation.)

Meeting with mentor: freshmen and sophomores

During the orientation period (usually the day before classes start in the fall), freshmen are provided with an opportunity to meet with their freshman mentor. During the semester, meetings may be initiated by the student or the mentor. Faculty mentors are encouraged to ensure that at least three meetings take place during the fall semester. The frequency of subsequent meetings depends primarily on the student's interest and availability.

Meeting with CSEE faculty advisor: all students

You should meet with your faculty advisor at least once each semester prior to the start of registration for the following semester. In conjunction with the advisement meeting, juniors and seniors must complete an *Advisement Form* with the help of their faculty advisor, and submit a signed copy of the completed form to the Undergraduate Studies Secretary.

The purpose of the advisement meetings is to help you choose the best available courses in proper sequence, and to facilitate completion of the degree program within the desired length of time and with your best performance. Without proper advisement, you can make mistakes in selecting courses that can delay graduation. Consultation with faculty advisors can help minimize the possibility of such errors. **Nevertheless, it is ultimately your responsibility to see that all degree requirements are met in time to enable graduation at the desired date.**

You may request a meeting with your CSEE faculty advisor at any time to obtain general academic and professional advice.

Degree audit: optional for seniors

After you have filed the required UB *Application for Degree* form (see Section 2.3), formal review of the academic records is performed by the SEAS Office of Undergraduate Education to verify that all graduation requirements have been met. At any point in time (typically during the semester preceding the anticipated final semester), you may request an informal degree audit from the Office of Undergraduate Education staff to verify that graduation requirements are being addressed in a timely fashion. This action is recommended for transfer students and/or students who have multiple approved course substitutions. An informal degree audit is probably not necessary if you entered UB as a freshman, have followed the recommended curriculum consistent with this manual, and have met regularly with your faculty advisor.

General advisement meetings

At regular intervals, general advisement meetings will be held to address special topics (e.g., combined-degree programs, work experience courses, professional registration, etc.). These meetings will be publicized via class announcements, flyers, and e-mail listservs.

2.2 CAREER DEVELOPMENT CURRICULUM

To assist you with your progress towards a job or graduate school after graduation, the SEAS faculty has created a career development curriculum. The curriculum comprises a series of milestones for each semester and summer during your academic career. The career development curriculum may be found [here](#). The key part of the career development curriculum is the [career development curriculum chart](#). Each semester, a faculty member or representative from Career Services will remind you of the milestones for that semester.

2.3 REGISTRATION

You can register for courses through [MyUB](#) (a web-based personal portal to online UB resources) during the appropriate periods indicated in the UB registration schedule. Several of the junior and senior courses require forced registration (see Section 2.1). To complete the registration process in junior/senior semesters, you should: 1) download the advisement form, 2) schedule an appointment with your faculty advisor to discuss course selection and obtain the necessary signature (list of advisors is [here](#)), 3) register for all non-force courses through MyUB, 4) submit a copy of a signed advisement form to the Undergraduate Studies Secretary (see contact list in Appendix B), and 5) check MyUB periodically to verify that preregistration, including the required forced registration, has been completed. **It is your responsibility to ensure that all course registration activities are completed in a timely fashion.** If you experience difficulty with any aspect of the registration process, contact the Director of Undergraduate Studies.

It should be noted that **pre- and co-requisite requirements, especially in the Department and SEAS, are strictly enforced.** Consult the University Catalog for pre- and co-requisite requirements.

Under some circumstances, juniors and seniors may select a graduate course as a Technical Elective. Good academic standing and permissions from the instructor and the Director of Undergraduate Studies are required. Forced registration will be accomplished by the Undergraduate Studies Secretary upon submittal of the advisement form with signatures from the instructor and Department Chair.

2.4 GRADUATION

The Bachelor of Science degree in environmental engineering is awarded upon successful completion of the required courses (summarized in Section 3) with grade-point averages (GPAs) of 2.0 or higher in two categories: *overall* (all UB courses) and *engineering* (EAS, CIE, and other courses offered in SEAS).

Application for Degree

To be considered for graduation (degree conferral), you must file an *Application for Degree Card* with the Student Response Center prior to deadlines published in the Undergraduate Catalog (February 1 for June 1 graduation, July 1 for September 1 graduation, and October 1 for February 1 graduation). **It is your responsibility to ensure compliance with this requirement, which is strictly enforced.**

2.5 ACADEMIC GOOD STANDING

You will be placed on UB Engineering academic probation if your cumulative technical GPA or cumulative engineering GPA is less than 2.0, *or* if your most recent semester technical GPA or engineering GPA is less than 2.0. (The technical GPA includes all science, math, and engineering courses.) Further details can be found [here](#).

3. CURRICULUM

3.1 OVERVIEW

The current environmental engineering curriculum is summarized in Table 2. (Students who entered as freshman prior to Fall 2000 or transferred prior to Fall 2002, may have slightly different requirements and should consult the Director of Undergraduate Studies.)

During the first two years of study, the environmental engineering curriculum provides for the development of knowledge and skills in the sciences, mathematics, basic engineering, and English composition and reading. In the junior year, this development is supplemented and followed by courses in environmental engineering, biology, geology, laboratory methods, and environmental engineering. During the senior year, students complete a sequence of “capstone” project-oriented courses and may select four technical electives from engineering and/or a wide range of supporting programs.

Students may also pursue “customized” double majors and minors, subject to the guidelines given in the UB Undergraduate Catalog (for more details, contact the Director of Undergraduate Studies).

3.2 GENERAL EDUCATION

All UB students must take a specified number of General Education courses. Several sets of requirements are potentially applicable depending on when (i.e., what year) and how (i.e., transfer or freshman) you entered UB. These requirements are summarized [here](#).

3.3 TECHNICAL ELECTIVES

Nine credits of upper-division Technical Electives (usually three courses) are required for the BS environmental engineering program. Any combination of approved Technical Electives (see Table 2) may be selected, subject to the following constraints:

- Only three credits of the work-experience courses (CIE 404, CIE 406-408, EAS 396, and EAS 495) may be counted as a Technical Elective.
- In some cases, graduate courses or senior-level courses from outside of environmental engineering may be taken as Technical Electives with *prior written approval* from the Director of Undergraduate Studies.
- Students are strongly encouraged to enhance their skills in computer analysis by taking EAS 230 (Higher Level Language), particularly if considering further study at the graduate level.

TABLE 2. BS ENVIRONMENTAL ENGINEERING CURRICULUM

FIRST YEAR			
FALL		SPRING	
MTH 141 Calculus I	4	MTH 142 Calculus II	4
CHE 107 Chemistry I	4	PHY 107 Physics I	4
EAS 140 Engineering Solutions	3	CHE 108 Chemistry II	4
General Education	3	MAE 177 Intro. Eng. Dwg./CAD	2
ENG 101 Writing 1 or ENG 102 Writing 2 ¹	3	ENG 201 Reading and Adv. Writing or General Ed. ¹	3
Library Skills Workbook			
TOTAL:	17	TOTAL:	17

SECOND YEAR			
FALL		SPRING	
MTH 241 Calculus III	4	MTH 306 Differential Equations	4
CIE 303 Geodesy, GPS, GIS	3	MIC 301 Fundamentals of Microbiology	4
EAS 207 Statics	3	EAS 209 Mechanics of Solids	3
CHE 203 Organic Chemistry I	3	CIE 340 Environmental Engineering	3
General Education	3	General Education	3
TOTAL:	16	TOTAL:	17

THIRD YEAR			
FALL		SPRING	
CIE 441 Ecological Engineering	3	CIE 442 Treatment Process Engineering	3
CIE 354 Fluid Mechanics	3	CIE 334 Mechanics of Soils	3
GLY 414 Hydrogeology	3	CIE 343 Hydraulic Engineering	3
BIO 309 Ecology (also offered as GLY 309)	3	CIE 415 Professional Practice Issues	3
CIE 308 Engineering Statistics	3	CIE 362 Civil Engineering Laboratory II	2
CIE 360 Environmental Engineering Lab.	2	General Education	3
TOTAL:	17	TOTAL:	17

FOURTH YEAR			
FALL		SPRING	
CIE 444 Hydrologic Engineering	3	CIE 445 Groundwater Engineering	3
CIE 447 Environmental Eng Practicum	3	CIE 449 Environmental Engineering Design	3
CIE 448 Chemical Principles in Env. Eng.	3	Technical Elective ²	3
CIE 469 Hazardous Waste Management	3	Technical Elective ²	3
Technical Elective ²	3	General Education	3
TOTAL:	15	TOTAL:	15

SUMMARY:

Required Civil Engineering Courses	= 49 credit hours
Required Science and Math Courses	= 41 credit hours
Required Engineering Science Courses	= 11 credit hours
Technical Electives	= 9 credit hours
General Education Courses ¹	= 18-21 credit hours
TOTAL	= 128-131 credit hours

NOTES:

1. Includes 3-6 credit hours of Writing Skill Requirement: ENG101 and ENG201 (or ENG102, contingent upon SAT or ACT score)
2. See Table 3

TABLE 3. APPROVED TECHNICAL ELECTIVES
(students may petition for other courses to be recognized as TEs)

Engineering		Natural Science	
<i>Civil, Structural and Environmental Eng.</i>		<i>Biology</i>	
CIE 404	Civil Engineering Internship ¹	BIO 200	Evolutionary Biology
CIE 406-408	Civil Engineering Co-op ¹	BIO 201	Cell Biology
CIE 458	Geoenvironmental Engineering	BIO 452	Limnology
CIE 461	Air Pollution		
CIE 493	Project Management		
	<i>Chemical Engineering</i>		<i>Chemistry</i>
CE 304	Chem. Eng. Thermodynamics	CHE 204	Organic Chemistry II
CE 318	Transport Processes II	CHE 214	Intro. to Analytical Chemistry
CE 429	Chem. Eng. Reaction Kinetics	CHE 215	Intro. to Analytical Chem. Lab.
		CHE 334	Phys. Chem. for Chem. Eng.
		CHE 413	Instrumental Analysis
		CHE 470	Analytical Chem. of Pollutants
	<i>Electrical Engineering</i>		<i>Geology</i>
EE 200	EE Concepts/Nonmajors	GLY 419	Environmental Geophysics
	<i>Industrial Engineering</i>		
IE 320	Engineering Economy		
	<i>Mechanical Engineering</i>		
MAE 204	Thermodynamics		
	<i>Engineering and Applied Science</i>		
EAS 230	Higher Level Language		
EAS 396	Engineering Career Institute ¹		
EAS 480	Technical Communications		
EAS 496	Engineering Co-op ¹		
Humanities/Social Science			
<i>Interdisciplinary Social Science</i>		<i>Economics</i>	
SSC 315	Field Ecology	ECO 405	Microeconomic Theory
SSC 317	Environmental Politics	ECO 407	Macroeconomic Theory
SSC 326	Great Lakes Ecology	ECO 412	Environmental Economics
SSC 360	Environmental Impact Statement		
SSC 385	Energy, Environment, Society		<i>Geography</i>
		GEO 481	Geographic Information Systems
		GEO 484	GIS Applications
		GEO 486	Spatial Decision Support

NOTES:

1. Only three credits of Technical Elective may be satisfied by work-experience courses (CIE 404, EAS 396, EAS 496, or CIE406-408).

4. SPECIAL PROGRAMS

4.1 OVERVIEW

Students pursuing the BS degree in environmental engineering have a number of opportunities to enhance their academic program of study through study abroad, work experiences, and combined degrees. Interested students should contact the Director of Undergraduate Studies to discuss current opportunities.

4.2 STUDY ABROAD

Study abroad programs are available to all UB students interested in enhancing their undergraduate or graduate degree, regardless of academic field. For details, visit the UB Study abroad [webpage](#). UB is also a participant in the [Global Engineering Education Exchange](#) (Global E³). Recently, civil and environmental engineering students have participated in study-abroad programs at the University of Troyes (France), University of Limerick (Ireland), and Beijing Polytechnic University (China).

4.3 WORK EXPERIENCE

Recent surveys of employers of UB environmental engineering graduates have indicated that prior work experience is an important factor in hiring and promotion. There are two primary means of obtaining external work experience while pursuing the BS environmental engineering degree:

1. The Engineering Career Institute (ECI), a work experience program administered by the School of Engineering and Applied Science, is offered every summer to students who have completed their junior-year coursework. Students participating in ECI register for EAS 396 in the spring of their junior year and receive one academic credit. Then they register for EAS 495 over the summer and receive two additional academic credits while performing paid full-time summer work for an approved environmental engineering employer. For details, see the [ECI webpage](#).
2. The civil engineering internship (CIE 408) provides 3 credits of academic coursework that can be counted as a Technical Elective. Students typically work for an approved environmental engineering employer on a part-time basis (paid or unpaid) during a senior-year academic semester, and must submit a written report and oral presentation at the end of the internship summarizing their experience. For details, contact the Director of Undergraduate Studies.

In meeting the environmental engineering degree requirements, only three credits of work experience coursework may be counted as a Technical Elective.

5. ASSESSMENT AND EVALUATION – A PEEK UNDER THE HOOD

5.1 OVERVIEW

To many students, the curriculum they follow to get their degree reads like a magical list of courses that someone long ago thought was the path towards graduation. Engineers are different. We follow a very formal procedure for getting you from where you are to the end of your career. *You are a big part of the process.*

The process is described below in detail. Briefly, we start with defining the people important to the program (*constituents* – this includes you). We ask the constituents (including you through the Senior Exit Survey starting in 2009) for help in identifying the appropriate career achievements for an environmental engineer (*program educational objectives*). Periodically, we ask alumni and employers if our graduates have met these achievements. We created a list of skills and knowledge that you need at the end of your senior year in order to achieve the career objectives. Items on this list are called the *program outcomes*. The curriculum is designed to help you achieve the program outcomes. We check your work throughout your time here and ask for your opinion to determine whether you have achieved the program outcomes. In the vernacular of higher education, the program is *outcomes based* (based on what you know and can do, not based on what is covered in class) and devoted to *continuous improvement*.

5.2 ACCREDITATION

UB's environmental engineering program is accredited by [ABET, Inc.](#) With an ABET-accredited BS degree, graduates eventually may apply for registration as a Professional Engineer (PE) (see Section 1.3). ABET conducts reviews of undergraduate programs for accreditation at 6-year intervals. The most recent review of the environmental engineering program took place in December, 2002. Our next review is scheduled for October, 2008.

The Department of Civil, Structural and Environmental Engineering has developed a program of self-evaluation and continuous improvement designed to sustain an environmental engineering education of increasing high quality and meet the accreditation requirements of ABET. Details regarding the current status of ABET-accreditation activities are available from the Department web site. Key components of this program include:

- Definition of the *constituents* served by the environmental engineering program
- Establishment of *program educational objectives* with our constituents
- Establishment of *program outcomes*, in conjunction with ABET and ASCE
- An ongoing program of *assessment* that measures the degree to which the program educational objectives and program outcomes are being met
- An ongoing program of *evaluation* to improve the environmental engineering program in response to feedback from the assessment process

5.3 CONSTITUENTS

The constituencies of the environmental engineering program include:

- Current students in the environmental engineering program and their families
- Department faculty
- Other faculty in the School of Engineering and Applied Sciences
- Other faculty of the University at Buffalo
- Employers who participate in the Engineering Career Institute and the environmental engineering internship and co-op programs
- Graduate and professional schools
- Employers of environmental engineering graduates, including engineering consulting firms, government agencies, manufacturing and construction companies, and educational and research institutions
- Program alumni

5.4 PROGRAM EDUCATIONAL OBJECTIVES

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing you to achieve. Consistent with the mission and vision of the Department, the program educational objectives of the environmental engineering program are to:

- Be employed and promoted as environmental engineers in consulting, industry, government, and academia or employed and promoted in related professions.
- Maintain state-of-the-art knowledge through lifelong learning, such as graduate study and continuing education.
- Respond to the changing impact of environmental engineering solutions in a global and social context.
- Advance and support the engineering profession through participation in professional societies, civic groups, and educational institutions.

5.5 PROGRAM OUTCOMES

Consistent with the program educational objectives outlined above, graduates of the environmental engineering program should be able to:

- solve problems in mathematics through differential equations, calculus-based physics, chemistry, and one additional area of science
- design an environmental engineering experiment to meet a need; conduct the experiment, and analyze and interpret the resulting data

- design a complex system or process to meet desired needs, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- function effectively as a member of a multi-disciplinary team
- solve well-defined engineering problems in technical areas appropriate to environmental engineering
- analyze a complex situation involving multiple conflicting professional and ethical interests, to determine an appropriate course of action
- organize and deliver effective verbal, written, and graphical communications
- determine the global, economic, environmental, and societal impacts of a specific, relatively constrained engineering solution
- demonstrate the ability to learn on their own, without the aid of formal instruction
- incorporate specific contemporary issues into the identification, formulation, and solution of a specific engineering problem
- apply relevant techniques, skills, and modern engineering tools to solve a simple problem

A more detailed list of program outcomes may be found in Appendix C. In each course syllabus, you will see how the course relates to the outcomes in Appendix C. For example, a course linked to “3a(K)” will help you “solve problems in mathematics through differential equations, calculus-based physics, chemistry, and one additional area of science.”

5.6 ASSESSMENT

Formal assessment activities were initiated in 1999 with the first exit survey of environmental engineering seniors. End-of-semester surveys and the senior exit survey are a component of the Department’s self-assessment. Since the 2002 ABET visit, assessment efforts have been expanded to include examination of student work to determine if program outcomes are being achieved. This effort includes a comprehensive examination of student work, student experiences in co-ops, and performance data from the Fundamentals of Engineering exam.

Program educational objectives were developed with the assistance of a target group of employers and other constituents. Program educational objectives are assessed through employer and alumni surveys

5.7 EVALUATION AND CONTINUOUS IMPROVEMENT

In response to the feedback received from the assessment program, the Department is engaged in an ongoing program of self-improvement. Recent examples of these activities include:

- Revisions to the program Educational Objectives assessment process
- Revisions to the program Outcomes based on the ASCE Body of Knowledge
- Execution of a pilot study to design the program outcome assessment and evaluation process
- Addition of primary data sources to the assessment process for program outcomes
- Inclusion of professional development milestones
- Cumulative design experience revisions
- Increase in the credit hours of the laboratory courses
- Prerequisite enforcement
- Standardization of course syllabi
- Student computing laboratory rehabilitation
- Undergraduate Studies secretary hired
- Redistribution of assessment/evaluation responsibilities
- Career Services specialist in engineering

APPENDIX B. IMPORTANT CONTACTS

People

Name	Extension	Room	Email Address	Function
DEPARTMENT OF CIVIL, STRUCTURAL AND ENVIRONMENTAL ENGINEERING (all phone numbers: 716-645-2114)				
A. Scott Weber	x2446	212 Ketter	chaircie@buffalo.edu	Department Chair
James N. Jensen	x2329	207 Jarvis	jjensen@eng.buffalo.edu	Director of Undergraduate Studies
Cherrie Robbins	x2332	207 Jarvis	robbins4@eng.buffalo.edu	Undergraduate Secretary
SCHOOL OF ENGINEERING AND APPLIED SCIENCES (all phone numbers: 716-645-2774)				
Name	Extension	Room	Email Address	Function
John Van Benschoten	x1130	410 Bonner	jev@eng.buffalo.edu	Associate Dean for Undergraduate Education
Kerry Collins-Gross	x1119	410 Bonner	collinsk@buffalo.edu	Senior Academic Advisor: Environmental
Jane Sinclair	x1117	410 Bonner	jsinclai@eng.buffalo.edu	Transfer Specialist
Bill Wild	x1214	301 Bonner	wgwild@eng.buffalo.edu	Director of Special Student Programs

Web Sites

Site	Address	Function
Department of Civil Structural and Environmental Engineering (CSEE)	http://www.csee.buffalo.edu	Departmental information
School of Engineering and Applied Science (SEAS)	http://www.eng.buffalo.edu	School information
University at Buffalo (UB)	http://www.buffalo.edu	Access to University information
MyUB	http://myub.buffalo.edu	Student access to grades, class schedules, and other general information
SEAS Office of Undergraduate Education	http://www.eng.buffalo.edu/currentundergraduate.php	Detailed information and services for engineering students
Student Response Center	http://www.src.buffalo.edu	Student access to registration, DARS, course offerings, calendars, financial aid, billing, etc.
Office of Student Affairs	http://www.student-affairs.buffalo.edu	Services and programs to support the social, interpersonal, and emotional growth of UB students.
Transfer and Articulation Services	http://taurus.buffalo.edu	Information about course transfers
Career Services	http://www.ub-careers.buffalo.edu	Information on careers, summer jobs, and the GRE
Engineering Career Institute	http://www.eng.buffalo.edu/Outreach/new_work02.html	Information on co-ops, internships

APPENDIX C. PROGRAM OUTCOMES AND PERFORMANCE CRITERIA

For assessment purposes, the program outcomes have been divided into performance criteria as follows:

Outcome	Description	Performance Criteria				
		Knowledge	Comprehension	Application	Analysis	Synthesis
3(a)	solve problems in mathematics through differential equations, calculus-based physics, and chemistry	define key factual information related to mathematics through differential equations, calculus-based physics, and chemistry	explain key concepts and problem-solving processes in mathematics through differential equations, calculus-based physics, and chemistry	solve problems in mathematics through differential equations, calculus-based physics, and chemistry		
3(b)	design an environmental eng. experiment to meet a need; conduct the experiment, and analyze and interpret the resulting data	identify the procedures and equipment necessary to conduct environmental eng. experiments	explain the purpose, procedures, equipment, and practical applications of environmental eng. experiments	conduct environmental eng. experiments according to established procedures, and report the results	conduct environmental eng. experiments according to established procedures, and analyze and interpret the results	design an environmental eng. experiment to meet a need; conduct the experiment, and analyze and interpret the resulting data
3(c)	design a complex system or process to meet desired needs, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	define eng. design; list the major steps in the eng. design process; and list constraints that affect the process and products of eng. design	describe the eng. design process; explain how real-world constraints affect the process and products of eng. design	design a simple component (e.g., a structural member) to meet a well-defined set of requirements and constraints	design a system or process (e.g., a truss or water treatment process) to meet a well-defined set of requirements and constraints	design a complex system or process to meet desired needs, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
3(d)	function effectively as a member of a multi-disciplinary	list the key characteristics of an effective multi-	explain the factors affecting the ability of a multidisciplinary	Function effectively as a member of a multidisciplinary		

Outcome	Description	Performance Criteria				
		Knowledge	Comprehension	Application	Analysis	Synthesis
	team	disciplinary team	nary team to function effectively	team		
3(e)	solve well-defined eng. problems in four technical areas appropriate to environmental eng.	list key factual information related to four technical areas of environmental eng.	explain key concepts and problem-solving processes in four technical areas appropriate to environmental eng.	solve well-defined eng. problems in four technical areas appropriate to environmental eng.		
3(f)	analyze a complex situation involving multiple conflicting professional and ethical interests, to determine an appropriate course of action	list the professional and ethical responsibilities of an environmental engineer	explain the professional and ethical responsibilities of an environmental engineer	apply standards of professional and ethical responsibility in a relatively clear-cut situation, to determine an appropriate course of action	analyze a complex situation involving multiple conflicting professional and ethical interests, to determine an appropriate course of action	
3(g)	organize and deliver effective verbal, written, and graphical communications	list the characteristics of effective verbal, written, and graphical communications	describe the characteristics of effective verbal, written, and graphical communications	Correctly apply the rules of grammar and composition in verbal and written communications; and apply appropriate graphical standards in preparing eng. drawings	organize and deliver effective verbal, written, and graphical communications	
3(h)	determine the global, economic, environmental, and	drawing upon a broad education, graduates can	drawing upon a broad education, graduates can ex-	drawing upon a broad education, graduates can de-		

Outcome	Description	Performance Criteria			Analysis	Synthesis
		Knowledge	Comprehension	Application		
	societal impacts of a specific, relatively constrained eng. solution	identify global, economic, environmental, and societal impacts of eng. solutions	plain the global, economic, environmental, and societal impacts of eng. solutions	termine the global, economic, environmental, and societal impacts of a specific, relatively constrained eng. solution		
3(i)	demonstrate the ability to learn on their own, without the aid of formal instruction	define life-long learning	explain the need for life-long learning and describe the skills required of a life-long learner	demonstrate the ability to learn on their own, without the aid of formal instruction		
3(j)	incorporate specific contemporary issues into the identification, formulation, and solution of a specific eng. problem	list contemporary issues that affect eng. problems	explain how contemporary issues affect the identification, formulation, and solution of eng. problems	incorporate specific contemporary issues into the identification, formulation, and solution of a specific eng. problem		
3(k)	apply relevant techniques, skills, and modern eng. tools to solve a simple problem	identify the techniques, skills, and modern eng. tools that are necessary for eng. practice	explain how these techniques, skills, and modern eng. tools are used in eng. practice	apply relevant techniques, skills, and modern eng. tools to solve a simple problem		