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ABET Self-Study Report for the Environmental Resources Engineering Program at SUNY ESF

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ABET
Self-Study Report

for the

Environmental Resources Engineering Program

at

State University of New York
College of Environmental Science and Forestry

Syracuse

27 June 2012

CONFIDENTIAL

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BACKGROUND INFORMATION

A. CONTACT INFORMATION

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B. PROGRAM HISTORY

The Bachelor of Science (BS) program in Environmental Resources Engineering (ERE) was implemented in the fall of the 2010–2011 academic year. This program has not had an ABET review; the development of the program is summarized below.

In 1971, the Department of Forest Engineering at the State University of New York College of Environmental Science and Forestry (ESF) began offering a BS degree in Forest Engineering (FEG). The BS in Forest Engineering was first accredited by ABET in 1982 and was most recently reviewed by the Engineering Accreditation Commission in 2006. This is the first ABET review for the BS program in Environmental Resources Engineering, which evolved out of the previously accredited BS in Forest Engineering.

Since 1971, the Department name has changed twice to reflect the evolution of the Department and the discipline; in 1996 the Department name changed to Environmental Resources and Forest Engineering, and then on 1 July 2010, it changed again to its current name, Environmental Resources Engineering. The revisions to the Department name involved significant interactions with our program constituencies. The most recent change to the Department of Environmental Resources Engineering better reflects the nature of the research performed in the Department, the content of the undergraduate and graduate degree programs, and the career paths of a majority of our alumni. Coinciding with the 2010 name change was an extensive evaluation of the BS in Forest Engineering program that engaged our program constituencies. The result of this evaluation was the decision to phase out the FEG degree and reshape it into the Bachelor of Science degree in Environmental Resources Engineering. The ERE degree program was approved by the New York State Department of Education in 2010.

Starting with the 2010-2011 academic year, continuing undergraduate students in the Department had the option to complete a BS in FEG (EAC/ABET accredited) or a BS in ERE (regionally accredited by the Middle States Commission on Higher Education). Starting with the 2010-2011 academic year all freshman and transfers (with degree completion after May 2013) have been enrolled in the ERE degree. The first graduates of the ERE program completed their degrees on 24 December 2010.

C. OPTIONS

The Environmental Resources Engineering program does not have formal options or tracks that are recognized on the student transcript; however, students can focus their upper division elective courses in areas that reflect the strengths of the faculty. In the sophomore and junior years, all ERE students engage in required coursework in the Department's three specialty areas: ecological engineering, geospatial engineering, and water resources engineering. Students take three engineering electives in the senior year that allow them to focus within an area of interest or to enhance breadth in engineering. The engineering elective courses provide theory and application of scientific principles and quantitative skills relevant to monitor, assess, or design in the environmental resources engineering profession. In addition, students are able to take a variety of minors offered generally to students at ESF.

D. ORGANIZATIONAL STRUCTURE

The Environmental Resources Engineering program is administered by the ERE Department The Department is led by the Chair (Dr. Theodore A. Endreny), who is appointed by and reports to the Provost and Vice President for Academic Affairs (Dr. Bruce C. Bongarten). Program administration is supported by the Undergraduate Coordinator, who was Dr. Jungho Im through the 2011–2012 academic year and will be Dr. Stewart Diemont beginning in the 2012–2013 academic year, and the Program Assessment Coordinator, Dr. Lindi Quackenbush. Each student in the program is assigned an ERE faculty member advisor.

The ERE Department offers bachelor's, master's, and doctoral degrees as a unit of the State University of New York (SUNY) College of Environmental Science and Forestry. The ERE

Department is one of eight departments at ESF; the three engineering departments—Environmental Resources Engineering, Paper and Bioprocess Engineering, and Sustainable Construction Management and Engineering—form the Division of Engineering. The Division serves as mechanism for coordinating the three departments and is not an administrative unit. The current Director of the Division is Dr. Gary Scott, Chair of Paper and Bioprocess Engineering. The relationship between the Departments, the Division and the upper administration of the College is detailed in the institutional section of this self-study in Appendix D.

E. Program Delivery Modes

The core curriculum in the Environmental Resources Engineering program is taught in a traditional, daytime format using lectures and laboratories. Most non-laboratory classes are on-campus using traditional and innovative classrooms, frequently utilizing electronic tools such as Blackboard to enhance learning. Many laboratory-based classes include off-campus experiences on campus properties—e.g. FOR 321 Forest Ecology and Silviculture employs weekly field trips—and throughout the region—e.g. the projects completed in ERE 489 Environmental Resources Engineering Planning and Design have involved partnerships with agencies throughout the state. Students also have the option to take elective courses—e.g. ERE 425 Ecosystem Restoration Design—that enables an international experience through their coursework.

F. Program Locations

The program is delivered through the Syracuse, NY campus of ESF. The Department is located in Baker Laboratory.

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

This is the initial accreditation for the ERE program. There was no prior ABET visit and therefore there are no Deficiencies, Weaknesses, or Concerns with the program.

Given the close relationship to the previously accredited FEG program we have drawn on the experiences of the last FEG accreditation visit to strengthen the ERE program. The last FEG review showed no deficiencies, but did identify weaknesses related to assessing specific outcomes and application of assessment results toward continuous improvement of the program. The Department has adopted a new assessment protocol that engages all faculty in the assessment process and produces an annual report to summarize assessment activities, provides recommendations for future activities, and reviews actions taken based on prior recommendations. The assessment protocol in place uses a multi-faceted approach with direct and indirect measures including course-based assessment of students at different levels, graduating student, alumni and employer surveys, and external examination results.

H. Joint Accreditation

The ERE program is not seeking joint accreditation.

GENERAL CRITERIA

CRITERION 1. STUDENTS

A. STUDENT ADMISSIONS

Students are admitted to the ERE program directly from high school and as transfer students from other institutions of higher learning, with the majority of students entering as freshman. Students seeking credit for courses taken at other institutions must submit official transcripts. The ESF Office of Undergraduate Admissions tries to accept students with a high school GPA $\geq$ 90, and a combined SAT for critical reading and math $\geq$ 1200 (equivalent to ACT 27 or 28).

The Office of Undergraduate Admissions implements admissions criteria developed in cooperation with each Department. Admission of freshman applicants is based on a review of their high school transcript, results of either the SAT or ACT examination, information provided on the SUNY application and the ESF Supplemental application, and their response to an essay question regarding their interest in the College and intended program of study. Freshman admission is based on a selectivity criteria with emphasis placed on the rigor of their high school program, especially in the areas of mathematics and science. The SUNY-wide Mission Review process includes an Undergraduate Admissions Selectivity component for freshman. ESF is classified as a group 2 campus, the second most selective level in the matrix. This matrix guides the review of freshman applications.

Students seeking admission to the programs must file their application under one of the processes detailed in the College Catalog and on the College website at www.esf.edu/admissions/freshman. The three primary application methods are described below.

Regular Freshman Admission
High school seniors may apply for Regular Freshman admission. This freshman enrollment option is available for students who meet the admission standards for bachelor’s degree programs. Freshman applicants require strong academic credentials in a college preparatory high school curriculum. A minimum of three units each of college preparatory mathematics and science are required for all majors. Completion of additional units of math and science, as well as advanced level coursework (honors or college level) indicates strong preparation for the academic rigor students will experience at ESF. An official high school transcript, including 12^{th}-year first-quarter grades, must be submitted as part of the student’s application credentials. Applicants are required to forward the results of either the SAT I or ACT examination. SAT II tests are not required, but in some cases they may highlight the special talents of an applicant. Freshman applicants are also required to submit a Supplemental application, an ESF essay question response, and an academic recommendation. High school seniors who are not offered freshman entry may be offered Guaranteed Transfer.

Early Decision Freshman Admission

Outstanding high school seniors who have selected ESF as their first-choice institution may apply for Early Decision admission and, if admitted, must commit to enroll at ESF. Early Decision students may apply to other institutions under Regular consideration, and if admitted to ESF, must withdraw their other applications and commit to enroll at ESF no later than March 15. Early Decision candidates must have a completed application on file by December 1. This must include submission of either the SUNY Application or The Common Application (a standardized first-year application form), official high school transcripts (including 12^{th}-year first-quarter grades), results of either the SAT I or ACT, Supplemental application, ESF essay question response and academic recommendation.

Guaranteed Transfer

ESF recognizes that some students have made arrangements to spend a portion of their first two years of college at other institutions and will transfer to ESF in either their sophomore or junior year. To facilitate this process and reduce difficulties associated with transferring, ESF has established a Guaranteed Transfer option. Under this option, admitted students are guaranteed admission to ESF for either their sophomore or junior year provided they meet the conditions specified in the offer of Guaranteed Transfer. Students benefit from long-term academic advising to ensure they meet all academic requirements for transferring to ESF. Guaranteed Transfer applicants may file the SUNY application or The Common Application indicating on their supplemental form the entry semester for which they wish to be considered. Applicants must submit the same credentials as outlined under Regular Freshman Admission. Successful applicants for this option must present a strong academic background including at least three years each of college preparatory mathematics and science. To satisfy the guarantee of admission, students must satisfactorily complete, with a minimum cumulative grade point average of 2.500 (A=4.000), any of the lower-division requirements, which are part of their program of study. Only coursework with grades of C or higher will transfer to meet ESF degree requirements.

B. EVALUATING STUDENT PERFORMANCE

Degree progress

Student progress is monitored each semester by the student's ERE advisor to ensure the student is meeting prerequisites and progressing through the program. Performance and progress are monitored using the ESF Curriculum Plan Sheet, hereafter referred to as a plan sheet. The Office of Undergraduate Admissions, the Registrar's Office and the Department Chair cooperate to prepare a plan sheet for each student admitted to the College. The ERE plan sheet illustrates the eight semesters of coursework required for completion of the degree and indicates any transfer or advanced placement credit matches, with reference to the institution where the credit was obtained. A blank plan sheet for the ERE program is provided in the appendix to this Criterion (Appendix 1-1). The first three pages of the plan sheet lay out the required courses, the alternatives for the earth science electives, and typical placement for the remaining electives. The fourth page of the plan sheet details the intent and options for the three engineering electives. The fifth page of the plan sheet explains the requirements for the SUNY general education electives. As programs are modified, the plan sheet is revised to reflect the new program. Students are required to fulfill the program requirements that were in place at the time when they first entered ESF. However, students always have the option of switching to the current program.

The plan sheet provides a semester-by-semester check against which students can gauge their progress towards the Bachelor of Science degree. The student and advisor can identify and rectify any issues related to progress towards the degree. Students access their plan sheet through the student (MyESF) portal (http://www.esf.edu/portals/). Faculty have access to the plan sheet for any assigned advisee through the Faculty and Staff portal. The Undergraduate Coordinator and the Department Chair have access to all ERE student records. All portals are password protected. The Registrar's Office updates plan sheets at the end of each semester by indicating courses completed (with grades) and courses in progress (indicated as IP). The plan sheet is also the Degree Audit Form used to certify that the program requirements have been met.

Prerequisites

ERE uses a flow chart (provided in the appendices to this Criterion: Appendix 1-2) to document the sequencing for classes in the ERE program and their pre- and co-requisites. Pre- and co-requisites are also provided on course syllabi and in the College Catalog (www.esf.edu/catalog). Plan sheets are typically reviewed by the advisor each semester during the scheduled advising meetings to verify that students are taking courses in an appropriate sequence, are satisfying necessary prerequisites, and are making progress toward the degree completion. Because of scheduling challenges, particularly in the case of transfer students, in some cases a student will take a course listed as a prerequisite while concurrently taking the subsequent course. The advisor will discuss sequencing concerns with the student and will consult with the instructor as appropriate to ensure that the student has sufficient preparation to succeed. The Registrar reviews student registrations each semester to verify that core course sequences, e.g. the calculus, physics or chemistry series, are being adhered to.

Additional reviews

An additional, independent review of course completion is provided for students in our ABET-accredited degrees on campus who are eligible to take the Fundamentals of Engineering (FE) Examination in their final year. The ESF Registrar reviews student progress and certifies that all students applying to take the FE exam are within one year of completing all degree requirements. This process currently considers the FEG students and will include all students within the ERE program once that program attains ABET-accreditation.

Each semester the College's Instructional Quality and Academic Standards committee reviews any student who has a cumulative grade point average below a 2.000. That committee decides whether a student should be placed on academic probation or dismissed. The department chair and student's advisor are notified of the decision. A student dismissed for poor academic performance has the right to appeal the decision. Students who are placed on probation are required to meet with staff in the Academic Support Services Office, a division of Student Affairs.

C. TRANSFER STUDENTS AND TRANSFER COURSES

Students applying to transfer into the ERE program must complete an ESF application, submit official high school and college transcripts, and the results of either the SAT I or ACT examination. The ESF Office of Undergraduate Admissions tries to accept students with a high school GPA ≥ 90, a combined SAT for critical reading and math ≥ 1200 (equivalent to ACT 27 or 28), having completed the 1st and / or 2nd year core math and science requirements for the ERE program, and have a transfer college GPA ≥ 3.4. We accept no course credit transfers with grades below C.

Transfer students comprised 16–18% of the incoming class in the ERE Department over the last three years and standard procedures are in place to smoothly integrate these students into the curriculum. The process for accepting transfer students is well established at ESF and detailed in the College Catalog. Transfer students enter the College based on the review of post-secondary transcripts, the SUNY application, the ESF Supplemental Application, and compatibility of prior course work with their intended program of study. Transfer students enter with anywhere from 30 to more than 70 transfer credits and may require additional advising support due to schedule challenges.

There are two distinct processes by which transfer credit is accepted by ESF: upon admission and after admission. Upon admission, the initial acceptance of transfer credit is determined the Office of Undergraduate Admissions. Each department establishes criteria for evaluation of transfer credit for freshman and transfer students. These criteria are used to guide the preparation of transfer articulation agreements for each of the cooperative colleges with which ESF has a transfer agreement (http://www.esf.edu/admissions/transfer/tags/). The College has developed transfer articulation agreements with colleges both in (Table 1-1) and out of New York State (Table 1-2). These institutions represent a broad spectrum of higher education, including private, public, two- and four-year colleges. To be considered for admission to ESF, a transfer student must have a minimum cumulative grade point average of 2.000 (A = 4.000) at the last institution where the student was enrolled full time. Only course work with grades of "C" or higher will transfer to meet ESF degree requirements.

Table 1-1. New York State cooperative transfer colleges with ESF articulation agreements

Adirondack Community College	Morrisville State College
Alfred State College	Nassau County Community College
Broome Community College	Niagara County Community College
Cayuga County Community College	North Country Community College
Clinton Community College	Onondaga County Community College
Columbia-Greene Community College	Orange County Community College
Corning Community College	Rockland County Community College
Dutchess County Community College	Schenectady Community College
Erie Community College	Suffolk County Community College
Finger Lakes Community College	Sullivan County Community College
Fulton-Montgomery Community College	SUNY Canton
Genesee Community College	SUNY Cobleskill
Herkimer County Community College	SUNY Delhi
Hudson Valley Community College	Syracuse University
Jamestown Community College	Tompkins-Cortland Community College
Jefferson County Community College	Ulster County Community College
Mohawk Valley Community College	Westchester County Community College
Monroe Community College	

Table 1-2. Out-of-state cooperative transfer colleges with ESF articulation agreements

Berkshire Community College, Pittsfield, MA
Bucks County Community College, Newtown, PA
Holyoke Community College, Holyoke, MA
Northampton Community College, Bethlehem, PA

Transfers from other colleges are handled on an individual basis. The staff of the Office of Undergraduate Admissions is responsible for interpreting the guidelines and reviewing course work from colleges with which we have no formal agreement. In these cases, course equivalences are based on a comparison on the learning outcomes provided in the catalog descriptions and course syllabi of the transferring college and the corresponding course at ESF. Again, the Office of Undergraduate Admissions makes the initial decisions of acceptance. The Department is regularly consulted on individual course content equivalency. In some cases, transfer students may get partial credit for a required course and then will take additional credits to satisfy remaining course outcomes, e.g. many transfer students take a three-credit surveying course that does not include coverage of global positioning systems (GPS). The four-credit ERE 371 Surveying for Engineers course that is required in the ERE program is structured such that students can take the component focused on GPS as a one-credit unit (ERE 566).

A student may petition to gain credit for courses that did not transfer when they were admitted to ESF. This may include courses completed prior to enrolling at ESF, or courses taken elsewhere when enrolled at ESF, e.g. during a summer session. The student must supply the documentation necessary (e.g., a syllabus for the course taken and/or a catalog description) to substantiate the claim that the course satisfies a program requirement and provide a transcript that shows a grade of "C". The petition must be approved with a signature of the student's advisor and the ERE Undergraduate Coordinator, and the ERE

Chair, with consultation of the course instructor as required. The petition is then sent to the office of the Associate Provost for Instruction for final approval. Once approved, the petition is forwarded to the Registrar's office. Petitions regarding the satisfaction of General Education requirements are adjudicated by the General Education subcommittee of the campus Committee on Curriculum. When Faculty Advisors know that a student is planning to take a course that requires a petition, they advise the student to complete the petition process prior to enrolling in the course.

Credit hours are transferred to the College; however, grades and grade points are not transferred. All transfer credit is tentative until official final transcripts are received and reviewed by the Office of Undergraduate Admissions staff. The student is responsibility for ensuring that official and final transcripts are sent to and received by the College. Only course work completed at institutions that are fully accredited by one of six regional accrediting agencies will be considered for possible transfer credit toward ESF degree requirements. These agencies are the Middle States Association of Colleges and Schools, New England Association of Schools and Colleges, North Central Association of Colleges and Schools, Northwest Association of Schools and Colleges, Southern Association of Colleges and Schools, and Western Association of Schools and Colleges.

D. Advising and Career Guidance

Advising

ERE students meet with their faculty advisor each semester to engage in academic advising and seek career guidance. Information about academic advising is summarized on our ERE website: http://www.esf.edu/ere/undergraduate/advising.htm. Communication with our students through advising is considered of paramount importance to ensure students maintain optimal progress toward personal goals and completion of their degree program.

The ERE Chair assigns an academic advisor for each student admitted to programs in the Department. All ERE faculty members participate in academic advising. Table 1-3 summarizes the faculty advising load, using data accessed from the College intranet on 18 Jan 2012 (Dr. Shaw joined the faculty in 2011, hence has only taken on one group of advisees). The class rank in this table was assigned based on expected graduation date; counts for Junior and Senior advisees include students in the ERE and FEG programs. Several faculty members—i.e., Diemont, Endreny and Quackenbush—also advise additional students within the Environmental Science program (not reflected by the numbers shown in Table 1-3).

Table 1-3. Advising load for ERE faculty members (as of Spring 2012)

Faculty member	Freshman	Sophomore	Junior	Senior
Daley	3	3	4	4
Diemont	2	2	5	6
Endreny	2	2	3	2
Im	2	3	5	6
Kroll	7	3	3	
Mountrakis	4	1	4	3
Quackenbush	5	4	4	3
Shaw	6			
Tao	2	2	4	6

The College schedules a week-long advising period each fall and spring in the week prior to registration for the upcoming semester. During the advising period, each faculty member provides extended office hours and schedules individual meetings with each student. The advisor is available to troubleshoot problems, differentiate between the various engineering electives, coordinate undergraduate research opportunities, and discuss summer internships or jobs. Students are expected to identify their required courses for the coming semester and check for any course schedule conflicts so that they are active participants in the navigation of their academic program. All students are required to meet with their advisor at least once per semester for this purpose. Undergraduate students are not allowed to register for classes without a signature from the advisor approving the next semester's course work. This system reduces the likelihood of students taking courses out of sequence, or without appropriate prerequisites or authorization. Students are required to bring a current copy of their plan sheet and a draft schedule to advising meetings to ensure they are engaged in their own advising. Advisors have access to records for their advisees through the Registrar information stored on the password-protected College intranet. For undergraduate students, this includes: contact information (campus and home), current class schedule, plan sheet, grade report, and copies of any scanned documents included transfer records or petitions.

In addition to the formal advising period, students are encouraged to meet with their advisors outside this time to discuss professional and personal goals and seek career advice. Students are encouraged to seek support from their advisor, as well as other faculty members, via e-mail or through in-person meetings. This includes guidance toward elective selection, employment opportunities, graduate study plans, and scholarship submissions. Advisers may also review resumes and provide training for interviews. In addition to serving as an advisor, all faculty members teach at least one required undergraduate class, supporting the positive connection between the faculty members and all students.

All departments at ESF offer a 100-level orientation class in the fall semester. The ERE offering of this course—ERE 132—is required of all freshman and transfer students in the ERE program. The ERE Department uses ERE 132 to provide exposure to the various teaching, service, professional, and research interests of the faculty members and also includes a group advising session to explain the process of advising and registration at ESF and the expectations of students in this process.

The assigned academic advisor is the primary contact and helps students utilize the many advising services on campus. The Office Student Affairs at ESF (http://www.esf.edu/students/dean/) provides academic support services, career services, student assistance (counseling and disability services), student conduct (judicial affairs), multicultural affairs, and student involvement and leadership (student activities). The ERE 132 course includes several sessions delivered by Student Affairs that address various topics associated with academic success.

Career development

Career guidance and professional preparation is part of the advising the Department provides for its students. We provide guidance for internship and job preparation and placement throughout the students' four years at ESF. We also provide FE exam preparation and registration during their senior year for those who are eligible. The Department has hosted an Employer Information Session for the last four years, and anticipates this continuing as an annual event. While the structure of this Session has varied, each event has included table-top displays set up by 10 to 15 local companies who are seeking students for internships as well as full time positions. Many of the company representatives are alumni of the Department. In preparation for this event, students prepare a resume, which is submitted to their advisor for editorial review prior to being shared with the company representatives. The event includes a panel discussion with engineering alumni focused on various topics around careers in environmental consulting and professional engineering practice, which has been well attended by the student body. The event is followed by a meet-and-greet between students, faculty, employers, and ERE Advisory Council members. Our ERE students are invited to attend Office of Career Services professional activities including a campus Career Fair and seminars aimed at career development.

The Department harnesses the enthusiasm of the upper classmen in various peer mentoring programs to improve retention and council new students. The student-led Environmental Resources Engineering Club organizes a freshman trip to the Adirondack Ecological Center at ESF's Huntington Wildlife Forest in the Adirondacks each fall as well as evening seminars on undergraduate research and professional preparation. Officers in the ERE Club are also involved in an ERE 132 session aimed at providing a student-perspective to the Department.

E. Work in Lieu of Courses

Overview

The ERE Department will allow credit for work in lieu of courses for things such as completion of Advanced Placement exams, and employment or military experience, which are described in more detail below. Students complete a petition form to have such credit considered. The College uses a petition form for a number of purposes including: late course add or drop; transferring credit from another school; substituting a course for a degree requirement; having a requirement waived. Undergraduate petition forms are reviewed by the advisor, ERE Undergraduate Coordinator and Chair, before being sent to the Associate Provost for Instruction for final review. If a petition is related to waiving or matching a specific course, the instructor may be consulted.

Advanced standing credit

The College will consider advanced standing credit based on the results of examinations from standardized testing agencies such as the College Entrance Examination Board's Advanced Placement (AP) Program or the College-Level Examination Programs (CLEP) as well as the Higher Level Exams of the International Baccalaureate (IB) program. The campus has specific minimum requirements for these three programs (posted online: http://www.esf.edu/admissions/transfercredit.htm). Departments can set thresholds to specify higher requirements. In most cases, such coursework is considered through the admissions process, though students can also petition additional credit after admission. On AP exams, scores of 4 or 5 are typically needed for credit in areas defined as the fundamentals of math and science, in other areas, scores of 3 or higher may be accepted. The AP exams indicative of knowledge areas in fundamentals of math and science are given in Table 1-4.

Table 1-4. Credit given for Advanced Placement (AP) scores in the area of math and science

AP Examination	Credits	Courses
Biology	8	EFB 101/102/103/104
Chemistry	8	FCH150/151/152/153
Calculus AB	4	APM 105 or APM 205
Calculus BC	8	APM 105/106 or MAT 205/206
Physics B	8	PHY 101/102
Physics C: Mechanics	4	PHY 211/221
Physics C: Electricity and Magnetism	4	PHY 212/222

Work experience

Students can gain credit for work or military experience in lieu of a curricular requirement. This uses the petition process and requires that student document how the experience attained would satisfy the learning outcomes of the course under consideration. When students petition out of a course in this manner, they typically have the course requirement waived, but are required to complete additional credit hours to satisfy the required degree total.

F. GRADUATION REQUIREMENTS

Students in the ERE program earn a Bachelor of Science in Environmental Resources Engineering. To earn the degree, students must satisfy the requirements for graduation presented in the Catalog in effect as of the date they first matriculated at ESF. The Catalog is available online at www.esf.edu/catalog. Students may graduate under the requirements stated in any Catalog issued subsequent to the one in effect the date they matriculated, but they may not use a prior Catalog. Graduation requires completion of all program requirements with a minimum cumulative grade point average of 2.000 (4.000=A) for all courses taken at ESF.

The 2011–2012 Catalog lists 58 credits of lower division required courses, 41 credits of upper division required courses, and 27 credits of elective courses for the ERE program, with a total minimum credit count for the degree of 126. With an increase in the credits for ERE 489 (the senior capstone course) from 3 to 4 credit hours, the 2012–2013 Catalog has a total minimum credit count for the ERE degree of 127. The breakdown of the required and elective courses is provided on the sample plan sheet (Appendix 1-1) and is also summarized in Table 5-1 in Criterion 5. As described previously, the plan sheet is used to document courses completed, either at ESF or through various transfer mechanisms, to meet program requirements. Students and faculty both have access to the plan sheet and work together to ensure degree progress is being made. The Registrar reviews the plan sheet for undergraduate students at the College at the completion of their degree program and certifies that all degree requirements have been met. The Department Chair then reviews all plan sheets and signs off to certify that the degree has been completed. A Diploma is generated only when both the Chair and Registrar agree that all published degree requirements have been met.

G. TRANSCRIPTS OF RECENT GRADUATES

We will provide transcripts for some of the ERE graduates to the ABET visiting team when requested by the team chair. The ESF transcript provides background information including the student name and ID, the basis for admission, including high school and any transfer information, and the record of attendance at ESF. Figure 1-1 provides an example (with student name removed) of the header information on the transcript. The transcript lists the program (Environmental Resources Engineering) and the degree received (Bachelor of Science), and any additional information such as honors records or minors completed.

Student:
I.D. No: XXX-XX-

Basis for Admission:
High School Diploma:
Union Endicott High School
Endicott, NY
Advanced Standing Credit in Semester Hours:

AP CREDIT	28.0
Onondaga Cmty Coll	4.0
Total Adv. Standing Credit Hours	32.0

Record of Attendance:
08/30/09 - Entered in BS program

Program: Environmental Resources Engineering

Title of Honors Thesis:
Development of a Hydrologic Model to Predict lakeshore Phosophorus Loadings for Prediction of Cladophora Biomass Blooms

Degree(s) Received:
05/13/12 - Bachelor of Science with Honors (Summa Cum Laude)

Figure 1-1. Example of header information on ESF Student Grade Report (Transcript)

The transcript lists the course number, title, credit hours, grade and grade points for all course completed at ESF broken down by semester attended. The College uses the grading system shown in Table 1-5. The grade of I is excluded from GPA calculation until one semester after the end of the course, at which time it is calculated as an F if course requirements have not been completed.

Table 1-5. Grading system used by ESF (in effect since Sept. 1978)

Grade	Grade points
A	4
A-	3.7
B+	3.3
B	3
B-	2.7
C+	2.3
C	2
C-	1.7
D	1
F	0

Grade	Definition
I	Work incomplete
P	Passed
S	Satisfactory
U	Unsatisfactory
WP	Withdrew passing
WF	Withdrew failing
W	Withdrew
SAU	Satisfactory audit
UAU	Unsatisfactory audit
V	Variable length course, grade not yet due, work satisfactory to date

Any course taken at ESF may be repeated. Courses taken at Syracuse University may only be repeated if a grade of F was assigned. Upon successful completion of a repeated course, the grade earned will be included in the semester and cumulative grade point averages, but the original grade in that course will revert to a grade of R on the transcript and will not be included in the current cumulative grade point average. The original grade received in the course will be shown in parentheses following the R [e.g. R (C)]. The cumulative grade point average will reflect the grade for the second time the course was taken if the course was repeated once. Grades for all subsequent times that the course is taken will be included in calculations of grade point average.

Appendix 1-1. Sample ERE Curriculum Plan Sheet

SUNY - ESF - Curriculum Plan Sheet
SSN :

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

LOWER DIVISION COURSE REQUIREMENTS

REQUIRED COURSES | EARNED COURSES

Freshman Year - Fall Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
EFB101	General Bio I: Organismal Bio & Ecol	3						
EFB102	General Biology I Laboratory	1						
FCH150	General Chemistry Lec I	3						
FCH151	General Chemistry Lab I	1						
APM205	Calculus I: Science and Engineering	4						
EWP190	Writing And The Environment	3						
ERE132	Orientation Seminar: FEG	1						

Freshman Year - Spring Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
FCH152	General Chemistry Lec II	3						
FCH153	General Chemistry Lab II	1						
PHY211	General Physics I	3						
PHY221	General Physics Lab I	1						
APM206	Calculus II: Science and Engineering	4						
ERE133	Intro to Engineering Design	3						
GENEDU	General Education Courses*	3						

Sophomore Year - Fall Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
PHY212	General Physics II	3						
PHY222	General Physics Lab II	1						
GNE172	Statics and Dynamics	4						
APM307	Calculus III: Science and Engineering	4						
FOR321	Forest Ecology and Silviculture	3						
EARSCI	Earth Science Elective (FCH399 or FOR 338 or FOR345)	3						

Curriculum Plan Sheet continued on next page

SUNY - ESF - Curriculum Plan Sheet
SSN :

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

LOWER DIVISION COURSE REQUIREMENTS

REQUIRED COURSES | EARNED COURSES

Sophomore Year - Spring Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
GNE273	Mechanics Of Materials	3						
ERE275	Ecological Engineering I	3						
APM485	Differential Equations for Engineers & Scientists	3						
EWP290	Writing, Humanities & Envrn	3						
GENEDU	General Educational Elective*	3						

Admission Officer: Date: This date indicates that all Admissions requirements have been satisfied.

UPPER DIVISION COURSE REQUIREMENTS

REQUIRED COURSES | EARNED COURSES

Junior Year - Fall Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
ERE371	Surveying For Engineers	4						
ERE335	Numerical and Computing Methods	3						
MAE341	Fluid Mechanics	4						
CIE337	Intro to Geotechnical Engineering	4						

Junior Year - Spring Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
ERE340	Engineering Hydrology & Hydraulics	4						
ERE365	Principles of Remote Sensing	4						
ERE430	Engineering Decision Analysis	3						
ERE440	Water Pollution Engineering	3						
ERE351	Basic Engineering Thermodynamics	3						

Curriculum Plan Sheet continued on next page

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

UPPER DIVISION COURSE REQUIREMENTS

REQUIRED COURSES | EARNED COURSES

Senior Year - Fall Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
ERE468	Solid Waste Management	3						
APM395	Probability & Statistics for Engineering	3						
GENEDU	General Education Course*	3						
ENGDES	Engineering Design Electives (1)	6						
ENGDES	Engineering Design Electives (1)							

Senior Year - Spring Semester

ID	Name	Credits	ID	Credits	Transfer College	ESF Semester	ESF Grade	Type
ERE489	Forest Engineering Planning & Design	3						
ENGDES	Engineering Design Elective (1)	3						
GENEDU	General Education Elective	3						
ELECT	Free Elective	3						

SUMMARIES

Lower Division Credit Hours		Upper Division Credit Hours		Grand Summary Credit Hours	
Required:	67	Required:	59	Required:	126
Earned:		Earned:		Earned:	
In Progess:		In Progess:		In Progess:	
Deficient:		Deficient:		Deficient:	

Curriculum Plan Sheet continued on next page

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

UPPER DIVISION FOOTNOTES

Engineering Elective

An upper-division engineering course that is advisor-approved and provides depth in engineering analysis, design or synthesis. Pre-approved SUNY ESF engineering courses are:

- ERE 412 River Form and Process
- ERE 445 Hydrologic Modeling
- ERE 448 Open Channel Hydraulics
- ERE 475 Ecological Engineering II
- GNE 461 Air Pollution Engineering
- ERE 496 and ERE 596 Special Topics courses must be pre-approved by Department prior to registration
- ERE 496 Environmental Systems Engineering
- ERE 496 Ecosystems Restoration Design

Pre-approved Syracuse University course that may be used to satisfy engineering electives include:

- CIE 331 Analysis of Structures and Materials
- CIE 332 Design of Concrete Structures
- CID 338 Foundation Engineering
- CIE 443 Transportation Engineering
- CIE 473 Transport Processes in Environmental Engineering

Special Topics courses offered through Syracuse Univeristy's L.C. Smith College of Engineering must be pre-approved by the Department prior to registration

500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll with permission of the instructor

- ERE 511 Ecological Engineering in the Tropics
- ERE 527 Stormwater Management
- ERE 551 GIS for Engineers

600-699 Graduate courses designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.

- ERE 621 Spatial Analysis
- ERE 622 Digital Image Analysis
- ERE 674 Methods in Ecological Treatment
- ERE 692 Remote Sensing of the Environment
- ERE 693 GIS-Based Modeling

Curriculum Plan Sheet continued on next page

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

General Educational Requirements

You must complete 12 credits in at least three of the five categories. Bold indicates course completed or in progres ___ **ESF** ___

Categories	ID	Name	Credits	Transfer College	Sem	Grade	Type

SOCIAL SCIENCES

FOR207 MICECON MACECON

AMERICAN HISTORY

Available for all students:

EST201 USHIS1 USHIS2 FOR204

For students scoring above 84 on the US History Regents:

EST361

WESTERN CIVILIZATION

EIN471 FOR203 EURHIS1 EURHIS2

OTHER WORLD CIVILIZATIONS

EST200 EFB217 EFB305

THE ARTS

PSE201 ARTHIS1 MUSTH1 ARTHIS2
MUSTH2

Curriculum Plan Sheet continued on next page

Program of Study:Environmental Resources Engineering
Advisor:
Entered: 2011 as a Freshman

Printed: January 27, 2012

INFORMATION ON HOW TO READ THIS PLAN SHEET

Student must match "required courses" with "earned courses" in order to satisfy curriculum requirements. Required courses are derived from the SUNY- ESF Course Catalog for the appropriate year. Earned courses
May be a combination of ESF courses and transfer courses, including advanced placement credit. The

"ID" refers to the Course ID, which my be an official College course ID or an abbreviation for a transfer course or course requirement.

Transfer courses will refer to the number of a transfer college identified at the top of the plan sheet.

Courses taken at ESF will display the semester taken and the grade recieved.

"Semester" - term and year in
which course was taken:
FA - Fall term
SP - Spring tem
SU - Summer term

"Type" of Course
IP - course in
Memo - Credit added via memo
Petn - credit added via petition

This report has been prepared to assist you in determining your academic progress at SUNY College of Environmental Science and Forestry. If this report does not appear to be accurate, contact your academic advisor and bring this report with you. Please be advised that final confirmation that you have met all degree requirements is subject to approval by your Faculty Chair and the Registrar.

CERTIFIED FOR

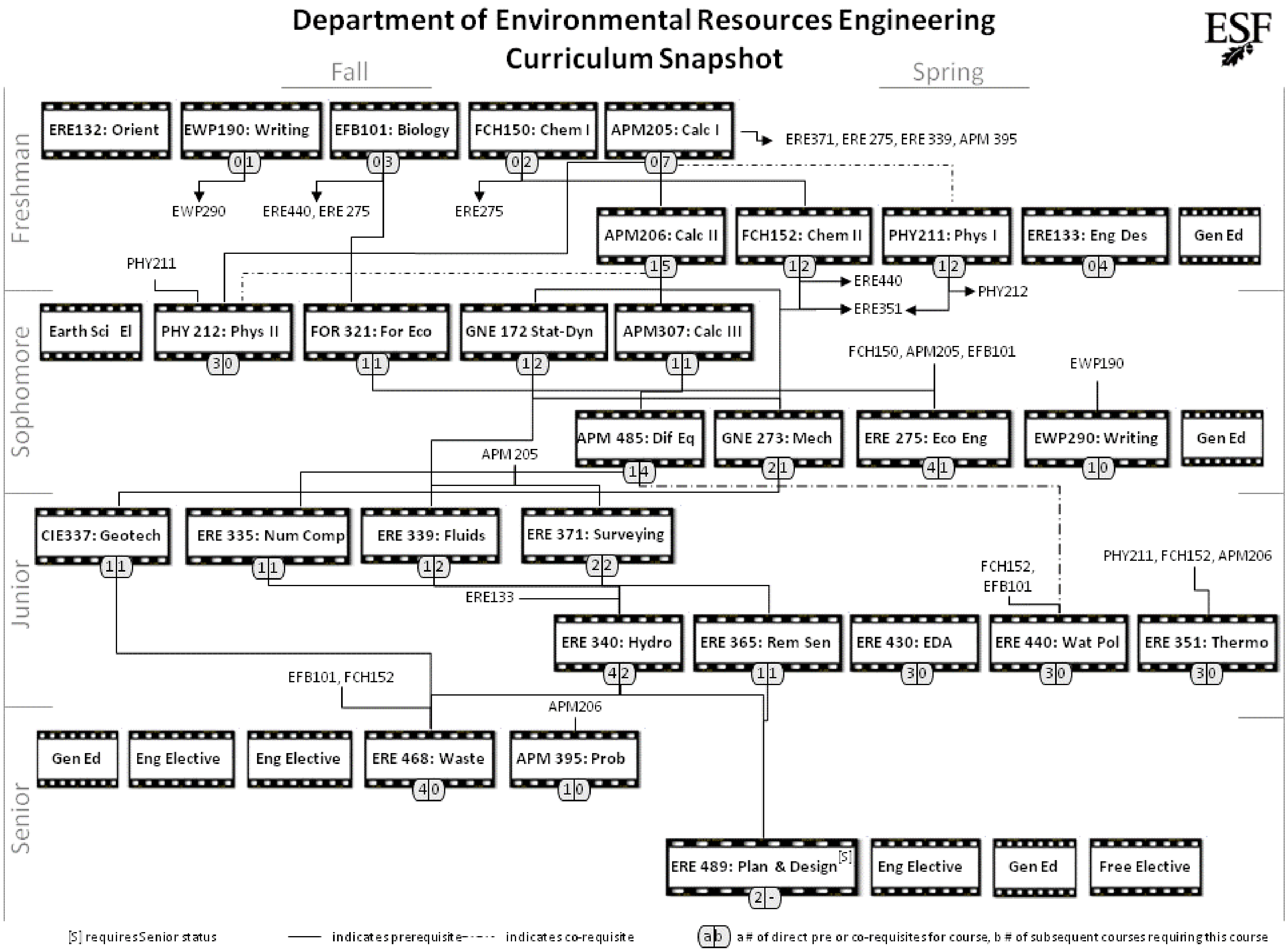
Hours: ________ GPA: ________

________________ ________
Registrar Date

________________ ________
Faculty Chair/ Designee Date

End of Curriculum Plan Sheet

Appendix 1-2. ERE curriculum flow chart



CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. MISSION STATEMENT

The mission of the College of Environmental Science and Forestry is to "advance knowledge and skills and to promote the leadership necessary for the stewardship of both the natural and designed environments".

The College was founded in 1911 as the New York State College of Forestry at Syracuse University. In 1948 the College became a unit within the newly formed State University of New York and in 1972 the College name was changed to its present version: State University of New York College of Environmental Science and Forestry. When it was formed, the College was legislatively tasked with educating people in the management and use of forest resources for the benefit of humanity. As the College has evolved, programs, faculty, and students all reflected the changing environment, and the scope of the College mission has expanded.

B. PROGRAM EDUCATIONAL OBJECTIVES

The program educational objectives of the Environmental Resources Engineering program are to prepare baccalaureate students who:

- Engage in professional engineering practice specializing in natural and designed environments;
- Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering, and
- Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world.

The mission and educational objectives for the graduate and undergraduate degrees offered by the ERE Department are provided online (http://www.esf.edu/ere/mission.htm) using the "Missions and Objectives" link from the "Departmental Links" on the ERE home page (http://www.esf.edu/ere/).

C. CONSISTENCY OF THE PROGRAM EDUCATIONAL OBJECTIVES WITH THE MISSION OF THE INSTITUTION

Each of the three ERE program educational objectives directly corresponds to a component of the College mission, to ensure consistency with the institutional focus. The connections are summarized in Table 2-1.

Table 2-1. Relationship between program educational objectives and College mission

ERE Program Educational Objective	Corresponding component of College Mission Statement
Engage in professional engineering practice specializing in natural and designed environments	"…stewardship of both the natural and designed environments."
Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering	"…promote leadership…"
Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world	"…advance knowledge and skills…"

D. PROGRAM CONSTITUENCIES

Through our strategic planning process, the Department has identified the primary constituencies of the ERE program as students, employers, alumni, and faculty.

ERE students seek a program that provides high quality teaching and advising to prepare them for professional practice or advanced study. The first two program educational objectives specifically target these two components. The third objective addresses the need for lifelong learning that is fundamental to the success of any engineer.

Employers value the scientific and engineering skills of our graduates. They require that graduates have core engineering skills as well as the ability to communicate ideas and expectations effectively, with suitable levels of professionalism. They seek graduates from a program with EAC/ABET accreditation who are able to succeed on the FE and PE exams. They seek employees who acknowledge the changing world and are willing to continue learning beyond their formal education to have sufficient knowledge and skills to engineer solutions to technological, environmental and social challenges.

Alumni value a sense of connection to the program and the College, our generation of well-trained new alumni, and our sustained academic excellence. They seek to have the skills necessary to ensure job placement and employment security. The program objectives directly reflect such goals by providing alumni with the ability to engage in engineering practice across a variety of fields, and to have the capacity to continue the engineering growth that is necessary to achieve career advancement.

The program educational objectives meet the needs of faculty in a variety of ways. Program graduates who are engaged in engineering practice provide project ideas, advice, contacts, and context to the capstone course experience (ERE 489). These alumni also provide support to extracurricular student events and clubs, and offer leadership in organizations such as the Air and Waste Management Association (AWMA) and the New York Water Environment Association (NYWEA). Program graduates who have moved on to advanced study are part of our professional network, supporting academic scholarship of discovery, application, and integration in our respective fields. Program graduates who seek to expand and adapt their knowledge and skills are also able to provide feedback to ensure that we are current with respect to the skills and technology that we teach. This also provides an avenue for critical input into service-focused courses and research.

E. Process for Revision of the Program Educational Objectives

Overview

The Environmental Resources Engineering program was formed in 2010 and we have not had any formal review of the program educational objectives since the formation. However, since the ERE degree evolved out of the Forest Engineering program, the procedure for evaluating those objectives is in place. The ERE program educational objectives will be reviewed every 3 to 6 years. As described below, the process of establishing and revising program education objectives includes input from all our constituencies. While the objectives are sufficiently broad to retain relevancy, this periodic evaluation ensures that the constituency needs are known and continue to be met by the program objectives.

The Department uses targeted questionnaires to gain input from each of the program constituencies on a regular basis. Students in each graduating class provide feedback by participating in an exit survey, while questionnaires are sent to alumni on a three-year cycle. The alumni survey has been a significant source of information for review of the FEG program educational objectives, and it is anticipated that this will continue in the ongoing review of the ERE program. Faculty surveys are used in association with targeted daylong Department retreats on a regular basis, most recently May 2010, to assess the program objectives.

ERE Advisory Council

A critical group for review of program objectives, and many other areas, is the Department's Advisory Council (http://www.esf.edu/ere/AdvisoryCouncil/). The ERE Advisory Council includes members of both our employer and alumni constituency groups. Table 2-2 summarizes the composition of the ERE Advisory Council as of March 2012. The Advisory Council provides strategic consultation, professional networking, information exchange, and resource development to assist the ERE Department achieve its mission and deliver the ERE program.

Table 2-2. Composition of ERE Advisory Council (as of March 2012)

Name	Affiliation	ESF Alumnus
David Gerber, P.E. Advisory Council Chair	Vice President Construction and Environmental Services, ARCADIS	Yes
Kris Dimmick, PE	Vice President of the Municipal Engineering Division, Bernier, Carr & Associates	Yes
Peter Gabrielsen	Chief Systems Operations Division, NOAA's National Weather Service-Eastern Region	Yes
Swiatoslav Kaczmar	Vice President and Chief Scientist, O'Brien & Gere Engineering	No
Al LaBuz, P.E.	Remediation Manager, Honeywell International Inc.	No
John LaGorga, P.E.	Senior Project Manager, Stearns & Wheler GHD	Yes
Megan Miller, P.E.	Program Manager, Parsons	No
Patricia Pastella, P.E.	Commissioner, C&S Companies	Yes
Meghan Platt, P.E.	Senior Engineer V, CHA Companies	Yes
John Thonet, P.E.	President, Thonet Associates, Inc.	Yes
Scott Wheeler	President, Strategy Arts	Yes

In May 2010, members of the ERE Advisory Council participated in a workshop focused on evaluating the FEG program in support of the transition to the ERE degree. This workshop provided a means to gain critical feedback regarding the appropriateness of the program educational objectives prior to the first freshman class being admitted to the ERE program. While the focus will vary, the intent is that Advisory Council workshops will be held periodically to draw from the knowledge base that the Advisory Council provides.

At the May 2010 workshop, the Advisory Council members spent a significant part of a day evaluating the existing FEG and proposed ERE curriculum, the outcomes for both programs, the process used to assess the outcomes, and the broader program goals. The survey used at the conclusion of the workshop restated the program educational objectives for the FEG program and asked the Council members to answer the following questions on a scale from 5 (strongly agree) to 1 (strongly disagree):

1. The educational objectives are consistent with ESF's Mission.
2. We have defined our major program constituents as: Students, Faculty, Alumni, and Employers. The educational objectives meet the needs of the program's constituents.
3. The Environmental Resources Engineering undergraduate curriculum fosters accomplishments of graduates that are consistent with the program objectives.

Department retreats

ERE faculty participated in a Department retreat in May 2010 that focused on the ERE program educational objectives and considered responses to the 2010 Advisory Council survey. Additional input from prior alumni and graduating student surveys, as well as results of a survey targeted at the faculty asking similar questions to those directed to the Advisory Council, was also available at the retreat. A particular focus of that retreat was a review of the program objectives in the context of the Advisory Council and alumni feedback and changes in the curriculum over recent years. A product of the retreat is the current ERE program educational objectives that combined the input from our constituency groups. Future Department retreats will review and consider necessary revisions to the program educational objectives.

CRITERION 3. STUDENT OUTCOMES

A. STUDENT OUTCOMES

The student outcomes for the ERE program are listed below and are documented on the ERE Department webpage that describes the program (http://www.esf.edu/ere/ere/). These student outcomes are stated identically to those listed in Criterion 3.

The BS in Environmental Resources Engineering program trains our graduates to have:

(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
(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 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

B. RELATIONSHIP OF STUDENT OUTCOMES TO PROGRAM EDUCATIONAL OBJECTIVES

The ERE student outcomes prepare graduates to attain the program educational objectives by providing key abilities and knowledge as well as understanding and recognition of areas critical to professional, advanced degree, and lifelong success. For example, successful engineers need to have a strong foundation in engineering background and application, as well as strong communication skills and an ability to continue their professional growth beyond their bachelor's degree. Table 3-1 maps student outcomes to program educational objectives.

Table 3-1. Relationship between student outcomes and program educational objectives

Program Educational Objective	Outcomes Supporting Objective										
	a	b	c	d	e	f	g	h	i	j	k
Engage in professional engineering practice specializing in natural and designed environments	×	×	×	×	×	×	×	×	×	×	×
Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering	×	×		×			×			×	×
Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world						×		×	×	×	

Graduates can attain objective one by completing all 11 student outcomes because to engage in professional engineering practice requires technical abilities (a-e, g, k), understanding of professional and ethical responsibility (f) and the impact of engineering in other contexts (h), the interest and ability to engage in life-long learning (i), and knowledge of contemporary issues (j).

Graduates can attain objective two by completing at least five student outcomes because to succeed in graduate studies requires abilities to apply math, science, and engineering (a), design and conduct experiments (b), communicate effectively (g), and use appropriate techniques, skills and modern engineering tools (k). Successful graduate study also requires knowledge of contemporary issues (j) to ensure meaningful research topics and secure research funding.

Graduates can attain objective three by completing at least four student outcomes. Expanding engineering knowledge to address tomorrow's technological, environmental, and social challenges requires an understanding of professional and ethical responsibility (f) and the impact of engineering in other contexts (h). It also requires knowledge of contemporary issues (j), and an ability to continue learning throughout their career (i).

CRITERION 4. CONTINUOUS IMPROVEMENT

The ERE Department places a high level of significance on continuous improvement of our degree programs, as is reflected by the appointment of an Assessment Coordinator within the Department, the involvement of all faculty in the annual outcome assessment and evaluation cycle, and the engagement of all faculty in the longer term assessment, evaluation, and revision of the program educational objectives. To support this involvement, the Department has produced an Assessment Handbook that summarizes the assessment procedures and provides examples of key documents. Each faculty member is provided with a copy of the handbook, which is also stored on the central file server.

A critical component of the documentation of assessment within the Department that supports continuous improvement is the annual ERE assessment report. This report summarizes relevant Departmental issues for the year, reviews recommendations from the prior annual assessment report and the response actions taken during the current year, inventories assessment related activities performed during the year including the results of outcome-based assessment, and recommends actions based on the current assessment cycle. The annual assessment report is distributed to all faculty members, as well as the Assistant Provost for Assessment and Academic Initiatives, Dr. Valerie Luzadis, who oversees assessment at the campus level. The annual assessment report is stored in a centralized server that is accessible to all Department faculty along with detailed assessment reports for the program learning outcomes (a-k). Significant components of the assessment report are also included in the Department's Annual Report, which is submitted to the Provost at the end of each academic year.

A. PROGRAM EDUCATIONAL OBJECTIVES

Assessment procedure

We have a protocol for assessment but we have not yet used assessment processes to gather data and evaluate our ERE program educational objectives because the ERE program has only had graduates since December of 2010. Based on guidance from ABET, we will complete our first evaluation when we have sufficient graduates with 3–5 years of experience post-graduation. However, given that this program evolved out of the previously accredited Forest Engineering program, the Department has established a protocol for assessing the attainment of the objectives. Table 4-1 provides a summary of our data collection process, listing the groups we target, the mechanisms used, and the frequency of the assessment. These items are then discussed in additional detail below.

Table 4-1. Summary of data collection processes for assessing program educational objectives

Group	Mechanism	Frequency
Advisory Council	Workshop	Every two to three years
Alumni	Survey	Every three years
Employers	Survey	Every three to five years
Faculty	Surveys	Every two to three years
	Retreats	Twice annually
	Strategic Planning	Every three to five years

The ERE Advisory Council, as discussed in Criterion 2, includes both alumni and employers, and thus has a unique role to play in the assessment process. The Advisory Council workshop held in 2010 that was used to help guide establishment of the program educational objectives will be repeated at periodic intervals (every two to three years) to not only evaluate the appropriateness of the objectives, but to also gather assessment data and evaluate the perceived level of attainment of the objectives.

ERE alumni surveys are performed every 3 years and these are a critical mechanism for generating data used in our continuous improvement of the program objectives. Table 4-2 summarizes the relationship between the coverage of the alumni survey questions and the program educational objectives.

Employers and faculty are also surveyed every at various cycles (see Table 4-1) to make sure our program is meeting our educational objectives. For employers we are most interested in their views on professional preparation (educational objective 1 and 3) and for faculty we are interested in their views on graduate school preparation (educational objective 2).

Table 4-2. Relationship between program educational objectives and alumni survey questions

Program Educational Objective	Survey Questions
Engage in professional engineering practice specializing in natural and designed environments	Current employment status and title
	Area of specialization
	Licensure or Certification status (intern or professional)
Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering	Advanced degrees completed
	Field of study
Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world	Professional society membership
	Annual continuing education/professional development
	Career challenges faced

Expected level of attainment of program educational objectives

We have set expected levels of attainment to balance providing an ambitious target while accommodating the fact some graduates will choose to leave the profession. We will revisit the attainment levels described below when we have sufficient data and determine if they should be adjusted.

As an overall target, we expect that 75% of our graduates will either engage in professional engineering practice (objective 1) or pursue graduate studies (objective 2). There is a recognition that some alumni will choose to work in non-engineering fields, or may make family-related decisions and choose not to seek employment or advanced degrees. We also expect that at least 75% of our graduate will engage in activities that expand and enhance their engineering knowledge and skills (objective 3). We measure this through participation in continuation education, professional development activities such as professional society engagement, and promotions.

As discussed previously, the alumni survey is an important tool to generate information for evaluating the attainment of program objectives. We anticipate a 20% alumni survey response rate. We also survey employers and our Advisory Council and expect that more than 90% of those surveyed within these groups would agree that we are attaining our program objectives.

Program educational objective evaluation and attainment

Because the ERE program has only been in existence since 2010, there has not yet been a suitable period to perform assessment and evaluation of the program educational objectives. Through our various surveys, and in particular the alumni survey questions as summarized in Table 4-2, we will gain data to assess each of the program objectives. In addition to determining whether specific targets have been met, the alumni surveys will also be evaluated to gain data about trends over time, e.g. we expect to see advancement in rank and management level positions increasing with time since graduation.

Documentation of assessment

All assessment related activities are documented in the Department's annual assessment report, which is distributed to faculty in the Department, stored in a centralized server that is accessible to all members of the Department and shared with the Assistant Provost for Assessment and Academic Initiatives. The annual assessment results, and assessment action plans for the previous and current year, are also included in the Department's Annual Report, which is submitted to the Provost at the end of each academic year. The results of the alumni and other surveys are also stored on the Department server. The Department has also posted alumni survey results online, and uses the information generated from such surveys to provide information to program applicants via prospective student information sessions.

B. STUDENT OUTCOMES

Assessment procedure

The ERE Department uses a range of tools to collect assessment data and evaluate the level that student outcomes for the ERE program are being achieved. To facilitate an efficient interpretation of this data, the Department developed a common format (shown in Figure 4-1) that is used for all assessments. Table 4-3 and Table 4-4 summarize the means to collect assessment data for each of the 11 student outcomes. The course-based assessment data shown in Table 4-3 is typically collected on an annual basis, with evaluation considering the trends in this data over successive years. Table 4-3 demonstrates that the course-based assessment uses a variety of different data collection measures including: exam questions (E), assignments (A), final projects (P), and lab exercises (L). The data using additional assessment tools shown in Table 4-4 are collected less frequently. Such an assessment protocol, which utilizes a variety of direct and indirect methods, ensures that we are effectively evaluating our undergraduate program. We have used the ERE Advisory Council to review and evaluate the assessment process.

Learning Outcome: [List outcome being assessed]
Context for Assessment: [Insert description e.g., course name, number, and semester/year]
Activity: [Insert description]
Assessment Method: [Insert description]
Time of data collection: [e.g., Annually in fall semester]
Collection Agent: [Faculty member name]
Responding Agent: [Generally ERE Faculty]

Quantitative rubric: [Insert description of rubric including specification of levels of Bloom's Taxonomy considered and meaning of ranks assessed e.g., 2, 1, 0]

Reflections on Prior Assessment: [Include response to prior assessments and triggers as appropriate]

Outcome Triggers: **Individual Statistic:** [Summarize acceptable aggregate score across levels assessed as well as within each level. Describe action necessary for scores below acceptable.]
Class Statistic: [Summarize acceptable average score for each level assessed. Describe action necessary for scores below acceptable.]

Results of Assessment: [Summarize \ assessment data, describe whether any individual or class statistics fell below acceptable levels (above), and present appropriate explanation of the results.]

Conclusions: [Provide an initial statement: This assessment **did/did not** produce any triggers in the class statistics that indicate the need for curriculum changes to address this learning outcome. Provide additional discussion documenting a response to a trigger or planned changes if appropriate.]

Attachment 1: [Example of] Measurement Rubric

	Knowledge	Comprehension	Application	Analysis
Performance Criteria	Match thermodynamic terms and equations	Describe key thermodynamic concepts/terminology	Interpret thermodynamic devices using continuity and energy equations	Calculate thermodynamic properties under given conditions
2 points	> 80% match	Described correctly	> 80% correct	> 80% correct
1 point	30 – 80%	Partially described	Some difficulty	Some difficulty
0 point	< 30% match	Described incorrectly	Major issues < 30%	Major issues < 30%
Max. points	**2**	**2**	**2**	**2**

Attachment 2: [Example of] Raw data and Statistics

	Performance Criteria				
	Knowledge	**Comprehension**	**Application**	**Analysis**	**Total Score**
Student 1	1	2	2	1	6
Student 2	1	2	2	1	6
Student 3	2	2	1	1	6
Average	1.3	1.6	1.8	1.0	

Attachment 3: Class assignment used for assessment [As appropriate]

Figure 4-1. Format for assessment memoranda

Table 4-3. Course-based assessment of learning outcomes (assessed annually) using exam questions (E), assignments (A), final projects (P), and class/lab exercises (L)

Course	Outcome										
	a	b	c	d	e	f	g	h	i	j	k
APM 395: Prob. & Statistics	P	P					P				
ERE 133: Intro. Eng. Design						A			A		
ERE 275: Intro. Ecol. Eng.			P	L							
ERE 371: Surveying	E						P				
ERE 335: Num. Methods					E/L						E/P/L
ERE 340: Eng. Hydrology								A		A	
ERE 365: Remote Sensing		L									
ERE 339: Fluid Mechanics							P				
ERE 430: Eng. Dec. Analysis						E/A			A		
ERE 440: Water Poll. Eng.					E/A					A	L
ERE 468: Solid Waste										A	
ERE 489: Eng. Plan & Design			P	P			P				
FCH 150: Chemistry I	E										

Table 4-4. Non-course based assessment of Learning Outcomes

Assessment activity	Cycle	Outcome										
		a	b	c	d	e	f	g	h	i	j	k
FE Exam results	Annual	×					×					
Alumni surveys	Every third year	×	×	×	×	×	×	×	×	×	×	×
Focus groups	Every second year		×	×			×	×			×	
Exit survey	Annual	×	×	×	×	×	×	×	×	×	×	×
Gen. Ed. Assessment	Every fourth year								×			
Order of the Engineer	Annual						×					

A summary of the results of the outcome assessments are provided in the annual assessment report. Detailed assessment reports for the program learning outcomes (a-k) are provided separately in our assessment files, which are stored in a centralized ESF ERE Department server, accessible to all department faculty members and ABET reviewers.

Expected level of attainment of student outcomes

To determine an appropriate level of attainment of student outcomes, we established the placement of each outcome within Bloom's (1956) taxonomy. Table 4-5 summarizes Bloom's taxonomy as it relates to classifying learning levels and identifies the minimum level that we expect students to attain. The table also identifies the course-based assessment that is performed and the level of assessment in that course. Since Bloom's taxonomy is hierarchical in nature, outcome assessment is appropriate at an equivalent or higher level than the minimum level identified in the second column of Table 4-5.

Table 4-5. Relationship of Bloom's Taxonomy to Outcomes and Assessment Level

Learning Categories (after Bloom 1956)	Minimum Level for Outcome	Course	Assessment Level
Knowledge	(j) Knowledge of contemporary issues	ERE 340	Application
		ERE 468	Comprehension
Comprehension	(f) Understand professional responsibility	ERE 133	Application
		ERE 430	Synthesis
	(h) Understand impacts of solution	ERE 340	Application
	(i) Recognize need for lifelong learning	ERE 133	Application
		ERE 430	Comprehension
Application	(a) Apply math/science/eng. knowledge	APM 395	Analysis
		ERE 371	Analysis
	(e) Solve engineering problems	ERE 335	
		ERE 440	Application
	(g) Communicate effectively	APM 395	Synthesis
		ERE 371	Analysis
		ERE 339	Application/Analysis
		ERE 489	Application
	(k) Use techniques and tools	ERE 335	Synthesis
		ERE 440	Application
Analysis	(d) Function on teams	ERE 275	Analysis
		ERE 489	Analysis
Synthesis	(b) Design/conduct experiments	APM 395	Evaluation
		ERE 365	Synthesis
	(c) Design system within constraints	ERE 275	Application
		ERE 489	Synthesis
Evaluation			
Valuation			

Student outcome evaluation and attainment

Table 4-6 summarizes the student outcome assessment performed on ERE students during the 2010–2011 and 2011–2012 academic years. This includes the wide range of course-based assessments (summarized in Table 4-3), as well as the annual exit survey. Most of the additional non-course based assessment methods shown in Table 4-4 were not completed given the compressed time frame. The collection of data over a two year period is not sufficient to evaluate the program in depth and recommend major changes. However, it does provide useful information in terms of areas that may require additional focus in the upcoming academic year.

Table 4-6 identifies a Trigger when group level thresholds were not met and indicates an outcome that requires attention. For example, the outcome (g) assessment performed in ERE 430 in 2010–2011 had a trigger that appeared to be related to poor performance within our transfer student group. The follow-up assessment performed in various contexts in 2011–2012, suggest that this is not a systemic problem, and does not require curricular change, but will continue to be monitored in the future. The Exit Survey results from 2011–2012 produced a trigger on outcome (j). When considered with the other assessments of this outcome, it does not seem that this shows a need for curricular change. Rather, this trigger indicated that some students placed an unreasonable expectation on their own abilities, which will be further explored in the future. Table 4-6 also identifies places where a trigger was identified that may relate more to the tool, rather than the student attainment of outcomes. The outcome will be reevaluated in the upcoming year with revisions to the tool as needed. Table 4-6 also shows where assessments did not produce a trigger, but identified individuals who failed to meet target levels. While individual concerns do not typically require curricular revisions, such data provides valuable information to ensure student success.

Table 4-6. Summary of Assessments for ERE degree (* used mixed FEG/ERE groups)

	Outcome	Class/ Activity	Collection Agent	Year	Action Item
a.	An ability to apply knowledge of mathematics, science and engineering	Exit Survey	Kroll	10/11	No Trigger
			Endreny	11/12	No Trigger
		APM 395	Kroll	11/12	No Trigger
		ERE 275	Diemont	10/11	No Trigger
		ERE 371	Quackenbush	10/11	No Trigger
			Mountrakis	11/12	No Trigger – Individual concern
b.	An ability to design and conduct experiments, as well as to analyze and interpret data	ERE 365	Mountrakis	10/11	No Trigger
				11/12	No Trigger
		APM 395	Kroll	11/12	Trigger – New tool: Reevaluation needed
		Exit Survey	Kroll	10/11	No Trigger
			Endreny	11/12	No Trigger
c.	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, env., social, political, ethical, health and safety, manuf., and sustainability	ERE 275	Diemont	11/12	No Trigger
		ERE 340	Endreny	10/11	No Trigger – Individual concern
		Exit Survey	Kroll	10/11	No Trigger
			Endreny	11/12	No Trigger
		ERE 489*	Daley	10/11	No Trigger – Individual concern
				11/12	No Trigger
d.	An ability to function on multi-disciplinary teams	Exit Survey	Kroll	10/11	No Trigger
			Endreny	11/12	No Trigger
		ERE 275	Diemont	11/12	Trigger – New tool: Reevaluation needed
		ERE 489*	Daley	10/11	No Trigger – Individual concern
				11/12	No Trigger
e.	An ability to identify, formulate, and solve engineering problems	ERE 440	Tao	10/11	No Trigger
				11/12	No Trigger
		ERE 335	Im	11/12	No Trigger
		Exit Survey	Kroll	10/11	No Trigger
			Endreny	11/12	No Trigger

	Outcome		Class/ Activity	Collection Agent	Year	Action Item
f.	An understanding of professional and ethical responsibility		ERE 133	Quackenbush	10/11	No Trigger – Individual concern
					11/12	No Trigger
			ERE 430	Daley	10/11	Trigger – New tool: Reevaluation needed
					11/12	No Trigger
			ERE 489	Daley	10/11	No Trigger
			Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	No Trigger
g.	An ability to communicate effectively	Overall	Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	No Trigger
		Graphical	ERE 371*	Quackenbush	10/11	No Trigger
				Mountrakis	11/12	No Trigger
		Oral	ERE 489	Daley	10/11	No Trigger
					11/12	No Trigger
		Written	ERE 339	Shaw	11/12	No Trigger
			ERE 430	Kroll	10/11	Trigger – Transfer student concern
			APM 395	Kroll	11/12	No Trigger
h.	The broad education necessary to understand the impact of eng. solutions in a global, economic, env., and societal context.		ERE 340	Endreny	10/11	No Trigger – Individual concern
					11/12	No Trigger – Individual concern
			Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	No Trigger
i.	A recognition of the need for, and an ability to engage in life-long learning		ERE 133	Quackenbush	10/11	No Trigger
					11/12	No Trigger – Individual concern
			Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	No Trigger
j.	A knowledge of contemporary issues		ERE 430	Kroll	10/11	No Trigger
			ERE 468	Daley	11/12	No Trigger
			ERE 340	Endreny	11/12	No Trigger – Individual concern
			ERE 440	Tao	11/12	No Trigger
			Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	Trigger
k.	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.		ERE 335	Im	10/11	No Trigger – Individual concern
					11/12	No Trigger
			ERE 440	Tao	10/11	No Trigger
					11/12	No Trigger
			Exit Survey	Kroll	10/11	No Trigger
				Endreny	11/12	No Trigger

Documentation of assessment

The results of the student outcome assessment are summarized in the Department's annual assessment report. As discussed at the start of this criterion, the report reviews the recommendations from the prior annual assessment report and the response actions taken during the current year, documents assessment related activities performed during the year including the results of outcome-based assessment, and lists recommended actions based on the current assessment cycle. The annual assessment report is stored in a centralized server that is accessible to all Department faculty along with detailed assessment reports for the program learning outcomes (a-k). This is also shared with the Provost and Assistant Provost for Assessment and Academic Initiatives.

C. CONTINUOUS IMPROVEMENT

Based on our experience with the ABET-accredited FEG program, the Department has established a systematic process of assessment, review and feedback to provide continuous improvement of our engineering programs. Our use of an annual assessment report, coupled with the twice-annual Department retreat cycle, provides an avenue for the faculty to regularly meet, review input from program constituencies, and discuss implementation of necessary changes to the curriculum, outcomes, and objectives.

The Department Chair has primary responsibility for implementing the assessment program, which is managed by the Assessment Coordinator. It is the Department policy that all faculty implement outcome assessment within at least one of the required courses that they teach. For the purpose of providing continuous monitoring, we encourage faculty to conduct assessments on an annual basis. As previously discussed, these assessments are compiled annually by the Assessment Coordinator and shared with the Department via the annual assessment report. The Department Chair, in consultation with the Undergraduate Coordinator and, if appropriate, the instructor, is responsible for reviewing and implementing course or curricular change. If an action is taken to improve student performance for a student outcome, we ensure there is a follow up assessment performed.

The Department proactively uses the twice-annual retreat to evaluate the ERE program. In the period leading up to this first ABET review of the ERE program we have made changes based on program evaluations performed at several retreats. One change was the addition of an earth science elective to the curriculum, starting in the 2011–2012 academic year. This change was triggered by a Department review of the ABET Program Criteria for Environmental and Similarly Named Programs in September 2010, which is discussed further in the Program Criteria section of this self-study. At the January 2011 Departmental retreat, the faculty approved a curriculum change to incorporate a directed elective in earth sciences. We made this modification using General Education flexibility provided by the SUNY Board of Trustees.

At the Department Retreat on May 2011, faculty engaged in a review of required undergraduate courses and engineering electives taught in the Department. This included a review of syllabi, text books, learning outcomes and work products. This curriculum-level review facilitated mentoring across all classes, and supported interpretation of the suitability of learning outcomes and necessary prerequisite course sequences. This review also laid the foundation for defining courses that satisfy the "engineering electives" in the ERE curriculum. The topic of engineering electives was revisited at the December 2011 retreat, culminating in formalizing the previously ad-hoc process of approving such electives. Based on faculty consensus, engineering electives in the ERE program "Focus on theory and application of scientific principles and quantitative skills to monitor, assess, or design in the environmental resources engineering profession". This definition recognizes that suitable engineering electives may include courses that are not exclusively design-focused. The Department approved the engineering elective definition at the December 2011 retreat, with subsequent approval by Faculty Governance, enabling implementation in the 2011–2012 Academic Year.

D. Additional Information

The Department maintains a server that contains the annual assessment reports, the individual assessment memos, samples of work used to perform assessments, departmental meeting minutes, and other information pertinent to assessment. These materials will be available for review during the ABET accreditation visit.

CRITERION 5. CURRICULUM

A. PROGRAM CURRICULUM

Table 5-1 describes the plan of study for students in the ERE program. This table includes information on course offerings required in the curriculum as a recommended schedule listed in typical order of completion, grouped by year and semester. This mirrors the data shown in the plan sheet in Appendix 1-1. Table 5-1 also shows the maximum section enrollments for all courses in the program over the two years immediately preceding the visit.

There is only one curricular path in the ERE program. Required courses are mandatory for all students in the program; selected elective courses are those for which students take one or more courses from a specified group. This includes the earth science elective (one 3-credit course) in the sophomore year and the engineering electives (three 3-credit courses) in the senior year. The engineering electives provide theory and application of scientific principles and quantitative skills to monitor, assess, or design in the environmental resources engineering profession. Many of these courses include a significant design component.

Table 5-1. Environmental Resources Engineering Curriculum

Course (Department, Number, Title) Listed from first semester of first year through last semester of fourth year	Required R, Elective E or Selected Elective SE	Subject Area (Credit Hours)				Last Two Course Offerings: Semester and Year	Maximum Section Enrollment for Last Two Offerings (Lecture L; Lab B; Recitation R)
		Math & Basic Sciences	Engineering Topics (× Significant Design)	General Education	Other		
EFB 101 General Biology I: Organismal Biology and Ecology	R	3		3		Fall 10 / Fall 11	L 175 / L 175
EFB 102 General Biology I Laboratory	R	1		1		Fall 10 / Fall 11	B 24 / B 24
FCH 150 General Chemistry I	R	3		3		Fall 10 / Fall 11	L 150 / L 150
FCH 151 General Chemistry I Laboratory	R	1		1		Fall 10 / Fall 11	B 54 / B 54
APM 205 Calculus I: Science and Engineering	R	4		4		Fall 11 / Spr 12	L 40 / L 30
EWP190 Writing and the Environment	R			3		Fall 10 / Fall 11	L 24 / L 24
ERE 132 Orientation Seminar	R				1	Fall 10 / Fall 11	L 45 / L 45
FCH 152 General Chemistry II	R	3				Spr 11 / 12	L 150 / L 150
FCH 153 General Chemistry II Laboratory	R	1				Spr 11 / 12	B 54 / B 54
PHY 211 General Physics I	R	3				Fall 11 / Spr 12	L 216 R 24 / L 290 R 24
PHY 221 General Physics Laboratory I	R	1				Fall 11 / Spr 12	B 24 / B 24
APM 206 Calculus II: Science and Engineering	R	4				Fall 11 / Spr 12	L 20 / L 40
ERE 133 Introduction to Engineering Design	R		3 (×)			Spr 11 / 12	L 19, B 19/L 39, B 39
General Education Elective	E			3			N/A
PHY 212 General Physics II	R	3				Fall 11 / Spr 12	L 275 R 24 / L 225 R 24
PHY 222 General Physics Laboratory II	R	1				Fall 11 / Spr 12	B 24 / B 24
GNE 172 Statics and Dynamics	R		4			Fall 11 / Spr 12	L 50 / L 20
APM 307 Calculus III: Science and Engineering	R	4				Fall 11 / Spr 12	L 35 / L 30
FOR 321 Forest Ecology and Silviculture	R	3				Fall 10 / 11	L 37 / L 35
Earth Science Elective	SE	3					
FCH 399 Introduction to Atmospheric Sciences						Fall 10 / 11	L 20 / L 20
FOR 338 Meteorology						Spr 11 / 12	L 40 / L 115
FOR 345 Introduction to Soils						Fall 10 / 11	L 90 B 30 / L 90 L 30

Course (Department, Number, Title) Listed from first semester of first year through last semester of fourth year	Required R, Elective E or Selected Elective SE	Subject Area (Credit Hours) Math & Basic Sciences	Engineering Topics (× Significant Design)	General Education	Other	Last Two Course Offerings: Semester and Year	Maximum Section Enrollment for Last Two Offerings (Lecture L; Lab B; Recitation R)
GNE 273 Mechanics of Materials	R		3			Fall 11 / Spr 12	L 30 / L 65
ERE 275 Ecological Engineering I	R		3 (×)			Spr 11 / 12	L 40 B 40/ L 22
APM 485 Differential Equations for Engineers and Scientists	R	3				Spr 11 / 12	L 50 / L 50
EWP 290 Research Writing and Humanities	R			3		Spr 11 / 12	L 24 / L 24
General Education Elective	E			3			N/A
ERE 371 Surveying for Engineers	R		4			Fall 10 / 11	L 53 B 20 / L 58 B 22
ERE 335 Numerical and Computing Methods	R	3				Fall 10 / 11	L 25 / L 37
ERE 339 Fluid Mechanics	R		4			Fall 11	L 42 B 14
CIE 337 Introduction to Geotechnical Engineering	R		4 (×)			Fall 10 / 11	L 80 B 23 / L 90 B 25
ERE 340 Engineering Hydrology and Hydraulics	R		4 (×)			Spr 11 / 12	L 40 B 20 / L 33 B 19
ERE 365 Principles of Remote Sensing	R		4			Spr 11 / 12	L 40 B 40 / L 38 L 38
ERE 430 Engineering Decision Analysis	R		3			Spr 11 / 12	L 38 / L 36
ERE 440 Water Pollution Engineering	R		3 (×)			Spr 11 / 12	L 32 / L 60
ERE 351 Basic Engineering Thermodynamics	R		3			Spr 11 / 12	L 30 / L 44
ERE 468 Solid Waste Management	R		3 (×)			Fall 10 / 11	L 25 / L 29
APM 395 Probability and Statistics for Engineering	R	3				Spr 10 / Fall 11	L 17 / L 28
General Education Elective	E			3		N/A	N/A
Engineering Electives	SE		6				
ERE 405 Sustainable Engineering						Spr 11 / 12	L 10 / L 8
ERE 412 River Form and Process						Spr 11	L 4 B 4
ERE 425 Ecosystems Restoration Design						Fall 10 / 11	L 13 / L 4
ERE 445 Hydrologic Modeling						Spr 11 / 12	L 10 / L 9
ERE 465 Environmental Systems Engineering						Fall 11	--
ERE 475 Ecological Engineering II						Fall 10 / 11	L 5 / L 10
ERE 496 Hydrology in a Changing Climate						Spr 12	L 5

Course (Department, Number, Title) Listed from first semester of first year through last semester of fourth year		Required R, Elective E or Selected Elective SE	Subject Area (Credit Hours) Math & Basic Sciences	Engineering Topics (× Significant Design)	General Education	Other	Last Two Course Offerings: Semester and Year	Maximum Section Enrollment for Last Two Offerings (Lecture L; Lab B; Recitation R)
Engineering Electives cont.								
ERE 511 Ecological Engineering in the Tropics							Spr	--
ERE 527 Stormwater Management							Fall 10 / 11	L / L 30
ERE 551 GIS for Engineers							Fall 10 / 11	L 22 B 22 / L 21 B 21
ERE 621 Spatial Analysis							Fall 10 / 11	L / L 7
ERE 622 Digital Image Analysis							Spr 11	L
ERE 674 Methods in Ecological Treatment							Spr 11 / 12	L 4 B 4 / L 7 B 7
ERE 692 Remote Sensing of the Environment							Fall 11	L 7 B 6
ERE 693 GIS-Based Modeling							Spr 12	L 6 B 6
CIE 331 Analysis of Structures and Materials							Fall 10 / 11	L 67 / L 67
CIE 332 Design of Concrete Structures							Spr 11 / 12	L 61 / L 62
CIE 338 Foundation Engineering							Spr 11 / 12	L 65 / L 64
CIE 443 Transportation Engineering							Fall 10 / 11	L 38 / L 58
CIE 473 Transport Processes in Environmental Engineering							Spr 10 / 12	L 4 / L 14
GNE 461 Air Pollution Engineering							Fall 10 / 11	L 29 / L 40
ERE 489 Environmental Resource Engineering Planning and Design		R		4 (×)			Spr 11 / 12	L 33 B 33 / L 27 B 27
Engineering Elective (see specific options above)		SE		3			N/A	N/A
General Education Elective		E			3		N/A	N/A
Elective		E				3	N/A	N/A
TOTALS-ABET BASIC-LEVEL REQUIREMENTS			47 Hours	58 Hours	30 Hours	4 Hours		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF PROGRAM		127 Hours						
PERCENT OF TOTAL			37.0%	45.7%	23.6%	3.2%		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours		32 Hours	48 Hours				
	Minimum Percentage		25%	37.5 %				

The ERE curriculum was designed to enable achievement of the program educational objectives. Table 5-2 provides specific examples of how the curriculum directly supports the objectives.

Table 5-2. Relationship between curriculum and program education objectives

Program Educational Objective	Curriculum focus
Engage in professional engineering practice specializing in natural and designed environments	Professional practice courses develop core skills: hydrology, remote sensing, solid waste, water pollution engineering
	Engineering electives: provide theory and application of scientific principles and quantitative skills
Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering	Required courses across all three Department specializations: ecological, geospatial and water resources engineering
	Engineering electives frequently taught as shared resource course, enabling engagement with current graduate students
Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world	Lifelong learning stressed from freshman year (ERE 133) to senior year (ERE 489)
	Revisit of freshman learning plan in junior year (ERE 430)
	Engineering electives: acquire specific training to meet perceived challenges
	Resume preparation supported from freshman through senior year (ERE 132, Faculty Advising) and Employer Information Session.

The Department has mapped the courses in the ERE curriculum to illustrate the development of concepts, skills, knowledge, and processes in our undergraduate engineering students. This course mapping uses three levels—*Introduce*, *Reinforce*, and *Emphasize*—to provide an overview of how courses within the curriculum are linked. Table 5-3 summarizes the relationship between the curriculum and the eleven student outcomes that the ERE program seeks to attain and also shows the level of depth of these outcomes—from introduce, through reinforce, to emphasize. This table is supported by the flowchart in Appendix 1-2, which shows the sequencing of courses throughout the program. While students are exposed to all learning outcomes in the freshman year, with three exceptions, these are almost all at the introductory level. By the sophomore year, five of the outcomes have reached the reinforcement level, and one—effective communication—is emphasized. By the junior year, seven outcomes are considered at the emphasis level, with three more added in the senior year.

Most of the earth science and engineering electives support multiple student outcomes; however, since these are not uniform, only the common outcome coverage is highlighted.

Table 5-3. Hierarchy of Learning Outcomes (I = Introduce; R = Reinforce; E = Emphasize)

Semester	Course Number	Course Name	Outcome										
			a	b	c	d	e	f	g	h	i	j	k
	APM 205	Calculus I	R	R									
	FCH 150/1	Chemistry 1 (w. lab)	I	I					I				I
Fall-I	EFB 101/2	Biology (w. lab)	I	I				I	I	I	I	I	
	EWP 190	Writing							I	I			
	ERE 132	Orientation											
	APM 206	Calculus II	R	R									
	PHY 211/21	Physics 1 (w. lab)	R	R			I						
Spring-I	FCH 152/3	Chemistry 2 (w. lab)	I	I					I				I
	ERE 133	Intro. Eng. Design	I	I	I	I	I	I	R	I	I	I	I
		Gen. Ed. Elective								I			
	APM 307	Calculus III	R	R									
	PHY 212/22	Physics 2 (w. lab)		R									
Fall-II	GNE 172	Statics/ Dynamics	R				I						
	FOR 321	Forest Ecology	R					I		I		I	
		Earth Sci. Elective	R						R			R	
	APM 485	Diff. Equations	E	R			I						
	ERE 275	Ecological Eng.	R	I	R	R	I	I	R	R	I	I	I
Spring-II	GNE 273	Mechanics Mat.	R		I		I						
	EWP 290	Research Writ. & Hum							E	I			
		Gen. Ed. Elective								I			
	ERE 371	Surveying	E	R		R	I	R	E				E
Fall-III	ERE 339	Fluid Mechanics	E				R		R				
	ERE 335	Numerical Methods	E				E						E
	CIE 337	Geotech. Eng.	E	R			E		R				E
	ERE 340	Eng. Hydrology	R	I	R	R	R	I	R	R	I	R	E
	ERE 365	Remote Sensing		E									
Spring-III	ERE 430	Eng. Dec. Analysis	R				E	E	R		R		R
	ERE 351	Thermodynamics	R				R			R		R	
	ERE 440	Water Poll. Eng.	E		R		E					E	E
	ERE 468	Solid Waste	E		R		E	R	R	E		E	R
	APM 395	Prob. & Statistics	E	E					R				R
Fall-IV		Gen. Ed. Elective								R			
		Engineering Elective	E				R			R			R
		Engineering Elective	E				R			R			R
	ERE 489	Eng. Plan & Design	E		E	E		R	E	R		R	R
Spring-IV		Engineering Elective	E				R			R			R
		Gen. Ed. Elective								R			
		Elective											

Appendix 1-2 includes a flowchart that illustrates the prerequisite structure of the required courses in the ERE program. In addition to the structure highlighted, the Department has a new policy that will require a minimum grade of C- in the Calculus sequence. This policy resulted from continued assessments and Department discussions, and provides a mechanism to ensure proficiency of all of our students in calculus.

Table 5-1 summarizes the ERE curriculum, and illustrates the credit hour totals for the key subject area. The degree program has a total credit hour requirement of 127. Of these, the Math and Basic Science courses make up 47 hours (or 37.0 %) and the Engineering Topics make up 57 hours (45.7%). These are above the ABET specified minimums of 25% and 37.5%, respectively.

While the program criteria for Environmental and Similarly Named Engineering Programs does not specify hours of study, it does identify subject area proficiencies. The match between these required proficiencies and the ERE curriculum are summarized in Table 5-4. The additional requirements in the program criteria are discussed in that section of this self-study.

Table 5-4. Courses satisfying required proficiencies for Environmental and Similarly Named Engineering Programs.

Required Proficiency	Curriculum component
Mathematics through differential equations	APM 205 Calculus I: Science and Engineering APM 206 Calculus II: Science and Engineering APM 307 Calculus III: Science and Engineering APM 485 Differential Equations for Engineers and Scientists
Probability and statistics	APM 395 Probability and Statistics for Engineering
Calculus-based physics	PHY 211/221 General Physics I (w. lab) PHY 212/222 General Physics II (w. lab) GNE 172 Statics and Dynamics
General chemistry	FCH 150/151 General Chemistry I (w. lab) FCH 152/153 General Chemistry II (w. lab) ERE 440 Water Pollution Engineering
Earth science	Directed Elective – students take one of: FCH 399 Introduction to Atmospheric Sci. FOR 338 Meteorology FOR 345 Introduction to Soils CIE 337 Introduction to Geotechnical Engineering ERE 340 Engineering Hydrology and Hydraulics
Biological science	EFB 101 General Biology FOR 321 Forest Ecology and Silviculture ERE 275 Ecological Engineering I
Fluid mechanics	ERE 339 Fluid Mechanics
Advanced principles and practice relevant to the program objectives	Completion of three engineering electives in the senior year (courses summarized in Table 5-1)

Overview of Environmental Resources Engineering Planning and Design

ERE 489 Environmental Resources Engineering Planning and Design is the capstone design course in the ERE curriculum. The class draws upon the knowledge and skills acquired in earlier coursework to provide a major design experience at the culmination of the ERE program. Students receive guidance in the systematic application of engineering design and project management skills to solve complex, environmentally-related problems. Enrollment in ERE 489 requires students to have senior status and completed all necessary prerequisite courses. Concurrent completion of prerequisite courses will be considered with consent of the instructor. The engineering projects require the students to incorporate engineering standards and address applicable local, state and national regulations. Projects are selected such that students must tackle realistic constraints including: economic, environmental, sustainability, ethical, health, constructability, manufacturability, safety, social, regulatory, and political.

In ERE 489, students strengthen their problem-solving skills by using and refining teamwork, critical thinking, evaluation and assessment skills that form the core of the course. The engineering projects require students to apply earlier coursework in a variety of contexts while learning and developing skills that are typically associated with professional practice. Through the engineering design process, students develop skills that assist them in becoming lifelong learners and self-growers.

Students design solutions to open-ended, complex problems that emphasize the Department’s strengths related to water resources engineering, ecological engineering and geospatial engineering. The students are aware that this approach is consistent with the first fundamental canon of the Engineering Code of Ethics, and is consistent with the mission of the College. The instructor typically seeks service learning projects from within a network of community-based organizations, municipal agencies, private sector businesses, or interested citizen groups, with particular focus on design projects that have a real possibility of effecting change in the local or regional community. Table 5-5 summarizes the coverage of some recent projects completed in ERE 489. Several class design projects have provided a foundation for continued planning and design efforts.

Table 5-5. Examples of recent design projects

Project Focus	Client/Partner/Location
CSO abatement e.g. Harbor Brook, Oswego disinfection	Onondaga County, Oswego
Reef protection e.g., flood mitigation and erosion control	Honduras
Dam rehabilitation	Town of Manlius, NY
Stormwater low-impact development and design strategies e.g., bioretention, green infrastructure	ESF; Town of Dewitt; Onondaga County, City of Syracuse
Renewable energy e.g., urban wind resource assessment	ESF
Green building design	ESF, Residence Hall; Private
Stream restoration, landfill cover, wetland mitigation e.g. PAH contamination	Private
Creek restoration, recreation and flood control	Buffalo and Niagara Riverkeeper
Brownfield restoration at manufactured gas plant and paper mill sites e.g., aquaponics	Groveton, NH
Wastewater treatment plant upgrades, landfill gas management and power generation	Clarks Mills, NY, Auburn, NY
Urban infrastructure e.g. bike paths, master planning, street design	Town of Dewitt, NY, Town of Riverhead, NY; City of Syracuse, NY
Treatment wetland for anaerobically digested waste	ESF, Town of Minoa

Students are expected to follow a design process, driven largely by their own initiative, which involves inquiry, deliberation, evaluation, innovation and attention to professional duty in order to specify a chosen solution that meets the design criteria. In the course of the project, students investigate problems and synthesize information in order to propose and test alternative solutions. They develop designs for critical elements of the project and evaluate and revise those designs as needed. Because of the inherent multidisciplinary nature of environmental problems, all design projects require students to employ their knowledge of different disciplines. The course instructor, in cooperation with the ERE Chair and Advisory Council, has used a network of engineers and related professionals to assist in various aspects of the course. Such assistance takes the form of meetings with the student team to provide professional guidance on goal setting, scheduling, and execution. The role of these client sponsors and technical advisors is described later in this section.

Relationship to prior courses

Projects are identified that require students to use knowledge and skills obtained from earlier courses. While the specific details of each project differ from year to year, students must be proficient in the fundamental knowledge base, and will extend this through application and practice during the design process. At the core, the projects typically require the students to build on experience gained in prior coursework related to several outcomes:

1. Apply fundamental math and science knowledge (calculus, physics, biology)
2. Utilize engineering design skills (ERE 133, ERE 275)
3. Communicate effectively in oral and written formats (ERE 133, EWP 190, EWP 290)
4. Understand the environmental and social systems context in which they practice (ERE 275, FOR 321)
5. Utilize and present descriptive statistics (APM 395, ERE 335)
6. Assess the potential economic impact on the client (ERE 430)

7. Apply accepted design practices in their specialized field of practice (ERE 365, ERE 340, ERE 440, ERE 468)

Work Products

Students typically work on design projects in teams of three to five students. The team function and expectations are reinforced throughout the execution of the design projects. The engineering design teams typically produce the following work products throughout the design process:

1. Scope of Work
2. Basis of Design Report (20% complete)
3. Oral Progress Report and Draft Document (50% complete)
4. Final Oral Presentation (95% complete)
5. Final Engineering Report (100% complete)

Students are expected to each contribute to the development of all written and oral work products. Bi-weekly internal peer assessments provide an opportunity to identify strengths and areas for improvement. This method is facilitated by the instructor so that it remains a positive experience for all; any student lagging in contributions to the team effort is identified first through this peer review, given the opportunity to improve, and if improvement is not observed, mentored by the instructor. In addition, the students are expected to document what portion of the written work they were responsible for and how much effort each team member put into the project.

Role of Client Sponsor

Project sponsors provide “real-life” opportunities for the students. Our project sponsors benefit from the synthesis, discussion and evaluation of alternative solutions that are conducted by the students. However, sponsors recognize that they are engaged in a learning experience for the students, and both sponsors and students understand that the projects do not substitute for planning and design efforts by licensed design professionals. We typically engage the client’s support at strategic times throughout the semester for activities such as:

1. Orienting students, developing objectives, and identifying criteria and constraints;
2. Obtaining information from, and liaising with internal and external stakeholders (e.g., owners, regulators, citizens’ groups);
3. Reviewing and critiquing interim work products for accuracy (Scope of Work, Basis of Design Report);
4. Assessing brief oral or poster presentations at mid-semester progress report;
5. Assessing final oral presentation and reviewing final report.

When external project sponsors are solicited for engineering design projects, the instructor ensures that the sponsor is able to provide a meaningful design experience, and that the design project will typically exhibit several of the following characteristics:

1. Environmentally-focused, with emphasis on engineering systems in water, wastewater, ecological, geospatial, waste management, or renewable energy;
2. Multidisciplinary, open-ended, “complex”;
3. Uses fundamental engineering science knowledge and tools;
4. Planning information, operating conditions and design data readily available;

5. Site is readily accessible from campus;
6. Project objectives are limited in scope, or can be reduced to a manageable focus;
7. Feasible for completion in 15 weeks during the Spring semester (January–April);
8. Suitable for design team size of 3–5 students;
9. Client is able to provide a single point of contact with sufficient authority for effective transfer of information, review of work, and flexibility of schedule;
10. Projects are typically in the early stages of conceptual planning and/or design;
11. Regulatory review or litigation is not required during student involvement.

Role of Technical Advisors

Technical advisors are typically drawn from the local engineering community, have a Professional Engineering license, and have about 10 or more years of engineering practice experience. Some are also registered as CPESC, CPSWQ, LEED, or FACEC. In some cases the technical advisor also serves as the client sponsor. The technical advisors in 2011–2012 included seven professional engineers representing four different engineering companies with experience ranging from 8 to over 30 years. The advisors work closely with the instructor, and are engaged on a volunteer basis to:

1. Support students with technical design
2. Offer insights and assist students with accessing sources of specialized information needed for the design, such as design standards, cost estimating, regulatory guidance
3. Provide a technical QC review and assessment of student work products, including basis of design computations
4. Provide a high-level review and constructive critique of interim and/or final work products for accuracy (such as the Scope of Work, Basis of Design Report)
5. Assess students at mid-semester progress report (brief oral presentation or a poster)
6. Assess oral communication skills at final presentation and review final report.

Outcomes of ERE 489

Student participation in the classes and as part of a team is essential to success in ERE 489. Students are expected to participate in classes, labs, field trips, investigations, guest speaker presentations, report writing, and oral presentations. All students will engage in preparing and making oral presentations of the work, as well as writing, editing and revising reports suitable for professional presentation. Students also maintain project management records and personal journals in addition to the usual class notes.

After completing ERE 489 students should be able to:

1. Design a system, product or process that meets specified requirements within specified constraints
2. Use project management tools, techniques and skills, such as scheduling, resource allocation, peer assessment and cost estimating.
3. Communicate effectively using oral and written formats common to professional practice, such as memos, letters, technical design reports, drawings, posters and oral presentation.
4. Function effectively as a member of an engineering design team.
5. Understand the professional, legal and ethical responsibilities of the professional engineer.

Cooperative education
The ERE program does not allow cooperative education to satisfy curricular requirements.

Materials available to reviews
Materials will be available for each of the required courses in the ERE program. This will include the syllabus, text, course packet or notes (if used), homework and project assignments, exams, representative student work, the official course description (approved through Committee on Curriculum), grading methodology (if not in syllabus), and a list of guest lecturers with their basic credentials.

B. COURSE SYLLABI

Appendix A includes a syllabus for each course that is used to satisfy the mathematics, science, and discipline-specific requirements for the ERE program. This includes the required courses, directed earth sciences and engineering electives. It does not include any of the general education electives.

CRITERION 6. FACULTY

A. Faculty Qualifications

During the 2011–2012 academic year, the Environmental Resources Engineering Department consisted of nine full-time faculty members and one visiting instructor. Table 6-1 summarizes the qualifications of these faculty. Eight of the nine full time faculty members have a Ph.D. as their highest degree and one full time faculty member has an M.S. as his highest degree. Three faculty are licensed as Professional Engineers. The Department has a policy of requiring that all faculty teach at least one required course in the ERE curriculum, typically focused on an area of expertise based on their background.

The ERE curriculum reflects the core strengths of our faculty in environmental/ecological (Daley, Diemont, Tao), geospatial (Im, Mountrakis, Quackenbush), and water resources (Endreny, Kroll, Shaw) engineering. The program emphasizes development in each of these areas through framework of the degree program. For example, Dr. Diemont teaches the sophomore introduction to ecological engineering (ERE 275), which is enhanced through the junior water pollution engineering course taught by Dr. Tao (ERE 440). Both courses are further reinforced by the ecological engineering electives taught by this group. In the water resources area, Dr. Shaw teaches the fundamental fluid mechanics (ERE 339), which is reinforced by Dr. Endreny in engineering hydrology and hydraulics (ERE 340), and subsequently built on by Prof. Daley in both solid waste management (ERE 468) and the senior capstone experience (ERE 489). Dr. Kroll adds strength to the water resources group in the engineering electives. Within the geospatial field, Dr. Quackenbush typically teaches the surveying course (ERE 371) that provides a foundation in coordinate systems and measurement science for the subsequent remote sensing course (ERE 365) taught by Dr. Mountrakis and the electives taught by Im, Mountrakis and Quackenbush. Outside these thematic sequences are additional core courses—e.g. numerical and computing methods (ERE 335: Im), engineering decision analysis (ERE 430: Daley), and probability and statistics (APM 395: Kroll)—that further utilize faculty strengths. The Department has some duplication in strengths, particularly within each of the three disciplines, which allow for coverage of courses e.g. during sabbaticals or other leaves.

The Department is supported in the delivery of required courses by instructors in other departments at ESF (Chemistry, Environmental and Forest Biology, Forest and Natural Resources Management, Paper & Bioprocess Engineering, and Sustainable Construction Management) and Syracuse University (Civil and Environmental Engineering, and Physics). The general education electives further extends this support both at ESF and at SU. By utilizing these additional strengths, the Department can more efficiently harness available resources. For example, the resources required to teach the geotechnical engineering and physics labs at SU would be costly to reproduce at ESF.

B. Faculty Workload

Table 6-2 summarizes the faculty workload, listing classes taught in the 2011–2012 academic year. This reflects a fairly typical assignment for most faculty members: all faculty members engage in undergraduate and graduate teaching, research and service to the department, campus and profession. Table 6-2 illustrates one example of the flexibility described in the prior section in terms of overlapping capabilities of the faculty; ERE 371, and two associated graduate units, ERE 553 and ERE 566, were taught by Dr. Mountrakis in the fall 2011 semester. Dr. Quackenbush typically teaches these courses, allowing Dr. Mountrakis to teach an additional advanced geospatial elective. Dr. Quackenbush was given a reduced teaching assignment for the 2011–2012 academic year to support the development of the materials for this ABET self-study.

C. Faculty Size

The Department has nine faculty, which is sufficient to provide coverage of some required lower level undergraduate courses and greater coverage of upper level required courses and engineering electives. The faculty members have a high quality of engagement with students. As discussed in Criterion 1, and summarized in Table 1-3, all members of the ERE faculty are engaged in undergraduate student advising and each faculty member teaches one required undergraduate course and offers one engineering elective. Excluding Dr. Shaw, who started at ESF in the fall 2011 semester, the average undergraduate engineering advisee load is approximately 14 advisees. The fact that all members of the ERE faculty teach a required course in the undergraduate curriculum further facilitates the quality of interaction with the students. The campus has additional counseling services that faculty can direct students to, particularly if a student is facing issues that are primarily non-academic in nature.

All Department members have served on department or campus committees, and in some cases both. Table 6-3 summarizes the obligations for the 2011–2012 academic year. The small size of the department historically created some challenges in trying to fulfill campus governance obligations. However, a recent restructuring of campus governance has reduced the required representation whereby several committees have rotating membership between the three engineering departments.

All faculty are members of discipline-appropriate professional societies, with many serving in leadership roles. Such engagement inherently connects faculty with professional practitioners, which is frequently strengthened by research partnerships. Faculty members also have opportunity to interact with the Department's Advisory Council at regular meetings on campus. Many practitioners, including those on the Advisory Council, are also engaged in classes, particularly the senior capstone class (ERE 489), which frequently uses professionals as both technical advisors and project clients.

D. Professional Development

The ERE faculty members engage in professional development in a variety of ways. This is facilitated at both the department and institutional levels. The Department encourages professional growth by regularly focusing on development-related activities at Department meetings and retreats. All members of the Department are encouraged to attend professional society conferences at the local, regional, national, and international levels. Faculty also seek additional training opportunities such as workshops and webinars offered by their associated societies. All faculty members are engaged in reviewing journal articles.

The campus has access to an extensive collection of online journals, which facilitate maintaining professional currency while both preparing course materials and engaging in research. The campus has an annual mentoring colloquium, which ERE Department members are encouraged to engage in, and typically do so in higher proportions than any other department on campus. Faculty have access to additional professional training e.g. through ABET workshops, conferences and webinars, and teaching training offered by various institutions.

E. AUTHORITY AND RESPONSIBILITY OF FACULTY

The Environmental Resources Engineering faculty members are the key leaders in developing, evaluating, and assessing the ERE program and implementing necessary continuous improvement measures related to both program educational objectives and student outcomes. While program constituents and campus administration are engaged in the development and implementation process to varying degrees, the bulk of the responsibility lies with the department. All ERE faculty are involved with direct class-based assessments that are performed in many of the required classes in the curriculum and they participate in twice annual retreats to consider the programs offered by the Department. Through this assessment, all faculty contribute to the development and review of assessment in the annual assessment report. To support this role, the department has developed an assessment handbook that is distributed to faculty within their first year. This handbook supports the ability of a new faculty member to quickly engage in evaluation of outcomes related to the classes they teach and facilitate program assessment. The Department retreats frequently provide an avenue for focused discussion related to various aspects of program development.

In addition to department-level assessment programs, administrative leaders at ESF actively support the continued improvement of our program and provide review of our assessment activities. Implementing and monitoring progress on strategic plan initiatives and the appointment of an Assistant to the Provost for Academic Initiatives, drawn from the faculty, to lead the further development of student learning assessment are two specific illustrations of this support. Incentives for implementing meaningful assessment of student learning outcomes include the use of these results to determine the allocation of resources to departments. An overall institutional assessment schematic can be found at www.esf.edu/assessment. Links from this page include relevant policies including the Provost’s Student Learning Outcome Assessment Policy at ESF. This includes the following policies guiding learning outcome assessment practice:

- The Faculty creates, manages, and assesses all curricular efforts at ESF;
- All academic programs shall have explicit learning outcomes and a plan to assess them;
- All assessment plans shall conform to Middle States Higher Education Commission standards;
- All course syllabi shall include student learning outcomes;
- Learning outcomes in required courses shall link with learning outcomes of the program(s) for which the course is required;

- All departments shall document assessment efforts in their annual reports of activity including data collected, assessments conducted, response to assessments, and adjustments to assessment plans;
- All assessment plans and results shall be made publicly available on the ESF assessment web page.

Table 6-1. Faculty Qualifications for the B.S. Program in Environmental Resources Engineering

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Daley, Douglas	M.S. Env. Res. Eng. 1984	ASC	T	FT	12	18	16	PE	H	H	L
Diemont, Stewart	Ph.D. Ecol. Eng. 2006	AST	TT	FT	5	6	5		H	M	M
Endreny, Theodore	Ph.D. Civil and Env. Eng. 1999	P	T	FT	4	13	13	PE, PH	H	H	M
Kroll, Charles	Ph.D. Civil and Env. Eng. 1996	P	T	FT	2	17	16	PE	M	H	L
Im, Jungho	Ph.D. Geography 2006	AST	TT	FT	2	5	5		M	H	L
Martin, Richard	B.S. Mech. Eng, 1982	V	NTT	PT	30	1.5	1	PE	L	M	H
Mountrakis, Giorgos	Ph.D. Spatial Inf. Sci. and Eng. 2004	AST	TT	FT	1	7	7		M	H	L
Quackenbush, Lindi	Ph.D. Env. Res. Eng. 2004	ASC	T	FT	3	11	14	CMS	H	M	L
Shaw, Stephen	Ph.D. Biol. and Env. Eng. 2009	AST	TT	FT	3	3	1		L	H	L
Tao, Wendong	Ph.D. Civil Engineering 2006	AST	TT	FT	10	7	5	EIT	H	H	L

[1] P = Professor, ASC = Associate Professor, AST = Assistant Professor, V = Visiting; [2] T = Tenured, TT = Tenure Track, NTT = Non Tenure Track; [3] FT = Full-time, PT = Part-time; [4] Level of activity reflects average over the three years prior to the visit.

Table 6-2. Faculty Workload Summary for the B.S. Program in Environmental Resources Engineering (2011–2012 academic year)

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Daley, Douglas	FT	ERE 430 Engineering Decision Analysis (3) Spr 12 ERE 468/796 Solid Waste Management (3) Fall 11 ERE 489 Env. Res. Eng. Planning and Design (3) Spr 12 ERE 596 Seminar/Natural Systems Eng. (1) Fall 11 ERE 796 Phytotechnology (3) Fall 11	60	25	15	100
Diemont, Stewart	FT	ERE 275 Ecological Engineering (3) Spr 12 ERE 496 Ecosystem Restoration Design (3/4) Fall 11 ERE 496/796 Ecol. Eng. Design/Sustainability (3) Spr 12	40	45	15	100
Endreny, Theodore	FT	ERE 340/540 Eng. Hydrology and Hydraulics (4) Spr 12 ERE 444 Hydrometeorology (3) Spr 12 ERE 485 Fundamentals of Eng. Prep (1) Spr 12 ERE 496 Appropriate Tech. for Dev. Count. (1) Spr 12	37.5	37.5	25	100
Kroll, Charles	FT	APM 395/595 Prob. and Statistics for Eng. (3) Fall 12 ERE 445/645 Hydrologic Modeling (3) Spr 12 ERE 496 Adv. Eng. Statistics (1) Fall 11 ERE 496 Hydrology and Biogeochemistry (1) Spr 12 ERE 596 Env. Systems Eng. (3) Fall 11	40	45	15	100
Im, Jungho	FT	ERE 132 Orientation Seminar (1) Fall 11 ERE 335 Numerical and Comp. Methods (3) Fall 11 ERE 693 GIS-Based Modeling (3) Spr 12 ERE 692 Remote Sensing of the Env. (3) Fall 11	35	50	15	100
Mountrakis, Giorgos	FT	ERE 371 Surveying for Engineers (4) Fall 11 ERE 365/565 Principles of Remote Sensing (4) Spr 12 ERE 553 Intro. To Spatial Information (1) Fall 11 ERE 566 Intro. to Global Positioning Systems (1) Fall 11 ERE 621 Spatial Analysis (3) Fall 11	47.5	40	12.5	100
Quackenbush, Lindi	FT	ERE 133 Intro. to Engineering Design (3) Spr 12 ERE 551 GIS for Eng. (3) Fall 11	30	30	40	100
Shaw, Stephen	FT	ERE 339 Fluid Mechanics (4) Fall 11 ERE 496/596 Hyd. in a Changing Climate (3) Spr 12 ERE 797 Readings/Contemporary Hyd. (1) Spr 12	40	40	20	100
Tao, Wendong	FT	ERE 440/643 Water Pollution Engineering (3) Spr 12 ERE 475/675 Ecol Eng. for Waste Manag. (3) Fall 11 ERE 674 Methods Ecol. Treatment Analysis (3) Spr 12 ERE 797 Research Methods I (1) Fall 11	35	45	20	100

[1] FT = Full Time PT = Part Time; [2] For 2011–2012 academic year; [3] Expressed as percent of effort; [4] Includes service; [5] Out of the total effort at ESF.

Table 6-3. Department and campus service summary (2011–2012 academic year)

Faculty Name	Department Service	Campus Service	Professional Service
Daley, Douglas	• Member, ERE Departmental Review Committee	• Member, Committee on Curriculum • Advisor, NYWEA and AWMA student chapters • Director, SUNY Center for Brownfield Studies • Member, Center for Urban Environment • Steering Committee, Urban Env. Sci. minor	• Professional Engineer PDH review • External reviewer for SUNY Stony Brook promotion and tenure • Editorial Board, *Clearwaters*, NYWEA
Diemont, Stewart		• GPES (Graduate Program in Env. Science) Study Area Leader • Sussman Awards Review Committee	• Vice President, American Ecological Engineering Society
Endreny, Theodore	• Chair, ERE Department	• Advisor, ESF Engineers without Borders chapter • Member, Provost's Academic Council • Member, Council on Hydrologic System Science	• Editorial Board for Hydrological Processes, Journal of International River Basin Management • ESF Representative, Consortium of Universities for the Advancement of Hydrological Science, Inc
Kroll, Charles	• Chair, ERE Departmental Review Committee	• Campus Review Committee (Promotion & Tenure) • Engineering Representative to Honors Program	
Im, Jungho	• Undergraduate Coordinator		• Principal Investigator, New York View, a member of AmericaView • Editorial Board of GIScience and Remote Sensing
Mountrakis, Giorgos		• Committee on Student Life	• Reviewer for scientific journals (15+), organizations (NSF, UN) and conference proceedings
Quackenbush, Lindi	• Assessment Coordinator • Faculty-Alumni Scholarship review committee • Member, ERE Departmental Review Committee	• Committee on Promotion and Tenure Policies and Procedures • Foundation Award for Excellence in Teaching review committee • Committee on Public Service and Outreach	• NYS GIS Conference Co-Chair • ASPRS Certification Peer review committee • ASPRS Ta Liang review committee Chair
Shaw, Stephen		• Committee on Research	
Tao, Wendong	• Graduate Curriculum Coordinator		• Executive editor, Journal of Forest Research • NSF and EPA Panelist

CRITERION 7. FACILITIES

A. OFFICES, CLASSROOMS AND LABORATORIES

Offices

The Environmental Resources Engineering Department has the facilities needed to support the attainment of the program educational objectives and student outcomes, and provide an atmosphere conducive to learning. The ERE Department moved into Baker Laboratory during the summer of 2007 and occupies various spaces on the 1^{st}, 3^{rd}, and 4^{th} floors of the building. Prior to our occupancy, the building was renovated to provide substantial improvement in facilities to the Department, which are described in this criterion.

Table 7-1 summarizes the primary office spaces utilized by the ERE faculty, staff and graduate students. These spaces were all furnished during the renovation and provide an excellent work environment. The Department and Faculty suites are accessible to students during regular business hours. University Police provide swipe-card based control to authorized users, primarily faculty and staff, at other times. Individual faculty offices are key-accessed with faculty having individualized policies as to office hours.

The graduate students have office space on the 3^{rd} floor of Baker that is swipe-card controlled. To facilitate student interaction with assigned teaching assistants for a class, the ERE Department utilizes a dedicated office space on the 4^{th} floor (room 410). This office includes three separate workstations, and is scheduled through the Department Secretary to minimize space conflicts.

Table 7-1. Administrative, faculty, teaching assistant office space

Office	Purpose	Equipment	Size
Department Office Baker 402	• Chair and Admin. Asst. offices • Work study space • General meeting area • Small conference room	• Comfortable seating • Conference Room • Kitchen	660 ft^2
Teaching Asst Office Baker 410	• Teaching Asst/ Student interaction	• Workstations	214 ft^2
Faculty Suite area Baker 413	• Small group meetings • Waiting area	• Meeting tables • Comfortable seating • Kitchen	1072 ft^2
Faculty Offices Baker 415–426	• Faculty work space • Individual student meetings	• Workstation • Bookcases • Filing cabinets	172 ft^2/each
Staff Suite area Baker 445	• Small group meetings • File storage	• Meeting tables • Comfortable seating	530 ft^2
Staff Offices Baker 446/449	• Staff work space	• Workstation • Bookcase	115 ft^2
Graduate Student Offices Baker 321	• Graduate student office space • Kitchenette	• Workstations (43) • Bookcase • Filing space	2,498 ft^2

Classrooms

Nearly all regular teaching spaces on the ESF campus include a mounted projector and an instructor console with a digital document camera. All rooms enable access with a laptop, in some cases the console has a built-in computer. The majority of the core engineering courses are taught in the instructional space within Baker Lab. Table 7-2 summarizes the classrooms used for many of the ERE classes.

Two of the classrooms—434 and 437—have computers housed in tables that can hide the computer system, leaving a flat working surface. This facilitates use of these rooms for both traditional lectures, and computer-based instruction. Students have the right to use to these classrooms when they are not being used for instruction. The classrooms are typically open from 7 AM to 8 PM, with students able to gain extended access through Department-controlled swipe-card access.

Two of the classrooms—105 and 432—are set up as flexible instruction space, with wheeled folding tables that can be easily maneuvered to facilitate a variety of instructional techniques. As can be seen from Table 7-2, these adaptable classrooms are ideal for instruction with relatively small class sizes. While we have access to some of the larger, theater style classrooms—e.g., 145, 146, and 148—these rooms do not have the level of flexibility that design courses frequently need.

Table 7-2. Classrooms and associated equipment where ERE courses are taught

Facility and Room	Purpose	Equipment	Seating
Design studio Baker 105	• Flexible instruction space • Instructional and work space for design classes	• Mounted projector • Instructor console • Wheeled folding tables	32 seats
Classroom Baker 145	• Lecture theater	• Mounted projector • Instructor console • Fixed seating	83 seats
Classroom Baker 146	• Lecture theater	• Mounted projector • Instructor console • Fixed seating	130 seats
Classroom Baker 148	• Lecture theater	• Mounted projector • Instructor console • Fixed seating	68 seats
Classroom Baker 432	• Flexible instruction space • Non-computer based instruction	• Mounted projector • Instructor console • Wheeled folding tables • Portable white boards	35 seats
Classroom Baker 434	• Computer or non-computer based instruction • Work space	• Mounted projector • Instructor console • Fixed tables with hidden monitor compartment	30 seats
Classroom Baker 437	• Used for computer or non-computer based instruction	• Mounted projector • Instructor console • Fixed tables with hidden monitor compartment	30 seats

Laboratory facilities

Table 7-3 summarizes the laboratory facilities used by the ERE students, including several specialized laboratories maintained by the Department and described in more depth in Appendix C. In addition to the computer-equipped classrooms described previously, Table 7-3 also highlights several computer clusters used by students in all departments on campus that are managed by Computing and Network Services (CNS).

Table 7-3. Summary of laboratory facilities used by ERE students.

Office	Management	Primary Purpose	Equipment	Size/seating
Hydrol./Hydraulics Lab Baker 106	ERE Department	• Lab instruction • Research	• Hydrology-focused including flumes and river tables • See Appendix C	1538 ft^2
Ecological Eng. Lab, Baker 108	ERE Department	• Lab instruction • Research	• Various testing equipment • See Appendix C	560 ft^2
Computer cluster Baker 309	CNS	• Lab instruction • Student work space	• Mounted projector • Instructor console • 38 computer workstations	50 seats
Computer cluster Baker 310	CNS	• Lab instruction • Student work space	• Mounted projector • Instructor console • 24 computer workstations	35 seats
Computer cluster Baker 314	CNS	• Lab instruction • Student work space	• Mounted projector • Instructor console • 32 computer workstations	45 seats
Computer cluster Baker 319	CNS	• Student work space	• 23 computer workstations	23 seats
Computer cluster Baker 438	ERE Department	• Graduate research space	• 9 computer workstations	9 seats
Computer cluster Moon 14	CNS	• Lab instruction • Student work space	• Mounted projector • Instructor console • 24 computer workstations	24 seats

All the CNS-managed computers use central authentication through Syracuse University. Through use of a common image, all systems have the same software, including standard productivity tools—e.g. Microsoft Office and Adobe—along with statistical, programming and data management tools, and specialized engineering applications such as ArcGIS, AutoCAD, ERDAS Imagine, R, and Matlab. A full list of available software is provided online (http://helpdesk.esf.edu/cns/ComputingCenter/BakerFacilities/SoftwareAvailable.aspx). All campus users—faculty, staff, and students alike—use Syracuse University credentials to log on to the shared network. Every desktop on campus has access to a 1 gigabit Ethernet connection, with full-coverage wireless, and network data storage for authenticated users.

With the exception of Baker 319, most of the computer clusters are available, through the Registrar's Office, to be scheduled for classes. When classes are not in session, students are able to use the clusters. General student access to the computer clusters is 8 AM – 11 PM Monday – Friday, 11 AM – 6 PM Saturday, and 10 AM – 11 PM Sunday.

The classrooms on the 4th floor house 54 Dell Optiplex systems, with access to 4 Dell PowerEdge Servers (T410 and T710) for advanced simulations and computational complex applications. The 3rd floor computer clusters house 117 Dell Optiplex systems and a 20 node Linux-based HPC for advanced computations. Students have access to a central printing station, whether on a campus computer or connected wirelessly, with an initial print quota of 500 units per year. The print station includes: an HP LaserJet 9050dn for fast, black-and-white, 8.5×11 inch prints with duplex capability; an HP LaserJet 5550dtn for high quality color, 8.5×11 inch and 11×17 inch prints with duplex capability; and an HP DesignJet 4500 PS for large format prints on 36 inch rolled paper.

B. COMPUTING RESOURCES

Computing resources are widely available and accessible at ESF and for the ERE program. The general facilities and hours of availability are summarized in the prior section. The adequacy of these facilities for scholarly and professional activity is assessed on an annual basis by our ERE faculty and our dedicated ERE staff member for computing, Mark Storrings. The use of computing technology is essential to all ESF programs; the computing labs maintained by CNS (described in the previous section) provide sufficient space and capabilities to meet the majority of student needs. All labs are open seven days a week during most of the academic year and contain computers with software commonly used by ESF academic programs.

In addition to these ESF campus computing resources, ERE students can access public computing labs managed by Syracuse University's Information Technology Services. Several of these labs are open 24 hours a day, seven days a week. All ESF students are assigned accounts through Syracuse University for their e-mail needs. This e-mail address is used by both ESF and SU for all official electronic communications with students.

ESF's EvergreenX wireless network is accessible from the main level of Moon Library, Marshall Hall, Baker Lab, Bray Hall rotunda, Walters Hall and the main lobby/classroom areas of Illick Hall and Walters Hall. Syracuse University's wireless network, AirOrangeX, can be accessed from a variety of locations around the SU campus.

ESF students living in the ESF's Centennial Hall and in Syracuse University residence halls have both wired (Ethernet) and wireless (Wi-Fi) connections, in all residential facilities. The College academic computer support personnel will install specific engineering-related software on the servers, at the request of an individual faculty member.

C. GUIDANCE

ERE students are provided appropriate guidance regarding the use of tools, equipment, computing resources, and laboratories through their ERE courses. In their first semester students are oriented to using ESF computing resources and facilities through the ERE 132 Orientation course and ESF's Freshman Orientation. In addition, ERE lab courses provide appropriate documentation, typically through the syllabus or supporting materials, to ensure that students are using equipment and facilities correctly. Students are also supervised by faculty, staff, or trained graduate assistants when using laboratory or field equipment.

D. Maintenance and Upgrading of Facilities

Department facilities

The ERE Department is responsible for the maintenance and upgrade of the labs and equipment controlled by the Department. In the summer of 2011 we updated tools and equipment in Baker 106 for use in our Fluid Mechanics course. In the summer of 2011 we updated 4 computers in Baker 438 for research and developed methods to access the new Linux cluster on campus. Equipment is monitored on a regular basis, with periodic maintenance performed as needed. ERE has assigned a staff member to be in charge of ecological, geospatial and water resources equipment, and this person is trained to assess equipment and recommend a maintenance plan. Since classes are not scheduled during the summer, this provides an ideal time to review equipment with minimal instructional impact. Some of the equipment—for example, the auto-levels used in surveying and other labs—are cleaned and calibrated on an annual basis on campus. Other equipment—for example, the total stations—require periodic calibration off-site. To minimize cost in any single year, this calibration is rotated through such that one or two instruments are sent out each summer. While the Department is able to charge a laboratory fee to support equipment upgrade and maintenance, we have tried to minimize additional costs to the students. These costs have historically been covered through the various funding avenues discussed in Criterion 8.

Campus computing facilities

The hardware in the computing clusters controlled by CNS is refreshed on a 3–5 year cycle depending on system warranties. Software images are updated on a monthly basis. The State-funded Information Technology Infrastructure budget is used to support software and hardware maintenance. Hardware replacement costs are primarily supported by the technology fee that students pay. The technology fee for undergraduate students in 2011–2012, was $13.10 per credit hour, with a maximum of $157. This fee generated approximately $594, 000. The fee will increase slightly in the next academic year to $13.50/credit or $162 for a full-time student. Computing lab upgrades have also been State-supported through the Student Computing Access Program ($30, 000 per year).

E. Library Services

Library facilities

The primary library facilities on the ESF campus are housed in F. Franklin Moon Library. The mission of Moon Library is "to provide information resources to the ESF community and to teach library users to learn independently." The Library's vision is to: have a user friendly learning environment; have access to a wide variety of resources that utilize state of the art technology; offer multiple and diverse services for library users; and have a highly trained, helpful and courteous staff. The library building opened in 1968 and can seat 400 people. An extensive renovation of the main floor was completed in 2007. The library is a wireless environment where students may use their personal laptop for work. The main reading areas are located on the upper level adjacent to the open stacks. The reference, reserve and circulation areas are located in the center of the building. The main level of the library also includes computer workstations for the library catalog, databases and Internet searching; printing, scanning, photocopying and fax services; individual study carrels; a conference room; library faculty offices; a writing support center; and tutoring areas, which create a learning commons atmosphere. The archives and special collections, a computer laboratory and library processing areas are located on the lower level.

The Syracuse University and SUNY Upstate Medical University libraries are within walking distance of ESF. Moon Library shares an online library catalog with Syracuse University, which also provides access to over 70,000 subscription online journals, databases, e-books, and hundreds of web-based databases (bibliographic and full text). The Library's website (http://www.esf.edu/moonlib) is continuously reviewed and updated. Regular articles about the Library appear in the student newspaper. Screen savers with library-specific information, a monitor with news, and improved signage now appear throughout the library.

Library support

The Moon Library provides access to more than 138,000 cataloged items and receives approximately 6,300 print and online journals. The collection constitutes a specialized information resource for the academic programs of the College. This collection includes access to key journals to support teaching and research in the primary focus areas of the ERE Department: ecological, geospatial, and water resources engineering. Due to licensing issues, access to journals that Syracuse University subscribes to will change in the near future; however, the library is being proactive in seeking input from faculty to ensure access to important journals is retained. Moon Library uses an on-line interface for Faculty to request acquisitions, and seek specific materials that are not in the College collection. While budget deliberations are always considered, the library has been highly responsive to acquisition requests that are course-focused. The library also facilitates rapid interlibrary loan response to holdings of other libraries throughout SUNY, NY State and beyond through its participation in various consortia such as OCLC and the Information Delivery Service (IDS) project (www.idsproject.org/) hosted at SUNY Geneseo.

Library faculty and staff offer a one-credit courses in information literacy for undergraduate (ESF 200) and graduate (ESF 797) students, orientation programs, class lectures, user aids and reference desk services. Additional lectures are given as requested, particularly to the 132 orientation classes offered by each faculty group to first semester students. A "library liaison" has been assigned to each Faculty and messages are sent routinely to faculty e-mail lists. The library staff has recently been enhanced through the employment of an additional librarian.

F. OVERALL COMMENTS ON FACILITIES

Safety in ERE classes

The ERE program participates in the ESF campus wide safety inspections and procedures to ensure facilities, tools, and equipment used in the program are safe for their intended purpose. Faculty, staff, and student safety is a consideration for any course in the ERE curriculum, particularly those with a lab focus. To ensure a safe working environment, all personnel are required to follow appropriate protocols when in the lab or using lab equipment. ERE lab courses provide appropriate documentation, typically through the syllabus or supporting materials, to ensure that students are using equipment and facilities correctly. For example the course reader in ERE 440 Water Pollution Engineering includes a Laboratory Safety Orientation sheet that explains safety procedures; and in ERE 371

Surveying for Engineers the lab manual provides guidance for correct equipment usage to ensure student safety as well as minimize equipment damage. In addition, students are supervised by faculty, staff, or trained graduate assistants when using laboratory or field equipment. Labs with chemical storage and use include first aid kits, eye washes, emergency showers and telephones.

Safety review through course proposals

Offering a new—or substantially revised—class at ESF requires submission of a proposal to the Committee on Curriculum for review. The proposals are maintained by ESF and kept on record by the ESF Registrar. Each course proposal includes a health and safety review that considers eight separate aspects of safety, summarized in Table 7-4. If the answer is "Yes" to any of the health and safety considerations, the associated narrative need to explains the actions taken to mitigate the hazard.

Table 7-4. Health and Safety Review Considerations

Consideration	Examples
Use of substances with characteristics to potentially cause harm or injury	Flammability, toxicity, corrosivity, reactivity, registered pesticide, legally controlled, or other
Presence of physical hazards during instruction	Machines that need safety guards; razor blades or syringes; compressed gases
Presence of biological hazards during instruction?	Handling animals (rabies or hantavirus); cultures or stocks of infectious agents (fungal spores, viruses, bacteria
Presence of radiation hazards during instruction	Radioisotopes, X-rays, ultraviolet rays, lasers
Potential for electrical equipment to pose a safety threat during instruction	Outdoor or potentially wet location
Personal safety issues	Time of day or location related issues e.g., danger of physical assault after organized class exercise
Students driving official vehicles during any instructional exercise	Land or water vehicles
Necessity for personal protective equipment during class exercises	Hard-hats, eye/face protection, hearing protection, hand/foot protection, lab coat, visibility clothing

Campus support

The ESF Office of Environmental Health and Safety (EHS) provides general oversight to facility safety on campus, including preparation for annual fire inspections. The EHS webpage (http://www.esf.edu/ehs/) includes a variety of information related to chemical and laboratory safety and hazardous waste management. EHS staff are available to provide class-specific safety information, for example, an EHS staff member is regularly invited as a guest lecturer to ERE 674 Methods in Ecological Treatment, an engineering elective that involves significant chemical usage.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The ESF President, Dr. Cornelius Murphy, began his tenure on 15 May 2000 after having been the Chief Executive Officer of O'Brien and Gere, Ltd., a nationally-known environmental engineering firm with headquarters in Syracuse, NY. Dr. Murphy understands the importance of engineering education and continues to provide support to our engineering programs. Dr. Bruce C. Bongarten is currently ESF's Provost and Vice President for Academic Affairs. Prior to coming to ESF on 1 July 2005 he was Associate Dean for Academic Affairs at the Daniel B. Warnell School of Forest Resources at The University of Georgia. Dr. Gary M. Scott currently serves as the Director for the Division of Engineering, having been appointed to this position on 1 September 2009. In this role, Dr. Scott coordinates activities amongst the three engineering departments.

Dr. Theodore Endreny has been the Chair of the ERE Department since 1 September 2011 and has leadership responsibility for the overall Department management. In this role, the Department Chair works with the College administration to develop and manage the educational programs and budgets for the Department and to coordinate support for the Department from the Research Foundation of the State University of New York (RF), the ESF Foundation, and other external sources. The Chair is also responsible for providing annual Departmental reports to the College administration.

The ERE Department currently offers two undergraduate programs leading to the B.S. degree: Environmental Resources Engineering and Forest Engineering. The ERE Undergraduate Coordinator is responsible for coordinating undergraduate educational opportunities; Dr. Jungho Im is the current Undergraduate Coordinator, with Dr. Stewart Diemont taking on this role starting in the 2012–2013 academic year. With the advice and counsel of the Chair, the Undergraduate Coordinator is responsible for:

1. Coordination of the undergraduate admissions process with the authority to:
    a. Answer questions and make recommendations to the Office of Admissions regarding acceptance of student, acceptance of transfer credit, and other matters related the admission of undergraduate students;
    b. Schedule admission and recruiting events.
2. Coordination of the undergraduate education program with the authority to:
    a. Sign undergraduate petitions.
3. Coordination of course and curriculum actions with respect to the Committee on Curriculum (COC) with the authority to:
    a. Submit Department-approved actions to the COC;
    b. Respond to comments received during the COC review process.

In addition, the Department offers a graduate program in Environmental Resources Engineering with options in Ecological Engineering, Environmental Management, Environmental Resources Engineering, Geospatial Information Science and Engineering, and Water Resources Engineering. The graduate program offers degrees at the M.P.S., M.S., and Ph.D. levels. Dr. Wendong Tao is the Graduate Coordinator for the ERE Department and has the responsibility for coordinating the graduate educational opportunities. With the advice and counsel of the Chair, Dr. Tao is responsible for:

1. Coordination of the graduate application review process with the authority to:
    a. Determine and communicate the graduate review process and timeline;
    b. Accept and decline graduate students applications through the Faculty and Staff Portal;
    c. Assign temporary major professors.
2. Coordination of the graduate education program with the authority to:
    a. Sign graduate petitions;
    b. Sign graduate forms.

B. PROGRAM BUDGET AND FINANCIAL SUPPORT

Program Budget

Departmental funding comes from state allocations, outreach activities, research funding, and development activities, which are explained in the text below. Table 8-1 summarizes the sources and amounts of funds available to the Department and comments on expenditure guidelines. The Department Chair has final authority on expenditures from all accounts except research funding, for which the individual Principal Investigator has final authority. However, the Chair has little discretion in salary matters, given that the unions that represent faculty and staff negotiate salaries on behalf of their members.

Table 8-1. Sources and amounts of funds expended for the academic year 2011–2012.

Source		Amount	Comment
State Allocation	Salaries	$887,252	ERE faculty and staff salaries are dictated by the collective bargaining agreement between SUNY and the relevant union.
	State budget (non-salary)	$17,200	Operational budget for other than personnel services.
	Academic equipment replacement	$4,155	Allocation is based on the number of student credit hours in laboratory courses.
Sponsored Research		$820,370	Total amount of research grants expended by ERE.
Outreach Program Development		$0	Allocation available from continuing education activities.
ESF Foundation		$32,650	Including expenditure from endowed and other funds.

State Allocation

The Budget for the State of New York, which should be in place in April of every year, contains the allocation to the State University of New York. The SUNY Central Administration staff works with each SUNY campus to determine a campus budget. The campus allocation is determined by a complex set of ever-changing metrics.

The Provost, in consultation with each Department Chair, determines the allocation of state funds to a particular Department. The Provost has the option of funding activities such as faculty searches by special allocations above and beyond the normal allocation. The state allocation covers salaries, wages, and benefits, with the remainder of the funds being allocated as "other than personnel service" and "temporary service" funds.

Outreach Activities

Funds accrue to the Department from the Office of Outreach by virtue of faculty involvement in continuing education activities. Such activities might include participation in the design and delivery of non-credit short courses, or work during the summer on grants managed by the Office of Outreach.

Research Funding

Sponsored research generates funds to support the Department in several ways. Some grants are designed to support and enhance undergraduate education or include funds to support undergraduates directly. Inevitably, some research equipment, computers, and software purchased from research funds is used in support of the undergraduate program, thus freeing state allocated funds for other purposes. Likewise, research funding is frequently used for travel to professional conferences, again reducing the demand on state allocated funds for this purpose.

ESF Foundation

The ESF Foundation (http://www.esf.edu/development/esffoundation/) is a not-for-profit corporation of alumni, college and community leaders committed to helping the College achieve its mission through resource development and resource management. The ESF Foundation supports the Department with a number of funds that benefit various classes of students in the ERE Department. Table 8-2 summarizes the ESF Foundation funds specific to the ERE Department. The Department also has an expendable account that is supported by alumni and faculty donations and can be spent out annual.

Table 8-2. ESF Foundation funds supporting the ERE Department.

Fund	Description
William L. Johnson Fund for the Mapping Sciences	Established in memory of staff member Bill Johnson to support geospatial instruction and research activities. This support includes, travel grants for undergraduate students, purchase of equipment or software, thesis research, staff training, and awards to graduate students
Earl Church Memorial Fund	Created in Mr. Earl Church's memory. Mr. Church spent twenty years teaching, developing, and researching the basic foundations of Analytical Photogrammetry. The fund supports students who are carrying on his legacy by studying photogrammetry and related fields
James M. Hassett Hydrology and Hydraulics Fund	Established to honor the contributions of past Departmental Chair James Hassett, this fund supports instruction and research activities related to Hydrology and Hydraulics. This fund has been used to purchase equipment for the Hydrology and Hydraulics laboratory that was used to create a new laboratory section for our undergraduate Fluid Mechanics course. The lab is also used in undergraduate courses in Engineering Hydrology and Hydraulics and Open Channel Hydraulics.

Research Incentive Funds

Each department also receives a yearly allocation from the Provost's Office via the Research Foundation proportional to the amount of research overhead funds generated by the unit during the previous year. These funds accrue to the Department Chair, and are used to support opportunities to generate more research funding as well as equipment within the Department. In addition, each principle investigator accrues Individual Research Incentive Funds based on the overhead generated by their extramural research funding.

Teaching Support

The institution primarily supports teaching in ERE through funding of Graduate Assistants (GAs) and hosting teaching workshops.

Graduate Assistants

Each department has funds allocated for Graduate Assistants (GA) and can select graduate students to assist in the delivery of the undergraduate program. The Faculty had 12 Graduate Assistants during the 2010–2011 and 2011–2012 academic years. It is anticipated that this number will remain constant in the future. The Graduate Assistants are used primarily as graders and laboratory assistants and are rarely responsible for delivery of formal instruction.

On-campus teaching programs

The campus presents various programs, typically through the Outreach office, which provide teaching support for both faculty and graduate assistants. Outreach staff offer a one-credit Seminar on College Teaching in the fall semester aimed at enhancing the teaching practice of graduate students. They also recruit graduate fellows to lead the annual College-wide GA Colloquium on Teaching and Learning, which is offered during the orientation week prior to the start of the fall semester. This workshop engages a variety of faculty and staff and describes the culture and expectations of ESF; outlines instructional survival skills and specific teaching-related skills necessary to function effectively as a GA; highlights some of the people and units who provide leadership and support to GA efforts; and introduces professional skills and resources that will endure beyond the ESF graduate assistant experience. Participation in this colloquium is required for all new GAs. Outreach also coordinates an annual Symposium on Teaching, Research and Outreach with a broader goal of engaging faculty, staff, and students in a focused dialogue on the synergy of teaching, research and outreach.

Infrastructure, facilities and equipment maintenance
With a major renovation to Baker Lab supported by State funds completed in 2007, the facilities for the ERE program provide a good foundation for program success. Unlike other departments in the building, the Development Office did not pursue sponsorship of ERE-controlled space during the renovation of Baker Lab. This provides an avenue for future support through alumni and supporters when additional upgrades are required. The campus has an ongoing commitment to infrastructure upgrades. Equipment is an ongoing challenge that is met through a continued balance of multiple funding sources.

The Department was also the recipient of a Congressional appropriation through the US Department of Education in 2009. The goals of this grant were to: improve ESF's technological and computing capabilities, with an emphasis on supporting new advancements in Geospatial, Ecological, and Water Resources Engineering; obtain, catalog, and distribute spatial data sources that are instrumental to addressing New York State's environmental problems; promote research, teaching, and service oriented activities throughout New York State; and provide the necessary support to further develop ESF's world-class programs in Geospatial, Ecological, and Water Resources Engineering, which are led by our new faculty members, the future environmental leaders of New York State. This grant provided funding for equipment, supplies, and data that is utilized in educational programs across the ERE curriculum.

Resource adequacy
The resources available to the ERE Department are sufficient to enable students in the ERE program to attain student outcomes. The Department has also been strategic in allocating resources for continual maintenance and upgrades to equipment employed for undergraduate teaching. The Department also provides resources for disposable supplies used in undergraduate teaching, such as in our water chemistry laboratories. Given our recent equipment purchases, the renovation of Baker Laboratory, and our equipment maintenance schedule, the Department is well prepared for maintaining existing equipment and supplies necessary for students to obtain the Departmental educational outcomes.

C. STAFFING

The staff in the Department of Environmental Resources Engineering includes the Department secretary and two instructional support staff, who serve under the direct supervision of the Department Chair. Responsibilities for the staff in these positions are detailed in Table 8-3. Staffing is adequate for the educational and research programs that are offered in the Department. Annual performance programs and performance evaluations are performed for each staff member. Retention of staff over the years has been excellent.

Table 8-3. Staff associated with the Department of Environmental Resources Engineering.

Name	Position	Duties	Years in ERE
T. Frese	Secretary	• Provide administrative support (e.g. manage mail, maintain Chair calendar, handle phone calls); • Manage logistics for Department events; • Greet visitors; • Supervise work study.	17
M. Storrings	Instructional Support Specialist	• Primary contact person for maintenance, preparation, and functioning of ERE Geospatial Engineering laboratories; • Update ERE web site; • Coordinating Department-related outreach activities, such the New York State Fair; • Maintaining and updating Department's poster displays; and • Coordinating and communicating with ESF Office of News & Publications; • Maintain and update ERE servers, including NYView internet portal; • Provide instructional support for Geospatial Engineering, including helping with delivery of laboratories and review of course material; • Manage and maintain all Departmental software licenses, including contact with software vendors. • Serve as ESF Support Contact for issues related to ESRI software products (primary GIS software used on campus), and provide geospatial research support to campus. • Provide Geospatial Engineering research support to Department's faculty and students with the goal of improving research scholarship and productivity. • Provide support for ERE faculty teaching and service activities, especially those related to Geospatial Engineering, the internet, and computational activities. • Assist Department's secretary in planning, coordination, and execution of Departmental events.	11

P. Szemkow	Instructional Support Specialist	• Catalog, maintain, and facilitate the purchase of equipment for teaching, research, and outreach; review teaching equipment status prior to beginning of semester; • Provide support for personal computers within Department; provide instruction and support for GPS equipment, including periodic workshops for ESF personnel; • Primary contact person for maintenance, preparation, and functioning of Ecological Engineering and Water Resources Engineering laboratories; • Catalog and disseminate Department's aerial photographs to College community; • Maintain, update, and aid in the development of content for all Departmental electronic displays; • Support operations in Baker 438 computing laboratory; • Provide field support for the development of Departmental laboratories.	34

Staff training is done on an as-needed basis. In-house training opportunities are also sometimes available from on campus. ESF employees also have opportunities for taking courses at no or reduced tuition at both ESF and Syracuse University. Additional training and education opportunities are offered through the NYS & CSEA Partnership for Education and Training (http://www.nyscseapartnership.org/), the NYS/United University Professionals Individual Development program (http://nysuup.lmc.ny.gov/development/individual.html), and the Governor's Office of Employee Relations (http://www.goer.ny.gov/).

D. FACULTY HIRING AND RETENTION

Outline of Hiring Process

New faculty positions and backfilling of vacant positions are authorized and filled using the process outlined below. The hiring process is generally coordinated by a search committee that consists of faculty and staff members from the hiring department, a representative outside the department, graduate and undergraduate students, and an HR representative. Others, such as representatives of key department constituents, can also be on the search committee.

- Search Process
    - Departmental Chair
        - Consults with ERE faculty members to outline the departmental needs and the priority for faculty position hires
        - Discusses departmental needs with Provost to determine which positions to fill, the level of the positions and negotiation term parameters
    - Provost
        - Discusses proposed position with President

        - Jointly authorizes recruitment and initiates search process
        - Consults with Department Chair for recommended search committee members, including students
        - Invites members to serve
        - Identifies financial allocation for search
        - Attends first search committee meeting with the Assistant Director of Human Resources
    - Search committee
        - Creates advertisements and announcements
        - Solicits nominations and applications
        - Identifies candidates for interview and invites selected candidates to campus
        - Establishes schedule for candidate to meets with search committee, faculty, staff, students, human resources, and other key constituents including the President and Provost
        - Solicits feedback regarding the candidates
        - Identifies recommended candidate(s)
- Hiring Process
    - Search Committee
        - Provides written recommendation to Chair
    - Chair
        - Provides written recommendation to Provost
        - Seeks approval to begin negotiations and negotiates with candidate
        - Forwards agreed upon terms to Provost
    - Provost
        - Requests approval of hire from President
        - Following approval, submits memo to HR for processing letter of hire
        - Sends letter with the agreed upon terms of offer to candidate, Department Chair, and Research Programs to begin tracking process

Faculty Retention Strategies

The Department Chair works in concert with the Provost to make sure that the needs of new faculty are met. New faculty members receive a start-up package to initiate their research at the College. Start-up packages typically include funds for equipment, funds for services (analytical and computational), research supplies, travel, summer salary, and support for graduate students. It is typically expected that these funds will be used within the first three years of the new faculty member's appointment. New faculty hires are often provided additional allocations of GAs to help develop their research program. The teaching load for new faculty is typically reduced during the first year of their appointment with the expectation that they will use the additional time to establish their research program.

A number of programs are in place to help retain faculty. As part of the promotion and tenure process, a new faculty member is formally reviewed by the Department Review Committee after one, three, and six years. The sixth year review is for continuing appointment (tenure). In consultation with representatives from all departments, the College has developed a document on Appointment, Promotion, and Continuing Appointment

(Tenure) Policies, Procedures and Standards. In addition, each department has developed a set of standards by which faculty members are reviewed. These documents were created so that the expectations of faculty members are clearly understood. Having clear expectations of faculty members is important for faculty retention.

After continuing appointment, Associate Professors are reviewed every three years until promoted to the rank of professor. While the pre-tenure reviews are part of the reappointment process, the reviews both before and after tenure also serve to provide constructive feedback to faculty members for their professional development. In addition, all faculty members meet at least annually with the Chair to discuss their progress in the preceding year and goals for the upcoming year.

E. SUPPORT OF FACULTY PROFESSIONAL DEVELOPMENT

The Department recognizes the importance of faculty development and routinely commits Department resources to that end. In addition, the College commits resources to this important endeavor. Development begins with recruiting faculty and professional staff. The Provost provides funding in addition to the normal state allocation for this important activity. Table 8-4 shows examples of other faculty development activities at the Department and College level.

Table 8-4. Examples of faculty development activities at the Department and College level.

Activity	Purpose	Comment
Mentoring	Provide untenured faculty formal interaction with senior faculty. Occurs at least on an annual basis.	Faculty Chair is responsible for assigning mentors and oversight as necessary.
Mentoring Conference	College activity for all faculty and their mentors to discuss scholarship issues in an informal atmosphere.	Provost's Office funds and organizes the event; senior faculty and invited guests lead discussion.
Annual Teaching, Research and Outreach Conference	Forum to discuss teaching and learning issues at the College. Keynote speakers and discussion leaders are from other institutions.	Provost's Office funds event, organized by Office of Outreach.

Indirect costs recovered are targeted to a variety of programs that help with faculty development. A portion of the indirect costs are allocated directly to the faculty members as Individual Research Incentive Funds (IRIF). These funds, allocated based on the amount of indirect costs recovered through the faculty member's grants, can be used as desired by the faculty member. These funds are often used for travel and other development activities. In addition, the department receives an allocation of the indirect costs as Research Incentive Funds (RIF). These funds can be spent at the discretion of the Chair for faculty development, research support, travel, or other activities as needed. The indirect costs are also used to fund travel grants for faculty and students and to fund seed grants for new research initiatives.

Faculty members are eligible for a sabbatical leave every seven years as outlined in the collective bargaining agreement between the College and United University Professionals

(UUP). The faculty member is eligible for full pay for a one-semester sabbatical and half-pay for a full-year sabbatical. In addition to providing salary, the College often provides the funding for hiring the replacement instructors for the period of the sabbatical. The process for application and approval of the sabbatical leave is provided in the collective bargaining agreement.

In addition to the College-wide activities and support described above the Provost often provides funding to individual faculty for specific activities. The Department Chair can also elect to support a particular activity from funding available to the Department.

9. PROGRAM CRITERIA

When the ERE Program was initiated in the Fall 2010 semester, it was reviewed for compliance with the Program Criteria for Environmental and Similarly Named Engineering Programs. The review summary is provided as an appendix to this section (Appendix 9-1). The match of the curriculum to each element of the criteria was discussed at a faculty retreat and an elective was introduced to strengthen one required proficiency (earth science). As this section describes, the program now satisfies all aspects of the Program Criteria for Environmental and Similarly Named Engineering Programs.

Curriculum

The Program Criteria for Environmental and Similarly Named Engineering Programs requires the curriculum to **prepare graduates to be proficient** in a variety of different subject areas. Table 5-4, in the Program Curriculum discussion under Criterion 5, highlighted these proficiencies and the corresponding core courses and electives. The engineering electives provide theory and application of scientific principles and quantitative skills to monitor, assess, or design in the environmental resources engineering profession.

The Program Criteria for Environmental and Similarly Named Engineering Programs also requires documentation of how students will **gain an introductory level knowledge of environmental issues** associated with air, land, and water systems and associated environmental health impacts. This is achieved by students taking a core engineering sequence in the program starting from the freshman year. These courses are summarized in Table 9-1.

Table 9-1. Courses used to provide an introductory level knowledge of environmental issues

Curriculum component
ERE 133 Introduction to Engineering Design
ERE 275 Ecological Engineering I
ERE 340 Engineering Hydrology and Hydraulics
ERE 440 Water Pollution Engineering
ERE 468 Solid Waste Management
ERE 489 Environmental Resources Engineering Planning and Design

The Program Criteria for Environmental and Similarly Named Engineering Programs also requires that students have the **ability to conduct laboratory experiments and critically analyze and interpret data** in more than one major environmental engineering focus area, e.g., air, water, land, environmental health. Students gain skills in conducting experiments and critically analyzing and interpreting data through the core program. This skill development starts from the freshman and sophomore science classes and builds through the junior and senior engineering courses (Table 9-2). These courses cover a range of key environmental resource engineering subject areas.

Students should also be able to **perform engineering design** by means of design experiences integrated throughout the professional component of the curriculum. Design experience starts from the freshman level introductory course with expectations building throughout the rest of the program (Table 9-2). The ERE 133 course introduces the area of engineering design and includes three group-based design projects that explore the Departmental strength areas: ecological, geospatial, and water resource engineering. The subsequent courses in the design sequence build on this introduction, culminating in the design experience in the capstone course (ERE 489), which is described in depth in Criterion 5.

Table 9-2. Courses used to provide required experimentation and design capabilities

Required Ability	Curriculum Component
Conduct laboratory experiments and critically analyze and interpret data	APM 395 Probability and Statistics for Engineers CIE 337 Introduction to Geotechnical Eng. ERE 340 Engineering Hydrology and Hydraulics ERE 365 Principles of Remote Sensing ERE 440 Water Pollution Engineering
Perform engineering design by means of design experiences integrated throughout the professional component of the curriculum	ERE 133 Introduction to Engineering Design ERE 275 Ecological Engineering I CIE 337 Introduction to Geotechnical Eng. ERE 340 Engineering Hydrology and Hydraulics ERE 440 Water Pollution Engineering ERE 468 Solid Waste Management ERE 489 ERE Planning and Design

The Program Criteria for Environmental and Similarly Named Engineering Programs also requires that students **gain an understanding of concepts** of professional practice and the roles and responsibilities of public institutions and private organizations pertaining to environmental engineering. As with the design experience, this is integrated throughout the curriculum, building from an introduction in the freshman year (ERE 133), reinforcement in the sophomore (e.g. ERE 225), junior (e.g. ERE 430) and senior years (e.g., ERE 468), and culminating in the capstone course (ERE 489). As described previously, the capstone course engages client sponsors and technical advisors. These participants bring a variety of public and private experiences to the project. In addition to the formal instruction within the class, students in ERE 489 are also invited to participate in the Order of the Engineer Ceremony at the culmination of the course. The Order of the Engineer was initiated in the US to foster pride and responsibility in the engineering profession. Membership in the Order requires participation in the Engineer's Ring Ceremony and public acceptance of the "Obligation of an Engineer", a formal statement acknowledging an engineer's responsibilities to the public and profession.

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.

As was indicated by the curriculum table shown in Table 5-1, design is integrated throughout the program. Table 9-3 highlights the courses that include a substantial design component, which include courses within all four years of the curriculum. The instructors of all these courses are tenured or are in tenure-track positions and have degrees in an engineering discipline. Of the six instructors, two are licensed professional engineers (PEs)—Daley and

Endreny—and one has EIT status and is seeking licensure—Tao. Professor Daley, who teaches both of the design-focused courses in the senior year, also has over ten years of industrial experience in engineering design. In addition, the senior capstone experience (ERE 489) is supported by project-specific technical advisors. In 2011–2012, these advisors included seven professional engineers representing four different engineering companies.

Table 9-3. Design-focused courses

Course	Instructor
ERE 133 Introduction to Engineering Design	Lindi Quackenbush
ERE 275 Ecological Engineering I	Stewart Diemont
CIE 337 Introduction to Geotechnical Engineering	Shobha Bhatia
ERE 340 Engineering Hydrology and Hydraulics	Ted Endreny
ERE 440 Water Pollution Engineering	Wendong Tao
ERE 468 Solid Waste Management	Doug Daley
ERE 489 Environmental Resources Engineering Planning and Design	Doug Daley

Appendix 9-1. ERE program match to criteria for Environmental and Similarly Named Programs (evaluation performed in September 2010)

Evaluation of ERE's Curriculum vs. ABET Program Criteria for Environmental and Similarly Named Engineering Programs
September 2010

1. ABET Criteria

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 and Biological Engineers, American Society of Civil Engineers,
American Society of Heating, Refrigerating and Air-Conditioning Engineers,
American Society of Mechanical Engineers, SAE International, 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. Mapping of ERE Curriculum to ABET Criteria

The program must demonstrate the graduates have

A proficiency in:

1) Mathematics through differential equations
    a. Calculus I, II, and III, and Differential Equations

2) Probability and statistics
    a. Probability and Statistics for Engineers

3) Calculus-based physics
    a. Physics I and II (with labs)

4) General chemistry
    a. Chemistry I (with lab)
    b. Chemistry II (with lab)

5) An earth science, e.g., geology, meteorology, soil science, relevant to the program of study
    a. Hydrology and Hydraulics
    b. Geotechnical Engineering

Note: These do not appear to be a good fit to this criterion.

6) A biological science, e.g., microbiology, aquatic biology, toxicology, relevant to the program of study
    a. Forest Ecology and Silviculture
    b. Ecological Engineering I

7) Fluid mechanics relevant to the program of study
    a. Fluid mechanics

8) Advanced principles and practice relevant to the program objectives
    a. 3 senior engineering design electives
    b. We should consider changing the name of these to:
        i. Advanced principles and practice
        ii. ERE Electives

An introductory level of knowledge of:

9) Environmental issues associated with air, land, and water systems and associated environmental health impacts;
    a. Solid waste management
    b. Ecological Engineering
    c. Water Pollution
    d. Engineering Design
    e. Hydrology and Hydraulics

An ability to:

10) 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
    a. Geotechnical Engineering (with lab)
    b. Hydrology and Hydraulics (with lab)
    c. Water Pollution Engineering (with lab)
    d. Remote Sensing
    e. Probability and Statistics

11) Perform engineering design by means of design experiences integrated throughout the professional component of the curriculum
    a. Planning and Design
    b. Introduction to Engineering Design
    c. Other design courses

An understanding of:

12) Concepts of professional practice and the roles and responsibilities of public institutions and private organizations pertaining to environmental engineering
    a. Planning and Design
    b. Introduction to Engineering Design
    c. Engineering Decision Analysis (add management component)
    d. Solid Waste Management

APPENDICES

Appendix A – Course Syllabi

Course syllabi are listed in order by department prefix and course number within the groupings of required, engineering electives, and earth science electives.

List of Required Courses

List of Engineering Electives

List of Earth Science Electives

APM 205 Calculus I for Science and Engineering
Nasri Abdel-Aziz

Textbooks

Hass, J.; Weir, M. D.; and Thomas, G. B. (2008). University Calculus: Elements with Early Transcendentals, First Edition. Addison Wesley.

Course Description

Calculus I is the first course in the sequence of three calculus courses for science and engineering. The focus is both on understanding mathematical concepts and techniques, and on applying this knowledge into other fields. We study limits, continuity, derivatives, anti-derivatives and their applications for algebraic, trigonometric and transcendental functions.

Prerequisite(s): Precalculus, algebra, trigonometry
Co-requisite(s): none
Course format: Four hours of lecture per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Have a basic knowledge and understanding of the analytic and geometric concepts taught, and of some of their classical applications to other sciences, such as physics.
2. Understand the nature and role of deductive reasoning in mathematics.
3. Use mathematical notation.
4. Do hand calculations accurately.
5. Follow proofs and other mathematical discourse.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary 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.

Topics Covered

1. Functions and limits, including graphing and combining functions, rates of change, tangents to curves, one sided limits, continuity, and limits involving infinity.
2. Differentiation, including derivatives at a point and as a rate of change, differentiation rules, the chain rule, implicit differentiation, related rates, and linearization.
3. Applications of the derivative, including extreme values of functions, the mean value theorem, curve sketching, applied optimization, L'Hûpital's Rule, Newton's Method, and hyperbolic functions.
4. Integration, including antiderivatives and estimating with finite sums.

Provided by: N. Abdel-Aziz
Date: 25 May 2012

APM 206 Calculus II for Science and Engineering
Nasri Abdel-Aziz

Textbooks

Hass, J.; Weir, M. D.; and Thomas, G. B. (2008). University Calculus: Elements with Early Transcendentals, First Edition. Addison Wesley.

Course Description

This course is a one semester continuation of the subject of Calculus. In this course we use integral calculus to describe growth and size. We will study techniques of integration, and their applications, as well as infinite series, power series, and differential equations.

Prerequisite(s): APM 205 (Calculus I)
Co-requisite(s): none
Course format: Four hours of lecture/discussion per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Recognize and apply appropriate techniques to evaluate definite, indefinite, and improper integrals, including calculating areas and volumes.
2. Approximate definite integrals or a functions value by appropriate numerical methods, including error estimation.
3. Use definite integrals for geometry, physics, and other applications.
4. Express functions as power series, and analyze convergence of infinite sequences and series.
5. Solve separable differential equations.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary 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.

<u>Topics Covered</u>

1. Integration, including antiderivatives, estimating with finite sums, sigma notation, limits of finite sums, definite and indefinite integrals, the substitution rule, and area between curves.
2. Techniques of integration, including integration by parts, trigonometric integrals and trigonometric substitutions, partial fractions, integration tables, and numerical integration.
3. Applications of definite integrals, including volumes by adding areas and the disk, washer, and shell methods, length of plane curves, moments, centers of mass, work, fluid forces, exponential change, and separable differential equations.
4. Infinite sequences and series, including the integral, comparison, ratio, and root tests, alternating series, absolute and conditional convergence, and power, Taylor, Maclaurin, and binomial series.
5. Polar coordinates and conics, including graphing polar coordinates, areas and lengths in polar coordinates, conics in polar coordinates, and parametric equations.

Provided by: N. Abdel-Aziz
Date: 25 May 2012

APM 307 Calculus III for Science and Engineering
Nasri Abdel-Aziz

Textbook

Hass, J.; Weir, M. D.; and Thomas, G. B. (2008). University Calculus: Elements with Early Transcendentals, First Edition. Addison Wesley.

Course Description

This is the third course in a three-semester sequence. This sequence is designed for Science and Engineering majors and for those students in other majors who intend to take advanced courses in mathematics. This course covers the concepts of vectors, vector-valued functions, functions of several variables, partial derivatives and multiple integration.

Prerequisite(s): APM 206 (Calculus II)
Co-requisite(s): none
Course format: Four hours of lecture/discussion per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Perform and apply vector operations, including dot and cross product of vectors in the plane and space. Graph and find equations of lines, planes, cylinders and quadratic surfaces.
2. Differentiate and integrate vector-valued functions. For a position vector function of time, interpret these as velocity and acceleration.
3. Evaluate limits and determine the continuity and differentiability of functions of several variables.
4. Describe graphs, level curves and level surfaces of functions of several variables.
5. Find arc length and curvature of space curves, including the use of unit tangents and unit normals; identify and interpret tangential and normal components of acceleration.
6. Find partial derivatives, directional derivatives, and gradients and use them to solve applied problems.
7. Find differentials of functions of several variables and use them to solve applied problems.
8. Find equations of tangent planes and normal lines to surfaces that are given implicitly or parametrically.
9. Use the chain rule for functions of several variables.
10. For functions of several variables, find critical points using first partials and interpret them as relative extrema/saddle points using the second partials test. Find absolute extrema on a closed region. Apply these techniques to optimization problems.
11. Use Lagrange multipliers to solve constrained optimization problems.
12. Evaluate multiple integrals in appropriate coordinate systems such as rectangular, polar, cylindrical and spherical coordinates and apply them to solve problems.
13. Use Jacobians to change variables in multiple integrals.
14. Evaluate line and surface integrals. Identify when a line integral is independent of path and use the Fundamental Theorem of Line Integrals to solve applied problems.

15. Find the curl and divergence of a vector field, the work done on an object moving in a vector field, and the flux of a field through a surface. Use these ideas to solve applied problems.
16. Introduce and use Greens Theorem, the Divergence (Gausss) Theorem and Stokes Theorem.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary 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.

Topics Covered

1. Vectors and the geometry of space, including the 3D coordinate system, dot and cross products, cylinders, quadratic surfaces, and lines and planes in space.
2. Vector valued functions and motion in space, including integrals of vector functions, arc length in space, curvature, acceleration, and velocity and acceleration in polar coordinates.
3. Partial derivatives, including limits and continuity in higher dimensions, the chain rule, directional derivatives, gradient vectors, tangent planes, extreme values and saddle points, and Lagrange multipliers.
4. Multiple integrals, including double and iterated integrals over rectangles and general regions, area by double integration, double integrals in polar form, triple integrals in rectangular, cylindrical, and spherical coordinates, moments and centers of masses, and substitution in multiple integrals.
5. Integration in vector fields, including line integrals, vector fields, work, circulation, flux, path independence, potential functions, conservative fields, Green's theorem in a plane, surface integrals, and stokes theorem.

Provided by: N. Abdel-Aziz
Date: 25 May 2012

APM 395 Probability and Statistics for Engineers
Chuck Kroll

Textbooks

Devore, J.L. (2011) Probability and Statistics for Engineering and the Sciences. Eighth Edition (Duxbury Press)

Course Description

This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses.

Prerequisite(s): One year of calculus
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Understand the need for statistical techniques in aiding with many aspects of their professional practice
2. Apply their knowledge of statistical and other mathematical techniques to better understand, interpret, and solve engineering and environmental problems
3. Analyze and interpret data as well as conceptualize the design of experiments
4. Effectively communicate highly technical information in a clear and concise manner.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [EA] an ability to apply knowledge of mathematics, science, and engineering
(b) [EA] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [RA] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Descriptive statistics including visual and numerical data presentation
2. Probability theory including Bayes Theorem, conditional probability, independence, and counting
3. Theory of discrete and continuous probability distributions, including the introduction to a variety of commonly implemented probability distributions, parameter estimation techniques, and percentile and moment estimation
4. Classical hypothesis testing and confidence interval estimation
5. Linear regression and model building

Prepared by: C.N. Kroll
Date: 7 June 2012

APM 485 Differential Equations for Engineers and Scientists
S.G. Chatterjee

Textbooks

Stroud, K.A and Booth, D. (2005). Differential Equations. Industrial Press, Inc, New York.

Course Description

First and second order ordinary differential equations, matrix algebra, eigenvalues and eigenvectors, linear systems of ordinary differential equations, numerical solution techniques and an introduction to partial differential equations.

Prerequisite(s): APM 205, APM 206, APM 307 (Calculus I, II, III)
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Succeed in later engineering courses.
2. Think logically and precisely about the solutions to problems.
3. Solve problems in subsequent engineering classes and professional practice using the mathematical techniques presented in this course.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [I] 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.

Topics Covered

1. Classification of differential equations.
2. First-order differential equations.
3. Second-order linear equations.
4. Laplace transforms.
5. Systems of linear first-order equations.
6. Numerical methods.

Provided by: S. Chatterjee
Date: 28 May 2012

CIE 337 Introduction to Geotechnical Engineering
Shobha K. Bhatia

Textbooks

Coduto, D.P. (1999). Geotechnical Engineering- Principles and Practices, Prentice Hall, Upper Saddle River, NJ.
Bardet, J. (1997). Experimental Soil Mechanics. Prentice-Hall. (*Recommended.*)
Holtz, R.D. and Kovacs, W.D. (1981). An Introduction to Geotechnical Engineering. Prentice Hall. (*Recommended.*)

Course Description

Nature and composition of soils. Formation and classification of natural soils and man-made construction materials. Compaction, permeability and seepage, consolidation and settlement, shear behavior and strength.

Prerequisite(s): Mechanics of Solids (GNE 273), ability to use a computer and working knowledge of spreadsheet program (e.g. Excel)
Co-requisite(s): none
Course format: 2.75 hours of lecture and 2.75 hours of lab per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Appreciate the interconnectivity between various elements of soil behavior, which lend themselves to solutions of practical soil problems.
2. Develop a "feel" for soil and man-made construction material behavior through laboratory experience.
3. Develop engineering judgment through a combination of theory and practice.
4. Understand sustainability principles and fundamentals of geotechnical engineering and their role in real-world geotechnical engineering design problems.
5. Produce technical reports in which information is presented clearly and concisely
6. Work in a team wherein tasks such as collecting, analyzing and reporting data are distributed evenly and every student does his/her fair share of work.
7. Prepare a joint report where each student gets an opportunity to author the report and thus take the leadership role.
8. Work with a sense of individual responsibility towards his/her partners and refrain from dubious methods such as cheating, copying, faking results, or anything that hampers the pursuit of knowledge.
9. Develop and sustain curiosity and interest, achieve learning success/ satisfaction resulting in a desire to continue learning, as emphasized by the guest speakers invited to address the role of Geotechnical engineering in current problems.
10. Develop an awareness of various ongoing projects dealing with various economic, social and environmental issues.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Soils and other Man-made Construction materials,
2. Sustainability Principles in Geotechnical Engineering
3. Engineering Geology and Soil Formation
4. Index Properties and Soil Classification
5. Construction Methods, Equipments and compaction
6. Ground Water, Flow through Soils
7. Flow Nets, Uplift Pressures and Filters
8. Geostatic Stresses
9. Compressibility of Soil and other Man-made Construction materials
10. Consolidation Process
11. Consolidation Settlement Prediction
12. Rate of Consolidation Accuracy of Settlement Prediction
13. Shear Failure in Soils
14. Shear Strength of Saturated Clays and Silts
15. Shear Strength of saturated Sands and Gravels
16. Shear Strength Measurements
17. Contemporary issues related to Geotechnical Engineering

Provided by: C. Isik
Date: 4 June 2012

EFB 101 General Biology I: Organismal Biology & Ecology
Melissa Fierke

Textbooks

Reece, J. B.; Urry, L. A.; Cain, M. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. (2011). Campbell Biology, Ninth Edition. Pearson Education, San Francisco, CA.

Course Description

This course encompasses an introductory exploration of biological principles at ecosystem, population, and organismal levels. Lectures are devoted to conceptual and general topics in biology. Emphasis is on form, function, diversity, ecology and evolution of living organisms.

Prerequisite(s): none
Co-requisite(s): EFB 102 (lab)
Course format: Three hours of lecture per week.
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

At the completion of the course, each student should be able to:

1. Describe different levels of biological hierarchy and how organisms interact with their environment (ecology).
2. Convey a basic understanding of nomenclature, classification & scientific literature of plants & animals.
3. Provide a short description of the three domains of life and dominant eukaryotic clades and phyla.
4. Convey an understanding of evolutionary relationships of various organismal groups (phylogeny).
5. Describe body forms (anatomy & morphology) of plants & animals, how they function internally (physiology), and how they respond to internal and external stimuli (behavior).

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [I] an understanding of professional and ethical responsibility

(g) [ ] an ability to communicate effectively
(h) [I] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [I] a recognition of the need for, and an ability to engage in life-long learning
(j) [I] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Themes in the study of life.
2. Animal behavior.
3. Population, community, and restoration ecology, ecosystems, and the biosphere.
4. Conservation biology and global change
5. Phylogeny and biology of bacteria, archaea, protists, fungi, animals, invertebrates, duetrosomes, and plants.
6. Plant structure, growth, development, resource acquisition, nutrition, and reproduction.
7. Animal form, function, nutrition, circulation, immune systems, osmoregulation, endocrine systems, reproduction and development, nervous systems, and sensory and motor mechanisms.

Provided by: M. Fierke
Date: 22 May 2012

EFB 102 Organismal Biology and Ecology Laboratory
Gregory G. McGee

Textbooks

McGee, G.G. (2011). Organismal Biology and Ecology Laboratory Manual.

Reece, J. B.; Urry, L. A.; Cain, M. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. (2011). Campbell Biology, Ninth Edition. Pearson Education, San Francisco, CA.

Course Description

EFB 102 (Organismal Biology and Ecology Laboratory) and EFB 101 (lecture, taught by Dr. Melissa Fierke) are co-requisite courses that are taught concurrently during the autumn semester. Together, these classes serve as the first semester introductory biology course sequence at ESF. This laboratory course is meant to complement Dr. Fierke's course in its content and sequence. However, in addition to providing hands-on learning of material taught in the lecture class, this laboratory course is also designed to develop student proficiency in scholarly scientific inquiry, laboratory and field techniques, and scientific writing.

Prerequisite(s): none
Co-requisite(s): EFB 101
Course format: Three hours of lab per week
Credits: 1

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Recognize major taxonomic groups of organisms based upon distinguishing morphological features;
2. Demonstrate proficiency in a variety of microscopy and sterile laboratory techniques;
3. Conduct information searches using library resources;
4. Develop and test hypotheses through controlled laboratory experiments and observational studies; and
5. Effectively communicate experimental findings through appropriately formatted scientific reports.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] 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 multidisciplinary teams

(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [I] an understanding of professional and ethical responsibility
(g) [I] an ability to communicate effectively
(h) [I] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [I] a recognition of the need for, and an ability to engage in life-long learning
(j) [I] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Hypothesis development and testing, lab analyses, data analysis, and report writing.
2. Microscopy and looking at bacteria, fungi, and protista.
3. Life cycles, diversity, structure, and function of viridiplantae.
4. Comparison of animal organ systems.

Provided by: G. McGee
Date: 24 May 2012

ERE 275 Ecological Engineering
Stewart Diemont

Textbooks

Mihelci, J.R., Zimmerman, J.B. 2010. Environmental Engineering: Fundamentals, Sustainability, Design. John Wiley and Sons, Hoboken, NJ

Course Description

This course will provide an overview of ecological engineering theory and practice. It will have a strong focus on sustainability and design. We will explore literature, key concepts, empirical models, and case studies of ecological engineering. This course will draw heavily from and teach biology, chemistry, mass balance, and systems theory related to ecological engineering. Students will come to understand the multidisciplinary nature of ecological and sustainable engineering

Prerequisite(s): One semester each of calculus, biology, chemistry, and ecology
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required

Course Outcomes

After completing this course the student should be able to:

1. Use ecology, biology, chemistry, and mass balance for ecological engineering
2. Draw from numerous disciplines to enhance your ecological engineering design
3. Apply consistently ecological engineering problem solving methodology
4. Choose among and use ecological engineering empirical models for ecological engineering, including for waste treatment and ecosystem restoration
5. Explain and discuss the potential role of ecological engineering in global society
6. Describe the relationship of ecological engineering tools to current problems

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [R] an ability to apply knowledge of mathematics, science, and engineering
- (b) [I] an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) [RA] 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) [RA] an ability to function on multidisciplinary teams
- (e) [I] an ability to identify, formulate, and solve engineering problems
- (f) [I] an understanding of professional and ethical responsibility
- (g) [R] an ability to communicate effectively

(h) [R] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [I] a recognition of the need for, and an ability to engage in life-long learning
(j) [I] a knowledge of contemporary issues
(k) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Natural wastewater treatment
2. Rain gardens
3. Remediation strategies
4. Sustainability evaluation
5. Waste management
6. Sustainable production
7. Ecosystem restoration
8. Water treatment
9. Air pollution management

Provided by: S. Diemont
Date: 4 Apr 2012

ERE 335 Numerical and Computing Methods
Jungho Im

Textbooks

Gilat, A and Subramaniam, V. (2010). Numerical Methods for Engineers and Scientists: An introduction with Applications using MATLAB, Second Edition, Wiley.

Course Description

This course focuses on an introduction to numerical and computing methods, commonly used in engineering. This course aims to provide a solid grounding for students on algorithm development and the techniques of solving problems by numerical and computational methods. It trains students to apply numerical methods in solving engineering problems using state-of-the-art software packages (MATLAB and EXCEL: Visual Basic for Applications) in writing computer programs and analyzing solutions of problems. The numerical methods include roots of equations, linear algebraic equations, optimization, curve fitting, and interpolation.

Prerequisite(s): Differential Equations
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

1. Students will learn how to solve engineering problems using the numerical methods.
2. They will learn how to use state-of-the-art software tools to solve the engineering problems using the numerical methods.
3. Students will work on individual projects to practice their programming skills and analytical techniques that they have obtained during the course.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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 multidisciplinary teams
(e) [EA] 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) [EA] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Data manipulation, functions, data input/output, logical functions and controls, recursion, matrix algebra, and plotting/images in MATLAB.
2. Logical functions and controls, data input/output, recursive functions, and forms in Excel: VBA.
3. Numerical methods in MATLAB and Excel: VBA, including finding roots of equations, linear algebraic equations, optimization, and curve fitting.
4. Engineering applications of MATLAB and Excel: VBA, including geospatial accuracy assessments and stream discharge calculations.

Provided by: J. Im
Date: 23 May 2012

ERE 339 Fluid Mechanics
Stephen Shaw

Textbooks

Munson, B.R., Young, D.F., and T.H. Okiishi (2005). Fundamentals of Fluid Mechanics, Sixth Edition. Wiley.

Course Description

An introduction to fluid mechanics within the context of civil and environmental engineering. This includes the standard topics of hydrostatics, Bernoulli's Equation, control volume analysis, drag, dynamic similitude, pipe flow, and open channel flow with some brief coverage of hydraulic machines and flow in porous media.

Prerequisite(s): APM 205 and GNE 172
Co-requisite(s): none
Course format: Three hours of lecture and one lab session per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Apply fundamental math and science concepts to problems involving fluids
2. Describe simple physical systems using mathematical expressions
3. Formulate and solve engineering design problems
4. Understand the theory and practice of making measurements of basic fluid phenomena
5. Design and conduct experiments to reveal fundamental behaviors of fluid systems
6. Use written and verbal communication skills to explain technical material as related to fluid phenomena
7. Recognize and qualitatively explain fluid mechanics concepts observable in everyday life

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] 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 multidisciplinary teams
- (e) [R] an ability to identify, formulate, and solve engineering problems
- (f) [] an understanding of professional and ethical responsibility
- (g) [RA] 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.

Topics Covered

1. Foundational Material: Viscosity, kinematic viscosity, surface tension, hydrophobicity, unit conversions, laminar vs. turbulent flow, super critical vs. subcritical flow, steady vs. unsteady flow, uniform vs. varied flow, velocity fields, total derivative, streamlines, boundary layers
2. Derivation and Application of Fundamentals: hydrostatics, Bernoulli's Equation, energy equation, momentum equation, conservation of mass, dynamic similitude.
3. Engineering Design: Use of hydrostatics to design dams and gates. Application of the energy equation to design pipelines. Application of Manning's Equation to design open channels. Use of pump characteristic curves to select pumps. Application of Darcy's Law to predict subsurface flow rates.
4. Broader Concepts: physics of flight, physics of baseball, physics of blood flow, physics of plant transpiration.

Provided by: S. Shaw
Date: 6 April 2012

ERE 340 Engineering Hydrology & Hydraulics
Ted Endreny

Textbooks

Wurbs, R.A. and James, W.P. 2002. Water Resources Engineering. Prentice Hall, New Jersey
Weisman, A. 1998. Gaviotas: A Village to Reinvent the World. Chelsea Green Pub.
Fundamentals of Engineering Reference Handbook, NCEES.

Course Description

Introduction to water resources engineering. Hydraulics processes include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes include watershed storage and flux, rainfall-runoff models, flood routing, and storm water design.

Prerequisite(s): ERE 133, ERE 335, ERE 339, ERE 371
Co-requisite(s): None
Course format: Three hours of lecture and three hours of laboratory and discussion per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Apply knowledge of mathematics, science, and engineering to solve water resources engineering problems and prepare water resource engineering designs;
2. Design, conduct, analyze and interpret water resources engineering experiments;
3. Function on a multi-disciplinary team, an understanding of professional and ethical responsibility, and effective communication;
4. A recognition of the need for, and be able to engage in, life-long learning;
5. Use the techniques, skills, and modern engineering tools necessary for water resources engineering practice.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] an ability to design and conduct experiments, as well as to analyze and interpret data
(c) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [I] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively

(h) [RA] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [I] a recognition of the need for, and an ability to engage in life-long learning
(j) [RA] a knowledge of contemporary issues
(k) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Watershed analysis
2. Precipitation
3. Infiltration
4. Evaporation
5. Runoff
6. Detention
7. Hydrograph routing
8. Water deliver
9. Pressurized flow in pipe networks
10. Open channel flow
11. Flow control devices
12. Flood routing
13. Groundwater flow
14. Water Resources Management

Provided by: T. Endreny
Date: 28 March 2012

ERE 351 Basic Engineering Thermodynamics
Richard Martin

Textbooks

Moran, M.J.; Shapiro, H.N.; Boettner, D.D.; Bailey, M.B., (2011). Fundamentals of Engineering Thermodynamics, Seventh Edition. Wiley, Hoboken, NY

NCEES (2011). National Council of Examiners for Engineering and Surveying Reference Handbook. Eight Edition, Second Revision, NCEES Org., Clemson, SC

Course Description

ERE 351 introduces principles of energy conservation and conversion: first and second laws. Relation to PVT behavior, property functions, equilibria and heat and mass transfer, and applications to energy and power systems. It introduces engineering problem analysis and computer methods.

Prerequisite(s): Physics, General Chemistry, Calculus
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

At the conclusion of this class, the student will be able to:

1. Demonstrate an ability to identify, formulate, and solve engineering problems.
2. Understand the impact of engineering solutions in a global, economic, environmental, and societal context, at least insofar as they relate to engineering thermodynamics.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [ ] an ability to communicate effectively
(h) [R] 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) [R] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Energy, work, heat, and first law analysis on control volumes.
2. Thermodynamic cycles, including vapor power cycles, Carnot cycle, and Otto cycle.
3. Second law analysis, including using entropy and isentropic processes in thermodynamic cycles.
4. Exergy analysis.
5. Combustion.
6. Psychrometrics.

Prepared by: Richard Martin
Date: 3 June 2012

ERE 365 Principles of Remote Sensing
Giorgos Mountrakis

Textbooks

Lillesand, Kiefer and Chipman (2008). Remote Sensing and Image Interpretation. Sixth Edition. Wiley.

Course Description

A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry.

Prerequisite(s): ERE 371
Co-requisite(s): none
Course format: Three hours of lecture and three hours of laboratory and discussion per week.
Credits: 4

Environmental Resources Engineering: Required in Program

Course Outcomes

After completing this course the student should be able to:

1. Describe the fundamental concepts of remote sensing,
2. Describe the applications of remote sensing,
3. Describe the applicability of simple remote sensing techniques,
4. Design and conduct experiments, as well as analyze and interpret remotely sensed data (e.g. aerial photography, satellite imagery).

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [ ] an ability to apply knowledge of mathematics, science, and engineering
- (b) [EA] 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 multidisciplinary 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.

Topics Covered

1. Basic principles and concepts in remote sensing
2. Commonly used terms
3. Application of Remote Sensing
4. Basic concepts in digital image processing and photogrammetry

Provided by: G. Mountrakis
Date: 28 March 2012

ERE 371 Surveying for Engineers
Lindi Quackenbush

Textbooks

Ghilani, Charles D., and Wolf, Paul R. (2008) Elementary Surveying: An Introduction to Geomatics. Twelfth Edition. Pearson Prentice Hall, Upper Saddle River, NJ.
Van Sickle, J. (2008). GPS for Land Surveyors (Third edition), CRC Press. (Recommended)

Course Description

Principles of plane surveying and position determination. Including introduction to measurement and error theory, reference surfaces, coordinate systems and datums, horizontal and vertical measurements, traverse computations, construction surveying, property surveys, foundations and applications of global positioning systems. Laboratory fieldwork and computations culminate in a topographic map.

Prerequisite(s): Calculus
Co-requisite(s): none
Course format: Three hours of lecture and three hours of lab per week
Credits: 4

Environmental Resources Engineering: Required in Program

Course Outcomes

After completing this course the student should be able to:

1. Describe, explain, and apply the principles and procedures of plane surveying;
2. Explain and demonstrate different techniques for position collection, data reduction and representation;
3. Perform field data collection as a member of a team;
4. Demonstrate ability to professionally present written and verbal communications, computations and adjustments, and graphical data.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [EA] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [I] an ability to identify, formulate, and solve engineering problems
(f) [R] an understanding of professional and ethical responsibility
(g) [EA] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Present the principles behind measurement science and the analysis and treatment of measurement error.
2. Discuss the theory and demonstrate the practical means to make horizontal and vertical measurements (including angles and directions).
3. Explain different reference surfaces and geo-referencing systems used to represent spatial data.
4. Discuss the theory of and provide an instruction in the practical implementation of GPS as a means to determine position.
5. Explain the application of traverses and the procedures used to perform traverse computations.
6. Explore the use of coordinate computations in performing coordinate geometry and area calculations.
7. Explain the application of surveying in construction including horizontal circular curves, vertical curves and earthwork.
8. Overview surveying for cadastral applications

Prepared by: L. Quackenbush
Date: 8 June 2012

ERE 430 Engineering Decision Analysis
Douglas Daley

Textbooks

D.G. Newnan, Eschenbach, T.G., and LaVelle, J. (2012). Engineering Economic Analysis, 11th ed., Oxford University Press.

Course Description

Classical engineering economics: time value of money, nominal and effective interest, and present worth, annual worth, rate of return, and benefit-cost ratio comparison techniques. Identification and evaluation of alternative investment and borrowing decisions, including the role of inflation, depreciation, taxes and uncertainty. Investment theory including the potential risks and rewards associated with investments options. Simulation and optimization techniques to aid in management decisions.

Prerequisite(s):
Co-requisite(s):
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in Program

Course Outcomes

After completing this course the student should be able to:

1. Explain concepts, principles and procedures of engineering decision analysis
2. Identify, select and use appropriate methods to make economic decisions on engineering projects
3. Evaluate and compare alternative proposals and using common comparative economic techniques
4. Understand how inflation, depreciation, taxes and uncertainty can affect engineering decisions
5. Use spreadsheets for economic analysis of engineering decisions (computation, modeling, graphing)

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [EA] an understanding of professional and ethical responsibility

(g) [R] 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) [R] a recognition of the need for, and an ability to engage in life-long learning
(j) [ ] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Decision making
2. Accounting
3. Cash flow, Equivalence and Interest
4. Annual cash flow analysis
5. ROR Analysis
6. Choosing the best alternative
7. Analysis Techniques
8. Uncertainty
9. Depreciation
10. Income Taxes
11. Inflation
12. Engineering Ethics

Provided by: D. Daley
Date: 30 April 2012

ERE 440 Water Pollution Engineering
Wendong Tao

Textbooks

Metcalf & Eddy, Inc. 2003. Wastewater Engineering – Treatment and Reuse, 4th edition. McGraw-Hill.

ERE 440/643 Course Reader: ESF Copy Center.

Course Description

Introduction to physical, chemical and biological parameters of water and wastewater quality as well as principles of unit operations and processes for water and wastewater treatment. Study of the design parameters and design procedures for wastewater treatment and reuse.

Prerequisite(s): FCH 152 General Chemistry II and EFB 101 General Biology I
Co-requisite(s): APM 485 Differential Equations
Course format: Three hours of lecture per week.
Credits: 3

Environmental Resources Engineering: Required in Program

Course Outcomes

After completing this course the student should be able to:

1. Recognize the importance of water pollution engineering in achieving societal goals for both public and environmental health
2. Characterize wastewater in terms of flow rate and constituents
3. Be familiar with the common unit treatment operations and processes
4. Apply mass balance analysis and reaction kinetics and expression to typical reactor configurations, solve under steady state, and apply to process analysis
5. Prepare a preliminary design for unit processes and operations

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [R] 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 multidisciplinary teams
(e) [EA] 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) [EA] a knowledge of contemporary issues
(k) [EA] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Introduction to wastewater management
2. Review of applied chemistry and characterization of water wastewater quality
3. Wastewater flow analysis
4. Overview of unit treatment operations and processes
5. Mass balance analysis and reactor design/analysis
6. Design of settling tanks

Provided by: W. Tao
Date: 24 April 2012

ERE 468 Solid Waste Management
Doug Daley

Textbooks

Daley, D.J. (2011). Course Reader for ERE 468. ISBN 9781121278356. McGraw Hill Create.

Course Description

Introduction to solid waste regulations, social, economic, environmental and technical factors. Design of solid waste management systems, including collection, recycling, composting, energy recovery, land disposal, leachate treatment, and stormwater control.

Prerequisite(s): Chemistry, biology, soil science, engineering hydrology
Co-requisite(s): none
Course format: Three hours of lecture/discussion per week
Credits: 3

Environmental Resources Engineering: Required in Program

Course Outcomes

After completing this course the student should be able to:

1. Understand the historical context of solid waste management in the United States.
2. Describe and discuss contemporary solid waste management issues of modern society.
3. Cite and describe relevant solid waste laws and regulations, including but not limited to RCRA, CERCLA, and 6NYCRR Part 360.
4. Describe physical, biological, chemical, hydrologic and geological factors that influence the design and implementation of solid waste management practices.
5. Describe and discuss technical, regulatory, economic, environmental and social criteria that affect the design, operation and closure of solid waste management facilities.
6. Perform fundamental engineering computations and use accepted engineering principles and practices to analyze and design components of solid waste management systems for collection, transfer, processing, volume reduction, and disposal.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [R] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [R] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [E] 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) [EA] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Systematic strategies to manage the generation, recycling, collection, treatment and disposal of solid waste.
2. Characteristics of solid waste.
3. Public agency solid waste regulations (RCRA, CERCLA and 6NYCRR Part 360 and SEQRA).
4. Physical, chemical, geological and biological considerations in designing solid waste management systems.
5. Economic, social and sustainability assessment of solid waste facilities.
6. Engineering design of systems or processes to reduce, recycle, collect, treat and dispose of solid waste (including examples from resource recovery, recycling, composting, thermal treatment, and land disposal).
7. Engineering design of support systems, including stormwater and leachate management, air and groundwater protection, collection routing, and energy (methane) recovery.
8. Site selection criteria, including soils, air and water.
9. Environmental monitoring.

Provided by: D. Daley
Date: 30 April 2012

ERE 489 Environmental Resources Engineering Planning and Design
Douglas Daley

Textbooks
No required text.

Course Description
A capstone course to integrate engineering coursework with the engineering design process to solve interdisciplinary environmental problems. Semester-long project provides experience in problem analysis, teamwork, project management, engineering ethics, professional communication and related aspects.

Prerequisite(s): Senior standing in ERE, ERE 340 and ERE 365
Co-requisite(s): none
Course format: Three hours of lecture and three hours of laboratory per week
Credits: 4

Environmental Resources Engineering: Required in Program

Course Outcomes
After completing this course the student should be able to:
1. Design a system, product or process that meets specified requirements within applied constraints
2. Use project management tools, techniques and skills, such as scheduling, resource allocation, and cost estimating.
3. Communicate effectively using oral and written formats such as memos, letters, technical design reports, drawings, posters and public presentation
4. Function effectively as a member of a multidisciplinary engineering design team
5. Understand the professional, legal and ethical responsibilities of engineers

Relation to Program Outcomes (Environmental Resources Engineering)
(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)
- (a) [E] 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) [EA] 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) [EA] an ability to function on multidisciplinary teams
- (e) [ ] an ability to identify, formulate, and solve engineering problems
- (f) [R] an understanding of professional and ethical responsibility
- (g) [EA] an ability to communicate effectively
- (h) [R] 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) [R] a knowledge of contemporary issues

(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Engineering design drawing upon knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints that include some or all of the following: economic; environmental; sustainability; constructability; manufacturability; ethical; health; safety; social; regulatory; and political.
2. Problem-solving skills teamwork, critical thinking, evaluation and assessment to develop skills for lifelong learning.
3. Systematic application of engineering design and project management skills to solve complex, environmentally-related problems.

Provided by: D. Daley
Date: 30 April 2012

FCH 150 General Chemistry I
Kelley J. Donaghy

Textbooks

Silberberg, M. (2007) Principles of General Chemistry, First Edition. McGraw-Hill, (suggested).

Course Description

General Chemistry I is the first half of an introductory course in the study of chemistry; the central science. Chemistry is the study of what materials and substances are made of and how they interact with each other and their environment. In this course we will begin to understand matter by studying the building blocks of atoms and molecules and end our discussions by looking at how elemental make-up, size, shape and specific properties influence the behaviors of the phases of matter.

Prerequisite(s): APM 104 (college algebra/precalculus)
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Use fundamental chemical concepts and principles.
2. Use and appreciate the scientific method.
3. Use problem solving and analytical skills.
4. Be able to perform scientific study.
5. Have developed critical thinking skills

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] 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 multidisciplinary 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) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Atomic theory, quantum chemistry, and periodic trends.
2. Light
3. Bonding, VSEPR, valence bond theory, and intermolecular forces.
4. The mole
5. Stoichiometry and solution stoichiometry.
6. Thermochemistry
7. Gases

Provided by: K. Donaghey
Date: 24 May 2012

FCH 151 General Chemistry I Laboratory
Neal M. Abrams

Textbooks

Instructor-authored lab manual

Course Description

In lecture, you will learn about the theories and principles of chemistry, but sometimes it is too easy to forget about the "real world". The laboratory experiments chosen for this course have been specifically designed and placed into this course so that they enhance learning and deepen the understanding of concepts presented in lecture. Wherever possible, experiments have been chosen that exemplify how chemists learn about the world around them through measurement, analysis, and observation.

Prerequisite(s): none
Co-requisite(s): FCH 150
Course format: Three hours of lab per week
Credits: 1

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Relate chemical theories and principles to real world experiments and processes.
2. Formulate and test hypotheses and recognize the importance of accuracy, precision and repeatability in such experimentation.
3. Produce and analyze data, interpret the information, and effectively communicate the results of analysis.
4. Demonstrate useful laboratory skills and use these skills in accordance with laboratory safety procedures.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [I] 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) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Chemistry laboratory techniques including filtration, balance use, spectroscopy, separation, and titration
2. Chemical lab safety
3. Physical measurements
4. Color/light theory
5. Atomic emission
6. Precipitation/solubility
7. Stoichiometry and synthesis
8. Gas laws
9. Thermochemistry
10. Quantitative analysis

Prepared by: N. Abrams
Date: 11 June 2012

FCH 152 General Chemistry II
Kelley J. Donaghy

Textbooks

Silberberg, M. (2007) Principles of General Chemistry, First Edition. McGraw-Hill.

Course Description

General Chemistry II is the second half of an introductory course in the study of chemistry; the central science. Chemistry is the study of what materials and substances are made of and how they interact with each other and their environment. In this course we will look deeper into the more physical aspects of chemistry including, equilibrium, kinetics and thermodynamics.

Prerequisite(s): FCH 150, APM 104 (college algebra/precalculus)
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Use fundamental chemical concepts and principles.
2. Use and appreciate the scientific method.
3. Use problem solving and analytical skills.
4. Be able to perform scientific study.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [I] 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 multidisciplinary 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) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Organic chemistry and polymers.
2. Reaction kinetics and equilibrium, including acid/base equilibrium, buffers and titrations, and ionic equilibrium.
3. Introduction to thermodynamics.
4. Introduction to electrochemistry.

Provided by: K. Donaghy
Date: 24 May 2012

FCH 153 General Chemistry II Laboratory
Neal M. Abrams

Textbooks

Instructor-authored lab manual

Course Description

The FCH153 lab course builds on many of the techniques and procedures you learned in the first semester FCH151 course. Fewer procedural details will be given in these labs as there is an increased emphasis on more independent work. You will be asked to develop experimental procedures to solve a problem or answer a question and gather corresponding data. Labs will also become increasingly more quantitative as you will use concepts from kinetics, equilibrium, and chemical reactions to solve problems.

Prerequisite(s): none
Co-requisite(s): FCH 152
Course format: Three hours of lab per week
Credits: 1

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Develop experimental procedures to solve a problem or answer a question and gather corresponding data
2. Formulate and test hypotheses and recognize the importance of accuracy, precision and repeatability in such experimentation.
3. Produce and analyze data, interpret the information, and effectively communicate the results of analysis.
4. Demonstrate useful laboratory skills and use these skills in accordance with laboratory safety procedures.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [I] 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) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Chemistry laboratory techniques including filtration, balance use, spectroscopy, separation, and titration
2. Chemical lab safety
3. Colligative properties
4. Intermolecular forces
5. Organic chemistry
6. Kinetics
7. Equilibrium
8. Acids-bases/buffers/titrations
9. Coordination chemistry
10. Thermodynamics

Prepared by: N. Abrams
Date: 11 June 2012

GNE 172 Statics and Dynamics
Rafaat M. Morsi-Hussein

Textbooks

Hibbeler, R. (2009), Engineering Mechanics Statics and Dynamics (12th Edition), Prentice Hall.

Course Description

GNE 172 covers the fundamental concepts of particles and rigid bodies at rest and in motion. The statics component covers general principles; equilibrium; force systems; internal forces; properties of areas. The dynamics component is divided into two parts: kinematics and kinetics. The kinematics part covers the displacements, velocities and accelerations, relative and dependent motions. The kinetics part covers Newton's laws, energy principles, Impulse and momentum.

Prerequisite(s): Algebra, derivative and integral calculus
Co-requisite(s): none
Course format: Four hours of lecture per week
Credits: 4

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Relate fundamentals of engineering mechanics to statics and dynamics problems.
2. Analyze relevant mechanics problems.
3. Apply the learned fundamentals to selected real world problems.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [R] 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 multidisciplinary teams
- (e) [I] 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.

Topics Covered

1. General principles of statics, equilibrium, force systems, internal forces, and properties of areas.
2. Kinematics, including displacement, velocities and acceleration, relative and dependent motions.
3. Kinetics, including Newton's laws, energy principles, impulse and momentum.

Provided by: R. Morsi-Hussein
Date: 23 May 2012

GNE 273 Mechanics of Materials
Rafaat M. Morsi-Hussein

Textbooks

Hibbeler, R., (2010), Mechanics of Materials, (8th Edition), Prentice Hall.

Course Description

GNE 273 covers the fundamental concepts of mechanics of deformable bodies. The concepts of strains and stresses, the characteristics of stress-strain relationships, and some mechanical properties of common engineering materials are introduced. The course presents in detail normal and shear strains and stresses in various components under different loads; including shaft, beams and rods. Various modes of local and overall instability are also covered including buckling. Methods to solve indeterminate problems are offered. Other aspects of GNE 273 include stress transformation and structural analysis of engineering systems.

Prerequisite(s): Integral calculus, statics
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Relate fundamentals of mechanics of materials and deformable bodies to engineering problems.
2. Model, analyze and correctly solve relevant mechanics problems.
3. Perform engineering tasks including selection of materials, design engineered products, and experimental stress analysis.
4. Apply some parts of national design codes such as AISC and NDS.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [R] 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) [I] 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 multidisciplinary teams
- (e) [I] 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.

Topics Covered

1. Stresses and strains and characteristics of stress-strain relationships.
2. Mechanical properties of common engineering materials.
3. Normal and shear strains and stresses in various components under different loads, including shaft, beams, and rods.
4. Various modes of local and overall instability, including buckling.
5. Methods to solve indeterminate problems.
6. Stress transformation.
7. Structural analysis of engineering systems.

Provided by: R. Morsi-Hussein
Date: 23 May 2012

FOR 321 Forest Ecology and Silviculture
Christopher A. Nowak

Textbooks

None.

Course Description

Survey of forest tree and stand ecology (silvics) and silviculture concepts, applications and implications for treatment of forest stands for various values. Experiential learning emphasized through a strong field component of assessing vegetation, site quality and land use history variables, and treatment alternatives to create different forest conditions. The purpose of this course is to introduce students to the complexity of sustainably managing natural, terrestrial systems by experiencing the depth, detail and organization of skills and knowledge needed to make efficient and effective management decisions using an environmental management system approach, featuring the silvicultural system, but including integrated vegetation management.

Prerequisite(s): EFB 101
Co-requisite(s): none
Course format: One hour of classroom lecture and 3 hours of field lecture/lab per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Identify, measure, and classify trees and other select plants (ferns, forbs and shrubs) commonly found in across Central New York.
2. Describe and explain common ways that trees and select other plants develop and interact.
3. Assess, describe and explain site quality and soil-site relations.
4. Identify, measure, and classify plant communities.
5. Describe and explain how plant communities change across time and space.
6. Define common environmental factors that influence plant species and communities.
7. Identify common natural and anthropogenic disturbances in terrestrial plant communities of upstate New York.
8. Measure, calculate, and graphically display relative stand density, stand stocking (over- and understory), stand structure, and species composition.
9. Define, describe and explain artificial and natural regeneration.
10. Define, describe and explain the mechanics and concepts of different management systems (silvicultural, IVM, EMS).
11. Identify forest conditions associated with silvicultural activity vs. Non-sustainable ways of using the forest (e.g., high-grading).
12. Define, describe and explain tending or maintenance treatments in silviculture and vegetation management.

13. Define, describe and explain regeneration or replacement / renewal methods in silviculture (variants of clearcut, seed tree, shelterwood, single-tree selection and group selection), including site preparation treatments, and vegetation management.
14. Predict general effects of management interventions in central New York plant communities.
15. Explain the role of timber harvesting, herbicide application, and other ways of disturbing and changing plant communities, and generally describe their effects on wood production, water, wildlife, and aesthetics.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [I] an understanding of professional and ethical responsibility
(g) [ ] an ability to communicate effectively
(h) [I] 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) [I] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Understanding tree species and other select plants as ecological units.
2. Understanding forest and other terrestrial plant communities as ecological units.
3. Understanding environmental factors and their influence on plant species and communities, with a focus on trees, but including other terrestrial plant communities.
4. Understanding and predicting effects of forest and other terrestrial community manipulations via silviculture and vegetation management.

Provided by: C. Nowak
Date: 25 May 2012

PHY 211 General Physics I
Tomasz Skwarnicki

Textbooks

Young, H.D.; Freedman, R.A.; and Ford, A.L. (2011). University Physics with Modern Physics, 13th Edition (Vol. 1). Addison Wesley.

Course Description

This course is primarily about motions of objects and forces, which underlie these motions. Some particular examples of the motions you will study include "free fall", collisions between objects (such as cars), rolling and spinning. The theory that describes the above phenomena was developed by Isaac Newton in the 17th century and is called "classical mechanics". Historically, this theory gave a foundation for development of all modern physics. Therefore, this course is an introduction to physics in general. Physics in turn provides a foundation for most other natural sciences and engineering.

Prerequisite(s): Working knowledge of high school level algebra
Co-requisite(s): PHY 211 (lab), MAT 285 or MAT 295 (Calculus I)
Course format: Three hours of lecture and two hours of recitation per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Understand basic concepts of classical physics, particularly Newtonian description of motion.
2. Solve problems in which physics laws and mathematics are combined to deduce new information about the physical system from the set of initial data.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] 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 multidisciplinary teams
(e) [I] 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.

Topics Covered

1. Particle motion, including velocity and acceleration vectors, projectile motion, and relative motion.
2. Newton's laws' concepts and applications, including forces, friction, circular motion, work, power, and energy.
3. Introduction to statics and dynamics, including impulse and momentum, collisions, center of mass, rotation, moment of inertia, rolling, and static equilibrium.
4. Introduction to wave motion and sound waves.

Provided by: T. Skwarnicki
Date: 11 June 2012

PHY 212 General Physics II: Electricity, Magnetism, and Light
Matt LaHaye

Textbooks

Young, H.D.; Freedman, R.A.; and Ford, A.L. (2011). University Physics with Modern Physics, 13th Edition (Vol. 2). Addison Wesley.

Course Description

This course is the second half of a two semester introduction to classical physics including electricity, magnetism and light. During the semester you will explore the nature of electric charge. You will learn some of the basic rules and concepts that we use to describe the behavior of charge and account for a wide range of electric and magnetic phenomena. From these studies, you will develop a solid foundation from which to begin to understand the electromagnetic world in which we live.

Prerequisite(s): PHY 211/221 (General Physics I), Calculus I
Co-requisite(s): PHY 222 (lab), Calculus II
Course format: Three hours of lecture and two hours of recitation per week
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

After completing this course the student should be able to:

1. Describe the laws of electromagnetism
2. Apply these laws, both qualitatively and quantitatively, in familiar and unfamiliar physical situations
3. Appreciate the essential role that electromagnetism plays both in our modern society and in the natural world at large.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [I] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary 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.

<u>Topics Covered</u>

1. Electric charges, forces, and fields. Gauss's Law.
2. Electric circuits and their potential, capacitance, resistance, and current.
3. Magnetic fields and forces and their sources.
4. Induction and Faraday's Law.
5. Electromagnetic waves.

Prepared by: K. Metz
Date: 23 May 2012

PHY 221 General Physics Laboratory I
Samuel Sampere

Textbooks

None.

Course Description

This course provides hands on intuition about general physics covered in the PHY211 lecture course while developing practical laboratory skills. Techniques of laboratory work include treatment of random errors and graphical representation of data. Experimental demonstration of principles of mechanics, thermodynamics, and waves (of vector forces, conservation of momentum and energy, thermal properties of gases).

Prerequisite(s): none
Co-requisite(s): PHY 211 (lecture)
Course format: Two hours of lab per week
Credits: 1

Environmental Resources Engineering: Required in program

Course Outcomes

Not provided by Physics Department

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [ ] an ability to apply knowledge of mathematics, science, and engineering
- (b) [R] 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 multidisciplinary 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.

Topics Covered

1. Particle motion, including position, displacement, velocity and acceleration vectors in 1-D and 2-D.
2. Newton's 2nd and 3rd laws, diverse forces, springs, and friction.

3. Work and energy, harmonic oscillation, and conservation of energy.
4. Rotational motion and torque.
5. Momentum and collisions, including conservation of kinetic energy and momentum.

Prepared by: K. Metz
Date: 23 May 2012

PHY 222 General Physics Laboratory II
Samuel Sampere

Textbooks

None.

Course Description

This course provides hands on intuition about general physics covered in the PHY212 lecture course. This involves experimental study of principles of electromagnetism and their application in electrical circuits. Activities include use of electronic instruments, such as the oscilloscope.

Prerequisite(s): none
Co-requisite(s): PHY 212 (lecture)
Course format: Two hours of lab per week
Credits: 1

Environmental Resources Engineering: Required in program

Course Outcomes

Not provided by Physics Department

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [ ] an ability to apply knowledge of mathematics, science, and engineering
- (b) [R] 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 multidisciplinary 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.

Topics Covered

1. Electric charges, electrical potential and electrostatic fields.
2. Waves and the interference and diffraction of light.
3. Ohm's Law and DC circuits.
4. Magnetic fields and the motion of electrons in electric and magnetic fields.
5. Ampere's and Faraday's Laws.

Prepared by: K. Metz
Date: 23 May 2012

CIE 331 Analysis of Structures and Materials
Eric M. Lui

Textbooks

Kassimali, A. (2010) Structural Analysis, 4th edition, Cengage Learning, Stamford, CT.

Course Description

Analysis of statically determinate and indeterminate trusses, beams and frames by traditional and computer-based methods. Physical, mechanical and thermal properties of conventional and environmental friendly construction materials.

Prerequisite(s): Mechanics of Materials (ECS 325/GNE 273), Calculus I and II (MAT 295, MAT 296 or APM 205, APM 206), ability to use computers and working knowledge of spreadsheet program (e.g. EXCEL)
Co-requisite(s): none
Course format: 2.75 hours of lecture and one hour or recitation/lab per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

At the completion of the course, each student should be able to:

1. Determine whether a structure is stable, unstable, statically determinate or statically indeterminate.
2. Construct free body diagrams and calculate reactions and internal forces for statically determinate structures using simple equilibrium equations.
3. Use the method of joints and method of sections for truss analysis.
4. Use the slope-deflection and moment distribution methods for beam analysis.
5. Use the slope-deflection method for frame analysis.
6. Use the virtual work method to compute displacements
7. Understand the concepts of superposition and compatibility.
8. Draw shear and bending moment diagrams.
9. Construct influence lines and understand their importance.
10. Use influence lines to determine the worst loading condition for purpose of design.
11. Calculate the maximum axial force in trusses, and the maximum shear and moment in beams for a given set of moving loads.
12. Understand the meaning of joints, elements and degrees-of-freedom.
13. Develop a structural model for computer-aided analysis.
14. Use a structural analysis software to perform structural analysis.
15. Determine and prepare the necessary input data for computer analysis.
16. Interpret the meaning of the computer results.
17. Verify the validity of the computer solution.
18. Understand the physical, mechanical and thermal properties of some commonly used construction materials such as concrete, steel, wood, and other novel materials such as structural plastics and fiber-reinforced polymers (FRP).
19. Select the right material(s) for use in a given project.

20. Appreciate the environmental impact associated with the use of a construction material.
21. Understand the issue of sustainability in construction.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] an ability to apply knowledge of mathematics, science, and engineering
- (b) [R] 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 multidisciplinary teams
- (e) [R] an ability to identify, formulate, and solve engineering problems
- (f) [ ] an understanding of professional and ethical responsibility
- (g) [R] an ability to communicate effectively
- (h) [R] 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) [R] a knowledge of contemporary issues
- (k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Loads on Structures, Statics Review
2. Geometrical Instability, Statical Determinacy and Indeterminacy
3. Plane and Space Truss Analysis, Shear and Bending Moment for Beams and Frames
4. Beam Deflection by Direct Integration and Superposition
5. Virtual Work Method applied to Trusses, Beams and Frames
6. Influence Lines – Quantitative and Qualitative Methods, Applications
7. Analysis of Statically Indeterminate Structures by Method of Consistent Displacements,
8. Slope Deflection Method and Moment Distribution
9. Sustainability, Green Buildings, LEED Standards and Certification
10. Construction Materials – Concrete, Steel, Wood and Structural Plastics

Provided by: C. Isik
Date: 4 June 2012

CIE 332 Design of Concrete Structures
Riyad Aboutaha

Textbooks

Wight, J. and MacGregor, J. (2008). Reinforced Concrete – Mechanics and Design, Fifth Edition. Prentice Hall.

American Concrete Institute (1999). Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary. Farmington Hills, Michigan.

Course Description

Analysis and design of environmentally reinforced concrete structures subjected to flexural, shear, and axial loads. Analysis of stresses and deformations and their relation to codes and specifications.

Prerequisite(s): none
Co-requisite(s): Analysis of Structure and Materials (CIE 331)
Course format: 2.67 hours of lecture and 80 minutes of lab/recitation per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

At the completion of the course, each student should be able to:

1. Understand role of building codes, public safety, and structural safety.
2. Calculate internal forces in structures due to external loads.
3. Analyze concrete sections using simple constitutive laws, compatibility and equilibrium equations.
4. Analyze concrete members and identify critical sections.
5. Determine the dimensions of concrete section, and the amount of flexural reinforcement (beams and one-way slab system).
6. Determine the amount of shrinkage and temperature reinforcement in a one-way slab system.
7. Examine if concrete sections and members meet the code requirements.
8. Understand the impact of various flexural design parameters.
9. Analyze and design concrete members in shear, determine the amount of shear reinforcement.
10. Examine if a concrete sections and members meet the code requirements.
11. Understand the impact of various shear design parameters
12. Analyze a concrete flexural member under service loads.
13. Determine the stresses in concrete and steel under service loads.
14. Calculate deformations in flexural member and examine code compliance.
15. Analysis and design of short concrete columns
16. Construction of the full P-M diagram for columns using computer software.
17. Detail concrete sections, members, and structures.
18. Calculate the development length of rebars, cut-off locations, and lap splicing.
19. Construct, analyze, and test a full-scale reinforced concrete beam.

20. Conduct non-destructive tests on fresh concrete.
21. Analyze and design a concrete structures subjected to various loads.
22. Work on a design team.
23. Prepare and present a design project

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] an ability to apply knowledge of mathematics, science, and engineering
- (b) [R] an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) [R] 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) [R] an ability to function on multidisciplinary teams
- (e) [R] an ability to identify, formulate, and solve engineering problems
- (f) [R] an understanding of professional and ethical responsibility
- (g) [R] an ability to communicate effectively
- (h) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Development, Design Process, ACI Building Code.
2. Types of Concrete, Concrete Properties, Reinforcing Bars.
3. Flexural Strength of Beams - Analysis and Design
4. Shear Strength of Beams and Beam-Columns
5. Development, Splicing and Anchorage of Reinforcing Bars
6. Serviceability - Deflection and Cracking
7. Continuous Beams and One-Way Slabs
8. Columns and Beam-Columns (Combined Axial Load and Bending)
9. Introduction to the Design of GFRP Reinforced Concrete Structures

Provided by: C. Isik
Date: 4 June 2012

CIE 338 Foundation Engineering
Dawit Negussey

Textbooks

Coduto, D.P. (2001). Foundation Design. Prentice Hall.
Coduto, D.P. (2010). Geotechnical Engineering: Principles and Practice. Prentice Hall.

Course Description

Site investigation, bearing capacity, design of shallow and deep foundations, lateral earth pressure and design of retaining structures, slope stability analysis and design, introduction to geotechnical CAD.

Prerequisite(s): none
Co-requisite(s): CIE 337, familiarity with MathCad
Course format: 2.67 hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

After completing this course the student should be able to:

1. Use field investigation results to
   a. Classify soil types
   b. Determine design parameters
   c. Develop representative design sections
2. Establish ASD/LRFD design loads
   a. Determine shallow foundation bearing pressures
   b. Calculate bearing capacities of footings
   c. Design shallow foundations
3. Identify deep foundation types and design
   a. Estimate pile capacities from in situ tests, load tests, soil strengths, driving energies.
   b. Assess the structural capacities of piles
   c. Evaluate pile group efficiencies and capacities
4. Understand earth pressure theories
   a. Estimate lateral earth pressure coefficients
   b. Calculate active, at rest and passive earth pressures
   c. Proportion, analyze and design cantilever walls
5. Recognize different modes of slope instabilities
   a. Perform block mode failure analyses
   b. Evaluate safety factors for simple circular failures
   c. Use a computer program for limit equilibrium analyses and design of slopes

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering

(b) [R] an ability to design and conduct experiments, as well as to analyze and interpret data
(c) [R] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [R] an understanding of professional and ethical responsibility
(g) [R] 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) [R] a recognition of the need for, and an ability to engage in life-long learning
(j) [ ] a knowledge of contemporary issues
(k) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Introduction to foundations
2. Review MathCad and soil properties
3. Design loads by ASD and LRFD
4. Settlements and serviceability criteria
5. Site investigation and in situ testing
6. Shallow foundation bearing pressures and bearing capacity
7. Effective stress profiles, induced stress increments and settlements
8. Design of shallow foundations
9. Deep foundations, pile types and shafts
10. Structural capacity of piles and shafts
11. Pile capacities by load tests, in situ tests, soil strengths and from driving records
12. Lateral earth pressures and design of retaining walls
13. Stability analysis and design of slopes

Provided by: C. Isik
Date: 4 June 2012

CIE 443 Transportation Engineering
Dawit Negussey

Textbooks

Garber, N. and Hoel, L (2009). Traffic and Highway Engineering, 4th Edition. Brooks/Cole.

Course Description

Transportation systems, modes and significance. Traffic engineering fundamental relationships and field studies. Intersection design and control. Geometric design of road alignments. Introduction to transportation planning.

Prerequisite(s): none
Co-requisite(s): MAT 296, PHY 211, CIE 272, use of MathCad
Course format: 2.67 hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Gain a broad understanding of transportation engineering
    a. Transportation systems and organizations
    b. Driver, vehicle, pedestrian and road characteristics.
    c. Contemporary issues and developments.
2. Develop an ability to assess and improve road traffic
    a. Conduct traffic engineering studies
    b. Design and control of intersections
    c. Evaluate highway capacity and level of service
3. Understand transportation planning
    a. Transportation planning process.
    b. Sustainability considerations
    c. Evaluation of alternatives.
4. Design highway alignments
    a. Classification of highways and design standards
    b. Criteria for and design of vertical alignments
    c. Criteria for and design of horizontal alignments

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] an ability to design and conduct experiments, as well as to analyze and interpret data

(c) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [R] 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) [R] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Introduction to transportation modes and fieldwork
2. Drivers and pedestrians
3. Vehicles, speeds and volume studies
4. Delays and parking
5. Traffic flow and density
6. Traffic modeling
7. Shockwaves, gaps and queues
8. Intersection control and timing
9. Capacity and LOS of highways
10. Capacity and LOS of intersections
11. Planning process and evaluation of alternatives
12. Sustainability and environment considerations
13. Geometric design standards
14. Design of vertical and horizontal alignments
15. Transitions and super elevations

Provided by: C. Isik
Date: 4 June 2012

CIE 473 Transport Processes in Environmental Engineering
Emmett M. Owens

Textbooks

Hemond, H.F. and Fechner-Levy, E.J. (2006). Chemical Fate and Transport in the Environment, Second Edition. Academic Press,

Course Description

This is a survey course covering the general area of pollutant transport and fate in the major portions of the natural environment, these being surface water bodies, subsurface water (in soil and rock), and the atmosphere. The emphasis is on physical transport processes, but chemical and biological processes are covered as well. Coverage of these processes is both descriptive and mathematical. The various processes that exist in common problems are synthesized into simple mathematical approaches that allow calculation of pollutant concentrations under various conditions.

Prerequisite(s): undergraduate courses in calculus, environmental engineering/science, chemistry, or fluid mechanics are helpful but not required.
Co-requisite(s): none
Course format: Three hours of lecture per week.
Credits: 3

Environmental Resources Engineering: Required in program

Course Outcomes

Not provided by Instructor

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] 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 multidisciplinary teams
- (e) [E] an ability to identify, formulate, and solve engineering problems
- (f) [ ] an understanding of professional and ethical responsibility
- (g) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Introduction, math review, fluid mechanics review, chemistry review
2. Surface Waters
3. The Subsurface Environment
4. The Atmosphere

Provided by: E. Owens
Date: 4 June 2012

ERE 311 Ecological Engineering in the Tropics
Ted Endreny

Textbooks

Mitsch, W. J. and S. E. Jorgensen (2004) Ecological Engineering & Ecosystem Restoration. Wiley Publishing.

Weisman, A. (1998) Gaviotas: A Village to Reinvent the World. Chelsea Green Publishing.

Course Description

Overview of ecological engineering theory and practice. Key concepts, empirical models, and case studies of ecological engineering. Living machines, treatment wetlands, bioremediation, municipal composting, agroforestry, traditional ecological knowledge, emergy analysis, and ecosystem restoration.

Prerequisite(s): one semester each of calculus, biology, chemistry, and ecology
Co-requisite(s): none
Course format: Two hours of lecture and three hours of group discussion per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Generate designs for watersheds that illustrate the governing principles of ecological engineering,
2. Present designs to the class using appropriate communication skills, responded to pertinent questions, and incorporated group supported suggestions in at least 1 design,
3. Investigate sites through exploration and appropriate questions of authorities to identify and rank development and design constraints or creating a sustainable future in the visited sites,
4. Write a short final report that addresses the science, engineering, and cultural features of the watershed management opportunities for visited sites,
5. Summarize growth of his/her awareness as it relates to professional opportunities in tropical countries, based on regularly recorded journal entries from the field trip.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] 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) [E] 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 multidisciplinary teams
- (e) [R] an ability to identify, formulate, and solve engineering problems

(f) [ ] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [E] 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) [R] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Ecological Engineering in the Tropics
2. Ecosystem Restoration
3. Theories and Paradigms of Ecological Engineering
4. Ecosystem Processes and Services
5. Ecological and Engineering Design Principles
6. Stream and River Restoration
7. Wetland Restoration
8. Coastal Restoration

Prepared by: T. Endreny
Date: 8 June 2012

ERE 405 Sustainable Engineering
Stewart Diemont

Textbooks

Allenby, Braden R. 2012. The Theory and Practice of Sustainable Engineering, Prentice Hall

Course Description

Introduction to sustainability metrics, such as emergy evaluation and life cycle assessment. Explore and evaluate potential solutions to societal and environmental problems in a changing world that is facing climate change, premium fuel depletion, and regional water shortages. Evaluation of system sustainability using a multidisciplinary framework.

Prerequisite(s): ERE 275 and upper division standing or permission of instructor
Co-requisite(s): none
Course format: Two hours of lecture and three hours of group discussion per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Develop a working knowledge of sustainability analysis tools
2. Use a sustainability analysis metric to determine the relative sustainability of system components and to measure the sustainability of different design solutions
3. Develop an increased understanding of current literature and topics in ecological and sustainable engineering

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

- (a) [E] an ability to apply knowledge of mathematics, science, and engineering
- (b) [R] an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) [R] 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) [E] an ability to function on multidisciplinary teams
- (e) [R] an ability to identify, formulate, and solve engineering problems
- (f) [R] an understanding of professional and ethical responsibility
- (g) [R] an ability to communicate effectively
- (h) [E] 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) [R] a knowledge of contemporary issues
- (k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Ecological engineering and sustainable engineering theory and practice.
2. Challenge of premium fuels depletion
3. Societal and environmental problems in a changing world that is facing climate change and regional water shortages.
4. Less energy intensive, lower pollution, and resource conserving approaches to support the main needs of society.
5. Sustainability metrics.

Provided by: S. Diemont
Date: 24 April 2012

ERE 412 River Form and Process
Ted Endreny

Textbooks

Julien, P. (2002) River Mechanics. Cambridge University Press

Harrelson, C.C., Rawlins, C.L., and Potyondy, J.P. (1994) Stream Channel Reference Sites: An Illustrated Guide to Field Technique. USDA

Doll, B.A., Grabow, G.L., Hall, K.R., Halley, J., Harman, W.A., Jennings, G.D, & Wise, D.E. (2003) Stream Restoration: A Natural Channel Design Handbook. NC Stream Restoration Institute, NC State University.

Brunner, G. (2010) HEC-RAS, River Analysis System Hydraulic Reference Manual. US Army Corps of Engineers.

Course Description

Field-based data collection methods for river classification. Bankfull flow estimates. Classified river form, suggested evolution sequences and governing fluvial processes. Computational river hydraulics, sediment transport, and issues of channel stability and restoration

Prerequisite(s): ERE340, ERE371, APM395
Co-requisite(s): none
Course format: Three hours of lecture per week including river field sites.
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Survey and interpret valley type, channel profile, pattern, dimension, and substrate characteristics from maps, photos and field visits,
2. Describe anthropogenic and geomorphic processes leading to instability and classification departure, and use reference reach method to design restoration,
3. Utilize river discharge data and probability functions to construct hydraulic geometry and flow frequency analysis,
4. Apply knowledge of mathematics, science, and engineering to solve river mechanics, fluid dynamics, sediment transport and river stability problems,
5. Design a river restoration system, component, or process to meet desired goals.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [R] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [R] a recognition of the need for, and an ability to engage in life-long learning
(j) [ ] a knowledge of contemporary issues
(k) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Fluvial geomorphology through measurement and interpretation of river pattern, profile, and dimension.
2. Investigations of form and process will be initiated with maps and photographs to extract information on valley type and watershed characteristics, and then completed with detailed field exercises.
3. Field exercises will provide site maps, photographs, descriptions, and survey points of river form and material relative to bankfull flow.
4. River form will be surveyed to reveal the pattern of meanders and belt width, the profile of bed, water, and bankfull slopes, and the dimension of cross sections at steps, riffles and pools.
5. Sediment surveys at cross sections and throughout longitudinal profiles will be used to characterize substrate distributions and roughness and together with site maps interpret dynamic forces and river processes.
6. Rosgen as well as Montgomery and Buffington river classification techniques will be applied.
7. Several computational and analysis approaches are used to estimate and critically evaluate bankfull or channel forming flow regimes.
8. Students will utilize hydraulic and sediment transport models to examine the stability of river geometry and restoration designs across a range of flood frequencies, and analyze results relative to common channel evolution theory.
9. Design exercises will consider satisfying ecological and economic constraints, and uncertainty of modeling open, complex, and dynamic systems.

Provided by: T. Endreny
Date: 11 June 2012

ERE 425 Ecosystem Restoration Design
Stewart Diemont

Textbooks

Matlock, M. and R. Morgan, 2011. Ecological Engineering Design: Restoring and Conserving Ecosystem Services. John Wiley and Sons.

Course Description

A summer field course followed by a weekly seminar and workshop during the Fall. Will travel in a less developed country. Will examine degraded and restored ecosystems. Will travel on public transportation and stay in low-cost hostels. Will use contemporary problems as source material for course projects. Continuation of restoration project designs and analysis from the field trip will be part of the coursework after returning to Syracuse. The course will explore restoration strategies in many different ecosystems. Will consider restoration needs in less developed countries, and how that shapes design and evaluation.

Prerequisite(s): One course in calculus, biology, and chemistry, upper division standing, and permission of instructor
Co-requisite(s): none
Course format: Two hours of lecture per week and two week field component
Credits: 3

Environmental Resources Engineering: Elective

Course Outcomes

After completing this course the student should be able to:

1. Understand and use ecology and engineering for ecosystem restoration in a variety of contexts
2. Choose among and use ecosystem restoration strategies that are appropriate for a given environmental and socioeconomic situations
3. Explain and discuss the potential role of ecosystem restoration in global society and be able to draw from numerous disciplines to enhance your ecosystem restoration designs

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility

(g) [R] an ability to communicate effectively
(h) [R] 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) [R] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Restoration strategies in different ecosystems, such as plains, mangroves, forests, brownfields, oceans, and/or beaches.
2. Restoration needs in developing countries vs. developed countries.
3. Impacts of culture and government on developing a framework for sustainable ecosystem restoration projects
4. Resource recovery
5. Monitoring and Management
6. Sustainability and sustainability analysis
7. Eco-cultural restoration
8. Economic analysis

Provided by: S. Diemont
Date: 24 April 2012

ERE 444 Hydrometeorology
Ted Endreny

Textbooks

Stull, R. (1999) Meteorology for Scientists and Engineers (Second Edition). Brooks Cole.

Course Description

Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data.

Prerequisite(s): Physics 1, Calculus II, permission of instructor.
Co-requisite(s): none
Course format: Three hours of lecture per week.
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Apply knowledge of mathematics, science, and engineering to solve hydro-meteorological problems,
2. Design, conduct, analyze, and interpret hydro-meteorological experiments,
3. Use the techniques, skills, and modern engineering tools necessary for hydro-meteorological practice,
4. Design a hydro-meteorological system, component, or process to meet desired goals.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [E] an ability to design and conduct experiments, as well as to analyze and interpret data
(c) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Physical equations of evaporation, atmospheric stability, condensation, winds, and precipitation.
2. Introduction of weather station instrumentation, sensor and data-logger programming, and data management.
3. Utilization of hydro-meteorology products such as synopsis, numerical weather prediction forecasts, quantitative precipitation forecasts, and radar precipitation data.

Provided by: T. Endreny
Date: 11 June 2012

ERE 445 Hydrologic Modeling
Chuck Kroll

Textbooks

No required text.

Course Description

An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses.

Prerequisite(s): Introductory computer programming, Probability and Statistics, one year of Calculus.
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes:

After completing this course the student should be able to:

1. Develop and program stochastic and deterministic hydrologic models
2. Understand analytical and theoretical approaches to modeling hydrologic processes, including precipitation, infiltration, evapotranspiration, groundwater discharge, runoff mechanisms, and stream flow
3. Understand uncertainty in environmental measurements, and how error in model inputs, parameters, and formulation impact model outputs
4. Critically evaluate hydrologic publications, models, and modeling results
5. Synthesize the major concepts in hydrology, and apply these concepts in engineering design applications

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [E] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility

(g) [R] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Deterministic and stochastic models of hydrologic phenomenon emphasizing model development and the use of computer programming to aid in the construction, manipulation, and interpretation of hydrologic models.
2. Theoretical and analytical approaches to describing a wide variety of hydrologic processes and approaches to rainfall-runoff modeling.
3. Theoretical and analytical models of hydrologic processes, including precipitation, evapotranspiration, infiltration and soil moisture, surface runoff, percolation, groundwater discharge, and streamflow.
4. Stochastic models and modeling approaches applied to hydrology, including frequency analyses, regression approaches, and techniques for handling censored and missing data
5. Hydrologic model construction and development, including techniques for model calibration and validation
6. Computer programming as a tool to assist in the efficient manipulation of large data sets, and the production of reproducible research results.

Provided by: C. Kroll
Date: 11 June 2012

ERE 465 Environmental Systems Engineering
Chuck Kroll

Textbooks

Revelle, C.S., Whitlatch, E.E., and Wright, J.R. (2003) Civil and Environmental Systems Engineering (Second Edition). Prentice Hall.

Louks, D.P. and Van Beek, E. (2006) Water Resources Systems Planning and Management An introduction to methods, models and applications, United Nations Educational

Maidment, D. (1993) Handbook of Hydrology, McGraw-Hill Professional.

Course Description

Mathematical models of environmental systems are presented and combined with optimization procedures, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to the planning, design, and sustainable management of complex environmental systems. Students will be exposed to a variety of optimization algorithms for a wide range of environmental applications.

Prerequisite(s): APM206
Co-requisite(s): APM395
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Understand the pros, cons, and application of a wide variety of classical and modern optimization algorithms
2. Apply engineering economic methods to compare competing alternatives with varying benefits and costs over time
3. Analyze environmental systems problems, formulate them as mathematical models, and develop optimal planning and management strategies for these problems
4. Integrate optimization algorithms, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to addressing complex environmental problems.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [E] 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 multidisciplinary teams

(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Economic methods to compare competing alternatives with varying benefits and costs over time.
2. Systems Analysis and numerical methods techniques, including unconstrained and constrained linear and constrained linear and nonlinear optimization.
3. Techniques for examining system uncertainty, including frequency analyses, trend analyses, and regionalization and simulation techniques.

Provided by: C. Kroll
Date: 11 June 2012

ERE 475 Ecological Engineering II
Wendong Tao

Textbooks

Kadlec, R.H., and Wallace, S.D. 2009. Treatment Wetlands, 2nd edition. CRC Press Taylor & Francis Group, Boca Raton, FL.

Mitsch, W.J., and Jorgensen, S.E. 2004. Ecological Engineering and Ecosystem Restoration. John Wiley & Sons, Inc., Hoboken, NJ.

Crites, R.W., Middlebrooks, E.J. and Reed, S.C. 2006. Natural Wastewater Treatment Systems. CRC Press, Boca Raton, FL.

Course Description

An engineering design/analysis course with hands-on construction, operation and monitoring of ecological treatment systems. Focusing on constructed wetlands for water quality improvement. Design exercises for treatment of sewage, stormwater runoff, landfill leachate, industrial effluent, or dairy wastewater.

Prerequisite(s): ERE 440/643 Water Pollution Engineering, or equivalent
Co-requisite(s): none
Course format: Three hours of lecture/seminar/discussion per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Recognize the importance of constructed wetlands and ponds as eco-technology for wastewater treatment and reuse
2. Design and conduct experiments with ecological treatment systems to derive design considerations
3. Evaluate treatment performance and interpret treatment mechanisms
4. Realize limitations and management issues
5. Design constructed wetlands, ponds and hybrid systems for various applications

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [E] an ability to design and conduct experiments, as well as to analyze and interpret data
(c) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility

(g) [R] an ability to communicate effectively
(h) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Ecological design principles for ecological treatment systems
2. Overview of constructed wetlands
3. Performance assessment and modeling of constructed wetlands
4. Physical structures, plants, soil, animals, microorganisms, hydrology, hydraulics and ecosystem of constructed wetlands
5. Case studies for ecological treatment of dairy wastewater, stormwater, municipal wastewater, landfill leachate, industrial effluent, or acid mine drainage.

Provided by: W. Tao
Date: 24 April 2012

ERE 496 Hydrology in a Changing Climate
Stephen Shaw

Textbooks

None.

Course Description

Although global climate model (GCMs) were originally developed with the primary intent of understanding global scale climate phenomena, in the last decade GCMs have been extensively used to predict local scale climate change. Despite the growing reliance on GCM output to inform strategic planning decisions at the local scale, most secondary users of climate predictions (i.e. water resource engineers, ecologists, city planners, farmers) have limited knowledge of GCMs or global-scale climate dynamics and must simply take the GCM projections at face value despite indications of large uncertainties. Thus, this class is intended to give students the background to critically assess the reasonability of GCM-based predictions of future changes in climate (as primarily related to hydrology) in different locales and at different scales.

Prerequisite(s): none
Co-requisite(s): none
Course format: Three hours of lecture and discussion per week.
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Describe basic global atmospheric circulation patterns and their origin.
2. Construct a simple global energy balance and use it to explain why temperature projections are easier to make than precipitation projections.
3. Describe different techniques for downscaling climate projections and demonstrate the simple change factor technique.
4. Explain what general circulation models (GCM) are, explain the history of their development, and provide examples of variations in climate projections among different GCMs.
5. Access, manipulate, and view climate model output (i.e. netcdf files).
6. Explain fundamental physical controls on extreme rainfall, mean annual rainfall, evapotranspiration, and runoff generation.
7. Describe regional variation in flood causation and relate the predictability of changes in flooding to the capacity of climate models to simulate certain hydroclimatological processes.
8. Create a climate change adaptation plan for a water utility. Apply basic planning techniques to make decisions under uncertainty.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [E] 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) [E] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Introduction to global climatology and the global hydrologic balance, moisture recycling, and precipitation tracking.
2. Introduction to climate models, including a history of GCMs, IPCC assessments, and limitations to use.
3. Regional models and variation, relation between temperature and precipitation intensity, and floods/droughts,
4. Adaptation planning in water resources and methods of decision making under uncertainty.

Provided by: S. Shaw
Date: 6 June 2012

ERE 527 Stormwater Management
John Dunkle

Textbooks

Pitt, R.; Clark, S.; and Lake, D. (2006). Construction Site Erosion and Sediment Controls: Planning, Design, and Performance. DEStech Publications, Lancaster, PA.
NYSDEC (2005). New York Standards & Specifications for Erosion & Sediment Control. http://www.dec.ny.gov/chemical/29066.html.
NYSDEC (2010). New York Stormwater Management Manual. http://www.dec.ny.gov/chemical/29072.html.

Course Description

This design elective class provides practical techniques for urban stormwater management, erosion control, and analysis of associated water quality impacts. Applicable industry design standards and current stormwater regulations are reviewed. The class applies student knowledge of soils, hydrology and hydraulics specifically to the design of stormwater management practices. Students will engage in individual and team oriented, stormwater related activities, including a field trip where examples of construction and post construction stormwater management facilities are examined and evaluated first-hand. Local development sites will be used for assignments in hydrology evaluation, and in the preparation of erosion and sedimentation control and post construction stormwater management plans. Successful completion of this class qualifies students to sit for the national CPESC –IT and CPSWQ – IT exams.

Prerequisite(s): ERE 340 or equivalent, or by instructor permission
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

After completing this course the student should be able to:

1. Apply knowledge of soils, hydrology and hydraulics to the design of stormwater management practices.
2. Evaluate pre- and post-construction stormwater management facilities.
3. Prepare erosion and sedimentation control and post-construction stormwater management plans.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [R] a knowledge of contemporary issues
(k) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Introduction to urban stormwater fundamentals and erosion and sedimentation control.
2. Stormwater permits and regulations.
3. Inspection of construction and evaluating soil loss.
4. Erosion and sedimentation designs.
5. Hydrology and hydrologic models.
6. Water quality impacts, pollutant load assessment, and watershed pollutant assessment.
7. Stormwater management practices, selection, and pond and wetland design.
8. Infiltration, filtering, and swale practices and design.
9. Green infrastructure.
10. Operation and maintenance of stormwater management infrastructure.

Provided by: J. Dunkle
Date: 24 May 2012

ERE 551 GIS for Engineers
Lindi Quackenbush

Textbooks

Longley, Goodchild, Maguire and Rhind (2010). Geographic Information Systems and Science, Third Edition, Wiley.

Course Description

Introduction to fundamental concepts in geographic information systems (GISs) with a focus on engineering applications. Fundamental concepts and development of geographic information systems including models and georeferencing systems used to represent and characterize spatial data. Data processing including collection and preprocessing, data management, spatial analysis and manipulation, and data output. Necessity and utility of spatial data in engineering design analysis.

Prerequisite(s): Calculus
Co-requisite(s): ERE 371 or equivalent
Course format: Two hours of lecture and three hours of lab per week
Credits: 3

Environmental Resources Engineering: Selected Elective

Course Outcomes

After completing this course the student should be able to:

1. Explain the fundamental concepts in the acquisition, processing, organization, and management of spatial data
2. Use spatial data and spatial analysis in engineering problem solving
3. Explain the advantages and disadvantages of using raster vs. vector based GIS
4. Utilize a GIS software package (ArcGIS) to perform spatial analysis

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Introduction to GIS and spatial analysis
2. Maps and map analysis
3. Spatial data and data models
4. Coordinate systems and datums
5. Data collection
6. Preprocessing
7. Rectification and registration
8. Spatial analysis: location, distance, and area based, density estimation and interpolation, terrain analysis, Data exploration and optimization
9. Uncertainty and error
10. Data management
11. Metadata
12. GIS output
13. Open Source GIS
14. GIS applications
15. GIS applications

Prepared by: L. Quackenbush
Date: 8 June 2012

ERE 621 Spatial Analysis
Giorgos Mountrakis

<u>Textbooks</u>

Bailey, T. and Gatrell, T. (1996) Interactive Spatial Data Analysis, Second Edition. Prentice Hall.

<u>Course Description</u>

Spatial statistics and modeling as applied to various data formats: single point data, continuous data and area data. First and second order effects, complete spatial randomness, tessellation, kernel, covariograms and variograms, kriging, distance measures, correlation/correlogram.

Prerequisite(s): APM391, ERE335 or permission of instructor.
Co-requisite(s): none
Course format: Three hours of lecture and discussion per week.
Credits: 3

Environmental Resources Engineering: Selected Elective

<u>Course Outcomes</u>

After completing this course the student should be able to:

1. Understand the basic principles and concepts in spatial statistics,
2. Apply spatial analysis methods to hands-on geographic problems,
3. Formulate their own hypotheses on a variety of geographic problems and establish a spatial analysis plan to test multiple hypotheses for each problem,
4. Synthesize various statistical methods to analyze their hypotheses, critique results from various methods and refine hypotheses as appropriate,
5. Apply the two aforementioned goals to geographic problems beyond their strict area of expertise.

<u>Relation to Program Outcomes (Environmental Resources Engineering)</u>

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Dot maps and labeling
2. First/second order effects,
3. Quadrat, kernel, nearest neighbor, k-function
4. Complete Spatial Randomness
5. Symbol maps
6. Moving average, tessellation,
7. Covariograms and variograms
8. Trend surfaces
9. Least squares, kriging (simple, ordinary and universal, block, co-kriging)

Provided by: G. Mountrakis
Date: 11 June 2012

ERE 622 Digital Image Analysis
Giorgos Mountrakis

<u>Textbooks</u>
Gonzalez, R.C., Woods R.E. (2007) Digital Image Processing. Third Edition. Prentice Hall

<u>Course Description</u>
Elements of digital image processing and analysis systems: Digital image representation, visual perception, sampling and quantization, pixel connectivity, Fourier transforms, image enhancement, filtering, image segmentation, edge detection, thresholding, representation schemes, descriptors, morphology, recognition and interpretation.

Prerequisite(s): APM391, ERE335 or permission of instructor.
Co-requisite(s): none
Course format: Three hours of lecture and discussion per week.
Credits: 3

Environmental Resources Engineering: Selected Elective

<u>Course Outcomes</u>
After completing this course the student should be able to:
1. Describe the fundamental concepts and process flow of digital image analysis,
2. Appropriately apply digital image analysis techniques to their research,
3. Enhance their critical thinking skills.

<u>Relation to Program Outcomes (Environmental Resources Engineering)</u>
(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)
(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Digital image representation
2. Visual perception
3. Sampling and quantization
4. Pixel connectivity
5. Fourier transforms
6. Image enhancement
7. Filtering
8. Image segmentation
9. Edge detection
10. Thresholding
11. Representation schemes
12. Descriptors
13. Morphology
14. Recognition and interpretation
15. Elements of video processing

Provided by: G. Mountrakis
Date: 11 June 2012

ERE 674 Methods in Ecological Treatment Analysis
Wendong Tao

Textbooks

C. N. Sawyer, P.L. McCarty, and G.F. Parkin. 2003. Chemistry for Environmental Engineering and Science, 5th ed. McGraw Hill Higher Education.

Standard Methods for the Examination of Water and Wastewater, 21st ed. 2005. APHA/AWWA/WEF

Course Description

Introduction to the principles and applications of laboratory methods in analysis of natural and engineered ecosystems for water quality improvement. Common lab exercises for a comprehensive analysis of an engineered ecosystem, including water quality, reaction kinetics, hydraulic characteristics, vegetation, soil and gravel, and microbial community. Discussion on experimental procedures and data analysis

Prerequisite(s): General chemistry with lab; General biology
Co-requisite(s): none
Course format: One and a half hours of lecture and 2-5 hours of lab per week
Credits: 3

Environmental Resources Engineering: Elective

Course Outcomes

After completing this course the student should be able to:

1. Use common laboratory skills to characterize water/wastewater quality and evaluate the performance of engineered ecosystems
2. Quantitatively characterize the components and internal processes of engineered ecosystems for various applications
3. Design and conduct experiments to explore design considerations of engineered ecosystems

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] an ability to apply knowledge of mathematics, science, and engineering
(b) [E] 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 multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Solids analysis of water/wastewater and biofilm samples
2. Organic/Inorganic carbon of water/wastewater
3. NH_3, NO_{2-}, and NO_{3-} in water/wastewater
4. Digestion for TKN and TP in water/wastewater and plant/soil extracts
5. Determination of TKN, orthophosphate and TP
6. Analysis of physical properties of gravel and soil
7. Reaction kinetics
8. Hydraulic conductivity of sand and gravel
9. Batch adsorption of copper
10. Microscopic observation/enumeration of microorganisms

Provided by: W. Tao
Date: 24 April 2012

ERE 692 Remote Sensing of the Environment
Jungho Im

Textbooks

Jensen, J. R. (2007). Remote Sensing of the Environment: An Earth Resource Perspective, Second Edition. Prentice Hall, Upper Saddle River, NJ.

Jensen, J. R. (2005). Introductory Digital Image Processing: A Remote Sensing Perspective, Third Edition. Prentice Hall, Upper Saddle River, NJ.

Course Description

This course investigates diverse applications of remote sensing as well as advanced digital image processing techniques for each application. This course covers understanding of various remote sensing systems (e.g. hyperspectral, LiDAR), their applications (e.g. vegetation, water) and advanced digital image processing techniques (e.g. object-based, machine learning, artificial immune networks). Several interactive digital image processing systems (e.g., ENVI, ERDAS IMAGINE, ArcGIS, and/or Matlab) are used by the students to analyze satellite and airborne-acquired remotely sensed image data.

Prerequisite(s): ERE 365 Principles of Remote Sensing (undergrad), or equivalent.
Co-requisite(s): none
Course format: Three hours of lecture and discussion/lab per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

After completing this course the student should be able to:

1. Explain the application of various remote sensing systems for different fields of study.
2. Apply diverse digital image processing techniques to real world remote sensing data in order to extract meaningful information.
3. Complete an individual project that demonstrates their knowledge and analytical techniques obtained during the course.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [E] 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) [E] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Multispectral remote sensing and object-based analysis.
2. Hyperspectral remote sensing and regression and subpixel mapping.
3. Remote sensing, applications, data processing, and systems of thermal infrared, forward-looking infrared, and LiDAR (including LiDAR data classification).
4. Remote sensing of vegetation, water, and the urban landscape, including hyperspectral vegetation indices.
5. Laboratory and *in situ* reflectance and *in situ* data collection.
6. Spectroradiometer, ceptometer, and clinometer measurements.
7. Advanced information extraction, including neural networks, decision trees, support vector machine, and artificial immune networks.

Provided by: J. Im
Date: 10 June 2012

ERE 693 GIS-based Modeling
Jungho Im

Textbooks
Chang, K. (2011). Introduction to Geographic Information Systems, 6th Edition. McGraw Hill.

Course Description
The purpose of the course is to present geographical, temporal, environmental modeling concepts using GIS-based modeling languages and techniques. Practical laboratory experience with state-of-the-art software and hardware will be used. At the conclusion of this course, students will be able to make informed decisions about the transformation of conceptual models to mathematical models using GIS components. This course includes various modeling concepts and techniques such as spatial interpolation, suitability/capability modeling, terrain form modeling, hydrologic modeling, diffusion modeling, calibration modeling, accessibility modeling, optimization modeling, and rainfall-runoff modeling.

Prerequisite(s): Basic knowledge of GIS and experience with ArcGIS, ERE 551 or equivalent
Co-requisite(s): none
Course format: Three hours of lecture and discussion/lab per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes
After completing this course the student should be able to:
1. Transform diverse conceptual models into mathematical models.
2. Develop such mathematical models using GIS constructs.
3. Complete an individual project that demonstrates the application of GIS-based modeling techniques to their own research interests (e.g., hydrological modeling).

Relation to Program Outcomes (Environmental Resources Engineering)
(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)
(a) [E] 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 multidisciplinary teams
(e) [E] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [E] 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) [R] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Model coupling
2. Continuous fields, reviewing spatial interpolation and Kriging
3. Modeling language constructs
4. Modeling in GIS with Python
5. Temporal modeling, including diffusion temporal
6. Model calibration, validation, verification, and optimization.
7. Embedded models
8. Modeling applications to environmental equity and runoff modeling.

Provided by: J. Im
Date: 17 May 2012

GNE 461 Air Pollution Engineering
S.G. Chatterjee

Textbooks

Cooper, C.D. and Alley, F.C. (2011). Air Pollution Control – A Design Approach, 4th Edition. Waveland Press, Long Grove, Illinois.

Course Description

This course is the study of physical, chemical, legislative, and meteorological aspects of air pollution and its control, air quality and emission standards, local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices also covered. The goal of the course is to study the fundamental principles of air pollution and the engineering and applied science concepts relevant to it.

Prerequisite(s): 1 year of college-level physics, chemistry, and calculus
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Selected elective

Course Outcomes

After completing this course the student should be able to:

1. Be familiar with the physical, chemical, legislative, and meteorological aspects of air pollution, with the sources and nature of air pollution, and with issues of air quality and emission standards.
2. Use air pollution dispersion models to predict ambient air concentrations of air pollutants.
3. Understand the operational and design principles of air pollution control devices (e.g., gravity settler, cyclone, electrostatic precipitator, fabric filter, adsorber, absorber, biofilter).

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [R] an ability to identify, formulate, and solve engineering problems
(f) [R] an understanding of professional and ethical responsibility
(g) [R] 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) [R] a recognition of the need for, and an ability to engage in life-long learning
(j) [R] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. Overview of Air Pollution - introduction, types of pollutants, air quality standards, Clean Air Act, sources and effects of air pollution, global warming, stratospheric ozone depletion.
2. Air Pollution and Meteorology - atmospheric physics, atmospheric chemistry (smog formation).
3. Atmospheric Dispersion Modeling - Gaussian plume model, fixed-box model.
4. Air Pollution Control Devices - gravity settler, cyclone, electrostatic precipitator, fabric filter, gas adsorber, gas absorber, biofilter.

Provided by: S. Chatterjee
Date: 28 May 2012

FCH 399 Introduction to Atmospheric Sciences
Huiting Mao

Textbooks

Wallace, J.M. and P.V. Hobbs (2006), Atmospheric Science: An Introductory Survey, (Second Edition), Academic Press.

Jacob, D. (1999), Introduction to Atmospheric Chemistry, Princeton University Press.

Course Description

Atmospheric composition, mass and structure; solar radiation and the global energy budget; atmospheric moisture budget, cloud and precipitation; photolysis, gas-phase oxidation, aqueous chemistry, and gas-to-particle conversion; physical and chemical mechanisms driving environment phenomena such as acid rain, the greenhouse effect, the ozone hole, remote and urban air pollution, and haze.

Prerequisite(s): PHY 211, FCH 150, Calculus I, II, and III.
Co-requisite(s): PHY 212
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Earth Science Elective

Course Outcomes

After completing this course the student should be able to:

1. Explain governing equations for mass, energy, entropy, and momentum.
2. Identify key chemical reactions that can change atmospheric chemical composition.
3. Explain physical and chemical driving mechanisms behind atmospheric phenomena.
4. Discuss issues of air pollution and climate change in a learned and scientific manner.
5. Gain basic knowledge for studies in atmospheric sciences.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [E] 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 multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems
(f) [ ] an understanding of professional and ethical responsibility
(g) [R] 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) [I] a knowledge of contemporary issues

(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Atmospheric composition, mass and structure
2. Fundamental physics and chemistry governing the atmospheric composition and structure
3. Application of the fundamentals in explaining atmospheric phenomenon

Provided by: H. Mao
Date: 8 June 2012

FOR 338 Meteorology
David N. Eichorn

Textbooks

Ahrens, C.D. (2009). Meteorology Today: an introduction to weather, climate, and the environment, 9th Edition. Brooks/Cole Publishing, CA.

Course Description

This course introduces you to the atmospheric physical processes important to understanding weather and in a larger scale, climate. You will learn the difference between the two and important relationships between them. While this is mostly a meteorology course, through understanding weather, you will be able to explain how changes in climate can impact weather. Some of the connectivity between weather and climate change attributes is counterintuitive and that is what makes understanding meteorological consequences of climate change so intriguing.

Prerequisite(s): none
Co-requisite(s): none
Course format: Three hours of lecture per week
Credits: 3

Environmental Resources Engineering: Earth Science elective

Course Outcomes

After completing this course the student should be able to:

1. Look at standard weather maps and understand current weather experienced at the ground and to make simple forecasts.
2. Understand the drivers of climate, and how and why climate varies around the world.
3. Understand major changes to climate now occurring and, in meteorological terms, explain the connectivity between changing climate and changing weather.
4. Understand and explain how changes in climate can affect the frequency and intensity of weather systems in the mid-latitudes.
5. Apply knowledge in Meteorology to further comprehend natural and anthropogenic stresses on hydrological, biological, and ecological systems.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [R] 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) [R] an ability to function on multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems

(f) [E] an understanding of professional and ethical responsibility
(g) [R] an ability to communicate effectively
(h) [E] the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) [E] a recognition of the need for, and an ability to engage in life-long learning
(j) [I] a knowledge of contemporary issues
(k) [I] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Topics Covered

1. Energy and temperature, including the Earth's atmosphere, heat transfer, the greenhouse effect, seasonal energy difference and weather results, daily temperature controls, and temperature and meteorological data measurement.
2. Atmospheric moisture, including humidity, fog, dew, cloud types, atmospheric stability, cloud development, precipitation processes and types, radar, satellites, lake effect, and air pressure.
3. Atmospheric pressure and winds, including the forces which influence winds, jet streaks and streams, wind measurement, local wind systems, El Nino, air masses fronts and mid latitude cyclones, thunderstorms, lightning, tornadoes, hurricanes, and arctic warming.

Provided by: D. Eichorn
Date: 24 May 2012

FOR 345 Introduction to Soils
Russell Briggs

Textbooks

Brady, N.C. and Weil, R. (2007). The Nature and Properties of Soils, 14th Edition, Prentice Hall

Briggs, R.D. and Craul, P.J. (2012). Introduction to Soil – FOR343/545 Laboratory Manual, 39th Edition. SUNY ESF

Anonymous (2010). New York State Forestry Best Management Practices for Water Quality BMP Field Guide. NY State Department of Environmental Conservation

Course Description

FOR345 introduces the fundamentals of soil science in the broader context of soil as a biogeochemical membrane. The essential role of soil in sustaining organism activity through regulation of fluxes of energy, water and gasses among the major global subsystems serves as the motivation to understand soil physical, chemical and biological properties. Human impacts on those fluxes are discussed. The laboratory component of the course reinforces learning through field (team based) and bench (individual) exercises. The course culminates with an integrated assessment of soil property impacts on vegetative production.

Prerequisite(s): chemistry
Co-requisite(s): none
Course format: Two hours of lecture and three hours of laboratory per week
Credits: 3

Environmental Resources Engineering: Earth Science elective

Course Outcomes

After completing this course the student should be able to:

1. Define and describe a soil in acceptable soil science terms;
2. Understand soil physical, chemical and biological properties and their interactions;
3. Understand how various types of soil form and are broadly classified;
4. Understand human impacts on the soil system; and
5. Apply fundamental soil science knowledge to inform resource management decisions and to effectively communicate (orally and written) that information.

Relation to Program Outcomes (Environmental Resources Engineering)

(I = Introduction, R = Reinforce, E = Emphasize, A = assessment point)

(a) [R] an ability to apply knowledge of mathematics, science, and engineering
(b) [I] 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) [R] an ability to function on multidisciplinary teams
(e) [ ] an ability to identify, formulate, and solve engineering problems

(f) [I] an understanding of professional and ethical responsibility
(g) [E] 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) [R] a recognition of the need for, and an ability to engage in life-long learning
(j) [R] a knowledge of contemporary issues
(k) [ ] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

<u>Topics Covered</u>

1. History of soil science and the role of soil in rise and fall of civilization.
2. Soil profile descriptions and soil morphology.
3. Parent material and soil formation.
4. Soil physical properties.
5. Soil water concepts- energy, storage and movement.
6. Soil erosion.
7. Soil aeration and temperature.
8. Soil colloids and cation exchange capacity.
9. Soil acidity and buffering.
10. Plant nutrition, nutrient cycles, and soil amendments.

Prepared by: Russ Briggs
Date: 21 May 2012

Appendix B – Faculty Vitae

Vitae for instructors of required engineering courses are listed in alphabetic order.

Shobha K. Bhatia
Laura J. and L. Douglas Meredith Professor and Professor
Department of Civil and Environmental Engineering
Syracuse University, Syracuse, NY 13244
Phone: 315-443-3352, E-mail: skbhatia@syr.edu

Education

Ph.D. Civil Eng., Commonwealth Scholar, Univ. of British Columbia, Canada, 1980
M.S.C.E Geotechnical Engineering, Gold Medalist, Roorkee University (India), 1973
B.E. Civil Engineering, First Class, Roorkee University (India), 1971

Academic experience

Professor, Syracuse University, 1997–present, Full-time.
Associate Professor, Syracuse University, 1984–1997, Full-time.
Assistant Professor, Syracuse University, 1980–1984, Full-time.

Related Academic experience

Department Chair, Syracuse University, 1996–2001
Research Assistant, University of British Columbia (Canada), 1976–1980
Lecturer, Earthquake Engineering, Roorkee University (India), 1974–1976

Non-academic experience

Consultant to: Blasland and Bouck Engineering, Honeywell Corporation, Niagara Mohawk Power Corporation, O'Brien & Gere Engineers, Reemay, Inc., SAGEOS, Stopen Engineers, Van der Horst Engineering, Woodward Clyde Consultants, Assistant Engineer, Uttar Pradesh Irrigation Department (India), 1973–1974

Current membership in professional organizations

American Society of Civil Engineers (ASCE); America Society of Testing Materials; American Society of Engineering Education; International Geosynthetic Society; International Society of Soil Mechanics and Geotechnical Eng.; International Erosion Control Association; Indian Geotechnical Society; North American Geosynthetic Society

Honors and awards

Chancellor Faculty Excellence and Scholarly Distinction, Syracuse University, 2009
Excellence in Graduate Education Faculty Recognition Award, Syracuse University, 2008
College Technology Educator of the Year award, Technology Alliance of Central NY, 2004
International Network for Engineering Education and Research (iNEER) Award for Excellence in Fostering Sustained and Unique Collaborations in International Research and Education, 2003
Laura J. and L. Douglas Meredith Professor of Teaching Excellence, Syracuse University, 2000
Crouse Hinds Award for Teaching in Engineering Education from the L.C. Smith College of Engineering, Syracuse University, 1996
Shamsher Prakash Research Award, for excellence in Geosynthetics and Geoenvironmental Engineering, 1993
Faculty Achievement Award for Women, for excellence in research and leadership in training future engineers, from NSF, 1991–1997

Service activities

Institutional: Member, Chancellor Citation Selection Comm., 2010; Chair, Meredith Professor Selection Comm., 2010; Member, Teaching Recognition Award Committee, 2010–2011; Member, Syracuse Scholar Selection Comm., 2008–2010; Member, Teaching Mentor Selection Comm., 2009–2010; Member and Chair, ECS Tenure and Reappointment Comm., , 2009–2011; Co-Director of the Women in Science and Engineering (WISE), 1997–present.

Professional: Co-Editor, Scour and Erosion, Geotechnical, Special Pub. No. 210, ASCE, 2010; Member, Technical Coordination Council, Geo-Institute, Div. of ASCE, 2005–2011; Member, International Activities Council, Geo-Institute, Div. of ASCE, 2009–2011; Member, Geotechnics of Soil Erosion and Geosynthetics Committee, Geo-Institute, the ASCE, 2008–2010; Member of Technical Committee , Sixth International Congress of Environmental Geotechnics, New Delhi, India. Nov. 8–10, 2010; Advisory Board Member for the National Science Foundation Funded Gender Equity Project, Hunter College, New York, 2002–2007.

Select Publications of last five years

Bhatia, S. K., and J.P. Amati (2010). If These Can Do It, I Can Do It Too: Building Women Engineering Leadership Through Graduate Peer Mentoring. *Leadership and Management in Engineering*, 10(4), 174–184. ASCE.

Bhatia, S. K., and J.L. Smith (2008, June). Bridging the Gap between Engineering and the Global World: a Case Study of the Coconut (Coir) Fiber Industry in Kerala India. *Synthesis Lectures on Engineering, Technology, and Society #6*. Morgan and Claypool Publishers.

Burns, S. E., S.K. Bhatia, C.M. Avila, and B.E. Hunt (2010). Scour and Erosion. *Geotechnical Special Publication No. 210*. ASCE.

Khachan, M. M., R.A. Bader, S.K. Bhatia, and B.W. Maurer (2011). Comparative dewatering performance of slurries conditioned with synthetic polymers vs. eco-friendly polymers. *Geotechnical Special Publication 211*, 3050–3058.

Satyamurthy, R., and S.K. Bhatia (2009). Effect of polymer conditioning on dewatering characteristics of fine sediment slurries using geotextiles. *Geosyn. Int.*, 16(2), 83–96.

Satyamurthy, R., and S.K. Bhatia (2009, February 25–27). Experimental Evaluation of Geotextile Dewatering Performance. *Geosynthetics*, 464–474.

Smith, J. L., and S.K. Bhatia (2009). Bioimprovement of Soils for Highway Applications Using Rolled Erosion Control Products. *Transportation Research Record: Journal of the Transportation Research Board No. 2108*, 117–126.

Zoli, C., S.K. Bhatia, V. Davidson, and K. Rusch (2008, June). Engineering – Women and Leadership. *Synthesis Lectures on Engineering, Technology, and Society #6*. Morgan and Claypool Publishers.

Recent Professional Development Activities

Attended Geo Institute, ASCE annual meetings, 2006–2011

Participated in the First US-India Workshop on Global Geoenvironmental Engineering Challenges, New Delhi, India, 2010

Fifth International Conference on Scour and Erosion, 2010

Women in Engineering and Leadership, Auburn University, 2010

Douglas J. Daley
Associate Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-4760, E-mail: djdaley@esf.edu

Education
M.S. Environmental Resources Engineering, SUNY-ESF, 1984
B.S. Forest Engineering, SUNY-ESF, 1982

Academic experience
Associate Professor, SUNY-ESF, 2002–present, Full-time
Assistant Professor, SUNY-ESF, 1996–2002, Full-time

Related Academic experience
Instructor, Principles and Practice of Engineering Exam Preparation, SUNY-ESF, 2003–present, Part-time
Director, SUNY Center for Brownfield Studies, 2001–present, Part-time
Adjunct Lecturer, Rochester Institute of Technology, 1995–1996, Part-time
Teaching Assistant, SUNY-ESF, 1982–1984, Part-time

Non-academic experience
Engineering Consultant, O'Brien & Gere, 2008–present, Part-time
Senior Project Engineer, Malcolm Pirnie, Inc., 1994–1996, Full-time
Project Engineer, Malcolm Pirnie, Inc., 1990–1994, Full-time
Engineer, Malcolm Pirnie, Inc., 1986–1990, Full-time
Environmental Engineer, Kansas Dept. of Health and Environment, 1985–1986, Full-time
Engineer, City of Wichita, KS, 1985, Full-time

Certifications or professional registrations
Professional Engineer, State of New York, License Number 067220

Current membership in professional organizations
New York Water Environment Association (NYWEA)
Central New York Air & Waste Management Association (AWMA)

Service activities
Institutional: Director, Outreach program for professional engineering exam preparation, 2007- present
Reviewer, certification of Professional Development Hours (PDHs) for NYS Professional Engineer registrants, 2010 – present
Advisor, Urban Environmental Science minor, 1999 – present
Faculty Governance Committee on Curriculum, 2009–present

Professional: Coordinator, New York Water Environment Association, 2010–present.
Coordinator, Order of the Engineer Link 100, 2000–present

Select Publications of last five years

Volk, T.A. and Daley, D.J. 2012. Annual Report: Monitoring and Maintenance of Willow as an Alternative Landfill Cover System. Prepared for Honeywell, Inc.

Volk, T.A. and Daley, D.J. 2011. Annual Report: Monitoring and Maintenance of Willow as an Alternative Landfill Cover System. Prepared for Honeywell, Inc.

Daley, D.J. 2010. Project Report: Percolation Measurements from the Root Zone of a Willow-Based ET Landfill Cover System. Honeywell, Inc.

Daley, D.J. 2009. Project Report: Comparison of Percolation Rate Estimates from an ET Landfill Cover using the HELP model and SHAW models. Honeywell, Inc. and New York State Department of Environmental Conservation.

Daley, D.J. 2009. Alternative Cover Conceptual Design for the Shrub Willow Sustainable Remedy (SWSR) for Settling Basins 9–15. Contributing Author to report by Honeywell, O'Brien & Gere and SUNY-ESF to NYSDEC.

Daley, D.J. and T.A. Volk, June 2009. Using Short-Rotation Willow Crops for Leachate Management and Biomass Production on Solvay Wastebeds. American Ecological Engineering Society Annual Meeting. Corvallis, OR

Daley, D.J, 2009. Comparison of Water Budget Models for Willow-based Alternative Cover System at the Solvay Settling Basins. Technical report to New York State Department of Environmental Conservation with O'Brien & Gere and Honeywell.

Daley, D.J. and Volk, T.A. 2007. Monitoring and Maintenance of Willow as an Alternative Landfill Cover System. Biomass Pilot Study Project. Semi-Annual Report. Honeywell, Inc.

Wastebed Botanical Garden and Site Design. 2007. Conceptual Design Report and Drawings submitted to Honeywell International. Role: Contributing author.

Recent Professional Development Activities

New York Water Environment Association Annual Meeting, 2012
American Ecological Engineering Society Annual Meeting, 2012

Stewart A.W. Diemont
Assistant Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-4707, E-mail: sdiemont@esf.edu

Education

Post-Doc.	Agroecology, El Colegio de La Frontera Sur (Mexico), 2006-2007
Ph.D.	Food, Agricultural, and Biological Engineering, Ohio State University, 2006
M.S.	Environmental Sciences and Engineering, University of North Carolina, 1997
B.A.	Anthropology, University of Texas, 1991

Academic experience

Assistant Professor, SUNY-ESF, 2007–present, Full-time
Adjunct Professor, El Colegio de La Frontera Sur (ECOSUR) (Mexico), 2007–present, Part-time

Related Academic experience

Postdoctoral Fellow, ECOSUR (Mexico), 2006–2007, Full-time
Fulbright Scholar, The US Department of State, Mexico, 2004–2005, Full-time
Graduate Fellow, Ohio State University, 2001–2006, Part-time
Graduate Fellow, University of North Carolina, 1993–1995, Part-time

Non-academic experience

Environmental Engineer, IT Corporation and BNC Environmental Services, 1997–2001, Full-time
Environmental Scientist and Engineer, PLAN International and Honduran Ministry of Health (Honduras), 1995–1996, Full-time

Certifications or professional registrations

None.

Current membership in professional organizations

American Ecological Engineering Society (AEES)

Honors and awards

Distinguished Advisor Award, 2011
SUNY-ESF President’s Award for Community Service, 2010

Service activities

Institutional: ERE Undergraduate Coordinator, 6/2012–present; Committee on Instruction, 1/2010–6/2011; Faculty Governance Library Resources Committee, 5/2012–present; Search Committee, Dean of Instruction, Spring 2010; Review Committee, Sussman Awards, Spring 2012

Professional: President, American Ecological Engineering Society, 6/2012–present; Vice President, American Ecological Engineering Society, 6/2011–6/2012; Treasurer, AEES, 5/2009–6/2011

Select publications of last five years

Cheng, K, S.A.W. Diemont, A.P. Drew, 2011. Role of tao (*Belotia mexicana*) in the traditional Lacandon Maya shifting cultivation ecosystem. *Agroforestry Systems,* 82 (3): 331–336.

Diemont, S.A.W., J. Bohn, D. Rayome, S. Kelsen, K. Cheng, 2011 Comparisons of Mayan forest management, restoration, and conservation. *Forest Ecology and Management,* 261 (10): 1696–1705.

Alfaro, R., S.A.W. Diemont, B. Ferguson, J.F. Martin, J. Nahed, D. Álvarez, R, Pinto Ruíz, 2010. Steps toward sustainable ranching. *Agricultural Systems*, 103(9): 639–646.

Martin, J.F., E. Roy, S.A.W. Diemont, and B.G. Ferguson, 2010. Traditional ecological knowledge (TEK): Ideas, inspiration, and designs for ecological engineering. *Ecological Engineering,* 36: 839–849.

Diemont, S.A.W., T.J. Lawrence, and T.A. Endreny, 2010. Envisioning ecological engineering education: An international survey of the educational and professional community. *Ecological Engineering*, 36: 570–578.

Diemont, S.A.W. and J.F. Martin, 2009. Lacandon Maya ecological management: A sustainable design for environmental restoration and human subsistence. *Ecological Applications,* 19: 254–266.

Recent Professional Development Activities

Tropical Forest Restoration Workshop, funded through a National Science Foundation grant, Morelia, Mexico, October 2010.

Theodore A. Endreny
Professor, Department Chair
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-6565, E-mail: te@esf.edu

Education

Ph.D. Water Resources Engineering, Princeton University, 1999
M.S. Soil & Water Engineering, North Carolina State University, 1996
B.S. Natural Resources Management, Cornell University, 1990

Academic experience

Professor, SUNY-ESF, 2009–present, Full-time
Associate Professor, SUNY-ESF, 2005–2009, Full-time
Assistant Professor, SUNY-ESF, 1999–2005, Full-time

Related Academic experience

Research Scholar, National Aeronautics & Space Administration GSRP, 1997–1999, Part-time
Research Scholar, Environmental Protection Agency EMAP, 1994–1996, Part-time
Research Associate, Environmental Law Institute, Washington DC, 1992–1994, Full-time

Non-academic experience

Volunteer, U.S. Peace Corps & Honduras Forest Service, 1990–1992, Full-time

Certifications or professional registrations

Professional Hydrologist (PH), American Institute of Hydrology, License Number 1559
Professional Engineer (PE), New York State, License Number 079912

Current membership in professional organizations

American Geophysical Union, American Society of Civil Engineers, American Ecological Engineering Society, American Society for Engineering Education

Honors and awards

Distinguished Teacher Award, ESF Undergraduate Student Association, 2009; Fulbright Commission Research & Lecturer Sabbatical Award, Cyprus, 2006; State University of New York Chancellor's Internationalization Award, 2004

Service activities

Institutional: Advisor, SUNY-ESF Engineers without Borders chapter, 2003–present; Member SUNY-ESF Hydrological System Science Council, 2000–present; Chair, Department of Environmental Resources Engineering, 2011–present; Member, Provosts Academic Council, 2011–present; SUNY-ESF Representative to CUAHSI, 2011–present.

Professional: Convener, American Geophysical Union fall 2011 conference; National Weather Service cooperative observer of daily weather, 2000-present; Advisor, Onondaga Lake Partnership, 2003-present; Advisory Board, International Journal of River Basin Management, 2003-present; Editorial Board, Hydrological Processes, 2010-present; Developer, iTree Hydro software for USDA Forest Service (www.itreetools.org/hydro), 2001-present; Developer, Stream Classification course or UCAR COMET (www.fgmorph.com), 2003-present.

Select Publications of last five years

Han, B. and T.A. Endreny, 2012. Spatial and temporal intensification Of lateral hyporheic flux in narrowing intra-meander zones, *Hydrological Processes*, 15, doi:10.1002/hyp.9250.

Zhou, T. and T.A. Endreny, 2012, Meander hydrodynamics initiated by river restoration deflectors, *Hydrological Processes*, 15, doi:10.1002/hyp.8352.

Endreny, T.A., L.K. Lautz, and D. Siegel, 2011. Hyporheic flow path response to hydraulic jumps at river steps: flume and hydrodynamic models, *Water Resources Research*, 47, W02517, doi:10.1029/2009WR008631.

Endreny, T.A., L.K. Lautz, and D. Siegel, 2011. Hyporheic flow path response to hydraulic jumps at river steps: hydrostatic model simulation, *Water Resources Research*, 47, W02518, doi:10.1029/2010WR010014.

Fabian, M., T.A. Endreny, A. Bottacin-Busolin, and L.K. Lautz, 2011. Seasonal variation in cascade driven hyporheic exchange, Northern Honduras, DOI: 10.1002/hyp.7924.

Crispell, J. and T.A. Endreny, 2009. Hyporheic Exchange Flow Around Three In-Channel Structures and Implications for Restoration Design, *Hydrological Processes*, 23: 1158–1168.

Endreny, T.A. and V.B. Collins, 2009. Implications of sub-optimal stormwater recharge basin arrangement on groundwater mounding, *Ecological Engineering*, 35: 670–677.

Endreny, T.A. and N.E.A Imbeah, 2009. Generating robust rainfall intensity-duration-frequency estimates with short-record satellite data, *Journal of Hydrology*, 371(1–4):182–191.

Endreny, T.A. and M. Higgins, 2007. Adding radar rainfall and calibration to the TR-20 watershed model to improve dam removal flood analysis, *ASCE Journal of Water Resources Management and Planning*, 134(3):314–317.

Endreny, T.A., 2007. Simulation of soil water infiltration with integration, differentiation, numerical methods & programming exercises, *International Journal of Engineering Education*, 23(3):608–617.

Recent Professional Development Activities

Channel Design Training, ASCE & FEMA courses, 1wk 2001

Stream Restoration Training, US Fish & Wildlife courses, 4wks 2002-2003

Rafaat M. Hussein
Associate Professor
Department of Sustainable Construction Management and Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-6833, E-mail: rmhussei@esf.edu

Education

Ph.D. Building Studies, Concordia University, Montreal, Canada, 1980
M.S. Mechanics of Solids and Structures, Concordia University, Montreal, Canada, 1978
B. Sc. Structural Engineering, El-Azhar University, Cairo, Egypt, 1974

Academic experience

Associate Professor, SUNY-ESF, 1987–present, Full time
Associate Professor, University of District of Columbia, Washington, DC, 1986-87, Full-time
Assistant Professor, University of Evansville, Evansville, Indiana, 1985–86, Full-time
Assistant Professor, New Jersey Institute of Technology, Newark, NJ, 1983–85, Full time

Related academic experience

Research Associate/Assistant, Concordia University, Montreal, Canada, 1976–81, Part-time

Non-academic experience

Structural Specialist, Lavalin Consultants, Inc., Montreal, Canada, 1981-83, Full-time

Certifications or professional registrations

Professional License No. 35020, Province of Quebec, Canada
Professional License No. 02050, Egypt

Current membership in professional organizations

American Society of Civil Engineers (ASCE)
American Academy of Mechanics

Honors and awards

US Army Corps of Engineers and the Civil Engineering Research Foundation for reviewing technical documents, 1993.
New faculty development award, SUNY College of Environmental Science and Forestry, Faculty of Wood Products Engineering, 1988.

Jungho Im
Assistant Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-4709, E-mail: imj@esf.edu

Education

Ph.D. Geography, University of South Carolina, 2006
M.C.P. Environmental Management, Seoul National University (South Korea), 2000
B.S. Oceanography, Seoul National University (South Korea), 1998

Academic experience

Assistant Professor, SUNY-ESF, 2007–present, Full-time.

Related Academic experience

Postdoctoral, GIS and Remote Sensing, University of South Carolina, 2006–2007
Research Assistant Fellow, Korea Research Institute for Human Settlements, 2000–2002, Full time
Research Assistant Fellow, Centennial Technology, Ansan, S. Korea, 1998–1999, Full time

Certifications or professional registrations

None.

Current membership in professional organizations

Member, American Society for Photogrammetry and Remote Sensing, 2004–present
Member, Association of American Geographers, 2003-present
Member, IEEE Geoscience and Remote Sensing, 2012-present

Honors and awards

The 2012 ASPRS ERDAS Award for Best Scientific Paper in Remote Sensing: 1st Place
The 2010 ASPRS ESRI Award for Best Scientific Paper in GIS: 1st Place
The 2010 ASPRS John I. Davidson President's Award for Practical Papers: 1st Place

Service activities

Institutional: ERE Undergraduate Coordinator, 2011–2012

Professional: Principal Investigator of New York View, a member of AmericaView; Editorial Board of GIScience and Remote Sensing

Select Publications of last five years

Gleason, C. and J. Im, 2012. A fusion approach for tree crown delineation from LiDAR data, *Photogrammetric Engineering & Remote Sensing*, in press.

Im, J., Z. Lu, J. Rhee, and L.J. Quackenbush, 2012. Impervious surface quantification using a synthesis of artificial immune networks and decision/regression trees from multi-sensor data, *Remote Sensing of Environment*, 117, 102–113.

Im, J., Z. Lu, and J.R. Jensen, 2011. A genetic algorithm approach to moving threshold optimization for binary change detection, *Photogrammetric Engineering & Remote Sensing*, 77(2): 167–180.

Gong, B., J. Im, and G. Mountrakis, 2011. An artificial immune network approach to multi-sensor land use/land cover classification, *Remote Sensing of Environment*, 115: 600–614.

Gleason, C. and J. Im, 2011. A review of remote sensing of forest biomass and biofuel: options for small area applications, *GIScience and Remote Sensing*, 48(2): 141–170.

Lu, Z., J. Im, and L.J. Quackenbush, 2011. A volumetric approach to population estimation using LiDAR remote sensing, *Photogrammetric Engineering & Remote Sensing*, 77(11): 1145–1156.

Ke, Y., L.J. Quackenbush, and J. Im, 2010. Synergistic use of QuickBird multispectral imagery and LIDAR data for object-based forest species classification, *Remote Sensing of Environment*, 114: 1141–1154.

Wang, Z., J.R. Jensen, and J. Im, 2010. An automatic region-based image segmentation algorithm for remote sensing applications, *Environmental Modelling and Software*, 25: 1149–1165.

Rhee, J., J. Im, and G.J. Carbone, 2010. Monitoring agricultural drought for arid and humid regions using multi-sensor remote sensing data, *Remote Sensing of Environment*, 114: 2875–2887.

Im, J., J.R. Jensen, M. Coleman, and E. Nelson, 2009. Hyperspectral remote sensing analysis of short rotation woody crops grown with controlled nutrient and irrigation treatments, *Geocarto International*, 24(4): 293–312.

Recent Professional Development Activities

Member, SUNY-ESF Council for Geospatial Modeling and Analysis
Attended or presented at Annual ASPRS Conference, 2004–2012
Attended or presented at Annual AAG Conference, 2004–2012
Attended at Annual AmericaView meeting, 2009-2011
Attended SUNY-ESF Hardy L. Shirley Faculty Mentoring Colloquium, 2010–2011

Charles N. Kroll
Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-6699, E-mail: cnkroll@esf.edu

Education

Ph.D.	Civil and Environmental Engineering, Cornell University, 1996
M.S.	Civil and Environmental Engineering, Tufts University, 1987
B.S.	Mechanical Engineering, Tufts University, 1983

Academic experience

Professor, SUNY-ESF, 2009–present, Full-time
Associate Professor, SUNY-ESF, 2002–2009, Full-time
Assistant Professor, SUNY-ESF, 1996–2002, Full-time
Lecturer, Cornell University, 1995–1996, Full-time

Related Academic experience

Department Chair, SUNY-ESF, 2008–2011, Full-time
Teaching Assistant, Cornell University, 1991–1995, Part-time
Research Assistant, Tufts University, 1987–1989, Part-time

Non-academic experience

Staff Hydrologist and Staff Engineer, GZA GeoEnvironmental Inc., 1989–1991, Full-time

Certifications or professional registrations

Professional Engineer, New York State, License Number 082971

Current membership in professional organizations

American Ecological Engineering Society
American Geophysical Union
American Society of Civil Engineers

Honors and awards

Tufts University Department of Civil and Environmental Engineering Distinguished Career Award, 2011.

ESRI Award for Best Scientific Paper in Geographic Information Systems, 1st Place, ASPRS, 2007.

ESF Foundation Award for Exceptional Achievement in Teaching, SUNY College of Environmental Science and Forestry, 2004.

Excellence in Teaching Award. School of Civil and Environmental Engineering, Cornell University, Award given for continued excellence as a teaching assistant, 1994 academic year.

John Perry Award for Teaching. School of Civil and Environmental Engineering, Cornell University, Award given to best teaching assistant in department, 1993.

Employee Commendation Award, GZA GeoEnvironmental Technologies, Inc., Award given for developing new soil vapor extraction modeling protocols and promotional materials, 1990.

Service activities

Institutional: Chair, Environmental Resources and Forest Engineering, 2008–2011; ERE Undergraduate Coordinator, 2005–2008; GPES Study Area Leader for Environmental Monitoring and Modeling, 2012; Engineering Representative to SUNY-ESF's Honors Program, 2010–2012; ERE Departmental Review Committee Chair, 2011–2012; ERE Representative to SUNY-ESF Campus Review Committee, 2011–2012; Advisor to the Environmental Resources Engineering Club 2000-2011.

Professional: Associate Editor, Water Resources Research, 2003–2005; Member, Hydrologic Information Systems Subgroup for the Consortium of Universities to Advance Hydrologic Science, Inc. (CUAHSI); Coordinator, International Association of Hydrological Sciences (IAHS) working group on Low Streamflow Prediction at Ungauged Basins (PUBs), 2006–2008

Select Publications of last five years

Hirabayashi, S., C.N. Kroll, and D.J. Nowak, 2012. Development of a distributed air pollutant dry deposition modeling framework, *Environmental Pollution*, accepted for publication.

Laaha, G., H. Hisdal, C.N. Kroll, H.A.J. van Lanen, E. Sauquet, L.M. Tallaksen, R. Woods, and A. Young, 2012. *Low flow estimation, Prediction at Ungauged Basins*, IAHS, Chapter 8, accepted for publication.

Hirabayashi, S., C.N. Kroll, and D.J. Nowak, 2011. Component-based development and sensitivity analyses of an air pollutant dry deposition model, *Environmental Modeling and Software*, 26(6), 804–816.

Gao, Y, R.M. Vogel, C.N. Kroll, N.L. Poff, and J.D. Olden, 2009. Development of representative indicators of hydrologic alteration, *Journal of Hydrology,* 374, 136-147.

Matonse, A.H., and C.N. Kroll, 2009. Simulating low streamflows with hillslope-storage models, *Water Resources Research*, 45, W01407, doi:10.1029/2007WR006529.

Zhang, Z., and C.N. Kroll, 2007. The baseflow correlation method with multiple gauged sites, *Journal of Hydrology*, 347(3–4), 371–380.

Zhang, Z., and C.N. Kroll, 2007. A Closer Look at Baseflow Correlation, *Journal of Hydrologic Engineering*, ASCE, 12(2): 190–196.

Recent Professional Development Activities

Attended the American Ecological Engineering Society (AEES) annual meeting, June 2012, SUNY-ESF, Syracuse, NY.

Attended the Environmental and Water Resources Institute (EWRI) of the ASCE annual meeting, May 2011, Palm Springs, CA.

Attended the American Board for Engineering and Technology (ABET) Faculty Workshop on Sustainable Assessment Processes and Commission Summit, November 2009, San Antonio, TX.

Richard L. Martin
Visiting Instructor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-669-6313, E-mail: rido.martin@verizon.net

Education

B.S. Mechanical Engineering, Washington State University, 1982

Academic experience

Visiting Instructor, SUNY-ESF, Syracuse NY, 2012, Part-time
Visiting Instructor, Eastern Washington University, 1982, Part-time

Non-academic experience

Sr. Technical Consultant, Carrier Corporation, Syracuse, NY, 2009–present, Full-time
Sr. Technical Consultant, UTC Power, South Windsor, CT, 2008–2009, Full-time
Sr. Technical Consultant, Carrier Corporation, Syracuse, NY, 1994–2008, Full-time
Design/Development Engineer, Carrier Corporation, Syracuse, NY, 1992–1994, Full-time
Special Products Group, Carrier Corporation, Syracuse, NY, 1989–1992, Full-time
Engineer in Research and Development, Brod and McClung PACE Co., Portland, OR, 1984–1988, Full–time
Sales Engineer, Colmac Coil Manufacturing Inc., Colville, WA, 1982–1984, Full-time

Certifications or professional registrations

Professional engineer in NY and OR

Current membership in professional organizations

American Society of Mechanical Engineers (ASME)

Honors and awards

Patent #5,515,769 for *Air Compressor*, co-owned by E.M. Basinski, M.W. Meese, J.H. Bothouse II, Thomas Industries Inc. and Carrier Corp.
Patent # 5,457,963 for *Controlled Atmosphere System for a Refrigerated Container*, co-owned by B.P. Cahill-O'Brien, M.W. Nevin, and Carrier Corp.

Recent Professional Development Activities

Studied Adult Education, Lemoyne College, 2003–2004

Giorgos Mountrakis
Assistant Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-4824, E-mail: gmountrakis@esf.edu

Education

Post.Doc. Intelligent Image Analysis, U.S. Geological Survey, 2004–2005
Ph.D. Intelligent Information Retrieval, University of Maine, 2004
M.Sc. Digital Image Analysis, University of Maine, 2000
Dipl.Eng. Spatial Information Engineering, National Technical University of Athens (Greece), 1998

Academic experience

Assistant Professor, SUNY-ESF, 2005–present, Full-time
Post-Doctoral Associate, USGS/National Academies of Science, 2004–2005, Full-Time

Related Academic experience

Graduate Assistant, National Center for Geographic Information and Analysis, University of Maine, 1998–2004, Part-time
Teaching Assistant, University of Maine, 2002–2003, Part-time

Non-academic experience

Cadastre Manager, Kotouzas, Inc., Athens, Greece, 1998, Part Time

Certifications or professional registrations

National Technical Chamber of Greece, Surveyor Engineer.

Current membership in professional organizations

American Society for Photogrammetry and Remote Sensing (ASPRS)
American Association of Geographers (AAG)

Honors and awards

European Association of Remote Sensing Laboratories, Invited Keynote Speaker at the 32nd EARSeL Symposium, 2012
Global Land Project Conference, Travel award, 2010
NASA New Investigator Program, Research Award, 2008
National Academies of Science, Postdoctoral Award, 2004
University of Maine, Graduate Student Award, 2004
SPIE, Travel Award, 2000
University Consortium for GIS, Poster Presentation Award, 2000
University Consortium for GIS, Travel Award, 2000
Evgenidion Foundation, Scholarship Award, 1998
National Technical Chamber of Greece, Outstanding Thesis Award, 1998

Service activities

Institutional: Member, Committee on Research, SUNY-ESF, 2009–2011; Member, Committee on Student Life, SUNY-ESF, 2011–2013

Professional: Reviewer for more than 15 scientific journals, 2005–present; Reviewer for several organizations (NSF, NASA, UN)

Select Publications of last five years

Mountrakis, G. and D. Triantakonstantis (in press). Inquiry-based learning in remote sensing: A space balloon educational experiment. *Journal of Geography in Higher Education*.

Gong, B., J. Im, and G. Mountrakis (2011). An Artificial Immune Network Approach to Multi-Sensor Land Use/Land Cover Classification. *Remote Sensing of Environment*, 115(2):600–614.

Mountrakis, G., J. Im, and C. Ogole (2011). Support vector machines in remote sensing: A review. *ISPRS Journal of Photogrammetry and Remote Sensing*, 66(3):247–259.

Mountrakis, G. and L. Luo (2011). Enhancing and replacing spectral information with intermediate structural inputs: A case study on impervious surface detection. *Remote Sensing of Environment*, 115(5):1162–1170.

Wang, J. and G. Mountrakis (2011). Developing a multi-network urbanization (MuNU) model: A case study of urban growth in Denver, Colorado. *International Journal of Geographical Information Science*, 25(2):229–253.

Luo, L. and G. Mountrakis (2010). Integrating intermediate inputs from partially classified images within a hybrid classification framework: An impervious surface estimation example. *Remote Sensing of Environment*, 114(6):1220–1229.

Mountrakis, G. (2009). Geographic Data Mining: An Introduction. Invited chapter in the ASPRS Manual of Geographic Information Systems. M. Madden (ed.), Chapter 27, pp. 495–508.

Mountrakis, G., R. Watts, L. Luo, and J. Wang (2009). Developing Collaborative Classifiers using an Expert-based Model. *Photogrammetric Engineering and Remote Sensing*, 75(7):831–844.

G. Mountrakis (2008). Next generation classifiers: Focusing on integration frameworks. Highlight article for October, 2008 issue of *Photogrammetric Engineering and Remote Sensing*, 74(10):1178–1180.

Recent Professional Development Activities

Member, SUNY-ESF Council for Geospatial Modeling and Analysis
Attended or presented at Annual ASPRS Conference, 1998–2012
Attended SUNY-ESF Hardy L. Shirley Faculty Mentoring Colloquium, 2010–2012

Lindi J. Quackenbush
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Department of Environmental Resources Engineering
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Phone: 315-470-4727, E-mail: ljquack@esf.edu

Education

Ph.D.	Environmental Resources Engineering: Remote Sensing, SUNY-ESF, 2004
M.S.	Environmental Resources Engineering: Remote Sensing, SUNY-ESF, 1998
B. Surv.	First Class Honors, The University of Melbourne (Australia), 1994
B. Sci.	The University of Melbourne (Australia), 1994

Academic experience

Associate Professor, SUNY-ESF, 2011–present, Full time
Assistant Professor, SUNY-ESF, 2004–2011, Full time
Lecturer, SUNY-ESF, 2001–2004, Full time

Related Academic experience

ERE Assessment Coordinator, SUNY-ESF, 2009–present, Part time
Research Assistant (ARC Coordinator), SUNY-ESF, 1998-2001, Full time
SUNY-ESF, Graduate Assistant, 1995-1998, Part time

Certifications

Certified Mapping Scientist: Remote Sensing, ASPRS, RS162
Certified Mapping Scientist: GIS/LIS, ASPRS, GS205

Current membership in professional organizations

American Society for Photogrammetry and Remote Sensing (ASPRS)

Honors and awards

ERDAS Award for Best Scientific Paper in Remote Sensing, Second Place, ASPRS, 2011
SUNY-ESF Foundation Award for Excellence in Teaching, 2010
SUNY-ESF Undergraduate Student Association Distinguished Faculty Advisor Award, 2010
SUNY-ESF Graduate Student Association Teaching Award, 1998
ASPRS Robert E. Altenhofen Memorial Scholarship Recipient, 1997
Central New York Region ASPRS Student of the Year Award, 1997

Service activities

Institutional: Member, Committee on Promotion and Tenure Policies and Procedures, 2008–2012; Director, Council for Geospatial Modeling and Analysis, 2006–2008; Member, Foundation Award for Excellence in Teaching review committee, 2011–2012; Member, Committee on Public Service and Outreach, 2011–2012

Professional: Co-Chair, New York State Geographic Information Systems Conference, 2008–2012; Member and Chair, ASPRS Ta Liang Scholarship review committee, 2006–2012; Member, Industrial Advisory Committee, Engineering Technologies

Program, Mohawk Valley Community College, 2010–2012 ; Member, peer review committee for ASPRS Mapping Scientist certification, 2012

Select Publications of last five years

Im, J., Z. Lu, J. Rhee, and L.J. Quackenbush, 2011. Impervious surface quantification using a synthesis of artificial immune networks and decision/regression trees from multi-sensor data, *Remote Sensing of Environment*, doi:10.1016/j.rse.2011.06.024.

Zhang, W., L.J. Quackenbush, J. Im, and L. Zhang, 2011. Indicators for separating undesirable and well-delineated tree crowns from high spatial resolution imagery, *International Journal of Remote Sensing*, 32(17): 4725-4727, doi:10.1080/01431161.2010.494184.

Ke, Y., and L.J. Quackenbush, 2011. A comparison of three methods for automatic tree crown detection and delineation from high spatial resolution imagery. *International Journal of Remote Sensing*, 32(13): 3625–3647.

Ke, Y., L.J. Quackenbush, and J. Im, 2010. Synergistic use of QuickBird multispectral imagery and LIDAR data for object-based forest species classification. *Remote Sensing of Environment*, 114: 1141–1154.

Ke, Y., W. Zhang, and L.J. Quackenbush, 2010. Active contour and hill-climbing for tree crown detection and delineation. *Photogrammetric Engineering and Remote Sensing*, 76(10): 1169–1181.

Gunson, K.E., G. Mountrakis, and L.J. Quackenbush, 2010. Spatial wildlife-vehicle collision models: A review of current work and their application to transportation mitigation projects. *Journal of Environmental Management*, 92(4): 1074–1082.

Zhang, W, Y. Ke, L.J. Quackenbush and L. Zhang, 2010, Using Error-in-Variable Regression to Predict Tree Diameter and Crown Width from Remotely Sensed Imagery, *Canadian Journal of Forest Research*, 40(6): 1095–1108.

Lu, Z., J. Im, L.J. Quackenbush, and K. Halligan, 2010. Population estimation based on multi-sensor data fusion, *International Journal of Remote Sensing*, 31(21): 5587–5604.

Doucette, J.S., W.M. Stiteler, L.J. Quackenbush, and J.T. Walton, 2009. A Rules-Based Approach for Predicting the Eastern Hemlock Component of Forests in the Northeastern United States. *Canadian Journal of Forest Research*, 39(8): 1453–1464.

Quackenbush, L.J., 2007. Separating Types of Impervious Land Cover Using Fractals, in *Remote Sensing of Impervious Surfaces* (Q. Weng, Ed.), CRC Press, Boca Raton, Florida, pp. 119–142.

Recent Professional Development Activities

Attended or presented at Annual ASPRS Conference, 1998–2012

Attended ABET Annual Conference, 2011

Member, SUNY-ESF Council for Geospatial Modeling and Analysis

Co-PI, project developing variable credit online course in Climate Change Science and Sustainability, 2009–2011

Stephen B. Shaw
Assistant Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-6939, E-mail: sbshaw@esf.edu

Education

Ph.D. Biological and Environmental Engineering, Cornell University, 2009
M.S. Agricultural and Biological Engineering, Cornell University, 2005
B.S. Agricultural and Biological Engineering, Cornell University, 2000

Academic experience

Assistant Professor, SUNY-ESF, 2011–Present, Full time

Related Academic experience

Post-Doctoral Researcher/Research Associate, Cornell University, 2009–2011, Full time
Adjunct Faculty, Hobart and William Smith Colleges, 2008–2009, Part time

Non-academic experience

Consulting Engineer, Malcolm Pirnie, Inc., 2000–2003, Full-time

Certifications or professional registrations

Certification: E.I.T. 2002

Current membership in professional organizations

American Geophysical Union

Service activities

Institutional: Member, SUNY-ESF Committee on Research, August 2011-Present

Select Publications of last five years

Shaw, S.B. and M.T. Walter. 2012. Using comparative analysis to teach about the nature of nonstationarity in future flood predictions. Hydrology and Earth System Sciences, 16: 1269-1279, doi: 10.5194/hess-16-1269-2012

Shaw, S.B. and S.J. Riha, 2012. Examining individual recession events instead of a data cloud: A modified interpretation of streamflow recession data applied to glaciated watersheds in a humid, temperate climate. *Journal of Hydrology*, 434–435: 46–54, doi:10.1016/j/jhydrol.2012.02.034.

Shaw, S.B., R.D. Marjerison, D.R. Bouldin, J.Y. Parlange, and M.T. Walter, 2012. A simple model of changes in stream chloride levels due to road salt applications. *ASCE – Journal of Environmental Engineering*, 138:112-118, doi:10.1061/(ASCE)EE.1943-7870.0000458.

Shaw, S.B., A.A. Royem, and S.J. Riha, 2011. The relationship between extreme hourly precipitation and surface temperature in different hydroclimatic regions of the US. *Journal of Hydrometeorology*, 12(2): 319–325, doi: 10.1175/2011JHM1364.1.

Shaw, S.B. and S.J. Riha, 2011. Assessing Possible Changes in Flood Frequency Due to Climate Change in Mid-sized Watersheds in New York State, USA. *Hydrological Processes*, 25(16):2542–2550, doi:10.1002/hyp.8027.

Shaw, S.B. and S.J. Riha, 2011. Assessing temperature-based PET equations under a changing climate in temperate, deciduous forests. *Hydrological Processes*, 25(9): 1466–1478, doi: 10.1002/hyp.7913.

Shaw, S.B., J.R. Stedinger, and M.T. Walter, 2010. Evaluating pollutant build-up/wash-off models using a Madison, Wisconsin catchment. *Journal of Environmental Engineering – ASCE*, 136(2):194–203, doi: 10.1061/(ASCE)EE.1943-7870.0000142.

Shaw, S.B., J.-Y. Parlange, M. Lebowtiz, and M.T. Walter, 2009. Accounting for surface roughness in a physically-based urban wash-off model. *Journal of Hydrology*, 367(1–2):79-85, doi: 10.1016/j.jhydrol2009.01.004.

Shaw, S.B. and M.T. Walter, 2009. Improving Runoff Risk Estimates: Formulating Runoff as a Bivariate Process Using the SCS-Curve Number Method. *Water Resources Research*, 45: W030404, doi:10.1029/2008WR006900.

Shaw, S.B., A.A. Harpold, J.C. Taylor, and M.T. Walter, 2008. Investigating a high-resolution stream chloride time series from the Biscuit Brook Catchment, Catskills, NY. *Journal of Hydrology*, 348(3–4): 245–256, doi:10.1016/j.jhydrol.2007.10.009.

Shaw, S.B., R. Mahklouf, M.T. Walter, J.-Y. Parlange, 2008. Experimental testing of a stochastic sediment transport model. *Journal of Hydrology*, 348(3-4): 425–430, doi:10.1016/j.jhydrol.2007.10.014.

Recent Professional Development Activities

Speaker, NY Section AWWA, New York's Water Event and Expo, Saratoga Springs, NY, April 17, 2012

Speaker, NY Section AWWA State Meeting, Seneca Fall, NY, December 1, 2011

Wendong Tao
Assistant Professor
Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry, Syracuse, NY 13210
Phone: 315-470-4928, E-mail: wtao@esf.edu

Education

Ph.D. Civil (Environmental) Eng., University of British Columbia (Canada), 2006
M.Sc. Environmental Geosciences, Beijing Normal University (China), 1990
B.Sc. Geography, Shaanxi Normal University (China), 1984

Academic experience

Assistant Professor, SUNY-ESF, 2007–present, Full-time
Senior Laboratory Instructor, University of Northern British Columbia (Canada), 2006–2007, Full-time

Related Academic experience

Researcher, Economy and Environmental Program for SE Asia, International Development Research Centre (Canada), 1997–1998, Part-time

Non-academic experience

Senior project scientist, New East Consulting Services Ltd (Canada), 2003–2005, Part-time
Senior engineer, Director of Lake Center, Yunnan Provincial Institute of Environmental Sciences (China), 1990-1999, Full-time

Certifications or professional registrations

Association of Professional Engineers and Geoscientists of British Columbia, Canada: Eligible for EIT; passed Professional Practice Exam; professional work experience in review.

Current membership in professional organizations

Water Environment Federation (WEF)
New York Water Environment Association (NYWEA)
Ecological Engineering Council, Amer. Soc. of Agr. and Biological Engineers (ASABE)

Honors and awards

Design for People, Prosperity, and the Planet (P3) Award. U.S. EPA. 4/23/2012.

Service activities

Institutional: Graduate Coordinator, Department of Environmental Resources Engineering, SUNY-ESF, September 2011–present; Coordinator, Ecological Engineering Laboratory, SUNY-ESF, 2008–present.

Professional: Reviewer, USDA (2010), NSF (2010, 2011); Panelist, NSF (2012), EPA (2012), USDA (2010); Executive editor, J. of Forest Research: Open Access, Nov 2011–present; Manuscript Reviewer for journals such as Ecol. Eng. and Water Research; Organizer of BE-10 Sessions on Nutrient Removal, Recovery, and Recycle at 2012 ASABE Annual International Meeting. August 2011–present.

Select Publications of last five years

Tao W., Wen J., Han Y., and Huchzermeier M, 2012. Nitrogen removal in constructed wetlands using nitrification-denitrification and nitritation-anammox: effects of influent nitrogen concentrations. *Water Environ. Res.* In press.

Xia M., Tao W., Wang Z., and Pei Y, 2012. Treatment of anaerobically digested dairy manure in a two-stage biofiltration system. *Water Sci. Technol.*, 65(11): 1975-1981.

Xia M., Tao W., Shayya W., and Lu Z, 2012. Passive solid-liquid separation of anaerobically digested dairy manure using two-stage filtration. *Biosys. Eng.*, 111(4): 392-397.

Huchzermeier M., and Tao W, 2012. Overcoming challenges to struvite recovery from anaerobically digested dairy manure. *Water Environ. Res.*, 84(1): 34-41.

Tao W., Wen J., and Norton C, 2011. Laboratory study on factors influencing nitrogen removal in marble chip biofilters incorporating nitritation and anammox. *Water Sci. Technol.*, 64(6): 1211-1217.

Tao W., Wen J., and Huchzermeier M, 2011. Batch operation of biofilter - free water surface wetland series for enhancing nitritation and anammox. *Water Environ. Res.*, 83(6): 541-548.

Cui B, Hua Y., Wang C., Liao X., Tan X., and Tao W, 2010. Estimation of ecological water requirements based on habitat response to water level in Huanghe River Delta, China. *Chinese Geograph. Sci.*, 20(4): 318-329.

Cui B., Wang C., Tao W., and You Z, 2009. River channel network design for drought and flood control: A case study of Xiaoqinghe River Basin, Jinan City, China. *J. Environ. Manag.*, 90(11): 3675-3686.

Tao W., and Wang J, 2009. Effects of vegetation, limestone and aeration on nitritation, anammox and denitrification in wetland treatment systems. *Ecol. Eng.*, 35(5): 836-842.

Tao W., Hall K., and Ramey W, 2007. Effects of influent strength on microorganisms in surface flow mesocosm wetlands. *Water Res.*, 41(19): 4557-4565.

Tao W., Hall K.J., and Duff S.J.B., 2007. Microbial biomass and heterotrophic production of surface flow mesocosm wetlands treating woodwaste leachate: responses to hydraulic and organic loading and relations with mass reduction. *Ecol. Eng.*, 31(2): 132-139.

Tao W., Hall K., and Hall E., 2007. Laboratory study on potential mechanisms for treatment of woodwaste leachate in surface flow constructed wetlands. *J. Environ. Eng. Sci.*, 6(1): 85-94.

Recent Professional Development Activities

Environmental and Chemical Safety Training, Office of Environmental Health and Safety SUNY-ESF, Syracuse, New York, January 21, 2011.

ESF Faculty Mentoring Colloquiums, Office of Sponsored Research Programs, SUNY-ESF, Syracuse, New York, January 12, 2012; January 6, 2010; January 8, 2009.

Appendix C – Equipment

Please list the major pieces of equipment used by the program in support of instruction.

The ERE Department has several major pieces of equipment used to support instruction. In addition to the computer spaces described in Criterion 7, ERE students use three primary hardware-focused laboratories maintained by the Department: the hydrology and hydraulics laboratory, the ecological engineering laboratory, and the surveying laboratory. These three laboratories are described below. Additionally, ERE students complete laboratory exercises using facilities maintained by other departments at ESF and at Syracuse University. These include the biology (Illick Hall), and chemistry (Jahn Lab) laboratories at ESF, and the physics and soil mechanics laboratories at Syracuse University.

Ecological Engineering Laboratory (Baker 108)
The Ecological Engineering laboratory supports instruction in required and elective courses in ecological engineering, including ERE 275 Ecological Engineering I, and ERE 440 Water Pollution Engineering. Table C-1 summarizes the major pieces of equipment in the room that are utilized by the ERE students. The lab also contains the glassware and lab materials needed to support a typical wet chemistry lab, as well as an auto-analyzer, drying oven and furnace that are primarily utilized for research.

Table C-1. Ecological Engineering laboratory equipment.

Description
2 Fisher Scientific Accumet pH meters
2 Fisher Scientific Accumet TDS meters
2 Fisher Scientific Accumet DO meters
2 Fisher Scientific zoom stereo microscopes
Fisher Scientific compound biological microscope
Fisher Scientific digital microscope
Fisher Scientific digital phase microscope

Hydrology and Hydraulics Laboratory (Baker 106)
The James Hassett M. Laboratory for the Study of Hydrology and Hydraulics is used to support lab instruction in a range of classes including ERE 339 Fluid Mechanics and ERE 340 Engineering Hydrology and Hydraulics. The major pieces of equipment in the lab are summarized in Table C-2. The lab also houses a variety of support instrumentation such as flow testing and demonstration weir inserts.

Table C-2. Hydrology and Hydraulics laboratory equipment.

Description
2 Armfield F1-10 hydraulic benches
Armfield C4MKII 3 m multi-purpose teaching flume
Armfield S6 MK II 7 m glass-sided sediment and water recirculating tilting flume
Emriver Em2 Geomodel River Model table
ESF River Model table

Surveying Laboratory (Baker 105 – Design Studio)

The ERE 371 Surveying for Engineers laboratories are primarily conducted outside. Major equipment used in the field includes total stations, global positioning system (GPS) receivers, levels, and other supporting accessories (e.g. steel tapes, plumb bobs, and tripods). The major pieces of equipment are summarized in Table C-3. The design studio used for surveying labs is divided into two sections that includes traditional classroom seating to facilitate recitation delivery, but also has four computer workstations equipped with large monitors and the necessary software (e.g. Excel and AutoCAD) to facilitate group-based data analysis and map production. This flexible studio space is used also used for other design-based required and elective classes taken by the ERE students.

Table C-3. Surveying laboratory equipment.

Description
5 Trimble GeoExplorer GeoXH's with Hurricane Antennas
3 Leica System 300
2 Leica System 500
6 Topcon GTS-239W total stations
1 Trimble 3603DR Zeiss Elta total station
6 Reflexive prisms with prism poles
5 Nikon AP-5 autolevels
3 Topcon AT-G3 autolevels

Appendix D – Institutional Summary

A. The Institution

Name and address of the institution
State University of New York College of Environmental Science and Forestry
One Forestry Drive
Syracuse, New York 13210-2778

Name and title of the chief executive officer of the institution
Cornelius B. Murphy, Jr., Ph. D.
President
224 Bray Hall
State University of New York College of Environmental Science and Forestry
One Forestry Drive
Syracuse, New York 13210-2778

Name and title of the person submitting the self-study report
Dr. Gary M. Scott
Director, Division of Engineering
Professor and Chair, Department of Paper and Bioprocess Engineering
SUNY College of Environmental Science and Forestry
One Forestry Drive
Syracuse, NY 13210

Dr. Theodore A. Endreny, P.E., P.H.
Professor and Chair, Department of Environmental Resources Engineering
SUNY College of Environmental Science and Forestry
One Forestry Drive
Syracuse, NY 13210

Organizations by which ESF is currently accredited and dates of initial and most recent accreditation evaluations

Middle States Commission on Higher Education	1952 / 2012
ABET Engineering Accreditation Commission	1983 / 2006
ABET Technology Accreditation Commission	2009 / 2010
American Society of Landscape Architects	1957 / 2012
Society of American Foresters	1935 / 2003
Society of Wood Science and Technology	2002 / 2003

B. TYPE OF CONTROL

ESF is a small, public specialized campus within the State University of New York (SUNY). ESF cooperates closely with Syracuse University, a private, comprehensive research university.

C. EDUCATIONAL UNIT

The Department of Paper and Bioprocess Engineering (PBE) and the Department of Environmental Resources Engineering (ERE) are two of eight academic departments at ESF. Together with the Department of Sustainable Construction Management and Engineering (SCME), the three engineering departments form the Division of Engineering (Figure D-1). The activities of the Division of Engineering are coordinated by the Director of Engineering (Gary M. Scott). The chairs of the engineering departments, as well as the chairs of the other departments and the Division of Environmental Science, on campus report directly to the Provost and Vice President for Academic Affairs (Bruce C. Bongarten). Figure D-1 shows these and the other offices reporting to the Provost.

The Provost and Vice President for Academic Affairs reports directly to the President of the College (Cornelius B. Murphy) (Figure D-2). Also reporting directly to the President are the Vice President of Administration, the Vice President of Enrollment Management and Marketing, the Interim Director of Renewable Energy Systems, the Director of Development, Director of Alumni Relations, and the Director of Government Relations and Institutional Planning.

The President reports to the Chancellor of the State University of New York (Nancy Zimpher) and the ESF Board of Trustees (William L. McGarry, Jr., Chair) (Figure D-2).

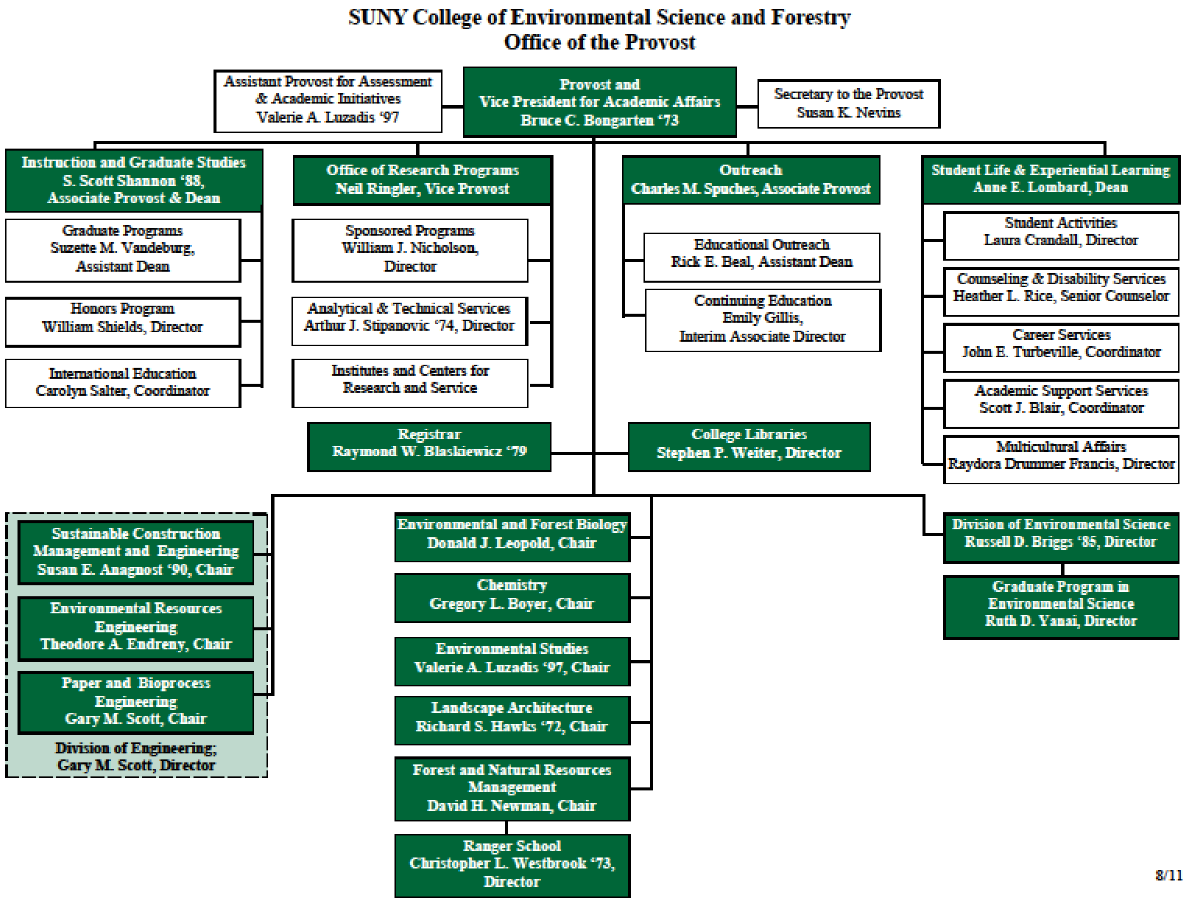

Figure D-1. Organizational chart for the Office of the Provost.

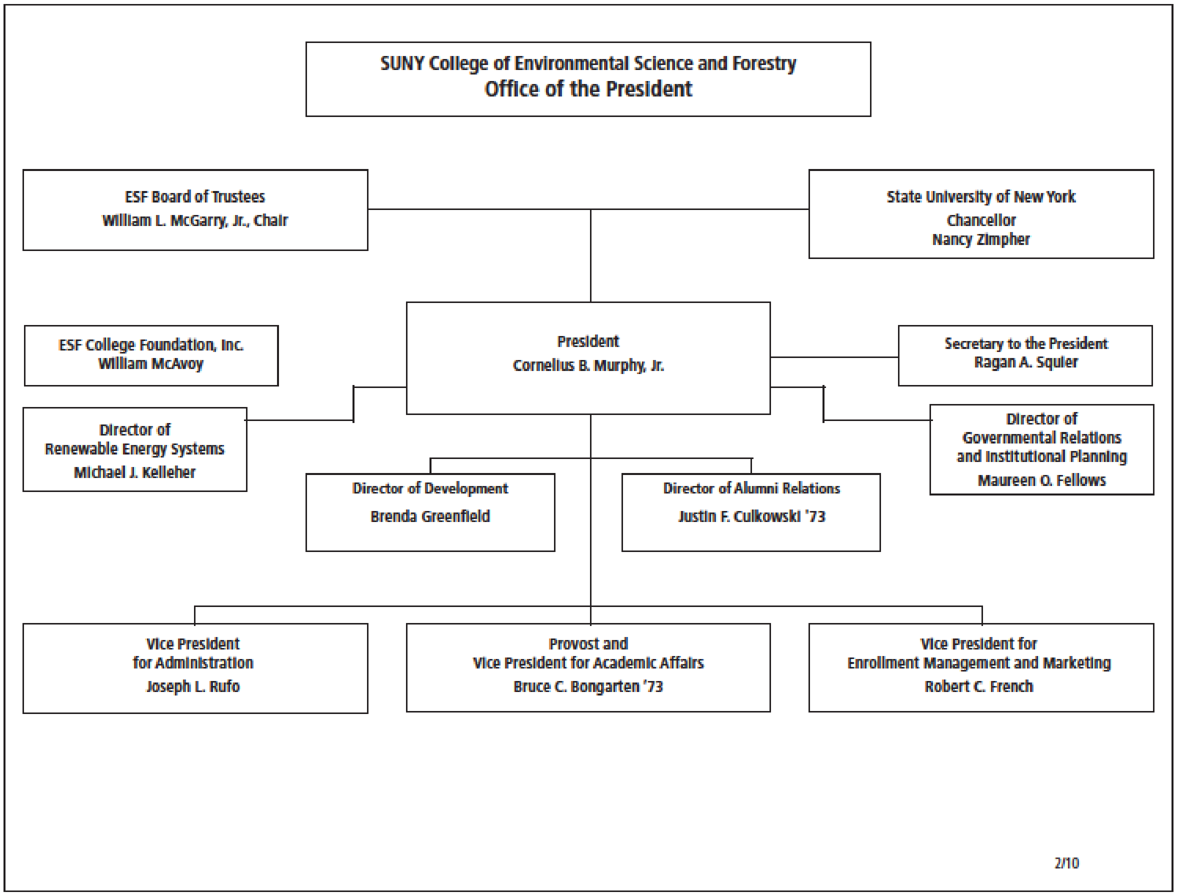

Figure D-2. Organizational chart of ESF from the Office of the President.

D. Academic Support Units

Table D-1 summarizes the courses taught by support units at ESF and Syracuse University. This table also shows the responsible persons for that unit (typically the Department Chair).

Table D-1 Support units teaching courses in support of the engineering programs.

Academic Unit	Courses Taught	Responsible Person
Chemistry	FCH 150: General Chemistry I FCH 151: General Chemistry I Laboratory FCH 152: General Chemistry II FCH 153: General Chemistry II Laboratory FCH 221: Organic Chemistry I FCH 222: Organic Chemistry I Laboratory FCH 223: Organic Chemistry II FCH 224: Organic Chemistry II Laboratory FCH 360: Physical Chemistry I FCH 361: Physical Chemistry II FCH 380: Analytical Chemistry I FCH 399: Introduction to Atmospheric Sciences	Gregory Boyer, Professor and Chair
Environmental and Forest Biology	EFB 101: Gen Bio I: Organismal Biol. & Ecol. EFB 102: General Biology I Laboratory EFB 103: Gen Bio II: Cell Biology and Genetics EFB 104: General Biology II Laboratory EFB 120: The Global Env. & the Evolution of Human Culture EFB 215: Interpreting Science Through Art EFB 217: Peoples, Pests, and Plagues EFB 305: Indigenous Issues and the Environment	Donald Leopold, Professor and Chair
Environmental Resources Engineering	APM 395: Probability and Statistics for Engineers ERE 440: Water Pollution Engineering	Theodore Endreny Professor and Chair
Environmental Studies	EST 200: Cultural Ecology EST 201: Amer. Hist.: Reconstruction to Present EST 361: History of the Amer. Env. Movement EWP 190: Writing and the Environment EWP 290: Research Writing and Humanities	Valerie Luzadis, Associate Professor and Chair
Forest and Natural Resources Management	APM 205: Calculus I: Science & Engineering APM 206: Calculus II: Science & Engineering APM 307: Calculus III: Science & Engineering FOR 202: Introduction to Sociology FOR 203: Western Civilization & the Env. FOR 204: Natural Resources in American Hist. FOR 207: Introduction to Economics FOR 321: Forest Ecology and Silviculture FOR 338: Meteorology FOR 345: Introduction to Soils	David Newman, Professor and Chair
Landscape Architecture	LSA 182: Drawing Studio LSA 205: Art, Culture and Landscape I LSA 206: Art, Culture and Landscape II	Richard Hawks, Professor and Chair
Moon Library	ESF 200: Information Literacy	Stephen Weiter Director, College Libraries

Academic Unit	Courses Taught	Responsible Person
Paper and Bioprocess Engineering	APM 485: Differential Equations for Eng. & Sci. GNE 461: Air Pollution Engineering PSE 201: The Art & Early Hist. of Paper Making PSE 361: Engineering Thermodynamics	Gary M. Scott, Professor and Chair
Sustainable Constr. Mgmt. and Eng.	GNE 172: Statics and Dynamics GNE 273: Mechanics of Materials	Susan Anagnost Associate Professor and Chair
Civil and Environmental Engineering (SU)	CIE 331: Analysis of Structures and Materials CIE 332: Design of Concrete Structures CIE 337: Introduction to Geotechnical Eng. CIE 338: Foundation Engineering CIE 443: Transportation Engineering CIE 473: Transport Processes in Env. Eng.	Chris E. Johnson, Professor and Chair
Mathematics (SU)	MAT 285: Calculus I MAT 286: Calculus II MAT 397: Calculus III	Eugene Poletsky Professor and Chair
Physics (SU)	PHY 211: General Physics I PHY 221: General Physics I Laboratory PHY 211: General Physics II PHY 221: General Physics II Laboratory	Peter Saulson, Professor and Chair

E. NON-ACADEMIC SUPPORT UNITS

Table D-2 lists the non-academic support units for the ERE program.

Table D-2. Non-academic support units for the engineering programs.

Support Unit	Responsible Person
Business Affairs	David Dzwonkowski, Director
ESF College Foundation, Inc.	Brenda Greenfield, Director
Environmental Health and Safety	John R. Wasiel, Env. Health and Safety Officer
Financial Aid and Scholarships	John E. View, Director
Human Resources	Marcia A. Barber, Director
Information Technology	Yuming Tung, Director
Instruction and Graduate School	S. Scott Shannon, Associate Provost for Instruction
Moon Library	Stephen P. Weiter, Director
Outreach and Instructional Quality	Charles M. Spuches, Associate Provost for Outreach
Physical Plant	Brian Boothroyd, Acting Director
Registrar	Raymond Blaskiewicz, Registrar
Research Programs	Neil Ringler, Vice Provost of Research
Student Affairs	Anne E. Lombard, Dean
Academic Support Services	Scott Blair, Coordinator
Career Services	John Turbeville, Assistant Dean for Student Affairs
Community Service & Service-Learning	Elizabeth Mix, Coordinator
Multicultural Affairs	Raydora Drummer Francis, Director
Student Involvement & Leadership	Laura Crandall, Director
Student Wellness and Support	Heather Rice, Coordinator
Undergraduate Admissions	Susan Sanford, Director

F. CREDIT UNIT

The College uses the semester calendar. The credit hour consists of a minimum of 750 minutes of instruction per credit hour as required by the State University of New York. ESF coordinates its schedule with Syracuse University to allow students to seamlessly take courses at each university. Typically, a three credit hour course meets M-W-F for 55 minutes for 14 weeks (2310 minutes) or T-Th for 80 minutes for 14 weeks (2240 minutes). A normal expectation is two hours of outside study per week for each credit hour. For laboratories associated with courses, a credit hour typically consists of 3 hours of activities per week for 14 weeks.

G. TABLES

Table D-3 summarizes the enrollment data for the ERE program for 2007–2012. Table D-3 also provides a total number of degrees awarded by the Department, which includes Bachelor's degrees in ERE and FEG, as well as graduate degrees. All faculty who are engaged in the ERE program are also involved in the FEG program and supervise graduate students.

Table D-3. Program enrollment for BS ERE program and degree data for ERE Department

Academic Year	Status	Enrollment Year[1]					Total Undergrad[1]	Total Grad	Degrees Awarded by ERE Department			
		1st	2nd	3rd	4th	5th			Assoc.	Bach.[1]	Masters[2]	Doctorates[2]
2011–12	Full time	32	23	6	18		79	22		30	4	
	Part time							14				
2010–11	Full time	17	2	8	10		37	22		22	7	2
	Part time							14				
2009–10	Full time							25		26	12	1
	Part time							16				
2008–09	Full time							25		21	5	2
	Part time							14				
2007–08	Full time							17		27	13	
	Part time							20				

[1] Enrollment data and total undergrad count includes only students in ERE program.
[2] Bachelor's degrees awarded are totals for the ERE Department and include students in ERE and FEG degree programs.
[3] Masters and Doctorates awarded are totals for the ERE Department; all Department faculty are engaged in graduate education.

Table D-4 summarizes the personnel within the ERE Department for the 2011–2012 academic year. All personnel in the Department contribute to the ERE program.

Table D-4. Environmental Resources Engineering personnel for 2011–2012

	Head Count[1]		FTE[2]
	Full time	Part Time	
Administrative[3]	1		0.5
Faculty (tenure-track)	9		8.5
Other Faculty (excluding student assistants)		1	0.25
Student Teaching Assistants	5	6	8.75
Student Research Assistants	5	1	5.25
Technicians/Specialists	2		2
Office/Clerical Employees	1		1
Others			

1 Includes all members of Environmental Resources Engineering Department
2 For student teaching and research assistants, 1 FTE equals 20 hours per week of work.
3 Persons with joint administrative/faculty positions are allocated to each category according to the fraction of the appointment assigned to that category.

Table D-5 summarizes the personnel in supporting academic departments at ESF and Syracuse University for the 2011–2012 academic year.

Table D-5. Personnel in supporting academic departments for 2011–2012

Department		Full-time Faculty Head Count	Part-time Faculty Head Count	FTE Faculty	Teaching Assistants	
					Head Count	FTE
ESF	Chemistry	17	1	17.25	15	7.5
	Environmental and Forest Biology	33	3	33.7	38	19
	Environmental Studies	14	10	20.25	23	11.5
	Forest and Natural Resources Management	20	3	22	17	8.5
	Paper and Bioprocess Engineering	9	1	8.75	14	14
	Sustainable Construction Management and Engineering	8	1	7.75	3	1.5
SU	Mathematics	31	6	34		
	Physics	31	0	31		
	Civil and Environmental Engineering	12	4	14		
	Electrical Engineering and Computer Science	35	16	43		
	Mechanical and Aerospace Engineering	13	1	13.5		

Table D-6 summarizes faculty salary data for the ESF campus, the division of Engineering, and the ERE Department for the 2011–2012 academic year.

Table D-6. Faculty salary data for 2011–2012 (converted to 10 months)

		Professor	Associate Professor	Assistant Professor	Instructor
ESF	Number	56	29	27	9
	High	$144,048	$94,500	$85,846	$72,011
	Mean	$106,509	$74,679	$67,247	$58,969
	Low	$66,608	$61,377	$51,015	$44,202
Division of Engineering	Number	10	5	8	2
	High	$144,048	$95,137	$85,846	$72,011
	Mean	$123,736	$92,053	$76,302	$70,524
	Low	$98,658	$83,572	$69,000	$69,036
ERE Department	Number	2	2	5	
	High	$122,710	$94,191	$80,132	
	Mean	$121,635	$88,881	$74,169	
	Low	$120,560	$83,572	$69,000	

Table D-7 and Table D-8 provide summary statistics for the admission standards for freshman and transfer students, respectively, entering the ERE Department over the last five academic years.

Table D-7. History of admissions standards for freshman entering the ERE Department

Academic Year	Composite SAT		Number of New Students Enrolled
	MIN	AVG	
2011–12[1]	1140	1240	37
2010–11[1]	1120	1200	18
2009–10[2]	1120	1190	28
2008–09[2]	1110	1160	31
2007–08[2]	1090	1170	13

[1] Includes only students enrolling in ERE degree.
[2] Includes only students enrolling in FEG degree.

Table D-8. History of admissions standards for transfers entering the ERE Department

Academic Year	Transfer GPA		Number of New Students Enrolled
	MIN	AVG	
2011–12[1]	3.14	3.51	7
2010–11[2]	3.42	3.49	4
2009–10[3]	2.59	3.19	6
2008–09[3]	2.57	3.22	11
2007–08[3]	2.44	3.22	14

[1] Includes only students enrolling in ERE degree.
[2] Includes students enrolling in ERE and FEG degrees.
[3] Includes only students enrolling in FEG degree.

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Environmental Resources Engineering program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

Gary M. Scott
Director of Engineering

28 June 2012

______________________________ ______________________
Signature **Date**