21 September 2005

TO: Dr. Lloyd Byars, Chair, Institute Undergraduate Curriculum Committee
FROM: Dr. Joseph B. Hughes, Chair, School of Civil & Environmental Engineering
RE: New degree B.S. in Environmental Engineering

The faculty of the School of Civil & Environmental Engineering (CEE) request approval of a new degree B.S. in Environmental Engineering. Approval for two new courses is also requested. Attached are the Letter of Intent and Formal Proposal in the Board of Regents format. The Letter of Intent was submitted to the Board of Regents in July 2005.

B.S.EnvE. curriculum will serve as the basis for a second A.B.E.T.-approved undergraduate degree offered by CEE. The curriculum is designed to provide students with a tailored (but flexible) program focused on Environmental Engineering, and to address limitations inherent to the B.S.C.E. degree with regard to preparation of students to enter the Environmental Engineering profession and/or pursue a graduate degree in Environmental Engineering.

New Courses:

Add CEE 3340 “Environmental Engineering Laboratory”
Add CEE 4395 “Environmental Systems Design Project”

Dr. Joseph B. Hughes, Chair of School of Civil & Environmental Engineering

Approval:

Dr. Don Giddens, Dean of College of Engineering

Dr. Jean-Lou Chameau, Provost
NEW COURSE PROPOSAL

SCHOOL, DEPARTMENT, COLLEGE: School of Civil & Environmental Engineering

DATE: April 8, 2005

Proposed Course Number: CEE 3340

2. Hours: LECTURE 2  LAB/RECITATION 3  SEMESTER CREDIT 3

3. Descriptive Title: Environmental Engineering Laboratory

5. Catalog Description – (25 words or less)
Theory and application of environmental laboratory methods for measurement of fundamental properties and characteristics of dissolved and particulate constituents in water, air and soil systems

6. Basis: L/G X P/F Audit

7. Prerequisites: CEE 2300: Environmental Engineering Principles; CHEM 1310: General Chemistry, BIOL 1510: Biological Principles

8. Has the course been taught as a special topic? NO If YES, When Enrollment

9. Is this course equivalent to another course (graduate or undergraduate) taught at Ga. Tech? NO If yes, list course number(s):

10. Are you requesting that this course satisfy: Humanities NO Social Science NO

11. Expected Mode of Presentation:

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12. Planned Frequency of Offering:

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<tr>
<td>Summer</td>
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13. Probable Instructor(s) – Please mark with an asterisk any non-tenure track individuals.
Ching-Hua Huang, Jaehong Kim, Mike Bergin, Kurt Pennell

14. Purpose of Course: Relation to other courses, programs and curricula:
This course is intended to provide undergraduate students in the environmental science and engineering program with the underlying theory and practical, hands-on experience using selected experimental methods to monitor water, air and soil systems. Students will use analytical instruments, perform environmental monitoring, conduct laboratory experiments, interpret experimental data, and present their findings in written reports and oral presentations.

15. Required X Elective

16. Please attach a topical outline of the course
Course Outline

Laboratory Introduction
Laboratory Overview and Manual (Lecture 1)
Laboratory Notebook and Preparation of Laboratory Reports (Lecture 2)
Basic Laboratory Safety Procedures, Use of Balances and Pipettes (Lab 1)

Unit 1. Water Quality Parameters
Theory and practical measurement of pH and buffer capacity (Lecture 3-7)
Calibrate pH meter and measure pH of tap water, river/stream water and rain water (Lab 2)
Measure buffer capacity of natural and prepared aqueous solutions by titration (Lab 3-4)
Written Laboratory Report

Unit 2: Turbidity and Particle Settling
Sources, measurement and control of turbidity (Lecture 8-13)
Use of turbidity meter, measure turbidity and total suspended solids (TSS) of natural and prepared water samples (Lab 5)
Comparison of coagulants (alum and gypsum) to control turbidity in batch tests (Lab 6-7)
Written Laboratory Report

Unit 3: Chemical and Biological Oxygen Demand
Principles and measurement of chemical and biological oxygen demand (Lecture 14-16)
Calculation and measurement of chemical oxygen demand (COD) (Lab 8-9)
Written Laboratory Report

Unit 4: Groundwater Flow
Theory and measurement of water flow porous media (Darcy’s Law) (Lecture 17-20)
Measure flow rate, hydraulic conductivity, and intrinsic permeability in packed columns (Lab 10-11)
Written Laboratory Report

Unit 5: Air Pollution Monitoring
Air pollution sources and measurement methods (Lecture 21-26)
Measurement of atmospheric particulate matter (PM) in Atlanta (Lab 12-14)
Written Laboratory Report

Group Presentations
Review of Laboratory Units (Lectures 27-28)
Oral presentation, review and discussion of laboratory units by student teams (Lectures 28-29, Lab 15).
NEW COURSE PROPOSAL

GRADUATE  Level I  Level II  UNDERGRADUATE  X

SCHOOL, DEPARTMENT, COLLEGE: School of Civil & Environmental Engineering  DATE: April 8, 2005

1. Proposed Course Number: CEE 4395  (Verify with Registrar’s Office)

2. Hours: LECTURE 2  LAB/RECI TATION 3  SEMESTER CREDIT 3

3. Descriptive Title: Environmental Systems Design Project

4. Recommended Abbreviation for Transcript – (24 characters including spaces):

ENVIRONMENTAL SYSTEMS DESIGN

5. Catalog Description – (25 words or less)
Design and assessment of an environmental system, component or process, including problem definition, data acquisition, modeling and analysis, evaluation of alternatives, and presentations.

6. Basis: L/G  X  P/F  Audit

7. Prerequisites: CEE4300 and Senior standing in Environmental Science and Engineering program
Prerequisites with concurrency:
Corequisites:

8. Has the course been taught as a special topic? NO  If YES, When  Enrollment

9. Is this course equivalent to another course (graduate or undergraduate) taught at Ga. Tech? NO  If yes, list course number(s):

10. Are you requesting that this course satisfy: Humanities  NO  Social Science  NO

11. Expected Mode of Presentation:

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<td>Discussion</td>
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<td>PRESENTATIONS</td>
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</table>

13. Probable Instructor(s) – Please mark with an asterisk any non-tenure track individuals.
Mike Saunders, Joe B. Hughes, Ted Russell, Kurt Pennell

14. Purpose of Course: Relation to other courses, programs and curricula:
The course will serve as an environmental systems design or assessment experience for Environmental Science and Engineering seniors, drawing on knowledge and skills obtained in prior coursework. Students will participate in small, multi-faceted teams to solve open-ended, system-assessment or design problems and will address environmental, socio-economical, and political constraints as applicable, prepare written project reports, and deliver oral presentations. The approach will include multiple groups of 4-6 students working interactively with faculty to address problems that couple laboratory-research activities to system design and extend to global system assessment and ramifications. The template for the class will vary with instructor but will include the critical components of open-ended problems; data generation and assessment; and oral and written defense of the end product.

15. Required  Elective  X

16. Please attach a topical outline of the course
CEE 4395: Environmental Systems Design Project
Course Outline

Credit Hours: 2-3-3
Catalog Description: Design and assessment of an environmental system, component or process, including problem definition, data acquisition, modeling and analysis, evaluation of alternatives, and presentations.
Textbook: to be announced by instructor(s)

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<th>Activity/Topic</th>
<th>Deliverables</th>
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<tr>
<td>1</td>
<td>Introduction and general description of system, component or process to be addressed. Discussion of project expectations and deliverables. Team selection (4-5 members) and preparation of preliminary team organizational chart.</td>
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<tr>
<td>2</td>
<td>Visit representative sites or locations or explored systems to be examined through web-based investigations. Initiate system, component or process assessment and characterization.</td>
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<tr>
<td>3</td>
<td>Laboratory (wet-lab or computational-lab) demonstration of system or process components or investigation of selected aspects of a regional or global system</td>
<td>Project proposal including description, objectives, plan, and timeline</td>
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<td>4</td>
<td>Discussion of process or system components and development of conceptual configurations or designs.</td>
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<tr>
<td>5</td>
<td>Discussion of scientific and technical components. Detailed discussion of report preparation and presentation components.</td>
<td>Written Status Report and oral presentation</td>
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<tr>
<td>6</td>
<td>Discussion of scientific and technical components. Discussion of critical evaluation of design alternatives and refinement of project components.</td>
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<tr>
<td>7</td>
<td>Discussion of scientific and technical components. Development of preliminary process-design and system-configuration renderings</td>
<td>Written Status Report</td>
</tr>
<tr>
<td>8</td>
<td>Discussion of technical design components. Cost analysis and budget of preliminary design.</td>
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<td>9</td>
<td>Preparation of draft written report.</td>
<td>Draft Written Report</td>
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<tr>
<td>10</td>
<td>Oral presentation of preliminary design for environmental system, component or process (30 minutes per group).</td>
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<td>11</td>
<td>Refinement of preliminary design. Preparation of final design calculations.</td>
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<tr>
<td>12</td>
<td>Refinement of preliminary design. Preparation of final engineering drawings or technical/scientific system description.</td>
<td>Written Status Report</td>
</tr>
<tr>
<td>13</td>
<td>Refinement of preliminary design. Preparation of final cost analysis and budget.</td>
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<tr>
<td>14</td>
<td>Preparation of final written report.</td>
<td>Final Written Report</td>
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<tr>
<td>15</td>
<td>Oral presentation of final design (30 minutes per group)</td>
<td>Presentation Overheads</td>
</tr>
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Notes: The content of the final report should include a clear and concise description of the final project design, including problem overview, engineering drawings, design calculations, economic analysis and budget. The report should also address relevant environmental, sustainability, ethical, health and safety, social and political issues related to the project.
Letter of Intent for New Degree

Institution:  Georgia Institute of Technology    Date:  May 2, 2005

School/Division:  School of Civil & Environmental Engineering

Name of Proposed Program:
Bachelor of Science in Environmental Engineering (BSEnvE)

Starting Date:  Spring 2006

Institutional Mission

1.  *Does this program further the mission of your institution?*

The program will provide Georgia residents (and all other students) the opportunity to earn an ABET-accredited Bachelor of Science degree in Environmental Engineering (BSEnvE). An ABET-accredited environmental engineering undergraduate degree program is not offered by the Georgia Institute of Technology (Georgia Tech) or any other University System institution.

2.  *Will the proposed program require a significant alteration of the institutional mission?*

No alternation of the institutional mission is anticipated.

3.  *Will the program require the addition of a new organizational unit to the institution (e.g. college, school, division or department)?*

The program will be offered within an existing unit, the School of Civil & Environmental Engineering (CEE). Therefore, no new organizational unit will be added to the institution. The BSEnvE curriculum will serve as the second ABET-accredited degree program offered by CEE, in addition to the existing Bachelor of Science in Civil Engineering (BSCE). This approach is similar to that employed in the School of Electrical & Computer Engineering, which offers ABET-accredited undergraduate degrees in Electrical Engineering and Computer Engineering.

An ABET-accredited Master of Science in Environmental Engineering (MSEnvE) degree is currently offered by CEE. As part of the development plan for the proposed BSEnvE, ABET accreditation will be dropped for the MSEnvE degree. Hence, accreditation of the environmental engineering degree program will be at the undergraduate level, consistent with all other ABET-accredited degrees offered by Georgia Tech.

4.  *Is it likely that a SACS visit for substantive change will be necessary?*

An additional SACS visit is not anticipated.

5.  *How does the proposed program help meet the priorities/goals of your strategic plan?*

One of the key tenants of the College of Engineering (COE) strategic plan is to prepare engineering graduates that are capable of adapting to changing societal needs. The
BSEnvE degree program addresses this critical issue by providing an educational experience that is based on a fundamental knowledge of scientific disciplines, which can be used to solve emerging environmental engineering issues (e.g., sustainable water resources, human health, and environmental toxicology). We anticipate that this program will increase undergraduate enrollment in the School of Civil & Environmental Engineering, and will serve to further bridge the gap between science and engineering disciplines.

6. **Will this proposal require an addition or change in your institution strategic plan?**
   No change to the strategic plan anticipated.

7. **Will the program require an increase in state appropriation within the next five years?**
   No increase in state appropriation will be required.

8. **If this is a baccalaureate program, will you be asking for an exception to the 120 hour expectation or to the core curriculum?**
   The core curriculum requirements will be satisfied. The proposed BSEnvE degree will have 127 semester hours plus 2 hours of Health/Physical Education. The existing BSCE requires 126 hours plus 2 hours of Health/Physical Education.

9. **Are there program delivery formats that will be new or different for your institution?**
   Delivery formats already in use at the Georgia Institute of Technology will be employed for the program.

**Need**

*Provide a brief justification for why the state needs graduates from this program and for why the University System needs this program. Give a brief justification for why your institution should offer the program.*

The State of Georgia needs graduates of the BSEnvE program to address current and emerging environmental engineering issues related to water supply and reuse, environmental toxicology and human health, air pollution control and management, and sustainable growth and development. Currently, an ABET-accredited Bachelor of Science degree in the field of environmental engineering is not offered by any institution within the University System. Currently, the University of Georgia offers a Bachelor of Science in Environmental Sciences (BSES) in the College of Agricultural and Environmental Sciences. The Georgia College & State University offers a Bachelor of Science in Environmental Science, and the University of West Georgia offers a Bachelor of Science in Environmental Science. However, the program proposed herein will represent the only ABET-accredited environmental engineering degree offered within the University System, which Georgia Tech is uniquely positioned to offer.

Existing degree programs offered by the Georgia Institute of Technology (e.g., Chemical & Biomolecular Engineering, Earth & Atmospheric Sciences) do not provide adequate
training in the fundamentals and application of chemical, biological, and engineering principles to environmental systems, nor do the existing programs realize opportunities in emerging fields relevant to environmental engineering, such as human health and nanotechnology. The proposed curriculum has been designed to provide students with fundamental knowledge in sciences, particularly in chemistry and biology, and expanded laboratory training and exposure to analytical methods, which are essential to environmental monitoring. The curriculum also contains a flexible set of technical electives geared toward student-selected specific areas of interest and/or career objectives (e.g., water resources, bioremediation, air pollution). The curriculum addresses limitations inherent to the BSCE degree with regard to environmental engineering education, while maintaining engineering fundamentals (e.g., statics, dynamics, deformable bodies, fluid mechanics) and providing both technical and culminating engineering design experiences. We intend the program to provide a “home” for students with interest and aptitude in science and engineering, and a desire to apply these combined skills to environmental systems. In addition, the proposed degree will serve as the academic training for Georgia engineering graduates who wish to become licensed Professional Engineers in Environmental Engineering (i.e., PE Exam in Environmental Engineering).

*If the program is applied or professional in nature, describe the kind of data you will use to support the need for the program.*

Assessment of need for a BSEnvE program will be based on; (a) direct survey of potential employers (e.g., consulting firms, corporations, government agencies), (b) published job market trends in environmental engineering, (c) survey graduates of CEE/GT working in the field of environmental engineering to assess potential value of new BSEnvE degree program.

Recently, both the visiting ABET-accreditation review team and the CEE Academic Program Review (APR) panel recommended development of an undergraduate degree in environmental engineering, to be offered in addition to the existing BSCE degree.

*Provide a brief description of whether and why students will enroll in the program. What kinds of data do you intend to use to show student demand for the program?*

The BSEnvE degree program will attract students for a number of reasons, including: (a) the unique combination of science (biology, chemistry, physics), mathematics, and applied engineering skills, (b) importance of environmental resources (e.g., water, air) for sustainable growth and development, (c) opportunities to restore and prevent human impacts on the environment, and (d) the increasing role of environmental factors in human health. Data will be collected during internal and external student recruitment activities. Based on interactions between CEE undergraduate coordinator and prospective students, questions related to the availability and content of the undergraduate environmental engineering program in CEE rank in the top 3. For example, at a recent Georgia Tech majors fair, more than half of the students asked about the environmental engineering program.

*Students*
Estimate the number of students who will graduate annually from the program in the steady state. What percentage will likely be from other existing programs? Which programs will the students come from?

A steady-state graduation rate (e.g. 5 years from establishment) of approximately 75 students per academic year is anticipated, although this number could be larger depending on popularity of the program and ability to attract new students into the program. Based on current specialization within the existing BSCE curriculum, we expect that 50% will come from BSCE pool, and 25% will come from College of Sciences, and 25% will come from undecided engineering majors and within-system transfers such as the Regent’s Engineering Transfer Program (RTEP).

Budget

1. **Estimate the steady-state cost of the program (in current dollars) and indicate the percentages from reallocation, student fees, grants, and outside dollars.**

   The proposed curriculum has been developed with recognition of the need to minimize additional resource requirements above those currently allocated to CEE. Student course and degree requirement approvals will be handled by existing staff members in the CEE student services office. Overall administration of the program will be overseen by Dr. Joseph Hughes (CEE Chair) and Dr. Larry Jacobs (CEE Associate Chair of Undergraduate Programs). Additional oversight with respect to technical content and student advisement will be provided by Dr. Kurt Pennell (Environmental Engineering), Dr. Don Webster (Environmental Fluid Mechanics & Water Resources), Dr. Mike Saunders (Environ. Eng. Group Coordinator), and an Advisory Panel consisting of faculty representatives from relevant College of Sciences and College of Engineering units.

2. **Estimate start-up costs for the program and indicate possible fund sources.**

   The program will be administered through an existing unit and the majority of courses are already offered at Georgia Institute of Technology, thus the start-up cost will be modest. The proposed program will involve the development of two new courses, CEE 3340: Environmental Science and Engineering Laboratory and CEE 4395: Environmental Systems Design Project, which will be taught by existing CEE faculty. The primary start-up costs for the program will be instrumentation for the proposed new undergraduate laboratory course (CEE 3340), estimated to be on the order of $25,000. These funds will be used to purchase balances, air-pollution collection units, glassware, chemicals and reagents, personal safety items, filtration stations, and analytical supplies (e.g., cuvets). Possible sources for these funds include the College of Engineering Dean’s Office and CEE.

Facilities

*If additional facilities are needed, how they will be acquired.*

The new undergraduate laboratory course, CEE 3340 “Environmental Science and Engineering Laboratory”, will be offered in existing laboratory space on the Georgia Tech campus, specifically, either Room 109/110 in the Daniel Laboratory or Room 3371 in the Ford Environmental Science & Technology Building.
Curriculum and Delivery

1. Are there special characteristics of the curriculum (as compared to similar programs)?

The proposed BSEnvE curriculum is distinct from the BSCE in that six science courses are required in the freshman and sophomore years (i.e., 2 Chemistry, 2 Physics, 1 Biology, 1 Earth & Atmospheric Sciences), and three upper-level laboratory courses are required (i.e., Civil Engineering Materials, Environmental Science and Engineering Laboratory, Hydraulic Engineering). The additional science courses provide for a greater foundation for upper-level electives and required courses, and for a broader spectrum of professional applications. The additional laboratory courses will provide students with hands-on training needed to perform environmental monitoring and testing activities central to professional activities. The upper-level technical and design electives for the BSEnvE emphasize several important environmental engineering areas of focus, including bioremediation, sustainability, air pollution, groundwater, and water resources.

2. Will the program require new or special student services?

Student services will be handled through the existing CEE Office of Student Services and the Georgia Institute of Technology Dean of Students Office.

3. Will the program be attractive to underserved populations?

The existing BSCE program and other engineering degree programs at Georgia Institute of Technology have been among the best in the country at attracting underserved populations. The proposed program will be consistent with these examples.

Collaboration

It should be noted here that efficient use of state resources is an essential ingredient in new program approval. If there is any doubt about how you will address the questions below, a conference is recommended.

1. If there are similar programs in your service area, how will the proposed program affect them?

The BSEnvE was developed with substantial input from units in the College of Sciences (e.g., the Schools of Earth & Atmospheric Sciences, Biology, and Chemistry & Biochemistry), and with approval from College of Sciences Dean Schuster and other units in the College of Engineering that could potentially be impacted (e.g., Chemical & Biomolecular Engineering). Based on this universal support and interest in contributing to the degree program, we do not anticipate any negative impacts on other programs in our service area.

2. Do you plan a collaborative arrangement with another institution or entity?

We plan to collaborate with College of Sciences at the Georgia Institute of Technology, specifically the Schools of Earth & Atmospheric Sciences, Biology, and Chemistry & Biochemistry, in the sequence of course offerings, recruitment and publicity for the program, and oversight through an Internal Advisory Panel that includes representatives from these units.
In addition to the Atlanta campus, the BSEnvE degree will be offered at Georgia Tech Regional Engineering Program (GTREP). The BSCE degree is currently offered at GTREP and four current faculty members at the Georgia Tech Savannah campus have expertise in coastal/environmental engineering systems. Courses required for the proposed BSEnvE degree are already offered at the GTREP campuses or are projected from the Atlanta campus.

Other

Are there other elements of the proposed program that might give the staff greater insight into the overall value of this program to the University System strategic plan?

The undergraduate environmental engineering program at Georgia Institute of Technology has been ranked 7th by U.S. News and World Report, even though an undergraduate degree is not currently offered in this area. We believe the creation of a distinct BSEnvE degree will bring further recognition to the Institute, and provide a “home” for students with interests in science and engineering, and a desire to preserve and improve our natural resources and meet the needs of a global economy in a sustainable manner.
Georgia Institute of Technology
September 2005

College of Engineering
School of Civil & Environmental Engineering

B.S. in Environmental Engineering

Degree: Bachelor of Science
Major: Environmental Engineering
CIP Code: 14.1401
Starting Date: Spring Semester 2006
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Section 1: Program Description and Objectives

The Georgia Institute of Technology (Georgia Tech) proposes to establish a Bachelor of Science degree in Environmental Engineering (B.S.Env.E.) that will be offered through the School of Civil & Environmental Engineering (CEE). The B.S.Env.E. curriculum will serve as the second ABET-accredited degree program offered by CEE, in addition to the existing Bachelor of Science in Civil Engineering (B.S.C.E.). This approach is similar to that employed in the School of Electrical & Computer Engineering, which offers two distinct ABET-accredited undergraduate degrees in Electrical Engineering and Computer Engineering. An ABET-accredited Master of Science in Environmental Engineering (M.S.Env.E.) degree is currently offered by CEE (original accredited in 1962). As part of the development plan for the proposed B.S.Env.E., ABET accreditation will be dropped for the M.S.Env.E. degree. Hence, accreditation of the Environmental Engineering degree program will be at the undergraduate level, consistent with all other ABET-accredited degrees offered by Georgia Tech. This change reflects the maturation of Environmental Engineering as a unique engineering discipline with a separate Professional Engineering (PE) licensing exam, and the need to provide residents of the State of Georgia with an ABET-accredited undergraduate degree in Environmental Engineering.

Program Mission and Objectives:
The mission is to create a quality education, research and service program designed to achieve five major program goals:
1. Educate a new generation of Environmental Engineers to meet the challenges of the future;
2. Promote a sense of scholarship, leadership and service among our graduates;
3. Create, develop and disseminate new knowledge;
4. Play a leadership role in fostering interdisciplinary education and research programs fundamental to solving the problems facing a complex society;
5. Provide national leadership to the Environmental Engineering profession that is increasingly being driven by advances in technology.

The B.S.Env.E. curriculum is designed to meet the needs of all students within the context of this mission statement. The Program Educational Objectives associated with this mission are to:
1. Provide an educational experience that prepares students for the challenges of the Environmental Engineering profession that they will face during their professional careers;
2. Promote scholarship and problem-solving skills;
3. Provide opportunities for our students to exhibit leadership and team-building skills;
4. Promote service to the profession and to society;
5. Incorporate interdisciplinary concepts and problem-solving exercises into the educational program;
6. Provide exposure to the environmental technologies of today and those likely of tomorrow.
**Program Content**

The Environmental Engineering profession seeks to manage natural resources and minimize anthropogenic impacts to achieve sustainable growth and development. Environmental Engineers utilize scientific and engineering principles to assess, design and implement environmental systems over a wide range of scales to ensure continued human and ecological health. The proposed undergraduate program in Environmental Engineering recognizes these needs by providing fundamental knowledge of chemistry, biology, physics, and engineering principles which is complemented with the development of communication, team-building, and problem solving skills realized through a combination of hands-on laboratory courses, technical and design electives, and a culminating capstone design experience.

Within this context, the following objectives were defined during the development of the Environmental Engineering curriculum:

1. Develop a B.S. degree program that integrates scientific (chemistry, biology, and physics) and engineering principles to provide students with a fundamental understanding of Environmental Engineering over a range of scales and media types.
2. Provide B.S.Env.E. students with skill sets and engineering tools to address problems encountered in both natural and engineered environmental systems in a sustainable and responsible manner.
3. Foster joint instruction and program guidance between the School of Civil & Environmental Engineering and allied Schools in the College of Sciences and College of Engineering.
4. Develop a comprehensive advisement program to guide students through the core B.S.Env.E. curriculum and assist in the selection of an upper-level elective concentration that provides advanced knowledge in a particular focus area (e.g., bioremediation, water resources, air pollution, sustainability).

To achieve the objectives stated above, the proposed B.S.Env.E. degree will combine existing strengths of CEE and the College of Engineering (COE) with expertise from the College of Sciences (COS), specifically the Schools of Biology, Chemistry & Biochemistry, and Earth & Atmospheric Sciences (EAS), to create a comprehensive and highly competitive undergraduate program in Environmental Engineering that will contribute to the strategic plans and missions of Georgia Tech. The proposed B.S.Env.E. curriculum is distinct from the B.S.C.E. in that six science courses are required in the freshman and sophomore years (i.e., 2 Chemistry, 2 Physics, 1 Biology, and 1 Earth & Atmospheric Sciences), and three upper-level laboratory courses are required (i.e., Civil Engineering Materials, Environmental Engineering Laboratory, and Hydraulic Engineering). The additional science courses provide for a greater foundation for upper-level electives and required courses and for a broader spectrum of professional applications. The additional laboratory courses provide students with hands-on training needed to perform environmental monitoring and testing activities central to professional activities. The upper-level technical and design electives for the B.S.Env.E. emphasize
several important environmental engineering areas of focus, including bioremediation, sustainability, air pollution, groundwater, and water resources.

The proposed program will involve the development of two new courses, CEE 3340: Environmental Engineering Laboratory, and CEE 4395: Environmental Systems Design Project, both of which will be taught by existing CEE faculty. The laboratory course (CEE 3340) will be offered in existing laboratory space, Room 3371 in the Ford Environmental Science and Technology (ES&T) Building.

Program Administration and Resource Requirements
The proposed B.S.Env.E. curriculum has been developed with recognition of the need to minimize additional resource requirements above those currently allocated to CEE. Overall administration of the program will be overseen by Dr. Joseph Hughes (CEE Chair) and Dr. Laurence Jacobs (CEE Associate Chair of Undergraduate Programs). Additional oversight will be provided by the existing CEE Undergraduate Curriculum Committee, chaired by Dr. Don Webster, and a proposed B.S.Env.E. Curriculum Subcommittee, chaired by Dr. Kurt Pennell. Student services will be handled through the existing CEE Office of Student Services and the Georgia Tech Dean of Students Office.

Anticipated Enrollments
A steady-state graduation rate (e.g., 5 years from establishment) of approximately 75 students per academic year is anticipated, although this number could be larger depending on popularity of the program and ability to attract new students into the program. Based on current specialization within the existing B.S.C.E. curriculum, we expect that 50% will come from B.S.C.E. pool, and 25% will come from College of Sciences, and 25% will come from undecided engineering majors and within-system transfers such as the Regent’s Engineering Transfer Program (RTEP).

Collaborations
We intend to collaborate with the Georgia Tech College of Sciences, specifically the Schools of Biology, Chemistry & Biochemistry, and Earth & Atmospheric Sciences in the sequence of course offerings, recruitment and publicity for the program, and oversight through an Internal Advisory Panel that will include representatives from each of these units. In addition to the Atlanta campus, the B.S.Env.E. degree will be offered at Georgia Tech Savannah through the Regional Engineering Program (GTREP). The B.S.C.E. degree is currently offered at GTREP, and four current faculty members at the Georgia Tech Savannah campus have expertise in coastal/environmental engineering systems. Courses required for the proposed B.S.Env.E. degree are already offered at the GTREP campuses or will be delivered via distance learning from the Atlanta campus.
Section 2: Justification and Need for the Program

a. Environmental Engineering was initially recognized as a sub-specialty within Civil Engineering in the late 1950’s to early 1960’s. At that time, Environmental Engineering focused primarily on engineered systems for water and wastewater treatment, and thus, was commonly referred to as Sanitary Engineering. Beginning in the late 1970’s, the discipline expanded to address toxic wastes sites that had been contaminated with anthropogenic compounds, such as gasoline, chlorinated organic solvents, and metals. The emphasis was not only on the design of remediation systems to treat these waste sites, but also on understanding the fate, transport and distribution of inorganic and organic contaminants in natural systems. During the 1980’s and 1990’s, the discipline of Environmental Engineering went through a period of rapid growth. In recognition of this increased prominence and the corresponding demand for jobs in environmental consulting, government and industry, many Civil Engineering departments changed their names to Civil & Environmental Engineering, or alternatively, separate Environmental Engineering programs were established. Initially, the educational approach followed by many Environmental Engineering programs in the United States assumed an entry-level degree at the Master’s level. This paradigm has shifted dramatically over the past 10 years, with the establishment of 31 new ABET-accredited undergraduate programs during this period (41 total), and only 8 ABET-accredited programs at the Master’s level. Prominent peer institutions, including Stanford University (2004) and Massachusetts Institute of Technology (1993), now have ABET-accredited undergraduate programs in Environmental Engineering.

One of the key tenets of the College of Engineering (COE) strategic plan is to prepare engineering graduates that are capable of adapting to changing societal needs. The proposed B.S.Env.E. degree program addresses this critical need by providing an educational experience that is based on a fundamental knowledge of scientific disciplines coupled with engineering principles to address emerging environmental engineering issues including sustainable water resources, human health, and environmental toxicology. Existing engineering degree programs offered at Georgia Tech (e.g., B.S.C.E.) do not provide sufficient training in the sciences and application of engineering principles to environmental systems, nor do the existing programs realize opportunities in emerging fields relevant to environmental engineering, such as human health and nanotechnology. The proposed curriculum has been designed to provide students with advanced knowledge in sciences, particularly chemistry and biology, and expanded laboratory training in environmental analytical methods, which are essential to environmental professionals. The curriculum also incorporates technical electives focused on student-selected areas of interest and career objectives (e.g., water resources, bioremediation, air pollution). In summary, the curriculum addresses several limitations inherent to the B.S.C.E. degree with regard to chemistry and biology, while maintaining engineering fundamentals (e.g., statics, dynamics, deformable bodies, fluid mechanics), and providing both technical and culminating engineering design experiences.
b. The B.S.Env.E. degree program will attract students for a number of reasons, including: (a) the unique combination of science (biology, chemistry, physics), mathematics, and applied engineering skills, (b) importance of environmental resources (e.g., water, air) for sustainable growth and development, (c) opportunities to restore and prevent human impacts on the environment, and (d) the increasing role of environmental factors in human health. The program will provide a “home” for students with interest and aptitude in science and engineering, and a desire to apply these skills to environmental systems. In addition, the degree will serve as the academic training for Georgia engineering graduates who wish to become licensed Professional Engineers in Environmental Engineering (i.e., PE Exam in Environmental Engineering). There is a growing demand for Professional Engineers in the Environmental Engineering area in the State of Georgia and around the country. We anticipate that this program will not only increase undergraduate enrollment in the School of Civil & Environmental Engineering, but will also foster interactions between science and engineering disciplines at Georgia Tech.

c. The undergraduate Environmental Engineering program at Georgia Tech is currently ranked 7th by *U.S. News and World Report*, even though an undergraduate degree is not currently offered. We believe the creation of a distinct B.S.Env.E. degree will bring further recognition to the Institute, and provide a “home” for students with interests in science and engineering, a desire to preserve and improve our natural resources, and a desire to meet the needs of a global economy in a sustainable manner.

d. In developing this new degree program we have consulted with the External Advisory Board (EAB) of the School of Civil & Environmental Engineering during regularly scheduled meetings. The Board is in favor of the proposed degree and provided input to the development of the curriculum. Both the visiting ABET-accreditation review team and the CEE Academic Program Review (APR) panel recommended development of an undergraduate degree in Environmental Engineering to be offered in addition to the existing B.S.C.E. degree.

e. No ABET-accredited undergraduate degree program in the discipline of Environmental Engineering is offered in the State of Georgia (see http://www.abet.org/). The University of Georgia, Department of Biological and Agricultural Engineering, offers two ABET-accredited degree programs under the discipline of Agricultural Engineering: Agricultural Engineering (established in 1961) and Biological Engineering (established in 1997). In the Agricultural Engineering (B.S.A.E.) program students select one of five “Areas of Emphasis” (i.e., 15 hours of upper level electives); Electrical and Electrical Systems, Mechanical Systems, Natural Resources Management, Process Operations, or Structural Systems. Similarly, in the Biological Engineering (B.S.B.E.) program students select one of three “Areas of Emphasis” (i.e., 15 hours of upper level electives); Biochemical, Biomedical, or Environmental. The University of Georgia, College of Agriculture and Environmental Sciences also offers an undergraduate program in Environmental Science (B.S.E.S.), with specialization in Entomology, Environmental Chemistry, Environmental Economics and Management, or Water and Soil Resources.
Additional details related to the University of Georgia programs can be found at http://bulletin.uga.edu/bulletin/ind/degrees.html. The Georgia College & State University and the University of West Georgia both offer a Bachelor of Science in Environmental Science (B.S.E.S.). However, the proposed B.S.Env.E. program will represent the only ABET-accredited Environmental Engineering degree offered within the State of Georgia University System.
Section 3: Procedures Used to Develop the Program

The undergraduate degree program in Environmental Engineering was developed over a two-year period (Fall 2003 – Fall 2005) and included extensive discussion and revisions at all levels within the School of Civil & Environmental Engineering (CEE), including the External Advisory Board (EAB). Considerable effort was made to involve and incorporate recommendations from external units in the College of Engineering (e.g., Chemical and Biomolecular Engineering) and College of Sciences (e.g., Schools of Biology, Chemistry & Biochemistry, and Earth & Atmospheric Sciences). A chronological summary of the process used to develop the program is provided below.

Initial development of the program began in Fall 2003, initiated by Dr. Kurt Pennell, following discussions with, and support from, Dr. Don Giddens (Dean, COE) and Dr. Joe Hughes (Chair, CEE). A preliminary curriculum was developed by Dr. Pennell with internal input provided by a committee of faculty from the Environmental Engineering group (Drs. Kurt Pennell, co-Chair, Mike Saunders, co-Chair, Mike Bergin, and Jim Mulholland), and external support from Dr. Larry Bottomley (School of Chemistry & Biochemistry, Director of Undergraduate Studies) with respect to required and elective chemistry courses. The tentative curriculum was then reviewed by faculty representatives from all CEE groups; Drs. Randy Guensler (Transportation Systems Engineering), Kimberly Kurtis (Structural Engineering, Mechanics and Materials), Glenn Rix (Geosystems Engineering), Jorge Vanegas (Construction Engineering and Management), and Don Webster (Environmental Fluid Mechanics and Water Resources), and Laurence Jacobs (CEE Associate Chair of Undergraduate Studies). The program justification, objectives, and preliminary curriculum were reviewed by Dr. Don Giddens (Chair, COE) in October 2003, and subsequently presented by Dr. Pennell to the CEE Undergraduate Committee (members at that date: Drs. Don Webster, Chair, Adjo Amekudzi, Leonid Germanovich, Kurt Pennell, Lisa Rosenstein, Don White, Jorge Venagas, and Lawrence Jacobs, ex-officio) for formal consideration in November 2003.

The proposed program was reviewed in detail at monthly CEE Undergraduate Curriculum Committee meetings during Spring 2004. Topics discussed included the program name, required chemistry and biology courses, laboratory courses, technical electives, and the design sequence. During this period, meetings were held with representatives from the Schools of Biology (Dr. Marc Weissburg, Chair of Biology Undergraduate Committee), Earth & Atmospheric Sciences (Dr. Judith Curry, School Chair), and Chemical and Biomolecular Engineering (Dr. Joseph Schork, Associate Chair for Undergraduate Studies) to solicit advice regarding specific courses and reach consensus on the program name. Input was also obtained from the CEE EAB (Fall 2004), which recommended that the curriculum contain core engineering fundamentals and a strong design experience. For this reason, a number of fundamental CEE engineering courses (e.g., CEE 3020, Civil Engineering Materials) were retained in the program, as well as a required design elective (e.g., CEE 4310, Water Quality Engineering) and capstone design experience (CEE 4090, Capstone Design). The curriculum was also presented to the CEE External Review Panel (Spring 2005), who strongly supported the
program. The External Review Panel specifically noted that program has the potential to increase enrollments and provide greater recognition and opportunities for the School.

The program was formally introduced to the CEE faculty in July 2004, and discussed in detail at faculty meetings held in January 2005. A new course (CEE 3340: Environmental Engineering Laboratory) in the curriculum was approved by the CEE faculty. Based on feedback during the faculty meetings, a group of faculty met with the Undergraduate Curriculum Committee in March 2005 to discuss the design course sequence. At this meeting, it was proposed that the design sequence consist of one required design elective (selected from a list of four design courses) and the CEE capstone design course (CEE 4090: Capstone Design). Final modifications were made to the curriculum, which was unanimously approved by the CEE faculty in April 2005. The “Letter of Intent for New Degree” was prepared in May 2005 with assistance from Dr. Ray Vito (Associate Dean for Academic Affairs) in the College of Engineering. The Environmental Engineering curriculum was approved by the Institute Undergraduate Curriculum Committee (Month Day, 2005) and the Institute Academic Senate (Month Day, 2005).
Section 4: Curriculum

4.1 Course of Study
The proposed Environmental Engineering curriculum incorporates all of the Board of Regent, Institute, and College of Engineering degree requirements, and is designed to meet ABET requirements under the Environmental Engineering discipline (see Appendix II). To provide students with a strong background in fundamental sciences, six science laboratory courses are required in the freshman and sophomore years (i.e., 2 Chemistry, 2 Physics, 1 Biology, 1 Earth & Atmospheric Sciences). Detailed knowledge of mathematical and engineering principles is achieved by requiring mathematics courses through differential equations (i.e., MATH 1501, 1502, 2401, 2403), and fundamental engineering courses through deformable bodies (i.e., COE 2001, CEE 2040, COE 3001). These engineering courses provide essential knowledge in statics, dynamics, and mechanics that are prerequisites for upper-level required, elective, and design courses (e.g., CEE 3040: Fluid Mechanics, CEE 4200: Hydrologic Engineering; CEE 4400: Geotechnical Engineering). To provide hands-on learning experiments three upper-level laboratory courses are required (i.e., CEE 3020: Civil Engineering Materials, CEE 3340: Environmental Engineering Laboratory, CEE 4200: Hydraulic Engineering). The additional laboratory courses provide students with hands-on training needed to perform environmental monitoring and testing activities central to professional activities. The upper-level technical and design electives for the B.S.Env.E. emphasize several important environmental engineering areas of focus, including bioremediation, sustainability, air pollution, groundwater, and water resources.

The proposed course of study consists of 127 semester hours (plus 2 hours of Wellness). Table 4.1 lists the courses used to satisfy the Institute’s core requirements. The general breadth courses are listed in Table 4.2. The Environmental Engineering breadth and depth courses are listed in Tables 4.3 (new courses are in **bold italics**). A sample Program of Study for a typical student is listed in Table 4.4.

<table>
<thead>
<tr>
<th>Area</th>
<th>Courses</th>
<th>Sem Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Skills</td>
<td>ENGL 1101 English Comp I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENGL 1102 English Comp II</td>
<td>3</td>
</tr>
<tr>
<td>Wellness</td>
<td>HPS 1040/106X Wellness</td>
<td>(2)</td>
</tr>
<tr>
<td>Humanities</td>
<td>Humanities Elective from Institute-approved list</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ethics Elective</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td>ECON 2100 Economics &amp; Policy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History/Govt Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Social Science Elective from Institute-approved list</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>MATH 1501 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 1502 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 2401 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 2403 Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>Area</td>
<td>Courses</td>
<td>Sem Hrs</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Physics</td>
<td>PHYS 2211 Physics I</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>PHYS 2212 Physics II</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry</td>
<td>CHEM 1310 General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Biology</td>
<td>BIOL 1510 Biological Principles</td>
<td>4</td>
</tr>
<tr>
<td>Earth Science</td>
<td>EAS 2600 Earth Processes</td>
<td>4</td>
</tr>
<tr>
<td>Computer Science</td>
<td>CS 1371 Computing for Engineers</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total (excluding HPS)</strong></td>
<td></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>

1. Does not count towards 127 semester hour limit
2. Select one course from:
   - PST 4176 Environmental Ethics (recommended)
   - PST 3105 Ethical Theories
   - PST 3109 Ethics and Technical Professions
   - PST 3127 Science, Technology, and Human Values

### Table 4.2 Breadth Courses

<table>
<thead>
<tr>
<th>Area</th>
<th>Courses</th>
<th>Sem Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>CEE/MATH/ISYE 3770 Statistics &amp; Applications</td>
<td>3</td>
</tr>
<tr>
<td>Engineering</td>
<td>CEE 2040 Dynamics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>CEE 3000 Civil Engineering Systems</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEE 3020 Civil Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>COE 2001 Statics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>COE 3001 Deformable Bodies</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>CHEM 1315 Survey of Organic Chem. Physical Chemistry 1</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>Approved Elective</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

3. Select one course from:
   - CHBE 2110 Chemical Engineering Thermodynamics I
   - CHEM 3411 Physical Chemistry I
   - EAS 3603 Thermodynamics-Earth Systems

### Table 4.3 Environmental Engineering Courses

<table>
<thead>
<tr>
<th>Area</th>
<th>Courses</th>
<th>Sem Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnvE Breadth</td>
<td>CEE 2300 Environ. Eng. Principles</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEE 3040 Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>CEE 3340 Environ. Eng. Laboratory</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td></td>
<td>CEE 4200 Hydraulic Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEE 4300 Environ. Eng. Systems</td>
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<tr>
<td>EnvE Depth</td>
<td>EnE Technical Elective4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEE 4090 Capstone Design</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EnE Design Elective5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Technical Electives6</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>36</strong></td>
</tr>
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</table>
Select one course from:
CEE 4210 Hydrology
CEE 4400 Geotechnical Engineering
CEE 4620 Environmental Impact Assessment
CEE 4795 Ground Water Hydrology

Select one course from:
CEE 4310 Water Quality Engineering
CEE 4320 Hazardous Substance Engineering
CEE 4330 Air Pollution Engineering

CEE 4395 Environmental Systems Design Project

Technical Electives are selected from the following list:
BIOL 2335 General Ecology
BIOL 3380 Introductory Microbiology
BIOL 4010 Aquatic Ecology
BIOL 4430 Environmental Sustainability
BMED 3400 Introduction to Biomechanics
BMED 4757 Biofluid Mechanics
BMED 4758 Biosolid Mechanics
CEE 3010 Geomatics
CEE 4100 Construction Engineering & Management
CEE 4210 Hydrology
CEE 4230 Environ. Transport Modeling
CEE 4310 Water Quality Engineering
CEE 4320 Hazardous Substance Engineering
CEE 4330 Air Pollution Engineering
CEE 4400 Geotechnical Engineering
CEE 4420 Subsurface Characterization
CEE 4600 Transportation Planning, Operation & Design
CEE 4620 Environmental Impact Assessment
CEE 4795 Ground Water Hydrology
CHBE 3200 Transport Processes I
CHEM 3281 Instrumental Analysis for Engineers
CHEM 3511 Survey of Biochemistry
CHEM 4740 Atmospheric Chemistry
CP 4210 Environmental Planning & Impact Assessment
CP 4510 Fundamentals of GIS
EAS 4420 Environmental Field Methods
EAS 4430 Remote Sensing & Data Analysis
EAS 4610 Earth Systems Modeling
EAS 4740 Atmospheric Chemistry
ECE 3710 Circuits and Electronics
ECE 3741 Instrumentation & Electronics Lab
ME 4171 Environmentally Conscious Design & Manufacturing
ME 4172 Designing Sustainable Engineering Systems
ME 4782 Biosystems Analysis
### Table 4.4 Sample Program of Study

<table>
<thead>
<tr>
<th>First Year Fall Semester</th>
<th>First Year Spring Semester</th>
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<tbody>
<tr>
<td>MATH 1501 Calculus I</td>
<td>MATH 1502 Calculus II</td>
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<tr>
<td>4</td>
<td>4</td>
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<tr>
<td>CHEM 1310 General Chemistry</td>
<td>PHYS 2211 Physics I</td>
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<tr>
<td>ENGL 1101 English Comp I</td>
<td>CHEM 1315 Survey of Org. Chem,</td>
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<td>3</td>
<td>3</td>
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<tr>
<td>CS 1371 Computing for Engineers</td>
<td>ENGL 1102 English Comp II</td>
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<td>Humanities Elective</td>
<td>HPS Wellness Elective</td>
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<td>3</td>
<td>2</td>
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<td><strong>Total Semester Hours</strong></td>
<td><strong>Total Semester Hours</strong></td>
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<td>17</td>
<td>16</td>
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<table>
<thead>
<tr>
<th>Second Year Fall Semester</th>
<th>Second Year Spring Semester</th>
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<tbody>
<tr>
<td>MATH 2401 Calculus III</td>
<td>MATH 2403 Differential Equ.</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>PHYS 2212 Physics II</td>
<td>EAS 2600 Earth Processes</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1510 Biological Principles</td>
<td>CEE 3000 Civil Eng. Systems</td>
</tr>
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<td>4</td>
<td>3</td>
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<td>CEE 2300 Environ. Eng. Principles</td>
<td>CEE 2040 Dynamics</td>
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<td>3</td>
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<td>COE 2001 Statics</td>
<td>ECON 2100 Economic Analysis</td>
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<td><strong>Total Semester Hours</strong></td>
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<td>17</td>
<td>16</td>
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<table>
<thead>
<tr>
<th>Third Year Fall Semester</th>
<th>Third Year Spring Semester</th>
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<tbody>
<tr>
<td>CEE 3020 Civil Eng. Materials</td>
<td>XXX 3770 Statistics &amp; Appl.</td>
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<td>3</td>
<td>3</td>
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<tr>
<td>COE 3001 Deformable Bodies</td>
<td>CEE 3340 EnvE Laboratory</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CEE 3040 Fluid Mechanics</td>
<td>Physical Chem I</td>
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<td>3</td>
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<tr>
<td>Social Science Elective</td>
<td>Technical Elective</td>
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<td>3</td>
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<tr>
<td><strong>Total Semester Hours</strong></td>
<td><strong>Total Semester Hours</strong></td>
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<td>15</td>
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<table>
<thead>
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<th>Fourth Year Fall Semester</th>
<th>Fourth Year Spring Semester</th>
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<tbody>
<tr>
<td>CEE 4XXX EnvE Technical Elective</td>
<td>CEE 4XXX EnvE Design Elective</td>
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<td>3</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>CEE 4090 Capstone Design</td>
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<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>Technical Elective</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Approved Elective</td>
<td>Approved Elective</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>History/Govt Elective</td>
<td>Social Science Elective</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PST Ethics Elective</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Semester Hours</strong></td>
<td><strong>Total Semester Hours</strong></td>
</tr>
<tr>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

TOTAL DEGREE HOURS = 127 (plus 2 hours of Wellness)
4.2 Curriculum Specifics

a. The new courses developed for the curriculum are listed in bold italics in Table 4.3. The new courses include one required course (CEE3340: Environmental Engineering Laboratory) and one elective course (CEE4395: Environmental Systems Design Project).

b. See Appendix I for a complete description for the new courses and all existing Breadth, EnvE Breadth, and EnvE Depth courses.

c. The prerequisites for required and elective Environmental Engineering courses are listed in Table 4.5.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 2335</td>
<td>General Ecology</td>
<td>none</td>
</tr>
<tr>
<td>BIOL 3380</td>
<td>Intro Microbiology</td>
<td>BIOL 1510, BIOL 1520, CHEM 2311</td>
</tr>
<tr>
<td>BIOL 4010</td>
<td>Aquatic Ecology</td>
<td>BIOL 2335</td>
</tr>
<tr>
<td>BIOL 4430</td>
<td>Environ Sustainability</td>
<td>BIOL 1510, BIOL 1520, CHEM 1311</td>
</tr>
<tr>
<td>BMED 3400</td>
<td>Intro to Biomechanics</td>
<td>MATH 2403</td>
</tr>
<tr>
<td>BMED 4757</td>
<td>Biofluid Mechanics</td>
<td>(AE2020 or BMED 3300 or ME 3340)</td>
</tr>
<tr>
<td>BMED 4758</td>
<td>Biosolid Mechanics</td>
<td>COE 3001 or BMED 3400</td>
</tr>
<tr>
<td>CEE 2040</td>
<td>Dynamics</td>
<td>COE 2001</td>
</tr>
<tr>
<td>CEE 2300</td>
<td>Environmental Engr Prin</td>
<td>PHYS 2211, CHEM 1310, MATH 1502</td>
</tr>
<tr>
<td>CEE 3000</td>
<td>Civil Engr Systems</td>
<td>MATH 2401</td>
</tr>
<tr>
<td>CEE 3010</td>
<td>Geomatics</td>
<td>CS 1371, CEE1770, MATH 2401</td>
</tr>
<tr>
<td>CEE 3020</td>
<td>Civil Engr Materials</td>
<td>COE 3001</td>
</tr>
<tr>
<td>CEE 3040</td>
<td>Fluid Mechanics</td>
<td>CEE 2040</td>
</tr>
<tr>
<td>CEE 3340</td>
<td>Environ. Eng. Laboratory</td>
<td>CEE 2300, CHEM 1310, BIOL 1510</td>
</tr>
<tr>
<td>CEE 3770</td>
<td>Statistics&amp; Applications</td>
<td>MATH 2401</td>
</tr>
<tr>
<td>CEE 4090</td>
<td>Capstone Design</td>
<td>none</td>
</tr>
<tr>
<td>CEE 4100</td>
<td>Construction Engr &amp; Mgt</td>
<td>none</td>
</tr>
<tr>
<td>CEE 4200</td>
<td>Hydraulic Engineering</td>
<td>CEE 3040</td>
</tr>
<tr>
<td>CEE 4210</td>
<td>Hydrology</td>
<td>CEE 3040</td>
</tr>
<tr>
<td>CEE 4230</td>
<td>Environ Transport Model</td>
<td>CEE 4200</td>
</tr>
<tr>
<td>CEE 4300</td>
<td>Environmental Engr Sys</td>
<td>BIOL 1510, CHEM1310</td>
</tr>
<tr>
<td>CEE 4310</td>
<td>Water Quality Engr</td>
<td>CEE 4300</td>
</tr>
<tr>
<td>CEE 4320</td>
<td>Hazardous Substance Engr</td>
<td>CEE 3040, CEE4300</td>
</tr>
<tr>
<td>CEE 4330</td>
<td>Air Pollution Engr</td>
<td>CEE 4300</td>
</tr>
<tr>
<td>CEE 4395</td>
<td>Environ. Sys. Design Project</td>
<td>CEE 4300</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Prerequisites</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>CEE 4400</td>
<td>Geosystems Engineering</td>
<td>COE 3001</td>
</tr>
<tr>
<td>CEE 4420</td>
<td>Subsurface Characterization</td>
<td>CEE 4400</td>
</tr>
<tr>
<td>CEE 4600</td>
<td>Transportation Plan&amp;Dsgn</td>
<td>MATH 2401, CS 1371</td>
</tr>
<tr>
<td>CEE 4620</td>
<td>Environ Impact Assess</td>
<td>none</td>
</tr>
<tr>
<td>CEE 4795</td>
<td>Groundwater Hydrology</td>
<td>(MATH 2403 and PHYS 2212 and CEE 3040) or EAS 3630</td>
</tr>
<tr>
<td>CHBE 2110</td>
<td>Chemical Engineering Thermodynamics I</td>
<td>CHBE 2100, CHBE 2120, BIOL 1510</td>
</tr>
<tr>
<td>CHBE 3200</td>
<td>Transport Processes I</td>
<td>CHBE 2110, CHBE 2120, MATH 2403, PHYS 2211</td>
</tr>
<tr>
<td>CHEM 1315</td>
<td>Survey of Organic Chem</td>
<td>CHEM 1310</td>
</tr>
<tr>
<td>CHEM 3281</td>
<td>Instrumental Analysis for Engineers</td>
<td>CHEM 2380, CHEM 3412</td>
</tr>
<tr>
<td>CHEM 3411</td>
<td>Physical Chemistry I</td>
<td>CHEM 1310</td>
</tr>
<tr>
<td>CHEM 3511</td>
<td>Survey of Biochemistry</td>
<td>CHEM 1315, CHEM 2312</td>
</tr>
<tr>
<td>CHEM 4740</td>
<td>Atmospheric Chemistry</td>
<td>CHEM 1311, CHEM 1312, PHYS 2211, MATH 2401</td>
</tr>
<tr>
<td>COE 2001</td>
<td>Statics</td>
<td>MATH 1502, PHYS 2211</td>
</tr>
<tr>
<td>COE 3001</td>
<td>Deformable Bodies</td>
<td>COE 2001</td>
</tr>
<tr>
<td>CP 4210</td>
<td>Envir Plan&amp;Impact Assess</td>
<td>none</td>
</tr>
<tr>
<td>CP 4510</td>
<td>Geographic Info Sys</td>
<td>none</td>
</tr>
<tr>
<td>EAS 3603</td>
<td>Thermodynamics-Earth Sys</td>
<td>MATH 2401, PHYS 2212</td>
</tr>
<tr>
<td>EAS 4420</td>
<td>Environmental Field Meth</td>
<td>EAS 2600, (EAS 3630 or EAS3640 or EAS 3650)</td>
</tr>
<tr>
<td>EAS 4430</td>
<td>Remote Sensing &amp; Data Analysis</td>
<td>PHYS 2212</td>
</tr>
<tr>
<td>EAS 4610</td>
<td>Earth System Modeling</td>
<td>(EAS 3601 or EAS 3602 or EAS 3620 or EAS 3630)</td>
</tr>
<tr>
<td>EAS 4740</td>
<td>Atmospheric Chemistry</td>
<td>CHEM 1311, CHEM 1312, PHYS 2211, MATH 2401</td>
</tr>
<tr>
<td>ECE 3710</td>
<td>Circuits &amp; Electronics</td>
<td>PHYS 2212</td>
</tr>
<tr>
<td>ECE 3741</td>
<td>Instrum &amp; Electronic Lab</td>
<td>ECE 3710</td>
</tr>
<tr>
<td>ME 4171</td>
<td>Environmental Dsgn &amp; Mfg</td>
<td>none</td>
</tr>
<tr>
<td>ME 4172</td>
<td>Dsgn Sustainable Eng Sys</td>
<td>none</td>
</tr>
<tr>
<td>ME 4782</td>
<td>Biosystems Analysis</td>
<td>MATH 1502</td>
</tr>
</tbody>
</table>

\(^7\)Elective course prerequisites that are not required in the B.S.EnvE. degree program may be fulfilled by students via their approved elective hours.

d. Not applicable.

e. All courses have met institutional requirements for approval. New course proposals are presented in [Appendix I](#).
f. The Accreditation Board for Engineering and Technology (ABET) general criteria and program criteria for Environmental Engineering degree programs can be found in Appendix II.

g. Internships and field experience are not required.

h. The B.S.EnvE. degree is patterned after existing engineering B.S. degree programs at Georgia Tech, all of which have achieved ABET accreditation. In addition, the curriculum of several leading Environmental Engineering undergraduate programs were examined during the development of the proposed program.

i. Student Outcomes

- Graduates will obtain the broad education necessary to understand the impact of environmental engineering solutions in a global and societal context consistent with the principles of sustainable development.
- Graduates will demonstrate an ability to solve engineering problems in practice by applying fundamental knowledge of mathematics, science, and engineering, and by using modern engineering techniques, skills, and tools.
- Graduates will demonstrate an ability to identify, formulate, and solve environmental engineering problems, particularly the planning, design, construction, and operation of systems, components, or processes that meet specified performance, cost, time, safety, and quality needs and objectives.
- Graduates will be able to design and construct experiments, and to analyze and interpret data.
- Graduates will be able to function and communicate effectively, both individually, and within multidisciplinary teams.
- Graduates will obtain a solid understanding of professional and ethical responsibility and will recognize the need for and ability to engage in life-long learning.
- Graduates will experience an academic environment that facilitates and encourages learning and retention.
Section 5: Inventory of Faculty Involved

The faculty involved in the proposed Environmental Engineering undergraduate degree are primarily in the School of Civil & Environmental Engineering (CEE). CEE currently offers three graduate degrees in Environmental Engineering (a Master of Science in Environmental Engineering (M.S.Env.E.), an undesignated Master of Science (M.S.), and a Doctor of Philosophy (Ph.D.)), and therefore has a strong core of faculty expertise. Additional faculty members that will be involved in the undergraduate program are located in several Schools in the College of Sciences and College of Engineering, as noted. No additional faculty members are needed to implement the proposed undergraduate degree program in Environmental Engineering.

School of Civil & Environmental Engineering
Aral, Mustafa – Professor
Assimaki, Dominic – Assistant Professor
Bergin, Michael – Associate Professor
Burns, Susan – Associate Professor
Ellingwood, Bruce – College of Engineering Distinguished Professor
Fritz, Hermann – Assistant Professor
Frost, David – Professor and Director of GT Savannah
Garrow, Laurie – Assistant Professor
Georgakakos, Aris – Professor
Germanovich, Leonid – Professor
Guensler, Randall – Professor
Haas, Kevin A – Assistant Professor
Huang, Ching-Hua – Assistant Professor
Hughes, Joseph – School Chair and Professor
Jacobs, Laurence – Professor and Associate Chair for Undergraduate Studies
Kim, Jaehong – Assistant Professor
Kurtis, Kimberly – Associate Professor
Löffler, Frank – Associate Professor
Mayne, Paul – Professor
Meyer, Michael – Professor
Mulholland, James – Associate Professor
Pavlostathis, Spyros – Professor
Pennell, Kurt – Associate Professor
Rix, Glenn – Professor
Roberts, Philip – Professor
Rodgers, Michael – Principal Research Scientist and Adjunct Professor
Rosenstein, Lisa – Academic Professional
Russell, Armistead – Georgia Power Distinguished Professor
Santamarina, Carlos – Professor and Goizueta Foundation Faculty Chair
Saunders, Michael – Professor and Associate Chair, Associate Director for GT Savannah
Sotiropoulos, Fotis – Professor
Spain, Jim – Professor
Stieglitz, Marc – Associate Professor
Sturm, Terry – Professor
Webster, Donald – Associate Professor
Webster, Peter – Professor
Work, Paul – Associate Professor
Yiacoumi, Sotira – Professor

School of Biology
Weissburg, Marc – Associate Professor and Chair of Undergraduate Committee

School of Chemistry and Biochemistry
Bottomley, Lawrence – Professor and Director of Undergraduate Studies

School of Chemical and Biomolecular Engineering
Koros, William – Professor and Robert C. Goizeuta Chair
Schork, Joseph – Professor and Associate Chair for Undergraduate Studies

See Appendix III for a list of faculty Curriculum Vitae.
Section 6: Outstanding Undergraduate Environmental Engineering Programs at Peer Institutions

The top four undergraduate degree programs in Environmental Engineering, based on the *U.S. News and World Report*’s rankings, are summarized in this section. The information provided below was obtained from the respective school or department web sites.

1. **Stanford University**, Stanford, CA, Department of Civil and Environmental Engineering
   Degree Name: Environmental Engineering (B.S.), ABET accredited since 2004 (ranked #1 nationally among schools offering Ph.D.)

   “The Environmental Engineering profession works to protect and manage our air, water, and energy resources. Environmental engineers quantitatively analyze the environmental changes that inevitably result from human activities, designing strategies to remediate problems, minimize impacts, and measurably improve environmental quality. The Environmental Engineering field is refreshingly multi-disciplinary in nature, combining fundamental principles drawn from physics, chemistry, geology and biology with analytical methods. Practitioners focus on developing devices, techniques and solutions that can effectively address a variety of real-world environmental problems. The mission of the Civil and Environmental Engineering department is to educate the next generation of societal, industrial, and academic leaders and discover knowledge that advances the state of the profession.”

   The Stanford Environmental Engineering degree, ABET-accredited in 2004, is based on core engineering and water resources coursework, with expanded chemistry requirements (3 courses), similar to the program proposed herein. The most striking differences are in the upper-level electives, with Stanford requiring 3 breadth (selected from 10 courses) and up to 3 free electives. In contrast, we have developed groups of advanced electives in specific areas (e.g., bioremediation, air pollution, and water resources), as well as technical and design electives, which culminates in a capstone design experience.

2. **Massachusetts Institute of Technology (MIT)**, Cambridge, MA, Department of Civil and Environmental Engineering
   Degree Name: Environmental Engineering Science (B.S.), ABET accredited since 1993 (ranked #2 nationally among schools offering Ph.D.)
   Undergraduate Program Contact: Prof. Ole Madsen, phone: 617-453-2721
   Department website: http://cee.mit.edu/

   “There is increasing demand for engineers who understand how to make best use of limited resources in the products and services they design. The department's new undergraduate program recognizes this by providing background in science and engineering fundamentals while also emphasizing hand-on design projects and case studies that provide context and motivation. Students are taught how to combine theory,
measurement, and modeling to develop a good understanding of the problem at hand and to point the way to desirable solutions.

The Department offers ABET accredited undergraduate degrees in Civil Engineering (1C) and Environmental Engineering (1E) as well as a more flexible Civil and Environmental Engineering degree (1A) for students who do not need ABET accreditation (e.g. pre-meds or students interested in careers in research). All three degrees share a common core, usually taken in the sophomore year, which includes subjects in ecology, mechanics, mathematics, and design. In the junior and senior years students build on the core by taking more specialized subjects in the three degree tracks. There is ample room for individual choice since the departmental unit requirements are among the lowest in the MIT School of Engineering (180-183 units beyond GIRs). This also provides the flexibility needed for minors, study abroad and exploration of interests outside engineering.”

Although the MIT core curriculum (freshman and sophomore years) is generally consistent with that of other programs, the number and breadth of upper-level Environmental Engineering courses is minimal, and there appears to be no attempt to offer upper level electives with a particular specialization.

3. University of Michigan, Ann Arbor, MI, Department of Civil & Environmental Engineering
Degree Name: Civil Engineering (B.S.), ABET accredited since 1936, specific degree program in Environmental Engineering not offered, environmental technical electives taken in senior year.
(ranked #3 nationally among schools offering Ph.D.)
Undergraduate Program Contact: Prof. Radoslaw Michalowski, Phone: 734-764-4106
Department website: http://www.engin.umich.edu/dept/cee/

“Civil and Environmental Engineering at the University of Michigan is an integrated discipline aimed at creating harmony between the natural and built environments and mitigating natural and man-made hazards. Our mission is to educate the leaders who will design the future infrastructure systems, protect the environment, and engineer a quality of life on a global scale. Our students learn how to fabricate new materials for infrastructure systems that improve security, reliability, and sustainability by engaging multidisciplinary groups, and encouraging technical and non-technical collaborations. Our students also learn how to develop microfluidics sensors and couple bioremediation with physicochemical processes for enhanced treatment of hazardous waste sites. Furthermore, our students learn how to deal with ambiguities in problem definition and contingencies in the process of problem solving. Upon graduation, our students are ready to lead an adaptive, rapidly changing organization, in which engineers of diverse specialties are brought together to act conjunctively and optimize their product by continuous improvement.”

University of Michigan provides a traditional Civil Engineering curriculum, with students given the opportunity to select 3 electives from 5 Civil Engineering disciplines in their
senior year. There is not a separate degree program or concentration of courses in Environmental Engineering other than two senior-level electives. It is reasonable to conclude that the recognition and reputation of the undergraduate Environmental Engineering program is based, in large part, on the Environmental and Water Resources Engineering graduate program, which has been consistently ranked in the top 3-4 by *U.S. News and World Report*.

4. **University of Illinois at Urbana-Champaign**, Urbana, IL, Department of Civil & Environmental Engineering  
Degree Name: Civil Engineering (B.S.), ABET accredited since 1936, offers a specific degree program in Environmental Engineering. (ranked #4 nationally among schools offering Ph.D.)  
Department website: http://cee.uiuc.edu/; http://cee.uiuc.edu/environmental/

“Environmental engineers have taken an increasingly important role in activities of the world in recent years, because of the problems related to air, land, and water contamination. Environmental engineers provide treatment facilities that render industrial and human wastes free from contaminants. They design, construct, and operate systems that purify water for drinking, industrial, and recreational uses. They also develop and implement air purification devices and models that describe the transport, transportation, and removal of contaminants in the atmosphere. Solid and hazardous waste management protocols are also developed and implemented by environmental engineers. Many environmental engineers develop plans and conduct research to solve problems related to our rapidly changing technological society and expanding human population. At the undergraduate level at the University of Illinois, Environmental Engineering is a specialization area for students seeking a B.S. degree in the Department of Civil and Environmental Engineering. The undergraduate Civil and Environmental Engineering program plan includes both primary and secondary areas of technical specialization. Students whose principal interest is Environmental Engineering take this area as their area of primary specialization. Environmental Engineering is also available as a secondary area to students whose primary area is some other field in Civil Engineering.”

Although University of Illinois does not offer an ABET-accredited undergraduate degree in Environmental Engineering, a distinct undergraduate program is offered which is very similar to that proposed herein, in particular the inclusion of primary and secondary technical electives at the upper levels. One important distinction is that Illinois allows students to select 2 science/math/engineering courses from a list of 7 (e.g., Elementary Organic Chemistry, Geology for Engineers, Thermodynamics), whereas the curriculum proposed herein requires almost all of these courses to ensure essential background information necessary for advanced applications of chemical and biological principles in Environmental Engineering.
Section 7: Library Resources

Students in the B.S.Env.E. program will have unrestricted access to the Georgia Tech library. Given the existing vibrant M.S., M.S.Env.E., and Ph.D. programs in Environmental Engineering, the library currently possesses an extensive collection of books and other materials and subscribes to the important research journals relevant to the Environmental Engineering field. The faculty of the School of Civil & Environmental Engineering will continue to provide advice to the library staff regarding future acquisition and development plans as the field evolves and matures. No significant holding acquisitions are anticipated specifically related to the proposed B.S.Env.E. degree program.

The Georgia Institute of Technology Library Resources

The Georgia Tech Library and Information Center (www.library.gatech.edu), located on Bobby Dodd Way on the Georgia Tech campus, houses collections of scientific and technical information. It includes over 3.5 million volumes, 2.6 million technical reports, and 700,000 government documents. It is an official depository of the U.S. Government Printing Office and U.S. Patent and Trademark Office. The Library’s goals include increasing the amount and quality of information available on the desktop, increasing productivity, and creation of a rich learning environment for students.

The catalog record of the library’s collections is part of the Georgia Tech Electronic Library (GTEL®) and is used by faculty, staff, and students through the campus network. GTEL® also contains abstracts and indexes to contents of journals and conference proceedings in general areas, as well as engineering, science, computing, business, and management. GTEL® is complimented by a campus-wide delivery service of library materials to faculty and staff.

The library has access to over 200 databases of citations, abstracts, full text, and numeric data through Galileo, which is funded by the state. The library’s corporate and research services department offers fee-based services to teaching and research faculty on campus and to individuals and businesses outside Georgia Tech. These services include research services, database searching, and reports on specific subjects tailored to meet client needs.

The Institute’s membership in the Atlanta Regional Consortium for Higher Education allows access to and delivery of materials from 13 other libraries in the area. Georgia Tech, Emory University, the University of Georgia, and Georgia State University participate in a reciprocal borrowing program to enhance access to information resources for the students and faculty. Georgia Tech students and faculty also may use the libraries of all other institutions in the University System.

The Library is a member of the Association of Research Libraries, Online Computer Library Center (OCLC), Solinet, International Association of Technological University Libraries, and the International Federation for Information and Documentation.
Section 8: Qualifications of Students

The recruitment and admission of undergraduate students to pursue programs leading to a B.S. degree in Environmental Engineering is the responsibility of the Office of Undergraduate Admission. That office will apply policies and procedures that are approved by the Office of the President and the Board of Regents of the University System of Georgia. Preference for admission will be given to qualified residents of the State of Georgia.

To be eligible for admission, students will be required to the following high school courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>4</td>
</tr>
<tr>
<td>Algebra</td>
<td>1</td>
</tr>
<tr>
<td>Plane Geometry</td>
<td>1</td>
</tr>
<tr>
<td>Advanced Algebra(^1)</td>
<td>1/2</td>
</tr>
<tr>
<td>Trigonometry(^1)</td>
<td>1/2</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory Science</td>
<td>2</td>
</tr>
<tr>
<td>Foreign Language(^2)</td>
<td>2</td>
</tr>
<tr>
<td>Social Science</td>
<td>3</td>
</tr>
<tr>
<td>Additional Academic Courses(^3)</td>
<td>4</td>
</tr>
</tbody>
</table>

\(^1\)The title of the course is not important. All students should have a sufficient background to be able to schedule introductory calculus during their first term at Georgia Tech. At least one-half year of trigonometry is essential.

\(^2\)Two courses in one language emphasizing speaking, listening, reading, and writing are required.

\(^3\)In order to determine whether or not a course qualifies as “academic,” students attending Georgia public high schools should consult their high school counselor for an approved definition. All other students should refer to their high school’s definition of “academic” courses.

All applicants for admission must take the Scholastic Assessment Test (SAT) or the American College Test (ACT).
Section 9: Facilities

The School of Civil & Environmental Engineering has an extensive infrastructure in support of its research and teaching missions. School operations are spread among five buildings. The School hosts sixteen specialized research laboratories across all disciplines of Civil and Environmental Engineering. We are proud of our alumni and industrial support for our many classrooms and offices. The School operates and maintains unique equipment not available to other Schools.

Buildings
The School of Civil & Environmental Engineering conducts its business in several building on the Georgia Tech Campus.

Mason Building - The Jesse W. Mason Building was completed in 1969 and is the main building of the School. The entire complex consists of a 5-story building with an appended 2-story high-bay building, totaling about 51,000 sqft. The building contains classrooms, offices, research laboratories, and the main administrative offices of the School. The Mason Building is named for Jesse Mason, Dean of the College of Engineering during the early 1950's.

Lamar Allen Sustainable Education Building (SEB) - The Lamar Allen Sustainable Education Building (SEB) is a 30,000 sq. ft. building that is intended to serve as a “living laboratory” for the education, research, and application of sustainable technologies. SEB was constructed using some of the most up-to-date sustainable materials - products that are produced in a more environmentally sound way and will last longer - available in Georgia. The Sustainable Education Building was built from top to bottom with sustainability principles in mind, adhering to many of the ideas that are now taught inside Tech classrooms. From the networking capabilities to the concrete, the building was built through donations from about 40 businesses and individuals. Opened in 1998, the $4 million facility has a multimedia theater, research labs, computer centers and faculty offices for the School. The building is named for Mr. O. Lamar Allen. Mr. Allen was the visionary who conceived the idea of the SEB to educate future engineers who better understand the relationship between economic development, technology, and the environment. Mr. Allen had the vision of creating a building at Georgia Tech where the areas of environmentally-conscious design could come together with manufacturing and sustainable technologies. Mr. Allen's business leadership helped pull together the consortium of donors to fund the SEB. Mr. Allen died at the age of 49 together with his 16-year-old son, Ashton Lamar Allen, in the explosion of TWA Flight 800 off Long Island, New York on July 17, 1996.

Daniel Laboratory Building - The Daniel Environmental Engineering Laboratory (DEEL) was constructed in 1942 and completely renovated in 1995. Originally housing the Chemistry Program at Georgia Tech, the building was reassigned to the Sanitary Engineering Program in 1972. DEEL is an excellent wet-lab facility in a three-story building with approximately 14,500 sq. ft. of usable floor space. The renovation of DEEL was completed with grants to the Environmental Engineering program from the
National Science Foundation and the Georgia Research Alliance and with funding from the Board of Regents. The laboratory has extensive analytical capabilities to support educational and research missions within the Environmental Engineering program.

**Ford Environmental Science and Technology Building** - The Ford Environmental Science and Technology Building (Ford ES&T), the largest academic building at Tech with 287,000 sq. ft., is named for its principal donor, the Ford Motor Company. Dedicated in 2002, the Ford ES&T Building is the second of four to open in the Institutes interdisciplinary Life Sciences and Technology Complex. The building contains classrooms and research facilities for the Schools of Chemical & Biomolecular Engineering, Civil & Environmental Engineering, and Earth & Atmospheric Sciences as well as the disciplines of environmental biology and chemistry. It also holds space for the Advanced Technology & Development Center. The $58 million Ford ES&T Building was built with a combination of state and private funding, with $38 million coming from the State of Georgia, $15 million from private donors and $5 million from the Georgia Research Alliance. The faculty, staff and students in Environmental Engineering have approximately 19,000 sq. ft. of space in the ES&T facility.

**Structures Laboratory** - The Structural Engineering and Materials Laboratory supports experimental research, testing, and evaluation capabilities in separate building with a total area of approximately 18,000 sq. ft. The facility includes a strong floor 174 ft. long, with widths ranging from 41 ft. to 53.5 ft., for a total testing area of over 8,000 sq. ft. The facility is also used for laboratory instruction, specifically for CEE 3020: Civil Engineering Materials.

**Rooms and Offices**
The following is a listing of unique and/or named offices within the School.

**C. Edward Crawford ASCE Student Chapter Office (SEB 101)** - The Crawford Office is the home of Student Chapters of ASCE and Chi Epsilon. The C. Edward Crawford office is named for C. Edward Crawford, CEE Class of 1953.

**Charles H. Jones Auditorium (ES&T L1255)** - The Charlie Jones Auditorium was dedicated for Charlie Jones (BSCE 1952) in 2003 in honor of his support of the School and the Environmental Engineering program. The auditorium holds 90 occupants and has an advanced PC-based lectern and AV system. This auditorium frequently serves the program for Distinguished Lectures, as well as seminars and large-undergraduate classes (e.g., CEE 2300, Environmental Engineering Principles).

**Darby Classroom (SEB 121)** - The Darby Classroom supports computer-based instruction. The Darby Classroom seats 40 people, and contains 20 computer workstations, a high-intensity overhead projector, and several white boards. The Darby Classroom is named for G. Derrick Darby, CEE Class of 1979.

**Instructional Computer Laboratories (Mason 297, 298)** - These teaching laboratories support course and short course needs of the School.
Marvin G. Mitchell Chair's Suite - The Marvin G. Mitchell Chair's Suite houses the Chair and other administrative functions within the School. The Mitchell Chair's Suite is named for Mr. Marvin G. Mitchell, CEE Class of 1939.

Mason 142A - Mason 142A is a general purpose classroom that seats 50. The classroom houses a fixed high-intensity overhead projector and may connect to remote facilities via TCP/IP.

Mason 311 - Mason 311 is a general purpose classroom that seats 36. The classroom houses a fixed high-intensity overhead projector.

Mason 312 - Mason 312 is a general purpose classroom that seats 40. The classroom houses a fixed high-intensity overhead projector.

Mason 519 - Mason 519 is a general purpose classroom that seats 60.

Richard C. Tucker Sr. Lecture Hall (Mason 142B) - The Richard C. Tucker Lecture Hall seats 80 students in a graduated-floor, fixed table setting. The Tucker Lecture Hall contains white boards and a high-intensity overhead computer display system for electronic presentations. The lecture hall is named for Richard C. Tucker, Sr. Mr. Tucker graduated from Georgia Tech with a B.S.C.E. in 1964 and a M.S.C.E. in 1965.

SEB 316 - SEB 316 is a general purpose classroom that seats 40. The classroom houses a fixed high-intensity overhead projector.

SEB Conference Room - The SEB conference room is a fully equipped conference room with computer projection and distance conferencing capabilities. The conference room facilities are used often by faculty and students in sharing both educational and research information with others off campus.

Sun Microsystems Theater (SEB 110) - The Sun Microsystems Theater is a distance learning classroom that facilitates GSAMS (the State of Georgia Distance Education network) and TCP/IP connections to remote facilities. Camera projection provides live instruction from the Georgia Tech Atlanta campus to remote students. The room is operated with a faculty member and technology facilitator who handles the equipment requirements and camera angles and exposures to ensure proper delivery of the classroom material. The room contains computers for every two students, a SmartBoard for both projection and large display of information in addition to the normal computer presentation capabilities found in all of the School's classrooms.

Tellepsen Classroom (SEB 102) - The Tellepsen Classroom supports computer-based instruction. The classroom can seat 40 people, and contains 20 computer workstations, a high-intensity overhead projector, and several white boards. The Tellepsen Classroom is named for Howard T. Tellepsen, Jr., Class of 1966.
Transportation Systems Library (SEB 217) - The Transportation Library at Georgia Tech houses an almost complete collection of TRB and NCHRP Reports, prior dissertations of GT graduates, and assorted environmental impact reports. The Transportation Library also houses a multimedia presentation podium and can be used for small presentations and meetings.

Computing Infrastructure

Information Systems - The Information Systems Group (ISG) focuses on installing, operating, securing, and maintaining information systems within the School. ISG assists faculty with computer selection, procurement, and installation. ISG supports web, mail, data access services, and other computer services required by the research and academic missions of the School of CEE.

Computer Labs - Computer labs are essential in supporting teaching and providing hands-on experience to the students with software used in the industry. ISG maintains more than one hundred computers spread among 4 computer labs available to students: Mason 297 contains 40 Pentium 4 class machines, SEB 102 houses 40 Pentium 4 class machines, SEB 121 houses Pentium 4 class machines, and ES&T houses 8 Pentium 4 class machines. In most cases, each of these computers is equipped with LCD screens. Software such as Autocad, Solid Edge, Matlab, Mathcad, SPSS, Gauss, Biowin are installed in all the labs and available to students and faculty. Several heavy duty laser printers (black and white or color) as well as plotters are also available. The Mason and SEB labs are equipped with swipe card readers to provide after hour access to students.

Desktops and Workstations - ISG currently maintains close to 1,000 computers ranging from regular desktops to state of the art multi-CPU workstations to conduct intensive simulations. ISG also maintains High Performance Computing (HPC) facilities for several research groups.

Network Infrastructure - The School of CEE network is based on a Gigabit backbone in order to support the multiple research activities, collaboration projects, and distance learning initiative. Every computer is provided with a 100MB full duplex connection.
Section 10: Administration

The proposed degree program will be administered by the School of Civil & Environmental Engineering (CEE). The School is one of nine schools within the College of Engineering at Georgia Tech. Overall administration of the program will be overseen by Dr. Joseph Hughes (CEE Chair) and Dr. Laurence Jacobs (CEE Associate Chair of Undergraduate Programs). Curriculum issues will be administered by the existing CEE Undergraduate Committee and a proposed sub-committee specific for the B.S.Env.E. A flow chart of the proposed administration hierarchy is shown in Figure 1.

The CEE Chair appoints an Undergraduate Curriculum Committee within the School (current members: Drs. Don Webster, Chair, Adjo Amekudzi, Leonid Germanovich, Kurt Pennell, Lisa Rosenstein, Larry Kahn, Sotira Yiacoumi). The Associate Chair of Undergraduate Programs is an ex-officio member of the committee. The specific responsibilities for the Undergraduate Curriculum Committee include consideration of all proposed new courses, texts, curricula modification, and program activities. In addition, the Undergraduate Curriculum Committee is responsible for establishing guidelines for accepting transfer students and the continued development and monitoring of assessment measures for the undergraduate program. The committee presents all of its recommendations to the full faculty of the School for discussion and decision. The Undergraduate Curriculum Committee meets several times per semester.

A B.S.EnvE. Curriculum Sub-committee will provide specific oversight of the proposed degree. The CEE Chair will appoint members to the sub-committee, which will be chaired by Dr. Kurt Pennell. Members will include CEE faculty and representatives of the Schools of Biology, Chemistry & Biochemistry, and Earth & Atmospheric Sciences. The Sub-committee will make recommendations to the CEE Undergraduate Curriculum Committee, which will consider all recommendations via existing procedures.

The proposed B.S.EnvE. curriculum has been developed with recognition of the need to minimize additional resource requirements above those currently allocated to CEE. Student course and degree requirement approvals will be handled by existing staff members in the existing CEE Office of Student Services. Additional student services will be handled through the CEE Office of Student Services and the Georgia Tech Dean of Students Office.
Figure 1: Flow Chart of Proposed Administration for B.S.Env.E.
Section 11: Assessment

Assessment of the proposed degree program will occur on a systematic basis. First, at the most basic level, student evaluation of individual courses provides a basic benchmark on the degree to which courses in the curriculum are successfully conveying the desired knowledge. Second, at a more general level, measures such as the percentage of CEE students taking and passing the FE exam (the pass rate during the years 2003-2004 averaged 84%), the level of satisfaction expressed by employers and alumni with our graduates through surveys, and faculty assessment of student abilities in teamwork and communications provide an ongoing assessment of the degree to which we are successfully meeting our objectives. Areas of importance to the industry, e.g., computer-aided engineering, sustainable development, new materials, and environmental impact assessment, are either incorporated into existing courses or offered in elective courses. Thus, we have the flexibility in the curriculum to incorporate new ideas and concepts that surface from our ongoing assessment process.

Our assessment strategy incorporates a regular and systematic review of information obtained from students, faculty, alumni, recruiters, employers, the School’s external advisory board, and universities that recruit our students for graduate school. The nature of this information varies from highly formal questionnaires completed by one or more of the sources to ad hoc communications, often oral, involving various aspects of the environmental engineering program. These serve as vehicles for communicating trends in enrollments, developing pedagogies, and student activities at the participating institutions.

The following is a list of specific assessment elements evaluated by the School:

Course Grades
Course grades are the most direct measure of whether or not a student demonstrates the outcomes required for the graded courses. Grades are based, in large part, on a student’s ability to perform on exams, write lab reports, construct solutions to homework assignments and term projects, and meet other criteria defined for each course.

Student Evaluations of Teaching
Results of an institute-conducted student evaluation of teaching (Course-Instructor Opinion Survey) by the students in each section of each course each semester offers a measure of the quality of teaching and testing in each course. The School Chair uses the results in the annual evaluations of each faculty member. While the survey contains information about many facets of the course, emphasis is given to the item stating that the “instructor was an effective teacher.”

Oral Presentations
Students in CEE are given many opportunities to create and deliver individual and group presentations. The first opportunity comes in CEE 3000 – Engineering Systems, where students deliver a final group presentation analyzing an engineered system. Additionally, many junior and senior Civil & Environmental Engineering courses incorporate a final
presentation as part of the course requirements. The final opportunity comes in our Capstone Design course, CEE4090, where each design group presents its proposed design to the project sponsors and the course instructors.

Exit Surveys
Graduating seniors are required to complete an Exit Survey, in which they give their views on various aspects of their educational experience. The Exit Survey for the proposed B.S.Env.E. degree is presented in Appendix IV. The survey asks students to assess their preparation in the various areas of environmental engineering, the effectiveness of the faculty members, the students’ preparation in non-technical skills such as oral presentation, the quality of the learning environment, and the effectiveness of our advising program.

Exit Interviews
While the Exit Survey provides useful information on the views of the graduating seniors on their educational experience, some items cannot be addressed easily in a written survey. For this reason, the Associate Chair for Undergraduate Programs meets with members of each graduating class for exit interviews. The entire graduating class is invited to attend an informal group discussion. While there is a list of “talking points” to generate discussion, the interviews cover any items that the students feel are important. The results of the interviews are summarized by the Associate Chair and reported to the School Chair. In compiling the results, the Associate Chair focuses on common themes expressed by multiple students. In the past, the exit interviews are helpful in obtaining additional information on issues which arise on the exit survey. For instance, students expressed a desire to have a copying facility available for their use in the Mason Building, and a low-cost copying machine was installed on the second floor in October 2001.

Alumni Surveys
The perspective of the graduating seniors may change after a few years of practicing their profession; therefore, an Alumni Survey is completed every four years of students who have graduated three to five years previously. The longer-term perspective of the respondents provides us a broader view of the quality of our program. Data from these surveys are compiled and compared with previous surveys. They are then reported to the members of the faculty with recommendations for actions toward improvement in the program.

Closing the Loop
These assessment tools used to evaluate the level of achievement of the program outcomes are applied systematically and the results analyzed against performance criteria established to determine success by the School’s Undergraduate Curriculum Committee and the School Chair. When the data collected by one or more assessment tools indicate a program weakness, the Undergraduate Curriculum Committee formulates options to remedy the weakness or weaknesses. These options are then presented to the faculty for discussion, refinement, and implementation. The assessment tools and their acceptability criteria are periodically re-evaluated to ensure that they remain valid indicators of the achievement of program outcomes.
Section 12: Accreditation

The accreditation agency for the degree program is the Accreditation Board for Engineering and Technology (ABET). ABET’s most current general criteria (Criteria 1 – 7) for basic level programs as well as program criteria (Criterion 8) for Environmental Engineering can be found in Appendix II. The following details how the proposed degree program meets these ABET criteria.

The expected student outcomes (Section 4.2i) as well as the assessment of the program (Section 11) were formulated to specifically address ABET Criteria 1, 2, and 3. These outcomes and assessment measures were based on the existing ABET-approved degree program in Civil Engineering within the School of Civil & Environmental Engineering. The core curriculum requirements of the College of Engineering at Georgia Tech are designed to meet ABET Criterion 4.

Criteria 5, which states the need for sufficient faculty size with a sufficiently broad range of expertise and proper facilities, is addressed in Section 5. Section 9 addresses the facilities available to the School of Civil & Environmental Engineering, which are sufficient for the program to satisfy Criterion 6. Criterion 7 raises the issues of the availability of adequate institutional support and financial resources. Section 15 of this proposal specifically addresses these issues.

Criterion 8 contains specific program criteria for the Environmental Engineering degree programs. We are confident that the required courses in the proposed curriculum, as shown in Tables 4-1, 4-2 and 4-3 of Section 4, will satisfy ABET’s curriculum requirements.

Following Board or Regents approval, the proposed program will be implemented and students will be recruited. Upon completion of the degree requirements by the first graduating class, the program will be submitted to ABET for accreditation consideration. Coincidentally, we will work with ABET to remove accreditation of the M.S.Env.E. program.
Section 13: Affirmative Action Impact

The School of Civil & Environmental Engineering operates in conformance to the affirmative action policies, procedures, and objectives of Georgia Tech. Georgia Tech has a diverse student body and is in compliance with all federally-mandated affirmative action requirements. Recruitment of undergraduate students for the B.S. degree will reflect a commitment to achieving a diverse and representative population. Faculty and staff recruitment and hiring has a similar commitment from Georgia Tech’s administration.

It is anticipated that this B.S. program will attract a significant number of female and minority students. In Fall 2005, of the approximately 7026 students pursuing undergraduate engineering degrees at Georgia Tech, about 20.4% are female and 13.3% are under-represented minorities. It should be noted that Georgia Tech is one of the leaders in the nation in graduating minority engineers.
Section 14: Degree Inscription

The degree will read: “Georgia Institute of Technology Bachelor of Science in Environmental Engineering” and will be signed by the President and Registrar of Georgia Tech, as well as the Chancellor of the University System of Georgia. The CIP Code will be 14.1401 (Environmental Engineering).
Section 15: Fiscal and Enrollment Impact and Estimated Budget

The B.S. degree will be a part of the overall educational and research activities of the School of Civil & Environmental Engineering (CEE) at Georgia Tech. Thus, in the tabulated enrollment and fiscal data, we focus on those aspects that are incremental to CEE as a result of the proposed B.S. degree, highlighting data specific to Georgia Tech.

Need table in BOR format
Appendix I

New course proposals for CEE3340 Environmental Engineering Laboratory and CEE4395, Environmental Systems Design Project are on the following pages.
**NEW COURSE PROPOSAL**

**SCHOOL, DEPARTMENT, COLLEGE:** School of Civil & Environmental Engineering  
**DATE:** April 8, 2005

<table>
<thead>
<tr>
<th>Proposed Course Number: CEE 3340</th>
<th>2. Hours: <strong>LECTURE</strong> 2 <strong>LAB/RECITATION</strong> 3 <strong>SEMESTER CREDIT</strong> 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive Title: <strong>Environmental Engineering Laboratory</strong></td>
<td></td>
</tr>
<tr>
<td>Recommended Abbreviation for Transcript – (24 characters including spaces):</td>
<td><strong>E N V I R O N M E N T A L  L A B O R A T O R Y</strong></td>
</tr>
<tr>
<td>Catalog Description – (25 words or less)</td>
<td>Theory and application of environmental laboratory methods for measurement of fundamental properties and characteristics of dissolved and particulate constituents in water, air and soil systems</td>
</tr>
<tr>
<td>Basis: <strong>L/G</strong> X <strong>P/F</strong> Audit</td>
<td></td>
</tr>
</tbody>
</table>
| Prerequisites: CEE 2300: Environmental Engineering Principles; CHEM 1310: General Chemistry, BIOL 1510: Biological Principles  
Prerequisites with concurrency: Corequisites: |  |
| Has the course been taught as a special topic? NO If YES, When Enrollment |  |
| Is this course equivalent to another course (graduate or undergraduate) taught at Ga. Tech? NO If yes, list course number(s): |  |
| Are you requesting that this course satisfy: **Humanities** NO **Social Science** NO |  |
| **Expected Mode of Presentation:** | **MODE** | **% of COURSE** |
| Lecture | 40% |  |
| Laboratory Supervised Unsupervised | 60% 0% |  |
| Seminar |  |
| Independent Study |  |
| Library Work |  |
| Demonstration |  |
| Other (Specify) |  |
| **Planned Frequency of Offering:** | **TERM TO BE OFFERED** | **EXPECTED ENROLLMENT** |
| Fall | 30 |  |
| Spring | 30 |  |
| Summer | N/A |  |
| Probable Instructor(s) – Please mark with an asterisk any non-tenure track individuals. | Ching-Hua Huang, Jaehong Kim, Mike Bergin, Kurt Pennell |
| Purpose of Course: Relation to other courses, programs and curricula: | This course is intended to provide undergraduate students in the environmental science and engineering program with the underlying theory and practical, hands-on experience using selected experimental methods to monitor water, air and soil systems. Students will use analytical instruments, perform environmental monitoring, conduct laboratory experiments, interpret experimental data, and present their findings in written reports and oral presentations. |
| Required Elective | X Elective |  |
| Please attach a topical outline of the course |  |
Laboratory Introduction  
Laboratory Overview and Manual (Lecture 1)  
Laboratory Notebook and Preparation of Laboratory Reports (Lecture 2)  
Basic Laboratory Safety Procedures, Use of Balances and Pipettes (Lab 1)  

Unit 1. Water Quality Parameters  
Weeks 2-4  
Theory and practical measurement of pH and buffer capacity (Lecture 3-7)  
Calibrate pH meter and measure pH of tap water, river/stream water and rain water (Lab 2)  
Measure buffer capacity of natural and prepared aqueous solutions by titration (Lab 3-4)  
Written Laboratory Report  

Unit 2: Turbidity and Particle Settling  
Weeks 5-7  
Sources, measurement and control of turbidity (Lecture 8-13)  
Use of turbidity meter, measure turbidity and total suspended solids (TSS) of natural and prepared water samples (Lab 5)  
Comparison of coagulants (alum and gypsum) to control turbidity in batch tests (Lab 6-7)  
Written Laboratory Report  

Unit 3: Chemical and Biological Oxygen Demand  
Weeks 8-9  
Principles and measurement of chemical and biological oxygen demand (Lecture 14-16)  
Calculation and measurement of chemical oxygen demand (COD) (Lab 8-9)  
Written Laboratory Report  

Unit 4: Groundwater Flow  
Weeks 10-11  
Theory and measurement of water flow porous media (Darcy’s Law) (Lecture 17-20)  
Measure flow rate, hydraulic conductivity, and intrinsic permeability in packed columns (Lab 10-11)  
Written Laboratory Report  

Unit 5: Air Pollution Monitoring  
Weeks 12-14  
Air pollution sources and measurement methods (Lecture 21-26)  
Measurement of atmospheric particulate matter (PM) in Atlanta (Lab 12-14)  
Written Laboratory Report  

Group Presentations  
Week 15  
Review of Laboratory Units (Lectures 27-28)  
Oral presentation, review and discussion of laboratory units by student teams (Lectures 28-29, Lab 15).
**NEW COURSE PROPOSAL**

**SCHOOL, DEPARTMENT, COLLEGE:** School of Civil & Environmental Engineering

**DATE:** April 8, 2005

1. **Proposed Course Number:** CEE 4395
   (Verify with Registrar's Office)

2. **Hours:**
   - Lecture: 2
   - Lab/Recitation: 3
   - Semester Credit: 3

3. **Descriptive Title:** Environmental Systems Design Project

4. **Recommended Abbreviation for Transcript:**
   - ENVIRON SYSTEMS DESIGN

5. **Catalog Description:**
   Design and assessment of an environmental system, component or process, including problem definition, data acquisition, modeling and analysis, evaluation of alternatives, and presentations.

6. **Basis:** L/G X P/F Audit

7. **Prerequisites:**
   - CEE4300 and Senior standing in Environmental Science and Engineering program
   - Prerequisites with concurrency:

8. **Has the course been taught as a special topic?** NO

9. **Is this course equivalent to another course taught at Ga. Tech?** NO

10. **Expected Mode of Presentation:**

    | MODE               | % of COURSE |
    |--------------------|-------------|
    | Lecture            | 15%         |
    | Laboratory         |             |
    | Supervised         | 10%         |
    | Unsupervised       | 30%         |
    | Discussion         | 15%         |
    | Seminar            |             |
    | Independent Study  |             |
    | Library Work       | 10%         |
    | Demonstration      |             |
    | PRESENTATIONS      | 20%         |

11. **Planned Frequency of Offering:**

    | TERM TO BE OFFERED | EXPECTED ENROLLMENT |
    |--------------------|---------------------|
    | Fall               | N/A                 |
    | Spring             | 30                  |
    | Summer             | N/A                 |

12. **Probable Instructor(s):**

    - Mike Saunders, Joe B. Hughes, Ted Russell, Kurt Pennell

13. **Purpose of Course:**
    The course will serve as an environmental systems design or assessment experience for Environmental Science and Engineering seniors, drawing on knowledge and skills obtained in prior coursework. Students will participate in small, multi-faceted teams to solve open-ended, system-assessment or design problems and will address environmental, socio-economical, and political constraints as applicable, prepare written project reports, and deliver oral presentations. The approach will include multiple groups of 4-6 students working interactively with faculty to address problems that couple laboratory-research activities to system design and extend to global system assessment and ramifications. The template for the class will vary with instructor but will include the critical components of open-ended problems; data generation and assessment; and oral and written defense of the end product.

14. **Required** X

15. Please attach a topical outline of the course
CEE 4395: Environmental Systems Design Project
Course Outline

Credit Hours: 2-3-3
Catalog Description: Design and assessment of an environmental system, component or process, including problem definition, data acquisition, modeling and analysis, evaluation of alternatives, and presentations.
Textbook: to be announced by instructor(s)

<table>
<thead>
<tr>
<th>Week #</th>
<th>Activity/Topic</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction and general description of system, component or process to be addressed. Discussion of project expectations and deliverables. Team selection (4-5 members) and preparation of preliminary team organizational chart.</td>
<td>Project proposal including description, objectives, plan, and timeline</td>
</tr>
<tr>
<td>2</td>
<td>Visit representative sites or locations or explored systems to be examined through web-based investigations. Initiate system, component or process assessment and characterization.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Laboratory (wet-lab or computational-lab) demonstration of system or process components or investigation of selected aspects of a regional or global system</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Discussion of process or system components and development of conceptual configurations or designs.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Discussion of scientific and technical components. Detailed discussion of report preparation and presentation components.</td>
<td>Written Status Report and oral presentation</td>
</tr>
<tr>
<td>6</td>
<td>Discussion of scientific and technical components. Discussion of critical evaluation of design alternatives and refinement of project components.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Discussion of scientific and technical components. Development of preliminary process-design and system-configuration renderings</td>
<td>Written Status Report</td>
</tr>
<tr>
<td>8</td>
<td>Discussion of technical design components. Cost analysis and budget of preliminary design.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Preparation of draft written report.</td>
<td>Draft Written Report</td>
</tr>
<tr>
<td>10</td>
<td>Oral presentation of preliminary design for environmental system, component or process (30 minutes per group).</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Refinement of preliminary design. Preparation of final design calculations.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Refinement of preliminary design. Preparation of final engineering drawings or technical/scientific system description.</td>
<td>Written Status Report</td>
</tr>
<tr>
<td>13</td>
<td>Refinement of preliminary design. Preparation of final cost analysis and budget.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Preparation of final written report.</td>
<td>Final Written Report</td>
</tr>
<tr>
<td>15</td>
<td>Oral presentation of final design (30 minutes per group)</td>
<td>Presentation Overheads</td>
</tr>
</tbody>
</table>

Notes: The content of the final report should include a clear and concise description of the final project design, including problem overview, engineering drawings, design calculations, economic analysis and budget. The report should also address relevant environmental, sustainability, ethical, health and safety, social and political issues related to the project.
Course descriptions for all existing Breadth, Environmental Engineering Breadth, and Environmental Engineering Depth courses (numbers in parenthesis correspond to (lecture hours - laboratory hours - credit hours):

**BIOL 2335 - General Ecology (3-0-3)**
Introduction to ecological processes at individual, population, and community levels that occur in plant, animal, and microbial taxa, and their relevance to current environmental problems.

**BIOL 3380 - Intro Microbiology (3-0-3)**
Introductory Microbiology Basic biology of bacteria, fungi, algae, and viruses, with emphasis on bacteriology.

**BIOL 4010 - Aquatic Ecology (3-0-3)**
Aquatic Ecology Physics, chemistry, and ecology of aquatic communities and ecosystems. Physical, chemical, and biological investigations of lakes, streams, and estuaries.

**BIOL 4430 - Environ Sustainability (3-0-3)**
Environmental Sustainability A general survey of the responses of biological systems to various kinds of radiation and air or water pollution.

**BMED 3400 - Intro to Biomechanics (4-0-4)**
Introduction to Biomechanics An introduction to the basic concepts and methods in biomechanics, including statistics and the mechanics of biomaterials. The biomedical applications of mechanics will be illustrated.

**BMED 4757 - Biofluid Mechanics (3-0-3)**

**BMED 4758 - Biosolid Mechanics (3-0-3)**

**CEE 2040 - Dynamics (2-0-2)**
Dynamics Kinematics and kinetics of particles and rigid bodies in one and two dimensions; principles of work/energy and impulse/momentum.

**CEE 2300 - Environmental Engr Prin (3-0-3)**
Environmental Engineering Principles Introduction to chemical, biological, and physical processes in the environment. Discussion of the basic processes governing air, water, and land quality, and the behavior and impacts of contaminants associated with human and industrial activities.
CEE 3000 - Civil Engr Systems (3-0-3)
Civil Engineering Systems Infrastructure viewed from a systems perspective; analytical approaches and modeling of civil-engineered facilities; sustainability; engineering economy applications.

CEE 3010 - Geomatics (2-3-3)
Geomatics Spatial data collection methods including surveying, photogrammetry, remote sensing, and global positioning systems; management, manipulation, and analysis of spatial and associated attribute data.

CEE 3020 - Civil Engr Materials (2-3-3)
Civil Engineering Materials Physical, mechanical, and durability properties of concrete, metals, unreinforced and reinforced plastics, timber, asphalt, and asphalt concrete.

CEE 3040 - Fluid Mechanics (3-0-3)
Fluid Mechanics Elementary mechanics of fluids with emphasis on hydrostatics, control volume analysis of flowing fluids using kinematics, continuity, energy, and momentum principles; similitude, pipe flow.

CEE 3770 - Statistics& Applications (3-0-3)
Statistics and Applications Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Example applied to the field of civil and environmental engineering. Crosslisted with MATH 3770 and ISYE 3770.

CEE 4090 - Capstone Design (2-3-3)
Capstone Design An interdisciplinary civil and environmental design experience. Problem definition, data acquisition, modeling and analysis, evaluation of design alternatives, oral and written presentation of final design.

CEE 4100 - Construction Engr & Mgt (3-0-3)
Construction Engineering and Management Fundamental concepts in planning, design, and construction of civil engineering projects. Introduction to project scheduling, cost estimating, controls, procurement, value engineering, quality assurance, and safety.

CEE 4200 - Hydraulic Engineering (2-3-3)
Hydraulic Engineering Applications of fluid mechanics to engineering and natural systems including fluid drag, open channel flow, turbomachinery, and environmental hydraulics; laboratory experiments; computational hydraulics.

CEE 4210 - Hydrology (3-0-3)
Hydrology Global circulation and the hydrologic cycle, precipitation mechanisms and analysis, evaporation and other losses, streamflow, hydrographs, river and reservoir routing, and frequency analysis.
CEE 4230 - Environ Transport Model (3-0-3)
Environmental Transport Modeling Introduction to mixing of pollutants and natural substances in the surface water environment. Use of mathematical models for mixing zones and water quality.

CEE 4300 - Environmental Engr Sys (3-0-3)
Environmental Engineering Systems Environmental engineering issues associated with water, air, and land pollution, including risk assessment, groundwater contamination, global climate change, and sustainable technologies.

CEE 4310 - Water Quality Engr (3-0-3)

CEE 4320 - Hazardous Substance Engr (3-0-3)
Hazardous Substance Engineering Technical aspects of hazardous waste management and treatment including legislation, exposure and risk assessment, contaminant fate and transport, waste treatment methods, and remediation technologies.

CEE 4330 - Air Pollution Engr (3-0-3)
Air Pollution Engineering Introduction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional, and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport.

CEE 4400 - Geosystems Engineering (3-0-3)
Geosystems Engineering Introduction to engineering behavior of soils; mechanical, chemical, electrical, and thermal properties; continuum design principles including theory of elasticity and limiting equilibrium applied to particulate soils.

CEE 4420 - Subsurface Characterization (2-3-3)
Subsurface Characterization Introduction to field and laboratory methods for characterizing subsurface geological, hydrological, geotechnical, and contaminant conditions.

CEE 4600 - Transportation Plan&Dsgn (2-3-3)
Transportation Planning, Operations, and Design Introduction to transportation engineering with specific emphasis on the planning, design, and operation of transportation facilities.

CEE 4620 - Environ Impact Assess (3-0-3)
Environmental Impact Assessment Key policy, planning, and methodological issues in the environmental impact assessment of engineering systems including the regulatory framework and analytical techniques.

CEE 4795 - Groundwater Hydrology (3-0-3)
Groundwater Hydrology Dynamics of flow and solute transport in groundwater, including theory, implementation, and case studies. Crosslisted with EAS 4795.

CHBE 2110 - Chemical Engineering Thermodynamics I (3-0-3)

CHBE 3200 - Transport Processes I (3-0-3)
Fundamentals of fluid mechanics and heat transfer. The design and analysis of equipment using the principles of fluid mechanics and heat transfer.

CHEM 1315 - Survey of Organic Chem (3-0-3)
Survey of organic chemistry as the basis for biochemical processes and commercial applications.

CHEM 3281 - Instrumental Analysis for Engineers (3-3-4)
Provides a background to modern analytical chemistry and instrumental methods of analysis with applications to engineering and other areas.

CHEM 3411 - Physical Chemistry I (3-0-3)
Chemical thermodynamics, energetics of chemical reactions, changes of state, and electrochemistry.

CHEM 3511 - Survey of Biochemistry (3-0-3)
Introductory course in biochemistry dealing with the chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4740 - Atmospheric Chemistry (3-0-3)
This course provides a general chemical description of the Earth's atmospheric system with a major focus on the two lowest layers of the atmosphere, i.e., the troposphere and the stratosphere. Crosslisted with EAS 4740.

COE 2001 - Statics (2-0-2)
Elements of statics in two and three dimensions, free-body diagrams, distributed loads, centroids, and friction.

COE 3001 - Deformable Bodies (3-0-3)
Bodies Stress and strain analysis applied to beams, vessels, pipes, and combined loading; stress and strain transformations; beam deflection; column buckling.

CP 4210 - Envir Plan&Impact Assess (3-0-3)
Covers the principles of environmental planning and decision making. Examines the methods and processes, and environmental impact assessment and regulation.

CP 4510 - Geographic Info Sys (3-0-3)
The course provides a basic understanding of the tools for collecting, storing, and analyzing spatially distributed data. Basic issues of software design and application are covered.

**EAS 3603 - Thermodynamics-Earth Sys (3-0-3)**
Introduction to the principles of equilibrium thermodynamics and physical chemistry with applications to the atmosphere, ocean, and solid earth.

**EAS 4420 - Environmental Field Meth (2-6-4)**
Semester-long focus on single environmental project in the local area. Chemical and physical techniques for parameterizing environmental problems, data analysis, report writing, and interpretation of results in societal context.

**EAS 4430 - Remote Sensing & Data Analysis (2-3-3)**
Introduction to the remote sensing of the atmosphere and the Earth. Laboratory examples of data and image analysis for remote sensing applications.

**EAS 4610 - Earth System Modeling (3-0-3)**
An introduction to computer modeling in Earth system science.

**EAS 4740 - Atmospheric Chemistry (3-0-3)**
This course provides a general chemical description of the Earth's atmospheric system with a major focus on the two lowest layers of the atmosphere, i.e., the troposphere and the stratosphere. Crosslisted with CHEM 4740.

**ECE 3710 - Circuits & Electronics (2-0-2)**
An introduction to electric circuit elements and electronic devices and a study of circuits containing such devices. Both analog and digital systems are considered.

**ECE 3741 - Instrum & Electronic Lab (0-3-1)**
Basic analog and digital electronic circuits and principles. Techniques of electrical and electronic measurements with laboratory instruments.

**ME 4171 - Environmental Dsgn & Mfg (3-0-3)**
Including environmental considerations in engineering design; reducing environmental impact by design; recycling; material selection; de- and remanufacturing; life-cycle considerations, analyses, tradeoffs; ISO 14000.

**ME 4172 - Dsgn Sustainable Eng Sys (3-0-3)**
Understanding sustainability in context of market forces, availability of resources, technology, society. Methods for identifying, modeling, and selecting sustainable designs.

**ME 4782 - Biosystems Analysis (3-0-3)**
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with BMED, CHE and ECE 4782.
Appendix II

CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS
ABET ENGINEERING ACCREDITATION COMMISSION
2005-2006 Accreditation Cycle

These criteria are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment. It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

I. GENERAL CRITERIA FOR BASIC LEVEL PROGRAMS

Criterion 1. Students
The quality and performance of the students and graduates are important considerations in the evaluation of an engineering program. The institution must evaluate student performance, advise students regarding curricular and career matters, and monitor student’s progress to foster their success in achieving program outcomes, thereby enabling them as graduates to attain program objectives.
The institution must have and enforce policies for the acceptance of transfer students and for the validation of courses taken for credit elsewhere. The institution must also have and enforce procedures to assure that all students meet all program requirements.

Criterion 2. Program Educational Objectives
Although institutions may use different terminology, for purposes of Criterion 2, program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.
Each engineering program for which an institution seeks accreditation or reaccreditation must have in place:
(a) detailed published educational objectives that are consistent with the mission of the institution and these criteria
(b) a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated
(c) an educational program, including a curriculum that prepares students to attain program outcomes and that fosters accomplishments of graduates that are consistent with these objectives
(d) a process of ongoing evaluation of the extent to which these objectives are attained, the result of which shall be used to develop and improve the program outcomes so that graduates are better prepared to attain the objectives.

Criterion 3. Program Outcomes and Assessment
Although institutions may use different terminology, for purposes of Criterion 3, program outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that student acquire in their matriculation through the program.
Each program must formulate program outcomes that foster attainment of the program objectives articulated in satisfaction of Criterion 2 of these criteria. There must be processes to produce these outcomes and an assessment process, with documented results, that demonstrates that these program outcomes are being measured and indicates the degree to which the outcomes are achieved. There must be evidence that the results of this assessment process are applied to the further development of the program.

Engineering programs must demonstrate that their students attain:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In addition, an engineering program must demonstrate that its students attain any additional outcomes articulated by the program to foster achievement of its education objectives.

**Criterion 4. Professional Component**

The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:
(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline
(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.
(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.
Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier coursework and incorporating appropriate engineering standards and multiple realistic constraints.

**Criterion 5. Faculty**
The faculty is the heart of any educational program. The faculty must be of sufficient number; and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.
The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program, its educational objectives and outcomes. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

**Criterion 6. Facilities**
Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the program and institution.

**Criterion 7. Institutional Support and Financial Resources**
Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program. In addition, support personnel and institutional services must be adequate to meet program needs.

**Criterion 8. Program Criteria**
Each program must satisfy applicable Program Criteria (if any). Program Criteria provide the specificity needed for interpretation of the basic level criteria as applicable to a given discipline. Requirements stipulated in the Program Criteria are limited to the areas of curricular topics and faculty qualifications. If a program, by virtue of its title, becomes subject to two or more sets of Program Criteria, then that program must satisfy
each set of Program Criteria; however, overlapping requirements need to be satisfied only once.

PROGRAM CRITERIA FOR
ENVIRONMENTAL
AND SIMILARLY NAMED ENGINEERING PROGRAMS
Lead Society: American Academy of Environmental Engineers
Cooperating Societies: American Institute of Chemical Engineers, American Society of Agricultural Engineers, American Society of Civil Engineers, American Society of Heating, Refrigerating and Air-Conditioning Engineers, American Society of Mechanical Engineers, Society of Automotive Engineers, and Society for Mining, Metallurgy, and Exploration

These program criteria apply to engineering programs including “environmental”, “sanitary”, or similar modifiers in their titles.

1. Curriculum
The program must demonstrate the graduates have: proficiency in mathematics through differential equations, probability and statistics, calculus-based physics, general chemistry, an earth science, e.g. geology, meteorology, soil science, relevant to the program of study, a biological science, e.g. microbiology, aquatic biology, toxicology, relevant to the program of study, and fluid mechanics, relevant to the program of study; introductory level knowledge of environmental issues associated with air, land, and water systems and associated environmental health impacts; an ability to conduct laboratory experiments and to critically analyze and interpret data in more than one major environmental engineering focus areas, e.g., air, water, land, environmental health; an ability to perform engineering design by means of design experiences integrated throughout the professional component of the curriculum; proficiency in advanced principles and practice relevant to the program objectives; understanding of concepts of professional practice and the roles and responsibilities of public institutions and private organizations pertaining to environmental engineering.

2. Faculty
The program must demonstrate that a majority of those faculty teaching courses which are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and equivalent design experience.
Appendix III

Brief Curriculum Vitae for faculty involved in the proposed degree are provided on the following pages.
Mustafa Aral  
Professor

Degrees
Ph.D., Civil and Environmental Engineering, Georgia Institute of Technology, 1971.
M.S., Civil and Environmental Engineering, Georgia Institute of Technology, 1969.
B.S., Civil Engineering, Middle East Technical University, 1967.

Research Interests
Large scale environmental simulations in surface water and groundwater; environmental exposure analysis; exposure-dose reconstruction; health risk assessment.

Selected Journal Publications
assist epidemiologic investigations." Journal of Water Resources Planning and Management-ASCE

**Professional Service and Development Activities**
Member, International Association of Hydrogeology
Member, International Society of Exposure Analysis
Member, Scientific Review Board, Waste Policy Institute, U.S. Department of Energy
Member, Scientific Review Panel on Eastern Research Group
Member, Scientific Review Panel on program Analytical and Monitoring Methods in Subsurface Remediation, USEPA
Member, Scientific Review Panel on program STAR Program, USEPA, 1995-present.
Vice President for International Affairs, American Institute of Hydrology, 2004 -2006
Organizing Committee Member, Achieving Sustainable Water Resources in Areas Experiencing Rapid Population Growth, 2003 AIH International Conf., Atlanta, GA.
Dominic Assimaki
Assistant Professor

Degrees
ScD, Civil Engineering, Massachusetts Institute of Technology, 2004.
MS, Civil Engineering, Massachusetts Institute of Technology, 2000.
BS, Civil Engineering, National Technical University of Athens, Greece, 1998.

Research Interests
Numerical methods in earthquake engineering, nonlinear dynamic soil behavior, soil-structure interaction, scattering of seismic waves in heterogeneous media, inverse problems in geophysics.

Selected Journal Publications
Michael Bergin  
Associate Professor

Degrees  
M.S., Mechanical Engineering (M.S.M.E.), University of Minnesota, 1991.  
B.S., Mechanical Engineering (B.S.M.E.), University of Minnesota, 1987.

Research Interests  
Air pollution; formation, transport, and deposition of aerosols; influence of aerosols on climate; air/snow exchange of aerosol chemical species; paleoclimate studies based on ice core chemistry; fog/cloud formation and chemistry; microcontamination in industrial processes.

Selected Journal Publications  


Professional Service and Development Activities  
American Association of Aerosol Research (AAAR), Member, 1993-present.  
American Chemical Society (ACS), Member, 1993-present.  
American Geophysical Union, Member, 1994-present.
Susan Burns
Associate Professor

Degrees
Ph.D., Civil Engineering, Georgia Institute of Technology September 1997
M.S., Civil Engineering (Geotechnical), Georgia Institute of Technology March 1996
M.S., Environmental Engineering, Georgia Institute of Technology June 1996
B.C.E., Civil Engineering, Georgia Institute of Technology December 1990

Research Interests
Geoenvironmental engineering, engineered materials, physical and chemical behavior of soils, cone penetration testing, image analysis.

Selected Journal Publications
Bruce Ellingwood  
College of Engineering Distinguished Professor

Degrees
Ph.D., Civil Engineering, University of Illinois at Urbana-Champaign, 1972.  
M.S., Civil Engineering, University of Illinois at Urbana-Champaign, 1969.  
B.S., Civil Engineering, University of Illinois at Urbana-Champaign, 1968.

Research Interests
Applications of methods of probability and statistics to structural engineering; structural reliability analysis; structural load modeling and analysis of combinations of loads; development of safety and serviceability criteria for structural design; random vibration; abnormal loads and progressive collapse; response of structures exposed to fires; probabilistic risk assessment of engineered facilities; performance-based engineering.

Selected Journal Publications

**Professional Service and Development Activities**

Distinguished Alumnus Award, Civil and Environmental Engineering Alumni Association, University of Illinois at Urbana-Champaign, 2002

Elected to the National Academy of Engineering, 2001

Walter P. Moore, Jr. Award, American Society of Civil Engineers, 1999

Norman Medal, ASCE, 1983 and 1998
Hermann Fritz  
Assistant Professor

Degrees  
Ph.D., Hydraulic Engineering, ETH (Swiss Federal Institute of Technology), 2002.  
M.S.C.E., Civil Engineering, ETH (Swiss Federal Institute of Technology), 1997.

Research Interests  
Dr. Fritz’ research interests include environmental hydrodynamics and hydraulic construction, fluid mechanics, geomechanics, wavelet transform analysis to landslide generated impulse waves, and sediment transport.

Selected Publications: Journal Articles  

Professional Service and Development Activities  
Swiss Army / Air Force Corps of Engineers. First Lieutenant. 1994-Present
David Frost  
Professor and Director of GT Savannah

**Degrees**
Ph.D. Purdue University Civil Engineering 1989.  
M.S.C.E. Purdue University Civil Engineering 1986.  
B.A.I. (Honors) Trinity College, Dublin, Ireland Civil Engineering 1980.  

**Research Interests**
Dr. Frost’s research interests include engineering the behavior of soils under static and dynamic loading; digital image processing and analysis in geosystems engineering; spatial information systems in subsurface hazard assessment; and performance of soil-polymeric material composite systems.

**Selected Journal Publications**
Laurie Garrow
Assistant Professor

Degrees
Ph.D., Civil and Environmental Engineering, Northwestern University, 2004.
M. P. Affs., Public Affairs, University of Texas at Austin, 1997.
M.S., Civil and Environmental Engineering, University of Texas at Austin, 1997.
B.S., Civil and Environmental Engineering, North Carolina State University, 1995.

Research Interests
Travel behavior analysis and forecasting, Application and estimation of advanced discrete choice models,
Airline revenue management, pricing, and schedule planning, Integration of customer and competitive
market information into forecasting models, Survey research methods, and Transportation policy analysis.

Selected Journal Publications

Professional Service and Development Activities
Appointed member, Transportation Research Board Passenger Travel Demand Forecasting Committee
Elected member, INFORMS Aviation Application's Cluster Chair
Member, INFORMS, AGIFORS, Transportation Research Board
Member, Travel demand committee
Reviewer for Transportation Research Board, Transportation Research Part B, Journal of Transportation
Statistics
Aris Georgakakos
Professor

Degrees
Ph.D., Civil and Environmental Engineering, Massachusetts Institute of Technology, 1984.
M.S., Civil and Environemental Engineering, Massachusetts Institute of Technology, 1983.
B.S., Civil Engineering, National Technical University of Athens, Greece, 1980.

Research Interests
Remote sensing of hydrologic variables; flood and drought management; hydropower scheduling;
agricultural planning; decision support systems for river basin planning, management, and conflict
resolution.

Selected Journal Publications
Georgakakos, A., and H. Yao, "Implications of Climate Variability and Change for Water Resources
Management," The Climate Report, 3(4), 9-13, 2002
Brumbelow, K. and A. Georgakakos, "Agricultural Planning and Irrigation Management: The Need for
106(D21), 27383-27406.
Yao, H, and A. Georgakakos, "Assessment of Folsom Lake Response to Historical and Potential Future
Georgakakos, K., N. Graham, and A. Georgakakos, “Can forecasts accrue benefits for reservoir

Professional Service and Development Activities
Georgia Water Resources Planning Committee, Member, 2001-present.
Sector Benefit Assessment Entebbe, Uganda May 2003 - Dec. 2004
Technical Consultant, Government of Egypt/DELFT Hydraulics HAD Management and Assessment
under Climate Change Cairo, Egypt Oct. 2002 - Dec. 2003
Technical Consultant, Greek Public Power Corporation Technical assistance on power system scheduling
Advisory Science Committee for the Department of Energy--Water Cycle Initiative, Member, 2000.
Water Resources Management Planning Management for Shared Rivers, WRI Workshop, Workshop
Organizer, 2000.
Water Resources Management Technologies for the Southeastern U.S., Technical workshop organized by
the Georgia Water Resources Institute and the Upper Chattahoochee Riverkeeper, Workshop Organizer,
2000.
Member, American Water Resources Association (AWRA).
Member, Institute of Electrical and Electronic Engineers (IEEE)
Member, International Association for Hydraulic Research (IAHR)
Member, American Geophysical Union (AGU)
Member, American Society of Civil Engineers (ASCE)
Leonid Germanovich
Professor

Degrees
Ph.D., Engineering Sciences, Moscow State Mining University, 1982.
M.S., Engineering Physics, Moscow State Mining University, 1977.

Research Interests
Properties of earth and extra-terrestrial materials, rock mechanics, fracture mechnanics, micro-mechanical modeling, geophysics, applied mathematical methods, mining and petroleum engineering.

Selected Journal Publications

Professional Service and Development Activities
American Geophysical Union, 1990-present.
Society of Petroleum Engineers, 1999-present.
Randall Guensler
Professor

Degrees
Ph.D., Civil Engineering, University of California at Davis, 1993.
M.S., Civil and Environmental Engineering, University of California at Davis, 1989.
B.S., Individualized Engineering, University of California at Davis, 1985.

Research Interests

Selected Journal Publications
Wolf, J., Guensler, R., and Bachman, W., 2001. Elimination of the Travel Diary: Experiment to Derive Trip Purpose from GPS Travel Data; Transportation Research Record; No. 1768; pp. 125-134.

Professional Service and Development Activities
Air and Waste Management Association, Member, 1987-Present.
American Society of Civil Engineers, Member, 1987-Present.
Society of Automotive Engineers, Member, 1988-Present.
Transportation and Air Quality (A1F03), Committee Chairman, 1997-Present.
Transportation Research Board, Member, 1992-Present.
Committee on Carbon Monoxide Episodes in Meteorological and Topographical Problem Areas; National Academy of Sciences, National Research Council, Board on Environmental Studies and Toxicology, Member, 2001-2002.
The Modeling Working Group, USEPA Office of Mobile Sources Technical Advisory Committee, Sub-Committee to the Clean Air Act Advisory Committee, Chair and Member, 1995-2001.
Environmental and Energy Aspects of Transportation, Member, 1992-1998.
Kevin Haas  
Assistant Professor

Degrees
Ph.D., Civil Engineering, University of Delaware, 2001.
M.S., Civil Engineering, Ohio State University, 1996.
B.S., Civil Engineering, Ohio State University, 1994.

Research Interests
Dr. Haas' research interests include coastal engineering, numerical modeling of nearshore circulation, sediment transport in coastal regions, hydrodynamics of rip current systems, and coastal monitoring systems.

Selected Journal Publications

Professional Service and Development Activities
American Geophysical Union, Member, 1998-present.
American Society of Civil Engineers, Associate Member, 2003-present.
Chi Epsilon, Member, 1993-present.
Tau Beta Pi, Member, 1994-present.
Ching-Hua Huang  
Assistant Professor

Degrees
M.S., Environmental Engineering, Johns Hopkins University, 1993.
B.S., Chemistry, National Taiwan University, 1990.

Research Interests
Environmental and analytical chemistry, transformation and fate of organic chemicals; chemical kinetics and mechanisms; structure-activity relationships; specification and transformation of metals in aquatic systems; environmental applications of chromatography, immunochemistry and mass spectrometry.

Selected Journal Publications

Professional Service and Development Activities
American Chemical Society, Member, 1994-present.
American Water Works Association (AWWA), Member, 2000-present.
Association of Environmental Engineering and Science Professors (AEESP), Member, 2000-present. Consultant on endocrine disruptors analysis and evaluation for the HDR Engineering, 2001-present.
Hazen and Sawyer, Technical Advisory Committee, 2003-present.
International Water Association (IWA), Member, 2004-present.
Society of Environmental Toxicology and Chemistry, Member, 1996-present.
Water Environment Federation (WEF), Member, 2001-present.
Joseph Hughes  
School Chair and Professor

Degree  
Ph.D. Civil and Environmental Engineering, The University of Iowa, 1992.  
M.S. Civil and Environmental Engineering, The University of Iowa, 1989.  

Research Interests  
Environmental biotechnology and in particular, determining how novel metabolic capabilities of living organisms can be harnessed to improve environmental quality; nanotechnology in environmental systems.

Selected Journal Publications  
**Professional Service and Development Activities**


Director, Environmental Nanotechnology Research Group, NSF Center for Biological and Environmental Nanotechnology, 2002 to present.

Member and Chair, West Coast Hazardous Substances Research Center Science Advisory Board, 2002-present.

Member, Association of Environmental Engineering and Science Professors (AEESP) Strategic Planning Committee, 2002.

Co-Director for Research, U.S. EPA Hazardous Substances Research Center South and Southwest, 2001 to present.

Director, Environmental Analysis and Decision Making Graduate Program, 2001 to 2003.

Member, National Research Council Committee on Bioavailability of Contaminants in Soils and Sediments, 2000 to 2002.


Member, U.S. Environmental Protection Agency Committee on Monitored Natural Attenuation, 2000 to 2001.

Professional Societies, Association of Environmental Engineering and Science Professors (AEESP)

Professional Societies, American Chemical Society (ACS)

Professional Societies, American Society of Civil Engineers (ASCE)
Laurence Jacobs
Associate Chair and Professor

Degrees
M.S., Civil Engineering, Polytechnic Institute of New York, 1981.
B.S., Civil Engineering, Lafayette College, 1979.

Research Interests
Quantitative nondestructive evaluation of civil engineering materials; wave propagation in solids, emphasizing guided waves, nonlinear methods and heterogeneous materials.

Selected Journal Publications

Professional Service and Development Activities
Acoustical Society of America
American Society for Engineering Education
American Society for Nondestructive Testing
American Society of Civil Engineers
American Society of Mechanical Engineers
Associate Editor, ASCE Journal of Engineering Mechanics, October 2000- November 2002
Jaehong Kim
Assistant Professor

Degrees
Ph.D., Environmental Engineering, University of Illinois at Urbana-Champaign, 2002.
M.S., Chemical Technology, Seoul National University, South Korea, 1997.
B.S., Chemical Technology, Seoul National University, South Korea, 1995.

Research Interests
Physicochemical processes for water and wastewater treatment; ozone disinfection by-products;
membrane processes (microfiltration, ultrafiltration, nanofiltration and reverse osmosis); desalination;
emulsion liquid membrane application.

Selected Journal Publications
Biologic Methods for Assessing Virus Removal by and Integrity of High Pressure Membrane Systems.”
Water Science and Technology: Water Supply, 3(5-6), 81-92
monitoring of RO and NF membranes.” Journal American Water Works Association, 95(12), 105-119
Kim, J. H.; Tomiak, R. B.; Rennecker, J. L; Mariñas, B. J; Miltner, R. J; Owens, J. H.
(2002). ”Inactivation of Cryptosporidium in a Pilot-Scale Ozone Bubble-Diffuser Contactor. Part I I:
Model Verification and Application.” ASCE Journal of Environmental Engineering, 128(6), 522-532
Kim, J. H.; Tomiak, R. B; Mariñas, B. J. (2002). “Inactivation of Cryptosporidium in a Pilot-Scale Ozone
Bubble-Diffuser Contactor. Part I : Model Development.” ASCE Journal of Environmental
Engineering, 128(6), 514-521
on Permeation in the Microfiltration of Brining Wastewater.” Desalination, 140(1), pp. 55-65
Concentration and pH in the Inactivation Kinetics of Cryptosporidium parvum Oocysts with Ozone and
Monochloramine.” Environmental Science and Technology, 35(13), pp. 2752-2757
(Kimchi) Industry.” Journal of Cleaner Production, 9(1), pp. 35-41
Polypropylene Microfiltration Membranes by Ozone-Induced Graft Polymerization.” Journal of
Membrane Science, 169, pp. 269-276.
Kimberly Kurtis
Associate Professor

Degrees
Ph.D., Civil Engineering, University of California, Berkeley, 1998.
M.S., Civil Engineering, University of California, Berkeley, 1995.
B.S.E., Civil and Environmental Engineering, Tulane University, 1994.

Research Interests

Selected Journal Publications
2000, V97:713.

Professional Service and Development Activities

Applied Microwave NDT Laboratory (amntl), University of Missouri, Rolla, MO, Microwave Characterization of Cement-based Materials, Spring 2001 - present.
Associate Editor, ASCE Journal of Materials in Civil Engineering, 2000 - present.
Associate Member, ACI Committee 201: Durability of Concrete, 2001 - present.
Chairman, ACI Committee E802: Teaching Methods and Educational Materials, 2001-present.
Editorial Board, Cement and Concrete Composites (Elsevier), 2004 - present.
Friend, TRB Committee AFF30 (A2C03): Concrete Bridges, 1999 - present.
Member, ACI Subcommittee 201C: Task Group charged with developing a state-of-the-art report on sulfate resistance as part of the revised document 201.2R, 2001-present.
Member, American Concrete Institute, Georgia Chapter, since 2003.
Member, Program Committee, Cements Division, 2004-2005.
Member, TRB Committee AFN30 (A2E01): Durability of Concrete, 1999 - present.
Program Chairman (Elect), Cements Division, 2005-2006.
Secretary, ACI Committee 236: Materials Science of Concrete, 2004 - present.
Member, American Concrete Institute, since 1997.
Frank Lößler
Associate Professor

Degrees
M.S., Microbiology, University of Hohenheim, Stuttgart, Germany, 1989.
B.S., Biology and Agricultural Sciences, University of Hohenheim, Stuttgart, Germany, 1986.

Research Interests
Microbial detoxification, bioremediation applications, novel bacteria, and environmental genomics.

Selected Journal Publications
Flynn, S., Lößler, F., and Tiedje, J., 2000. Microbial community changes associated with a shift from

**Professional Service and Development Activities**
Joint Interagency Program on Phytoremediation (DOE, NSF, EPA), Panel Member, 2003.
DOE-EMSP Program, Panel Member, 1999.
Bioaugmentation Roundtable Discussion, Seventh International Symposium In Situ and On-Site Bioremediation, Panel Member.
Alexander von Humboldt Association of America, AvHAA.
American Association for the Advancement of Science, AAAS.
American Society for Microbiology, ASM.
Association of General and Applied Microbiology, VAAM, Germany.
Paul Mayne
Professor

Degrees
Ph.D., Geotechnical Engineering, Cornell University, 1991.
M.S., Geotechnical Engineering, Cornell University, 1977.
B.S., Civil & Environmental Engineering, Cornell University, 1976.

Research Interests
In situ testing, site characterization, foundation systems, soil properties determination, geostatic stress state, ground improvement by dynamic compaction and plasma arc vitrification.

Selected Journal Publications

Professional Service and Development Activities
American Society for Testing and Materials (ASTM), Member, 1979-present.
American Society of Civil Engineers (ASCE), Member, 1976-present.
ASCE Technical Committee: Engineering Geology & Site Characterization - Meetings: Boston (June,
2003) and Orlando (January, 2004).
Association of Drilled Shaft Contractors (ADSC), Technical Affiliate, 1994-present.
Canadian Geotechnical Society, Member (CGS), Member, 2000-present.
Chair, Technical Comm TC 16 (Ground Property Characterization by In-Situ Tests). International
Deep Foundations Institute (DFI), Member, 2001-present.
International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE), Member, 1988-present.
Transportation Research Board (TRB), National Research Council, Member, 1991-present.
Michael Meyer  
Professor

Degrees  
Ph.D., Civil Engineering, Massachusetts Institute of Technology, 1978.  
M.S., Civil Engineering, Northwestern University, 1976.  
B.S., Civil Engineering, University of Wisconsin, 1974.

Research Interests  

Selected Journal Publications  

Professional Service and Development Activities  
Committee on Transportation Information Systems, 2005  
Executive Committee, Transportation Research Board, 2000-present. Vice Chair, 2005  
International Activities Committee, 2004-  
International Secretary, Executive Committee, 2004-  
Steering Committee, National Conference on Performance Measures, 2003-2004  
Steering Committee, National Conference on Women in Transportation, 2003-2004  
Subcommittee on Plan and Program Review, 2002--  
Department of Civil Engineering Evaluation Committee, University of Toronto, 1999.
James Mulholland
Associate Professor

Degrees
Ph.D., Chemical Engineering, Massachusetts Institute of Technology, 1992.
M.S., Mechanical Engineering, Stanford University, 1981.
B.S., Mechanical Engineering, Cornell University, 1979.

Research Interests
Combustion byproduct formation and control; incineration; thermochemistry of polycyclic aromatic hydrocarbons and chlorinated aromatic species; molecular modeling; spatio-temporal analysis of ambient air pollutants.

Selected Journal Publications

Professional Service and Development Activities
Air and Waste Management Association, Member.
Association of Environmental Engineering Professors, Member.
The Combustion Institute, Member.
Spyros Pavlostathis
Professor

Degrees
M.S., Environmental Engineering, Cornell University, 1982.
Diploma, Agricultural Engineering, Agricultural University of Athens, Greece, 1974.

Research Interests
Environmental biotechnology and bioprocesses for bioremediation of contaminated natural systems and treatment of industrial wastewaters; bioavailability, fate and biotransformation of recalcitrant organic compounds in natural systems; biological decolorization, biotransformation and fate of textile dyes; kinetics and modeling of reductive biotransformation and anaerobic treatment processes.

Selected Journal Publications


Professional Service and Development Activities
American Society of Civil Engineers, 1983-present.
Association of Environmental Engineering and Science Professors, 1988-present.
Water Environment Federation, 1981-present.
Associate Editor, Journal of Environmental Engineering, 2000 - present.
Member, Anaerobic Digestion Modeling Task Group, 1997 - present.
Member, Hazardous Wastes Committee, 1996 - present.
Member, Toxic Substances Committee, 1996 - present.
Member, Anaerobic Digestion Specialist Group, 1994 - present.
Society of Environmental Toxicology and Chemistry, 1993 - present.
Georgia Water & Pollution Control Association, 1991 - present.
American Chemical Society, 1988 - present.
American Society for Microbiology, 1986 - present.
International Water Association (formerly IAWQ), 1985 - present.
Water Environment Research Foundation, Research Council Member.
Kurt Pennell  
Associate Professor

Degrees
M.S., Forest Resources, North Carolina State University, 1986.  
B.S., Forest Resources, with high distinction, University of Maine, 1984.

Research Interests
Physical, chemical and biological processes influencing the fate and transport of contaminants in the subsurface: sorption rates and equilibria, bioavailability of organic contaminants and interfacial phenomena. In-situ remediation technologies; remediation, cosolvent flushing, soil vapor extraction, and bioremediation.

Selected Journal Publications


Professional Service and Development Activities
Soil Science Society of America, Soil Physics Division, Internet and Newsletter Administrator, 1996-present.
University of Maine Alumni Mentor Program, Member, 1997-present.
Literature Review Committee, Water Environment Federation, Member, 1997-2002.
NIEHS SBIR Flushing Technologies Review Panel, Member, 2002.
NIEHS/EPA Superfund Basic Research Program Center Review Panel, Member, 1999.
Glenn Rix
Professor

Degrees
Ph.D., Civil Engineering, University of Texas at Austin, 1988.
M.S., Civil Engineering, University of Texas at Austin, 1984.
B.S., Civil Engineering, Purdue University, 1982.

Research Interests
Geotechnical earthquake engineering; dynamic properties of soils; non-destructive and non-invasive methods for site and material characterization in geotechnical and transportation engineering.

Selected Journal Publications

Professional Service and Development Activities
Advisory Committee, Advanced National Seismic Systems - Mid-America Region (ANSS-MA), June 2000-present.
American Society for Testing and Materials Subcommittee on Dynamic Properties of Soils, 1990-present
American Society for Testing and Materials Task Group D18.09.05 on In Situ Testing, Chairman, 1994-present.
American Society for Testing and Materials, Member, 1990-present
American Society of Civil Engineers Geophysics Committee, Member, 1994-present.
American Society of Civil Engineers Soil Dynamics Committee, Member, 1992-present.
American Society of Civil Engineers, Member, 1988-present.
Consortium of Universities for Research in Earthquake Engineering, Member, 2001-present.
Earthquake Engineering Research Institute, Member, 1990-present.
Environmental and Engineering Geophysics Society, Member, 1993-present.
Mid-America Earthquake Center Hazards Evaluation Program, Co-Coordinator, 1999-present.
Mid-America Earthquake Center Leadership Team, Member, 1997-present.
Near Surface Geophysics Section of the Society of Exploration Geophysicists, Member, 1993-present.
Seismological Society of America, Member, 1988-present.
Transportation Research Board Committee on Strength and Deformation Characteristics of Pavement Sections (A2B05), Member, 1994-present.
Symposium on Applications of Geophysics to Engineering and Environmental Problems (SAGEEP), Atlanta, Georgia, General Chairman, 2005.
National Science Foundation Network for Earthquake Engineering Simulation (NEES) System Integration Project, Site Visit Team, 2004.
Philip Roberts  
Professor

Degrees  
S.M., Mechanical Engineering, Massachusetts Institute of Technology, 1970.  
B.Sc. (Eng), Mechanical Engineering, Imperial College of Science and Technology, University of London, 1968.

Research Interests  
Environmental fluid mechanics, mixing and dynamics of rivers, lakes, coastal waters, and estuaries; outfalls for wastewater discharge; mathematical models of wastewater fate and transport; oceanographic field programs and data interpretation.

Selected Journal Publications  

Professional Service and Development Activities  
Hydrologic Transport and Dispersion Committee ASCE, Member, 1988 - present.  
Skidaway Institute of Oceanography, Adjunct Professor of Oceanography.  
Michael Rodgers
Principal Research Scientist and Adjunct Professor

Degrees
Ph.D., Geophysical Sciences (Atmospheric Sciences), Georgia Institute of Technology, 1986.
M.S., Physics, Georgia Institute of Technology, 1978.
B.S., Physics (Applied Optics), Georgia Institute of Technology, 1976.

Research Interests
Mobile and Biogenic Emissions, Air Quality Policy, Atmospheric Chemistry, Chemistry and Physics of Aerosols

Selected Journal Publications
Lisa Rosenstein  
Academic Professional

Degrees  
Ph.D., English, Emory University, 1989  
M.A., English, Emory University, 1987  
B.A., English, Connecticut College, 1982

Teaching Interests  
Technical writing, visual communication, creating and delivering technical presentations

Graduate Courses  
CEE/MSE 6754: Engineering Communication  
MSE 8001: Seminar

Undergraduate Courses (co-taught)  
CEE 3000: Engineering Systems  
CEE 4090: Senior Design  
MSE 3020: Materials Laboratory  
MSE 4020/4021: Design with Materials

Course Development  
CEE 6754: Engineering Communication  
MSE 8001: Graduate Seminar on Technical Presentations  
LCC 4700: Undergraduate Thesis Writing Laboratory

Academic Service  
CEE: Member, Undergraduate Curriculum Committee  
CEE, Member, Geotech Search Committee  
MSE: Member, Undergraduate Curriculum Committee

Recent Awards  
2004—CEE Excellence in Service Award  
2004—NASA SHARP Excellence in Mentoring Award

Recent Presentation  
Armistead Russell  
Georgia Power Distinguished Professor

Degrees
Ph.D., Mechanical Engineering, California Institute of Technology, 1985.  
M.S., Mechanical Engineering, California Institute of Technology, 1980.  

Research Interests

Selected Journal Publications
**Professional Service and Development Activities**


California Air Resources Board, Member.


Reactivity Scientific Advisory Committee.

World Bank Blue Ribbon Panel on Mexico City Air Quality.
Carlos Santamarina  
Goizueta Foundation Faculty Chair and Professor

Degrees  
Ph.D., Geotechnical Engineering, Purdue University, 1987.  
MSc., Geotechnical Engineering, University of Maryland, 1984.  
Ing., Civil Engineering, Universidad Nacional de Cordoba, 1982.

Research Interests  
Micro-scale behavior of particulate materials, experimental micro-mechanics, engineered soils; wave-based process monitoring, geotechnical and resource recovery applications; and inverse problems.

Selected Journal Publications  
F. Michael Saunders  
Associate Chair, Associate Director for GT Savannah, and Professor

Degrees  
Ph.D., Environmental Engineering in Civil Engineering, University of Illinois, 1975.  
M.S., Environmental Engineering, Virginia Polytechnic Institute, 1969.  
BSCE., Civil Engineering, Virginia Polytechnic Institute, 1967.

Research Interests  
Hazardous substances in sediments, soils and sludges; aquatic plant assimilation of toxic organics;  
phytoremediation and bioremediation of hazardous substances; membrane separations; potable-water  
reclamation; Hg transformations; activated sludge modeling and removal of recalcitrant organics and  
nutrients in biological reactor systems; industrial ecology; industrial and municipal residue  
characterization, treatment and reclamation.

Selected Journal Publications  
Rosa Krajmalnik-Brown, T. Hölscher, I. N.Thomson, F. M. Saunders, K. M. Ritalahti, and Frank E.  
Strain BAV1", Applied Environmental Microbiology: 70(10): 6347-6351  
Environmental Toxicology and Chemistry, 25(3): 613-620  
that demonstrates mercury methylation rates in marine sediments are based on the community  
composition and activity of sulfate-reducing bacteria", Environmental Science and Technology. 35(12):  
2491-2496  
demonstrates mercury methylation rates in marine sediments are based on the community composition  
and activity of sulfate-reducing bacteria,” Environmental Science and Technology. 35(12): 2491-2496.  
analysis of microbial community structure using 16S rRNA targeted oligonucleotides in saltmarsh  
sediments”, Applied & Environmental Microbiology. 66: 3037-3043  
Frischer, M., Healy, M., Saunders, F., et al., 2000, “Whole cell vs. Total RNA extraction for analysis of  
microbial community structure using 16S rRNA targeted oligonucleotides in saltmarsh sediments,”  
Applied & Environmental Microbiology. 66: 3037-3043  
King, J., Kostka, J., Frischer, M., and Saunders, F., 2000, Sulfate-reducing bacteria methylate mercury at  
variable rates in pure culture and in marine sediments, Applied and Environmental Microbiology,  
66(6):2430-2437  
mercury at variable rates in pure culture and in marine sediments”, Applied and Environmental  
Microbiology, 66(6):2430-2437

Professional Service and Development Activities  
American Association for the Advancement of Sciences (AAAS), Member, 1996-Present.  
American Chemical Society, Member, 1976-Present.  
American Society of Civil Engineers, Member, 1970-Present.  
American Society of Microbiology, Member, 1997-Present.  
Association of Environmental Engineering and Science Professors, Member, 1974-Present.  
Georgia Water and Pollution Control Association, Member, 1974-Present.  
International Water Association, Member, 1980-Present.  
University Forum and Program Committee, Member, 1998-Present.  
Water Environment Federation, Member, 1967-Present.
Fotis Sotiropoulos
Professor

Degrees
M.S., Aerospace Engineering, The Penn State University, 1989.
B.S., Mechanical Engineering, National Tech. Univ. of Athens, Greece, 1986.

Research Interests
Computational fluid dynamics, turbulent shear flows, sediment transport, hydraulic structures, renewable energy systems, stratified flows, cardio-vascular fluid mechanics, biofluids, laminar and turbulent mixing.

Selected Journal Publications

Professional Service and Development Activities
American Physics Society, Member, 1995-present.
American Society of Civil Engineers, Member, 1992-present.
American Society of Mechanical Engineers, Member, 1992-present.
ASCE/EWRI task committee on Advanced Environmental Hydraulics Modeling, Chair, 2001-present.
Associate Editor of the ASCE Journal of Hydraulic Engineering, 2002-present.
Numerical Modeling of Selective Withdrawal in the lake Billy Chinook Reservoir, Battelle Seattle Research Center, 2003 - present.
Jim Spain
Professor

Degrees
Ph.D., University of Texas at Austin, Microbiology and Biochemistry, 1979.

Research Interests
Environmental distribution, persistence, and biodegradation of chemical pollutants; Green chemistry synthesis of organic compounds by biocatalysis; Biodegradation pathways in bacteria for application to bioremediation; Environmental biotechnology related to marine, freshwater and subsurface ecosystems; Evolution and adaptation of microbial communities; Biochemistry, ecology, and molecular biology of environmentally relevant microbes; Discovery and characterization of bacteria that degrade synthetic organic compounds; Photobiological hydrogen production by cyanobacteria.

Selected Journal Publications
Bacteriol. 185:5536-5545.

**Professional Service and Development Activities**
Editorial Board, Applied and Environmental Microbiology
Editorial Board, Biodegradation
Editorial Board, Bioremediation
Editorial Board, Journal of Industrial Microbiology
Editor, Applied and Environmental Microbiology
Editorial Board, Applied and Environmental Microbiology
Marc Stieglitz  
Associate Professor

**Degrees**  
Ph.D., Physics, Columbia University, 1995.  
B.S., Physics, Columbia University, 1983.

**Research Interests**  
Watershed dynamics with emphasis on the interactions between climate, climate variability, hydrology and terrestrial biology; terrestrial carbon and nitrogen cycling; hydroclimatology and land-atmosphere interactions; impacts of climate change.

**Selected Journal Publications**

Déry, S. J., M. Stieglitz, 2002, A Note on Surface Humidity Measurements in the Cold Canadian Environment, Boundary Layer Meteorology, Vol. 102, 491-497  
Shaman, J., M. Stieglitz, C.P. Stark, S. Le Blancq, M. Cane, 2002, Using a Dynamic Hydrology Model to Predict Mosquito Abundances in Flood and Swamp Water, Emerging Infectious Diseases, Vol. 8, 6-13  

Professional Service and Development Activities
Panel participant for the NASA EOS Snow and Ice Products Workshop, Greenbelt, Maryland, November 2004
Arctic Scaling Workshop, U.S. Arctic Research Commission, Seattle, October 2003
DOE-Biosphere 2 Modeling Workshop, Tucson, Arizona, August 2000
NSF-ARCSS Workshop on Arctic System Hydrology, National Center for Ecological Analysis and Synthesis Santa Barbara, September 2000
NSF-SEARCH (Study of Environmental Arctic Change) Workshop, Seattle, July 2000
Terry Sturm  
Professor

Degrees
Ph.D., Mechanics and Hydraulics, University of Iowa and Iowa Institute of Hydraulic Research, 1976.  
B.S., Civil Engineering, University of Illinois, 1969.

Research Interests
Hydraulic engineering; open channel flow resistance; compound channel hydraulics; sediment transport; scour around bridge abutments; cohesive sediment re-suspension.

Selected Journal Publications

Professional Service and Development Activities
Corresponding Member, ASCE Task Committee on Bridge Scour, 1995-Present.  
EPA Technical Advisory Group (TAG) on Sediment TMDLs in Georgia, Invited Member, 2000-Present  
FHWA Regional Excellence Team on Hydraulics, Member, 1990-Present.  
Member, FHWA Regional Excellence Team on Hydraulics, 1990-Present.  
Member, Erosion and Sedimentation Control Steering Committee, Georgia Certification, Georgia Section ASCE, 2004-2005.  
Member, Leadership Group, Environmental Technical Group, Georgia Section ASCE, 2004-2005.  
Invited Member, City of Atlanta Technical Advisory Committee on Stormwater Monitoring, 2003-2004.  
Invited Member, EPA Technical Advisory Group (TAG) on Sediment TMDLs in Georgia, 2000-2003.  
Member, ASCE and AGU.
Donald Webster
Associate Professor

Degrees
Ph.D., Mechanical Engineering, University of California at Berkeley, 1994.
B.S., Mechanical Engineering, University of California at Davis, 1989.

Research Interests
Fluid mechanics; turbulence; turbulent and chaotic mixing; biological, ecological and environmental flow applications; experimental methods.

Selected Journal Publications

Professional Service and Development Activities
Review of Fluid Mechanics 1999 Wrote and starred in a video produced and distributed by ASME as part of a series of video reviews of topics for the P.E. exam.
American Physical Society, APS, Member.
American Society of Limnology and Oceanography, ASLO, Member.
Peter Webster  
Professor

Degrees  
Ph.D., Massachusetts Institute of Technology, 1972.  
B.S., Royal Melbourne Institute of Technology, 1964.

Research Interests  
Low frequency atmospheric and ocean dynamics, Ocean-atmosphere interactions, Wave propagation through complex flows.

Selected Journal Publications  
Lawrence, D, and P. J. Webster, 2002: The boreal summer intraseasonal oscillation and the South Asian monsoon. J. Atmos. Sci., 59, 1593-1606.  
Paul Work
Associate Professor

Degrees
Ph.D., Coastal and Oceanographic Engineering, University of Florida, 1992.
M.S., Civil Engineering, University of California at Berkeley, 1987.
B.S., Civil Engineering, University of California at Berkeley, 1986.

Research Interests
Dr. Work's research interests include coastal engineering, water waves, sediment transport, field data collection, numerical modeling and coastal and riverine flooding.

Selected Journal Publications

Professional Service and Development Activities
2004 RETEC Group, Savannah, GA. Sediment scour, Ocmulgee River, Macon, GA.
2002-03, Evans-Hamilton, Inc., Charleston, SC. Sediment sampling, Brunswick, GA.
Panelist, Savannah Engineering Academy, Armstrong Atlantic State University, Savannah, Georgia, June 18, 2004.
Participant in Georgia Sea Grant Research Planning meeting, February, 2004.
Sotira Yiacoumi  
Professor

Degrees  
Ph.D., Environmental Engineering, Syracuse University, 1992.  
M.S., Environmental Engineering, Syracuse University, 1987.  
Dipl. Engr., Civil Engineering, Aristotle University (Greece), 1985.

Research Interests  
Interfacial and colloidal phenomena in environmental systems; sorption of metal ions from aqueous solutions; sorption/desorption of organic compounds from aqueous solutions by natural particles; colloidal particle interactions in aquatic systems; bubble interactions in gas/liquid reactive systems; influence of sorption rates on particle flocculation kinetics.

Selected Journal Publications  
Chin, C.J., Yiacoumi, S., and Tsouris, C., "Probing DLVO Forces Using Interparticle Magnetic Forces:
Transition from Secondary-Minimum to Primary-Minimum Aggregation," Langmuir, vol. 17, 6065-
6065-6071.
Dambies, L., Guimon, C., Yiacoumi, S., and Guibal, E., "Characterization of Metal Ion Interactions with
Chitosan by X-Ray Photoelectron Spectroscopy," Colloids and Surfaces A: Physicochemical and
Subramaniam, K., and Yiacoumi, S., "Modeling Kinetics of Copper Uptake by Inorganic Colloids under
High Surface Coverage Conditions," Colloids and Surfaces A: Physicochemical and Engineering
Subramaniam, K., Yiacoumi, S., and Tsouris, C., "Copper Uptake by Inorganic Particles - Equilibrium,
Kinetics, and Particle Interactions: Experimental," Colloids and Surfaces A: Physicochemical and

**Professional Service and Development Activities**

AIChe Annual Meeting, Indianapolis, IN, Session Organizer and Chair, 2002.
AIChe Annual Meeting, Los Angeles, CA, Session Organizer and Vice-Chair, 2000.
72nd ACS Colloid and Surface Science Symposium, Session Chair, The Pennsylvania State University,
1998.
Marc Weissburg  
Associate Professor

Degrees  
Ph.D., Ecology and Evolution, State University of New York at Stony Brook, 1990.  

Research Interests  
Chemical ecology: chemically-mediated orientation and guidance in marine invertebrates, behavioral strategies for orientation in relation to fluid flow in aquatic environments, predator-prey and mating behavior mediated by chemical cues. Sensory ecology and physiology: sensory physiology of chemo- and mechanosensory system in marine crustaceans, development of chemosensory systems, neuroanatomy of crustacean chemosensory and mechanosensory systems, signal structure and transmission of chemical and fluid mechanical signals.

Selected Journal Publications
Lawrence Bottomley
Professor

Degrees
Ph.D., Chemistry, University of Houston, 1980.
B.S., Chemistry, California State University, 1976.

Research Interests
Bottomley's research interests are in biological applications of scanning probe microscopy, microcantilever and microacoustic array sensors, and electroanalytical chemistry. Current projects include: Force Spectroscopy of Biopolymers: Correlating Molecular Structure with Single Molecule Elasticity, Microcantilever and Microacoustic Array-based Immunoassays, Chemical Force Microscopy on Single-walled Carbon Nanotubes, Atomic Force Microscopic Imaging Drug-DNA Complexes, Reductive Biotransformation and Decolorization of Reactive Anthraquinone and Phthalocyanine Dyes, Theory and Application of Cyclic Square Wave Voltammetry

Selected Journal Publications
William Koros  
Professor and Robert C. Goizeuta Chair

Degrees
Ph.D., Chemical Engineering, University of Texas at Austin, 1977.  
M.S., Chemical Engineering, University of Texas at Austin, 1969.

Research Interests
Our research group pursues both fundamental and applied research related to the burgeoning area of membrane-based gas separation. In addition, selected liquid separation topics are also considered. Our strategy continues to rely upon a balanced emphasis on three complementary areas of membrane research: Membrane and Barrier Materials, Formation and Application of Polymeric, Ceramic, and Carbon Membranes, Penetrant History and Temperature-Dependent Phenomena.

Selected Journal Publications

Professional Service and Development Activities
The GRA Eminent Scholar in Membranes
Joseph Schork  
Professor  
  
Degrees  
Ph.D., Chemical Engineering, University of Wisconsin, 1981.  
M.S., Chemical Engineering, University of Louisville, 1974.  
B.S., Chemical Engineering, University of Louisville, 1973.  

Research Interests  
Dr. Schork's research interests involve the dynamics and control of reacting systems, including the development of mathematical models, on-line sensors, digital control schemes, and novel reactor configurations for polymerization, and other reaction systems. Current research areas include emulsion, solution, suspension, and dispersion polymerization, and control of nonlinear systems. Specific topics of interest in emulsion polymerization include modeling, dynamics, and control of batch and continuous systems, and the development of on-line sensors for data acquisition and control in such systems. Interests in suspension, dispersion, and solution polymerization's include determination of component kinetic mechanisms, modeling, reactor design, and closed-loop control of molecular weight.  

Selected Journal Publications  
Luo, Yingwu, F. Joseph Schork, Yulin Deng and Zegui Yan, " Emulsion/Miniemulsion Polymerization of Butyl Acrylate with the Cumene Hydroperoxide/Tetraethlenepentamine Redox Initiator" Polymer Reaction Engineering, 9(3), 91-106 (2001).  
## Appendix IV

### School of Civil & Environmental Engineering: Undergraduate Exit Survey

Your name: ___________________________

Your student ID number: ___________________________

Expected semester of graduation:  
- O Fall
- O Spring
- O Summer  20____

### Knowledge & Skills

To what extent do you think your Environmental Engineering education contributed to your development of the following knowledge and skills?

<table>
<thead>
<tr>
<th></th>
<th>VERY MUCH</th>
<th>SOME WHAT</th>
<th>VERY LITTLE</th>
<th>NOT AT ALL</th>
<th>DON'T KNOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to understand the environmental impact of environmental engineering solutions</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to understand the societal impact of environmental engineering solutions</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to identify environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to formulate alternatives to environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to apply knowledge of mathematics to solve environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to apply knowledge of the sciences to solve environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to apply knowledge of core engineering topics to solve environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to apply modern engineering tools to solve environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to apply fundamental techniques and skills necessary to solve complex environmental engineering problems</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to design and conduct experiments related to environmental engineering disciplines</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Ability to analyze and interpret data from designed experiments</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Understanding of the role of computers in engineering</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Understanding of professional responsibility</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

### General Program

Please rate your level of satisfaction with the following areas:

<table>
<thead>
<tr>
<th></th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>NO OPINION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth of elective course offerings</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Availability of elective offerings</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Originality of material in core course subject areas</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>If you answered “Fair” or “Poor”, which courses contained substantial overlap?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Currency of course material?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>If you answered “Fair” or “Poor”, which courses were not current?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>To what extent do you think that the B.S.EnvE. has prepared you for a career in engineering?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>To what extent do you think your Environmental Engineering education prepared you for graduate school?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
To what extent do you think your Environmental Engineering education prepared you to take the FE exam? 
What is your overall view of the Civil & Environmental Engineering faculty?
Which me professor(s) do you consider to be an especially effective teacher?
Which me professor(s) do you consider to be an especially ineffective teacher?

<table>
<thead>
<tr>
<th>What are the 3 greatest strengths of the EnvE program?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What are the 3 biggest weaknesses of the EnvE program?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Please provide any other comments regarding your Environmental Engineering education at Georgia Tech:

Thank you for taking the time to fill out this exit survey.