ABET
Self-Study Report

for the

Civil Engineering BS Program

at

The University of Maine

Orono, Maine

30 June 2012

CONFIDENTIAL

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Background Information

A. Contact Information

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B. Program History

The University of Maine first awarded civil engineering degrees in 1872, the year of the institution's first graduating class. The civil engineering program has been accredited since 1936, and the last general review took place in 2006. Only minor program changes, which focus on ensuring adequate breadth in the discipline, have taken place since the last program review.

C. Options

There are no options, tracks, or concentrations specified on transcripts or diplomas.

D. Organizational Structure

The Department of Civil & Environmental Engineering is administered by a Department Chair, appointed by the Dean of Engineering, typically from the among the members of the department. The chair is responsible for the overall management of the program, and oversight of the faculty. The chair reports to the Dean of Engineering. An organization chart for the Academic Affairs unit of the institution is presented in Figure 1.

E. Program Delivery Modes

The Bachelor of Science program in Civil Engineering is a day program, although occasionally some 400-level civil engineering courses (designated as CIE) are taught in the evening based on schedule constraints. While the primary mode of instruction on campus is classroom-based, students can take some web-based courses to fulfill humanities electives, as well as some mathematics courses. In the academic year 2011-12, all CIE courses were traditional lecture/laboratory, with the exception of Engineering Ethics, which was a hybrid of web-based materials and classroom discussion.

F. Program Locations

With the exception of transfer students, students fulfill all program requirements on the Orono campus. Starting in the fall of 2012, the first two years of the program will be offered in Brunswick, Maine at the new campus of MATEC, a collaboration between the University

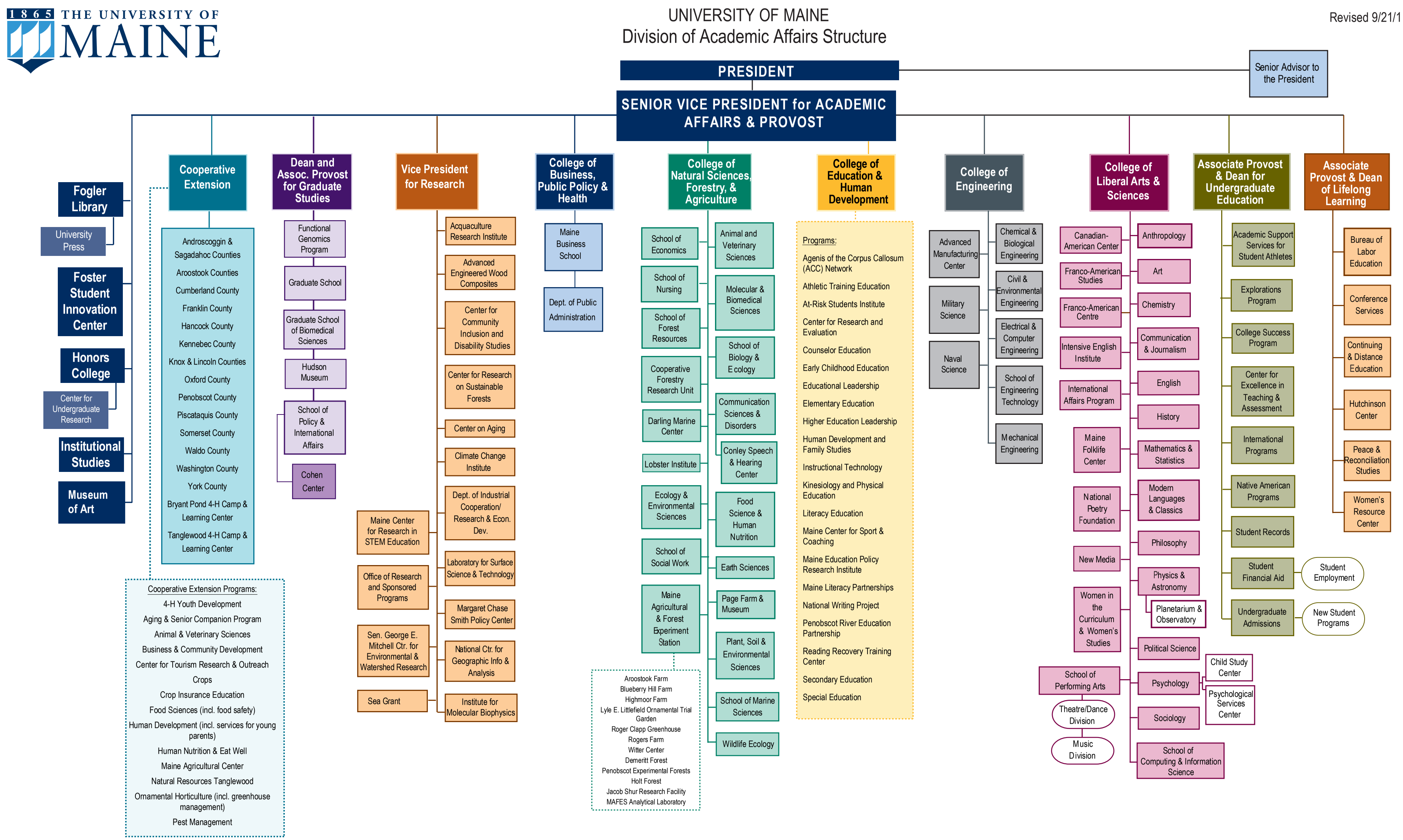

Figure 1. Organizational Chart for the Academic Affairs Unit of the University of Maine

of Maine and Southern Maine Community College, in cooperation with the University of Southern Maine. This new program is not considered in the current ABET review cycle.

G. Weaknesses or Concerns from Previous Evaluation and the Actions Taken

The last (2006) ABET accreditation review cited a weakness, two concerns, and an observation.

The program weakness related Criterion 3: Program Outcomes and Assessment:

> *Criterion 3 states that engineering programs must demonstrate that their students have attained outcomes "a" through "k." Although a functioning, closed-loop outcome assessment process is in place that has been used to identify shortcomings and produce curricular and other program improvements, the current process does not clearly assess or demonstrate individual student achievement of individual program outcomes based on quantitative performance measures against an established standard.*

The program concerns were related to Criterion 7: Institutional Support and Financial Resources, and Criterion 8: Program Criteria:

> *Criteria 7: Undergraduate laboratories and equipment are maintained and operated by faculty alone without the assistance of any dedicated technician or support personnel. The physical adequacy of the facilities and equipment and the effectiveness of the laboratory experiences for students could eventually be compromised without day-to-day technical support.*
>
> *Criteria 8: Depending on the electives taken by a student, the required achievement of proficiency in four areas of civil engineering may rely on a single course in any of the available areas of structures, hydraulics, environmental, geotechnical, and transportation. With required hydraulic and soil mechanics laboratories on top of the associated lecture course and a strong required first course in transportation, this criterion is marginally satisfied. The program thread in transportation is currently dependent on a single faculty member with this specialty. Although the program could be satisfied in the absence of a transportation thread, the strength of the overall program would be jeopardized by the loss of this faculty member.*

The program observation was as follows:

> *Although the civil engineering classrooms, laboratories, offices and administrative areas in Boardman Hall appear adequate for delivery of the program, they present an old and shabby appearance that reflects poorly on the program and university and may adversely affect future attraction of students and faculty.*

Actions taken to address Program Weakness

In response to the Program Weakness under Criterion 3, the following actions were taken:

1. For our specific program outcomes, we adopted the language and notation of ABET Criterion 3 (a through k) as our program outcomes. Our previously adopted program outcomes (denoted 1 through 7) were sound and matched up well with ABET Criterion 3, but the notational differences made documentation difficult, and placed an additional burden on ABET program evaluators.
2. We tightened up the relationship between program course outcomes and program outcomes. This allowed us to better track individual achievements in the courses, and

thus overall program outcomes. Each CIE course has specific outcomes that contribute to overall program outcomes. This tightened course outcome-program outcome relationship was implemented for the 2007-08 academic year.

3. Course assessment instruments have been improved to better match the specific course and program outcomes. Among these are course specific student assessments that have certain common elements and common formatting so students quickly become familiar with the purpose and use. These new instruments were implemented in the 2007-08 academic year.

Actions taken to address Program Concerns

No long term progress has been made to address the Criterion 7 Program Concern regarding the lack of a dedicated technician. In the fall of 2008, we were able to hire a full time laboratory manager who took responsibility for day-to-day operations of teaching and research laboratories in Boardman Hall, including formalizing safety protocols. The person hired took a maternity leave after two years, and ultimately decided not to return to the position. Budget uncertainties during that time led us to shift the responsibilities from a full-time professional to a series of temporary staff members, who have included short term research faculty, graduate assistants, and undergraduate assistants. This is admittedly not a desirable arrangement for us, and while it perhaps adversely affects our research activities, particularly in the environmental area, it has not affected our ability to deliver quality laboratory experiences for our undergraduate students.

With respect to the concerns of the 2006 evaluator on Criterion 8 regarding the marginal satisfaction of proficiency in four areas of civil engineering, we stood by our program on this matter. However, as part of our regular program review, we made the conclusion that a not insignificant number of our students were taking all their advanced civil engineering elective classes in a single sub-discipline (e.g. structures or environmental). We did not believe this was in line with our Program Educational Objectives for breadth in the discipline. In response, we made a curricular revision such that students are now required to take at least one advanced elective in three out of the five civil engineering sub-disciplines in which we offer courses. This "three out of five" requirement is intended to assure both breadth as well as depth.

There has been no action to address the second Criterion 8 Concern regarding the lone faculty member with expertise in transportation. We note that while we are indeed relying on this single faculty member for transportation-related elements of our program, we contend that the departure of this faculty member would not automatically mean the end of that aspect of our program. Indeed, the lone transportation faculty member will be on sabbatical leave in the fall of 2012, and we had little trouble finding competent practicing design professionals to cover this aspect of our program in the regular faculty member's absence.

Actions taken to address Program Observation

We are pleased to report that considerable progress has been made with respect to our "somewhat shabby and outdated" facilities. During past six years, we have secured endowments for all of our teaching laboratories, as well as some of our additional student work spaces. Major investments in our Materials Laboratory and our Soils Laboratories in particular have led to both cosmetic and functional improvements. Improvements to the department office and the surrounding area now presents a more respectable face for visitors.

H. Joint Accreditation

No joint accreditation is requested for this program.

General Criteria

Criterion 1. Students

A. Student Admissions

Students are admitted to the program through a process administered by the University of Maine Office of Admissions as guided by the Associate Dean of the College of Engineering. The admission decision is made based on the materials included in the complete application and is done on a holistic basis, considering academic records (courses completed and grades earned, class rank and grade point average), standardized test scores, official school recommendations, the student's essay and the student's activities/leadership. For admission to Engineering, first-year students are expected to follow the listed guidelines:

Entrance Requirements (courses at the College Prep Level or higher):

- 4 years of English
- 2 years of Algebra - I and II
- 1 year of Geometry
- 1/2 year Trigonometry (or Pre-calc or higher) - Prefer a full year of an advanced math course
- 2 years of Lab Science (Physics and Chemistry are both required)
- 2 years of History/Social Science
- A senior year mathematics course is preferred if the math requirements are fulfilled by the junior year.

Academic Criteria:

- B's or better in key courses (math and science), especially junior and senior years and top 30% of HS class with a combined SAT (verbal+quantitative) of 1100, *or* top 15% of HS class with a combined SAT of 1000, *or* top 25% and combined SAT of 1050, *or* top 40% and combined SAT of 1200.

Typically only candidates from very competitive high schools (better than 50% going on to 4 year college programs are admitted to engineering - questions about class rank should be directed to Associate Dean. Strong candidates taking physics or chemistry with out a physics or chemistry grade can be admitted by the admissions office. Excellent candidates without physics or chemistry are referred to the Associate Dean for review.

B. Evaluating Student Performance

Students are evaluated in each course by the professor. Grades of A, B, C, D, and F (fail) are used in this part of the process. The evaluation instruments consist of homework assignments, project reports, laboratory reports, presentations, and examinations. A minimum of three examinations over the course of a semester is encouraged by the department. In some courses, teaching assistants help with grading of assignments but not examinations. There is a one-week final examination period at the end of the semester. Evaluation of the senior capstone course involves four or more professors in the department.

Performance is based on team-participation, technical content, and understanding of the broader societal interrelationships, and a minimum of two presentations.

Additional evaluations are conducted by the Co-op coordinator for those students who participate in Co-op during the summer. These evaluations consist of site visits, interviews with supervisors and progress reports. Up to three academic credits can be earned through Co-op as a Technical Elective.

Finally, all students in Civil Engineering are strongly encouraged to take the Fundamentals of Engineering (FE) exam. Although not required, nearly all Civil Engineering students take the exam.

C. Transfer Students and Transfer Courses

Transfer candidates are evaluated by the UMaine Admission Office in conjunction with the Associate Dean of the College of Engineering. They are evaluated on the basis of their high school record and strength of their academic work in college. Academic evaluations in math and science courses are a key part of the transfer evaluation process. For consideration, transfer students must possess a minimum 2.0 GPA on a 4.0 scale.

Evaluation of transfer credit occurs at two levels. The first is the “Evaluation of Transfer Credit” performed at the University level by the Office of Student Records with the assistance of the Associate Dean of the College of Engineering. This determines which courses are acceptable for University of Maine credit and the equivalent UMaine courses. In many cases there is not an exact match with a UMaine course, so only the equivalent academic program and level are identified. These courses are designated with an equivalency such as HTY 2XX, where the three letters designate the academic program and the number designates the level (1 = first-year, 2 = sophomore, 3 = junior, 4 = senior). The University of Maine accepts academic work completed with grades of "C-" or better at regionally accredited institutions of higher education.

Occasionally Civil Engineering students take courses during the summer at another institution within the University of Maine System (UMS). For these cases, the equivalent UMaine course is determined by an equivalency table available on the UMS and UMaine web sites.

The second evaluation is performed by the Chair at the department level with assistance from the Associate Dean of the College of Engineering. In this step, the Civil Engineering curriculum requirements that have been satisfied are determined. For a particular transferred course to count for a program requirement, it must have substantially the same content. Equivalency is determined by examination of course descriptions, textbooks, course outlines, and student work. Past experience with students from the school involved is also considered when available. The UMaine Civil Engineering requirements that have been satisfied are recorded on the curriculum sheet contained in each student’s file.

Authority to determine equivalency of the University’s Human Values and Social Context requirements rests with the Associate Dean of the College of Engineering. To determine equivalency for courses in this category, the normal procedure is for the Department Chair to propose a list of courses taken at a other institution that satisfy HVSC requirement and then the Associate Dean approves, or if needed, modifies this list. The e-mail confirming this determination is included in the student's file.

For transfers within the University, only students with a minimum GPA of 2.0, and a C- or better in MAT 126 Calculus I will be considered. For these students, only the second step described above is applicable.

D. Advising and Career Guidance

Students are assigned a CIE faculty advisor at the time of entry into the program. This advisor provides both an academic and professional guidance, and the students normally keep this advisor until they graduate. Students also receive the Undergraduate Brochure. This brochure is also available on the departmental web page, and contains necessary program information. Incoming students take a Mathematics Placement Examination Test. The result of this test is used to place the students in the appropriate level of mathematics courses. Typically, students who do not have a sufficiently high score in mathematics will be advised to take a pre-calculus course.

At the start of the first semester, each student is given a copy of the two-sided Civil Engineering Curriculum sheet. The sheet effective for the 2011-12 academic year is shown in Figure 1-1. This sheet shows and explains the graduation requirements, including the requirements for engineering design, engineering science, and the human values and social context (HVSC) credits that must be met with elective courses. Students are required to meet with faculty advisors during pre-registration week to discuss elective course selections. The advisor ensures that the student has satisfied prerequisites, and is prepared to advance in the most efficient way. The advisor is responsible for the completion of the Advisor's Check List for Graduation which records the courses taken by a student to complete all program requirements. The sheet effective for the 2011-12 academic year is shown in Figure 1-2. The University's general education requirements are also included on the check list so that all graduation requirements are listed in a single place. Official copies of the Civil Engineering Curriculum Sheet and the Advisor's Check List for Graduation are kept by the Department in the student's official file. These are the working documents used by the advisor and Department Chair to ensure that the student fulfills the graduation requirements in an orderly manner. In addition to the official copies, most students keep independent copies for their personal academic planning.

Substitutions for required courses are rarely allowed and then only with the concurrence of both the student's Academic Advisor and the Chair.

E. Work in Lieu of Courses

Typically work in lieu of courses is not allowed in the program. The exception is Advanced Placement (AP) courses in the mathematics (typically Calculus I) and the humanities. In the case of calculus courses, credit in the program is only granted if the students earn an appropriate score on the math placement exam.

CIVIL ENGINEERING CURRICULUM

Revised 6/12

NAME: Sept 2012

ADVISOR:

FIRST YEAR

FALL SEMESTER		HOURS	Grade	SPRING SEMESTER		HOURS	Grade
CIE 100	Intro to Civil & Env Eng	1		CIE 101	Cvl Eng Graphics	3	
CIE 110	Materials	3		CIE 115	Computing in CE	3	
CIE 111	Materials Lab	1		MAT 127	Calculus II	4	
CHY 131	Chemistry for Engr	3		PHY 121	Engr Physics I	4	
CHY 133	Chemistry Lab	1		______	HVSC W S C P A [1]	3	
ENG 101	College Comp	3				17	
MAT 126	Calculus I	4					
		16					

SECOND YR

FALL SEMESTER		HOURS	Grade	SPRING SEMESTER		HOURS	Grade
CET 101	Plane Surveying	3		CIE 225	Transportation Engr [2]	3	
MEE 150	Statics	3		ECP 225	CE Tech Writing I	1	
MAT 228	Calculus III	4		MAT 258	Diff Eq & Lin Alg	4	
PHY 122	Engr Physics II	4		MEE 251	Strength of Materials	3	
______	HVSC W S C P A [1]	3		______	Approved Sci. Elective [7]	4	
		17				15	

THIRD YEAR

FALL SEMESTER		HOURS	Grade	SPRING SEMESTER		HOURS	Grade
CIE 331	Fund Env Eng	3		CIE 365	Soil Mechanics	3	
CIE 340	Intro to Structural Anal	4		CIE 366	Soil Mechanics Lab	1	
CIE 350	Hydraulics	3		MAT 332	Statistics for Engr	3	
CIE 351	Hydraulics Lab	1		______	CIE Elective [3, 4] E W G T S	3 4	
CMJ 103	Fund of Public Comm	3		______	CIE Elective [3, 4] E W G T S	3 4	
______	HVSC W S C P A [1]	3		______	Engr Sci Elect [5]	3	
		17				16	

FOURTH YR

FALL SEMESTER		HOURS	Grade	SPRING SEMESTER		HOURS	Grade
CIE 412	Engr Decisions [6]	2		CIE 410	Engineering Ethics	1	
CIE 413	Project Mgmt [2, 6]	2		CIE 411	Engr Project Design	1	
ECP 413	CE Tech Writing II	1		ECP 411	Tech Writing Workshop	3	
______	CIE Elective [3, 4] E W G T S	3 4		______	CIE Elective [3, 4] E W G T S	3 4	
______	CIE Elective [3, 4] E W G T S	3 4		______	CIE/Tech Elect [3, 4] E W G T S	3 4	
______	CIE/Tech Eelct [3, 4] E W G T S	3 4		______	HVSC W S C P A [1]	3	
______	HVSC W S C P A [1]	3				14	
		17					

TOTAL CREDIT HOURS = 129

Revised 9/11

Figure 1-1 (a). Curriculum Sheet (page 1)

EXPLANATION OF REQUIREMENTS

1. Students are assisted by faculty advisors in developing an elective program to meet their individual needs within the University's general education requirements. While most of the general education requirements are automatically met with a civil engineering degree, a student is required to select an additional 15 credit hours of electives to help meet the 18 credit hour "Human Values and Social Context" requirement (the required CMJ 103 satisfies the other three credit hours),
2. General education requirements mandate two writing intensive courses. CIE 225 and CIE 413 are designated as writing intensive courses within the CIE major, while ECP 411 meets the outside the major writing intensive course. NOTE: CIE 225 must be taken concurrently with ECP 225 and CIE 413 must be taken concurrently with ECP 413 for CIE 225 and CIE 413 to count as writing intensive courses.
3. Civil Engineering and technical electives must be a minimum of 21 credit hours with no more than two technical elective courses. Civil engineering electives are advanced (400 or 500 level) civil engineering courses. The technical elective is an advanced Civil Engineering course or CIE 394 Civil Engineering Practice or other advanced level engineering, science, or mathematics course relevant to Civil Engineering. In addition, either ERS 101 Intro. to Geology or BIO 100 Basic Biology can be taken as the technical elective.
4. An additional requirement of the CIE Electives is that students take a CIE elective course in at least three of the five civil engineering subdisciplines: Transportation (CIE 42X), Environmental (CIE 43X), Structural (CIE44X), Water Resources (CIE 45X), and Geotechnical (CIE 46X).
5. Three credits of approved engineering science electives, usually in mechanical or electrical engineering, are required. Civil Engineering courses cannot be used for these three specific credit hours. Typical courses taken are:
   MEE 230 Thermodynamics I
   MEE 270 Dynamics   ECE 209 Fundamentals of Electric Circuits
6. CIE 412 and CIE 413 must be taken in the Fall semester immediately preceding CIE 411.
7. Courses that will satisfy the Approved Science Elective are: BIO 100 Basic Biology, ERS 101 Introduction to Geology, ERS 102 Environmental Geology of Maine, PSE 140/141 Soil Science and CHY 122/124 The Molecular Basis of Chemical Change.

SPECIAL NOTE:

Sixteen credit hours of engineering design courses are required. Eleven hours are earned in the required courses. At least five additional design hours must be included in the electives selected by the student. The College of Engineering only allows seniors whose "advancement in the field will permit their taking a graduate level course among graduate students without disadvantage to themselves" to take 500-level courses. The design content of CIE electives are as follows:

Engineering Science & Design Content of Departmental Electives

Course No.	*	Engr. Design	Engr. Science	Course No.	*	Engr. Design	Engr. Science
CIE 394		1-3	0	CIE 533	E	0	3
CIE 424	T	2	1	CIE 534	E	0	3
CIE 425	T	1	2	CIE 537	E	0	3
CIE 426	T	3	0	CIE 540	S	0	3
CIE 427	T	1	0	CIE 543	S	2	1
CIE 430	E	3	1	CIE 544	S	4	0
CIE 431	E	3	0	CIE 545	S	0	3
CIE 432	E	3	0	CIE 547	S	3	0
CIE 434	E	4	0	CIE 548	S	3	0
CIE 439	E	0	3	CIE 549	S	0	3
CIE 440	S	0	4	CIE 556	W	1	2
CIE 442	S	4	0	CIE 562	G	3	0
CIE 443	S	4	0	CIE 563	G	1	1
CIE 450	W	1	2	CIE 564	G	3	0
CIE 455	W	1	2	CIE 565	G	3	0
CIE 456	W	1	2	CIE 566	G	3	0
CIE 460	G	3	0	CIE 567	G	3	0

- T = transportation; E = environmental; W = water resources; S = structures; G = geotechnical

Figure 1-1 (b). Curriculum Sheet (page 2)

Student:______________________ Advisor: _________________

ADVISOR'S CHECK LIST FOR GRADUATION REQUIREMENTS

1. **Engineering Design** - At least 16 credit hours of engineering design are required. Eleven hours are included in the required courses. At least five hours of additional design must be included in the electives selected by the student (see course list in catalog).

Civil Engineering Elective		Credit Hours Design	Grade
CIE	_____	_____	_____
CIE	_____	_____	_____
CIE	_____	_____	_____
CIE	_____	_____	_____
CIE	_____	_____	_____
CIE or Technical Elective			
_____	_____	_____	_____
_____	_____	_____	_____

Subtotal in electives _____ Credit Hours (5 minimum)

2. **Civil Engineering Breadth Requirement** – Must have three or four credit CIE elective in three of the five areas.

	Course	Grade
Environmental	______	_____
Water Resources	______	_____
Geotechnical	______	_____
Transportation	______	_____
Structures	______	_____

3. **Academic Standard** - In addition to meeting all University academic requirements, a civil engineering student must have an accumulative grade point average of not less than 2.0 in Civil and Environmental Engineering courses. CIE GPA _____

4. **General education requirements**: University general education requirements are met by required courses, except that students must earn 18 credit hours in Human Values and Social Context (Areas 1 through 5). Each area must be satisfied, although a single course can be applied to more than one area. In addition, a course or series of courses placing substantial emphasis on ethic issues must be completed.

Human Values and Social Context Areas	Course	Credit Hours	Grade
1. Western Cultural Tradition	______	______	______
2. Social Contexts & Institutions	*CMJ 103*	3	______
3. Cultural Diversity and International Perspectives	______	______	______
4. Population and the Environment	______	______	______
5. Artistic and Creative Expression	______	______	______

Ethics Course or Series of Courses – one credit minimum

	Course	Credit Hours	Grade
	CIE *410*	*1*	______

Figure 1-2. Advisor's Checklist for Graduation.

A second exception to work in lieu of courses is for students with extensive writing backgrounds to place out of ENG 101 (College Composition). Students who wish to exercise this option are evaluated by faculty in the English Department.

F. Graduation Requirements

The Civil Engineering Program requirements can be summarized by the course content and the academic standards as follows. (Details are presented in Section 5.)

Table 1-1. Program Course Requirements

Mathematics	- Calculus I, II, III - Differential Equations - Statistics	19 credit hours
Laboratory Science	- Chemistry - Physics (2 semesters) - Science Elective	16 credit hours
Engineering Basics	- Materials - Graphics, Computing - Mechanics (Statics, Strengths) - Plane Surveying - Engineering Science Elective	22 credit hours
Core Civil Engineering (five content areas)	- Transportation - Environmental - Hydraulics - Structures - Soil Mechanics	18 credit hours
Humanities	College Composition, plus five UMaine humanities content areas, including Public Communication	21 credit hours
Civil Engineering Electives	Advanced electives in at least three of five core content areas. May also include up to two courses in non-CE technical areas.	21 credit hours
CE Professional Prep Courses	- First Year Seminar - Project Management, Design (Capstone) - Ethics - Engineering Decisions - Technical Writing	12 credit hours
		129 credit hours

In addition to the course requirements above, students are required to maintain academic standards consisting of a cumulative GPA of at least 2.0, and a cumulative GPA of at least 2.0 in CIE courses.

G. Transcripts

Transcripts of program graduates will be provided as requested by the Team Leader. In addition, we will provide documentation to show how transcripts are interpreted.

Criterion 2. Program Educational Objectives

A. Mission Statement

The University of Maine has the following mission statement, approved by the University of Maine System Board of Trustees November, 2010:

The University of Maine advances learning and discovery through excellence and innovation in undergraduate and graduate academic programs while addressing the complex challenges and opportunities of the 21st century through research-based knowledge.

Opportunity for all members of the University of Maine community is a cornerstone of our mission. The university welcomes students, research partners and collaborators into an atmosphere that honors the heritage and diversity of our state and nation.

Founded in 1865, the University of Maine is a Land and Sea Grant institution and the flagship campus of the University of Maine System. This vibrant and dynamic university serves the residents of Maine, the nation, and the world through our acclaimed programs in teaching, research, and outreach.

Inspiring and dedicated teaching propels students into new fields of learning and promotes interdisciplinary understanding. Our educational goals are to help students develop their creative abilities, communication, and critical thinking skills, and understanding of traditions in ethics and rationality within the arts, sciences, and professions.

Internationally recognized research, scholarship, and creative activity distinguish the University of Maine as the state's flagship university, where faculty and students contribute knowledge to issues of local, national, and international significance. As the state's doctoral-granting institution, research and education are inextricably linked.

Comprehensive outreach, including public service, Cooperative Extension, continuing education, and distance learning, engages learners of all ages in improving their lives and communities. Using research-based knowledge, outreach efforts promote sustainable use of Maine's abundant natural resources and build intellectual, cultural, and economic capacity throughout Maine and beyond.

Through integrated teaching, research, and outreach, the University of Maine improves the quality of life for people in Maine and around the world, and promotes responsible stewardship of human, natural, and financial resources.

This mission statement reinforces the institution's role as the Land Grant university for the state, and, as indicated below, the statement is reflected in the program objectives for civil engineering.

B. Program Educational Objectives

The Civil Engineering Program Educational Objectives (PEOs) are as follows. Within three to five years of graduation, Civil Engineering Program graduates will:

1. *Practice the disciplines of transportation, environmental, structural, water resources, and geotechnical engineering, and/or related fields.*
2. *Engage in advanced education, research, and development.*
3. *Pursue continuing education and professional licensure.*

4. *Promote and advance public health and safety, and enhance quality of life.*
5. *Act in a responsible, professional, and ethical manner.*

C. Consistency of the Program Educational Objectives with the Mission of the Institution

The mission of the University of Maine is based on its Land Grant heritage to serve the state "...Through integrated teaching, research, and outreach," and in doing so the institution "improves the quality of life for people in Maine and around the world, and promotes responsible stewardship of human, natural, and financial resources." Perhaps most relevant to our program is the university's mission for "Inspiring and dedicated teaching propels students into new fields of learning and promotes interdisciplinary understanding. Our educational goals are to help students develop their creative abilities, communication, and critical thinking skills, and understanding of traditions in ethics and rationality within the arts, sciences, and professions."

Each objective of the Civil Engineering program is consistent with the mission of the University. Education of engineers at the undergraduate level is part of the mission. The mission requires that undergraduates are provided with the broad foundation required to "Practice the disciplines of [civil engineering]" while a background in the liberal arts and sciences is consistent with the Civil Engineering objectives of promoting and advancing public health and safety, while enhancing the quality of life in Maine and beyond.

D. Program Constituencies

There are essentially two primary constituencies for which the PEOs are intended: our students and their employers. In this context, we include program alumni with students, and we can loosely include the taxpayers of the state of Maine,and the general public who are affected by the decisions of our graduates as employers. Using market parallels in this a bit challenging, since the students are both "customers" and "products" of our program.

With respect to students, achievement of the PEOs is a reflection of their success in the profession, whether it be engineering practice, public service, academia, or any other learned discipline. With respect to employers (and general public), achievement of the PEOs means the "product" of our program is making meaningful contributions to our collective society.

A critical component in our program's constituency is the Department's external advisory board, the Civil Engineering Association (CEA), which was founded in 1985. The CEA is comprised of ten highly esteemed civil engineering practitioners plus the Department Chair and one Civil Engineering faculty member who serves as secretary. The civil engineering practitioners are selected to span the breath of the civil engineering profession and include representatives from consulting engineering firms, municipal government, state government, the service sector, and the construction industry. While a range of inputs are used in the development and evaluation of PEOs, the CEA is the lead mouthpiece for alumni and employers of our graduates. Indeed, most CEA members are both.

While not a constituent in the same way as the previously listed group, ABET is viewed here as a constituent through the standards it sets for the accreditation process. Most significantly, ABET defines the terms through which we present our program. Indeed, the revised ABET definition of a 2-5 year time horizon for evaluating Program Educational Objectives was the primary driver for the major revisions made this cycle. As detailed under Criterion 4, the spirit of the PEOs has remained fairly consistent with the institution's Land Grant mission. However, PEO language was revised this cycle for consistency with ABET definitions.

E. Process for Revision of the Program Educational Objectives

The Department has had educational objectives since the mid-1980's. We view PEOs as fundamental guiding principles that should not substantively change without a major change in either our constituencies or the institutional mission. As such, PEOs are reviewed once every six years by the faculty and the external advisory board. An evaluation is made on whether constituency changes justify a revision. If a change is deemed necessary, then the faculty drafts revisions that are submitted to the CEA for comment. The faculty incorporate the comments of the CEA into a final revision that is approved by the faculty.

This most recent review of our PEOs took place in the spring of 2011. Revisions were initiated by the faculty in the spring of 2011 based on a 2011 ABET Accreditation Alert.[1] Prior to this revision, our previous program objectives (adopted April 15, 2004) were as follows:

- *Prepare individuals to become professional practitioners of civil engineering;*
- *Develop fundamental science, mathematics, computer, and engineering knowledge necessary for civil engineering;*
- *Provide broad education to understand the relationship between civil engineering and other design/construction professionals and society as a whole;*
- *Prepare students to communicate facts and ideas;*
- *Prepare and encourage students to continue learning beyond the undergraduate years;*
- *Promote and advance the profession of civil engineering*.

Clearly the previous PEOs were written from a faculty perspective rather than a program graduate perspective. A revised set of PEOs incorporating the new definitions was drafted by the faculty in April of 2011 with the intent to be consistent with the ABET definition that Program Educational Objectives are "what graduates are expected to attain within a few years of graduation." We argue that the basic guiding principles behind both the old and the new PEOs are the same. So at a basic level, our vision for our graduates has not changed. Only the context has changed.

A draft of the revised PEOs was reviewed by the CEA at its April 26, 2011 meeting. After further deliberation, CIE faculty formally adopted the new PEOs listed in section B above at its April 6, 2012 meeting.

[1] http://abet.org/changed-definitions-for-program-educational-objectives/

Criterion 3. Student Outcomes

A. Student Outcomes

Student Outcomes for our program were originally established in 1998, and underwent several revisions prior to the last revision in 2007. As stated in the response to the last ABET review, in 2007 we acknowledged that our previous student outcomes had essentially the same elements as the ABET *a-k* outcomes, and as such we adopted the same language and notation of ABET in presenting the program's student outcomes. The result of this change is a simpler task for the ABET examiner, as it eliminates the need to map UMaine student outcomes to ABET student outcomes. As such, the Student Outcomes for the Civil Engineering Program are as follows.

Students who complete the program will, at graduation, have:

(a) an ability to apply knowledge of mathematics, science, and engineering.

(b) an ability to design and conduct experiments, as well as 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.

As with the Program Educational Objectives, our student outcomes are reviewed at least every six years by the faculty in consultation with the program's external advisory board.

B. Relationship of Student Outcomes to Program Educational Objectives

The eleven Student Outcomes presented above follow from and support the Program Educational Objectives presented in Section 2.B. In some cases there is a direct correspondence between an objective and a single outcome. For others, several outcomes are needed to reach the objective. Most notably, every outcome is important to meet the objective to "prepare individuals to become professional practitioners of civil engineering".

Table 3-1 illustrates the relationships between Program Educational Objectives and Program Student Outcomes.

Table 3-1. Program Objectives - Outcomes Relationships

Student Educational Objective:	Supported by Outcome:
(1) Practice the disciplines of transportation, environmental, structural, water resources, and geotechnical engineering, and/or related fields.	(a) - (k)
(2) Engage in advanced education, research, and development.	(a) - (c), (e)
(3) Pursue continuing education and professional licensure.	(i), (k)
(4) Promote and advance public health and safety, and enhance quality of life.	(h), (j)
(5) Act in a responsible, professional and ethical manner.	(h), (f), (g)

Criterion 4. Continuous Improvement

As detailed below, a hierarchical assessment and evaluation process is used for the continuous improvement of our program. The process involves all our constituents, and consists of both quantitative and qualitative measures. The process is hierarchical in both frequency of assessment and evaluation and breadth of constituencies involved. The entire process is illustrated in Figure 4-1.

At the heart of Figure 4-1 are the curriculum and its associated courses. The entire continuous improvement process centers around curriculum. The curriculum is established based on our intended Student Outcomes as directed by our Program Educational Objectives. The assessment instruments associated with both the Student Outcomes and the Program Educational Objectives are shown in the figure and are presented in more detail below along with the relevant evaluation criteria.

Guiding Principle

One can view our continuous improvement process using a ballistics analogy. Our target is represented by our PEOs. This target is established by the faculty and the external advisory board as discussed under Criterion 2 Section E. Periodic review of PEOs dictate if we are indeed aiming at the correct target. Our Student Outcomes represent the exit velocity (muzzle velocity) and trajectory that we believe will land our projectile on the target. Since the muzzle velocity and trajectory angle are all that we can control (through appropriate inputs such as powder charge), we must take advantage of all information available to make sure we get these inputs correct. Thus, we use our constituencies to help us judge prevailing winds and other atmospheric conditions that will affect flight once the projectile is in the air.

Continuing with the metaphor, our first assessment and evaluation process comes when we consider the Student Outcomes that are represented by the actual exit velocity and initial trajectory angle. Did we get the amount of powder correct? We have an array of assessment instruments that tell us whether our actual trajectory angle and muzzle velocity are what we intended. We are confident that if we get our initial conditions correct, we will be very close to our target. However, ultimately we must also assess our PEOs to confirm that we are, in fact, close to our target.

This metaphor is used to emphasize that the only things we can control in our program are the trajectory angle and the powder charge. Once the projectile is in flight it is out of our hands. Thus we must do everything we can to make sure that we are doing the right things for whatever we can control. Furthermore, the metaphor allows us to emphasize that the question of how well are we meeting our Student Outcomes and our Program Educational Objectives is independent of what these outcomes and objectives actually are. Thus, a review of our PEOs (as noted in Criterion 2) is made with regard to what is happening in the profession and the institution, not with respect to how well we are doing at achieving our objectives. (i.e. Choice of target is independent of how close we are to hitting it.)

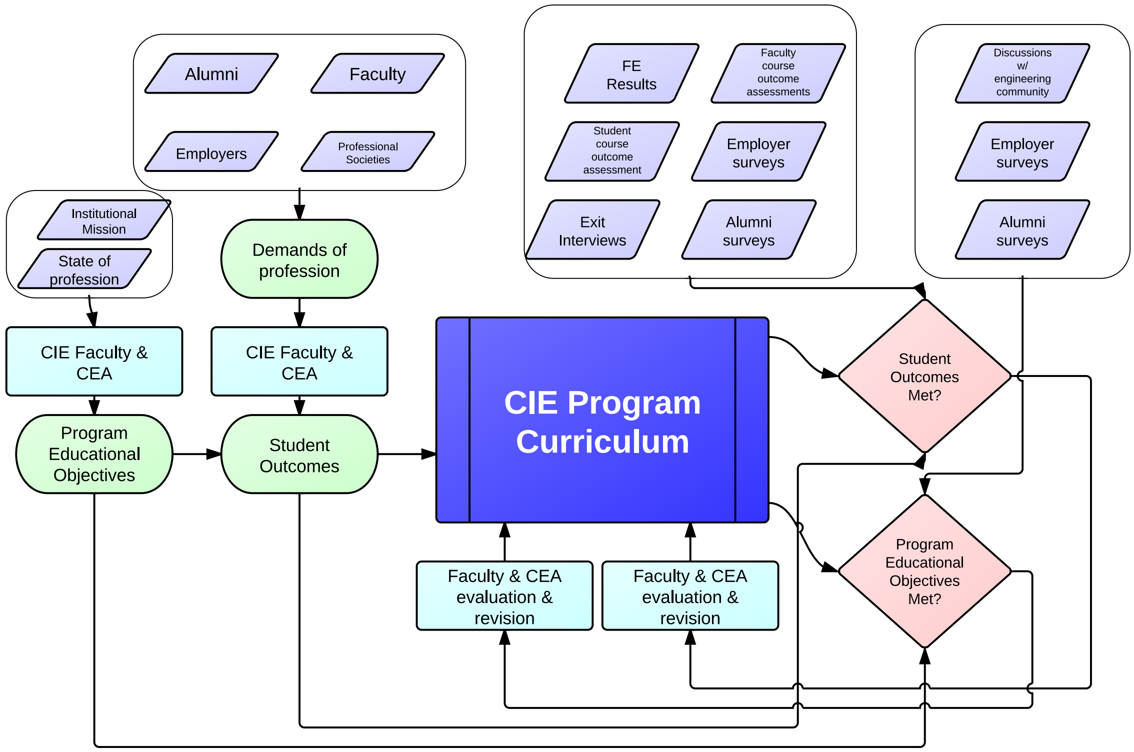

Figure 4-1. Illustration of Program Continuous Improvement Process

A. Program Educational Objectives

Evaluation of how well we are meeting our Program Educational Objectives is conducted every six years by the civil engineering faculty with help from our external advisory board, the CEA. Assessment instruments include alumni and employer surveys that are both quantitative and qualitative, as well as more qualitative discussions with members of the professional community. Historically the College of Engineering administered the alumni and employer survey instruments through direct mailings. Because response was extremely poor, a move was made to web-based instruments that, at least for the alumni, produced a better response.

The most recent review of how well we were doing at meeting PEOs was in the spring of 2010, when we reviewed survey data from our graduating classes of 2004 - 2007, representing 3-6 years out from our program. The survey was intended to provide information on both Program Objectives as well as Student Outcomes. A list of the survey questions is shown in Figure 4-2. (Note that this survey instrument was developed by the college in 2006, and as such the survey is designed to assess our previous set of Program

Objectives.[2]) In addition to the specific student outcome-based questions, students are asked to provide information on the following:

- Employment status and history
- Professional licensure
- Professional society membership (are they promoting and advancing the profession?)
- Additional coursework beyond graduation, and professional development hours (are they engaged in continuing education?)
- General comments on their own strengths & weaknesses relative to their UMaine education.

Expected Level of Attainment

Quantitative analysis of our survey data is straightforward thanks to the simplicity of the instrument. A numerical average is made for each question by assigning a “3” to the “outstanding” response, “2” to the “effective” response, and “1” and “0” to the marginal and unacceptable responses, respectively. To the resulting numerical averages, we then apply a standard for attainment of objectives. The standard is as follows:

- Greater than 2.0: standard is exceeded, no action required
- Between 1.0 and 2.0: standard is met, but consider potential improvements
- Less than 1.0: standard is not met; immediate action required

The expected level of attainment for our PEOs is that we meet the standard for all outcomes identified in the survey. Additional criteria are described in the next section on evaluation

Evaluation Process

In the evaluation of the survey data, we are looking at both the previously mentioned quantitative measures as well as qualitative assessments. The qualitative assessments are important for providing the context for many of the quantitative responses.

The first part of the evaluation considers the qualitative data. From our admittedly limited survey data, we find that of our respondents:

- 70% are practicing professionals. Of the remaining:
  - 20% are pursuing advanced engineering degrees
  - 10% left the profession.
- 100% have either completed additional course credit hours or professional development hours.
- Of practicing professionals and graduate students, 90% are members of at least one professional society.

Student comments ranged from specific program elements (e.g. how some exposure to certain software packages might have been useful) to very broad (e.g. how important communications skills have been for them).

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[2] A new survey instrument was adopted by the college in the Spring of 2012 to reflect updated PEOs across all programs.

Figure 4-2. Questions From Alumni Survey for Program Objectives

1. How well did your college education prepare you to apply your knowledge of mathematics, science and engineering?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

2. How well did your college education prepare you to design and conduct experiments, as well as to analyze and interpret data?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

3. How well did your college education prepare you 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?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

4. How well did your college education prepare you to function on a multi-disciplinary team?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

5. How well did your college education prepare you to identify, formulate, and solve engineering problems?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

6. How well did your college education prepare you to understand professional and ethical responsibility?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

7. How well did your college education prepare you to communicate effectively both orally and in writing?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

8. How well did your college education prepare you to understand the impact of engineering solutions in a global, economic, environmental, and societal context?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

9. How well did your college education prepare you to engage in life-long learning?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

10. How well did your college education prepare you to evaluate technical solutions with consideration of contemporary economical, environmental, social and political issues?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

11. How well did your college education prepare you to apply the techniques, skills, and modern engineering tools necessary for engineering practice?

□ Outstanding □ Effective □ Marginal □ Unsatisfactory □ Unable to evaluate

Comments (up to 2048 characters)

Please add below any comments that you feel would help us improve the quality of the engineering education provided at the University of Maine. These comments may well introduce new topics or expand on those presented in the preceding questionnaire.

The second part of our evaluation considers the quantitative data. Table 4-1 shows 2010 survey results for graduates 3-6 years post graduation. While the data shows that we clearly meet the standard for all outcomes measured, there are clearly differences. For example the data shows a very good response to question 9, “How well did the your college education prepare you to engage in lifelong learning?” Based on the the above qualitative comments that 100% of the survey respondents have engaged in either formal continuing education or some form of professional development, we can conclude that we have met our objective to *Prepare and encourage students to continue learning beyond the undergraduate years*.

Below, the remaining (2006) Program Educational Objectives are considered individually.

Prepare individuals to become professional practitioners of civil engineering

As noted above, the survey shows that 90% of our graduates are either currently engaged in the profession, or are pursuing degrees that will advance their position in the profession. Because of the wide range of professional interests and personal goals, we would never expect 100% of our graduates to be actively engaged in the profession. But with an overwhelming majority involved with the profession, we can conclude that we clearly meet this objective.

Develop fundamental science, mathematics, computer, and engineering knowledge necessary for civil engineering

For this objective, we rely on the response to survey question 1, which asked "How well did your college education prepare you to apply your knowledge of mathematics, science and engineering?" The four year average of 2.4 indicates we exceed this objective. As discussed in the Student Outcomes section below, we do have some concerns based on FE exam results. However, regardless of FE results, we can conclude that basic math and science skills have not been an issue for graduates in relation to their careers.

Provide broad education to understand the relationship between civil engineering and other design/construction professionals and society as a whole

Table 4-1. Results from 2010 Alumni Surveys

Question Number (see Fig. 4-2)	Mean Numerical Response by Graduating Class				Four Year Average
	2004	2005	2006	2007	
1	2.375	2.667	2.500	2.000	2.386
2	1.875	3.000	2.200	2.500	2.394
3	1.830	2.667	2.100	2.500	2.274
4	2.250	2.667	2.400	3.000	2.580
5	2.429	3.000	2.400	2.000	2.457
6	2.000	2.667	2.400	2.500	2.392
7	2.125	2.333	2.000	2.500	2.240
8	1.750	2.667	1.900	2.000	2.080
9	2.429	3.000	2.500	3.000	2.732
10	1.750	3.000	2.600	2.000	2.337
11	2.571	3.000	1.800	2.500	2.468

To evaluate this objective, we considered the survey responses to questions 4, 6, 8, and 10. While the responses to all these questions averaged above our "exceeds" standard of 2.0, question 8 ("How well did your college education prepare you to understand the impact of engineering solutions in a global, economic, environmental, and societal context?") had the lowest average response, and for the 2004 and 2006 graduating classes, the mean was below 2.0. So we conclude that although we meet the objective, we have identified this as an area to be considered for future curricular revisions.

Prepare students to communicate facts and ideas

Communication skills were cited by several survey respondents as a critical to their professional interests. In evaluating this objective we looked to the response to survey question 7: "How well did your college education prepare you to communicate effectively both orally and in writing?" The mean response of 2.24 is satisfactory, and we consider that we have met this objective. One interesting anecdote is the that the highest response to this question was from the class of 2007. This is of note because they are the first cohort to complete the ECP (Engineering Communications Project) curricular modification in which technical writing was better integrated into the engineering curriculum through explicit linkages between engineering and writing courses. As a part of our capstone design experience, student projects are evaluated by practicing engineering professionals, and the response of those reviewers to the quality of work done by those and subsequent students is overwhelmingly positive.

Promote and advance the profession of civil engineering.

To evaluate this objective we look at the percentage of respondents who are members of professional societies. Since the purpose of professional societies is to advance the profession, membership implies an interest in doing so. Based on the high percentage of our graduates who are active in professional societies, (90%), we conclude that we have met this objective.

The survey instruments provide useful feedback on attainment of Program Educational Objectives. In addition to the hard data they provide, we also rely on personal contact with practicing professionals around the state for additional feedback. Faculty actively participate in functions such as monthly ASCE meetings, the Maine Transportation Conference, and other state level events. These frequent face-to-face interactions provide extremely useful qualitative feedback that faculty can bring into the evaluation process.

To summarize, the overall conclusion is that we have met our objectives. However, we can always improve and get closer to our "target," and we continue to make revisions to our curriculum as detailed below.

Maintenance of Documentation

All documentation (both raw and reduced data) are maintained by the Department Chair with the aid of the Departmental Administrative Assistant. An ABET file cabinet is housed in the Departmental office suite, and is accessible to all departmental faculty.

B. Student Outcomes

In our continuous improvement process, we consider both Program Educational Objectives and Student Outcomes. As described in the previous section, we take active measures to evaluate how well we are meeting our PEOs. In our hierarchical process, however, we focus most of our attention on Student Outcomes. While there are several reasons for this approach, it is primarily because we wish to focus our attention where we have the most control. We can make immediate changes in a course, and the feedback loop for evaluation of our changes is shorter.

Table 4-2 Student Outcomes and Associated Assessment

Outcome	Primary Assessment Instrument(s)
an ability to apply knowledge of mathematics, science, and engineering.	Course assessments (all), FE results
an ability to design and conduct experiments, as well as analyze and interpret data.	Relevant course assessments
an ability to design a system, component, or process to meet desired needs	Course assessments (design designations), alumni survey
an ability to function on multi-disciplinary teams	Course assessment (CIE 411), exit interview, alumni survey
an ability to identify, formulate, and solve engineering problems	Course assessments, FE results, exit interview
an understanding of professional and ethical responsibility.	FE results, exit interview, alumni survey
an ability to communicate effectively.	Employer feedback, exit interview, course assessments
the broad education necessary to understand the impact of engineering solutions in a global and societal context.	Exit interview, alumni survey
a recognition of the need for, and an ability to engage in life-long learning.	Course assessments, exit interviews alumni survey
a knowledge of contemporary issues.	Exit interview, alumni survey
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Course assessments, exit interviews alumni survey

Table 4-3. Civil Engineering Student Outcome Matrix

Student Outcomes in the Civil Engineering Program													
	Outcomes		**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Course Outcomes that relate to Program Student Outcomes													
Course #	Title	*											
CIE 100	Intro to CIE	R								x		x	
CIE 101	CE Graphics	R	x		x		x		x				
CIE 110	Materials	R	x				x				x		
CIE 111	Materials Lab	R	x	x			x		x				x
CIE 115	Computers	R	x	x			x						x
CIE 225	Transportation	R	x		x		x		x				x
CIE 331	Env Engineering	R	x				x						x
CIE 340	Intro to Structure	R	x	x	x		x						x
CIE 350	Hydraulics	R	x				x						x
CIE 351	Hydraulics Lab	R	x	x		x	x		x				x
CIE 365	Soil Mechanics	R	x				x						x
CIE 366	Soil Mech Lab	R		x			x		x				x
CIE 410	Ethics	R						x					
CIE 411	Eng Prog Design	R			x	x	x	x	x		x	x	x
CIE 412	Eng Decisions	R	x				x			x		x	x
CIE 413	Project Mgmt	R			x		x	x					x
CIE 394	Eng Practice	E				x		x	x	x	x		x
CIE 424	Urban Trans	E		x	x		x			x		x	x
CIE 425	Trans Safety	E	x	x	x		x	x					x
CIE 426	Adv Road Design	E			x		x						x
CIE 430	Water Treatment	E	x	x	x		x						x
CIE 431	Pollutant Fate & Transp.	E	x	x	x		x						x
CIE 434	Wastewater Treatment	E	x	x	x		x						x
CIE 440	Structural Anal I	E	x				x						x
CIE 442	R/F Concrete Des	E	x		x		x				x		x
CIE 443	Structl Steel Des	E	x		x		x				x		x
CIE 450	Open Chan Hydr	E	x				x						x
CIE 455	Hydrology	E	x		x		x			x	x	x	x
CIE 456	GW Hydrology	E	x		x		x			x	x	x	x
CIE 460	Geotech Eng	E	x		x		x	x		x	x	x	x
EXTRACURRICULAR ACTIVITIES[1]													
	ASCE Student Chapter								x		x	x	
	Chi Epsilon Honor Society								x				
	Concrete Canoe Comp				x				x				
	Engineers Without Borders				x	x	x	x	x	x	x		
OUTCOME ASSESSMENT													
	Exit Survey & Interview		x			x	x	x	x	x	x	x	x
	Alumni Survey					x		x	x	x	x	x	
	FE Exam		x		x		x	x					x

* R-Required; E-Elective (21 credits of CIE electives are required)

[1] Activities contribute to Student Outcomes, but are not individually assessed.

As illustrated in Figure 4-1, the evaluation process takes inputs from a variety of sources: course assessments (completed independently by both instructors and students), Fundamentals of Engineering (FE) exam results, senior exit interviews, and alumni and employer surveys. Table 4-2 lists the eleven student outcomes along with the primary method(s) of assessment. Table 4-3 lists the entire matrix of CIE courses and extra-curricular activities along with their associations with Student Outcomes. We present here our use of exit surveys and interviews, and how we use the data in our evaluations.

UNIVERSITY of MAINE - COLLEGE of ENGINEERING

Exit Survey for B.S. Degree Graduates

Maintaining an ABET accredited program includes obtaining and utilizing feedback from our alumni; consequently, your completion of this form is very important to all future as well as past graduates of this college. Your thoughtful consideration in filling out this questionnaire is greatly appreciated by all.

1. Name:____ Major:________________
2. Address after graduation: ____
3. Graduation Semester/Year:____________ ☐ Fall ☐ Spring ☐ Summer
4. Offers of Employment: # Received:________ Has an offer been accepted? ☐ Yes ☐ No
5. If yes, name of employer and location: ____
6. Job title: _________________________________ Starting Salary (optional): ________________

   Number of interviews in-state _____
   Number of interviews out-of-state _____
7. Graduate School: ☐ Applied ☐ Accepted School:______________________________
8. Estimated B.S. GPA: ☐ 3.5-4.0 ☐ 3.0-3.49 ☐ 2.5-2.99 ☐ 2.0-2.49
9. Did you enter major as a first year student: ☐ Yes ☐ No
   If yes, number of semesters taken to graduate:

   ☐ <8 ☐ 8 ☐ 9 ☐ 10 ☐ >10
10. Average number of hours/week you worked FOR PAY while in school.
    ☐ 0 ☐ 1-5 ☐ 5-10 ☐ 10-15 ☐ 15-20 ☐ >20
11. How well did first-year and sophomore courses prepare you for upper level courses?
    ☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently
12. How well did the faculty advising system meet your needs?
    ☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently
13. How well did laboratories succeed in increasing your understanding of and ability to utilize classroom concepts?
    ☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently

Form modified 1-25-99

Figure 4-3 (a). Senior Exit Survey (page 1)

14. How successfully have your written and oral communications skills been developed?
☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently

15. How successfully has the program instilled in you a sense of global/societal responsibility?
☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently

16. How successfully has the program provided you an understanding of professional and ethical responsibility?
☐ Poorly ☐ Marginally ☐ Satisfactorily ☐ Very Well ☐ Excellently

17. Did you hold a co-op/intern position at any time during your undergraduate years? ☐ Yes ☐ No

If yes, would you recommend a co-op/intern position as very worthwhile? ☐ Yes ☐ No

18. Did you find the faculty generally to be available and helpful? ☐ Yes ☐ No

19. Do you feel group projects significantly enhanced your ability to perform productively in a team environment? ☐ Yes ☐ No

20. Do you feel that you have learned to use the computer efficiently and effectively as an engineering tool?
☐ Yes ☐ No

21. Did you have your own PC during at least the last two years of your undergraduate program? ☐ Yes ☐ No

22. Did you make significant use of the computer clusters on campus? ☐ Yes ☐ No

23. Have you given any significant thought as to how you will continue to learn and expand your capabilities?
☐ Yes ☐ No

24. Did you take the Fundamentals of Engineering (FE) exam as a first step toward registration as a Professional Engineer? ☐ Yes ☐ No

25. Are you a student member of at least one Professional Society? ☐ Yes ☐ No

26. If you were starting over at the beginning of your college career would you choose engineering again?
☐ Yes ☐ No

27. Would you recommend this College of Engineering to new applicants? ☐ Yes ☐ No

You are encouraged to add below any comments that you feel would help us improve the quality of the engineering education provided at the University of Maine. These comments may well introduce new topics or expand on those presented in the preceding questionnaire. We also hope that you will maintain contact with us in the future. Your feedback is very important to us. Thank you for your help and good luck in your new career.

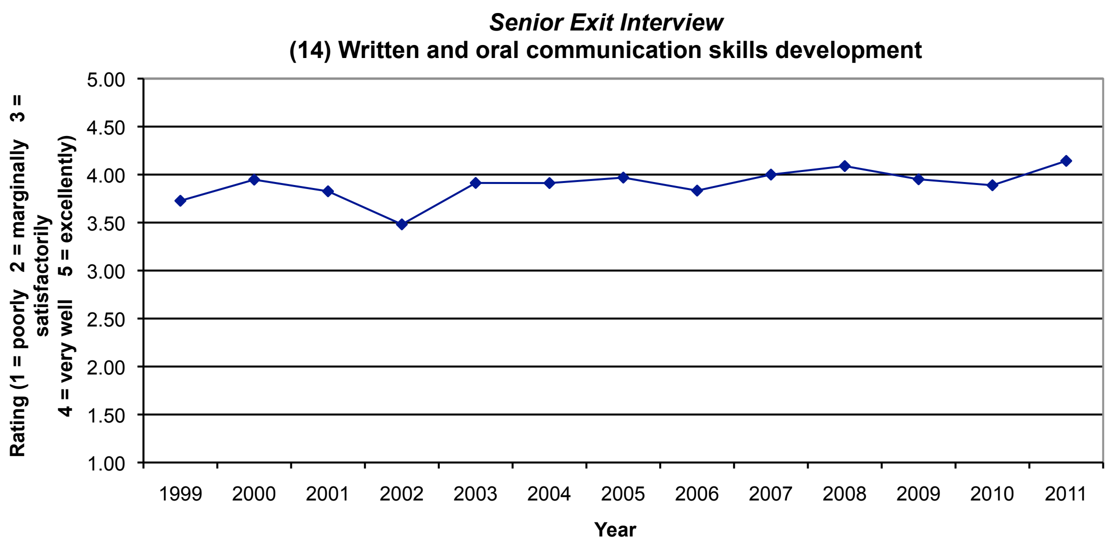
Form modified 1-25-99

Figure 4-3 (b). Senior Exit Survey (page 2)

Exit Survey and Interview

Towards the end of each semester each year, students who expect to graduate that term are given an Exit Survey that they complete and return to the Department Chair. The instrument was first implemented by the college in 1999, and it has been used to track student assessment of outcomes since that time. The interview form is shown in Figure 4-3. The questions in the survey are a mix of outcome measures as well as basic information of use to the faculty or administration (e.g. number of semesters required to graduate, and was the faculty advising system effective).

In addition to completing the survey, students are requested to meet individually with the Department Chair for an informal exit "interview" where the student and the chair can discuss issues that warrant additional attention (as indicated by the survey), topics of interest to the chair, and issues of interest to the student that are not addressed by the survey. In a given semester the chair might meet with about 70% of the graduating seniors. Interviews last anywhere from 15 to 30 minutes. When all interviews are complete, the chair writes up a summary of any trends or items of note that should be brought to the attention of the faculty, along with any action items if appropriate.



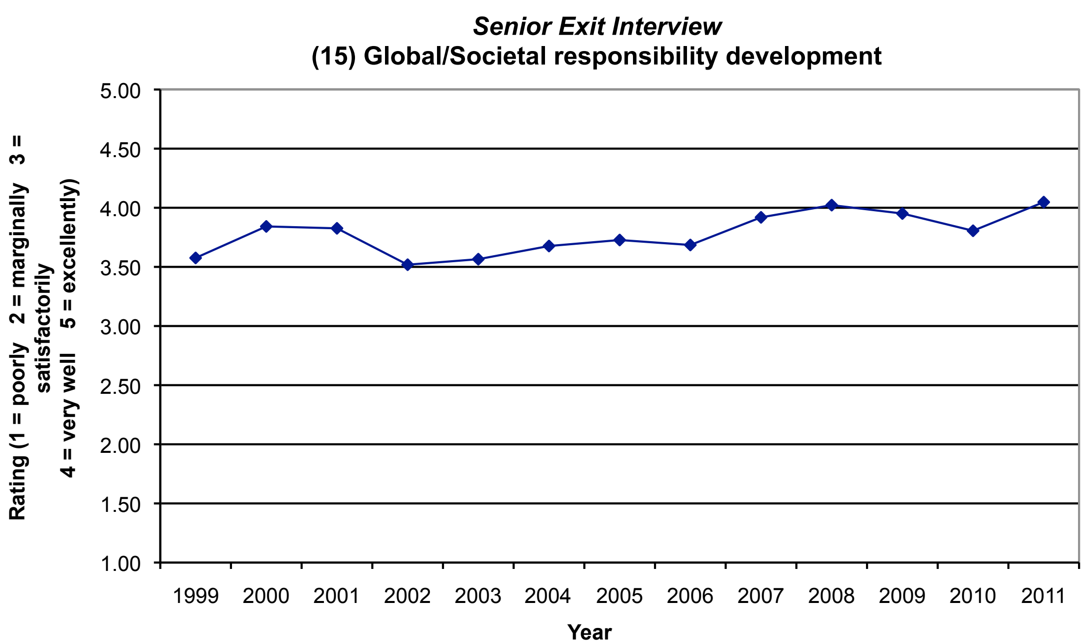


Figure 4-4. Sample trends from senior exit surveys

The length of the data record allows us to look for trends in addition to our current status. For example, question 14 asks the student "How successfully have your written and oral communication skills been developed?" Figure 4-4 shows that our students assess their attainment of this outcome to be between "satisfactory" and "very well" with the more recent years pointing more towards the latter. A similar trend can be observed for question 15 "How successfully has the program instilled in you a sense of global/society responsibility?"

Expected Level of Attainment

For the Student Outcomes assessed in the the exit survey, we apply a standard similar to the one we used in the alumni surveys. From the numerical average of the survey response:

- Greater than 4.0 : standard is exceeded, no action required
- Between 3.0 and 4.0: standard is met, but consider potential improvements
- Between 2.0 and 3.0: standard marginally met, action should be considered.
- Less than 2.0: standard is not met; immediate action required.

During the six year review period, survey results show that our standards have been met for all the relevant Student Outcomes measured by the assessment instrument. Complete documentation of Survey and Exit Interview results will be made available to the ABET evaluator at the site visit.

Fundamentals of Engineering Examination

We believe the exit and alumni surveys to give meaningful results for some of the "softer" professional outcomes. However, we look to other means of assessment for outcomes related to technical knowledge. For these outcomes we look to individual course assessments and the Fundamentals of Engineering (FE) Examination.

Over 90% of our seniors take the FE exam before graduating from the program. Since it is a comprehensive exam covering a range of engineering topics, it is an effective means for us to assess several Several Student Outcomes. In particular, we use this instrument to evaluate Student Outcomes (*a*), (*e*), and (*f*).

Our use of the instrument has some limitations. For some unknown reason, we have a significant number of students who sit for the exam in their junior years. Back when the examination was not discipline-specific, this was a good idea, for most of the examination material was seen by the students in their recent coursework. When the examination became discipline specific, students who sit for the exam as juniors are at a disadvantage compared to the seniors since they have not seen as much of examination material in their coursework. All our FE results data is aggregated, so we can not separate out juniors. Regardless, the examination results, particularly as separated out by subject, give us a good indication of where we need to focus our attention for improvement.

Figure 4-5 shows an example report for a student cohort at a particular exam sitting. While the overall pass rate is of interest, of greater interest is the breakdown by subject, for that gives us an indication where our students are strong, and where they are weak relative to national averages.

Expected Level of Attainment

October 2011

NCEES

Fundamentals of Engineering Examination

ABET - Accredited Programs

Currently Enrolled **Engineering**
Subject Matter Report by Major and PM Examination

Board Code: **27**
Major **Civil**

Institution:
University of Maine, Orono (Engineering)
School Code: **2702**
PM Exam **FE - Civil**

	*Institution	National	Carnegie Comparator
Examinees Taking	28	4,140	1,264
Examinees Passing	22	3,198	1,015
Examinees Passing %	79	77	80

	# Exam Questions	Institution AVG % Correct	National AVG % Correct	National Standard Deviation **	Prof+A&S/HGC AVG % Correct ***
AM Subject					
Mathematics	19	57	61	3.1	60
Engineering Probability & Statistics	8	76	74	1.5	75
Chemistry	11	59	59	2.0	60
Computers	8	69	64	1.5	63
Ethics & Business Practices	8	88	82	1.2	83
Engineering Economics	10	75	63	2.0	64
Engineering Mechanics (Statics)	8	65	68	1.6	69
Engineering Mechanics (Dynamics)	5	49	56	1.2	56
Strength of Materials	8	58	59	1.8	60
Material Properties	8	60	55	1.6	55
Fluid Mechanics	8	59	61	1.9	60
Electricity & Magnetism	11	32	42	2.2	40
Thermodynamics	8	50	47	1.7	48
PM Subject					
Surveying	7	58	67	1.4	68
Hydraulics & Hydrologic Systems	7	60	60	1.5	62
Soil Mechanics & Foundations	9	67	66	1.8	67
Environmental Engineering	7	47	46	1.3	46
Transportation	7	53	57	1.5	57
Structural Analysis	6	55	58	1.3	58
Structural Design	6	43	50	1.4	50
Construction Management	6	68	67	1.2	69
Materials	5	60	64	1.1	66

* 0 examinees have been removed from this data because they (1) Answered fewer than 10% of the questions or (2) were flagged as a Random Guesser.

** The standard deviation of the above is based on number of questions correct not percentage of questions correct.

*** Indicates schools in your Carnegie classification, see www.carnegiefoundation.org

TERMS AND CONDITIONS OF DATA USE

This report contains confidential and propiertary NCEES data. Any use of the data unrelated to accreditation review requires prior approval by NCEES.

Figure 4-5. Sample FE result for student cohort.

In general, we expect our graduates to be at or better than national averages for all examinees. We use the national averages rather than the Carnegie Comparator averages because overall institution selectivity puts UMaine at the lower end of the comparator group. Thus, the following standard is applied to each subject:

- Greater than or equal to the Carnegie Comparator Avg: standard is exceeded, no action required
- Greater than or equal to the National Avg: standard is met but consider potential improvements
- Within five points of National Avg: standard marginally met, action should be considered.
- More than five points below National Avg: standard is not met; immediate action required.

(One caveat to this standard are Dynamics, Thermodynamics, and Electricity & Magnetism subjects. Our curriculum requires a course in only one of these topics. Thus, it is probably unrealistic for our students to have nationally competitive results in all three subject areas.)

Examination of Figure 4-5 shows that students exceeded the standard in Probability & Statistics, Computers, Ethics, Engineering Economics, Material Properties, Thermodynamics, Soil Mechanics & Foundations, and Environmental Engineering. Students of this cohort met the standard in Chemistry, Hydraulics and Hydrologic Systems, and Construction Management. Students did not meet the standard in Mathematics, Strength of Materials, Fluid Mechanics, Transportation, and Materials. Special attention is required in Surveying and Structural Design.

Note that these evaluations fluctuate considerably from year to year, so curricular revisions are only made if there is a consistent trend in a particular subject.

Individual Course Assessments

The final piece of the Student Outcomes assessment process comes in the form of individual course outcomes assessments. Each course in the curriculum has student course outcomes associated with it, and those outcomes relate directly with program level student outcomes. In most courses, assessment has two parts. First, a Student Outcomes survey for each course is distributed at the end of the semester. Students are asked to assess their own achievement of course outcomes. The second part of the assessment is done by the instructor, who specifies performance indicators for each individual course outcome. Performance indicators range from a set of exam questions or homework problems to written or oral presentations. We find that using both student and instructor assessments are effective in covering what can be a broad range of outcomes. For example, surveys are useful in assessing softer outcomes such as life-long learning or functioning on multidisciplinary teams. However, instructor assessments tend to be more reliable measures of specific knowledge, such as analysis of a system, or design of a component.

The expected level of attainment for a particular student outcome is established by the instructor. The instructors' assessment and evaluation methods are reviewed periodically by the faculty as a whole, with the last comprehensive review of course assessments being done in the spring of 2011. Documentation for all course outcomes will be available for the ABET evaluator to review at the site visit. An example of the approach is presented here.

Example: CIE 110 Materials

CIE 110 - Materials is a required course of all students in the program. As detailed in the syllabus provided in Appendix A, this course has five outcomes:

1. The student will demonstrate the ability to perform a simple statistical analysis of experimental data, including fitting data to standard models, and making predictions based on those models.
2. The student will demonstrate understanding of stress, strain, strength, toughness, durability and fatigue, and the student will be able to perform calculations that involve these quantities.

3. The student will demonstrate an understanding of the role of microstructure in material properties.
4. The student will demonstrate an understanding of production and properties of steel, concrete, wood and wood composites, and FRP composites.
5. The student will be able to identify critical design issues in material selection.

As shown in Table 4-3, these course outcomes support program level student outcomes (*a*), (*e*), and (*i*). For this course, the five outcomes listed above, the first one is deemed to support program level Student Outcome (*a*), while the remainders are deemed to support program level student outcome (*e*). We have added Student Outcome (*i*) to the list because if the

Figure 4-6. Example student survey for course outcomes.

CIE 110 - Materials **Fall 2011**

Student Assessment of Course Outcomes

This survey is intended to assess the effectiveness of the course at meeting its intended outcomes. It is part of the overall civil & environmental program evaluation process.

Please answer the questions below as honestly as you can. The results will be used to make changes in the course content and program criteria if appropriate.

Course Specific Outcomes

1. I am able to perform a simple statistical analysis of experimental data, and use that data to make predictions based on statistical models.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

2. I understand stress, strain, strength, toughness, durability and fatigue, and I am able to perform calculations that involve these quantities.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

3. I have an understanding of the role of microstructure in material properties.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

4. I have an understanding of production and properties of steel, concrete, wood/wood composites, and FRP composites.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

5. I am able to identify critical design issues in material selection.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

Comments:

General Outcomes

6. The course enhanced my ability to apply knowledge of mathematics, science, and engineering.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

7. The course enhanced my ability to identify, formulate, and solve engineering problems.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

8. The course has given me an appreciation of the need for lifelong learning.

5	4	3	2	1
strongly agree	*agree*	*neither agree nor disagree*	*disagree*	*strongly disagree*

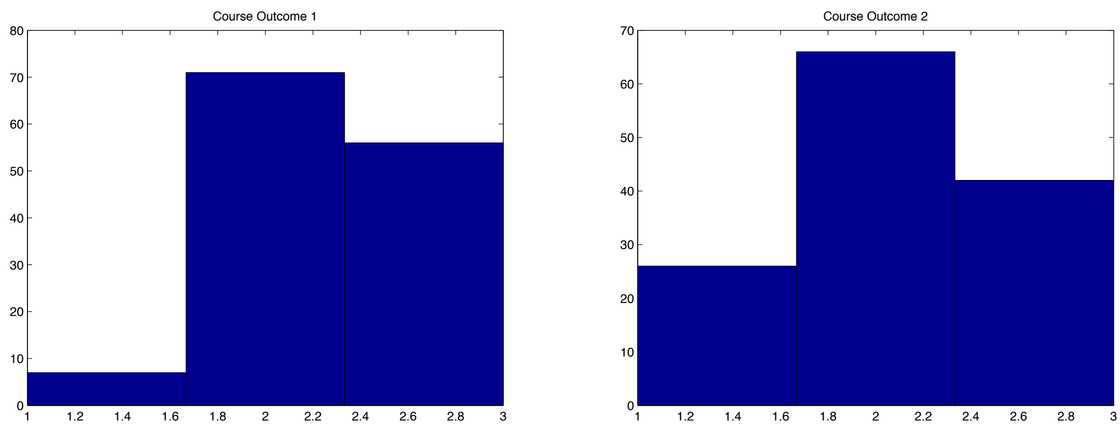
9.

Comments:

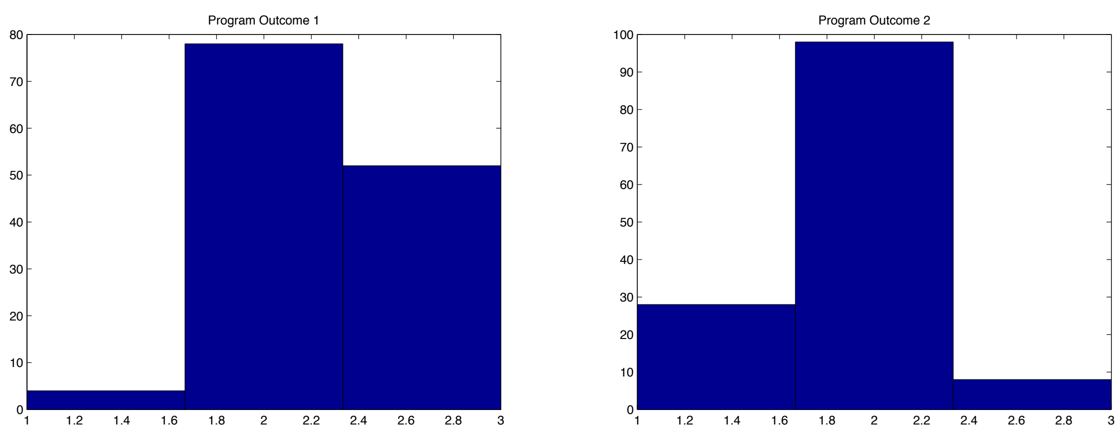
course's role in our "Engineering Basics" portion of the curriculum. The course plays a role in introducing a broad array of engineering concepts beyond just the topic of materials.

An example student survey is shown in Figure 4-6. This instrument illustrates how the students are asked to assess their achievement of the course outcomes. In this particular survey, the students are also asked about broader level student outcomes.

For this particular course, the instructor's assessment is based on student response to specific questions on the final exam. This particular course is historically a large class, averaging 135 students over the past five years. Because of the large numbers, the final exam is a machine graded multiple choice format with 80 questions. Each of the eight questions is tagged for a course level student outcome and a program level student outcome. The machine grading format allows the instructor easily extract the desired information.



(a) Course level student outcomes 1 and 2.



(b) Program level student outcomes 1 and 2 corresponding to SO (a) *and* (e)*.*

Figure 4-7. Illustration of course level and program level student outcomes for CIE 110 - Materials. In all cases the bars indicate the relative fraction of students who exceed (right bar), meet (middle bar) and do not meet the standard for the particular outcome.

The expected level of attainment is based on the percentage of students who correctly answer the particular group of questions. Specifically, the student is said to:

- exceed the standard if 90% of the selected questions are answered correctly.
- meet the standard if 70% of the selected questions are answered correctly.
- not meet the standard if less than 70% of the questions are answered correctly.

Figure 4-7 illustrates results for two selected course outcomes and two selected program level student outcomes. The data clearly indicates the distribution of students who do not meet, meet, and exceed the standard for the outcome.

The next step in the course assessment process is to determine where actions are required. For CIE 110, the standard is as follows:

- 90% achieve the outcome: standard is exceeded, no action required
- Between 70% and 90%: standard is met, but consider potential improvements
- Less than 70% achieve the outcome: standard is not met; immediate action required

An example of a corrective action occurred in 2010; in the two previous years, almost half of the students did not meet course outcome 5: "...identify critical design issues in material selection." In 2011, course materials for this topic were improved, and we saw an improvement.

The final step in the course assessment process is for the instructor to examine the results of the student assessment survey for the semester. For the outcomes of which the survey is the primary assessment tool, the results are evaluated and brought into the continuous improvement process. For the remaining outcomes, the difference between the students' assessment and the instructor's assessment can often be illuminating.

Schedule for Student Outcome Assessment and Evaluation

Assessment data comes in at fairly regular intervals. Exit Surveys come in every semester, as do FE exam results. Student assessments of course outcomes are done every semester, however a full instructor assessment and analysis typically is done every other time the instructor teaches the course.

Full review of the Student Outcome assessment data is done nominally every three years, with the last review taking place during the spring semester 2011. Individual instructors presented course assessments and evaluation to the department faculty. The Department Chair presented results of exit surveys and alumni surveys to the faculty for evaluation. The results of Student Outcomes evaluation of assessment data was presented to the external advisory board for comment and input. The results of this evaluation process is presented in the Section C below.

Maintenance of Documentation

All documentation (both raw and reduced data) are maintained by the Department Chair with the aid of the Departmental Administrative Assistant. An ABET file cabinet is housed in the Departmental office suite, and is accessible to all departmental faculty.

C. Continuous Improvement

The outcome of the assessment and evaluation of both Program Educational Objectives and Student Outcomes is potential program change. This can take the form of either changes in individual course content, requirements for individual or groups of courses, or changes in curricular structure. Examples of all these are presented below.

Table 4-4 presents a summary of program changes that have taken place over the past six years. The table includes both a description of the change, as well as the rationale and analysis if relevant.

Table 4-4. Curriculum changes since the previous ABET review

Description of change	Rationale	Date Impleme nted	Analysis
Program level change: students must take at least one CIE elective in three out of the five sub-disciplines of civil engineering.	Exit interviews showed that too many students were taking all their elective classes in a single area. CEA believed this was not appropriate at BS level.	Fall 2006	Exit interviews show students actually prefer the breadth requirement.
Curricular change: move: CIE 231 from fall of second year to fall of junior year, rename as CIE 331.	Course outcome assessments showed students relatively weak in problem solving skills. By moving later in curriculum, students benefit from additional academic experience.	Fall 2009	Evaluation ongoing.
Course change: use Matlab as primary tool for Computers class rather than visual basic.	Move was part of a vertical program integration effort, where advanced tools are used at multiple stages in the curriculum.	Spring 2008	Evaluation ongoing.
Curricular change: modify CIE 413 Project Management to be integral part of Capstone Design, making the Capstone experience two semesters.	Student assessment of outcomes for Capstone Design, as well as exit interviews showed that students would like to get the process started sooner. With ECP move (below), Capstone project proposal became major curricular element.	Fall 2009	Making the capstone experience two semesters has allowed students more time to do multiple iterations in their design process, improving design as well as teamwork skills.

Table 4-4. Curriculum changes since the previous ABET review

Description of change	Rationale	Date Impleme nted	Analysis
Curricular change: move 2nd ECP class to fall of senior year, link to CIE 413 Project Management.	Part of capstone expansion (above), also helped balance teaching workload of associated English Dept. faculty.	Fall 2009	(see above)
Add ERS 102 *Environmental Geology of Maine* and PSE 140/141 *Introduction to Plant & Soil Science/Lab* to list of approved science electives.	Gives students more flexibility in meeting science requirement. Faculty believed PSE was a practical option for environmental engineering.	Fall 2010	None yet.
Curricular change: Recommend new chemistry course: CHY 131/133 *Chemistry for Civil, Electrical, and Mechanical Engineers*.	Environmental faculty felt the previous basic chemistry course did not fulfill needs of our students in one semester. New course is aimed at coverage of critical elements in a single semester.	Fall 2011	None yet.
Course change: use AutoCAD as primary graphics tool rather than Microstation.	Students and employers have called for this change for several years. New licensing arrangements made the change possible.	Spring 2012	None yet.
Course change across curriculum: Require C or better in pre-requisite courses for courses in the program.	Course outcome assessments as well as FE assessment. Evaluation of data led us to believe that students who don't have strong foundation have difficult time recovering.	Fall 2012	None yet.
Course change: Enhance coverage of risk analysis in CIE 412.	CEA cited risk analysis and risk management as something that is gaining greater importance in the profession, and something that we have not emphasized in our curriculum.	Fall 2012	None yet.

D. Additional Information

The assessment instruments and evaluation procedure presented here is intended to give the reviewer an idea of how our process works, along with sample outcomes of the process. All supporting documentation will be made available to the reviewer during the site visit.

Criterion 5. Curriculum

A. Program Curriculum

The Civil Engineering curriculum is presented in Table 5-1. The University of Maine operates on a semester system, and the curriculum is designed for students to complete in eight semesters. There is a single path for a BS degree, however, students pursuing minors or dual degrees work with their academic advisor on schedule adjustments that minimize the time to complete all requirements.

Table 5-1. Program Curriculum

	Course	Required (R) or Elective (E)	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms Course was Offered
			Math & Basic Sciences	Engineering Topics (✓ indicates design component)	General Education	Other		
Yr. 1/Sem. 1	CHY 131/133 Chemistry for Engrs./Lab	R	4				(New F11)	137/16
	CIE 100 Intro to Civil & Env. Engineering	R		1			F11, F10	82
	CIE 110 Materials	R		3			F11, F10	135
	CIE 111 Materials Lab	R		1 (✓)			F11, F10	20
	ENG 101 College Composition	R				3	S12, F11	20
	MAT 126 Anal. Geom. & Calculus I	R	4				S12, F11	75/25
Yr. 1/Sem. 2	CIE 101 Civil Engineering Graphics	R		3 (✓)			S12, S11	87/31
	CIE 115 Computers in Civil Engineering	R		3			S12, S11	81/21
	MAT 127 Anal. Geom. & Calculus II	R	4				S12, F11	78/35
	PHY 121 Engineering Physics I	R	4				S12, F11	242/24
	Human Values & Social Context	E			3			
Yr. 2/Sem. 1	CET 101 Plane Surveying	R		3			S12, F11	81/21
	MEE 150 Statics	R		3			S12, F11	59
	MAT 228 Calculus III	R	4				S12, F11	45
	PHY 122 Engineering Physics II	R	4				S12, F11	216/24

(Table 5-1 continued)

	Human Values & Social Context	E			3			
Yr. 2/Sem. 2	CIE 225 Transportation Engineering	R		3 (✓)			S12, S11	67
	ECP 413 Technical Writing II	R				1	S12, S11	20
	MAT 258 Differential Eqs & Lin. Algebra	R	4				S12, F11	78/14
	MEE 251 Strength of Materials	R		3			S12, F11	77
	Approved Science Elective	SE	4					
Yr. 3/Sem. 1	CIE 331 Fund. of Environmental Eng.	R		3 (✓)			F11, F10	53
	CIE 340 Intro. to Structural Analysis	R		4 (✓)			F11, F10	61/37
	CIE 350 Hydraulics	R		3			F11, F10	56
	CIE 351 Hydraulics Lab	R		1			F11, F10	20
	CMJ 103 Fund. Public Communication	R			3		S12, F11	24
	Human Values & Social Context	E			3			
Yr. 3/Sem. 2	CIE 365 Soil Mechanics	R		3			S12, S11	59
	CIE 366 Soil Mechanics Lab	R		1			S12, S11	17
	MAT 332 Statistics for Engineers	R	3				S12, F11	49
	CIE Elective	SE		3				
	CIE Elective	SE		3				
	Engineering Science Elective	SE		3				
Yr. 4/Sem. 1	CIE 412 Engineering Decisions	R		2			F11, F10	62
	CIE 413 Project Management	R		2			F11, F10	63
	ECP 413 Technical Writing II	R				1	F11, F10	63
	CIE Elective	SE		3				
	CIE Elective	SE		3				
	CIE/Tech Elective	E		3				
	Human Values & Social Context	E			3			
Yr. 4/Sem. 2	CIE 410 Engineering Ethics	R			1		S12, S11	62/34
	CIE 411 Engineering Project Design	R		3 (✓)			S12, S11	62
	ECP 411 Technical Writing Workshop	R				1	S12, S11	62
	CIE Elective	SE		3				
	CIE/Tech Elective	E		3				
	Human Values & Social Context	E			3			

(Table 5-1 continued)

TOTALS - ABET BASIC-LEVEL REQUIREMENTS			35	69	19	6
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM		**129**				
PERCENT OF TOTAL			27%	53%	15%	5%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours		32	48		
	Minimum Percentage		25%	37.5%		

Alignment with Program Objectives

The curriculum supports the Program Objectives through vertical integration of basic scientific and engineering principles with engineering design, professional preparation, and an exposure to the liberal arts. The curriculum is constructed so that students are well grounded in engineering analysis and design (PEO #1), while having a broad background for understanding context and impact of their engineering decisions (PEOs #4 & #5). (As previously noted, the lifelong learning of PEOs #2 & #3 are addressed not by specific course requirements, but rather by conduct of the courses in the curriculum.)

Structure of Prerequisites

The curriculum structure is intended to develop problem solving skills starting with the first semester in the program. The student problem solving ability is built by developing math skills and science principles such that these tools can be gradually introduced into progressively more advanced engineering problem solving. This building of problem solving skills is illustrated in our first year course sequence: Materials, Graphics, and Computers, wherein a range of different problems can be introduced. As the students become more proficient in mathematics, and obtain a better understanding of basic physical sciences, we can build upon the foundation of math, science, and engineering coursework. All 200 and 300-level required CIE courses have some kind of mathematics and/or science prerequisite, with the exception of Transportation Engineering, which is a sophomore level course. All advanced CIE electives have a core course in the sub-discipline as a prerequisite.

As described in Section 4, in order to address perceived deficiencies in program outcomes, we recently introduced an added program prerequisite requirement that all CIE courses will now require a grade of “C” or better in the relevant prerequisite course.

A flowchart that illustrates the prerequisite structure is shown in Figure 5-1.

Program Requirements and Subject Areas

1. Mathematics and Basic Sciences

   Students are required to take thirty-five credits in mathematics and basic sciences. This requirement includes five courses in mathematics, totaling nineteen credits including

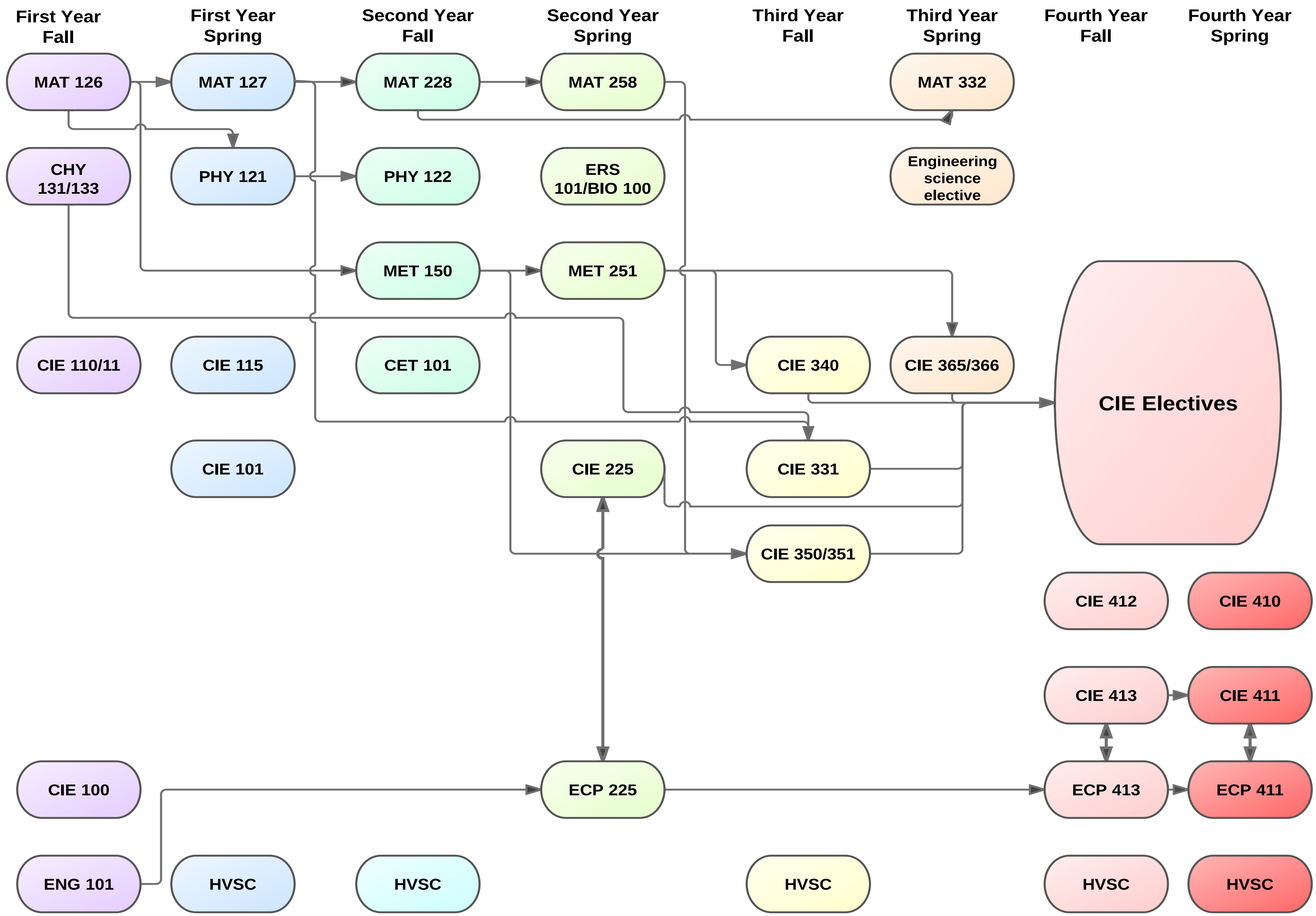


Figure 5-1. Flowchart illustrating Civil Engineering Curriculum with Prerequisite Structure

calculus and analytic geometry, differential equations and linear algebra, and statistics. The courses are taken through the mathematics department, although a number of applied statistics courses are offered in various disciplines across the campus. Some students take the applied statistics rather than the statistics in the mathematics department.

Our students are required to take four basic science courses with a total of sixteen credits. These include one course in chemistry, two courses in calculus-based physics, and one approved science elective. The science elective must be a laboratory-based course from a list of approved options in geology, biology, plant & soil science, or an additional course in chemistry.

Students may elect to take up to six additional credits of upper level mathematics or upper level sciences for credit toward graduation. (See Technical Elective, below.) Introductory biology or geology also satisfy this requirement.

2. Engineering Topics

Engineering analysis and design is integrated into the curriculum through what may be classified as engineering basics (22 credits), core civil engineering sub-disciplines (18 credits), advanced civil engineering (21 credits), and professional preparation (12 credits, 3 of which is technical communication). Engineering basics are covered primarily in the first two years, core civil engineering comes in the second and third year, while advanced civil engineering come in the third and fourth year. Professional preparation spans the entire curriculum, but is mostly built into the fourth year.

Engineering basics begin in the first year, first semester with Materials and Materials Laboratory. While the course has important content objectives, secondary objectives such as basic statistical analysis and data analysis are addressed. Basic problem solving skills are further developed in the second semester in Graphics and Computers. The computer class, although taught by a civil engineering faculty, is essentially an introduction to programming and basic numerical methods. Students get a preview of what they will be seeing in the core civil engineering courses through numerical analysis of environmental, geotechnical, structures, transportation, and water resources problems, hence the course's classification as an "engineering" topic. Engineering basics continue with courses in plane surveying, statics, strength of materials, and an engineering science elective, from which the students choose either thermodynamics (MEE 230), dynamics (MEE 270), or electrical circuits (ECE 209).

The core civil engineering sub-disciplines are covered through required courses in transportation engineering (CIE 225), environmental engineering (CIE 331), structural engineering (CIE 340), hydraulics and water resource engineering (CIE 350/351), and geotechnical engineering (CIE 365/366). As noted under Criterion 9, these five courses combined with the civil engineering basics courses form the basis for the competency in at least four areas of civil engineering.

Beyond the core courses, students are required to take 21 credits of civil engineering elective courses. In order for students to gain depth in analysis and design in different sub-disciplines, our students are required to take elective courses in at least three of the five sub-disciplines offered in the program. The students are allowed some flexibility in the form of “technical elective” courses. Technical electives are technical courses outside of civil engineering that are relevant to civil engineering disciplines. Examples include advanced math, an additional laboratory science class, or other engineering classes. Students are allowed to take up to two technical electives. On occasion, special topics courses are offered based on current student and/or faculty interests (typically courses offered for the first time are offered as special topics). These courses are treated as civil engineering electives, but do not count towards the three-out-of-five rule unless the course content has been reviewed by the faculty. High achieving undergraduates are allowed to take 500-level (graduate classes) as civil engineering electives, however, these typically do not count toward the three-out-of-five rule. Students may get up to three credits through an internship with a suitable employer (CIE 394). The experience is overseen by a civil engineering faculty member, and the course may be counted as a technical elective.

Part of the preparation for engineering practice is design. Each student must take sixteen credits of design within the civil engineering courses. The design credits for each course are approved by the departmental curriculum committee based upon evidence submitted by the instructor. Eleven design credits are included in the required civil engineering courses, and thus students must elect five credits for design in the civil engineering or technical electives. Some of the upper level civil engineering courses contain no design or only one or two credits for design.

The courses classified here as professional preparation begin the first semester, first year, with an introductory seminar class (CIE 100). This course gives an overview of different areas of civil engineering and introduces important issues, such as engineering ethics, employment opportunities, graduate and continuing education, professional organizations, and historical perspective. Professional preparation courses conclude in the fourth year with the a required two course major design capstone experience (CIE 413 and 411). For these courses, students are required to work in groups and interact with consultants of various disciplines and with community members involved in a project. Economic, environmental, safety, social, ethical, and technical issues from many civil engineering areas are incorporated into this project. Public presentations and written reports are a part of these courses.

3. General Education Component

The University of Maine has General Education requirements that every graduate must fulfill. These include Science, Mathematics, Writing Competency, Ethics, and Human Values and Social Context (HVSC). The Civil Engineering Program fulfills all General Education requirements,with the exception of HVSC, via required courses. The combination of the required program courses with the HVSC courses provides our students with the broad education necessary to understand the impact of engineering solutions in a global and societal context and a knowledge of contemporary issues. The HVSC requirement is eighteen credits that must satisfy five categories: 1. western cultural tradition; 2. social contexts and institutions; 3. cultural diversity and international perspectives, 4. population and the environment; and 5. artistic and creative expression. HVSC courses are approved for the various designations by the university-wide Undergraduate Program Curriculum Committee. The communications course, CMJ 103, Fundamentals of Public Communication is required for our students and satisfies a requirement for human values and social context.

The one-credit course, CIE 410 Engineering Ethics, is taught by an adjunct faculty member from the English department with a philosophy background. The course is required for all undergraduates, and covers the philosophical foundations of the ASCE Code of Ethics, as well as the Maine Professional Engineers Code of Ethics.

4. Other

   Students are required to take six credits in the 'other' category. These are courses in English and Technical Writing that are an integral part of the professional component of the curriculum, but do not fit in well with the above three categories. They include ENG 101 College Composition, ECP 225 CE Technical Writing I, ECP 413 CE Technical Writing II, and ECP 411 Technical Writing Seminar.

   The technical writing courses are integrated with civil engineering courses. ECP 225 is linked with CIE 225 Transportation Engineering. ECP 413 is linked with CIE 413 Project Management. ECP 411 is linked with CIE 411 Engineering Project Design.

Site Visit Review Materials

During the site visit, the ABET reviewer will have full access to our web-based documentation for all curricular activities including:

- program curriculum sheets with links to individual courses
- electronic syllabi with links to outcomes
- course outcome assessment instruments and analysis
- program outcome assessment instruments and analysis
- records of internal program reviews for Program Educational Objectives
- examples of student work (both electronic and hard copy).

If requested, the reviewer will have full access to raw data for all assessment instruments.

E. Course Syllabi

Course syllabi for all required and CIE elective courses are provided in Appendix A.

Criterion 6. Faculty

A. Faculty Qualifications

The Department of Civil & Environmental Engineering consists of 13 full time faculty members, 12 of whom have teaching roles in the undergraduate Civil Engineering Program. (One is full time director of a research center, and does not directly engage in the undergraduate program.) All faculty but one have terminal degrees in civil engineering or a related discipline, and all but three are either licensed or on track for professional licensure.

In broad terms the teaching faculty expertise is broken down as follows:

- 2 faculty in environmental engineering
- 3 faculty in geotechnical/materials engineering
- 1 faculty in transportation engineering
- 2 faculty in water resources engineering
- 4 faculty in structural engineering/mechanics

The faculty expertise is sufficient to be able to cover proficiency in the above five sub-disciplines of civil engineering.

Details of faculty qualifications are presented in Table 6-1, and in Appendix B.

B. Faculty Workload

Regular tenure-stream faculty have nominal 50% teaching appointments. The exceptions to this include the department chair, who is nominally 25% teaching. Non-tenure-stream faculty have 100% teaching appointments. Teaching workload is assessed by the chair. A baseline teaching load for tenure-stream faculty is two courses per semester, however, this workload is adjusted based on factors such as number of students in the course, number of contact hours, and other teaching and departmental service related activities. Also, untenured faculty are given a reduced teaching workload to help them develop their research programs.

Table 6-2 summarizes teaching workload assignments for the faculty over the past academic year.

C. Faculty Size

Over the past six years, the Civil Engineering BS Program has an average of 265 students. During most of that time we averaged around 10 regular full time teaching faculty. When graduate students are added, we maintained a student-faculty ratio of close to 30. This is exceptionally high given that during that same time frame we were responsible for an average of $5M per year in external research funding. This was an absolutely unsustainable workload for the faculty. Some relief came this past year in the form of a new full time teaching faculty member, and the delayed replacement of a retired faculty member.

Despite the very heavy workload on faculty, student-faculty interaction and mutual respect is exceptional and is a source of great pride. Faculty support of student activities such as CIE 1000 (a Friday evening gathering at the local pizza/watering hole), capstone design projects, and ASCE student chapter meetings is outstanding. There is excellent interaction between

Faculty Name	Highest Degree Earned - Field and Year	Rank [1]	Type of Academic Appointment [2]	Full Time (FT) or Part Time (PT)	Years of Experience			Professional Registration	Level of Activity		
					Gov./Ind/ Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Amirbahman, Aria	PhD, Civil Engineering, 1993	P	T	FT	5	15	15	PE	M	L	L
Dagher, Habib	PhD, Civil Engineering, 1984	P	T	FT	0	17	27	PE	H	L	L
Davids, William	PhD, Civil Engineering, 1998	P	T	FT	4	14	14	PE	M	M	M
Garder, Per	PhD, Civil Engineering, 1982	P	T	FT	1	30	20	PE	M	L	L
Jain, Shaleen	PhD, Civil Engineering, 2001	ASC	T	FT	5	6	6	EIT	M	L	L
Landis, Eric	PhD, Civil Engineering, 1993	P	T	FT	4	18	18	PE	H	N	N
Lopez Anido, Roberto	PhD, Civil Engineering, 1995	P	T	FT	3	14	14	PE	H	M	L
MacRae, Jean	PhD, Civil Engineering, 1997	ASC	T	FT	2	13	13	n/a	H	L	L
Manion, William	MS, Civil Engineering, 1992	I	NTT	FT	1	12	12	PE	H	M	H
Maynard, Melissa	PhD, Civil Engineering, 2007	AST	TT	FT	2	4	4	EIT	M	L	L
Nagy, Edwin	PhD, Civil Engineering, 2010	I	NTT	FT	5	1	1	PE/SE	M	L	H
Sandford, Thomas	PhD, Civil Engineering, 1976	ASC	T	FT	11	31	31	PE	M	L	L
Zou, Qingping	PhD, Physical Oceanography, 1995	AST	TT	FT	9	8	1	n/a	M	L	N

[1] Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor
[2] Code: T = Tenured, TT = Tenure Track, NTT = Non Tenure Track

Table 6-1. Faculty Qualifications, Civil Engineering faculty and the civil engineering profession in the state, although part of that is aided by the fact that we are the only civil engineering degree program in the state, and thus a majority of practitioners are also alumni.

D. Professional Development

This department promotes faculty professional development primarily related to teaching effectiveness, grant writing, and enhancing professional competence in the faculty member's field of expertise.

Faculty development with respect to teaching effectiveness is typically coordinated by UMaine's Center for Teaching Excellence, which sponsors a wide range of workshops and seminars on a diverse range of teaching and learning topics. The Center also manages the university's program for new faculty, including mentorship programs.

Faculty quality development is further enhanced by mandatory student class evaluations, and annual faculty peer reviews for untenured members and quadrennial reviews for associate and full professors. These evaluations are followed up for all faculty members by the Department Chair. The Department follows a prescribed set of Evaluation Criteria approved by the Administration.

Sabbaticals are encouraged by the department as part of a faculty professional development plan. Since the last general ABET review, four faculty members took sabbaticals ranging from six months to a year. In the fall of 2012 two faculty members will be on sabbatical leave.

The university also has a Faculty Development Center within the IT department that provides training workshops, some funding for hardware, small grants for course development and incorporation of technology into the classroom. The Faculty Development Center also provides support for and administers University instructional software packages such as Blackboard and WebCT.

E. Authority and Responsibility of Faculty

Faculty have a relatively high degree of autonomy, but all maintain a high level of commitment to the quality of the program. Faculty take individual responsibility for curricular content and collective responsibility for program content. In each case, their work is subject to review by the appropriate constituencies. In addition to teaching responsibilities, each faculty member is responsible for undergraduate advising. Finally, each faculty member takes on a certain level of service to the department. In some cases, service roles are formalized, such as Graduate Coordinator, or Student Chapter Advisor. All faculty participate in regular departmental faculty meetings. New faculty take on a reduced service load as part of their start-up program.

Table 6-2. Faculty Workload Summary

Faculty Member	FT/ PT	Classes Taught	Program Activity Distribution			% of Time Devoted to Program
			Teaching	Research or Scholarship	Other	
Aria Amirbahman	FT	CIE 350 (3 cr. hr.), Fall 2011 CIE 351 (1 cr. hr.), Fall 2011 CIE 431 (4 cr. hr.), Fall 2011 CIE 533 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Habib Dagher	FT	(Not currently engaged in teaching)	0%	50%	50%	0%
William Davids	FT	CIE 442 (4 cr. hr.), Fall 2011 CIE 549 (3 cr. hr.), Fall 2011 CIE 640 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Per Garder	FT	CIE 425 (3 cr. hr.), Fall 2011 CIE 426 (3 cr. hr.), Fall 2011 CIE 225 (3 cr. hr.), Spring 2012 CIE 424 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Shaleen Jain	FT	CIE 455 (3 cr. hr.), Fall 2011 CIE 552 (3 cr. hr.), Fall 2011 CIE 456 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Eric Landis	FT	CIE 100 (1 cr. hr.), Fall 2011 CIE 110 (3 cr. hr.), Fall 2011 CIE 115 (lecture portion) (3 cr. hr.), Spring 2012 CIE 440 (4 cr. hr.), Spring 2012	35%	15%	50%	100%
Roberto Lopez Anido	FT	CIE 340 (4 cr. hr.), Fall 2011 CIE 545 (3 cr. hr.), Fall 2011 CIE 543 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Jean MacRae	FT	CIE 331 (3 cr. hr.), Fall 2011 CIE 534 (3 cr. hr.), Fall 2011 CIE 434 (4 cr. hr.), Spring 2012 GEE 250 (3 cr. hr.), Spring 2012	45%	45%	10%	100%

Will Manion	FT	CIE 111 (1 cr. hr., 8 sections), Fall 2011 CIE 413 (3 cr. hr.), Fall 2011 CIE 101 (3 cr. hr.), Spring 2012 CIE 366 (1 cr. hr., 5 sections), Spring 2012	90%	0%	10%	100%
Melissa Maynard	FT	CIE 660 (2 cr. hr.), Fall 2011 CIE 661 (3 cr. hr.), Fall 2011 CIE 365 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Edwin Nagy	FT	CIE 544 (4 cr. hr.), Fall 2011 CIE 598(1) (2 cr. hr.), Fall 2011 CIE 598(2) (2 cr. hr.), Fall 2011 CIE 115(lab portion, 3 sections), Spring 2012 CIE 443 (4 cr. hr.), Spring 2012 CIE 598(1) (3 cr. hr.), Spring 2012	90%	0%	10%	100%
Thomas Sandford	FT	CIE 412 (2 cr. hr.), Fall 2011 CIE 460 (3 cr. hr.), Fall 2011 CIE 411 (3 cr. hr.), Spring 2012 CIE 562 (3 cr. hr.), Spring 2012	45%	45%	10%	100%
Qingping Zou	FT	CIE 450 (3 cr. hr.), Fall 2011 CIE 598(2) (3 cr. hr.), Spring 2012	45%	45%	10%	100%

Criterion 7. Facilities

Boardman Hall is the primary residence for the Department of Civil & Environmental Engineering, including faculty offices, teaching laboratories, and student work space. A majority of the CIE courses are delivered in Boardman Hall. However, some of the larger lecture courses are offered in adjacent Bennett and Little Halls.

A. Offices, Classrooms and Laboratories

Offices

The departmental administrative office suite is conveniently located on the first floor of Boardman Hall. The suite houses the administrative staff (including the Department Chair) and an adjoining conference room that is available for student meeting space.

All faculty but one have their offices on the third floor of Boardman Hall. Offices vary in size (130 to over 250 ft^2), but all have sufficient workspace for faculty to conduct their business and meet with students. All full time faculty have individual offices so that student interactions can have appropriate privacy. Faculty have individual hard-wired workstations connected to shared printing, scanning, and photocopying facilities, one each on first and third floor. Faculty offices are considered adequate.

Most graduate students are housed in four separate shared office spaces in Boardman Hall, although a majority of the graduate structures students are located in offices at the Advanced Structures and Composites Laboratory. Students with Teaching Assistant responsibilities often hold office hour sessions in their offices in Boardman, however, some students choose to hold their office hours in the Hamm Student Projects Laboratory. Graduate student offices in Boardman are admittedly shabby in their appearance, and are a priority for future improvements.

Classrooms

Nearly all classrooms used to deliver courses in the program are both hard-wired with active computer ports, although all university buildings have wireless internet access. Classrooms typically have permanently mounted LCD projectors, in addition to blackboards or whiteboards. Additional media is available from the Department of Instructional Technologies and can be requested by instructors. Classrooms are scheduled by a central facilities office, and faculty can request different classrooms to meet their particular needs.

A general-purpose classroom/workroom on the third floor of Boardman Hall (room 309), in among the CIE faculty offices, is supported and controlled by the department. The room is easily configurable for different uses, but is most typically arranged for collaborative work. The room features recessed power for laptop plug-in, making it an effective location for civil engineering computation labs, such as first year graphics and computing classes, as well as upper level design labs. In addition to regularly scheduled classes, the space is used for weekly ASCE lunch meetings, as well as other special events.

Laboratories

All department teaching laboratories are housed in Boardman Hall. The teaching laboratories support a very hands-on program. The main laboratories that support the BS program are:

- The Richard & Jean Higgins Materials Testing Laboratory
- The SW Cole Concrete Laboratory
- The Kleinschmidt Hydraulics Laboratory
- The Gorrill Palmer Soil Mechanics Laboratory
- The Franklin Woodard Environmental Laboratory
- The Alton '38 and Adelaide Hamm Student Design Project Laboratory

Additionally, several research laboratories are used for special topics/special projects:

- The Advanced Soil Mechanics Laboratory
- The Micromechanics Laboratory
- The CES Environmental Chemistry Laboratory
- The Olver Associates Environmental Microbiology Laboratory

Finally, though not formally a departmental facility, the Advanced Structures & Composites Laboratory with its associated Offshore Wind Lab, is a world class research facility housing equipment and instrumentation for materials and structures ranging from nano-composites to 70 meter wind turbine blades. It is mentioned here as roughly 50 of our students per year work in the lab as research assistants or engineering interns. It has become a showcase for our program, as it is most certainly a showpiece for the university.

The condition of the teaching laboratories ranges from very good to barely adequate. The last six years has seen a vast improvement in the spaces due to heightened development efforts spearheaded by the Dean of Engineering. All teaching labs are endowed, providing base funds for maintenance and instrumentation upgrades. Since the last ABET visit, the Materials Testing Laboratory and the Soil Mechanics Laboratory saw substantial upgrades.

A list of equipment and instrumentation used by the students is presented in Appendix C.

B. Computing Resources

Students have access to several other clusters on campus, e.g., in the Student Union and the Library. All student dorm rooms are connected through fiber optic cables with the internet and academic buildings on campus, so that students can transfer data from the department's laboratory computers or communicate with professors electronically. All faculty offices and teaching laboratories have desktops that are connected to the internet.

Two specific computer clusters are dedicated to the program, one in room 118 Boardman, and the other in room 218 Boardman. The former is shared between CIE and the School of Engineering Technology, and the latter is shared between CIE and the Department of Mechanical Engineering. The 118 cluster is primarily for office productivity applications, although some CAD software is available. The 218 cluster has more advanced engineering analysis and design packages. Both labs have printers that the students can access with their Student ID card. (Printing funds are a part of their comprehensive student fees.)

Over the past four years, we have been gradually reducing out support of computer hardware in support of students using personal laptops. The primary software packages used in the program (MS Office, AutoCAD, Matlab) are all available to students at a reduced price. Even though it is not a formal program requirement, over the past 4-5 years we have had 100% computer ownership among our students. We are taking advantage of this by using laptops in some of the introductory courses as well as the upper level engineering design courses.

C. Guidance

All instrument and equipment training, as well as general laboratory safety protocols are integrated into the courses that utilize the laboratories. Use of software is also integrated into the course content where the packages are used.

Students may use laboratory facilities for independent or special projects. In such cases, students are required to undergo university-wide general safety training as well as site-specific training. Depending on the laboratory, the site-specific topics range from general hazardous communications (HAZCOM) training to chemical hygiene plan training.

All students who work in a departmental laboratory outside of a regular class activity are issued a copy of *The Department of Civil & Environmental Engineering has a Laboratory Safety Plan* that documents all safety procedures and laboratory protocols.

D. Maintenance and Upgrading of Facilities

Several funding mechanisms are used to maintain and upgrade laboratory facilities. As noted above, all teaching labs have annual endowment payments that can be used for any aspect of laboratory operations. The endowed funds typically are not sufficient for major instrumentation purchases, so the department relies on funds from the College of Engineering Curriculum Fee Competition. This competition is intended to support major laboratory upgrades that bring new capabilities to the program. As shown in Table 8-1 below, we have received funding from this source each of the past six years, at a funding level from $12K to $27K.

Additional laboratory investments have used alumni gift funds an other special projects funding sources.

E. Library Services

The University of Maine Library has kept pace with technology for disseminating information and has created an up-to-date environment conducive to learning, with many on-line resources available 24 hours a day. A software interface called “Mariner” serves as the gateway to electronic information resources for patrons of the participating libraries. The Gateway provides a common entry point to networked information created and maintained by librarians at the seven campuses of the University of Maine System (UMS) libraries. Mariner provides access to Web sites and other online resources available through the UMS Libraries, the Maine State Library, the Bangor Public Library, and the Maine State Law and Legislative Reference Library. Number one among these online resources is URSUS, the shared catalog of all campuses of the University of Maine System as well as the Education Network of Maine, and the other Maine libraries mentioned above. The Mariner gateway is a vehicle for locating and accessing local and remote databases. It includes electronic resources created by individual UMS libraries, as well as other free and fee-based resources. Web site resources are linked to a topical directory that may be customized by each library to address the particular campus mission. The Library's Science and Engineering Center covers all areas of the sciences, engineering and technology. Librarians in the Center have subject expertise in the natural and physical sciences and engineering, and work closely with students, faculty, and staff on developing and accessing the engineering and science collections. The library also has an active users instruction program. The collections include approximately 1,040,000 volumes, 3,889 periodical subscriptions, 1.6 million microforms, 2.2 million United States Federal, Maine State, and Canadian federal and provincial government publications, and a rapidly growing number of electronic resources. The Library also has a large number of information resources in a variety of electronic formats. Timely acquisition of new periodical subscriptions, however, is not always possible. On the other hand the library is able to purchase essentially all the new book titles requested by our faculty through the Science and Engineering Center.

Criterion 8. Institutional Support

A. Leadership

The College and Department leadership team has been fairly stable since the last ABET General Review. Through all six years of review, Dana Humphrey has been Dean of Engineering, and Eric Landis has been Chair of Civil & Environmental Engineering. 2011 saw a transition at the college Associate Dean position, as Mohamad Musavi (previously Chair of Electrical and Computer Engineering) replaced the retiring Chet Rock.

The Dean leads the College of Engineering Executive Committee, which consists of all college department chairs and directors, meeting bi-weekly during the academic year, and monthly during the summer. These meetings serve as a forum for college policy discussions, as well as dissemination of university initiatives and various action items.

At the department level, the Civil Engineering Program is administered by the Department Chair, with shared governance among all faculty. The small size of the department allows us to dispense with a formal administrative structure, as all program decisions are made collectively by the faculty. The only other formal administrative appointment within the department is the Graduate Coordinator, who oversees admissions and administration of our graduate program, and acts as a liaison with the Graduate School.

B. Program Budget and Financial Support

The program is supported by a departmental budget that has a diverse array of components. These components are summarized as follows. Annual totals of all non-salary departmental funding since the last ABET site visit are presented in Table 8-1.

1. **Operational Budget** – The College of Engineering receives an annual operational budget from the University of Maine Education and General Fund (E&G Fund). This fund is divided between different college units.
2. **Curriculum Fee Base and Curriculum Fee Competition** – Each College of Engineering course is charged a Curriculum Fee in the amount of $100. From the generated Curriculum Fee money each year, approximately half is provided to the departments based on their 3-year average enrollments. The remaining half is allocated based on Curriculum Fee Proposals submitted by faculty to the College Academic Council. The objective of the Curriculum Fee competition is to improve the College of Engineering teaching laboratories and to ensure students receive a superior laboratory experience with better equipment, adequate supplies, and quality facilities. The Curriculum Fee's increase rate is similar to the University of Maine tuition increase rate.
3. **Program Fee** - A $75 program fee is assessed for all engineering course designators within the College of Engineering. The majority of Program Fee money generated each year is allocated to the departments based on their 3-year average enrollments. The departmental allocations are to be used for needs such as teaching assistantships, undergraduate student tutor, temporary instructors, purchase and maintenance of critical laboratory equipments, and supporting activities such as retention, student professional societies, and students travel.   The remaining Program Fee money is allocated by the

Table 8-1. Departmental Annual Budgets 2007-2012

Fiscal Year	University		College of Engineering			Department		Total
	Operating Budget	TA base	Curriculum Fee Base	Curriculum Fee Merit	Program Fee Base	Alumni Support	Endowed/ Others	
FY 2007	$6,395	$34,500	$18,580	$16,580	$11,361	$44,346	$55,771	$187,533
FY 2008	$6,395	$35,931	$21,575	$12,000	$72,300	$54,979	$60,813	$263,993
FY 2009	$5,395	$37,500	$58,413	$27,016	$88,404	$52,977	$34,896	$304,601
FY 2010	$7,895	$38,367	$22,008	$27,016	$61,808	$64,912	$41,934	$263,940
FY 2011	$7,895	$39,360	$33,983	$20,500	$71,036	$52,381	$37,906	$263,060
FY 2012	$7,895	$40,800	$59,757	$25,220	$70,624	$50,442	$83,054	$337,792

College of Engineering to student centered activities such as student professional organizations, student travel to conferences, student projects, and others.

4. **Teaching Assistantships** – The University of Maine Graduate School provide a certain number of Teaching Assistants (TA) each year to the College of Engineering. These TA are divided to the departments based on their 3-year average enrollments.
5. **Endowed Funds** – The Civil & Environmental Engineering Department has an array of endowed funds that support the civil engineering program. These may be classified broadly as excellence funds and laboratory funds. The Patten Fund is a long standing endowment that generates about $25K per year, and is used to support general program expenses. The Taylor Fund is a newer endowment that also generates about $25K/year. Over the past six years we have used that fund primarily for faculty professional development. Regarding the laboratory funds, each teaching laboratory in the program has an endowed fund to help support operations. These funds typically generate about $5K per year per laboratory, (about $25K for all teaching labs), and the proceeds are used for supplies, maintenance, instrument calibration, and other small expenses. Curriculum Fee monies are typically used for major instrumentation purchases or upgrades.
6. **Alumni Support** – The Department of Civil & Environmental Engineering receives support from alumni as the result of annual fundraising effort. Over the past six years the average alumni gift support has been about $50K per year. The money is deposited in the departmental gift accounts, which is used at the discretion of the department chairperson to support all departmental activities. Priorities over the past six years have been scholarship support, student activities, and departmental facilities upgrades.

The operating funds of the department are adequate, if not good. Through all the funding sources available, we are able to provide reasonably good support to classroom instruction, student activities, graders for instructors. When necessary or appropriate, we have been able to hire adjunct instructors to complement our regular faculty, and we have been able to provide a good level of support to faculty professional development. As noted below, the biggest gap in our institutional support is the lack of a full time staff member to manage our laboratories.

C. Staffing

At present, the department support personnel consists of one administrative assistant who is involved with all academic administrative tasks, and one manager of funded accounts, who handles the financial matters of the department. This level of administrative support is adequate.

The Department contracts for network and computer support services from the University's Instructional Technology group. We contract for the equivalent of ¼ of a full-time position. This method of obtaining computer support was instituted in Fall, 2004. The services that are provided include: maintenance of the local computer network that is shared with Mechanical Engineering, implementation and monitoring of network security, repair of minor computer hardware problems, installation and upgrading of software packages, and troubleshooting of problems on individual faculty, graduate student, and laboratory computers. Major computer hardware repairs are contracted out.

The department has essentially no technical support staff to assist with operation of our teaching and research laboratories. This was cited as a concern in our last ABET review, and little progress has been made. One of the department's one non-tenure track instructors does have some responsibility to oversee our laboratories, however, the teaching burden placed on this individual by the Department's growing undergraduate enrollment has left him with time to perform only a limited number of essential and time-critical maintenance activities. Our greatest staffing need is clearly a full-time laboratory technician to properly maintain and monitor operation of our laboratory facilities.

The Department hires undergraduates on an ad hoc basis during the summer to dispose of outmoded equipment and samples that have been tested, refill aggregate bins, and clean the laboratories.

D. Faculty Hiring and Retention

Hiring of New Faculty

Hiring of new faculty is normally based on retirement, resignation of current faculty or departmental needs due to growth in educational and/or research missions. In either case, the following process is followed:

1. The department chair/school director first discusses the need to hire with the Dean of the College of Engineering giving the justification for the requested position.
2. Upon Dean approval, the dept. chair/school director prepares a draft Request to Fill, Request to Fill-Supplement, Faculty Recruitment Strategy Form, and draft Job Announcement and forwards those documents via email to HR for review and revisions.
3. Upon return of the documents back to the hiring dept. they are put in final form, signed by the dept. chair/school director and forwarded to the Dean for his approving signature and date. The search packet is then forwarded to HR.
4. Upon receipt of the packet at HR, the Faculty Human Resources Officer does a comparative salary analysis to make sure that the proposed hiring salary range is equitable when compared to both current faculty of similar academic rank within the

academic department or school and national faculty salary survey data. These results are added to the search packet and the packet is forwarded to the Senior Associate Director of HR for review and approval.

5. Once the Senior Associate Director of HR has reviewed and approved the packet, it is forwarded to the Office of Equal Opportunity for review and approval of the Faculty Recruitment Strategy Form and then on to the Provost and President for final approval.
6. Once the packet is returned to HR after this final administrative approval, the search chair is contacted to begin recruiting/advertising the position based on the criteria/approved venues in the approved Faculty Recruitment Strategy Form. At this point, the job announcement is also posted on the UMaine HR website.
7. The individual search committee members review and rate candidate applications on a comparative applicant rating sheet on a scale of 1-5 based on the educational attainment, skills, abilities, and qualifications for the position as detailed in the job announcement.
8. The search committee members meet together to aggregate their individual scores on a combined search committee comparative applicant rating sheet to determine the top candidates to be Skype or telephone interviewed.
9. HR reviews this combined search committee comparative applicant rating sheet and the draft Skype/telephone interview questions and authorizes the search committee to commence with these interviews.
10. HR reviews the results of the Skype/Telephone interviews and authorizes the search committee to commence the on-campus interviews
11. Candidates are invited to campus to interview and meet with stakeholders and give academic seminars. The search committee does a strengths and weaknesses assessment of these candidates and makes a hiring recommendation to the Dean. This information is also shared with Human Resources.
12. Candidate references are contacted at this point for their assessment and input regarding the candidates.
13. The Dean negotiates with the selected candidate and tenders a tentative offer in writing that clearly states that the final official offer of employment will be in the form of a letter from the President of the University of Maine.
14. The hiring payroll paperwork and associated supporting documents are prepared and routed for approving administrative signatures as detailed above.
15. HR prepares an official appointment letter on behalf of the Presdient of the University of Maine detailing the terms, conditions, and salary for the position..
16. The faculty member signs, dates, and returns the official appointment letter to HR to accept the appointment
17. The payroll paperwork is transmitted to payroll to be entered into our payroll processing system to generate a paycheck beginning on the last day of the first month of employment and the last day of each month thereafter.

Strategies used to Retain Qualified Faculty

It is a source of great pride, that the Department of Civil & Environmental Engineering as not had a faculty departure (other than retirements or a move to administration) in 14 years. We have consistently been able to recruit top candidates, and keep them them in Orono. The following strategies are used to retain our qualified faculty.

1. Start-up packages including equipment, summer salary, and graduate research assistant ships
2. Research laboratory space,
3. Reduced teaching load to establish research area,
4. Teaching and research mentors,
5. Cost share, course releases on research projects
6. Promotion in rank and associated salary increases.
7. Post-tenure review salary increases
8. Salary retention offers when faculty have employment offers from other academic institutions
9. Equity salary increases as an exception to the collective bargaining agreement
10. Paid sabbatical leaves and unpaid leaves of absence for educational purposes
11. Extension of the probationary period for tenure for family friendly reasons and other exceptional life circumstances
12. Nomination for National and International awards as well as the University of Maine Presidential awards such as the Outstanding Teaching Award, Public Service Award, Research and Creative Achievement Award, and Maine Distinguished Professor Award.

E. Support of Faculty Professional Development

The Department of Civil & Environmental Engineering funds a wide range of professional development activities for faculty. Out of previously mentioned department funds, approximately $10,000 is expended per year to support faculty travel to professional meetings and conferences. Additional resources for faculty support come from start-up funds for new faculty, as well as departmental and university named professorships, which in total generate over $100,000 per year for faculty discretionary spending. Currently there are five departmental faculty with such professorships.

Additional faculty support comes in the form of sabbatical leaves. The department is supportive of such leaves, and over the past six years it has covered the cost of filling the faculty members' teaching responsibilities during their absence.

Program Criteria for Civil Engineering Programs

A. Curriculum

> *The program must prepare graduates to apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of basic science, consistent with the program educational objectives apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.*

The Civil Engineering program curriculum has evolved over the 140-plus years of its existence to meet the needs of the profession and the people of Maine. Itemized below is documentation of how the program meets the program criteria specified above.

Proficiency in mathematics through differential equations, probability and statistics, calculus-based physics, and general chemistry.

Students complete three semesters of calculus and one semester of differential equations which includes linear algebra, through courses offered by the Mathematics Department for a total of 16 credit hours. One semester of probability and statistics for engineers is required (3 credit hours). Most students take a course offered by the Mathematics Department, but a statistical process course offered by Chemical and Biological Engineering is also acceptable. Students take two semesters of calculus based physics with lab (8 credit hours), and one semester of general chemistry with lab (4 credit hours). Proficiency in mathematics, physics and chemistry is reinforced throughout the curriculum in engineering science and design courses. Mathematics is further reinforced in CIE 115 – Computing in Civil Engineering, where students are introduced to computers as a computational tool by solving examples relevant to civil engineering. The algorithmic aspects of numerical methods are covered at a point in the curriculum when students are concurrently taking mathematics courses. The Approved Science Elective in the curriculum is intended to give students experience in an area beyond chemistry and physics. We must note that a second course in chemistry is allowed in our curriculum. This option is in response to constituents in the environmental engineering profession who value graduates with a deeper understanding of chemistry. Between 2007 and 2012, 7% of our graduates chose to take a second chemistry course, while the remainder took either geology (84%), biology (8%), or Plant & Soil Science (1%).

Proficiency in a minimum of four recognized major civil engineering areas.

Students are required to take at least one course in the following five recognized major civil engineering areas: structures, transportation, geotechnical, environmental, and water resources engineering. These five required courses define the core of the discipline, but they are supported by introductory courses in materials, computers, and graphics, which all take examples from the five areas as part of their course curricula. The five basic areas are also reinforced by the capstone design sequence. The curriculum requires additional depth in three of those five areas through advanced elective courses.

Ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas.

Laboratory experiments with critical analysis and interpretation of data are conducted in the following required classes: (1) CIE 111 – Materials Laboratory, (2) CIE 350 – Hydraulics and (3) CIE 366 – Soil Mechanics Laboratory.

- CIE 111 – This laboratory course provides first year students the opportunity to use various testing techniques to measure physical and mechanical properties of construction materials. The laboratory exercises emphasize variability of materials and test results, effects of defects on material properties as a function of temperature, strain rate, specimen size and configuration. Thus the arbitrary nature of materials testing and the need for standardized test procedures are illustrated. The testing is coordinated with the lectures in CIE 110 on the selection and use of materials in engineering design. Students design concrete mixtures to meet design requirements for specific situations. The success of these designs is evaluated by subsequent laboratory testing. Formal reports written on laboratory work include discussions of the applicability of the test results to engineering design. Safety issues focus on the dangers of working around mechanical equipment and exposure to the corrosive effects of Portland cement.
- CIE 351 – The Department has developed its own manual of laboratory experiments which are designed to demonstrate fundamental hydraulic principles, such as buoyancy and metacentric height, Bernoulli's Principle, momentum principle, open channel flow, and friction losses in pipes and appurtenances. The hydraulics laboratory equipment involves the use of electrical pumps and motors around water, so great care is taken to ensure that the equipment is well maintained and operated correctly.
- CIE 366 – Again, the Department has prepared its own laboratory manual to ensure that fundamental soil properties explained in lecture are covered in experimental situations. The "hands on" laboratory experiences include Atterberg limits, compaction, permeability, direct shear, unconfined compression, and consolidation. The laboratory reports emphasize the significance of the results and their practical use rather than the details of the experiments. Laboratory safety emphasis includes discussions on good housekeeping practices, the dangers associated with using equipment operated by high pressure compressed air, and fundamentals of nuclear safety for operation of nuclear densiometers.

Most students receive additional laboratory exposure in their elective courses. Conventional "wet" laboratories are part of three environmental engineering electives: CIE 430 - Water Treatment, CIE 431 - Pollutant Fate and Transport, and CIE 434 - Wastewater Treatment. The environmental courses include sessions on laboratory safety.

Ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum.

The students are required to accumulate sixteen credit hours of engineering design. Eleven hours are earned in the required courses, and at least an additional five design hours must be included in the electives selected by the students. Advisors keep track of design hours earned with a check sheet inserted in each student's file. This check sheet lists all CIE courses with number of credit hours of design and number of credit hours of science.

The design content in the required classes is listed below (design credit hours in parentheses).

CIE 111 (1)	CIE 340 (1)
CIE 101 (1)	CIE 411 (3)
CIE 225 (3)	CIE 413 (1)
CIE 331 (1)	

Although various aspects of design are covered throughout the curriculum, the integration of the sub-disciplines is accomplished in a focused capstone design course, CIE 411, giving the students a good understanding for a complete project design. This major design experience is required for all civil engineering majors in their last spring semester of the program. Students in this class are required to work in small teams and perform typical consulting firm activities, including: marketing with potential clients to secure a project, weekly team leader meetings, preparation of presentations, and submittals of reports to the owner's representative.

Each group is responsible for defining their own project during the preceding fall semester. To be acceptable the project must have a real owner who has vested interest in the outcome and the project must employ several civil engineering disciplines.

Understanding of professional practice issues such as: procurement of work; bidding versus quality based selection processes; how the design professionals and the construction professionals interact to construct a project; the importance of professional licensure and continuing education; and/or other professional practice issues.

Although some of the above issues are being discussed in classes throughout the professional component of the curriculum, the students are exposed to the above issues in a more structured way in (1) CIE 411 – the Capstone course, (2) CIE 410 – Engineering Ethics, and (3) CIE 413 – Project Management. All three are required courses.
CIE 411 – Capstone Course. A variety of previously developed and new skills, besides written and oral communication, are required for students to successfully complete the capstone design course. It prepares students for civil engineering practice by working on a realistic, open-ended project that cannot be solved by one student alone. Students quickly learn that to become effective professional practitioners of civil engineering, the humanities, political and social factors must play an important role in project planning, alongside their technical skills. To give the students a continuous perspective on practice issues and other practical matters of the project, each team meets regularly with a practicing engineer or a faculty advisor with design experience.

CIE 410 – Engineering Ethics. This course introduces students to deontological theory, general concepts and principles pertaining to engineering ethics and handling ethical situations in practice. Throughout the course, students are presented with a combination of lecture, engineering ethical situations using a case or example approach and discussion sessions.

CIE 413 – Project Management. This course focuses on procurement of work, bidding versus quality based selection processes, how the design professionals and the construction professionals interact to construct a project, the importance of licensure and continuing education, and other issues related to contracts, ethics and liability. Additional topics include project management and scheduling, advertising and contracting process, construction plans and specifications, and estimating.

B. Faculty

The program must demonstrate that faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The program must demonstrate that it is not critically dependent on one individual.

Faculty qualifications for teaching design.

Nine of the 12 faculty members in the department with regular teaching assignments eight have PE licenses, while two are progressing through the licensure process and have current EIT certification. Of the two professors without a PE license, one teaches in the environmental engineering area (Dr. MacRae). She teaches courses such as CIE 331 Fundamentals of Environmental Engineering (1 design credit) and CIE 434 Water and Wastewater Treatment (4 design credits). Dr. MacRae has conducted research on wastewater treatment effectiveness and operational parameters, maintains good relations with operators of the local plants and ensures that senior level classes include at least two field trips to operating facilities. She also has ties to design consultants and has invited speakers to discuss design elements. During her graduate studies, Dr. MacRae took all of the available environmental design courses at the University of British Columbia, and did research related to wastewater treatment plants during her tenure at Environment Canada. The other non-PE faculty member, Dr. Zou, who teaches in the hydraulics area, is a new faculty member who contributes to our coastal engineering and offshore structures efforts. Her longer term teaching assignments will be Hydraulics (CIE 350), and her role in the design aspects of our curriculum will be limited.

Critical dependency of program on faculty.

Except for the transportation area which is covered by one faculty member, all areas are covered by at least two faculty members, i.e., four in structures, two in the environmental, two in the water resources area, and three in the geotechnical/materials area.

In past accreditation visits, the lone transportation faculty member has been a concern. We believe, however, that as much as we depend Dr. Garder, we are not "critically dependent." We have a strong connection with the professional community, and we often fill teaching gaps through the use of highly qualified adjunct instructors. This fall, Dr. Garder will be on sabbatical leave, and we have lined up a practicing engineer (MS/PE) who will teach for Dr. Garder. In the future, if Dr. Garder, or any other faculty are unable to meet their teaching obligations to the department, we have qualified adjuncts who are capable of filling our teaching needs until a permanent replacement can be made.

Appendix A - Course Syllabi

- Civil Engineering Courses
- Other Engineering Courses
- Math Courses
- Science Courses

Civil Engineering Courses

1. CIE 100: **Introduction to Civil and Environmental Engineering**

2. 1 credit, 1 contact hour

3. Coordinator: Eric Landis

4. Textbook: none

5. Specific course Information:
   (a) Description: Introduces first-year and transfer students in Civil Engineering to the multifaceted field of Civil and Environmental Engineering. Each week a different faculty member will conduct the class. Challenging problems will be introduced and team work will be practiced.
   (b) Prerequisite: none
   (c) Required course.

6. Course Goals and Outcomes:
   (a) Goals:
      - Introduces students to the multifaceted field of Civil Engineering
      - Introduce students to the multi-faceted field of Civil Engineering
      - Introduce students to all faculty members in department
      - Introduce students to concept of teamwork for solving problems in engineering
      - Introduce students to professional issues in engineering, such as ethics, professional licensure
      - Introduce students to civil engineering in a societal context.
      - Introduce students to the importance of disciplined studying habits and group learning
      - Make students aware of services available to them, such as tutoring, faculty advising and more.
      - Generally make students feel comfortable and give them a sense of belonging by getting to know one another (retention).

   (b) Outcomes:
      - Students will obtain a broad education to understand the impact of engineering solutions in a global and societal context
      - Students have a knowledge of contemporary and ethical issues.

   (c) Relates to ABET Student Outcomes (h) and (j)

7. Topics Covered:
      - Week 1: Introduction, ground rules, engineering success...
      - Week 2: Sustainability & the Built Environment/Library Resources.
      - Week 3: Environmental Sustainability
      - Week 4: Getting involved in the profession/Other opportunities on campus and abroad
      - Week 5: Geotechnical Engineering
      - Week 6: Class Presentations
      - Week 7: Tour of Advanced Structures & Composites Lab
      - Week 8: The CIE Curriculum and Registering for Classes

- Week 9: Transportation Engineering
- Week 10: Environmental Engineering
- Week 11: Engineering Issues in Current Events
- Week 12: Water Resources Engineering
- Week 13: Internships & Co-op Opportunities; Wrap-up and where do we go from here?

1. CIE 101: **Civil Engineering Graphics**

2. 3 Credits; 3 contact hours

3. Instructor: Will Manion

4. Textbook:
   (a) Architectural Graphic Standards, student edition, Bassler/Hoke, John Wiley & Sons, abridged 9th edition, 2000, 0-471-43817-1
   (b) Construction Drawings lab package
   (c) Internet access to WebCT course website

5. Specific Course Information
   (a) Description: Two dimensional and three dimensional CADD (computer aided design and drafting), drawing fundamentals, drawings of buildings, roads and bridges, components of buildings, sitework, roads and bridges, building codes, contour lines, cut and fill calculations.
   (b) Prerequisite: none
   (c) Required course.

6. Course Goals and Outcomes
   (a) Goals:
      - To know and understand fundamental drawing and drafting standards. For example, drawing organization with title blocks, scales, standard views, such as plan, section, detail, elevations, 3D and CADD layers / levels.
      - To read, understand and create representations of civil engineering projects. For example, buildings, sitework, roads and bridges and 3D models.
      - To solve problems in civil engineering using graphical understanding and drawing tools. For example, measurements, material quantity takeoffs and calculations from drawings, surveying layouts, slopes and contours and road profiles with cuts and fills.
   (b) Outcomes:
      - The student will be able to use CADD software.
      - The student will be able to read and understand engineering drawings typical of the industry.
      - The student will be able to solve design problems using graphical tools.
      - The student will know how to recommend appropriate graphical skills and applications to solve particular problems.
   (c) Relates to ABET Student Outcomes (a), (c), (e), & (g)

7. Topics Covered: Two dimensional and three dimensional CADD (computer aided design and drafting), drawing fundamentals, drawings of buildings, roads and bridges, components of buildings, sitework, roads and bridges, building codes, contour lines, cut and fill calculations.

1. CIE 110: **Materials**

2. 3 Credits; 3 contact hours

3. Instructor: Eric Landis

4. Textbook:
   (a) *Lecture Notes in Civil Engineering Materials*, 2011, Eric Landis

5. Specific Course Information
   (a) Description: The structure, properties, and testing of engineering materials and their use in constructed facilities. Includes metals, wood, concrete, bituminous mixtures, plastics, insulation, adhesives, and corrosion of materials. Engineering design is introduced by readings and discussions on creativity, the design process and the concepts of marginal economic analysis, probability of failure and safety factors. Design problems include design of concrete mixtures and insulating systems to satisfy specific realistic situations taking into account uncertainty, safety, economic factors, and intangibles, as well as technical considerations.
   (b) Prerequisite: MAT 122 or concurrently
   (c) Required Course

6. Course Goals and Outcomes:
   (a) Goals
      - The students will learn basic physical, mechanical and chemical properties of different construction materials
      - The students will be introduced to various tools of engineering problem solving including statistical and experimental analysis.

   (b) Outcomes:
      - The student will demonstrate the ability to perform a simple statistical analysis of experimental data, including fitting data to standard models, and making predictions based on those models.
      - The student will demonstrate understanding of stress, strain, strength, toughness, durability and fatigue, and the student will be able to perform calculations that involve those quantities.
      - The student will demonstrate an understanding of the role of microstructure in material properties.
      - The student will demonstrate an understanding of production and properties of steel, concrete, wood and wood composites, and FRP composites.
      - The student will be able to identify the critical design issues in material selection

   (c) Relates to ABET Student Outcomes (a), (e), & (i)

7. Topics covered:
   - Experimentation and Laboratory Analysis
     - Role of experimentation and testing in engineering analysis and design
     - Variability and statistical analysis
     - Sampling and testing
   - Basic Properties of Materials

  - Some basic mechanics
  - Physical, mechanical and chemical properties
- Basic Materials Science concepts
  - Chemical bonding
  - Energy principles
  - Microstructural basis for strength, stiffness, and ductility
- Construction Materials
  - Portland cement concrete
  - Steel
  - Wood
  - Composites
  - Bituminous concrete
- Design Process and Materials Selection Issues

1. CIE 111: **Materials Lab**

2. 1 Credit; 2 contact hours

3. Instructor: Will Manion

4. Textbook:
   (a) Internet access to laboratory manual online at http://www.civil.maine.edu/cie111/.

5. Specific Course Information:
   (a) Description: Evaluation of material performance under applied loads for engineering applications. Physical properties of concrete, metals, plastics and wood. Exercises include study of the variability of materials, construction of probability density functions from test data and computation of the probability of failure..
   (b) Corequisite: CIE 110
   (c) Required Course

6. Course Goals and Outcomes:
   (a) Goals:
      - To familiarize the student with basic material testing procedures.
      - To learn memo report writing and communication skills.
      - To learn data manipulation in spreadsheets.
      - To learn to work in teams.
   (b) Outcomes:
      - The student will be familiar with common materials testing equipment and testing, such as wood, plastic, steel, aluminum, aggregate and concrete.
      - The student will have written enough laboratory memo reports to have learned the fundamentals of technical writing.
      - The student will have learned to analyze laboratory test data, using computer spreadsheets as a tool.
      - The student will have acquired fundamental teamwork skills
   (c) Relates to ABET Student Outcomes (a), (b), (e), (g), & (k)

7. Topics Covered:
   - Material strength variability
   - plastics
   - steel and aluminum
   - aggregate
   - wood
   - concrete mix design
   - concrete mix
   - concrete strength

1. CIE 115: **Computers in Civil Engineering**

2. 3 Credits; 4 Contact Hours

3. Instructor: Eric Landis

4. Textbook:
   (a) Matlab Student Version

5. Specific Course Information:
   (a) Description: Introduces the student to computers and computations by solving examples relevant to civil engineering. The algorithmic aspects of programming as well as the development of simple graphical user interfaces are taught. Approximately one half of the course time is allocated to programming with the remainder involving problems and applications. Specific examples typically include problems from structures, geotechnical, transportation and environmental engineering. Emphasis is placed on examples introducing statistical methods. Also introduces the use of spreadsheets, word processing and a mathematics program.
   (b) Prerequisites: Civil Engineering Major and MAT 126
   (c) Required Course

6. Course Goals and Outcomes
   (a) Goals:
      - Develop basic computational problem solving and numerical analysis skills.
      - Gain a working knowledge of different computer tools, and matching the tool to the problem.
      - Introduce a variety of civil engineering problem types.

   (b) Outcomes:
      - Student will be able to identify the appropriate computational tool for a given engineering problem.
      - Student will be able to work with different types of variables, arrays, operators and data formats.
      - Student will be able to work to develop computational algorithms, pseudo code, and executable code that includes input processing, logical operator and case testing, looping, and iteration.
      - Student will be able to solve multistep problems using a series of simple functions.
      - Student will be able to produce clear and meaningful graphs.
      - Student will be able to apply computational algorithms to solve numerical problems, including nonlinear equations, systems of linear equations, time stepping, integration, differentiation,and simple differential equations.

   (c) Relates to ABET Student Outcomes (a), (b), (e), & (k)

7. Topics Covered:
      - Introduction and Preliminaries
        - engineering problems and tools
      - Matlab Fundamentals
        - workspace, variables, arithmetic operators and built in functions

  - scripts and user-defined functions
  - arrays & vectors, graphs
- Program Design and Algorithm Development
  - elements of a well-designed program
  - algorithm development and pseudocode
  - error trapping
- Numerical Methods & Applications
  - solution of nonlinear equations
  - numerical integration
  - numerical differentiation
  - systems of equations
  - time-stepping
  - iterative solutions
  - differential equations
- Other Appropriate Computational Tools
  - spreadsheets
  - other mathematical computer tools
  - specialty software
- which program do I use??

1. CIE 225: **Transportation Engineering**

2. 3 Credits: 3 Contact Hours

3. Instructor: Per Garder

4. Textbook:
   (a) Traffic and Highway Engineering, Third Edition by Garber & Hoel, Brooks/Cole Pacific Grove, California, 2001.

5. Specific Course Information:
   (a) Description: An introduction to the broad field of transportation with emphasis on the motor vehicle mode. Principles of roadway and urban transportation planning, economic analysis methods, and route design elements are discussed and related to the planning and design of highway transportation routes. Students design a section of roadway and prepare a technical paper on a current transportation engineering problem.
   (b) Prerequisite: Civil Engineering Major or permission; Corequisite: ECP 225
   (c) Required Course

6. Course Goals and Outcomes:
   (a) Goals:
      - To introduce students to basic concepts and practices in the field of transportation planning, design, and evaluation.
   (b) Course Outcomes:
      - The student will understand basic terminology used by transportation engineers.
      - The student will have a basic understanding of some of the history behind today's transportation system.
      - The student will understand different transportation modes implications of this on minimum curve radii, and sight-distances.
      - The student will understand how basic traffic-engineering studies are conducted.
      - The student will understand the fundamental traffic-flow equation and be able to apply it to calculation of speeds and delays.
      - The student will be familiar with traffic safety concepts and mechanisms causing crashes.
      - The student will be familiar with the level-of-service concepts.
      - The student will be familiar with geometric design basics.
      - The student will design a basic parking lot.
      - The student will do a literature search topic and write a scientific paper which may be presented to the class.
   (c) Relates to ABET Student Outcomes (a), (c), (e), (g), & (k)

7. Topics Covered:
   (a) The areas listed under Course Outcomes are covered. Lectures include the following areas: Transportation Systems, Driver-Vehicle Characteristics, Road Characteristics, Speed, Volume, Delay Studies, Parking, studies and design, Highway Safety, Pedestrian Safety, Bicyclist's safety in Maine/Planning for Bicyclists, Speed-Flow-Density, Shock Waves and Gap Acceptance, Intersection Design and Control, Level of Service—Basic

Freeways, Level of Service—2-lane roads, L o S at Signalized Intersections, Transportation Planning, Trip Generation and Trip Distribution, Gravity Models and Modal Split, Choice Models, Traffic Assignment. Also, a student paper and two projects are assigned.

1. CIE 331: **Environmental Engineering**

2. 3 Credits; 4 Contact Hours

3. Instructor: Jean MacRae

4. Textbook:
   (a) Michelcic, J.R., J.B. Zimmerman, 2010. Environmental Engineering: Fundamentals, Sustainability, Design. Published by John Wiley and Sons, Inc.

5. Specific Course Information:
   (a) Description: Introduction to environmental engineering including water quality, water and wastewater treatment plant design, solid and hazardous wastes, landfill design, radioactive waste control and air pollution abatement
   (b) Prerequisite: CHY 131 and MAT 127
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To study the fundamental physicochemical processes in environmental (with an emphasis on water) systems.
      - To introduce some of the major unit operations used in water and wastewater treatment plants.
      - To study the major regulated air pollutants, how they are formed and how they can be reduced
      - To introduce solid waste handling approaches
   (b) Course Outcomes:
      - Student will have an improved understanding of basic environmental engineering principle in chemistry, biology, physics and the mass balance approach.
      - Student will be able to apply those principles to solve environmental problems.
      - Student will be familiar with the "traditional" scope of the environmental field including water treatment, wastewater treatment,solids waste treatment and air pollution.
   (c) Relates to ABET Student Outcomes (a), (e), & (k)

7. Topics Covered:
      - Ecology and the Environment
      - Environmental regulations
      - Mass balance approach
      - Environmental chemistry
      - Water treatment
      - Water quality
      - Wastewater treatment
      - Air pollution
      - Solid waste and treatment

1. CIE 340: **Introduction to Structural Analysis**

2. 4 Credits; 6 Contact Hours

3. Instructor: Roberto Lopez Anido

4. Textbook:
   (a) Fundamentals of Structural Analysis by Leet and Uang, 2nd. Ed., 2004.
   (b) Class notes and supplementary material supplied in class
   (c) Internal Web Site http://www.umit.maine.edu/Login/CIE340

5. Specific Course Information:
   (a) Description: The cyclic process of analysis and design. Structure idealization and modeling. Design methodologies and loads considerations. The analysis of determinate trusses, beams and frames. Introduction to indeterminate structures.
   (b) Prerequisite: MEE 251
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - The student will understand the fundamental concepts of the theory and applications of structural analysis.
      - The student will develop an understanding on how different types of loads are applied on building and highway structures.
      - The student will develop the ability to both model and analyze simple structurally determinate and indeterminate structures
      - The student will gain comprehension on the assumptions and limitations of structural idealization for analysis and design of actual structural systems
   (b) Course Outcomes:
      - The student will demonstrate the ability to model simple civil engineering structures using standard assumptions about geometry, joints, loads and support conditions.
      - The student will acquire the ability to model design loads acting on structures and integrate them in the structural analysis process.
      - The student will demonstrate the ability to determine structural indeterminacy and geometric stability of trusses, beams and simple frames.
      - The student will gain an understanding on how structural members are connected through different types of joints and how to model them during the structural analysis process.
      - The student will demonstrate the ability to analyze member forces in statically determinate beams, frames and trusses.
      - The student will demonstrate the ability to calculate deformations in structures using both geometric and energy methods.
   (c) Relates to ABET Student Outcomes (a), (b), (c), (e), & (k)

7. Topics Covered:
      - Structural Modeling and Loads
         - Introduction, classification of structures

    - Loads, codes, structural design
    - Idealized structure, principle of superposition, equilibrium, determinacy and stability
- Analysis for Structurally Determinate Structures
    - Trusses, method of joints, method of sections
    - Internal loading, shear and moment diagram for beams and frames, method of superposition
    - Influence lines and envelopes
- Deflections
    - Beam differential equation. Elastic deflections using double integration
    - Beam elastic deflections using moment area methods
    - Principle of virtual work. Truss and beam elastic deflections using energy methods

1. CIE 350: **Hydraulics**

2. 3 Credits; 3 Contact Hours

3. Instructor: Aria Amirbahman

4. Textbook:
   (a) Fluid Mechanics Fundamentals and Applications. Cengel and Cimbala. McGraw-Hill.
   (b) Extensive supplementary course notes, largely based on the text

5. Specific Course Information:
   (a) Description: An elementary course presenting fundamental principles of fluid flow and their applications to engineering problems. Includes study of hydrostatics, liquid measuring devices and channel and pipe flow.
   (b) Prerequisite: MEE 150 and MAT 258 or concurrent
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - Understand the basic concepts, principles, law, and models for fluids at rest and in motion.
      - Gain a working knowledge to determine and calculate mass, energy, and momentum balances and understand their resultant effect on fluid flows in engineered and natural systems.

   (b) Course Outcomes:
      - The student will demonstrate a basic understanding of the concepts, principles, laws, and models of fluids at rest and in motion.
      - The student will demonstrate an understanding of fluid behavior land of basic engineering design and control of fluid systems (static and kinematics).
      - The student will demonstrate proficiency in understanding and calculating mass, energy, and momentum balances, and their application in the resulting glow interactions in engineered and natural systems.
      - The student will demonstrate the ability to describe and display simple fluid flow regimes by correlating experimental data,designing tests, and using scale models of fluid flows.

   (c) Relates to ABET Student Outcomes (a), (e), & (k)

7. Topics Covered:
      - Properties of water. Development of equations of conservation of mass, energy, and momentum using the macroscopic control volume concept. Pumps, turbines, and the beginnings of open channel flow.

1. CIE 351: **Hydraulics Lab**

2. 1 Credits; 2 Contact Hours

3. Instructor: Aria Amirbahman

4. Textbook:
   (a) Fluid Mechanics Fundamentals and Applications. Cengel and Cimbala. McGraw-Hill.
   (b) Extensive supplementary course notes, largely based on the text

5. Specific Course Information:
   (a) Description: Application of hydraulic principles in laboratory experiments. Includes experiments on buoyancy and flotation, forces on submerged planes, venturi meter calibration, pipe friction, losses, weirs and others.
   (b) Prerequisite: CIE 350 or concurrent
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - The overall objective is to provide a physical and visual perspective for the basics of fluid flow from the macroscopic point of view
      - Cover hydrostatics and forces on plane surfaces.
      - Study conservation of Mass, Energy, and Momentum
      - Study flow of viscous fluids in pipes and open channel flow.
      - Acquaint the student with problem solving methods in fluids.

   (b) Course Outcomes:
      - The student will obtain a broad based ability to solve a variety of fluids based problems relating to the Civil Engineering discipline

   (c) Relates to ABET Student Outcomes (a), (b), (d), (e), (g), & (k)

7. Topics Covered:
   - Properties of water
   - Development of equations of conservation of mass, energy, and momentum using the macroscopic control volume concept
   - Pumps, turbine, and the beginnings of open channel flow

1. CIE 365: **Soil Mechanics**

2. 3 Credits; 3 Contact Hours

3. Instructor: Melissa Landon Maynard

4. Textbook:
   (a) An introduction to Geotechnical Engineering by R.D Holtz, Prentice Hall, 1981.

5. Specific Course Information:
   (a) Description: An introduction to fundamental physical properties, engineering behavior and performance of soils and rocks.
   (b) Prerequisite: MEE 251 or concurrent
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To study the fundamental physical properties, engineering behavior and performance of soils.

   (b) Course Outcomes:
      - The student will understand the context of Geotechnical Engineering.
      - The student will be able to identify the phases and components of soils and their relative distributions.
      - The student will develop a sense of how to classify soil using standard engineering classification rubrics (e.g. USCS).
      - The student will be able to describe the effects of hydrostatic water in soils 9e.g., frost, water table).
      - The student will be able to explain the principle of effective stress and changes that occur from water flow and loading.
      - The student will be able to describe the effect of water flow through soils and calculate flow quantities over time.
      - The student will be able to calculate the magnitude and time rate of settlements.
      - The student will be able to determine shear and normal forces in a soil mass and on a failure plane using Mohr circle.
      - The student will be able to explain differences between cohesive and cohesionless soils and this leads to different behavior.

   (c) Relates to ABET Student Outcomes (a), (e), & (k)

7. Topics Covered:
      - Description of soil and rock
      - Definitions and relationships
      - Water and its effects
      - Compaction
      - Stresses
      - Compression and expansion
      - Strength

1. CIE 366: **Soil Mechanics Laboratory**

2. 1 Credits; 2 Contact Hours

3. Instructor: William Manion

4. Textbook:
   (a) Internet access to laboratory manual online at http://www.civil.umaine.edu/cie366/

5. Specific Course Information:
   (a) Description: Covers geotechnical laboratory testing including classification, density, permeability, shear strength, and consolidation tests.
   (b) Prerequisite: Civil Engineering Major or permission; Corequisite: CIE 365
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To familiarize the student with basic soil testing procedures.
      - To practice memo report writing for laboratory and consulting practice.
      - To learn to critically evaluate laboratory procedures and the resulting data.
      - To learn to work in teams.

   (b) Course Outcomes:
      - The student will be familiar with common physical soils testing equipment and testing, such as classification, grain size distribution, Atterberg limits, specific gravity, permeability, density, consolidation and direct shear.
      - The student will have practiced writing laboratory memo reports, advancing their technical writing skills.
      - The student will have developed the ability to analyze laboratory testing methods and subsequent data.
      - The student will have learned teamwork skills.

   (c) Relates to ABET Student Outcomes (b), (e), (g), & (k)

7. Topics Covered:
      - Physical properties of soils: classification, grain size distribution, Atterberg limits, specific gravity, permeability, density, consolidation and direct shear.

1. CIE 394: **Civil Engineering Practice**

2. Credits: 1-3

3. Coordinator: Thomas Sandford

4. Textbook:
   (a) None

5. Specific Course Information:
   (a) Description: Cooperative Work Experience in Civil Engineering.
   (b) Prerequisite: Sophomore standing
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To experience civil engineering practice prior to graduation
      - To critically assess one's undergraduate program based on practice experiences.
      - To assess the interrelationship of contractor, consultant and owner.

   (b) Course Outcomes:
      - The student will develop an appreciation of learning required for civil engineering practice.
      - The student will develop a sense of organizational structure and teamwork for companies involved in civil engineering practice.
      - The student will develop an understanding of the interrelationships involved among representatives of contractors, owners, and consultants.

   (c) Relates to ABET Student Outcomes (d), (f), (h), (g), (i), & (k)

7. Topics Covered:
      - N/A

1. CIE 410: **Engineering Ethics**

2. Credits: 1; 1 Contact Hour

3. Instructor: Mary Larlee

4. Textbook:
   (a) None

5. Specific Course Information:
   (a) Description: Introduces students to ethics theory, general concepts and principles pertaining to engineering ethics and handling ethical situations in practice. Throughout the course, students will be presented with a combination of lecture, engineering ethical situations using a case or example approach and discussion sessions.
   (b) Prerequisite: ENG 101 and Junior standing.
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - Introduce students to ethical theory;
      - Give students tools to evaluate situations that are ethically problematic;
      - Provide students with resources for engineering ethics material;
      - Review professional ethical codes, their use, and limitations;
      - Orient students to engineering ethics for professional practice; and
      - Give students practice in ethical analysis and how to deal with problems involving ethical considerations.

   (b) Course Outcomes:
      - The student will understand a framework of ethical theory, including the main ethical theories, the stages of moral development, the steps in ethical problem solving, and the impediments to ethical action.
      - The student will be familiar with the ASCE engineering code of ethics.
      - The student will gain experience with responding to various ethical situations.
      - The student will have some confidence in their ability and understanding of their responsibility in dealing with ethical situations.

   (c) Relates to ABET Student Outcomes (f)

7. Topics Covered:
      - Introduction, ethical duty and ethical terms, ethical decision making as design.
      - Introduction to ethical theories and stages of moral development
      - Introduction to impediments to ethical action and ASCE Code of Ethics
      - Engineering Case Studies

1. CIE 411: **Engineering Project Design**

2. 3 Credits; 3 Contact Hours

3. Instructor: Thomas Sandford

4. Textbook:
   (a) Recommended - *Standard Handbook for Civil Engineers*. Ricketts, et al. McGraw Hill 5th edition. 2003.

5. Specific Course Information:
   (a) Description: Student design teams develop the conceptual design of an active civil engineering project. Topics include: consulting firm practice, the design process, evaluation of alternatives, regulatory constraints and the permit process, legal, ethical and social aspects of professional engineering practice, cost and scheduling estimations. Oral presentations and written technical reports are required. Open only to civil engineering students during their last spring semester.
   (b) Prerequisite: CIE 413
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
   - Students will use hands-on-experience to learn how to design open-
   - ended engineering problems to meet their client's needs.
   - Students will develop teamwork skills by functioning as part of a multi-disciplinary team.
   - Students will develop leadership and project management skills by bringing a multifaceted engineering design to a successful conclusion.
   - Students will learn the legal and ethical issues involved in civil engineering practice.
   - Students will enhance their understanding of the role that civil engineers play in protecting the safety of the public and preserving the environment.
   - Students will learn basic cost estimating and project scheduling skills.
   - Students will improve their written communications skills by preparing a series of major reports.
   - Students will improve their oral communication skills by making two public presentations.
   - Students will practice their lifelong learning skills by using library resources, the internet, and professional contact to gather the information needed to design a complex engineering project.

   (b) Course Outcomes:
   - Students will demonstrate an ability to solve open-ended, ill-defined engineering problems in a way that meets the needs of clients.
   - Students will be able to function as part of a multi-disciplinary team.
   - Students will demonstrate leadership and project management skills.
   - Students will demonstrate a basic understanding of the legal and ethical issues involved in civil engineering practice.

- Students will demonstrate an understanding of the role civil engineers play in protecting the safety of the public and preserving the environment.
- Students will demonstrate basic skills in cost estimating and project scheduling.
- Students will demonstrate strong written communication skills.
- Students will demonstrate strong oral communication skills.
- Students will demonstrate an ability to do lifelong learning by using library resources, the internet, and professional contacts to gather the information needed to design a complex engineering project.

(c) Relates to ABET Student Outcomes (c), (d), (e), (f), (g), (i), (j), & (k)

7. Topics Covered:
   - Consulting firm practice (2 weeks)
   - Evaluation of alternatives (1 week)
   - Regulatory constraints and the permit process (2 weeks)
   - Legal, ethical and social aspects of engineering practice (4 weeks)
   - Cost and scheduling estimations (1 week)
   - Professional engineering reports (2 weeks)
   - Student oral presentations (2 weeks)

1. CIE 412: **Engineering Decisions**

2. 2 Credits; 2 Contact Hours

3. Instructor: Thomas Sandford

4. Textbook:
   (a) *Engineering Economic Analysis*. Newnan et al., Oxford University Press. 2004.
   (b) Supplementary Notes

5. Specific Course Information:
   (a) Description: Application of various analysis methods to engineering design decisions. Evaluation of economic, financial, legal, and ethical factors affecting engineering design. Topics include: engineering economy, consideration of risk and uncertainty, and evaluation of ambiguous and intangible factors in engineering design.
   (b) Prerequisite: Senior Standing
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To introduce the idea that many engineering project decisions are based in part upon financial considerations.
      - To study the time value of money and develop skills in applying these concepts to a variety of problems.
      - Students work in teams to present some of the course material and to present a term project.
   (b) Course Outcomes:
      - Students will have a working knowledge of engineering economic analysis tools; present value, future, annual series, arithmetic series, and geometric series.
      - Students will have a working knowledge of basic decision processes. Minimum attractive rate of return; rate of return, comparison of alternatives, replacement analysis, depreciation, cost benefit analysis.
   (c) Relates to ABET Student Outcomes (a), (e), (h), (j), & (k)

7. Topics Covered:
   (a) Compound interest, future value, present value, uniform series of payments, arithmetic and geometric gradient series. Present worth, future worth, equivalent series of uniform payments, rate of return, incremental rate of return, break even analysis. Other topics may include stocks and bonds.

1. CIE 413: **Project Management**

2. 2 Credits; 2 Contact Hours

3. Instructor: William Manion

4. Textbook:
   (a) *Project Management Tools and Trade-Offs*, Ted Klastorin, John T. Wiley & Sons, 2004.

5. Specific Course Information:
   (a) Description: Role of civil engineer in the implementation process of engineering projects from project conceptualization through design, construction, commissioning, start-up, and operations. Topics include: project life-cycle, project manager's tools, quality and risk management, required deliverables of design, cost and time estimates, and dispute resolution.
   (b) Prerequisite: Senior Standing or permission; Corequisite: ECP 413
   (c) Required Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To introduce principles of project management to Civil Engineers.
      - To provide an overview of project development from concept to advertisement.
      - To discuss the "softer-side" of a project.
      - To show basic project management tools such as cost estimating and scheduling.
      - To work in team environments.
      - To develop a preliminary proposal for the Senior Civil Engineering Capstone Project.

   (b) Course Outcomes:
      - Students will be able to understand the fundamental processes of project management, including project initiation, estimating, budgeting, work plan, scheduling, tracking work, design coordination, construction and project close out.
      - Students will be able to practice and develop teamwork and management skills.
      - Students will develop knowledge of contemporary issues.
      - Students will define and describe an appropriate capstone project using a written proposal.

   (c) Relates to ABET Student Outcomes (c), (e), (f), & (k)

7. Topics Covered:
   - Organizational structure, the design process, project stakeholders, project environments, cost estimating, project scheduling, proposal development, human relations, and team building.

1. CIE 424: **Urban Transportation Planning**

2. 3 Credits; 3 Contact Hours

3. Instructor: Per Garder

4. Textbook:
   (a) *Urban Transportation Planning, Second Edition* by Michael D. Meyer & Eric J. Miller. Publisher: McGraw-Hill, 2001.

5. Specific Course Information:
   (a) Description: Basic concepts and practices in the field of transportation planning, including the process and policy surrounding urban transportation planning, characteristics of urban travel, air quality - noise, energy - land use, the elements of decision making, data management and diagnosis, demand and supply analysis, project evaluation and implementation. A transportation demand management study constitutes a major part of the course.
   (b) Prerequisite: CIE 225
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To teach students basic concepts and practices in the field of transportation planning, including the process and policy surrounding urban transportation planning.

   (b) Course Outcomes:
      - The student will understand basic terminology yaws by transportation planners.
      - The student will have a basic understanding of some of the history behind today's transportation planning.
      - The student will understand how automobile traffic influences safety, mobility, environment, and financing.
      - The student will understand how trips are generated, distributed and assigned to modes and routes.
      - The student will acquire an understand of professional and ethical responsibility.
      - The student will acquire an understanding of the impact of engineering solutions in a global and societal context.
      - The student will acquire an ability to design and conduct experiments,as well as to analyze and interpret data.
      - The student will acquire an ability to design a system,component, or process to meet desired needs, such as maximum allowed noise levels.

   (c) Relates to ABET Student Outcomes (b), (c), (e), (h), & (k)

7. Topics Covered:
      - Lectures include: Consensus exercise, Rethinking Urban Sprawl, Characteristics of Urban Travel, Energy-Land use, Transportation Planning and Decision-Making, The Elements of Decision Making, Data Management and Diagnosis, An Introduction to Analysis and Evaluation, Urban Activity System Analysis, Gravity

model, Logit model, Supply Analysis, Time-distance diagrams, queuing theory, Transit/walking, Cost models, Transportation System and Project Evaluation, Program and Project Implementation, Speed control—SL or calming? Arterial roads, how important are they?

1. CIE 425: **Transportation Safety**

2. 3 Credits; 3 Contact Hours

3. Instructor: Per Garder

4. Textbook:
   (a) *Lecture Notes*

5. Specific Course Information:
   (a) Description: Fundamental theory on transportation safety processes and evaluation methodology. Topics: vehicle/road/driver interaction, countermeasure effectiveness, enforcement, education and engineering measures.
   (b) Prerequisite: CIE 225
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To teach student the fundamental theory on transportation safety processes and evaluation methodology.

   (b) Course Outcomes:
      - Student will understand terminology used by transportation-safety engineers.
      - Student will understand the [safety] interdependency between roads, vehicles and drivers.
      - Student will understand crash factor analysis.
      - Student will understand basic concept for how to predict [expected] future crash numbers based on past crash data, conflict data and volumetric models.
      - Student will have the ability to apply knowledge of mathematics and statistics to the analysis of crash data.
      - Student will be able to interpret transportation safety data and identify, formulate, and solve simple transportation systems.
      - Student will be aware of the transportation safety data and identify, formulate, and solve simple transportation engineering problems.
      - Student will be aware of the transportation engineer's professional and ethical responsibility to create safer transportation systems.
      - Student will have designed, conducted, reported and presented an independent safety study.
      - Student will understand how to use computer spreadsheets (such as Microsoft Excel) to analyze data.
      - Student will be familiar with handbooks giving crash-reduction factors for different countermeasures.

   (c) Relates to ABET Student Outcomes (a), (b), (c), (e), (f), & (k)

7. Topics Covered:
      - Lectures include: Defining safety, Student paper and project topics, Reportable accidents, Safe Design, Number of accidents and exposure, Future Safety, Accident Causation, Accident severity, Insurance Data, Exposure, Hospital data, FARS and

NASS, Maine Police Report, Blackspots, Traffic conflict techniques and other surrogate techniques, The LTH technique, The U.S. Traffic conflict technique, Other TCTs and Quasi-Induced Exposure, Poisson Process, Countermeasure effectiveness, Regression-to-the-mean, Best estimate, Epidemiology, Exposure, Quasi-Induced Exposure, Value of life/injury, International Comparisons, Modal Comparisons, Air, Rail, Ferries, Road Accident Victims. Trucks, Age, Gender, Shoulder Rumble Strips, Speeds, Road Class, Intersection Design/Control, Roundabouts, Pedestrians, Bicyclists, Geometric Standards, Alcohol, Demerit points, Inner safety, Education, Enforcement.

1. CIE 426: **Advanced Roadway Design**

2. 3 Credits; 3 Contact Hours

3. Instructor: Per Garder

4. Textbook:
   (a) *Traffic and Highway Engineering* by Garber & Hoel, Third Edition, Brooks/Cole, 2001.

5. Specific Course Information:
   (a) Description: Principles of highway location, design of vertical and horizontal alignment, design and construction of surface treatments, pavement structures and roadway drainage systems. Student project preparing necessary plan-profile and cross section drawings required to construct a 3,000 foot section of roadway, which is evaluated with respect to road-user travel time, comfort and safety; impact on surrounding environment including aesthetic aspects; and construction cost.
   (b) Prerequisite: CIE 225
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To give students a deeper understanding and insight into the field of transportation engineering.

   (b) Course Outcomes:
      - The student will understand terminology used by transportation engineers.
      - The student will understand how to optimize the location of roadways from a systems perspective and how the location of roads impacts society with respect to safety, mobility,environment, and financing.
      - The student will be able to do cut-and-fill balancing of earth.
      - The student will understand how forces act on vehicles and the implications of this on minimum curve radii, sight-distances and lengths of acceleration and climbing lanes.
      - The student will have the ability to account for functional classification and other factors in design of roads.
      - The student will be able to do basic design of asphalt pavements.
      - The student will be able to apply the principles above for how to select geometric design components and how to synthesize them into the design of a section of roadway and a junction.

   (c) Relates to ABET Student Outcomes (c), (e), & (k)

7. Topics Covered:
      - Lectures include: Principles of Highway Location, Volumes of Earthwork, Highway Plans, Highway Functional Classification, Design Standards—DHV, design speed, design vehicle; Cross-section elements, Vertical Alignment, Horizontal Alignment, Compound Curves, Spirals, Superelevation, Special Facilities, Bicycle Facilities, Design of Intersections and Roundabouts: Safety and delay, Pedestrian facilities, Safety-geometric layout, speed, moose/deer, fatigue, alcohol, alignment, sight

distances, lane width, medians, side slopes, Safety—pavement standards, RRR, pavement edge drop-off; Legal liability; Drainage & run-offs, Design of Open Channels, Soil Engineering , Asphaltic & Bituminous Materials, Design of Flexible Pavements: Asphalt Institute Method; AASHTO Method, Design of Rigid Pavements, Pavement Management. Traffic Signs and Markings.

1. CIE 430: **Water Treatment**

2. 4 Credits; 6 Contact Hours

3. Instructor: Aria Amirbahman

4. Textbook:
   (a) *Theory and Practice of Water and Wastewater Treatment* by Droste.

5. Specific Course Information:
   (a) Description: Introduction to environmental chemistry as related to water treatment technology, and anlaysis and design of water treatment systems.
   (b) Prerequisite: CIE 231 and CIE 350
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To study the fundamentals of chemical thermodynamics and chemical processes involved in water including acid-base equilibria, carbonate system, solubility and redox as they relate to aquatic systems.
      - To study the physical and chemical processes involved in water treatment.

   (b) Course Outcomes:
      - The students will gain knowledge of fundamentals of chemical thermodynamics, chemical equilibria, precipitation, dissolution and redox as they relate to environmental systems.
      - The students will learn the basic physical and chemical processes involved in treatment of drinking water.
      - The students will gain knowledge to design components of water treatment plants.

   (c) Relates to ABET Student Outcomes (a), (b), (c), (e), (g), & (k)

7. Topics Covered:
      - Water Chemistry, Water supply, Water treatment plant operation, Sedimentation, Filtration, Disinfection, Membrane processes.

1. CIE 431: **Pollutant Fate and Transport**

2. 4 Credits; 6 Contact Hours

3. Instructor: Aria Amirbahman

4. Textbook:
   (a) *Water Quality* by G. Tchobanoglous and E.D. Schroeder. Published by Addison-Wesley, 1985.

5. Specific Course Information:
   (a) Description: Introduction to environmental transformation processes that control the fate and transport of contaminants in the environment and in engineered systems. Topics include reaction energetics and kinetics, reactor engineering concepts, interface mass transfer and phase partitioning.
   (b) Prerequisite: CIE 231 and MAT 258
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - The student will gain knowledge of reaction thermodynamics and kinetics.
      - The student will understand the physicochemical processes in environmental systems such as groundwater, lakes and rivers.
      - The student will learn the design of reactors for water and wastewater treatment purposes.
      - The student will develop practical understanding of solute transport in mixed tank and packed bed reactors, ion exchange, adsorption and microbial degradation, through laboratory experiments

   (b) Course Outcomes:
      - The student will apply their knowledge of basic and engineering sciences by analyzing the physicochemical processes in natural systems.
      - The student will demonstrate their understanding of transport phenomena and reaction kinetics by designing reactors for chemical and biochemical reactions.
      - The student will demonstrate their practical knowledge of related unit operation processes in water and wastewater treatment by setting up and performing laboratory experiments.

   (c) Relates to ABET Student Outcomes (a), (b), (c), (e), & (k)

7. Topics Covered:
      - Review of differential equations, Chemical reaction kinetics, Material balance and reactor theory, and Transport phenomena including mass transfer.

1. CIE 434: **Wastewater Process Design**

2. 4 Credits; 6 Contact Hours

3. Instructor: Jean MacRae

4. Textbook:
   (a) T Metcalf and Eddy. Inc. 2003. *Wastewater Engineering: Treatment and Reuse*, 4th Edition, McGraw-Hill.

5. Specific Course Information:
   (a) Description: Theory and design of wastewater treatment facilities. Design projects cover processes such as sedimentation, biological treatment, aeration and disinfection.
   (b) Prerequisite: CIE 231 and CIE 350
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - Be familiar with and understand how commonly used water quality parameters are measured and used
      - Be familiar with and understand the technical basis for the most commonly used wastewater treatment unit operations
      - Be able to use water quality and flow data to make treatment plant design decisions and size basic unit operations
      - Know how and where to find information on wastewater treatment to learn more.

   (b) Course Outcomes:
      - Have improved your biology, math and chemistry skills in the analysis and solution of wastewater-related problems.
      - Have improved your ability to obtain, analyze and interpret laboratory data
      - Have improved your ability to identify, formulate, and solve wastewater-related problems using laboratory data, models and other engineering tools
      - Be able to do basic design of unit operations commonly applied to wastewater treatment.
      - Have improved your written and oral communication skills.

   (c) Relates to ABET Student Outcomes (a), (b), (c), (e), (g), & (k)

7. Topics Covered:
   - Wastewater Characteristics and Flow
   - Reactors and Kinetics
   - Sedimentation
   - Aeration
   - Fundamentals of Biological Treatment
   - Activated Sludge
   - Attached Growth Reactors
   - Anaerobic Treatment
   - Disinfection
   - Sludge Handling

1. CIE 440: **Structural Analysis I**

2. 4 Credits; 6 Contact Hours

3. Instructor: William Davids

4. Textbook:
   (a) None. (Refer to CIE 340 text on occasion). Handouts and supplementary materials supplied in class.

5. Specific Course Information:
   (a) Description: Classical and matrix methods in the analysis of linear redundant systems. The basic concepts of equilibrium, stress-strain relations, and compatibility are emphasized. Manual and introductory computer aided solution techniques are utilized.
   (b) Prerequisite: CIE 340
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - The student will understand the elements of basic matrix structural analysis including modeling of structural systems, and the assumptions and limitations of analysis.
      - Gain a working knowledge of computational analysis techniques for structural systems
   (b) Course Outcomes:
      - The student will demonstrate the ability to apply equilibrium,compatibility and constitutive relationships to the analysis of indeterminate structures (ABET outcomes a and e)
      - The student will demonstrate ability to apply classical methods of analysis such as the force method, slope deflection and moment distribution to simple engineering structures (ABET outcomes a and e).
      - The student will demonstrate the ability to apply the matrix stiffness method to the analysis of beams, trusses and frames,and interpret the results of such an analysis (ABET outcomes a, e and k).
   (c) Relates to ABET Student Outcomes (a), (e), & (k)

7. Topics Covered:
      - I. Review of Essential Structural Analysis and Mechanics Concepts (1.5 wks.)
        - Analysis of statically determinate trusses
        - Analysis of statically determinate beams and frames
        - Curvature and bending stress in beams
        - Computation of beam deflections
      - II. Classical Methods of Indeterminate Structural Analysis (2 wks.)
        - The force method
        - The slope-deflection method
        - Moment distribution
      - III. Review of Essential Linear Algebra Concepts (0.5 wk.)

  - Matrices and vectors
  - Basic rules for matrix operations, including solving systems of equations
- IV. Introduction to the Stiffness Method (1 wk.)
  - Essential concepts: equilibrium, compatibility, constitutive relations
  - The direct stiffness method for bars and beams
- V. Matrix Analysis of Trusses (3 wks.)
  - Development of stiffness equations
  - Local-global element transformations
  - Solution of real problems
  - General boundary conditions, including support displacement
  - Analysis including the effect of member pre-strains
- VI. Matrix Analysis of Beams and Frames (4 wks.)
  - Development of stiffness equations for a beam element
  - Statically equivalent nodal loads
  - Solution for displacements and member forces in beams
  - Local-global element transformations for frame elements
  - Solution for displacements and member forces in frames
  - Internal hinges, beams on elastic foundations, thermal gradients
- VII. Computer Software for Structural Analysis (1 wk.)
  - History, relevance, and current state of practice
  - Introduction to RISA 2D, a basic computerized structural analysis package
- VIII. Influence Lines (1 wk.)
  - Review of influence lines for statically determinate beams
  - Derivation of the Muller-Breslau principle
  - Influence lines for statically indeterminate beams and frames
- IX. Introduction to Structural Dynamics (if time allows)
  - Undamped SDOF oscillators
  - Damped SDOF oscillators
  - Application to and ties with structural analysis

1. CIE 442: **Reinforce Concrete Design**

2. 4 Credits; 6 Contact Hours

3. Instructor: William Davids

4. Textbook:
   (a) *Reinforced Concrete: Mechanics and Design*, Fourth Edition. J.G. MacGregor and J.K. Wight. Pearson Prentice-Hall, 2005.
   (b) *Building Code Requirements for Reinforced Concrete*. ACI 318, 2005.

5. Specific Course Information:
   (a) Description: The behavior design and detailing of reinforced concrete structures: beams, columns, beam-columns, slabs, footings, retaining walls. Microcomputer aided design project.
   (b) Prerequisite: CIE 340
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - Student will develop a basic understanding of integration of analysis and design;
      - Student will learn how to design and detail reinforced concrete components such as beams, columns, slabs and footing using the latest ACI 318 Specification;
      - Develop an understanding of the engineering principles underlying the specifications for the design of various reinforced concrete components, with a strong emphasis on structural mechanics.

   (b) Course Outcomes:
      - Student will develop the ability to apply fundamental engineering mechanics concepts to the analysis of reinforced concrete structures (ABET outcomes e).
      - Student will develop understanding of the relationship between fundamental engineering mechanics concepts and the design of reinforced concrete structures (ABET outcomes e).
      - Student will develop knowledge and ability to apply basic DRFD concepts (ABET outcomes c and k).
      - Student will demonstrate knowledge of basic structural serviceability requirements in the current ACI Specifications (ABET outcomes c and k).

   (c) Relates to ABET Student Outcomes (a), (c), (e), (i), & (k)

7. Topics Covered:
   - Introduction
     - Concept of Reinforced Concrete
     - Loads, codes, and specifications
     - Design philosophies
     - Material properties of concrete and reinforcing steel
   - Beam Flexure
     - Elastic response of RC beams
     - Strain compatibility and ultimate strength in bending

- Sizing of singly-reinforced beams for flexure
- Design of 1-way slabs
- Doubly reinforced beams
- T-beams

• Beam Shear
  - Fundamentals for unreinforced beams
  - Concept of web reinforcement
  - Shear design for slender beams
  - Effect of axial forces
  - Shear friction

• Bond and Bar Cut-offs
  - Concept of bond and development length
  - Development length calculations
  - Hooked anchorages
  - Bar cut-offs and detailing of flexural members

• Serviceability
  - Elastic analysis of beams
  - Cracking
  - Deflections

• Short Columns: Combined Axial Load and Bending
  - Compressive strength
  - Ties and spiral reinforcing
  - Interaction diagrams
  - Design of short columns
  - Biaxially loaded columns

• Continuous Beams and Floor Systems
  - Analysis of continuous structures, pattern loading
  - ACI moment and shear coefficients
  - Design of continuous floor beams

• Design of Footings (time permitting)

1. CIE 443: **Structural Steel Design**

2. 4 Credits; 6 Contact Hours

3. Instructor: Edwin Nagy

4. Textbook:
   (a) *LRFD Steel Design, Third Edition*. William T. Segui. PWS Publishing Co., Boston, MA, 2003.
   (b) *Manual of Steel Construction, Load and Resistance Factor Design, Third Edition*. AISC, 2001.
   (c) Photocopied handouts prepared by instructor.

5. Specific Course Information:
   (a) Description: The design and detailing of steel structures: tension members, beams, columns, beam columns, and connections. Covers composite construction. Introduces the Load and Resistance Factor Design concept. Microcomputer aided design project.
   (b) Prerequisite: CIE 340
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - Give students a basic understanding of integration of analysis and design;
      - Students will learn how to design structural steel components such as tension members, compression members, beams, beam-columns, and connections in accordance with the latest AISC LRFD Specification;
      - Develop an understanding of the engineering principles underlying the specifications for the design of various structural steel components, with a strong emphasis on structural mechanics.
   (b) Course Outcomes:
      - Student will demonstrate knowledge of basic LRFD concepts, including the following loads: axial tension, axial compression, mono- and bi-axial bending,and combined axial and bending.
      - Student will demonstrate ability to communicate and understand steel structural systems, including detailing of members and connections.
      - Student will improve ability to identify, formulate, and solve engineering problems; design a system, component, or process to meet desired needs; use the techniques, skills, and modern engineering tools necessary for engineering practice; and recognize the need for, and ability to, engage in life-long learning.
   (c) Relates to ABET Student Outcomes (a), (c), (e), (i), & (k)

7. Topics Covered:
   - Introduction
     - The design process
     - Loads, codes, and specifications
     - Design Philosophies
     - Structural steel – types, properties, and rolled shapes

- Tension Members
  - Concepts – yielding and fracture
  - Yielding limit state
  - Fracture limit state – net and effective areas
  - Block shear
- Compression Members
  - Review of column buckling
  - Slenderness, residual stresses, initial crookedness
  - AISC LRFD design provisions for WF sections
  - Effective length of columns in frames
  - Torsional and flexural-torsional buckling
- Flexural Members
  - Concept of plastic moment capacity
  - Bending and shear strength of laterally-supported W and S shapes
  - Design of laterally supported W and S shapes
  - Lateral-torsional buckling and the moment gradient
  - Design of W and S shapes subject to lateral-torsional buckling
  - Biaxial bending; bending strength of other shapes
- Beam-Columns
  - Concept of moment magnification
  - AISC provisions for combined axial load and flexure
  - Analysis and design of beam-columns in braced frames
  - Analysis and design of beam-columns in unbraced frames
- Simple Connections
  - Bearing-type bolted shear connections
  - Slip-critical bolted shear connections
  - Bolts in tension and prying action
  - Combined shear and tension
- Simple Welded Connections
  - Weld types, properties, size limitations
  - Weld capacity calculations
  - Design of simple welded connections
- Eccentric Connections
  - Eccentric bolted shear connections
  - Combined shear and tension for bolted connections
  - Welded shear connections
  - Welded connections – combined shear and tension
- Composite Construction (time permitting)

1. CIE 450: **Open Channel Hydraulics**

2. 3 Credits; 3 Contact Hours

3. Instructor: Qingping Zou

4. Textbook:
   (a) *Hydrology and Floodplain Analysis,* Bedient and Huber, Addison Wesley, 2nd ed., 1992.
   (b) *HEC-RAS Manual*.

5. Specific Course Information:
   (a) Description: Covers uniform and non-uniform flow in open channels, gradually and rapidly varying flow. Computational methods of flow profiles, open channel flow structures.
   (b) Prerequisite: CIE 350
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To obtain and understanding of the basic principles of Open Channel Hydraulics
      - Analysis of uniform flow
      - Analysis of gradually varied flow
      - Effects of hydraulic structures on open channel flow
      - Analysis of unsteady flow
      - To apply a floodplain hydraulic model to gradually varied flow (HECRAS) and develop case studies of floodplain delineation (project)
      - To discuss socio-political and ethical issues of contemporary water resources problems.

   (b) Course Outcomes:
      - The student will develop the ability to apply knowledge of mathematics, science and engineering.
      - The student will develop an ability to identify, formulate and solve engineering problems.
      - The student will acquire the broad education necessary to understand the impact of engineering solutions to the global and societal context.
      - The student will develop an understanding of contemporary issues.
      - The student will develop ability to use techniques, skills and modern engineering tool necessary for engineering practice.

   (c) Relates to ABET Student Outcomes (a), (e), & (k)

7. Topics Covered:
      - Basic principles reviewed, Specific energy, Momentum, Uniform flow, Gradually varied flow, Hydraulic structures, Unsteady flow, HEC-RAS project,Flow in alluvial channels, sediment transport

1. CIE 455: **Hydrology**

2. 3 Credits; 3 Contact Hours

3. Instructor: Shaleen Jain

4. Textbook:
   (a) *Hydrology and Floodplain Analysis,* Bedient and Huber, Addison Wesley, 2nd ed., 1992.

5. Specific Course Information:
   (a) Description: Application of statistical analysis to rainfall and runoff processes for the development of design parameters of water resources projects, including uncertainty of these parameters. Includes collection and presentation rainfall and runoff data, methods for developing hydrographs and flood control, development of design hydrographs for urbanizing watersheds.
   (b) Prerequisite: CIE 350
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To study rainfall and runoff processes
      - To study probabilistic analysis of rainfall-runoff processes (frequency analysis)
      - To study hydrologic and hydraulic flood routing processes
      - To study urban hydrology and how to design under development
      - To study hydrologic simulation models such as HEC1 and TR55
      - To study local, national and global aspects of hydrology in the broader context of social, political and ethical issues of water resources.

   (b) Course Outcomes:
      - The student will become familiar with principles and terminology of the hydrologic cycle
      - The student will develop an ability to quantify runoff, and to work with the unit hydrograph concept
      - The student will be able to conduct a frequency analysis of rainfall and stream flow data
      - The student will be able to calculate the temporal and spatial variation of a flood wave through a river reach or reservoir, and to design detention ponds.
      - The student will be able to apply TR-55 to study urbanizing watersheds, and to apply the HEC1 simulation model for hydrologic watershed analysis
      - The student will develop an understanding of design issues in hydrology, often subject to uncertainty
      - The student will develop an understanding of social, political and ethical issues of national and global water resources.

   (c) Relates to ABET Student Outcomes (a), (c), (e), (h), (i), (j), & (k)

7. Topics Covered:
      - Hydrologic principles (7 classes)
      - Rainfall runoff analysis (7 classes)

- Frequency analysis (8 classes)
- Flood routing and detention pond design (6 classes)
- Hydrologic simulation and watershed analysis (5 classes)
- Urban hydrology (4 classes)
- Hydrologic design (5 classes)

1. CIE 456: **Groundwater Hydraulics and Hydrology**

2. 3 Credits; 3 Contact Hours

3. Instructor: Shaleen Jain

4. Textbook:
   (a) *Groundwater,* Freeze and Cherry - Prentice Hall

5. Specific Course Information:
   (a) Description: Fundamentals of the hydrodynamics of flow through porous media, and the development of methodology for solving the many open-ended problems of groundwater flow, supply and pollution. Concepts of groundwater modeling design. Aspects of field variability and uncertainty.
   (b) Prerequisite: CIE 350 and MAT 258 or MAT 451 or permission
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To study the physical principles and concepts of flow through porous media
      - To provide an overview of physico-chemical properties and principles of groundwater flow
      - To provide an overview of groundwater geology
      - To study the development and use of flow nets in local and regional groundwater flow systems
      - To study well hydraulics and groundwater management
      - To study groundwater contamination and provide concepts of remediation
   (b) Course Outcomes:
      - The student will understand the concepts and principles of groundwater flow.
      - The student will develop an ability to analyze groundwater flow through flow nets
      - The student will develop an ability to analyze and understand groundwater systems through the use of spreadsheet-based systems modeling.
      - The student will be able to apply well hydraulics to the principles of designing pump tests for obtaining aquifer parameters and for aquifer management
      - The student will apply knowledge to analyze and solve groundwater contamination problems.
   (c) Relates to ABET Student Outcomes (a), (c), (e), (h), (i), (j), & (k)

7. Topics Covered:
      - The groundwater environment (2 classes)
      - Physical properties and principles of porous media including basic laws and equations (12 classes)
      - Groundwater chemistry and geology (5 classes)
      - Flow nets – regional groundwater flow (7 classes)
      - Groundwater modeling (4 classes)
      - Groundwater resources evaluation, pump tests and management (10 classes)
      - Groundwater contamination and contaminant transport (5 classes)

1. CIE 460: **Geotechnical Engineering**

2. 3 Credits; 3 Contact Hours

3. Instructor: Thomas Sandford

4. Textbook:
   (a) *Principles of Foundation Engineering, 5th ed.,* by B.M. Das, 2004

5. Specific Course Information:
   (a) Description: The application of geotechnical engineering to practical engineering design and construction problems including consideration of economic and safety constraints.
   (b) Prerequisite: CIE 365
   (c) Elective Class

6. Course Goals and Outcomes:
   (a) Goals:
      - To develop and apply the geotechnical principles studied in CIE 365 to practical geotechnical problems.

   (b) Course Outcomes:
      - Develop an acquaintance with the language of geotechnical engineering.
      - Be able to conduct calculations for basic geotechnical design.
      - Develop a sense of the magnitude of various parameters used in geotechnical engineering, such as unit weight, porosity, or friction angle.
      - Develop an understanding of the application of geotechnical principles to obtain safe geotechnical designs.
      - Start to develop a sense of the performance of soil deposits to expected loadings.
      - Examine the role of the engineer to society in an investigation of geotechnical failure.
      - Develop written communication skills.
      - Gain knowledge of contemporary issues by investigating a geotechnical innovation.
      - Gain an ability to do lifelong learning by improving library and world-wide-web skills.

   (c) Relates to ABET Student Outcomes (a), (c), (e), (f), (g), (i), (j), & (k)

7. Topics Covered:
      - Subsurface investigations (2 weeks)
      - Shallow foundations (3 weeks)
      - Walls (3 weeks)
      - Deep foundations (3 weeks)
      - Slope stability (3 weeks)

Other Engineering Courses

MECHANICAL ENGINEERING DEPARTMENT
UNIVERSITY OF MAINE

MEE 150 APPLIED MECHANICS: STATICS

3 Credits; Recitation 3 hours.

Course Coordinator: Richard Sayles, Associate Professor of Mechanical Engineering.

TEXTBOOK: *ENGINEERING MECHANICS: STATICS,12TH EDITION* BY R. C. HIBBELER, PRENTICE-HALL, 2010.

Catalog Description: A study of force systems and equilibrium, structural models, friction, distributed forces. Designed to develop the ability to analyze and solve engineering problems.

Prerequisites: MAT 126(Calculus I).

Designation: Required.

Course Outcomes:

1. The student will demonstrate the ability to use both S. I. and U. S. C. U. units and use significant figures correctly.
2. The student will demonstrate the ability to use vectors in the solution of problems.
3. The student will demonstrate the ability to analyze the equilibrium of a particle including the use of Free Body Diagrams.
4. The student will demonstrate the ability to determine moments, couples, and reduce simple distributed loads.
5. The student will demonstrate the ability to analyze the equilibrium of a rigid body including the use of Free Body Diagrams.
6. The student will demonstrate the ability to analyze structures including trusses, frames and machines including the use of Free Body Diagrams.
7. The student will demonstrate the ability to determine the internal loads for a structural member.
8. The student will demonstrate the ability to analyze the equilibrium of objects subjected to friction forces.
9. The student will demonstrate the ability to determine the centroid of an area and the center of gravity of an object.
10. The student will demonstrate the ability to determine the moment of inertia of an area and apply the parallel axis theorem correctly.

Student Outcomes: (Criterion 3)

The student will demonstrate

a) an ability to apply knowledge of mathematics, science, and engineering.
e) an ability to identify, formulate, and solve engineering problems.
f) an understanding of professional and ethical responsibilities.
i) a recognition of the need for, and an ability to engage in life-long learning.

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

Topics to be covered:

1) Systems of Units
2) Force Vectors
3) Vector Operations
4) Free Body Diagrams
5) Equilibrium of a Particle
6) Two and Three Dimensional Equilibrium
7) Moment of a Force: 2-D and 3-D calculations
8) Moment of a Couple
9) Movement of a Force on a Rigid Body
10) Reduction of a Distributed Load
11) Equilibrium of a Rigid Body
12) Two Force Members
13) Truss Analysis
14) Frame and Machines
15) Internal Forces and Moments Developed in Structural Members
16) Characteristics of Dry Friction
17) Wedges
18) Centroid of an Area
19) Center of Gravity
20) Composite Bodies and Areas
21) Moment of Inertia
22) Product of Inertia
23) Mass Moment of Inertia
24) Parallel Axis Theorem

MECHANICAL ENGINEERING DEPARTMENT
UNIVERSITY OF MAINE

1. *Course number and name*
   MEE 251: Strength of Materials

2. *Credits and contact hours*
   3 credits; three hours per week

3. *Instructor's or course coordinator's name*
   Coordinator: Vincent Caccese, Professor of Mechanical Engineering

4. *Text book, title, author, and year*
   Mechanics of Materials, T. Philpot, Wiley and Sons, 2011

   a. other supplemental materials
   On line tools optional

5. *Specific course information*
   a. brief description of the content of the course (catalog description)
   The principles of solid mechanics and their applications to practical problems, stresses and deflections in axial loading, torsion, beams, columns, combined stresses.

   b. prerequisites or co-requisites
   MEE 150: Statics
   MAT 127: Calculus 2

   c. indicate whether a required, elective, or selected elective course in the program
   Required for Mechanical Engineering

6. *Specific goals for the course*
   a. *specific outcomes of instruction.*

Students will gain a basic understanding of the concepts of stress and strain transformation, strain deformation relationships and stress-strain relationships.
Students will develop a basic understanding of the response of discrete members such as axial bar, beams and circular bars under torsion.
Students will gain an understanding of the importance of performing work thoroughly and correctly.

- Students will gain a basic understating of stress analysis and of the structural design process.

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   Course addresses ABET Student Outcomes:

   - [3a] An ability to apply knowledge of mathematics, science, and engineering principles

- [3c] Ability to design a system, component, or process to meet desired needs
- [3e] An ability to identify, formulate and solve engineering problems
- [3k] An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

7. *Brief list of topics to be covered*

- Introduction
- Stress
- Strain
- Mechanical Response of Materials
- Structural Design
- Axial Deformation
- Torsion
- Shear Force and Bending Moments in Beams
- Bending Stress in Beams
- Shear Stress in Beams
- Deflection of Beams
- Stress and Strain Transformations
- Pressure Vessels
- Stress due to Combined Loads
- Brief Introduction to Columns

Math Courses

1. Course number and name
   MAT 126 Calculus I

2. Credits and contact hours
   4 credits - 5 contact hours

3. Instructor's or course coordinator's name
   Dr. Natasha M. Speer

4. Text book, title, author, and year
   Calculus: Single Variable by Hughes-Hallett et al., Wiley & Sons, 5th edition, ISBN-10: 0470089156, ISBN-13: 978-0470089156
   a. Other supplemental materials
      i. *WileyPLUS, on-line homework and course materials system provided by the textbook publisher;*
      ii. *The Better File Cabinet (betterfilecabinet.org) and other sources of Emerging Scholars Program calculus problems for collaborative groupwork during recitations;*
      iii. *(Optional) Graphing calculator*

5. Specific Course Information
   a. brief description of the content of the course (catalog description)

An introduction to calculus for students in mathematics, engineering, and the sciences. Covers the differential calculus of the algebraic, trigonometric, exponential and logarithmic functions, concluding with the definite integral and the fundamental theorem of calculus. The approach is intuitive and geometric, with emphasis on understanding the basic concepts of function, limit, derivative and integral.

   b. prerequisites or co-requisites

      A grade of C or better in MAT 122, or no grade record in MAT 122 and a passing score on Part 3 of the Math Placement Exam

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

      Required

6. Specific goals for the course
   a. specific outcomes of instruction.

- recognize the importance of limits
- distinguish between limits from the left and the right
- explain why a limit need not exist
- determine whether or not a limit exists
- apply limits to graphing, asymptotes

- determine where a function is and is not continuous
- find average and instantaneous velocities
- differentiate elementary and transcendental functions
- find the derivative of a function using the definition
- determine where a function is and is not differentiable
- deduce properties of a function from its derivative
- determine the intervals where a function is increasing/decreasing
- determine the intervals where a function is convex/concave
- use the above information to sketch an accurate graph
- understand interpretations of values/signs of functions, first derivatives and second derivatives in applied contexts
- set up and solve optimization problems
- set up and solve related rate problems
- evaluate limits of indeterminate forms
- understand how/why definite integrals model accumulation
- distinguish between signed and unsigned area
- calculate areas under and between curves
- express an integral as a limit of sums
- estimate integrals using upper and lower sums
- calculate accumulation using definite integrals
- evaluate integrals by antidifferentiation
- evaluate integrals by substitution

b. explicitly indicate which of the student outcomes listed in Criterion 3 (please see a-k outcomes below and list any that applies to the course) or any other outcomes are addressed by the course.
   Criteria explicitly addressed: a (but only in terms of applying knowledge of mathematics in general, not applying mathematics, science and engineering)

7. Brief list of topics to be covered
   - *i. Limits and limit computations*
   - *ii. Rates of change, average rates of change*
   - *iii. Definition of derivative*
   - *iv. Derivative computations, techniques for computing derivatives*
   - *v. Applications of derivative concepts and computations (e.g., optimization)*
   - *vi. Anti-derivatives and techniques for constructing anti-derivatives*
   - *vii. Measuring accumulation and using/interpreting definite integrals*
   - *viii. Generating and interpreting graphs of functions, their derivatives, their second derivatives and their anti-derivatives*
   - *ix. The Fundamental Theorem of Calculus*

Criterion 3 - Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

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

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on 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.

1. Course number and name
   MAT 127 – Calculus II

2. Credits and contact hours
   4 credits - 4 contact hours

3. Instructor's or course coordinator's name
   Dr. Eisso J. Atzema

4. Text book, title, author, and year
   Text Book: Hughes-Hallett e.a., Single-Variable Calculus, 5th Edition (Wiley) 2009, ISBN-13: 978-0-470-08915-6

   a. Other supplemental materials
      i. WileyPLUS: a digital on-line learning environment and homework system
      ii. (optional) Calculator

5. Specific Course Information
   a. brief description of the content of the course (catalog description)
      MAT 127 is the second semester of the calculus sequence, primarily serving mathematics, science, and engineering majors.
   b. prerequisites or co-requisites
      MAT 126 (Calculus I), is a pre-requisite.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      Required

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

      i. Students will demonstrate a mastery of the basic techniques of integration.
      ii. Students will demonstrate a heuristic understanding of definite integrals as a bounded or unbounded accrual of infinitesimally small quantities and demonstrate an ability to apply this understanding to assorted situations such as the study of improper integrals, the determination of the volume of simple rotation-symmetric solids, and the determination of arc length of arbitrary curves and simple examples of similar types of problems in the sciences and engineering.
      iii. *Students will demonstrate a heuristic understanding of the summation of series as a discrete form of integration and apply this understanding to determine the convergence or divergence of simple series.*
      iv. *(optional) Students will demonstrate an ability to set up and solve simple separable differential equations as applied to simple problems in the sciences.*

b. explicitly indicate which of the student outcomes listed in Criterion 3 (please see a-k outcomes below and list any that applies to the course) or any other outcomes are addressed by the course.
   Criteria explicitly addressed: a.

7. Brief list of topics to be covered
   i. integration by substitution
   ii. integration by parts
   iii. integration by partial fraction decomposition
   iv. integration by trigonometric substitution
   v. improper integrals
   vi criteria for divergence and convergence of improper integrals
   vii. (optional) numerical integration
   v. solids of revolution
   vi. washer method for volume & (optional) surface area
   vii. (optional) cylindrical shells
   viii arc length
   ix. parametrization of curves by means of polar coordinates
   x. arc length and enclosed area in terms of polar equations
   xi. (optional) separable differential equations & applications to physics
   xii geometric series
   xiii. convergence and divergence tests for series
   xiv. Taylor series expansion

Criterion 3 - Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

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

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on 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.

1. Course number and name
   MAT 228 – Calculus III

2. Credits and contact hours
   4 credits - 4 contact hours

3. Instructor's or course coordinator's name
   Dr. Eisso J. Atzema

4. Text book, title, author, and year
   Text Book: McCallum e.a., Multivariable Calculus, 5th Edition (Wiley) 2009, ISBN-13: 978-0-470-13158-9

   a. Other supplemental materials
      i. *WileyPLUS: a digital on-line learning environment and homework system*
      ii. *(optional) Calculator*

5. Specific Course Information
   a. brief description of the content of the course (catalog description)
      MAT 228 is the third semester of the calculus sequence, primarily serving mathematics, science, and engineering majors.
   b. prerequisites or co-requisites
      MAT 127 (Calculus II), is a pre-requisite.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      Required

6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

      i. *Students will demonstrate a mastery of the basic tools of (3-dimensional) vector geometry and an ability to apply these tools to solve basic geometrical problems in plane and spatial geometry.*
      ii. *Students will demonstrate an understanding of basic multi-variable calculus as a generalization of single-variable calculus as well as an understanding of single-variable calculus as a special case of multi-variable calculus.*
      iii. *Students will demonstrate an ability to apply the specific tools of multi-variable calculus in the context of simple scientific situations.*
      iv. *Students will demonstrate an awareness of some of the limitations of vector calculus in "pathological" situations.*

   b. explicitly indicate which of the student outcomes listed in Criterion 3 (please see a-k outcomes below and list any that applies to the course) or any other outcomes are addressed by the course.
      Criteria explicitly addressed: a.

7. Brief list of topics to be covered

   i. dot and cross products and their application to spatial geometry
   ii. space curves and curvature
   iii. partial derivatives and their application to tangent lines and planes
   iv. optimization of functions in two variables.
   v. (optional) Lagrange multipliers
   vi. double and triple integrals
   vii. transformation of double integrals from Cartesian to polar coordinates
   viii. transformation of triple integrals from Cartesian to cylindrical and/or spherical coordinates.
   ix. scalar and vector line integrals
   x. flow, flux, and Green's Theorem
   xi. (optional) Divergence Theorem

Criterion 3 - Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

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

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on 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.

MAT258: University of Maine: Fall 2008
Instructor: Jerry Farlow
Text: Differential Equations & Linear Algebra by Farlow, Hall, McDill and West (2^{nd} edition)

Testing Policy: Over the course of the semester we will have 4 exams, each counting 100 points. There will be no make-up tests, but the lowest grade will be thrown out with the exception of the last exam. I will not collect homework but the exams will always include at least one problem, sometimes more, from the homework.

Office Hours: You can get help at any time in the MathLab, which is now located in room 410 Neville. I will let you know of my office hours after the class begins. If you cannot make my scheduled office hours, you can always make an appoint to meet with me. Class info it also posted on my webpage at
http://germain.umemat.maine.edu/faculty/farlow/index.htm

Online Tools: You can draw direction fields and phase plane plots online by going to www.prenhall.com/farlow , then click on Syllabus Manager/ODE Solver and enter either DFIELD 2002 or PPLANE2002. A window opens and you can enter your differential equation etc. The only difference from the text is that the dependent variable is x instead of y. This program was written by John Polking of Rice University.

Chapter 1 First-Order Differential Equations
Sec 1.1 Dynamical Systems: Modeling 4, 7, 11
Sec 1.2 Solutions and Direction Fields: 2, 7, 16-21
Sec 1.3 Separation of Variables 1-5, 11, 27, 57
Sec 1.4 Approximation Methods 1, 17, 29,
Sec 1.5 Picard's Theorem (Existence and Uniqueness of Solutions) 1, 9, 24, 26

Chapter 2 Linearity and Nonlinearity
Sec 2.1 Linear Equations: Nature of Their Solutions 1-10, 18, 24, 26, 35
Sec 2.2 Solving the First-Order Linear DE 2, 8, 16, 23, 32
Sec 2.3 Growth and Decay Problems 1, 2, 24, 28, 31
Sec 2.4 Linear Models: Mixing and Cooling
Sec 2.5 Nonlinear Models: Logistic Equation 1, 6, 19, 35
Sec 2.6 Systems of Differential Equations: A First Look 1, 21

Review, Test 1, Go Over Test

Chapter 3 Linear Algebra
Sec 3.1 Matrices: Sums and Products 2, 9, 25, 47, 61, 62
Sec 3.2 Systems of Linear Equations 1, 11-19, 20, 26, 54, 76
Sec 3.3 The Inverse of a Matrix 1, 7, 15, 26
Sec 3.4 Determinant and Cramer's Rule 1, 15, 30, 45
Sec 3.5 Vector Spaces and Subspaces 1-9, 11-16, 37, 38, 50, 53, 66. 71
Sec 3.6 Basis and Dimension 1, 6, 7, 15, 19, 26, 55, 66

Chapter 4 Higher-Order Differential Equations
Sec 4.1 The Harmonic Oscillator 1, 3, 24, 57, 68
Sec 4.2 Real Characteristic Roots 4, 5, 27, 29, 59
Sec 4.3 Complex Characteristic Roots 2, 19, 45-46, 74

Review, Test 2, Go Over Test

Sec 4.4 Undetermined Coefficients 1, 7, 13, 18, 61
Sec 4.5 Variation of Parameters 1, 9, 22
Sec 4.6 Forced Oscillation 1, 16-17, 27-30, 31
Sec 4.7 Conservation and Conversion 1, 2, 6, 14, 25, 45

Chapter 5 Linear Transformations
Sec 5.1 Linear Transformations 1, 2, 10, 17, 20-21, 36, 75
Sec 5.2 Properties of Linear Transformations 1, 5, 7, 27, 72
Sec 5.3 Eigenvalues and Eigenvectors 2, 19, 72, 76

Chapter 6 Linear Systems of Differential Equations

Sec 6.1 (skip) I'll give you a summary of this material
Sec 6.2 Linear Systems with Real Eigenvalues 1, 9, 51, 56
Sec 6.3 Linear Systems with Non Real Eigenvalues 1, 13, 32, 39
Sec 6.4 Stability and Linear Classification 1, 2, 5

Review, Test 3, Go Over Test

Chapter 7 Nonlinear Systems of Differential Equations
Sec 7.1 Nonlinear Systems 1, 20, 31, 35
Sec 7.2 Linearization 1, 6, 14, 15

Chapter 8 Laplace Transforms
Sec 8.1 The Laplace Transform and Its Inverse 4, 25, 27, 41, 49
Sec 8.2 Solving DEs and IVPs with the Laplace Transform 4, 5, 10
Sec 8.3 The Step Function and Delta Function 1, 8, 47, 51
Sec 8.4 The Convolution Integral and the Transfer Function 1, 14, 20, 25, 32, 40

Chapter 10 Control Theory
Sec 10.1 Feedback Controls 1, 9, 14, 18, 19
Sec 10.2 Introduction to Optimal Control 1, 7, 13, 16

Review, Test 4, Go Over Test

University of Maine – Department of Mathematics & Statistics

Mat 332, Engineering Statistics
Spring 2009

Welcome to the Spring 2009 edition of MAT 332. My name is **Dan Juska**. My office is in **412 Neville Hall**. My telephone is **581-3955**, and you can send me **e-mail on First Class** (Please don't send me trivial e-mails…you'll know I consider it trivial if I don't answer it. I don't have time to answer e-mails from over 200 students. You can ask me your question face-to-face). My office hours are usually by appointment. Just see me after class, and we can set up a mutually convenient time to meet. Also, if you're ever around the 4th floor of Neville Hall, I'll have my schedule posted on my office door, and if I'm not in class, I'll probably be in my office.

Solving many types of engineering problems requires an appreciation of variability and some understanding of how to use both descriptive and analytical tools in dealing with variability. Statistics is the branch of applied mathematics that is concerned with variability and its impact on decision making. This course is intended for engineering students who may find themselves in situations where statistical methods could prove to be useful in the solution of quantitative problems. It is intended as an introduction to the language and methods of statistical analysis, probability, graphic and numeric descriptive methods and inferences made from sample data.

Required Text: ***Engineering Statistics***, Montgomery, Runger, Hubele (Wiley 4th ed.)

Technology: Minimum of a TI-83 graphing calculator, or preferably a TI-89, or equivalent. **You should know how to use your calculator. It is not part of the subject material.**

First Class: I've set up a class folder on First Class containing the syllabus, homework assignments, etc. You should put the **MAT332(Juska)** icon on your First Class desktop.

Homework: You are expected to do assigned problems from the book. When you do them and pass them in, they must be done neatly in pencil (not pen) and erase….don't cross out. I will return them to you. **Homework will be collected on Monday only. You need do only the homework on topics we've covered in class. I will post the homework solutions a couple of days after I collect the homework. Once the solutions have been posted, homework will no longer be accepted for that section.** Doing and passing in your homework shows me that you are putting in an effort.

DOING your homework doesn't mean copying the answers from the back of the book. You actually need to do out the work leading to the answer. Any questions on problems will be answered during a class meeting or during my office hours, if that's better for you. It's up to you to keep up with the work. Also, don't worry about passing in late homework. I'm interested in your ability to do the problems, not meet an arbitrary deadline. Let me know you need more time for a particular assignment. Just don't get too far behind where you won't be able to catch up. Homework assignments will be posted in our class conference folder. **Doing homework problems is one of the best ways to learn. Passing in all your assigned homework will result in 5% being added to your final class average.**

One must learn by doing the thing, for though you think you know it – you have no certainty until you try –SOPHOCLES

Attendance: I expect you to attend all classes. The only legitimate excuses for missing class are sickness, Family emergencies, and athletics or involvement in other university sanctioned events. In any of these instances, I expect you to turn in appropriate verifying paperwork. Rarely, either the University or I will cancel class due to inclement weather. Use your common sense. If you have a lengthy commute and there is bad weather, don't come to class. If I call off class ahead of time, I'll post a notice in our class conference folder on First Class.

Some points for class attendance and in-class conduct: When you come to class, you must come prepared to learn by taking notes and paying attention to the lecture.

The following are not permitted:

a. Cell phones (turn them off before class and don't play with them during class).
b. Laptop computers are <u>not permitted</u> unless you get prior permission from me. Class time is not to be used for surfing the Internet.
c. Reading material other than that which is directly related to the class (no romance novels, etc.).
d. No sleeping, chatting with your neighbor, or otherwise wasting time.

If you don't think I'll notice that you're doing any of the above …. Think again….I'll notice.

Lack of attendance will be considered excessive when cumulative unexcused absences for the semester exceed the total number of credit hours for the class. This will result in a deduction of 10% in your final course average.

Testing: There will be 3 tests during the semester as well as an optional final exam. All tests will be done in blue examination books which I'll provide. Later in the semester, I'll publish some additional test-taking rules in our class conference folder. **Makeup tests will be offered at my discretion.**

Grades: Your final course grade will be based on the test scores, plus any homework bonus, minus any attendance penalty. The optional final will carry the same weight as a regular test. If you choose to take the final, then the lowest grade of the 4 tests will be dropped.

The **Math Lab** is located in 419 Neville Hall. It is staffed by math faculty and graduate students who will assist you if you have questions. It is open every day from 10:00 am until 4:00 pm (3:00 pm on Fri.). Take advantage of it! **Also, don't hesitate to ask me for help at any time.**

<u>There are only 3 things you need to do to succeed in this course:</u>

Come To Class
Do Your Homework
Ask For Help

Science Courses

CHY131 Chemistry for Civil, Electrical and Mechanical Engineers

Fall 2011

MWF 11:00 – 11:50 AM
316 Aubert Hall

Dr. Barbara Stewart

barbara.stewart@ maine.edu

171 Aubert Hall (581-1948)

Office hours: MWF 1:00 – 2:00 pm, Th 10:00 – 11:00 am, and by appointment
Peer tutors are available M-Th, 3-5 and 6-8 in the lobby of Aubert Hall.

Required Materials

- Chemistry for Engineering Students, 2nd Edition; Cengage Learning; Brown, Holme; ISBN: 1-439-04791-X
- OWL electronic homework system access code (http://www.cengage.com/owl)
- Peer Lead Team Learning Workshops manual, in bookstore
- Calculator with basic math functions as well as scientific notation, powers and roots, and logarithms
-
- CHY121 Course Folder on First Class

Your course grade will be based on the following:

10 % - OWL assignments
10% - Recitation workshops and attendance
20 % - EXAM I- Wednesday, September 21st -3:10-5:10 pm or 6:00-8:00 pm
20 % - EXAM II- Wednesday, October 19th - 3:10-5:10 pm or 6:00-8:00 pm
20 % - EXAM III- Wednesday, November 16th - 3:10-5:10 pm or 6:00-8:00 pm
20 % - FINAL EXAM- TBA

- All exams are in 316 Aubert Hall

Owl Homework

Weekly homework assignments are accessed through Cengage Learning's OWL Electronic Homework System. The system is "mastery" based, meaning that you can work on an assignment as long as you want and try questions as many times as you want, until succeeding. There is no penalty for getting an answer wrong. There is only a penalty for not getting it right before the due date.

Access to OWL is available in to bookstore or online at http://www.cengage.com/owl (click on General Chemistry/Buy an Access Code). To access your OWL electronic homework system account, go to http://www.cengage.com/owl and choose General Chemistry/Login/ Chemistry for Engineering Students, 2nd Edition, Brown and Holme /University of Maine). Be sure to choose the correct text (Chemistry for Engineering Students, 2nd Edition, Brown and Holme). Assignments will be made weekly and will be due on **Sundays @ midnight**. OWL assignments count as 10 % of your final grade.

Recitation Workshops

Your assigned recitation/workshop time is 3-5 or 6-8 on Wednesdays. Workshops begin the first week of class with an introductory meeting during your assigned recitation time. Workshops involve groups of 6-8 students who work through challenging and interactive exercises directly related to the course. Undergraduate students who have done very well in the course will act as peer leaders, rotating through the groups and facilitating the workshops. Each week, we will meet in 316 Aubert and break up into study groups, using the conference rooms (165 and 265 Aubert), the break room, and the 3 large tables in the lobby. Workshop materials will be available for purchase in the bookstore. Recitation **will meet** the first week of class for an introductory meeting. Recitation **will not meet** exam weeks, October break, or Thanksgiving week. Peer tutoring/exam review is available Mon through Thursday 3-5 and 6-8 in the lobby of Aubert during exam weeks.

Our data demonstrates that students who participate in the workshops do better on exams and also get more out of the course through participating in group-problem-solving activities. As such, 10% of your grade will be based on participation in the workshop. For most students, these points help boost the overall course average. If you do not attend workshops or your workshop grade does not help your final grade, I will reweigh your exam average (10 % OWL homework, 90 % exams).

Exams

You must have a passing exam average in order to pass the course and must take the final exam. In the event of a severe illness or family emergency or other legitimate conflict, contact me as soon as possible for makeup exams.

Academic Honesty

I expect that you will abide by the academic honesty policy on campus. This policy includes participating and contributing to class activities and completing the OWL homework assignments. For the exams, you will only need a pencil and calculator (no pda or cell phone) and must complete the exam individually.

> *If you have a disability for which you may be requesting an accommodation, please contact either me or Ann Smith, Director of Disability Services in* ***East Annex****, 581-2319, as early as possible in the term.*

In the event of disruption of normal classroom activities, the format for this course may be modified to enable completion of the course. In that event, you will be provided an addendum to this syllabus that will supersede this version.

CHY131 Chemistry for Engineers Schedule (Stewart)

Week of	Chap	Subject	OWL assignment (due Sunday @ midnight)	Workshops
Aug 29	1,2	Matter and Global Energy Use	OWL #1 (due 9/4)	8/31 Intro to Workshops
Sept 5	2,3	From Stone Age to Electronic Materials: Atoms, Molecules, and Ions	OWL #2 (due 9/11)	9/8 Workshop 1
Sept 12	3,4	Chemical Reactions and Global Chemical Production	OWL #3 (due 9/18)	9/15 Workshop 2
Sept 19	4,5	Stoichiometry, Atom Economy and Green Chemistry	No OWL, exam	EXAM I (W Sept 21st)
Sept 26	6	Electronic Structure and Spectroscopy	OWL #4 (due 10/2)	9/29 Workshop 3
Oct 3	6,7	Electronic Configurations; Lasers, LEDs, and Materials	OWL #5 (due 10/9)	10/6 Workshop 4
Oct 10	7	Bonding in Metals, Insulators, and Semiconductors	OWL #6 (due 10/16)	fall break 10/11-12
Oct 17	7,8	Intermolecular Forces and Polymers	No OWL, exam	EXAM II (W Oct 19th)
Oct 24	8,9	Thermodynamics and Energy Use	OWL #7 (due 10/30)	10/27 Workshop 5
Oct 31	9,10	Entropy, Free Energy and Recycling	OWL #8 (due 11/6)	11/3 Workshop 6
Nov 7	11	Corrosion and Kinetics	OWL #9 (due 11/13)	11/9 Workshop 7
Nov 14	11,12	Concrete and Equilibrium	No OWL, exam	EXAM III (W Nov 16th)
Nov 21	12	Water Quality and Equilibrium	No OWL	Thanksgiving break
Nov 28	12	Acid Base Equilibrium	OWL #10 (due 12/4)	12/1 Workshop 8
Dec 5	13	Electrochemistry and Batteries	OWL #11 (due 12/9)	12/8 workshop 9
Dec 12	1-13	FINALS	FINAL (TBA)	

1. PHY 121 – Physics for Engineers and Physical Scientists I

2. 4 credits - 6 contact hours

3. Dr. David E. Clark

4. a. **Physics for Engineers & Scientists A Strategic Approach** by Randall D. Knight, 2nd Edition (Pearson/Addison Wesley) 2008, ISBN-13: 978-0-8053-2736-6
   b. Mastering Physics, an online physics homework and tutorial assessment system;
   c. an iClicker, a personal response system;
   d. Engineer's Pad (National 42-381) for weekly problem assignments;
   e. Laboratory Notebook (National 43-591) for recording weekly laboratory experiments.

5. a. PHY 121 is a first semester, calculus-based, introductory physics course primarily serving students majoring in engineering or the physical sciences.

   b. MAT 126, Calculus I, is a co-requisite.

   c. Required

6. a. Students will demonstrate an understanding of the basic laws of physics and apply them to scientific and engineering situations.
   Students will demonstrate an ability to identify, formulate and solve problems in applied and basic physics.
   Students will demonstrate an ability to conduct experiments and to analyze and interpret data.
   Students will demonstrate an ability to effectively communicate scientific concepts observations, measurements and conclusions.
   Students will demonstrate an appreciation of the role of physics in contemporary scientific and engineering situations.

   b. Criteria explicitly addressed: a, b, e, g

7. Topics include:
   a. both linear and angular dynamics (and kinematics);
   b. conservation laws of momentum and energy;
   c. oscillations.

1. PHY 122 – Physics for Engineers and Physical Scientists II

2. 4 credits - 6 contact hours

3. Dr. David E. Clark

4. a. **Physics for Engineers & Scientists A Strategic Approach** by Randall D. Knight, 2nd Edition (Pearson/Addison Wesley) 2008, ISBN-13: 978-0-8053-2736-6
   b. Mastering Physics, an online physics homework and tutorial assessment system;
   c. an iClicker, a personal response system;
   d. Engineer's Pad (National 42-381) for weekly problem assignments;
   e. Laboratory Notebook (National 43-591) for recording weekly laboratory experiments.

5. a. PHY 122 is a second semester, calculus-based, introductory physics course primarily serving students majoring in engineering or the physical sciences.

   b. MAT 126, Calculus I, is a prerequisite.

   c. Required

6. a. Students will demonstrate an understanding of the basic laws of physics and apply them to scientific and engineering situations.
   Students will demonstrate an ability to identify, formulate and solve problems in applied and basic physics.
   Students will demonstrate an ability to conduct experiments and to analyze and interpret data.
   Students will demonstrate an ability to effectively communicate scientific concepts observations, measurements and conclusions.
   Students will demonstrate an appreciation of the role of physics in contemporary scientific and engineering situations.

   b. Criteria explicitly addressed: a, b, e, g

7. Topics include:
   a. waves and interference;
   b. optics;
   c. electrical and magnetic phenomena;.

Appendix B - Faculty Vita

Aria Amirbahman
William Davids
Per Garder
Shaleen Jain
Eric Landis
Roberto Lopez Anido
Jean MacRae
William Manion
Melissa Landon Maynard
Edwin Nagy
Thomas Sandford
Qingping Zou

Roster of Civil Engineering Association (External Advisory Board)

1. Name: Aria Amirbahman

2. Education

B.S. Civil Engineering, San Jose State University, Dec. 1984.
M.S. Civil and Environmental Engineering, San Jose State University, May 1989.
Ph.D. Civil and Environmental Engineering, University of California, Aug. 1994.

3. Academic Experience

Professor of Civil and Environmental Engineering, University of Maine. 2009-present.
Associate Professor University of Maine, Civil and Environmental Engineering. 2003.
Assistant Professor University of Maine, Civil and Environmental Engineering. 1997.
Visiting professor; Institute of Terrestrial Ecology (ITÖ), Swiss Federal Institute of Technology (ETH-Zürich), Switzerland. 1998.
Postdoctoral Research Fellow, Swiss Federal Institute of Environmental Science and Technology. 1995-1997.

4. Non-academic Experience

Sabbastical leave; U.S. Geological Survey, Menlo Park, CA. 2004;2011.
Environmental Engineer, Santa Clara Valley Water District, San Jose, CA. 1985-1989.
Hydraulic Engineer, Hydro-Research Science, Inc., Santa Clara, CA. 1984-1985.

5. Certification

California, Registration number: C49994

6. Current Membership in Professional Organizations

Am. Chemical Society; Am. Geophysical Union; Geochemical Society

7. Honors and Awards

2011 University of Maine Board of Trustees Professorship.
Dean's Award of Excellence, College of Engineering, University of Maine, 2010-2011.
Excellence in Review Award, Environmental Science & Technology, 2009.
Civil and Environmental Engineering Professor of the Year; elected by the ASCE Student Chapter at the University of Maine, 2009.

8. Service Activities

Reviewed 46 scientific articles for 12 peer-reviewed journals.
Reviewed funding proposals for the NSF, USGS, USDA, Petroleum Research Fund, DOE.
Chaired a scientific session at the ASLO Conference, Puerto Rico, February 2011.
University committees: University Research Council (2011-present); University Research and Service Committee (2005-present); New Faculty Mentoring Program (2008-09); Advisory Board of the Sawyer Environmental Chemistry Research Lab (2003-present);

College Representative to the Academic Program Prioritization Working Group (2009-10).
Departmental committees: Civil Engineering Curriculum Committee (1998-2003); Civil Engineering Alumni Association (1999-present); Departmental Peer Committee (2003-present); Chair faculty search committee (2005); Member faculty search committee (2010).

9. Important Publications from Past Five Years

Amirbahman A., B.A. Lake, and S.A. Norton, "Seasonal phosphorus dynamics in the surficial sediment of two shallow temperate lakes: A solid-phase and pore-water study." *Hydrobiologia*, in press.
-Sunderland E., A. Amirbahman, N. Burgess, J. Dalziel, G. Harding, S.H. Jones, M.R. Karagas, and C.Y. Chen, "Mercury sources and fate in the Gulf of Maine." *Environmental Research*, 10.1016/j.envres.2012.03.011.
-Lake B.A., C.R. Wigdahl, K.E. Strock, J.E. Saros, and A. Amirbahman, 2011, "Multi-proxy paleolimnological assessment of biogeochemical versus food web controls on the trophic states of two shallow, mesotrophic lakes." *Journal of Paleolimnology*, 46, 45-57.
-Amirbahman A., B.C. Holmes, I.J. Fernandez, and S.A. Norton, 2010, "Mobilization of metals and phosphorus from intact forest soil cores by dissolved inorganic carbon." *Environmental Monitoring and Assessment*, 171, 93-110.
-Wilson T.A., A. Amirbahman, S.A. Norton, and M.A. Voytek, 2010, "A record of phosphorus dynamics in oligotrophic lake sediment." *Journal of Paleolimnology*, 44, 279-294.
-Ohno T., and A. Amirbahman, 2010, "Phosphorus availability in boreal forest soils: A geochemical and nutrient uptake modeling approach." *Geoderma*, 155, 46-54.
-Merritt K.A., and A. Amirbahman, 2009, "Mercury methylation dynamics in estuary and coastal marine sediments – A critical review." *Earth Science Reviews*, 96, 54-66.
-Porcal P., A. Amirbahman, J. Kopáček, F. Novák, S.A. Norton, 2009, "Photochemical release of humic and fulvic acid-bound metals from simulated soil and streamwater." *Journal of Environmental Monitoring*, 11, 1064-1071.
-Merritt K.A., and A. Amirbahman, 2008, "Cycling of methylmercury in estuarine sediment pore waters (Penobscot River Estuary, Maine, USA)." *Limnology and Oceanography*, 53, 1064-1075.
-Merritt K.A., and A. Amirbahman, 2007, "Mercury dynamics in sulfide-rich sediments: Geochemical controls on contaminant storage potential of the Penobscot River Estuary, Maine, USA." *Geochimica et Cosmochimica Acta*, 71, 929-941.
-Merritt K.A., and A. Amirbahman, 2007, "Mercury mobilization in estuarine sediment porewaters: A diffusive gel gradient study." *Environmental Science & Technology*, 41, 717-722.

10. Most Recent Professional Development Activities

N/A

1. Name: William Davids

2. Education

Ph.D. in Civil/Structural Engineering, University of Washington, 1998
M.S. in Civil/Structural Engineering, University of Maine, 1991
B.S. in Civil Engineering, University of Maine, 1989

3. Academic Experience

Professor of Civil and Environmental Engineering, University of Maine. 2009-present.
Associate Professor of Civil and Environmental Engineering, University of Maine. 2004-2009.
Assistant Professor of Civil and Environmental Engineering, University of Maine. 1998-2004.
Graduate Research Assistant, University of Washington. 1994-1998.
Graduate Research Assistant, University of Maine. 1989-1991.

4. Non-academic Experience

Structural Engineer, Sverdrup Corporation, Seattle, WA (now Jacobs Engineering). 1991-1994.
Design of reinforced and prestressed concrete bridges
Retrofit and design of movable bridges and components
Preliminary design of two cable-stayed bridges
Engineer/Engineering Assistant (summers), Kleinschmidt Associates. 1987-1989.

5. Certification

Registered Professional Engineer in Maine (No. 9195)

6. Current Membership in Professional Organizations

Member, ASCE; Member, Forest Products Society

7. Honors and Awards

L.J. Markwardt Wood Engineering Award from the Forest Products Society, 2012
George Marra Award (1st place) from the Society of Wood Science and Technology, 2012
Ashley Campbell Award from University of Maine College of Engineering, 2011
State of Maine Civil Engineer of the Year (awarded by the Maine ASCE), 2010
Director's Award, University of Maine AEWC Center, 2008, 2011
John C. Bridge Professorship, University of Maine College of Engineering, 2007-2112
Dean's Award of Excellence, University of Maine College of Engineering, 2005-2006 AY
Civil Engineering Professor of the Year, University of Maine, 2003-2004 AY

8. Service Activities

At the request of the MaineDoT, served on the statewide 2007 committee on bridge safety formed by an executive order of Gov. John Baldacci following the I-35 bridge collapse
Chaired or served on six faculty search committees
Chaired or co-chaired four sessions at international conferences

ASCE Timber Bridge Committee Member (2002-2008)
Reviewer for multiple journals, typically reviewing 6-10 manuscripts per year
Proposal reviewer and panelist for NSF on multiple occasions, NOAA, USDA
External reviewer of tenure and promotion packages for faculty at other institutions

9. Important Publications from Past Five Years

Brayley, K.E., Davids, W.G. and Clapp, J.D. (2012). "Bending Response of Externally Reinforced, Inflatable, Braided Fabric Arches and Beams." *Construction and Building Materials*, 30(2012): 50-58.
Lagaňa, R., Davids, W.G., Muszyński, L., Shaler, S.M. (2011). "Moment-Curvature Analysis of Coupled Bending and Mechano-sorptive Response of Red Spruce Beams." *Wood and Fiber Science*, 43(3): 280-292. (winner of 2012 George Marra Award from SWST and the Markwardt Award from the FPS).
Alvarez-Valencia, D., Dagher, H.J., Davids, W.G. Lopez-Anido, R.A. and Gardner, D.J. (2010). "Structural Performance of Wood Plastic Composite Sheet Piling." *Journal of Materials in Civil Engineering*, 22(12): 1235-1243.
Silva-Henriquez, R., Gray, H., Dagher, H.J. Davids, W.G. and Nader, J. (2010). "Strength Performance of Prestressed GFRP-Glulam Beams." *Forest Products Journal*, 60(1): 33-39.
Davids, W.G., Sandford, T., Ashley, S., DeLano, J. and Lyons, C. (2010). "Behavior of Integral Abutment Bridges with Short Steel Pile-Supported Abutments." *Journal of Bridge Engineering*, 15(1): 32-43.
Davids, W.G. (2009). "In-Plane Load-Deflection Response and Buckling of Inflated Fabric Arches." *Journal of Structural Engineering*, 135(11): 1320-1329.
Davids, W.G., Nagy, E. and Richie, M.C. (2008). "Fatigue Behavior of Composite-Reinforced Glulam Bridge Girders." *Journal of Bridge Engineering*, 13(2): 183-191.

10. Most Recent Professional Development Activities

Attended and gave presentations at 9 international conferences from 2008 – 2012.
Significant consulting activities from 2008-2012 are listed below.
Engineering Analytics, Inc. (2/2012). Conducted expert peer-review of in-house, nonlinear finite-element software for the analysis of pier heave and tension in expansive soils.
Kleinschmidt Energy and Water Resource Consultants (9/2011). Developed and delivered a short course on finite-element analysis for structural engineering staff.
Advanced Infrastructure Technologies (1/2011 – present). Developed methodology and software for the analysis of soil-structure interaction in buried concrete-filled FRP arch bridges that accounts for nonlinear soil stiffness, staged construction, and effect of transverse decking. Serve as senior-level consultant and mentor for young engineering staff.
Kleinschmidt Energy and Water Resource Consultants (6/2010 – 8/2011). Developed MATLAB-based software for the stability analysis of gravity dams. This is general-purpose code used by the firm on a variety of projects for design and regulatory analyses.
Advanced Infrastructure Technologies (3/2010 – 11/2010). Initiated and co-authored draft *AASHTO LRFD Guide Specifications for Design of Concrete-Filled FRP Tubes for Flexure and Axial Members*.

1. Name: Per Erik Garder

2. Education

Ph.D.-degree, Civil Engineering, Lund Institute of Technology, Lund, Sweden, 1982
M.S. in Civil Engineering, Lund Institute of Technology, Lund, Sweden, 1975

3. Academic Experience

Prof., University of Maine, Dept of Civil and Environmental Engineering, 2002 - present
Cooperating Professor, School of Policy and International Affairs, 2010 - present
Assistant/Associate Professor, University of Maine, 1992 - 2002
Head of Department Royal Institute of Technology, 1984 - 1988 and 1989 – 1992
Assoc. Prof., Royal Institute of Technology (KTH), Stockholm, Sweden, 1983 – 1992

4. Non-academic Experience

Only minor consulting and summer employments and internships prior to acad. career.

5. Certification

State of Maine Board of Registration, March 24, 2005: Prof. Engineer No. 10843
Registered Professional Engineer in Sweden since 1975

6. Current Membership in Professional Organizations

Member of the Editorial Advisory Board of Accident Analysis & Prevention
Member on the New England University Transportation Center Policy Committee
Member of the Maine Department of Transportation Research Advisory Board
Member of the Swedish Institute of Transportation Engineers
Member of the Maine Chapter of the Institute of Transportation Engineers
Transportation Research Board Representative of the University of Maine

7. Honors and Awards

The 2002 D. Grant Mickle Award by the Transportation Research Board
Best Paper Award of the TRB Committee on Operational Effects of Geometrics for 2001
Best Paper Award of the TRB Committee on Operational Effects of Geometrics for 1999
The Swedish Inst. of Transportation Engineers' Transportation Excellence Award of 1990

8. Service Activities

Campus Committees: Member of the Campus Security Management Group
Elected Member of SPIA Policy Advisory Committee
Elected member of the Faculty Senate
Member of the Parking and Transportation Committee
Member of Campus Crosswalk Committee
College Committees: Academic Council
Department Committees: Peer Committee
Curriculum Committee
Search Committee for Chair of Civil and Env. Eng.
Search Committee for joint SSI/Water resource faculty position
Search Committee for Hydraulics faculty position

9. Important Publications from Past Five Years

Lars Leden, Per Gårder, Charlotta Johansson and Anna Schirokoff, "Improving child safety on the road network—a future based on ITS?" accepted by *Traffic Engineering and Control*, 2012

Per Gårder, "Fuel Consumption at a Modern Roundabout vs. a Signalized Intersection: A case study comparing two similar intersections in Bangor, Maine." *91st Annual TRB Meeting Compendium of Papers*, 2012

T. Olaf Johnson and Per Gårder, "An Evaluation of the Effects of Different Driver Groups on 1 Control Delay at a Low-Volume Roundabout Approach in Bangor, Maine," *91st Annual TRB Meeting Compendium of Papers,* 2012

Gautam Divekar, Hasmik Mehranian, Matthew R. E. Romoser, Jeffrey W. Muttart, Per Garder, John Collura, Donald L. Fisher, "Predicting Drivers' Route Choices when Given Categorical and Numerical Information on Delays Ahead: The Effect of Age, Experience, and Prior Knowledge," *Transportation Research Record* No. 2248, pp 104-110, 2011

T. Olaf Johnson, Per Gårder, Adam Stern, and Jonathan Rubin, "Driver Age and Safety on Winter Roads," Published in the *90th Annual TRB Meeting Compendium of Papers*, 2011

Adam Stern, Per Gårder, T. Olaf Johnson, and Jonathan Rubin, "Effects of Adverse Winter Weather on Drivers in High Risk Age Groups: Statewide Analysis," Published in the *90th Annual TRB Meeting Compendium of Papers,* 2011

Hongmei Zhou, John N. Ivan, Nicholas E. Lownes, Per E. Gårder, "Differences in Gap Acceptance of Elderly Drivers," Published in the *89th Annual TRB Meeting Compendium of Papers*, 2010

Nathan P. Belz and Per E. Gårder, "Maine Statewide Deployment and Integration of Advanced Traveler Information Systems," *Transportation Research Record* No 2129, pp 16-23, 2009

Jörgen Lundälv, Per Gårder, Ralf Risser , Lars Leden, "Police Cycle-Patrols in Finland: A Qualitative Study Applying the Diamond Model," *the Police Journal*, Volume 81, pp 323-335, 2009

John Collura and Donald Fisher and Per Gårder, "Evaluation of Dynamic Message Signs and their Effects on Older Drivers" New England University Transportation Center, Report UMAR19-12, 2009

John N. Ivan, Per E. Garder, and Adel W. Sadek, "Differences in Gap Acceptance of Elderly Drivers and the Impact on Traffic Simulation Modeling, Final Report: The New England University Transportation Center Report UCNR19-10, 2009

10. Most Recent Professional Development Activities

Participated in Maine Section ASCE meetings; Maine Better Transportation Association meetings; Maine Transportation Conferences in Augusta, Maine; Active Communities Conferences, Administrators and the Responsible Conduct of Research seminar and workshop in the Soderberg Center; "Cost-Benefit Analysis in Road Safety: Selected Issues," 7-hr workshop, sponsored by the standing committee on Transportation Economics (ABE20) on Sunday, January 23, 2011.

1. Name: Shaleen Jain

2. Education

PhD, Civil and Environmental Engineering, Utah State University, 2001
MS, Civil and Environmental Engineering, Utah State University, 1998
BTech, Civil Engineering, Indian Institute of Technology, Bombay, 1993

3. Academic Experience

University of Maine, Assistant Professor of Civil and Environmental Engineering, 2006 - present, Full-time.
University of Colorado at Boulder and NOAA Earth System Research Laboratory
Research Scientist II, 2004-2006, Full-time
Research Scientist I, 2011-2204, Full-time
Visiting Fellow, 2000-2001, Full-time
University of Colorado at Denver
Lecturer, Department of Civil Engineering, 2006, Part-time

4. Non-academic Experience

None.

5. Certification

FE, State of Utah

6. Current Membership in Professional Organizations

American Geophysical Union

7. Honors and Awards

CIRES Visiting Fellowship, University of Colorado
Honorable Mention, Universities Council on Water Resources Dissertation Competition
National Science Foundation CAREER Award
Contributing Author, U.S. National Climate Assessment
Invited Participant, NSF Towards a Science of Sustainability Conference, Warrenton, VA

8. Service Activities

Leadership Team Member, Maine’s Sustainability Solutions Initiative
Faculty Representative, UMaine President’s Council on Disabilities
Member, UMaine College of Engineering Research Council
Associate Editor, Journal of the American Water Resources Association
Proposal Review Panelist for the National Science Foundation
Manuscript Reviewer for Journal of Hydrometeorology, Geophysical Research Letters, ASCE Journal of Hydrologic Engineering, ASCE Journal of Water Resources Planning and Management, Water Resources Research, Environmental Science and Technology, and several others.

9. Important Publications from Past Five Years

Sen Gupta, A., S. Jain, and J.-S. Kim (2011), Past climate, future perspective: An exploratory analysis using climate proxies and drought risk assessment to inform water resources management and policy in Maine, USA. Journal of Environmental Management, 92, 941-947. doi: 10.1016/j.jenvman.2010.10.054

Kim, J.-S., S. Jain, and Y.-I. Moon (2011), Atmospheric teleconnection-based conditional streamflow distributions for the Han River and its sub-watersheds in Korea. International Journal of Climatology. doi: 10.1002/joc.2374

Kim, J.-S., and S. Jain (2011), Precipitation trends over the Korean peninsula: Typhoon-induced changes and a typology to characterize climate-related risk. Environmental Research Letters, 6 034033. doi:10.1088/1748-9326/6/3/034033

Kim, J.-S., S. Jain, and S. A. Norton (2010), Streamflow variability and hydroclimatic change at the Bear Brook Watershed in Maine (BBWM), USA. Environmental Monitoring and Assessment, Volume 171, Numbers 1-4, 47-58, doi: 10.1007/s10661-010-1525-1

Kim, J.-S. and S. Jain (2010), High-resolution streamflow trend analysis applicable to annual decision calendars: A western United States case study. Climatic Change,102, 3-4, 699-707. doi: 10.1007/s10584-010-9933-3

Jain, S., and J. K. Eischeid (2008),What a difference a century makes: Understanding the changing hydrologic regime and storage requirements in the upper Colorado River basin. Geophysical Research Letters, doi: 10.1029/2008GL034715.

10. Most Recent Professional Development Activities

Attendee, Society for Risk Analysis Workshop on Multicriteria Decision Analysis, 2012
Attendee, International Environmetrics Society Workshop on Data Analysis, 2012
Presenter, Maine ASCE Technical Conference, 2012
Co-convener, UMaine Hal Borns Symposium (Climate Change Institute), 2011
Attendee, NSF Science Communication Workshop, 2011

1. Name: Eric N. Landis

2. Education

PhD, Civil Engineering, Northwestern University, 1993
BS, Civil & Environmental Engineering, University of Wisconsin, 1985

3. Academic Experience

University of Maine, Orono, Maine. Frank M. Taylor Distinguished Professor, 2007-present (Asst. Prof. 1994-2000, Assoc. Prof. 2000-2006, Prof. 2006-present, Department Chair 2006-2012)
Université Joseph Fourier, Grenoble, France, Visiting Professor, Summer 2008
Eidgenössische Technische Hochschule (ETH), Zürich, Switzerland. Guest Professor, Jan-June 2005.
École Polytechnique Fédéral de Lausanne (EPFL), Lausanne, Switzerland. Visiting Professor, Summer 1998.
Northwestern University, Evanston, Illinois. Post Doctoral Research Fellow, Center for Advanced Cement-Based Materials.

4. Non-academic Experience

Northwestern Engineering Consultants P.C., Buffalo Grove, Illinois. Staff Engineer for small firm specializing in civil/site work. Prepared plans and specification for a variety of small to medium sized projects. 1985-1989. Full time.
Wisconsin Department of Transportation, Madison, Wisconsin. Engineering Technician. Construction inspection, stake-out, and document review. for large interstate highway reconstruction project. 1984. Full time.

5. Certification

Maine P.E. (#8211)

6. Current Membership in Professional Organizations

American Society of Civil Engineers (ASCE)
American Society for Engineering Education (ASEE)
International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM)
Society for Experimental Mechanics (SEM)

7. Honors and Awards

Carnegie/CASE U.S. Professor of the Year in Maine, 2006.
UMaine College of Engineering “Ashley Campbell Award”, 2006.
Distinguished Maine Professor, 2004.
University of Maine Presidential Outstanding Teaching Award, 2002.
ASCE Zone I Faculty Advisor of the Year, 2002.
UMaine College of Engineering “Early Career Research Award,” 1999.
NSF CAREER Award, 1998.
UMaine College of Engineering “Early Career Teaching Award,” 1998.

UMaine Civil Engineering “Professor of the Year,” 1996, 1999, 2003, 2007.

8. Service Activities

Department Chair, 2006-2012.
Associate Editor, *Advances in Civil Engineering Materials*

9. Important Publications from Past Five Years

C. Poinard, E. Piotrowska, Y. Malécot, L. Daudeville, and E. N. Landis, “Compression triaxial behavior of concrete: The role of mesostructure by analysis of X-ray tomographic images,” *European Journal of Environmental and Civil Engineering* , V. 16, Supplement 1, 2012, pp. S115-s136.
D. Asahina, E. N. Landis, and J. E. Bolander, “Modeling of Phase Interfaces During Pre-Critical Crack Growth in Concrete,” *Cement and Concrete Composites,* V. 33, No. 9, 2011, pp. 966-977.
E. N. Landis and D. T. Keane, “Tutorial Review: X-Ray Microtomography,” *Materials Characterization,* V. 61 No. 12, 2010, pp. 1305-1316.
E. N. Nagy, E. N. Landis, and W. G. Davids, “Acoustic Emission Measurements and Lattice Simulations of Microfracture Events in Spruce,” *Holzforschung*, V. 64, 2010, pp. 455-461.
S. J. Peters, T. S. Rushing, E. N. Landis, and T. K. Commins, “Nano and Micro Cellulose Fibers for Concrete,” *Transportation Research Record,* No. 2142, 2010, pp. 25-28.
E. N. Landis and J. E. Bolander, “Explicit Representation of Physical Processes in Concrete Fracture” *Journal of Physics D: Applied Physics*, V. 42, No. 21, 2009, 17 pp.
E. N. Landis and P. Navi, “Modelling Crack Propagation in Wood and Wood Composites. A Review” *Holzforchung*, V. 63, No. 2, 2009, pp. 150-156.

10. Most Recent Professional Development Activities

Approximately 40 state, national and international scientific and educational conferences and workshops.

1. **Name: Roberto A. Lopez-Anido**

2. **Education**

Ph.D. in Civil Engineering (Structures, Mechanics and Materials), West Virginia University (WVU), Morgantown, WV, 1995.
Degree in Civil Engineering (equivalent to B.S. plus two years of Graduate Studies), National University of Rosario (UNR), Argentina, 1985.

3. **Academic Experience**

University of Maine, Dept. of Civil & Environmental Engineering, Professor, 2009-present, full time. Graduate Coordinator, 2010-present.
University of Maine, Dept. of Civil & Environmental Engineering, Associate Professor, 2004-2009, full time.
University of Maine, Dept. of Civil & Environmental Engineering, Assistant Professor, 1998-2004, full time.
University of Maine, Malcolm G. Long '32 Professor of Civil Engineering, 2008-present.
University of Maine, Advanced Structures and Composites Center, Faculty Member, 1998-present.
Sabbatical Leave, Fulbright Grantee, Universidad de Chile, Institute of Research and Testing of Materials (IDIEM), Santiago, Chile, Spring Semester 2006.
West Virginia University, Constructed Facilities Center (CFC), Department of Civil & Environmental Engineering, Research Assistant Professor, 1995-1998, full-time.
National Council of Scientific Research (CONICET), Institute of Applied Mechanics & Structures, National Univ. of Rosario, Argentina, Research Fellow, 1987-1990, full-time.

4. **Non-academic Experience**

Ingenieria S.R.L. (Structural consulting company), Rosario, Argentina, Structural Engineer, perform structural analysis of high-rise buildings, 1988, part-time.

5. **Certification**

Professional Engineer (P.E.): State of Maine Board of Registration. Reg. No.: 10092.

6. **Current Membership in Professional Organizations**

American Society of Civil Engineers (ASCE), 1993-current.
Society for the Advancement of Materials and Process Engng. (SAMPE), 1994-current.
American Society of Testing and Materials (ASTM), 2003-current.

7. **Honors and Awards**

First Place Outstanding Paper Award. International SAMPE Symposium and Exhibition, Society of Materials and Process Engineering, May 2008.
Fulbright Scholar Award. U.S. Department of State and the J. William Fulbright Foreign Scholarship Board. Visiting Scholar at Universidad de Chile, 2006.
National Science Foundation – CAREER Award. Division of Civil and Mechanical Systems, Directorate for Engineering, Mar. 2001.

Professor of the Year, 2007-2008 ASCE Student Chapter Recognition Award, University of Maine, May 2008.
Professor of the Year, 2004-2005 ASCE Student Chapter Recognition Award, University of Maine, May 2005.
Professor of the Year, 2000-2001, ASCE Student Chapter Recognition Award, University of Maine, May 2001.

8. Service Activities

Member of the Editorial Board of the Journal of ASTM International, Section 1 on Materials Performance and Characterization. 2005-present
Member of the Editorial Review Board of the Journal of Advanced Materials, published by the Society for Advancement of Materials and Process Engineering, 2003-present.

9. Important Publications from Past Five Years

Berube, K.A., Lopez-Anido, R.A., and Caccese, V., "Integrated Monitoring System for Carbon Composite Strands in the Penobscot-Narrows Cable-Stayed Bridge," Transportation Research Record: Journal of the TRB, No. 2050, pp. 177–186, 2008.
U.S. Patent No. 7,416,368. Dagher, H.J., Lopez-Anido, R.A., Gardner, D.J., Dura, M.J., and Stephens, K.L. (Inventors). "Sheet Piling Panels with Elongated Voids." 2008.
Silva-Muñoz, R., and Lopez-Anido, R. "Structural Health Monitoring of Marine Composite Structural Joints using Embedded Fiber Bragg Grating Strain Sensors," Composite Structures, 89(2): 224-234, 2009.
Berube, K.A., and Lopez-Anido R.A. "Variability in the Material Properties of Polymer Matrix Composites for Marine Structures," Journal of ASTM International, 7(4), 18 pp., DOI: 10.1520/JAI102900, 2010.
Alvarez-Valencia, D., Dagher, H.J., Davids, W.G., Lopez-Anido, R.A. and Gardner, D.J. "Structural Performance of Wood Plastic Composite Sheet Piling." Journal of Materials in Civil Engineering, ASCE, 22(12): 1235-1243, 2010.
Tamrakar, S., and Lopez-Anido, R.A. "Effect of strain rate on flexural properties of wood plastic composite sheet pile." Forest Products Journal, 60(5): 465-472, 2010.
Nader, J.W., Dagher, H.J., and Lopez-Anido R. "Size effects on the bending strength of fiber-reinforced polymer matrix composites," Journal of Reinforced Plastics and Composites, 30(4): 309-317, 2011.
Tamrakar, S., and Lopez-Anido, R.A. "Water absorption of wood polypropylene composite sheet piles and its influence on mechanical properties." Construction and Building Materials, 25(10): 3977-3988, 2011.
Tamrakar, S., Lopez-Anido, R.A., Kiziltas, A., and Gardner, D.J. "Time and temperature dependent response of a wood-polypropylene composite." Composites Part A: Applied Science and Manufacturing, 42(7): 834-842, 2011.

10. Most Recent Professional Development Activities

Pre-Standard for Load & Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures, American Society of Civil Engineers (ASCE), 2009-current.
New England Transportation Consortium: Member of the Advisory Committee, 2002-current.

1. **Name: Jean D. MacRae**

2. **Education**

Ph.D. Civil Engineering, University of British Columbia, Vancouver, B.C., Canada, 1997.
M.Sc. Microbiology, University of British Columbia, Vancouver, B.C., 1991.

3. **Academic Experience**

9/06 – present Associate Professor, Department of Civil and Environmental Engineering, University of Maine, graduate coordinator 2007-2010.
4/99 – 6/06 Assistant Professor, Department of Civil and Environmental Engineering, University of Maine.

4. **Non-academic Experience**

Health Canada, Health Protection Branch Western Region, Burnaby, B.C., Canada. Chemist (developing analytical methods, testing samples, designing experiments, grant writing – full time). 1998-1999.
Environment Canada, Aquatic and Atmospheric Sciences Division, Vancouver, B.C. Canada (data analysis, report writing, full time). 1997-1998.

5. **Certification**

N/A

6. **Current Membership in Professional Organizations**

Association of Environmental Engineering and Science Professors
American Society for Microbiology
American Society for Engineering Education
Engineers Without Borders
American Geophysical Union
American Association of University Women

7. **Honors and Awards**

University of Maine College of Engineering 2006 Dean's Award of Excellence
University of Maine College of Engineering 2004 Award for Outstanding Accomplishments in Teaching by Young Faculty
NSF Career Awardee, 2002

8. **Service Activities**

Faculty advisor for UMaine Engineers Without Borders, coordinating student design, fundraising and skills development, creating linkages with the professional community, facilitating development of skills needed to complete sustainable projects that benefit members and partner communities.
Internet Resources Committee for Association of Environmental Engineering and Science Professors: member from 2008 – present, listserv administrator 2008-2011 chair 2011-present

Center for Excellence in Teaching and Assessment Panelist, workshop leader, new faculty mentor and guest speaker
University committees: Distinguished Lecture Series and Cultural Affairs Committee (2000-2010), Advisory Committee for the Green Loan Fund (2006-2010), Advisory committee for the Center for Undergraduate Research (CUGR; 2007-2011), Graduate Board (2007-2010)
Civil and Environmental Engineering Graduate Coordinator (2007 – 2010)
Departmental Committees: Graduate Committee (2007 – present)
Environmental and Water Resources Engineering seminar series coordinator (2006, 2008)
Grant reviewer for NSF, EPA, NIH, DOE and USGS
Peer reviewer for FEMS Microbiology Ecology, Journal of Environmental Engineering, Water Research, Journal of Environmental Engineering and Science, Journal of Soil and Sediment Contamination, FEMS Microbiology Letters
Workshop leader/role model/project supervisor for Expanding Your Horizons (introduces science and engineering career options to middle school girls), Consider Engineering (program to introduce high school students to engineering careers), Upward Bound (program to provide high school students from families without a history of attending University with some experience in a University setting). Also serve regularly as mentor for students doing science fair projects and as science fair judge. Work with local high school teachers and their classes on water related activities.

9. Important Publications from Past Five Years

Lloyd, J.R. Gault, A.G., Hery, M., MacRae, J.D., 2011. Microbial Transformations of Arsenic in the Subsurface. Ch 5 in *Environmental Microbe-Metal Interactions: Advances and Applications*. Pp 77 – 90. J.F. Stolz, R.S. Oremland, eds. ASM Press.

MacRae*, J.D. 2011. Introducing elements of sustainability into formal and informal environmental engineering education. 118th Annual ASEE Conference and Exposition. June 26-29.

MacRae, J.D.*, Anna Springsteen, Firooza Pavri, Abraham Daily, Jong Suk Kim, Shaleen Jain, Andrew S. Reeve, Michael Scott. Sebago Lake, ME – Science to Support Water Quality Management and Education. Poster presented at the Association of Environmental Engineering and Science Professors Biennial meeting, July 10-12, 2011.

MacRae*, J.D., J.-S. Kim, Shaleen Jain. 2010. User-driven data exploration of a managed lake system: first steps toward integrated watershed modeling and management tool in support of decision making and community education. The 6th International Conference on Sustainable Water Environment: Water Infrastructures in Time of Climate Change. University of Delaware, Newark, DE, USA, 29-31 July 2010. (*Invited presentation)

MacRae, J.D., McGuirl, K. 2009. The Picture Project: A Way to Get to Know a Community When Time is Tight. Water Technologies for Emerging Regions (WaTER) Conference, Norman, OK (October 26-27, 2009; oral presenation).

10. Most Recent Professional Development Activities

Mothur bioinformatics workshop (April 23-25, 2012), Detroit, MI
EWB Northeastern regional workshop (Northeastern University, Nov. 6-8, 2009)
EWB Eastern regional workshop (University of Delaware Nov. 7-8, 2008)

1. **Name: William P. Manion**

2. **Education**

M.S. Civil Engineering; Geotechnical, University of Maine. 1992.
B.S. Engineering; Wood Products, Construction and Management. State University of New York. Syracuse, New York. 1989.

3. **Academic Experience**

Instructor: Teaching a variety of Civil Engineering courses in materials, soil mechanics and computer applications. 2000-present.
Laboratory and Facilities Manager: Teaching laboratory courses in materials and soils. University of Maine.1992-2000.
Research Associate: "Use of Tire Chips for road embankment fill". University of Maine. 1990-1992.

4. **Non-academic Experience**

Project Manager: Summer season work for Sargent Corp.. 2011-present.
Field Engineer and Estimator: Working in Virginia and Maryland for Sargent Corp.. 2006-2007.
Boathouse Associates, LLC. Planning, permitting, and developing residential real estate project. Part-time. 2005-present.
Bucks Harbor Marine and self. Charter sailing, Coast Guard licensed captain. Part time. 2006-present.
Apex Engineering and Technologies, SMA Consulting. Networking consultant, designing, implementing, and managing local and internet network projects from workgroup printer sharing to troubleshooting international email routing problems. Part time. 1995-2002.
NewRic Construction Co.. Inc. Project manager, engineering and estimator. Commercial and Industrial estimating. Auburn, New York. 1989-1990.

5. **Certification**

Licensed professional engineer (P.E.) in the State of Maine
Coast Guard licensed US Merchant Marine officer

6. **Current Membership in Professional Organizations**

American Society of Civil Engineers (ASCE) National and Maine Section Member
National ASCE Committee on Student Activities member 2012-present.
Faculty Advisor to the University of Maine Student Chapter 2007-present
American Society of Engineering Education member (ASEE)
City of Old Town technology committee, 1998, Y2K committee chair, 1999.
University of Maine Environmental Health and Safety Committee member, 1995 - 1998
University of Maine Electronic Communication Policy Task Force member, 1998

7. **Honors and Awards**

ASCE Citizen Engineer of the Year, 2010

Civil Engineering Professor of the year 2000, 2002
College of Engineering Dean's award of excellence 2003-2004
University of Maine Professional employee of the year 2000

8. Service Activities

American Society of Civil Engineers Committee on Student Activities (national) member.
American Society of Civil Engineers Maine Section, Engineering Gala committee member.
Faculty advisor to student chapter of ASCE.
Helped one Mechanical Engineering capstone groups with physical testing.
Faculty liason to the Sigma Phi Epsilon fraternity.
Coordinated Materials labs and Soils labs for Eastern Maine Community College students at the University of Maine.
On multiple occasions, provided building science and testing advice to public clients.
Provided testing services through DIC for the Weld Test Center at EMCC

9. Important Publications from Past Five Years

Manion, W.P. (2012). "More substance than software: a combined CADD and construction drawings course," 48th International Conference Proceedings of the Associated Schools of Construction April 10-13, 2012.

Manion, W.P. and Hakola, J. (2012). "Civil Engineering Capstone Consultants: from RFP to Reality," Proceedings of the 2012 ASEE Annual Conference and Exposition. June 10-13, 2012.

10. Most Recent Professional Development Activities

Presented several project management presentations at the Sargent Corporation superintendent and foreman training sessions. Black Bear Inn, Orono. March 5-7, 2012
Maine Transportation Conference in Augusta, Maine. December 1, 2011
American Society of Civil Engineers Workshop for Student Chapter Leaders, Nashville, Tenessee. January 20-21, 2012.
Associated Schools of Construction Annual Conference, Birmingham, England UK, April 11-14, 2012
Maine Better Transportation Association Annual Conference, Augusta, Maine. May 10, 2012
American Society of Engineering Education Annual Conference, San Antonio, Texas. June 10-13 2012

1. **Name: Melissa Landon Maynard**

2. **Education**

   Ph.D. University of Massachusetts, Amherst, Massachusetts - Department of Civil and Environmental Engineering (May 2007) (geotechnical concentration).
   M.S.C.E. University of Massachusetts, Amherst, Massachusetts - Department of Civil and Environmental Engineering (May 2004) (geotechnical concentration).
   B.S.C.E. Lafayette College - Easton, Pennsylvania - Department of Civil and Environmental Engineering (May 2001).

3. **Academic Experience**

   Assistant Professor, Dept. Civil & Environmental Engineering, University of Maine (6/08 – Present; full time)
   Research Associate, University of Massachusetts Amherst (5/07 – 5/08; full time)
   Research Assistant, University of Massachusetts Amherst (9/01 – 5/07 full time)

4. **Non-academic Experience**

   Task Manager, DeepCwind Consortium, University of Maine (2009 - present).
   Managed micrositing, geophysical surveys, and geotechnical investigations and reporting for the University of Maine Deepwater Offshore Wind Test Site, Offshore Monhegan Island, ME.
   Geotechnical Testing Consultant, University of Maine (2010 – present)
   Geotechnical Testing Consultant, Don J. DeGroot, University of Massachusetts Amherst (2005 - 2007)

5. **Certification**

   Fundamentals of Engineering (F.E.): July 2001, Pennsylvania No. ET000963

6. **Current Membership in Professional Organizations**

   American Geophysical Union (AGU) (2009-present)
   American Society of Civil Engineers
      Geo-Institute Member (2007 – Present)
      Associate Member (2007 – Present)
   Tau Beta Pi – Member (2000 - Present)

7. **Honors and Awards**

   2012 ONR-ASEE Summer Faculty Research Program Fellow; Navy Facilities Engineering Services Center (NAVFAC ESC), Port Hueneme, CA; June – August 2012. Research on the potential of geotechnical characterization of offshore soils using non-contact geophysical methods.

8. **Service Activities**

   Maine Tidal Power Initiative (MTPI: www.umaine.edu/mtpi) Member (2009 – present)
   United States Universities Council on Geotechnical Education and Research (USUCGER), Member and University of Maine liaison (7/08 – present).

ASCE Geo-Institute Soil Properties and Modeling Committee Member (2009 - present)
Reviewer: External Ph.D. reviewer for Centre for Offshore Foundation Systems at UWA, Perth, ASCE Journal of Geotechnical & Environmental Engineering, ASTM Geotechnical Testing Journal, OMAE2009, ASCE 2008 GeoCongress

9. Important Publications from Past Five Years

Lo, H.E., **Landon Maynard, M.**, Randolph, M.F., and DeGroot, D.J. (2011) "Geotechnical Characterizing and Engineering Properties of Burswood Clay." *Géotechnique*, 61(7), 575 –591, DOI: 10.1680/geot.9.P.035.
Brothers, L.L., Kelley, J.T**., Landon Maynard, M.**, Belknap, D.F., and Dickson, S.M. (2010). "Development in the Gulf of Maine: Avoiding GeoHazards and Embracing Opportunities." *Maine Policy Review*, 19(1), pp. 46-57.
Landon Maynard, M. and Schneider, J. (2010). "Geotechnics for developing offshore renewable energy infrastructure industries in the US." *2nd Int. Symp. on Frontiers in Offshore Geotechnics (ISFOG)*, University of Western Australia, Perth, Western Australia, 8-10 November.
Landon, M.M., Gaudin, C., and Cassidy, M.J. (2009). "Jack-up installation on an Uneven Seabed: Recommendations from Model Testing in Overconsolidated Clay," *Proc. 28th Int. Conf. Ocean, Offshore and Arctic Engineering (OMAE2009)*, Honolulu, Hawaii, May 31 - June 6.
Landon, M.M., DeGroot, D.J., and Sheahan, T.C. (2007). "Sample Quality Assessment using Shear Wave Velocity for a Marine Clay," *J. of Geotech. and Geoenvironmental Engineering,* ASCE, 133(4), pp. 424-432.

10. Most Recent Professional Development Activities

Co-PI (5% responsibility, $499,348) of the US Dept. of Energy funded DeepCwind: Deepwater Offshore Wind Consortium ($7.1M, 12/2009-12/2011; w/ PI H.J. Dagher). Manager for *Siting, Geophysical & Geotechnical Investigations* project task aimed at characterization of the UMaine Deepwater Offshore Wind Test Site, offshore of Monhegan Island, ME for both engineering and permitting purposes. Assistant to DeepCwind design team for foundation design and initial developer of GIS database of environmental data for Gulf of Maine offshore wind development.
Consultant researcher for foundation system development based on physical modeling of suction caissons and piles (at CU Boulder) for the Ocean Renewable Power Company's (ORPC) full scale fixed seabed TidGen™ tidal turbine to be installed in Cobscook Bay, ME. The ORPC "TidGen™ Power System Commercialization Project", (2011-2013) is funded by US DOE Marine and Hydrokinetic Technology Readiness Advancement Initiative (DE-FOA-0000293).
Member, Maine Tidal Power Initiative (MTPI) at University of Maine, Orono, ME. MTPI is a collaboration between research and industry partners in the fields of engineering, marine sciences and social sciences focused on "evaluation and responsible development of tidal energy resources.

1. **Name: Edwin Nagy**

2. **Education**

   PhD Civil and Environmental Engineering, *University of Maine* (2010)
   M.S. Civil and Environmental Engineering, *University of Maine*, Orono, ME (1998)
   A.B. Mathematics and Physics, *Amherst College*, Amherst, MA (1993)

3. **Academic Experience**

   Instructor, UMaine Department of Civil and Environmental Engineering and UMaine Graduate Faculty (2003-Present). Engineering Graphics, Timber Design, Steel Design, Special Topics in Composite Bridge Design.
   Adjunct Faculty, Northern Arizona University (NAU) Dept. of Civil Engineering (2001-2002).Timber and Masonry Design, Intro. to Structural Analysis.
   Instructor, UMaine Department of Civil and Environmental Engineering (1998) Special Topics in Microtomography and Fracture Mechanics.
   Teaching Assistant, UMaine Dept. of Civil and Environmental Engineering (1995, 1996)
   High School Math Teacher and Volunteer Trainer, Peace Corps, Niger, West Africa (1993-1995)
   Teaching Assistant, Amherst College Departments of Math and Physics (1992-1993)

4. **Non-academic Experience**

   Senior Structural Engineer, Kleinschmidt Associates. Pittsfield, ME (2010-present) Project management for hydro-engineering projects, technical consultant for structural engineering problems, technical and career mentor for junior and mid-level staff including development and presentation of training materials.
   Consulting Structural Engineer, *Private Practice*. Orono, ME (2003-2010) Structural design for new construction and renovations, construction inspection and field investigations. Practice included consulting to UMaine AEWC Center on military and civilian research projects as well as non-University consulting.
   Consulting Structural Engineer, *Shephard-Wesnitzer, Inc*. Flagstaff, AZ (1998-2002) Structural design for new construction and renovations, construction inspections and field investigations. Designed concrete, masonry, timber and steel residential and commercial structures.

5. **Certification**

   Registered Engineer: Arizona No. 37926 (Structural); Maine No. 10211; Member, ASCE, AISC

6. **Current Membership in Professional Organizations**

   American Society of Civil Engineers (ASCE)
   American Institute of Steel Construction (AISC)

7. **Honors and Awards**

   2012 CIE Professor of the Year

8. Service Activities

9. Important Publications from Past Five Years

Parlin, N.J., Davids, W.G., Nagy, E. and Cummins, T. “Dynamic Response of Lightweight Wood-Based Flexible Wall Panels to Blast and Impulse Loading.” *Construction and Building Materials*, Submitted.

Nagy, E.N., E.N. Landis, W.G. Davids (2010). “Acoustic Emission Measurements and Lattice Simulations of Microfracture Events in Spruce.” *Holzforschung*. 64(4): 455-461.

Davids, W.G., Nagy, E. and Richie, M.C. (2008). “Fatigue Behavior of Composite-Reinforced Glulam Bridge Girders.” *Journal of Bridge Engineering*, ASCE 13(2): 183-191.

Fournier, C.R., W.G. Davids, E. Nagy, and E.N. Landis (2007). “Morphological Lattice Models for the Simulation of Softwood Failure and Fracture”. *Holzforschung,* 61(4): 360-366.

Landis, E.N., T. Zhang, E.N. Nagy, G. Nagy, and W.R. Franklin, (2007). “Cracking, Damage and Fracture in Four Dimensions,” *Materials and Structures*, V. 40, No. 4, pp. 357-364.

10. Most Recent Professional Development Activities

RiSE 2012 National Summer Conference: Integrating STEM Education Research into Teaching. University of Maine. Orono, ME. June 20-22, 2012.
Structures Congress 2012. Chicago. March 2012
Leveraging the 2010 AISC Manual. Portland, ME. June 2012
Change in Southern Pine Design Values. Online (WoodWorks). June 2012
Hydrovision 2011. Sacramento. July 2011

1. Thomas C. Sandford

2. Education

B.S. in C.E., MIT, 1965
M.S. in C.E., MIT, 1967
Ph.D. in C.E., University of Illinois, 1976

3. Academic Experience

9/87 – present Associate Professor, Department of Civil and Environmental Engineering, University of Maine.
9/81 – 8/87 Assistant Professor, Department of Civil and Environmental Engineering, University of Maine.

4. Non-academic Experience

1979 – 1981 Sr. Geotech Engr. – Tippets-Abbett-McCarthy-Stratton.
Tarbela Dam, Pakistan. Evaluation of right abutment seepage and related gypsum dissolution, as well as grouting.
1976 – 1979 Geotech Engr. – Tippets-Abbett-McCarthy-Stratton.
Botswana. Resident project engineer for 50-km Gabarone-Molepolole Road with three bridges.
1970 – 1973 Geotech Eng. – Tippets-Abbett-McCarthy-Stratton.
New York City. Design and construction supervision of piling foundations, dams, cellular cofferdams, and underpinning.
1971 – 1972 Instructor – Rutgers Univ. Sch. of Cont. Engr. Education.
Teaching construction cost estimating.
1967 – 1970 Project Cost Eng. – Esso Research And Eng. Florham Park, N.J. Preparation of cost estimates for refinery construction.

5. Certification

P.E. New Jersey (1970- 2003), Maine (since 1982)

6. Current Membership in Professional Organizations

Member, American Society of Civil Engineers
Member, Int'l Soc of Soil Mech & Fdn Eng
Member, Chi Epsilon, Phi Kappa Phi, Sigma Xi

7. Honors and Awards

2008, "Dean of Engineering Award" Special Service to College

8. Service Activities

General Education Committee, Faculty Senate, chair 2011-2012, member 2010-2011
Presentation on "Modeling of Slope Stability" at Maine DEP Conference, 2011
Renewable Energy Minor Committee, member, 2011
Design-Build Grading Comm, Veteran's Mem Bridge, MaineDOT, member 2010
Design-Build Grading Comm, Sibley Pond Bridge, MaineDOT, member 2010

Maine Geological survey, Analysis & advice for landslides, 2009
Academic Affairs Budget Advisory Team, member, UMaine, 2008-2009
TRB AFS20 Committee (Soils & Rock Instrumentation), Member, 2008
Civil Engineering Geotechnical Assistant professor search, chair, 2008
TRB AFS20 Committee (Soils & Rock Instrumentation), Member, 2007
Award Committee, member, American Consulting Engineers Council, 2007
Paper reviews (number reviewed in parentheses): Transportation Research Board (12), Maine Geological Survey (1), Canadian Geot Jnl (2), Eng Geoscience Jnl (1)
Faculty Senator, Member from the Engineering College from Sept. 2010 to present
University of Maine Chess Club, Faculty Advisor from Sept. 1997 to present
Chi Epsilon (Civil Engineering Honor Society), Faculty Advisor, from Sept. 1997

9. Important Publications from Past Five Years

Sandford, T. C., McCarthy, J., and Bussiere, J. (2011) “Development of Supplemental Resistance Method for the Design of Drilled Shaft Rock Sockets,”, NETC 05-1, 31 March 2011, for the New England Transportation Consortium (NETC), 164 pp.
Davids, W. G., Sandford, T. C., Ashley, S., DeLano, J. and Lyons, C. (2010), "Field Measured Response of Integral Abutment Bridges with Short Steel H-Piles, Journal of Bridge Engineering, American Society of Civil Engineers, vol. 15, No. 1 , pp. 32-43.
Sikora, L. J. and Sandford, T. C, (2009) “Strength of a lime-treated fine-grained soil in Maine subject to frost,” , for University of Maine Cooperative Extension, Orono, Maine, 40 pp.
Davids, W. G., Sandford, T. C., Ashley, S., DeLano, J., and Lyons, C. (2008), "Field-Measured Response of an Integral Abutment Bridge with Short Steel H-Piles," International Bridge Conference, Pittsburgh, PA, June 2-4, 2008.
Sandford, T. C., Humphrey, D. N., and Kingsbury, D. (2006), “Effect of Insulation on the Performance of a Soil-Nailed Wall in Frost-Susceptible Conditions,” 13th International Conference on Cold Regions Engineering, Jul 23-26, 2006, Orono, ME, Paper No. 14223, 10 pp
Sandford, T. C., Davids, W. G., Hartt, S. L., and DeLano, J. G. (2006), “Construction-Induced Stresses in H-Piles Supporting an Integral Abutment Bridge,” Transportation Research Record No. 1975, pp 39-48.

10. Most Recent Professional Development Activities

Dec 2011, One Day, MaineDOT Conference
Oct 2011, Two Day, Deep Found Inst 36th Annual Conference, Boston MA
Sep 2011, Two Day, 52nd Annual Conf of NE States Geotech Eng, Portland
Mar 2011, One Day, Shoreline Stabilization, MaineDEP
Dec 2009, One day conference, MaineDOT Conference
Dec 2008, One day conference, MaineDOT Conference
Mar 2008, One day ASCE Technical Seminar
Jan 2007, Five day TRB Annual Conference
Dec 2006, One day, MaineDOT Conference
Jul 2006, Three day, 13th Int’l Conf on Cold Regions Engineering, Orono

1. **Name: Qingping Zou**

2. **Education**

   Ph.D Physical Oceanography, University of California, San Diego. 1995.
   B.S. Physics, Nanjing University. 1986.

3. **Academic Experience**

   Assistant Professor, Department of Civil and Environmental Engineering, The University of Maine, 2011-present.
   Reader (US equiv. of Full/Assoc. Prof.), School of Marine Science and Eng., University of Plymouth. 2009-2011.
   Senior Lecturer (US equiv. of Assoc. Prof.), School of Marine Science and Eng., University of Plymouth. 2007-2009
   Lecturer (US equiv. of Assist. Prof.), School of Marine Science and Eng., University of Plymouth. 2004-2007.
   Visiting Research Scientist, Bedford Institute of Oceanography. 2003-2004.
   Research Associate, Dept. of Oceanography, Dalhousie University. 1997-2002.
   Guest Investigator, Dept. of Applied Phys. & Eng., MIT-Woods Hole Oceanographic Institution. 2000.
   Postdoctoral Researcher, Dept. of Earth and Planetary Sciences, Johns Hopkins University. 1995-1997.

4. **Non-academic Experience**

   N/A

5. **Certification**

   N/A

6. **Current Membership in Professional Organizations**

   N/A

7. **Honors and Awards**

   K.C. Wong Award, K. C. Wong Education Foundation, Hong Kong. 2006.
   Postdoctoral Scholarship, U.S. Office of Naval Research. 1997-2002.
   Postdoctoral Scholarship, U.S. Office of Naval Research. 1995-1997.
   GFD Fellowship, MIT-Woods Hole Oceanographic Institution.1992.

8. **Service Activities**

   N/A

9. **Important Publications from Past Five Years**

   Zhang, Y.L., **Zou, Q.-P**., Greaves, D. 2012. "An investigation of hydrodynamic characteristics of an oscillating water column device using a two-phase flow model." *Renewable Energy*, Vol. 41, Pages 159–170 (10.1016/j.renene.2011.10.011)

Vandamme, J., **Q.-P. Zou**, & E. Ellis, 2012: "A novel particle method for episodic collapse of coastal cliffs", *Geomorphology*, Vol 138, Issue 1, Pages 295–305.

Gonzalez-Santamaria, R., **Q.-P. Zou**, & S. Pan, 2011: "Two-way coupled wave and tide modelling of a wave farm", *Journal of Coastal Research*, SI 64, 1038 -1042, (ISSN 0749-0208)

Lv, X., **Q.-P. Zou**, & D. E. Reeve 2011: "Numerical Simulation of Overflow at Vertical Weirs Using an Accurate Hybrid Free Surface Flow Model", *Advances in Water Resources*, Vol 11, No 1, Pages 215-248.

Zou, Q.-P. 2011: Generation, transformation and scattering of long waves induced by a short-wave group over finite topography, *Journal of Physical Oceanography*, (doi: 10.1175/2011JPO4511.1)

Vandamme, J., **Zou, Q.-P.** , Reeve, D. E. 2011. "Modelling floating object entry and exit using Smooth Particle Hydrodynamics." *J Waterway, Port, Coastal and Ocean Engineering*, (doi:10.1061/(ASCE)WW.1943-5460.0000086)

Peng, Z. **Zou, Q.-P.** 2011. " Spatial distribution of wave overtopping water behind coastal structures." *Coastal Engineering*, (doi: 10.1016/j.coastaleng. 2011.01.010).

Zou, Q.-P., Peng, Z. 2011. " Evolution of wave shape over a Low-crested Structure." *Coastal Engineering*, (doi: 10.1016/j.coastaleng. 2011.01.00).

Zhang, Y.L., **Q.-P. Zou** and D. Greaves, D. Reeve, A. Hunt-Raby, D. Graham, P. James and X. Lv 2010: "A level set immersed boundary method for water entry and exit.", *Communications in Computational Physics*, Vol 8, No. 2, pages 265-288, (doi: 10.4208/cicp.060709.060110a).

Lv, X., **Zou, Q.-P.**, Zhao, Y. & Reeve, D.E. 2010. " A Novel Coupled Level Set and Volume of Fluid Method for Sharp Interface Capturing on 3D Tetrahedral Grids", *Journal of Computational Physics,* Volume 229, Issue 7, Pages 2573-2604, (doi:10.1016/j.jcp.2009.12.005)

Zhang, Y.L., **Zou, Q.-P**., Greaves, D., Reeve, D., Hunt-Raby, A., Graham, D., James, P., Lv, X. 2010. "A level set immersed boundary method for water entry and exit." *Communications in Computational Physics,* Vol. 8, No. 2, pp. 265-288, (doi: 10.4208/cicp.060709.060110a).

Pedrozo-Acuna, A., A. Torres-Freyermuth, **Q.-P. Zou**, T.-J. Hsu, D. E. Reeve 2010: Diagnostic investigation of impulsive pressures induced by plunging breakers impinging on gravel beaches, *Coastal Engineering*, Vol. 57, Issue 3, Pages 252-266, doi:10.1016/j.coastaleng.2009.09.010

Wang, Z.Y., **Q.-P. Zou**, & D. E. Reeve 2009. "Simulation of spilling breaking waves using a two phase flow CFD model", *Computers & Fluids,* Vol. 38, Issue 10,1995-2005, (doi:10.1016/j.compfluid.2009.06.006)

10. Most Recent Professional Development Activities

N/A

UMaine Civil Engineering Association 2011-12

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Jeff Andrews, PE	TY Lin International 12 Northbrook Drive Bldg A, Suite One Falmouth, ME 04105	207-347-4330 Office 207-415-1692 Cell	jeffrey.andrews@tylin.com
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William A. Scott, PE	Maine Drilling and Blasting 423 Brunswick Ave Gardiner, ME 04345	207-582-2338 Office 207-624-2955	bscott@mdandb.com
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Appendix C - Equipment

Name	Equipment
Boardman 1 CIE Student Work Room	4 Pentium 3.20 GHz networked engineering workstations with installed engineering applications, HP Laserjet 2200dtn black and white printer, HP 2500CM 11-in.x17-in. color inkjet printer, HP DesignJet 600 black and white plotter
Boardman 6 Adv. Geotechnical	2 Brainard Kilman air actuated consolidometers and cells 2 Consolidation lathes 1 Triaxial specimen lathe 1Triaxial compression frame 3 Triaxial cells for sample diameters up to 2.8 in. 1 Triaxial cell for sample diameters up to 4 in. 1 Triaxial sample trimming frame 3 Harvard miniature compaction devices 3 automated computer controlled direct shear devices 3 direct shear boxes 4 automated computer controlled load frames for triaxial compression and 1D consolidation testing 4 back pressure consolidation cells 1 automated and computer controlled stress-path triaxial load frame 1 automated and computer controlled direct simple shear device 1 fall cone undrained strength index test device 1 laboratory vane shear device 1 1D soil swelling cell 1 Vacuum pump 2 Water deaerators 1 Muffle furnace 2 specific gravity pychnometers

Boardman 8 Materials Lab	Baldwin Universal Loading Device (300 kip capacity) w/Instron computer interface and electronic extensometer. (Controller replaced in 2005). Instron 4400R universal testing machine (10 kip capacity) with computer interface Instron 4485 universal testing machine (40 kip capacity) with computer interface 2 Instron electronic extensometers Mechanical extensometer Concrete cylinder strain device and several sets of testing caps 2 Schmidt hammers 3 PC computers on carts Assorted hand tools and measurement equipment
Boardman 9 Soils Lab	4 manual direct shear devices 4 Unconfined compression devices 2 Ovens 1 maximum-minimum density apparatus and associated specimen chambers 4 Electronic balances 4 Permeability testing devices 4 Atterberg limit devices 4 Brainard Kilman air actuated consolidometers 100 (approx.) 8-in. diameter sieves 6 Moisture density devices 4 Field density devices 30 assorted dial gages Vacuum pump Shelby tube extrusion setup Soiltest Versatester universal testing machine Microwave oven 4 PC laptop Computers Attached constant humidity room Assorted small soil testing equipment
Boardman 15 & 17 Woodard Environmental Lab	Two fume hoods, 2 Spectronics spectrophotometers, 1 digital balance, 1 digital analytical balance, 1 drying oven, 1 muffle furnace, 1 refrigerator, 2 pH meters and probes, 2 jar test mixers, 1 Hach turbidimeter, 1 Hellige turbidimeter, 1 Hellige colorimeter, 1 COD digestion heater block and spec, 1 BOD meter, 2 peristaltic pumps, glass columns, and glassware, 4 magnetic stirrers, dessicators.

Boardman 18 Concrete Lab	2 3-cubic foot capacity concrete mixers 1 small capacity concrete mixer Concrete vibrator 1 Volumetric concrete air meter 2 Type B Pressure concrete air meter 2 ovens Fairbanks Morse 200 lb scale Gilson large screen sieve shaker with sieves 2 Gilson 8-inch diameter sieve shakers Aggregate storage bins Assorted small equipment for concrete testing
Boardman 26 Environmental Lab	Ice maker, Nikon phase contrast/fluorescence microscope, transilluminator, Kodak camera and gel documentation system
Boardman 29+32 Env. Microbiology	2 fume hoods, thermal cycler, bead beater, microcentrifuge, protein and DNA gel boxes and power packs, top loading digital balance, digital analytical balance, water baths and shakers, 2 refrigerators (one in rm. 32), freezers (-20 °C and -80°C in room 32), heating and cooling incubator (rm. 32), floor model refrigerated centrifuge (room 32), magnetic stirrer, vortex mixer, microwave oven, desiccator, organic extraction glassware, standard labware, autoclave, RO/UF water purification system.
Boardman 30 Environmental Lab	BOD incubator, HP gas chromatograph with autosampler and FID/ photoionization/ECD (organics), GOW MAC 600 gas chromatograph with TCD, air generator.
Boardman 40/46 Env. Chemistry	Two fume hoods; Metrohm voltametric analyzer, Perkin Elmer flame atomic absorption spectrometer, OI Analytical total carbon analyzer, Anaerobic glovebag, Autoburette and pH-stat equipment, Carey (Varian) Diode array UV spectrophotometer, Rayonett-RMR 100 irradiation chamber reactor, two pH electrodes and meters, three dessicators, Mettler digital analytical balance, convection oven, two refrigerators, glass column apparatus, standard labware
Boardman 116 Hydraulics	Flume (Engineering Design Lab) 2 Hydraulics Benches (Technovate) Scott Pipe Network
Engineering Computer Lab (218 Boardman)	12 Pentium 3.20 GHz networked engineering workstations with installed engineering applications, Hewlett Packard 5si Laser Printer, shared between Civil and Mechanical Engineering
Computer Cluster (118 Boardman)	15 Pentium networked computers with installed MS Office, Internet communications, MathCAD, and Microstation applications. 1 SVGA projector with screen Hewlett Packard 8150 laser printer

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Civil Engineering Program at the University of Maine 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.*

Dana N. Humphrey, Ph.D., P.E.
Dean, College of Engineering
University of Maine

Signature

6/26/2012
Date