ABET
Self-Study Report

for the
Civil Engineering
Program

at
University of Utah
College of Engineering
Salt Lake City, Utah

July 1, 2015

CONFIDENTIAL

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BACKGROUND INFORMATION

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B. Program History

The University of Utah (U of U) was founded in 1850 and is the State of Utah’s flagship university. The U of U is a member of the Pac-12 Conference. The 1,500-acre campus is located in Salt Lake City at the base of the Wasatch mountain range. It serves more than 32,000 students from across the United States and the world. Offering more than 100 undergraduate majors and more than 90 graduate degree programs, including medicine, engineering and law; the university prepares students to live and excel in the global workplace.

The Civil Engineering Program at the University of Utah was founded in 1891. Shortly thereafter, it was combined with Mining Engineering to form the Civil and Mining Engineering Program. In 1903, the Department of Civil Engineering was founded. It received its Civil Engineering ECPD accreditation in 1936, the first year for this accreditation. From WWII through the 1960s, the Program had a strong national reputation, but there was a subsequent decline which affected the long-term standing of the Department. Unfortunately, in the early 1990s, as a result of a change in leadership in the College of Engineering (COE), a motion was brought forth for the possible closure of the Civil Engineering Program at the University. Nevertheless, due to pressure from concerned state and regional civil engineering leaders (e.g., ASCE, Utah Association of Professional Engineers, etc.), the Program was continued under new leadership at both the College and Departmental level. Professor Lawrence Reaveley, served as department chair of the Civil and Environmental Engineering (CVEEN) Department from 1993 until 2006. Following this, Dr. Paul J. Tikalsky served as the department chair from 2007 until the summer term of 2012. During the 2012 academic year, the Department was under the leadership of interim chair Dr. Chris Pantelides as a search was performed for a new
departmental head. From then until present, Dr. Michael Barber has served as the department chair.

Currently, the CVEEN program at the University of Utah is undergoing continued and moderate growth with the relatively recent hiring of a diverse faculty (http://www.civil.utah.edu/). CVEEN graduates receive training in several technical disciplines (e.g., structures, geotechnical, transportation, engineering materials, water resources, and environmental engineering), as well as professional communications and project management. They have opportunities to seek advanced degrees or additional training in engineering, law, business, or medicine.

During this ABET review cycle, several new full-time faculty have joined CVEEN. These include: Dr. Araree Lintereur (Nuclear Faculty), Dr. Luther McDonald (Nuclear Faculty), Dr. Haori Yang (Nuclear Faculty), Dr. Joshua Lenart (CLEAR Program Instructor), Dr. Douglas Schmucker (Lecturer), Dr. Cathy Liu (Transportation Faculty), Dr. Daniel Fagnant (Transportation Faculty), Dr. Amanda Bordelon (Materials Faculty), Dr. Otakuye Conroy-Ben (Environmental Faculty), Dr. Luis Ibarra (Structures Faculty), Dr. Tatjana Jevremovic (Nuclear Faculty).

The following full-time faculty have left CVEEN during this review cycle: Dr. Paul Tikalsky (Structures/Materials), Dr. Lawrence Reaveley (Structures Faculty – Emeritus Professor currently), Dr. Kevin Wong (Structures Faculty), Dr. Peter Martin (Transportation Faculty), Dr. Xuesong Zhou (Transportation Faculty), Dr. Torch Elliot (Lecturer), Dr. Haori Yang (Nuclear Faculty) and Dr. Otakuye Conroy-Ben (Environmental Faculty).

The following staff members have left CVEEN during this review cycle: Janice Sherwood (Administrative Officer), Amanda May (Undergraduate Academic Program Specialist), Amy Van Roosendaal (Program Assistant), Diana Hanson (Executive Secretary of Utah Traffic Lab) and Andrea Gallegos (Administrative Program Coordinator).

The following administrative staff have joined CVEEN or have changed administrative positions during this cycle: Ashley Arpero (Administrative Program Coordinator), Alexi Crabb (Undergraduate Academic Advisor), Bonnie Ogden (Graduate Academic Advisor).

In addition, Dr. Steven Bartlett has replaced Dr. Torch Elliot as the ABET coordinator and as the Chair of the Undergraduate Committee in 2013. At this time, Dr. Pedro Romero also replaced Dr. Torch Elliot as the Director of Undergraduate studies.

Since the last ABET visit, the curriculum of CVEEN has remained relatively stable with minor changes to courses and course offerings. The most notable items are listed below:

- CVEEN 3320 (Concrete and Steel I) was separated into separate 3-semester hour courses. The new courses CVEEN 4221 (Concrete Design I) and CVEEN 4222 (Steel Design I) were also removed from the list of courses required for all CVEEN undergraduate students. Currently, these courses are listed as 4000-level technical electives within the CVEEN handbook (Section 4B2di).
• Additional basic science courses were recommended by faculty and added to the CVEEN handbook to fulfill the ASCE Program criteria of an additional basic science course. These additions were made during fall semester 2012. The list of recommended basic science courses can be found in Section 4B2dvi.

• The COE has initiated a new math sequence for engineering majors and CVEEN adopted this sequence during fall semester 2013. The new sequence is: Math 1310 (Calc. I), Math 1320 (Calc. II), Math 2250 (Calc. III w/ ODEs), Math 3140 (Vector Calc. and PDEs). The COE math sequence replaces the previous sequence of: Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III) and Math 2250 (ODEs) (Sections Background C8 and 4B2dix).

• In summer 2014, the COE removed Communication, Leadership, Ethics and Research (CLEAR) instructional support for CVEEN 1000 (Introduction to Civil and Environmental Engineering) and CVEEN 4910 (Professional Practice and Design). Prior to this, these courses had been co-taught by one CVEEN and two CLEAR instructors and one CVEEN graduate teaching assistant. Currently, these courses are being taught by one CVEEN instructor with the assistance of one graduate teaching assistant. Some modification to the course content and delivery have been necessary due to these changes. Further, CVEEN 3100 (Technical Communication) is currently being taught by a CLEAR instructor dedicated to the CVEEN program with input and guidance from CVEEN (Sections Background C2 and C3, and 4B2dxi and 4B2dxii).

• In the 2014 fall semester faculty retreat, the College of Engineering made the recommendation that CVEEN and other COE departments consider removing the requirement of passing of the F.E. exam as a requirement for graduation for their respective programs. The recommendation was approved by CVEEN faculty and the revised policy is: “The Department faculty considers the passing of the FE exam to be an important step in an individual’s progress towards professional practice. The faculty also considers the passing of this exam as a demonstration of the quality of the basic engineering capabilities of each student. The Department highly encourages students to take the exam prior to graduation, as it is an important step for a career in civil engineering. Students are encouraged to attend the College of Engineering FE review sessions and take the Department’s Engineering Economics, Statics, Strengths of Materials, the Junior level civil courses prior to taking the test (2014-16 CVEEN handbook).” (See also Section 4B2bii).

• In spring semester 2015, the faculty approved the splitting of the 4-semester hour course CVEEN 2130 (Statistics and Economics) into two separate courses. As currently constituted, each of these topics is taught during one block (i.e., during one-half of the semester). However, the two new courses consist of 2-semester hours each, and will be taught for the full duration of the semester. This change will be implemented during the 2015-2016 academic year.
C. Options

The CVEEN Program provides a general civil and environmental engineering degree at the undergraduate level with the option to focus on technical electives from discipline areas offered by the Department. These areas include: structural, water resources, environmental, transportation, geotechnical and construction materials and engineering management (http://www.civil.utah.edu/disciplines). An additional construction engineering discipline is under development by CVEEN, but staffing, curriculum and implementation details have not been completed as of summer 2015.

The following describes some of the options and programs that support the CVEEN curriculum.

1. COE CLEAR Program

The CLEAR Program (Communication Leadership, Ethics, and Research) began as an interdisciplinary endeavor between the Colleges of Humanities and Engineering and was designed to enhance undergraduate engineering education by equipping students with the necessary professional skills (oral and written communication, teamwork, and ethics) to be effective in the workplace. Engineers are uniquely positioned to be leaders in industry, politics, and education because their decisions influence medical technologies, transportation systems, and the structures within which members of society live and work. In other words, engineering decisions affect society as a whole, and as such, engineering education must encompass more than a strictly technical focus.

The CLEAR Program was developed in response to this need. Its objectives are to ensure that engineering graduates can communicate clearly in both oral and written form, participate on teams productively, recognize ramifications of decisions they will make in the global marketplace, and develop a sophisticated understanding of ethical dilemmas which regularly follow engineering industry trends. The CLEAR Program is unique and innovative due to its: (1) emphasis on speaking, writing, teamwork, and ethics, (2) integrated professional skills instruction, and (3) situated, developmental approach to teaching and learning. In short, engineering undergraduates at the University of Utah are continually exposed to communication and ethics throughout their engineering training. As a result, students are better prepared for the transition from the university to the workplace.

While program objectives remain unchanged, the pedagogical practices of how to accomplish these objectives in the best way have undergone significant revisions over the last two years. In the original implementation, graduate students from the University Writing Program and the Department of Communications partnered with designated engineering faculty in select courses to provide direct classroom instruction, student feedback, and consult on best practices for speaking, writing, and teamwork.

Based on student and departmental feedback, the Program has been successful. Nevertheless, there have been ongoing discussions about how to ensure continuous improvement. Thus, program changes have been implemented in response to the following observations:
• The number and type of courses that CLEAR teaching assistants (TAs) participated in differed from Department to Department. From the College of Engineering’s perspective, this complicated college-wide assessment of the Program.

• Each TA participated in the CLEAR Program for only one or two years. This created continuity issues, particularly in the manner in which TAs interacted with students and engineering faculty.

• College of Engineering faculty were often listed as the only instructors of record for these classes. To some students, this gave the impression that the engineering topics were more important than the communication or ethics topics in any given class.

• Industry representatives offered graduate satisfaction feedback that credited graduates with improved technical communications skills, yet noted that they would benefit from additional assistance in improving their job search interactions.

To address these concerns, the College of Engineering is changing the way CLEAR operates and encouraging Departments to adopt a new model for the CLEAR Program. For this model, the College has hired permanent associate instructors who are experts in communications and extremely knowledgeable about engineering-related fields and industries. For their part, Departments have been asked to create stand-alone 3 credit hour technical communications courses that have a CLEAR instructor as the sole instructor of record. By virtue of having semester long classes devoted to this topic, instructors can teach not only oral and written communications and ethics issues in the context of engineering, but also topics related to email, resume, cover letter, and memoranda writing, as well as interviewing skills. Because CLEAR instructors are now instructors of record for the classes they teach, students recognize the importance of technical communication to their engineering education. During the transition to the new model, programs have been offered teaching assistance in whatever form best fits departmental needs.

2. CLEAR in CVEEN (2004 – 2014)

Emphasis by alumni and by the CVEEN significantly influenced how the CLEAR program was implemented within CVEEN. CLEAR consultants from the College of Humanities started working with CVEEN in fall semester 2003. With their help, CVEEN had CVEEN 3100 approved as meeting the University’s upper-division writing requirement in spring semester 2004. This allowed CVEEN to tailor the communications requirements of this course so that they were representative of communications performed by practicing engineers. In addition, the development of teamwork skills was greatly enhanced.

At this time (2004), the courses supported by CLEAR (CVEEN 1000, CVEEN 3100, and CVEEN 4910) were recognized as important courses for student learning related to professional criteria (e.g., student outcome 1). Therefore, the decision was made to require all students, including transfer students, to take and complete CVEEN 3100.

CVEEN 1000 is an introductory course to the CVEEN program. The students do most of their assignments as members of teams. Although they do not have the tools that are necessary for engineering design, they are placed in role-playing design experiences that show them that by
teamwork and using their common sense, they can achieve. This is done in conjunction with introducing them to the disciplines of civil engineering.

CVEEN 3100, Technical Communication for Engineers, meets the University’s requirements for an upper-division communications/writing designated course. The course teaches upper division communications skills in the context of documents and presentations that are most meaningful to a practicing civil engineer. Many of the students in the CVEEN 3100 classes have already completed CVEEN 1000. They become leaders and mentors in working with transfer students as they expand their communications and teamwork skills, and apply them as potential future civil engineers.

CVEEN 4910, Professional Practice and Design, is the final course that is in part supported by the CLEAR program. All students entering this course have successfully completed CVEEN 3100. Many have the further professional depth provided by the CVEEN 1000 course taken within the CVEEN program. The sequencing of these three courses, standards and mentoring, coupled with the knowledge gained in the technical 3000-level courses have instilled confidence and an expanding perspective within the students. CVEEN 4910, which is the capstone course synthesizes this training. As a result of this latter course, the students are poised to become effective civil engineers and contribute to society as educated, licensed professionals and leaders.

3. CLEAR in CVEEN (post 2014)

After the 2014 academic year, the College of Engineering restructured the CLEAR program. It was decided to remove CLEAR support from the instruction of CVEEN 1000 and CVEEN 4910. As a result, the curriculum and the student outcomes addressed by these two courses was restructured. In the case of CVEEN 4910, it was decide to include more design content in the course work by the CVEEN instructors. This was done because of two reasons: (1) more design content could be added because some of the writing and presentation exercises sponsored by the CLEAR instructors was reduced, (2) student feedback from the exit interviews suggest that there was some overlap between the content of CVEEN 3100 (technical communication) and CVEEN 4910. This duplication has been eliminated.

4. Utah Nuclear Engineering Program

Students pursuing a B.S. degree in Civil Engineering have the opportunity to complete a minor in Nuclear Engineering from the Utah Nuclear Engineering Program (UNEP). A UNEP minor in Nuclear Engineering requires the courses shown in the table below and a cumulative GPA of 2.85 or higher, and a minor GPA of 3.30, or higher. The elective courses may be selected either from the list of UNEP courses, or from CVEEN department major courses approved by the UNEP Director. Additional information may be found at http://www.nuclear.utah.edu/minor.

In addition CVEEN students not seeking a Nuclear Engineering minor may take NUCL 3100 and NUCL 4000 as technical elective in the CVEEN program.
5. **FASTRAX Program**

The FASTRAX program is an undergraduate research track that allows undergraduate students with an Engineering GPA of 3.2 or higher to start working on their Master’s degree (Research Track) during their senior year of their B.S. degree. Through the FASTRAX program, most students can complete their MS degree with one additional year of full-time study beyond the BS degree (including a summer term). Students who have an Engineering GPA of 3.2 or higher are welcome to apply to the FASTRAX program. Students should apply during the second semester of their Junior year (usually spring semester). Students need to complete the FASTRAX Application and have 3 letters of recommendation, one of these must be from the supervising faculty who will assist with the completion of the M.S. degree. FASTRAX students are required to take 5 technical electives, instead of 6 at the undergraduate level, and complete a graduate level course (i.e., 6000-level or higher) that will be applied toward their M.S. degree ([http://www.civil.utah.edu/fastrax](http://www.civil.utah.edu/fastrax)). A flowchart for the FASTRAX program is given below.

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<th>Course Number (Semester Offered)</th>
<th>Credit Hours</th>
<th>Course Title</th>
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<td>Nuclear Principles in Engineering and Science</td>
</tr>
<tr>
<td>NUCL 3100 (Spring)</td>
<td>3</td>
<td>Neutron-Based Engineering</td>
</tr>
<tr>
<td>NUCL 3200 (Spring)</td>
<td>3</td>
<td>Radiochemistry with Laboratory I</td>
</tr>
<tr>
<td>NUCL 4000 (Fall/Spring)</td>
<td>3</td>
<td>Nuclear Science and Engineering using TRIGA</td>
</tr>
<tr>
<td>NUCL 5999</td>
<td>2</td>
<td>UNEP Seminar (complete 2 times)</td>
</tr>
</tbody>
</table>

*Two 3-credit Elective Courses*
Students enrolled in the FASTRAX program often complete an independent study course in preparation for developing a thesis topics at the M.S. level. This course replaces a non-design technical elective in the CVEEN program and the student is supervised by a faculty member. The final report or deliverable for the course is submitted for approved by the supervising faculty member and the Director of Graduate Studies (http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/fastrax_is.pdf.)

6. Graduate Courses Taken As Undergraduate

CVEEN allows undergraduates to take 6000-level graduate courses to fulfill the Department’s undergraduate technical elective requirements. The following requirements are placed on students wishing to complete this option.

- A minimum GPA of 3.20 is required
- Instructor permission to enroll
- Petition must be filed and approved by the CVEEN undergraduate committee.
- All CVEEN undergraduate requirements must be met, include requirement for courses with significant design content.

The form required for this process is found at:
7. E-LEAP Program

CVEEN also participates in the E-LEAP is a two semester course sequence that is available to all COE engineering students (http://leap.utah.edu/program-options/). The seminar is offered in a small classroom setting where students can benefit from the guidance of a faculty advisor and a peer advisor. Students are provided the opportunity to network with other COE engineering students and form study groups. All CVEEN students are required to take both E-LEAP courses (LEAP 1101 in the fall semester and LEAP 1100 in the spring semester). Transfer students to CVEEN who receive intermediate or major status, or who already have 2 Humanities or Social Behavior Science courses, or have 1 course from each of these, do not have to enroll in the E-LEAP sequence (http://leap.utah.edu/program-options/eleap.php).

8. COE Math Sequence

In the fall semester of 2012, the COE implemented a new math sequence. This sequence was subsequently implemented in CVEEN in the fall semester of 2013. The COE math sequence is: Math 1310 (Calc. I), Math 1320 (Calc. II), Math 2250 (Calc. III w/ ODEs), Math 3140 (Vector Calc. and PDEs). Transfer students into CVEEN are required to complete, or have completed the following sequence of courses or its equivalent: Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III), Math 2250 (ODEs), and Math 3150 (PDEs).

The sequence was designed by faculty in Mathematics and Engineering with two goals: to provide a more streamlined presentation by deemphasizing proofs and to connect the mathematics to practical applications. The traditional and engineering sequences are outlined in Table A–1. The engineering track is 16 units, the traditional, is 17. The two sequences share one course, 2250, Linear Algebra and Differential Equations. Most transfer students follow the traditional track because the engineering path is not available at two- and four-year colleges in Utah. Most U of U engineering students pursue the engineering track. The traditional track requires 5 semesters, the engineering, 4.
Table A–1. Outline of Traditional and Engineering Math Sequences

<table>
<thead>
<tr>
<th>Traditional Track</th>
<th>Common Courses</th>
<th>Engineering Track</th>
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<tbody>
<tr>
<td>MATH 1210 Calc I (4)</td>
<td>MATH 1310 Eng Calc I (4)</td>
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</tr>
<tr>
<td>MATH 1220 Calc II (4)</td>
<td>MATH 1320 Eng Calc II (4)</td>
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</tr>
<tr>
<td>MATH 2210 Calc III (3)</td>
<td>MATH 2250 LA &amp; DEs (4)</td>
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</tr>
<tr>
<td>MATH 3150 PDEs (4)</td>
<td>MATH 3140 Vector Calc and PDEs (4)</td>
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<tr>
<td>17 units</td>
<td>16 units</td>
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</tbody>
</table>

9. Honors in Engineering

The Honors in Engineering Program in the COE is designed to provide a challenging, individualized educational experience to high achieving students and to promote life-long learning throughout their careers. The objective is to challenge top students by offering them access to more advanced levels of study, to facilitate the fullest possible use of their creative abilities, to encourage a sustained interest in advanced education and basic research, and to foster leadership and fellowship within the engineering community [https://www.coe.utah.edu/honors](https://www.coe.utah.edu/honors).

10. University Honors

The University Honors Program is sponsored by the Honors College and has a long and distinguished history of excellence in undergraduate education. The centerpiece of Utah’s Honors College is Engaged Learning Opportunities — a signature experience that brings together students and community partners to collaborate on research that results in real-world applications. For more information, see: [http://honors.utah.edu/](http://honors.utah.edu/).

D. Program Delivery Modes

The Department of Civil & Environmental Engineering offers courses in three modes: (1) day, (2) evening, and (3) use of distance or remote learning (video conferencing which is currently under development). There are also plans to develop future on-line content for select courses in the undergraduate curriculum, but none have been implemented as of 2015.

Day courses are offered in the standard University format with three 50-minute classes or two 50-minute classes, depending on the semester hours associated with the class. There are also offerings given in twice-a-week format with two 75-minutes sessions per week. Evening courses begin at 4:35pm or later. Three courses have required laboratories which are offered during a 3-hour period during the week in the afternoon. These laboratory sessions are taught usually 3 to 4 times a week, and the students receive 1 semester hour of credit for their attendance.
Typically, the Department offers an average of five evening courses each fall and spring semester. Many of these evening courses are typically advanced technical courses and topics desired by working professionals and part-time students. Additional courses are offered in the late afternoon or early evening, and a few courses are taught at 7:30 a.m. at the 5000/6000 level to accommodate working professionals and part-time students. Select courses are sometimes offered from the Meldrum Civil Engineering Building Layton Conference Room as part of the federally funded University Transportation Center (UTC). However, these are typically offered at the 5000/6000 level, or higher.

**E. Program Locations**

All of CVEEN courses are delivered at the University of Utah campus. This includes the Warnock (WEB), Merrill (MEB) and Meldrum Civil Engineering (MCE) buildings. The CVEEN offices are located at:

Meldrum Civil Engineering Bldg.
110 Central Campus Dr.
Salt Lake City, UT 84112

**F. Public Disclosure**

The CVEEN program educational objectives and student outcomes are found at: http://www.civil.utah.edu/program

The links found on this page lead the reader to the enrollment and graduation data.

The annual enrollment data is found at: http://www.civil.utah.edu/files/2012/10/EngineeringEnrollmentF141.pdf

The annual graduation data is found at: http://www.civil.utah.edu/files/2014/08/EngineeringDegrees.pdf

**G. Previous Deficiencies, Weaknesses or Concerns**

The 2009 ABET review of CVEEN cited no deficiencies, weaknesses or concerns in the final report.
GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

1. Admission to the University of Utah

Freshman admitted to the University of Utah are required to have graduated, or expected to be graduating from an accredited high school within the semester preceding matriculation at the University. Since 1991, prospective students have been admitted using an “admissions index,” which is essentially a matrix of high school GPA and standardized test scores.

2. Admission to the Department of Civil and Environmental Engineering

To be admitted into the Civil Engineering Program, students must first be admitted to the University. Once matriculated, the potential CVEEN students enter as pre-civil engineering, if requested on their application. These students are permitted to enroll in CVEEN 1000-level engineering classes.

Transfer students must meet with the Departmental Undergraduate Advisor and with an assigned faculty advisor to discuss their program of study. For those students transferring within the University, or from other regional schools, acceptance of previous courses to fulfill Program requirements can be accomplished directly using the regional articulation agreement shown at http://www.civil.utah.edu/files/2014/07/2014-15-Articulation.pdf, or by a faculty advisor reviewing and approving the transfer course as meeting CVEEN curriculum requirements. For other transfer students, or when there is doubt, the students must submit an Out of State Course Evaluation form shown at http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/ofs_evaluation.pdf, which is reviewed for approval by the Departmental Undergraduate Advisor. If meeting the requirements, transfer students may be awarded intermediate status or major status as defined on page 24 of the Student Handbook.

Students are officially admitted into the Program when they are awarded intermediate or major status. Each student must have a minimum GPA of 2.50 out of 4.0 in select engineering and other technical prerequisite courses in order to be accepted into the Program. This 2.50 GPA, known as the “engineering GPA” must be maintained throughout the academic career and is a minimum requirement for graduation.

B. Evaluating Student Performance

1. Evaluation of Student Progress at the University Level
The students’ progress toward completion of their degree is evaluated using a variety of tools. The implementation of the PeopleSoft software package on a campus-wide basis now allows considerable flexibility in implementing these tools. Of particular importance is the DARS (Degree Auditing Reporting System) report. The DARS is essentially an advising report that shows progress toward a degree. Students can request a degree audit report, at no cost through the Web, for the degree program(s) in which they are enrolled, or for degree programs in which they are interested. The DARS report is also intended to help students select courses for future enrollment. University major and graduation (i.e. General Education and Bachelor's degree) requirements are displayed, and the DARS report shows which of these requirements have been fulfilled and which remain to be completed. The report has instructions for easy interpretation, and students can print copies and have them available for consultation with their academic advisors.

2. **Evaluation of Student Performance at the Program Level**

DARS reports can also be accessed by the Departmental Academic Coordinator who, upon request, can provide the reports to members of the faculty and the students’ faculty advisor. These DARs reports are used extensively to monitor each student’s progress through the Program and to graduation.

At the Program level, adequate student performance is considered to be progression through the curriculum with a 2.50, or higher, engineering GPA. Final grades for each course are collected by the University and available to students and programmatic academic support personnel online through the DARs system.

The Department controls access to upper division classes and advancement toward graduation using intermediate and major status designations. The procedure for applying for intermediate or major status is: (1) completion of the required form by the student, (2) obtaining approval from the student’s faculty advisor, and (3) final approval by the Departmental representative. Intermediate status applications are reviewed and approved for the Department by Dr. Romero, and major status applications are reviewed and approved by Dr. Bartlett.

Petitions for status change must be approved by the student’s faculty advisor and reviewed and approved by the Director of Undergraduate Studies (Dr. Romero). During summer term breaks, sabbaticals, and other times of excused faculty absence, students may consult with other faculty who have not been assigned as their designated faculty advisor.

**a) Intermediate Status**

As discussed in Section 1A, all U of U students become civil engineering students, as opposed to pre-civil engineering students, by meeting the requirements for intermediate status. Transfer students, who are accepted into the program have their transcripts reviewed, as discussed later, and are given either intermediate or major status pending the results of the review.

The granting of intermediate status includes having an engineering GPA of at least 2.50, and having completed the pre-requisite math, science, writing and engineering courses (see table
Intermediate status is usually obtained before the sophomore year for students with the 2.50 minimum engineering GPA. The form for intermediate status application can be found at: [http://www.civil.utah.edu/files/2014/04/Intermediate-Status-2014-2016.pdf](http://www.civil.utah.edu/files/2014/04/Intermediate-Status-2014-2016.pdf).

**CVEEN Requirements for Intermediate Status**

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<tr>
<th>Course Number</th>
<th>Credit Hours</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>MATH 1310*</td>
<td>4</td>
<td>Engineering Calculus I</td>
</tr>
<tr>
<td>CHEM 1210</td>
<td>4</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH 1320**</td>
<td>4</td>
<td>Engineering Calculus II</td>
</tr>
<tr>
<td>PHYS 2210</td>
<td>4</td>
<td>Physics for Scientists &amp; Engineers I</td>
</tr>
<tr>
<td>WRTG 2010 or ESL 1060</td>
<td>3</td>
<td>Intermediate Writing or Advanced Writing for Non-Native Speakers of English</td>
</tr>
</tbody>
</table>

Note: Successful completion of each of the above listed courses with the exception of WRTG 2010 or ESL 1060, require a grade of C or better.

*MATH 1210 or MATH 1311 are acceptable alternatives
**MATH 1220 or MATH 1321 are acceptable alternatives.

**b) Major Status**

Students prepared to enter the junior year of study usually apply for major status, if they have met the requirements which are an engineering GPA of 2.50, or higher, and have a minimum of 25 semester hours from the courses shown in the table below. The CVEEN application form for major status is found at: [http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/Major%20Status%202012.pdf](http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/Major%20Status%202012.pdf)
### CVEEN Requirements for Major Status

For these listed courses, achievement of major status requires completion of the course with a C grade, or better, in all listed math, physics, chemistry courses, and for CVEEN 2010, 2130, and...
Successful completion of all other courses listed with a C-, or better grade, is required. Additionally, because of the changes in the math curriculum by the COE (see Background Section C8), Math 1310 or Math 1311 are acceptable alternative to Math 1210, and Math 1320 or 1321 are acceptable alternatives to Math 1220.

**c) Academic Advisement of Probationary Students**

If a student gains intermediate or major status in the Program and his or her engineering GPA falls below the 2.50 minimum requirement, the student’s status in the Department is removed. Once removed, status can be reapplied for when all Program requirements for status have been met.

The Departmental Academic Advisor uses the DARs reports to verify the GPA requirement for all students with status after the completion of each semester. For cases where a student’s GPA has fallen below 2.50, the student is required to meet with the Director of Undergraduate Studies. Such students receive counsel and are required to develop a mutually-agreed upon plan for improving their engineering GPA. The Director of Undergraduate Studies advises such students to develop a path forward for regaining status. To reinstate status, some students are simply required to repeat courses, or to raise their engineering GPA above the minimum GPA requirement before being allowed to continue in the Program.

Students on academic probation with the University are also placed on academic probation with the Department. Status can be reobtained in the Department by becoming a student in good standing with the University and meeting the Departmental requirements.

In addition, it should be noted that for other students outside the CVEEN Program, the University places a freeze on enrollment for all students who have not declared a major after earning 60 credits.

**d) Prerequisite Courses**

The CVEEN Program has established prerequisites and / or co-requisites for most of the courses in the undergraduate program. These are listed in Table 5-2, or are found at: [http://catalog.utah.edu/preview_program.php?catoid=6&poid=5144](http://catalog.utah.edu/preview_program.php?catoid=6&poid=5144). The University has implemented a program that verifies when CVEEN students have completed all prerequisites, or in the case of a co-requisite, when the students is concurrently enrolled in the co-requisite course. These requirements must be met before the system will allow registration access for the course. In addition, if a specific grade, or higher, is required for a particular course, the CVEEN Academic Advisor manually checks the students’ grades to verify that the prerequisite course requirement(s) have been met. For example, courses that require departmental consent or requirements to enroll (e.g., CVEEN 4910) also use the permission code system.

For transfer and non-departmental students, CVEEN also requires such students to fill out a permission code request form. This is subsequently reviewed by the CVEEN Undergraduate Academic Advisor to ensure that students have met all prerequisites prior to allowing enrollment in the requested CVEEN course(s). The Academic Advisor reviews each permission code.
request and the student’s transcripts for the respective prerequisite(s). The form for the permission code request is found at: http://www.civil.utah.edu/permission.

The Department enforces prerequisite checking for all undergraduate engineering courses (i.e., courses below the 6000-level). Students are required to submit a permission for any of the below situations:

- when the prerequisite was taken at another institution
- when the prerequisite grade does not meet the requirement of a C-, or higher
- if the class enrollment cap is full
- if the student is not a CVEEN major
- if a CVEEN special permission is required for the course (e.g., CVEEN 4910).
- if the prerequisite was met by taking an AP exam or ACT score.

For these situations, the Academic Advisor issues a permission code to that student, which allows enroll in the course on the computerized system. For courses taken the prior semester, where final grades have not been issued, the academic advisor may issue a provisional permission code. When final grades have been issued, the Academic Advisor is required to review a report summarizing all permission codes issued. If a particular student did not passed a prerequisite course and was issued a provisional permission code, the Academic Advisor will drop such students from the course before the semester begins.

If a student has not met the prerequisite requirements for a particular course, they are welcome to petition the CVEEN Undergraduate Committee for an exception. The merits of the petition are reviewed by this committee. However, the Program strictly enforces the prerequisite requirements, so the Undergraduate Committee rarely approves an exception request.

In addition by University policy, the Department cannot waive or make exceptions for courses under the General Education (G.E.) or Bachelor Degree (B.D.) requirements of the University. Petitions for these courses must be filed with the University College (Office found at 450 SSB). If intellectual exploration courses are accepted by the University, then the student may petition the Department to have the same course count towards the Civil Engineering degree major requirement.

**C. Transfer Students and Transfer Courses**

1. **Transfer Students and Credit at the University Level**

Transfer students must be accepted by the University before they can enter the Civil Engineering Program. During the University’s acceptance process, the student’s records are assessed and decisions concerning transfer of credits are made. At the University level, these decisions are generally restricted to general educational courses and requirements.
As an institution of higher education, the formal policy of the University of Utah regarding the transfer of academic credit from other institutions of higher learning is stated in the University’s general catalog:

“Transfer credit earned in residence at other accredited collegiate institutions is normally accepted for advanced standing if the work is parallel in nature to programs offered at this university, and if grades of D- or better have been earned in the credited courses. No transfer credit toward a bachelor’s degree is allowed for courses graded below D-. Please note: Prerequisite courses and major courses may require higher grades. The transfer evaluation and summary of transfer credit is subject to audit and re-evaluation.”

Students can petition the University’s Admissions Office, if they disagree with a University-level decision. In the case of general education requirements, the Department generally accepts the University decision regarding acceptance and transfer of general education requirements. However, an exception to this is for the case of students transferring from regional schools with an Associate’s degree. These students are considered by the University to have met all intellectual exploration general education requirements. However, the CVEEN still requires such students to have at least two fine arts, two humanities and two social/behavioral science courses.

In addition to the general U of U transfer credit policy, the University of Utah has entered into articulation agreements with all public institutions of higher learning in the state including 4-year institutions (i.e., Utah State University, Weber State University, Southern Utah University, Utah Valley University) and community colleges (Dixie State College, College of Eastern Utah, Snow College, and Salt Lake Community College) and two private institutions (Brigham Young University and BYU-Idaho). All but the last institution are within the State of Utah. Courses covered by the articulation agreement have been examined by officials of the University administration to ensure that course content is equivalent and are automatically accepted as transfer credits by the participating institutions. Courses covered by these articulation agreements include nearly all of the lower division science and engineering courses in the civil engineering curriculum. These articulation agreements are reviewed on an annual basis by committees coordinated by the Utah System of Higher Education through the so called “Major’s Meeting.” This meeting is attended by the Chair and/or the Director of Undergraduate Studies. CVEEN works with representatives of specific institutions when short-comings are identified in the curriculum or with the quality of course instruction and delivery. If necessary, CVEEN can discontinue acceptance of such courses, if the course does not meet CVEEN’s standards and needs in terms of content and quality.

It is important to point out that over the past decade, the number of transfer students from Utah’s community colleges to the University of Utah has increased dramatically as a result of specific policies adopted by the State Board of Regents. These policies encourage high school students to enroll in 2-year institutions prior to completing the remainder of their major at a 4-year institution. This has increased the number of transfer students entering the CVEEN program during that time period.
Additionally, the Chair seeks input from transfer students through the Undergraduate Student Advisory Committee (SAC) and during exit interviews regarding the acceptance and quality of transfer credits and their corresponding curriculum.

2. **Transfer Students and Credit at the Program Level**

Transfer students must have a minimum engineering GPA of 2.50 out of 4.0 in order to be accepted into the CVEEN Program. In addition, for those students transferring within the University or from other regional schools (i.e., universities or colleges located in the State of Utah and BYU-Idaho) correlation of previous courses to CVEEN Program requirements normally can be accomplished directly, using the regional articulation sheet [http://www.civil.utah.edu/files/2014/07/2014-15-Articulation.pdf](http://www.civil.utah.edu/files/2014/07/2014-15-Articulation.pdf) (Figure C1-1), or by faculty advisor review. For other transfer students, or when there is doubt, students must submit an “Out of State Course Evaluation” form which are reviewed for approval by a Departmental advisor [http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/ofc_evaluation.pdf](http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/ofc_evaluation.pdf). All requests for exceptions must be approved by the transfer student’s CVEEN faculty advisor, and the exception is requested in writing and submitted to the CVEEN Academic Advisor in the first semester of transfer. It is the student’s responsibility to request that their records be updated according to any approved exceptions.

The Program has a few standard exceptions found on page 22 of the CVEEN student handbook [http://www.civil.utah.edu/files/2014/08/2014-2016_handbook.pdf](http://www.civil.utah.edu/files/2014/08/2014-2016_handbook.pdf). The first group of exceptions pertain to required, full-semester courses that can be routinely substituted for half-semester courses of the same or similar course content. The second standard course exception pertains to CVEEN 1000 (Introduction to Civil and Environmental Engineering). The waving or granting of an exception to this course is dependent on whether or not a student has enrolled in a similar introductory course elsewhere, or if status has been granted by CVEEN upon transferring to the University.
### CIVIL & ENVIRONMENTAL ENGINEERING ARTICULATION SHEET

**PRE & INTERMEDIATE MAJOR COURSES**

*Updated July 18, 2014*

<table>
<thead>
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<th>Course</th>
<th>U of U</th>
<th>BYU</th>
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<th>DIXIE</th>
<th>SLCC</th>
<th>SNOW</th>
<th>SUU</th>
<th>USU/DUSU - Eastern</th>
<th>UVU</th>
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<td>ENGR 2030</td>
<td>ENGR 2030</td>
<td>ENGR 2100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermodynamics I</td>
<td>CH EN 2300</td>
<td>ME EN 321</td>
<td>ME 322</td>
<td>ENGR 2300</td>
<td>CEEN 2300</td>
<td>ENGR 2300</td>
<td>ENGR 2300</td>
<td>ENGR 2300</td>
<td>ENGR 2300</td>
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<td></td>
</tr>
<tr>
<td>Material Science</td>
<td>MSE 2160</td>
<td>ME EN 250</td>
<td>ME 250</td>
<td>MSE 2160</td>
<td>ME 2160</td>
<td>ME 2160</td>
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<td>ME 2160</td>
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<td></td>
</tr>
<tr>
<td>Material Science</td>
<td>MSE 2170</td>
<td>ME EN 250</td>
<td>ME 250</td>
<td>MSE 2170</td>
<td>ME 2170</td>
<td>ME 2170</td>
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<td>ME 2170</td>
<td>ENGR 2100</td>
<td></td>
</tr>
<tr>
<td>Tech Communications</td>
<td>MG EN 1000</td>
<td>CEEN 112</td>
<td>AME 110</td>
<td>ENGR 1000</td>
<td>ECE 2200</td>
<td>EGDT 2200</td>
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<td></td>
</tr>
<tr>
<td>Intro Surveying</td>
<td>MG EN 2400</td>
<td>CEEN 113</td>
<td>CEEN 2240</td>
<td>ENGR 2240</td>
<td>CEEN 2240</td>
<td>ENGR 2240</td>
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<td></td>
</tr>
<tr>
<td>Intro to Civil Engineering</td>
<td>CVEEN 1000</td>
<td>CVEEN 10A/B</td>
<td>CVEEN 1000</td>
<td>CVEEN 1000</td>
<td>CVEEN 1000</td>
<td>CVEEN 1000</td>
<td>CVEEN 1000</td>
<td>CVEEN 1000</td>
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</tr>
<tr>
<td>Statics</td>
<td>CVEEN 2010</td>
<td>ENGR 2010</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 2100</td>
<td>CVEEN 1000</td>
<td></td>
</tr>
<tr>
<td>Strength of Mat. I</td>
<td>CVEEN 2140</td>
<td>CVEEN 203</td>
<td>ME 202</td>
<td>ENGR 2140</td>
<td>CEEN 2140 &amp; ENGR 2140</td>
<td>ENGR 2140</td>
<td>ENGR 2140</td>
<td>ENGR 2140</td>
<td>ENGR 2140</td>
<td>ENGR 2140</td>
<td></td>
</tr>
<tr>
<td>Structural Analysis</td>
<td>CVEEN 3210</td>
<td>CVEEN 321</td>
<td>CVEEN 321</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td>ENGR 4000</td>
<td></td>
</tr>
</tbody>
</table>

**Figure C1 – 1. CVEEN Articulation Sheet.**
D. Advising and Career Guidance

One of the primary objectives of the CVEEN Program at the University of Utah is to produce intellectually curious and technically capable graduates that have the ability to solve complex problems using engineering technology and materials. Academic advising is a critical component of achieving this goal. The formal and informal interaction both inside and outside the classroom aids in meeting this goal. Academic advising is accomplished through formal individual advising sessions as well as informal interactions with students.

When applying to the University, students can choose a specific classification, such as pre-civil engineering, or they may choose to be classified as “undecided.” During the morning session of their initial student orientation, the COE Administrative Program Coordinator gives a presentation to students in which they are advised to attend the afternoon session, if they are potentially interested in entering an engineering program. During the afternoon session the COE Program Coordinator provides more specific information about all COE programs of study.

Subsequently, students meet with the appropriate Departmental Academic Advisor. To ensure advising, access to student registration is blocked until such orientations are completed. Upon completion, the Departmental Undergraduate Academic Advisor removes the block and helps students complete the registration process, when requested.

During their first semester, students must meet with a University advisor before they can register for the next semester. Prior to that meeting, there is a hold placed on their registration, but after attending the advising meeting they receive priority registration. Students who have declared “pre-civil engineering” as their major meet with the Departmental Academic Advisor and review the Program requirements.

In addition, there is a requirement for students to meet with an advisor during their third semester, before registering for the following semester. Students who are undecided after completion of 60 semester hours are not allowed to register until they have selected a major, as per University requirements. Nonetheless, it is the hope of CVEEN to have such students declare as civil engineering majors long before that time.

After declaring as pre-civil or civil engineering students, such are given the opportunity to be advised by a member of the faculty in the civil engineering specialty area of most interest to them. The advising request form is found at: http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/undergrad/advisor.pdf. Faculty advisors help the students with curricular and career matters. U of U pre-civil engineering freshman students make a request for a departmental faculty advisor while enrolled in CVEEN 1000 (Introduction to Civil and Environmental Engineering). Transfer students submit their request for faculty advising at the time of admission to the University. All faculty members except for the Chair and the Director of Graduate Studies have advising responsibilities and routine meet with undergraduate students. Additionally, the Academic Advisor and Director of Undergraduate Studies have open door policies and meet to discuss any students’ questions or issues, during
Departmental business hours. In addition, the CVEEN Chair is available for student consultation, by appointment.

At the Program level students are encouraged to talk to their faculty advisor about career options and professional development. CVEEN also invites its Industrial Advisory Board (IAB) members, and other guest lecturers, into the CVEEN 2000/3000/4000 seminar series to discuss career and professional issues with CVEEN students. Additionally, the ASCE student chapter sponsors an annual career fair during spring semester. This event has drawn as many as 20 representatives from industry and government agencies, and results in many students getting internships and/or being employed upon graduation. Often the industrial / government representatives at these career fairs are graduates of the Program. This interaction is very helpful and encouraging for CVEEN students.

The University Career Services also sponsors a fall semester Science and Engineering Career Fair which is an event for students to meet and mingle with potential employers. Career Services also presents a series of workshops prior to these career fairs to help students prepare for the fairs. In addition, Career Services has walk-in hours within the COE which are held several times a week. They also coordinate a series of brown bag seminars on preparing for internships and how to perform job searches. Career Services has 2 full-time career counselors who work directly with engineering students.

Lastly, the COE invites alumni to several events to meet with students and to talk about their careers and how to network.

**E. Work in Lieu of Courses**

CVEEN does not award any academic credit for life or work experiences (e.g., internships or technical work) in lieu of its courses or curriculum.

However, students may obtain credit earned through Advanced Placement courses in high school for a select group of courses. Students must earn an AP score of 4, or higher, to receive credit for the corresponding courses. If students wish to have a lab section of a course waived, they must provide a lab notebook or other documented proof for successfully completing the laboratory portion of the course. The courses for which the Program accepts AP credit are:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Equivalent Course(s) at the U of U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus BC</td>
<td>MATH 1310</td>
</tr>
<tr>
<td>Physics C: Mech.</td>
<td>PHYS 2210</td>
</tr>
<tr>
<td>Physics C: E &amp; M</td>
<td>PHYS 2220</td>
</tr>
<tr>
<td>Chemistry</td>
<td>CHEM 1210/1220</td>
</tr>
<tr>
<td>English</td>
<td>WRTG 2010</td>
</tr>
</tbody>
</table>
**F. Graduation Requirements**

A final, detailed review of the requirements for graduation is conducted when the student submits a request for graduation form. This form is usually submitted in the semester just prior to the graduating semester. During an interview with the student’s faculty advisor, there is a final completion check of all required course work and other requirements. At this time, the faculty advisor ascertains if the student will most likely graduate with an engineering GPA of at least a 2.50, or higher; and that the student has met the minimum GPA requirements for other CVEEN and prerequisite courses (Section 1B2). The form for this final check can be found at: [http://www.civil.utah.edu/files/2014/02/Graduation-Packet-2014.pdf](http://www.civil.utah.edu/files/2014/02/Graduation-Packet-2014.pdf). (Also found as Figures C1-2a, b, c below).

In addition, the graduation requirements on this form are manually checked by the CVEEN Undergraduate Academic Advisor using the University’s DARs report at the time when the student submits a request for graduation. The Academic Advisor ensures that the student has taken or is scheduled to take all courses required for graduation. Lastly, just prior to graduation, the Academic Advisor conducts a final check at the time when all course work has been completed and grades have been issued to ensure that all required courses and other requirements have been taken and satisfactorily completed, and that the student has met the required minimum engineering GPA.
### Graduation Requirements

- GPA on required engineering courses (minimum 2.5)
- Cumulative GPA on all U of U courses (minimum 2.0)
- FE Exam Results (official letter must be brought into 2008 MCE)

<table>
<thead>
<tr>
<th>Intermediate Status</th>
<th>Major Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course</td>
<td>Grade</td>
</tr>
<tr>
<td>MATH 1210, Calculus I</td>
<td></td>
</tr>
<tr>
<td>PHYS 2210, Physics for Sci. &amp; Eng. I</td>
<td></td>
</tr>
<tr>
<td>CHEM 1210, General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CVEEN 1000, Intro. To CVEEN</td>
<td></td>
</tr>
<tr>
<td>LEAP 1101, Community as Idea and Experience: Definitions of Others</td>
<td></td>
</tr>
<tr>
<td>WRTG 2010, Intermediate Writing</td>
<td></td>
</tr>
<tr>
<td>OR ESL 1060</td>
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</tr>
</tbody>
</table>

**Additional Required 1000/2000 Level Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade</th>
<th>Course</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 2130, Statistics/Economics</td>
<td></td>
<td>ECE 2200*, Electrical Engineering</td>
<td></td>
</tr>
<tr>
<td>CHEM 1215, Chemistry Lab I</td>
<td></td>
<td>ME EN 2300*, Thermodynamics</td>
<td></td>
</tr>
<tr>
<td>CHEM 1225, Chemistry Lab II or CHEM 2315, Organic Chemistry or</td>
<td></td>
<td>MSE 2170*, Material Science Eng.</td>
<td></td>
</tr>
<tr>
<td>PHYS 2215, Phys for Sci. Lab I</td>
<td></td>
<td>*two of these three courses must be taken</td>
<td></td>
</tr>
</tbody>
</table>

Figure C1-2a CVEEN graduation requirements worksheet.
### Required 3000/4000 Level Course

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade</th>
<th>Course</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 3000, Seminar</td>
<td></td>
<td>CVEEN 3510, Materials</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3210, Structural Analysis I</td>
<td></td>
<td>CVEEN 3610, Environ. Eng. I</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3310, Geotech. I</td>
<td></td>
<td>CVEEN 4000, Seminar</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3410, Hydraulics</td>
<td></td>
<td>CVEEN 4910, Prof. Practice &amp; Design</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Science Requirement
Approved courses are listed in the handbook.

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 5000 Level Requirement
Minimum of 6 courses are required. Students must take, and pass, at least one course in three of the five areas shown in Section 1. Of those three courses two must be design, indicated by a (D) in Section 1. The other technical electives may be taken from section 1 or 2 (only 1 course may be taken from Management). Fasstrax students need to complete 5 technical electives out of Section 1 and 2 (must meet Section 1 requirements) and one Graduate Course (6000- level or higher).

#### Section 1

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Grade</th>
<th>Structures</th>
<th>Course</th>
<th>Grade</th>
<th>Geo/Materials</th>
<th>Course</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 5605 Environmental II</td>
<td></td>
<td>CVEEN 4221 Concrete I (D)</td>
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<td>CVEEN 5305 Intro to Foundations</td>
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<tr>
<td></td>
<td></td>
<td>CVEEN 4222 Steel I (D)</td>
<td></td>
<td>CVEEN 5570 Pavement Design (D)</td>
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</table>

<table>
<thead>
<tr>
<th>Transportation</th>
<th>Grade</th>
<th>Water Resources</th>
<th>Course</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>CVEEN 5510 Highway Design (D)</td>
<td></td>
<td>CVEEN 4420 Eng. Hydrology (D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVEEN 5560 Transportation II</td>
<td></td>
<td>CVEEN 5420 Open Channel (D)</td>
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</table>

#### Section 2

<table>
<thead>
<tr>
<th>Environmental</th>
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<th>Structures</th>
<th>Course</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>CVEEN 5610 Water Chemistry</td>
<td></td>
<td>CVEEN 5210 Structural Analysis II</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>CVEEN 5220 Concrete II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVEEN 5230 Steel II</td>
<td></td>
<td>CVEEN 5240 Timber/Masonry</td>
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</table>

<table>
<thead>
<tr>
<th>Nuclear Engineering</th>
<th>Grade</th>
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<tbody>
<tr>
<td>NUCL 3100 Neutron Based Engr</td>
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<tr>
<td>NUCL 4000 Nuclear Sci. &amp; Engr.</td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>Management (Max 1)</th>
<th>Other</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 5810 Cost Est. &amp; Prop. Writing</td>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>CVEEN 5820 Project Scheduling</td>
<td>Grade</td>
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</tr>
<tr>
<td>CVEEN 5830 Proj. Mgmt &amp; Cont. Admin.</td>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>CVEEN 5850 Eng. Law &amp; Contracts</td>
<td>Grade</td>
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</table>

<table>
<thead>
<tr>
<th>Fasstrax: Graduate Level Class (6000-level or higher)</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade</td>
</tr>
</tbody>
</table>

Figure C1-2b CVEEN graduation requirements worksheet (continued).
## General Education and Bachelor Degree Requirements

<table>
<thead>
<tr>
<th>1. General Education Courses</th>
<th>Previous Degree does not waive requirement, must list courses that apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Arts (FF)</td>
<td></td>
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<td>Fine Arts (FF)</td>
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<tr>
<td>Humanities (HF)</td>
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<td>Humanities (HF)</td>
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</tr>
<tr>
<td>Social/Behavioral Science (BF)</td>
<td></td>
</tr>
<tr>
<td>Social/Behavioral Science (BF)</td>
<td></td>
</tr>
<tr>
<td>2. Writing (WR)</td>
<td>WRTG 2010</td>
</tr>
<tr>
<td>3. American Institutions (AI)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Bachelor Degree Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Diversity Requirement</td>
</tr>
<tr>
<td>5. International Requirement (IR)</td>
</tr>
<tr>
<td>6. Quantitative Reasoning</td>
</tr>
<tr>
<td>(QA) Math</td>
</tr>
<tr>
<td>(QB) Statistics/Logic</td>
</tr>
<tr>
<td>MATH 1210</td>
</tr>
<tr>
<td>MATH 1220</td>
</tr>
<tr>
<td>7. Upper-division Communication/Writing</td>
</tr>
<tr>
<td>CVEEN 3100</td>
</tr>
<tr>
<td>8. Bachelor of Science Quantitative Intensive (QI)</td>
</tr>
<tr>
<td>2 of these 3 courses will fulfill this requirement</td>
</tr>
<tr>
<td>CVEEN 3210</td>
</tr>
<tr>
<td>CVEEN 3410</td>
</tr>
<tr>
<td>CVEEN 3420</td>
</tr>
</tbody>
</table>

Faculty Advisor’s Signature  
Department Chair Signature  
Date  
Date  

Figure C1-2c CVEEN graduation requirements worksheet (continued).
G. Transcripts of Recent Graduates

Upon meeting all requirements, the degree is awarded as “Bachelor of Science in Civil Engineering” at the University of Utah. There are no program options listed on the transcripts beyond minor degrees recognized and awarded by the University.

CVEEN will provide transcripts from some of the most recent graduates to the visiting team upon request by the team chair. Also, CVEEN will provide any additional information or explanation of how the transcripts are to be interpreted.
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

1. The University of Utah Mission Statement

The mission of the University of Utah is to serve the people of Utah and the world through the discovery, creation and application of knowledge; through the dissemination of knowledge by teaching, publication, artistic presentation and technology transfer; and through community engagement. As a preeminent research and teaching university with national and global reach, the University cultivates an academic environment in which the highest standards of intellectual integrity and scholarship are practiced. Students at the University learn from and collaborate with faculty who are at the forefront of their disciplines. The University faculty and staff are committed to helping students excel. We zealously preserve academic freedom, promote diversity and equal opportunity, and respect individual beliefs. We advance rigorous interdisciplinary inquiry, international involvement, and social responsibility (http://admin.utah.edu/office_of_the_president/university-mission-statement).

2. The College of Engineering Mission Statement

To prepare students for leadership positions and professional practice in academia, industry and government; to improve the productivity, health, safety and enjoyment of human life through leading-edge research; and to stimulate and grow the economy by providing qualified engineering professionals and by transferring the technologies developed in College of Engineering research to the private sector (http://www.coe.utah.edu/about).

3. The Department of Civil and Environmental Engineering Mission Statement

Provide high quality education in engineering and leadership, life-long learning opportunities, and innovation for the benefit of the State of Utah and the world. (http://www.civil.utah.edu/mission).

B. Program Educational Objectives

The CVEEN program educational objectives are presented below. They can also be found at: http://www.civil.utah.edu/program. The CVEEN program educational objectives were revised during faculty meeting in fall semester 2014 to clarify the language and to align them more directly with the CVEEN core curriculum and faculty expertise. In addition, the revisions also facilitated a closer alignment with the program criteria for civil engineering programs as articulated by the American Society of Civil Engineers (ASCE).

For convenience, both the 2009 to 2013 and the 2014 to current program education objectives are given below for comparative purposes. The current objectives have been shown in bolded.
italicized type. The current version reflects comments and changes made by CVEEN as a result of IAB and COE review and comment.

(1) The graduate will be employed and effective as a civil engineer, or will perceive himself/herself to be employable as an effective civil engineer, or will perceive that the Civil Engineering Program effectively prepared her/him for graduate training in engineering or another professional discipline (2009 to 2013).

(1) CVEEN graduates will be prepared for the profession of civil and environmental engineering, or related fields, and have the ability to apply their knowledge in engineering practice or research (2014-2015).

(2) If employed as an engineer, the graduate will be or will be aspiring to become a licensed engineer. Additionally, the graduate will be active in ASCE and/or other professional organizations that work to improve the engineering profession and will be involved in continuing education (2009 to 2013).

(2) CVEEN graduates are encouraged to seek professional licensure, when appropriate, and to be active in professional organizations, seek opportunities for life-long learning and participate in the betterment of their profession (2014 to 2015).

(3) The graduate will affirm that the Civil Engineering Program was effective in preparing her/him for a leadership role in society and to be an advocate of Civil Engineering to the broader community (2009 to 2013).

(3) CVEEN graduates are encouraged to seek leadership roles and to be advocates for their profession utilizing engineering in solving complex societal issues for the broader good of the community (2014 to 2015).

C. Consistency of Program Educational Objectives with U of U Mission

The mission of the University includes “dissemination of knowledge by teaching,” emphasizes “the highest standards,” and elaborates by stating that the “faculty and staff are committed to helping students excel.” The program educational objectives encourage excellence by emphasizing “effectiveness” at a “licensed” engineering level of achievement. The mission of the University speaks of “community engagement” and “social responsibility.” The CVEEN program educational objectives encourage graduates to “seek leadership roles and to be advocates for their profession in solving complex societal issues for the broader good of the community.” The CVEEN program educational objectives also address the responsibility to society that graduate have to be “active in professional organizations, seek opportunities for life-long learning and participate in the betterment of their profession.” The local-to-global view of the mission of the University is not explicitly included in CVEEN program educational objectives, but is implied in the “leadership role in society and to be an advocate of Civil
Engineering to the broader community. The local-to-global view is also included in the Department mission statement, which guides the undergraduate and graduate programs, and other Departmental activities.

**D. Program Constituencies**

The primary requirement-generating constituencies of the CVEEN Department are:

- CVEEN faculty
- College of Engineering (COE)
- University of Utah (U of U)
- American Society of Civil Engineers (ASCE).

These constituencies are called “requirement-generating,” because they initiate or sponsor initiatives that directly affect the Program and its requirements.

Other constituencies that provide feedback at the program level are:

- CVEEN Industrial Advisory Board (IAB) ([http://www.civil.utah.edu/iab](http://www.civil.utah.edu/iab))
- COE IAB
- Engineering National Advisory Council (ENAC) ([https://www.coe.utah.edu/enac](https://www.coe.utah.edu/enac))
- CVEEN alumni board ([http://www.civil.utah.edu/alumni](http://www.civil.utah.edu/alumni))
- Current CVEEN students

These latter constituencies provide feedback regarding the Program Education Objectives, academic requirements, and curriculum; however, they do so in an advisory role. The current members of the CVEEN and COE IAB are presented in Attachment 1.

CVEEN program objective 1 meets the mission of the COE to provide engineers prepared to enter the workforce of the State of Utah. As a state funded school, the COE and CVEEN has the obligation to provide an educated workforce to assist in the economic and social development of the State. For example, the Utah Technology Council recently secured $4.5 million per year for Utah’s public universities through its lobbying efforts at the 2015 Utah legislative session. With a regional match from university presidents, this becomes $9 million. The so called “Engineering Initiative” plans to increase the number of engineering graduates, which will help attract and sustain talent for technology companies that have helped put Utah at the top of the Forbes list for business and job growth potential for the last several years (source: [http://utahpolicy.com/index.php/features/featured-articles/5192-utc-perfect-in-2015-utah-legislative-session-%3Cstrong%20class](http://utahpolicy.com/index.php/features/featured-articles/5192-utc-perfect-in-2015-utah-legislative-session-%3Cstrong%20class)).

In addition, because the University of Utah is a Research 1 institution, CVEEN also has the obligation to provide a select handful of undergraduate students that are prepared to enter graduate school and fulfill the Department’s research mission.
CVEEN program objective 2 addresses the need to provide qualified engineers active in professional organizations (e.g., ASCE) and that continue in seeking professional development throughout their careers. The achieving of this objective is important to all constituencies of CVEEN. The obtainment of professional licensure is important to CVEEN graduates in terms of employment opportunity and career progression, to the Department and University in terms of reputation and stature, and to the engineering profession in terms of maintaining a professional and uniform standard of practice. Professional licensure provides this uniform practice of engineering in the public arena by enforcing standards and restricting practice by unqualified individuals.

In addition, it is important to professional societies and industry that CVEEN graduates seek membership in such organizations and continue their education. This membership improves the influence of these organizations and improves the state of engineering practice by providing a venue for networking and sharing of knowledge, and by providing a venue for life-long learning by courses, seminars and conferences organized or sponsored by these organizations. Such continuing education is also a requirement for continued professional licensure. CVEEN provides to its graduates the foundation for continuing education by providing critical reasoning, analysis and communication skills through the formal educational process offered by the University.

CVEEN program objective 3 expresses the need to have CVEEN graduates engaged in society through leadership and advocacy for their profession. This meets the needs of the constituency of CVEEN by offering leadership and problem solving skills to address 21st century challenges regarding topics of sustainability, infrastructure renewal, energy and clean water.

**E. Process for Review of the Program Educational Objectives**

The COE ABET committee meets monthly to discuss ABET related issues. It is chaired by the COE Associate Dean of Academic Affairs. This committee provides feedback, guidance and recommendations to CVEEN regarding its program objectives, ABET processes and review, and other accreditation topics.

The CVEEN program objectives were drafted by the CVEEN undergraduate committee and were amended and approved in faculty meeting in fall 2014. The objectives were also reviewed by the COE ABET committee in 2014 and 2015 and by the COE ENAC and the CVEEN IAB in spring 2015.

CVEEN has strong participation from its IAB (http://www.civil.utah.edu/iab) (Attachment 1), which is composed of consulting, industry and public-sector engineers. The Industrial Advisory Board (IAB) consists of 15 industry professionals that meet four times a year. They advise the CVEEN Chair on the needs of the profession in regards to private and public enterprises so that CVEEN can better meet the needs of the State and its citizens. The IAB also helps in fundraising, serves as a public relations medium, and disseminates information on CVEEN status to the state legislature, agencies, counties and cities. CVEEN routinely seeks comments from the IAB regarding its program objectives (http://www.civil.utah.edu/program), curriculum, (http://www.civil.utah.edu/files/2015/02/2014-2016_handbook.pdf) and strategic plan (http://www.civil.utah.edu/wp-content/themes/cvee-express-theme/pdf/strategic_plan.pdf). IAB
meeting minutes and recommendations are routinely discussed in faculty meeting, and acted upon, as appropriate, when faculty concurrence is reached. (It should be noted that the strategic plan referenced above is currently being revised as a result of a faculty retreated held in December, 2014.)

Alumni also participate in informal review the CVEEN program and its objectives. The CE Alumni Society Board members consists of former graduates that attended the University of Utah. The current board members can be found at (http://www.civil.utah.edu/board). This board also gives feedback to the CVEEN chair, but also mainly exists as a resource to provide guidance and panel discussions to current students.

Students directly affect the crafting and assessment of the Program Educational Objective through student-faculty communications and interactions. Course-level student input and feedback are provided to each instructor at semesters end. At the departmental level, the Undergraduate Student Advisory Council (SAC) provides input to the CVEEN Chair regarding students’ needs and concerns. The Chair also conducts exit interviews with all students prior to graduation. Lastly, the Engineering Benchmarking (EBI) survey results of graduating students also are considered in evaluating the Program and its objectives.
CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The student outcomes for the CVEEN program are listed below. They are also found at: http://www.civil.utah.edu/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

(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

Note that outcomes (a) through (k) are unmodified from the 2015-2016 criteria published by ABET. Also note that outcome (l) addresses, in part, program criteria given by the American Society of Civil Engineers (ASCE) (see PROGRAM CRITERIA section of this report). In regards to this, in 2008 the Undergraduate Committee (UGC) of CVEEN recognized that it was important to have an outcome that directly addressed ASCE emphasis on management, business, public policy and leadership.
B. Relationship of Student Outcomes to Program Educational Objectives

The relationship between program educational objects and CVEEN student outcomes is shown and discussed in Table 3-1.
<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Student Outcomes</th>
<th>Comments</th>
</tr>
</thead>
</table>
| CVEEN graduates will be prepared for the profession of civil and environmental engineering, or related fields, and to apply their knowledge in engineering practice or research | (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  
(g) an ability to communicate effectively  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. | These student outcomes support the preparation of the CVEEN graduate to apply the knowledge of civil engineering. This is done by preparation in mathematics, science, experimentation, design, teaming, problem solving and communication. |
| CVEEN graduates are encouraged to seek professional licensure, when appropriate, and to be active in professional organizations, seek opportunities for life-long learning and participate in the betterment of their profession. | (f) an understanding of professional and ethical responsibility  
(i) a recognition of the need for, and an ability to engage in life-long learning  
(l) explain the importance of professional licensure | These student outcomes prepare the CVEEN graduate for profession practice in terms of licensure, ethics, life-long learning and professional engagement. |
| CVEEN graduates are encouraged to seek leadership roles and to be advocates for their profession in solving complex societal issues for the broader good of the community. | (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context  
(j) a knowledge of contemporary issues  
(l) an ability to explain basic concepts in management, business, public policy, and leadership | These student outcomes prepare the CVEEN graduate for community involvement and leadership beyond the practice of civil engineering. Also, training relating to business practice is given (i.e., management, business). |
A. Student Outcomes

1. Assessment and Evaluation of Student Outcomes at Course Level

a) Introduction

The CVEEN program continues to improve its processes in evaluating student outcomes and implementing recommendations obtained from assessments, evaluations and student feedback. There is a continuing effort to make assessments more standardized and quantitative across the discipline groups within CVEEN so that year-to-year trends can be identified and evaluated in a systematic manner. In addition, younger faculty continue to receive mentoring in how to make their student outcome assessments and course evaluations more meaningful.

b) Assessment / Evaluation Tools

A variety of methodologies have been employed as internal mechanisms to assess and continuously improve the Program. These are summarized below:

I. Course examinations and problems. Specific course problem sets and exams are relatively easy to link to student outcomes (e.g., outcome A, application of basic math and science knowledge) is relatively easy for quantitatively-oriented courses such as those focused on engineering mechanics.

II. Informal examination of students. This methodology involves the instructor establishing a metric for a particular student outcome, for instance, achieving 80% correct response about a particular contemporary, social or ethical issue.

III. Student memos. Students are asked to write memos based on seminars on some of the "soft" topics associated with certain outcome. These are graded assignments by the CLEAR instructors or course teaching assistants. Students are assessed on their communication skills by the instructional team, faculty visitors, and external advisors. Student work is assessed and the reporting and work products are found in the course folders.

IV. Student projects. Extended student projects are a critical feature of certain courses in the curriculum, particularly in the capstone design course (CVEEN 4910). Student work from this course will be made available during the site visit.
V. Student feedback on questionnaires. At the end of each course, students provide feedback to the course instructor regarding the administration and delivery of the course. These questionnaires are compiled by the University and given to the instructor to evaluate and make recommendations for improvement.

VI. Student exit interviews. The chair of CVEEN conducts exit interviews with all graduating seniors. Part of the format of the resulting document is oriented toward assessing student outcomes.

c) Assessment / Evaluation Process

The assessment of student outcomes is primarily done at the course-level by the respective instructor with participation from the discipline groups and the CVEEN Undergraduate Committee (UG). The instructor with assistance from the respective discipline group is responsible for: (1) determining the assessment method for each course, (2) gathering the data, (3) performing an assessment, (4) completing the course evaluation, (5) documenting any recommended changes, (6) bringing recommendations to the undergraduate committee for discussion and possible action, and (7) following up on the implementation plan of the recommendation or change, if approved by the faculty body.

It should be noted that course instructors may make changes to individual course administration and delivery at their discretion according to University policy http://regulations.utah.edu/academics/6-316.php. However, for changes that may have significant impact on the curriculum, faculty members have a shared responsibility to communicate, discuss and receive CVEEN faculty approval before implementing these more substantive changes.

The student outcome assessments and course evaluations are documented in course folders (i.e., ABET binders). In addition to this information, each course receives a web-based course and instructor feedback evaluation completed by the students, which is later compiled by the University and provided to the instructor. These are also reviewed by the instructor for suggestions for potential improvements to the teaching methodology, class administration, etc. An example of a course level assessment and evaluation is given in Attachment 2. These assessments and evaluations typically contain: (1) course information, (2) a table showing relationship of student outcomes to the learning objectives of the course, (3) outcome assessment indicating the method of assessment, (4) assessment data, (5) student/instructor course evaluations, and (6) instructor comments on potential improvements to the course. The assessment data collected by the instructors varies, but may include: exam, quiz or homework questions, student work products (e.g., senior project reports, term reports, laboratory reports, essays, etc.) and oral exams. These materials found in the ABET course folders will be available to the reviewers during their visit.

CVEEN has adopted Bloom’s Taxonomy as a tool to define the expected level of achievement for each outcome at the time of graduation from the Program. Table 4-1 shows the relationship of the student outcomes, Bloom’s Taxonomy level expected by graduation, and the CVEEN core
curriculum and design technical electives. In order of increasing cognitive development, the levels of achievement are: a) knowledge, b) comprehension, c) application, d) analysis, e) synthesis, and f) evaluation.

The core courses shown in Table 4-1 are required of all CVEEN students. In addition, listed in this table are the CVEEN primary technical electives containing significant design content. CVEEN students are required to complete at least two of these courses as part of their program of study, as more fully explained in Criterion 5, Section A - Program Curriculum. The relationship of the courses to student outcomes is presented in Table 4-1 to show the progression and cognitive development of the student outcome topic(s) throughout the curriculum. Those course marked with an (●) indicate courses where the outcome is of major importance in the course. Those courses marked with (○) signify courses where the outcome is dealt with in some manner, but the subject matter may not be at the cognitive level (i.e., Bloom’s taxonomy level) desired at the time of graduation, or because the course is a technical elective not required of all CVEEN students.

Table 4-2 shows the relationship between the CVEEN courses, instructors, discipline groups, student outcomes and actual assessment frequency (i.e., semesters when an assessment was performed). In general, CVEEN has the policy to perform assessments on outcomes having a (●) symbol found in Table 4-1 on a biennial basis. Some introductory courses have been assessed more often to gain information about students’ performance at the entry level of the Program. Additional outcomes marked with a (○) symbol may be assessed at the instructor’s discretion. The assessment of these latter outcomes is optional because: (1) often the coverage of the outcome may not be at the Bloom’s Taxonomy level desired at graduation, (2) or the coverage of the outcome is not in-depth and assessment data is not routinely collected, (3) or the course is a technical elective not required for enrollment by all CVEEN students.

It should be noted that differences exist between Tables C4-1 and C4-2 in terms of the student outcomes addressed by the various courses, especially for those assessments completed prior to 2014. This occurred because Table 4-1 was modified by the CVEEN UG Committee and approved by the faculty body during the fall 2014 faculty retreat. Modifications were made to the outcomes-curriculum relationship (i.e., Table 4-1) in order to improve the subsequent assessment and evaluation process. As a result, the assessment/evaluation process was made more sustainable by creating a better balance and more uniform distribution of assessed outcomes throughout the curriculum and instructional team. For the reviewer’s reference, the old table previously used by CVEEN from 2009 to 2014 has been included as Attachment 4 of this report.
### i. Table 4-1 Student Outcomes and CVEEN Curriculum Map for Core and Design Technical Elective Courses

<table>
<thead>
<tr>
<th>CVEEN Core Courses</th>
<th>(a) math, sci. engr. (Ap)</th>
<th>(b) experimentation (Sy)</th>
<th>(c) design (Sy)</th>
<th>(d) teams (Ap)</th>
<th>(e) engr. problems (Ap)</th>
<th>(f) prof. &amp; ethical (Co)</th>
<th>(g) communications (An)</th>
<th>(h) impact of solutions (Co)</th>
<th>(i) life-long learning (Ap)</th>
<th>(j) contemporary issues (Co)</th>
<th>(k) engr. tools (Ap)</th>
<th>(l) mang. business, policy, leadership (Co)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 1000 Intro. to CVEEN</td>
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<td>CVEEN 2/3/4000 Seminar</td>
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<td>CVEEN 2010 Statics</td>
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<td>CVEEN 2130 Statistics and Eng. Econ.</td>
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<tr>
<td>CVEEN 2140 Strength of Materials</td>
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<tr>
<td>CVEEN 3100 Technical Communication</td>
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<tr>
<td>CVEEN 3210 Structural Analysis</td>
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<tr>
<td>CVEEN 3310 Geotechnical Engineering</td>
<td>●</td>
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<tr>
<td>CVEEN 3410 Hydraulics</td>
<td>●</td>
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<tr>
<td>CVEEN 3510 CE Materials</td>
<td>●</td>
<td>●</td>
<td>○</td>
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<td>CVEEN 3520 Transportation Engineering</td>
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<tr>
<td>CVEEN 3610 Environmental Engineering</td>
<td>●</td>
<td>●</td>
<td>○</td>
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<tr>
<td>CVEEN 4910 Prof. Practice and Design II</td>
<td>●</td>
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<tr>
<td>CVEEN Design Technical Electives</td>
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<td>CVEEN 4410 Engineering Hydrology</td>
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<td>CVEEN 4221 Concrete Design I</td>
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<td>CVEEN 4222 Steel Design I</td>
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<tr>
<td>CVEEN 5305 Intro. Foundations Eng.</td>
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<td>CVEEN 5420 Open Channel Flow</td>
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<td>CVEEN 5510 Highway Design</td>
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<tr>
<td>CVEEN 5570 Pavement Design</td>
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<td>CVEEN 5605 Water/Waste Water Treatment</td>
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</tbody>
</table>

Key to matrix entries

- (●) = topic of major importance in course.
- (○) = topic addressed by course in some manner, but not at the Bloom’s taxonomy level desired graduation, or technical elective course not completed by all students.

ABET student outcomes (a) through (k) and ASCE outcome (l) with the expected Bloom's Taxonomy for level of achievement by graduation: (Co = comprehension, Ap = application, An = analysis, Sy = synthesis).


2 Approved in fall Faculty Retreat 2014, minor changes made during 2014 by undergraduate committee.
### Table 4-2 Summary of Assessment Methods and Frequency of CVEEN Outcomes

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>Discipline Group</th>
<th>Course Instructor(s)</th>
<th>Major Student Outcomes Addressed</th>
<th>Other Student Outcomes Addressed</th>
<th>Method(s) of Assessment</th>
<th>Assessment Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 1000, Intro to CvEEN</td>
<td>Infrastructure</td>
<td>T. Elliot (F10-F12); L Reaveley - D. Schmucker (F13); D. Schmucker (F14)</td>
<td>f,j</td>
<td>d,e,g,h,i,j</td>
<td>Presentations, writing assignments, course/instructor evaluation report; competency-based rubric; review of pre-requisite knowledge, skills and aptitudes</td>
<td>F10, F11, F13, F14</td>
</tr>
<tr>
<td>CVEEN 2/3/4000 Seminar</td>
<td>All</td>
<td>P. Tikalsky (F11)</td>
<td>i,j</td>
<td>f,h</td>
<td>i,j=course/instructor evaluation report</td>
<td>F11</td>
</tr>
<tr>
<td>CVEEN 2010 Statics</td>
<td>Infrastructure</td>
<td>T. Elliot (Sp11), D. Schmucker (Sp13, F14, Sp15)</td>
<td>a,e,g</td>
<td></td>
<td>a= exam question, e,g=homework and course/instructor evaluation report using competency-based rubric, review of pre-requisite knowledge skills and aptitudes</td>
<td>Sp11, Sp13, F14, Sp15</td>
</tr>
<tr>
<td>CVEEN 2130 Statistics and Eng. Econ.</td>
<td>Water/Enviro</td>
<td>Fagnant (F14)</td>
<td></td>
<td>a,b,k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVEEN 2140 Strength of Materials</td>
<td>Infrastructure</td>
<td>T. Elliot (Sp11), Romero (Sp13), Schmucker (F13, Sp14, Sp15)</td>
<td>a,c,d,e,f,g (Sp11)</td>
<td></td>
<td>a=homework, c,d,e,f,g=course design project exam questions</td>
<td>Sp11, Sp13, F13, Sp14, Sp15</td>
</tr>
<tr>
<td>CVEEN 3100 Technical Communication</td>
<td>CLEAR</td>
<td>CLEAR (F10, F11, F12, Sp12) J. Lenart (F14, Sp15)</td>
<td>d,g</td>
<td>f,h,i,j,k,l</td>
<td>d,g = CLEAR course/instructor evaluation report;</td>
<td>F10, F11, F12, Sp12, F14, Sp15</td>
</tr>
<tr>
<td>CVEEN 3210 Structural Analysis</td>
<td>Infrastructure</td>
<td>Ibarra (F11, F12, F14) E. Weber (F13)</td>
<td>a,k</td>
<td>e</td>
<td>a,k=exams questions</td>
<td>F11, F12, F14</td>
</tr>
<tr>
<td>CVEEN 3310 Geotechnical Engineering</td>
<td>Infrastructure</td>
<td>Bartlett (Sp 11, Sp13) Lawton (Sp12 15)</td>
<td>b,e</td>
<td>a</td>
<td>b=laboratory exercise e=competency-based rubric with evaluation based on</td>
<td>Sp11, Sp13, Sp15</td>
</tr>
<tr>
<td>Core Courses</td>
<td>Discipline Group</td>
<td>Course Instructor(s)</td>
<td>Major Student Outcomes Addressed</td>
<td>Other Student Outcomes Addressed</td>
<td>Method(s) of Assessment</td>
<td>Assessment Frequency</td>
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<tr>
<td>CVEEN 3410 Hydraulics</td>
<td>Water/Enviro</td>
<td>S. Burian (F12, F14), Pomeroy (F13)</td>
<td>a,b</td>
<td>e,k</td>
<td>targeted exam questions</td>
<td>F12, F14</td>
</tr>
<tr>
<td>CVEEN 3510 CE Materials</td>
<td>Infrastructure</td>
<td>Romero (Sp 11), A. Bordelon (Sp 12, F12, F14)</td>
<td>b,d (Sp 11)</td>
<td>b,d,k (Sp 12, F12) e (F14)</td>
<td>b=laboratory reports,</td>
<td>Sp 11, Sp12, F12, F14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c=team leadership, g=group project, k=laboratory exercise</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3520 Transportation Engineering</td>
<td>Transportation</td>
<td>C. Liu (F13, F14)</td>
<td>c,h</td>
<td>a,b,e,g,i,k</td>
<td>b=laboratory reports,</td>
<td>F13, F14</td>
</tr>
<tr>
<td>CVEEN 3610 Environmental Engineering</td>
<td>Water/Enviro</td>
<td>R. Goel (F11)</td>
<td>h,i</td>
<td>a,c,e,k</td>
<td></td>
<td>F11</td>
</tr>
<tr>
<td>CVEEN 4910 - Prof. Practice and Design II</td>
<td>Infrastructure</td>
<td>S. Bartlett (Sp14, Sp15), D. Schmucker (F14)</td>
<td>c,d,f,l</td>
<td>g,h,i,j,k</td>
<td>c,d= sr. project reports; f,l= essays &amp; memos. quizzes</td>
<td>Sp14, F14, F15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CVEEN Design Technical Electives</th>
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<tbody>
<tr>
<td>CVEEN 4410 Engineering Hydrology</td>
</tr>
<tr>
<td>CVEEN 4421 Concrete Design I</td>
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<tr>
<td>CVEEN 4222 Steel Design I</td>
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<table>
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<tr>
<th>Other CVEEN Technical Electives</th>
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</thead>
<tbody>
<tr>
<td>CVEEN 5110 Intro to GIS</td>
</tr>
<tr>
<td>CVEEN 5210 Structural Analysis II</td>
</tr>
</tbody>
</table>
d) Summary of Assessment and Evaluation of Student Outcomes by CVEEN

Table 4-3 summarizes the results of the student outcome assessment, evaluations and recommendations, and the current status of the recommendations. Underlined items found in this table are emphasized to show the connection between instructor recommendations and the follow-up by the appropriate CVEEN committee or group. In addition, many of these recommendations and actions are further discussed in Section 4B (Continuous Improvement) of this report. The important points that can be drawn from Table 4-3 are:

1. CVEEN course objectives that directly address student outcomes have been written, assessed and evaluated by most instructors for the CVEEN core curriculum (course levels 1000 to 4000). However, the method of assessment varies by instructor. There is a trend to move from qualitative assessment to more quantitative assessment starting in the 2013 to 2014 academic year. Nonetheless, more standardization of the assessment and evaluation process would be useful in order to obtain better metrics and tracking of temporal trends in student performance. To this end, the following topics for continued improvement will be discussed during 2015 fall Faculty meetings:
   - Developing standardized assessment tools and performance measures at the Departmental level that can be used by the various instructors on a routine basis.
   - Developing better rating system of student performance. Currently, CVEEN instructors have developed their own, usually based on an 80 to 90 percent achievement of the stated performance goal.

2. For student outcomes where quantitative assessments were performed at the course level, the students’ success rate in meeting the desired performance level for the various outcomes is generally at the 80 percent level, or higher, for most of the 3000 and 4000-level courses. This is to be expected because such students are in their junior and senior year of the Program; hence is to be expected that such students will perform better when compared with less experienced students. Student performance at the 2000-level courses appears to be somewhat less than the 80 percent level, due to many factors discussed in the next paragraph. Nonetheless, the CVEEN requirement of maintaining 2.50, or higher, engineering GPA appears to have contributed to the improved performance of the students, especially at the junior and senior levels (see Sections 4B2ai and 4B2aii).

3. However, in some courses, e.g., CVEEN 2010 (F 2013, Sp 2014, F 2014, Sp 2105), CVEEN 2140 (Sp 2015), CVEEN 3210 (F12), CVEEN 3510 (F14), CVEEN 3310 (Sp. 15), it appears that the success rate in meeting the desired performance level for some student outcomes is less than 80 percent (e.g., 60 to 70 percent), and in some cases, notably less (e.g., CVEEN 3310, Sp. 15). Some of the low achievement levels are due, in part, to the particularly low performance by a group of students that entered in the CVEEN program in fall 2014 CVEEN 2010 and continued into CVEEN 2140 during spring 2015. Notwithstanding this, there appears to be complex, systemic issues associated with lower performance at the entry level of the Program that are under evaluation by the CVEEN Undergraduate committee. These issues may include:
General societal and systemic lack of preparation of high school students for a rigorous university education

Unauthorized use of homework solutions, sharing of homework and unauthorized working as groups, sharing solutions, and other forms of academic misconduct

Participation in these entry-level courses by non-CVEEN students (e.g., mining and geological engineering students) and transfer students (e.g., Salt Lake City Community College), who have not been fully prepared for the rigors of an engineering curriculum

Recent changes in the CVEEN instructional team and difference in level of expectations, assessment and teaching methods used by the various instructors.

Regarding academic misconduct, the University has a relatively comprehensive policy http://regulations.utah.edu/academics/6-400.php; thus, it does not appear that CVEEN can greatly improve on this. A draft policy was brought to the faculty, but not approved (see Section 4B2aiii). Nonetheless, CVEEN faculty have been instructed by the Chair to discuss academic misconduct at the beginning of each course and include what constitutes unauthorized use of material, sources and assistance, etc. with the students. In addition, the CVEEN homework format requires that CVEEN students include the following honor pledge on the front of the assignments: “On my honor as a student of the University of Utah, I have neither given nor received unauthorized aid on this assignment” (http://www.civil.utah.edu/files/2013/01/Homework-Requirements.pdf). However, it appears that CVEEN faculty can improve the culture within the Department by continuing to discuss academic integrity with students and increase their enforcement efforts of academic misconduct.

4. Evaluation and discussions are on-going in the CVEEN UG committee about how to improve students’ performance, especially at the entry level to the Program. It is clear that CVEEN needs to attract and retain better prepared students. The December, 2014 Faculty Retreat identified updating the undergraduate program as the number one priority of CVEEN in preparing the new departmental strategic plan (on-going). In addition, CVEEN held a May 2015 meeting with its IAB to further discuss issues related to improving and updating the undergraduate curriculum. Potential solutions or action may include:

- Improving recruitment of highly qualified high school students and raising academic standards for admission to the Department.
- Developing remedial courses or additional curriculum offered by CVEEN (e.g., on-line content, etc.)
- Course-level curriculum changes to CVEEN courses at the 1000 to 2000-level

5. The loss of CLEAR instructional support for CVEEN 4910 (Professional Practice and Design) and changes to CVEEN 3100 have necessitated modifications to how these courses
are delivered (Sections 4B2fxi, 4B2fxii and 4A2). These courses are currently being revised to reflect changes in the instructional team.
### Table 4-3 CVEEN Student Outcome Assessment / Evaluation Summary

<table>
<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Instructor</th>
<th>Outcome Assessment</th>
<th>Evaluation / Recommendations</th>
<th>Status of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 1000</td>
<td>fall 2010</td>
<td>Elliot + CLEAR</td>
<td>Student Questionnaires, Presentations and Written Work on CD but information not assessed</td>
<td>No changes planned</td>
<td>No action required.</td>
</tr>
</tbody>
</table>
| CVEEN 1000 | fall 2011 | Elliot + CLEAR | (1) Outcome d was met – The students had two formal team requirements. The first was a 3-part written requirement for which the project was developed in the first two phases and the final report was written as a team report in the third phase. For the first two phases the instructor team felt that it was too early in the students’ program to be academically effective, so a new set of requirements dealing with the text and team oral presentations will be developed. The second team assignment was an oral assignment at the end of the course. Feedback was provided to the students, but not documented. This was discovered during this review and will be corrected in the future.  
(2) Outcome e was met – no changes recommended.  
(3) Outcome f was met – no changes recommended. | (1) Outcome d - Feedback on oral assignment needed.  
(2) Outcome e – met, no changes  
(3) Outcome f – met, no changes | (1) Implemented  
(2) No action required  
(3) No action required |
<table>
<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Instructor</th>
<th>Outcome Assessment</th>
<th>Evaluation / Recommendations</th>
<th>Status of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 1000</td>
<td>fall 2012</td>
<td>Elliot + CLEAR</td>
<td>(4) Outcome g was met – same modifications as recommended for Outcome d.</td>
<td>(4) Outcome g – same modifications as recommended for Outcome d.</td>
<td>(4) Implemented</td>
</tr>
<tr>
<td></td>
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<td>(5) Outcome h was met - Students need to be more involved in developing the lessons to be learned from the issues developed in the text. Recommended changes to increases student involvement.</td>
<td>(5) Outcome h – Students should be developing lessons learned from the issues developed in the text. Recommended changes to increases student involvement.</td>
<td>(5) Implementation uncertain – Instructor has retired. Course taught by new instructional team</td>
</tr>
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<td></td>
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<td>(6) Outcome i - no changes planned;</td>
<td>(6) Outcome i = met, no changes planned</td>
<td>(6) No action required</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(7) Outcome j - no changes</td>
<td>(7) Outcome j = met, no changes planned</td>
<td>(7) No action required</td>
</tr>
<tr>
<td>CVEEN 1000</td>
<td>fall 2013</td>
<td>Reaveley + Schmucker</td>
<td>Student Questionnaires, Presentations and Written Work on CD, Summary assessment of Student Feedback CLEAR Questionnaires on CD</td>
<td>Data not assessed.</td>
<td>(1) No action taken</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Outcomes were generally met - The student team presentations were overall very well done for first semester students. The student written team reports were marginal in their quality and completeness.</td>
<td>(1) Minor changes recommended to course flow to reflect the number of students and the instructional resources available.</td>
<td>(1) Adopted. This course has lost is support from the CLEAR program in F14, so course changes were required to the course to adapt to the loss of part of the instructional team</td>
</tr>
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<td>(2) Consider requiring a math pre-requisite so that only those students who are serious about engineering enroll in class. No changes recommended to course outcomes.</td>
<td>(2) not adopted after discussions within undergraduate committee. CVEEN 1000 needs to be taught during the first (i.e., fall) semester, which precludes the possibility of taking Calc I before CVEEN 1000.</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
<td>Evaluation / Recommendations</td>
<td>Status of Recommendation</td>
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<tr>
<td>CVEEN 1000</td>
<td>fall 2014</td>
<td>Schmucker</td>
<td>Outcomes d,f,g,h,i,j were generally met. The average performance exceeded the minimum requirements in each case. Students underperformed in a significant manner in two areas: (1) identifying education</td>
<td>(1) No changes to course outcomes recommended.</td>
<td>(1) No action required</td>
</tr>
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<td></td>
<td>(2) Minor changes to the flow of course may be needed to reflect the number of students and the instructional team</td>
<td>(2) At discretion of instructor, no action required</td>
</tr>
</tbody>
</table>

Rising Tide. This text is more accessible.

(4) Remove exams and replace with individual essay assignment focused on course content.

(5) Revised the grade formula into three categories: individual assignments, team project and individual professional development.

(6) Establish formal performance rubric that enable easy assessment along the lines of the assessment rubric present in the assessment report.

(7) Maintain overall flow of course content, but move the team presentations one week earlier.

(8) Institute a final essay for the last day of class where students have to respond to connections between the course text, the student team projects, and the course learning objectives.

(3) At instructor discretion, no action required by committee.

(4) At instructor discretion, no action required by committee.

(5) At instructor discretion, no action required by committee.

(6) At instructor discretion, no action required by committee.

(7) At instructor discretion, no action required by committee.

(8) At instructor discretion, no action required by committee.
<table>
<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Instructor</th>
<th>Outcome Assessment</th>
<th>Evaluation / Recommendations</th>
<th>Status of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 2/3/4000</td>
<td>fall 2011</td>
<td></td>
<td>requirements and (2) in the design project.</td>
<td>available.</td>
<td>(3) At discretion of instructor, no action required.</td>
</tr>
<tr>
<td>CVEEN 2010</td>
<td>fall 2013</td>
<td>Schmucker</td>
<td>Outcomes met as judged by the course/instructor evaluation report</td>
<td>No changes planned.</td>
<td>No action required</td>
</tr>
<tr>
<td>CVEEN 2010</td>
<td>Sp. 2014</td>
<td>Schmucker</td>
<td>Percentage of Class Reaching Minimum Competence 1. Free Body Diagrams = Not Assessed 2. External Forces = 64.7 3. Internal Forces = 66.4 4. Properties of Area = 74.0 5. Friction = 74.6 6. Basic Models of Forces and Moments = 77.5 Outcomes generally met. The average performance met or exceeded the requirement of meeting minimum competence in each of the areas assessed. The lowest student performance was in finding internal forces, which was deemed a more difficult topic by the instructor. At least 74 percent of the class met minimum competence in the 3 easiest areas of the course (basic models, properties of areas, and friction).</td>
<td>(1) No major changes to course outcomes, grading formula, performance rubric, nor flow of course content. (2) Change text to Beer, Johnston, and Mazurek (3) Implement a pre-requisite knowledge, skills and aptitude (KSA) quiz or assignment associated with the first lesson (4) Create a larger spread of content on the final exam (5) Build greater redundancy to assessment measures on the final exam (6) Add a mini test at the end of the semester</td>
<td>(1) No action required (2) Text was changed (3) At instructor discretion, no action required by committee. (4) At instructor discretion, no action required by committee. (5) At instructor discretion, no action required by committee. (6) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
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<tr>
<td>CVEEN 2010</td>
<td>fall 2014</td>
<td>Schmucker</td>
<td>outcomes generally met. No major changes to course outcomes, grade formula, performance rubric, nor flow of course content.</td>
<td>(1) See other comments in file about student behavior. Instructor is a bit distressed by the direction of the educational system. Concerned that performance trend as indicated by F2014 class is going in the wrong direction. Areas of concern: (1) tardiness to class, (2) preparation not bringing course material, (3) egregious mistakes on exams, (4) poor performance reqd. cancellation of course design and build project, and removal of friction subject matter, (5) only 67 percent of</td>
<td>(1) In progress, discussions are on-going in the undergraduate committee about how to improve student performance at the entry level to the program. It is clear that we need better prepared student to enter the program. In Dec. 2014 Faculty Retreat identified the updating and modernization of undergraduate program as the number one priority of CVEEN in its preparing of its new strategic plan (on-going). We have had an advisement meeting with the CVEEN IAB in May 2015 to discuss this issue about improving and updating the undergraduate curriculum. Course of action may include: (1) remedial courses, (2) remedial on-line</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
<td>Evaluation / Recommendations</td>
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<tr>
<td>CVEEN 2010</td>
<td>Sp. 2015</td>
<td>Schmucker</td>
<td>This cohort of students appeared to perform at barely acceptable level (very few high performing students). The average performance met or exceeded the requirement of meeting minimum competence in three of the directly measured areas: basic models, external forces, properties of areas. Internal forces were almost at an acceptable level. Friction was sub-par. Free body diagrams were indirectly measured by an item that requires an appropriate FBD to then make a qualitative conclusion. The course grades and assessment data correlate very well in this respect. In other words, this cohort was an underperforming group. Friction problems in the CE version of the course are not highly stressed. Performance on the final exam was correspondingly low. Percentage of Class Reaching Minimum Competence 1. Free Body Diagrams = not assessed</td>
<td>the class received a C or better grade, (6) concern about preparedness of mining engr. Performance, (7) Frequent quizzes required to improve performance and attendance.</td>
<td>(1) In progress, discussions are on-going in the undergraduate committee about how to improve student performance at the entry level to the program (Section 4Ad).</td>
</tr>
</tbody>
</table>

(1) No major changes to course outcomes, grade formula, performance rubric, nor flow of course content. However, discussion of how to improve student performance at the entry level of program brought to UG committee.

(2) The Beer, Johnston, and Mazurek text is sufficient; however, students clearly have access to the solutions manual and clearly do not abide by the course policy associated with its authorized use. It is recommended that a change in text be made for the 2015-16 AY.

(3) Implement a more substantive pre-requisite KSA quiz or assignment associated with the first lesson.

(4) Mini-tests particularly over the last 20% of the semester greatly aid achievement of content, (3) curriculum changes, and (4) raising academic standards for admission to Department. (Section 4Ad).

(2) A draft academic misconduct policy has been drafted for faculty consideration, which includes: (i) definition of Academic misconduct, (ii) sanctions and appeals, (iii) instructor responsibilities, (iv) students’ responsibilities, (v) acknowledgement form. The draft document was discussed in Dec. 2014 faculty meeting. Revisions are being considered, but faculty feel that U of U policy is generally sufficient (Section 4B2aiii).

(3) At instructor discretion, no action required by committee.

(4) At instructor discretion, no action required by committee.
<table>
<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Instructor</th>
<th>Outcome Assessment</th>
<th>Evaluation / Recommendations</th>
<th>Status of Recommendation</th>
</tr>
</thead>
</table>
| CVEEN 2130 | fall 2014 | Fagnant    | 2. External Forces = 80  
3. Internal Forces = 64.0  
4. Properties of Area = 64.0  
5. Friction = 56.0  
6. Basic Models of Forces and Moments = 84.0 | course content in the last quarter of the content. A final exam “threat” does not work nearly as well as a mini-test.  
(5) It is clear that students use online class management systems as a way to automatically have someone else manage their time. Students do not read syllabi nor do they look ahead. Instead, they let the computer tell them what is next and what to do. It is check-list mentality and not a mature approach. However, the online system only fosters this dependency and does not enable them at all. It seems ridiculous to have to have a syllabus quiz on the second day of class, but that may be the only option. | (5) At instructor discretion, no action required by committee. |
| CVEEN 2140 | Sp. 2011 | Elliot     | (1) Outcome a = 81 percent obtained mastery. Of seven students that didn’t obtain mastery four were one or less points away from mastery. | (1) No changes to course outcomes or content recommended.  
(2) Instructor will spend more time working problems in class | (1) No action required.  
(2) At instructor’s discretion, no action required. |
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<tr>
<th>Course</th>
<th>Semester</th>
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<td>concepts. All students were required to retake exam problems successfully did so, but any who had not would have failed the course. All students were required to submit 70 percent of the homework in acceptable form to pass the course. All students met this requirement</td>
<td>(2) No change</td>
<td>(2) No action required</td>
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<td></td>
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<td>(2) Outcome c met – The students completed team design projects. Samples of which are given in the folder. Students rated the design experience 5.8 out of 6 on the University Course and Instructor Feedback Report.</td>
<td>(3) No change</td>
<td>(3) No action required</td>
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<td>(3) Outcome d met – The only team requirement was the design project done in Outcome c. One initial issue with a team was solved, and no further problems were encountered. The students rated this outcome as 5.86 out of 6.0 on the University Course and Instructor Feedback report.</td>
<td>(4) No change</td>
<td>(4) No action required</td>
</tr>
<tr>
<td></td>
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<td>(4) Outcome e met – The course design project discussed in outcome c</td>
<td>(4) No change</td>
<td>(4) No action required</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
<td>Evaluation / Recommendations</td>
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<td>was structural design of a stage platform. The students liked the concept and instructor spent much time out of class discussing issues with team members. The students rated this outcome as 5.79 out of 6.0 on the University Course and Instructor Feedback report.</td>
<td>(5) No change</td>
<td>(5) No action required</td>
</tr>
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<td>(5) Outcome f – Professionalism was emphasized throughout the course and addressed at a higher level than might be expected in an entry level strength of materials course. Failure modes, determination of appropriate safety factors and fail-safe design concepts were discussed and some effort to consider fail-safety was required on the term project. All student groups did fairly well on this.</td>
<td>(5) No change</td>
<td>(5) No action required</td>
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<td>(6) Outcome g – Communications was limited to the final team project design report. Because the reports were submitted late in the course, the feedback to students was limited. Based on the University</td>
<td>(6) No change</td>
<td>(6) No action required</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
<td>Evaluation / Recommendations</td>
<td>Status of Recommendation</td>
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<tr>
<td>CVEEN 2140</td>
<td>Sp. 2013</td>
<td>Romero</td>
<td>Outcomes a &amp; e were met – There were 26 students in this class; all students were required to complete a problem contained in folder. Five of them made some conceptual error and were required to resubmit the problem. All students were evaluated more comprehensively during the examinations. At the end of the class, there were six students who did not meet the performance criterion. These students were required to repeat the course.</td>
<td>(1) No changes in course content or course delivery are recommend at this time. While only 75 percent of the class met the performance goal, CVEEN policy requires that students achieve a C or better grade in this course. This requirement ensures that only those students that have mastered these concepts can move forward in the program.</td>
<td>(1) No further action required, Note that the C or better grade requirement was passed by the faculty and implemented fall 2012. For more information, see Section 4Baii and Section 4Baiii).</td>
</tr>
<tr>
<td>CVEEN 2140</td>
<td>F2013</td>
<td>Schmucker</td>
<td>Outcomes a &amp; e met -The average performance met or</td>
<td>(1) No major changes to course outcomes, grade formula,</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
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<tr>
<td>CVEEN 2140</td>
<td>Sp. 2014</td>
<td>Schmucker</td>
<td>exceeded the requirement meeting minimum competency in each of the directly measured areas. The percentage if the class reaching minimum competency exceeded 80 percent in all areas except the basic models of stress and strain. Percentage of Class Reaching Minimum Competence 1. Models of Stress and Strain = 69 2. State of Stress at a Point = 96 3. Design = 100 4. Strains and Deformation = 81 5. Statistically Indeterminate Analysis = 96</td>
<td>performance rubric, nor flow of course content. (2) Switch to Beer, Johnston, Dewolf and Mazurek for course text to include sufficient plastic modelling theory (3) Create larger spread of content on final exam (4) Add mini test at end of semester (5) Add supplemental material (video, demo aids, etc.)</td>
<td>(2) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
<td>Evaluation / Recommendations</td>
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<td>CVEEN 2140</td>
<td>Sp. 2015</td>
<td>Schmucker</td>
<td>Outcomes a &amp; e – The average performance met or exceeded the requirement of meeting minimum competence in three directly measured areas: Basic Stress and Strain, State of Stress at a Point, and Design. The other three areas had average performances just below minimum competence (averages ranged from 1.76 to 1.95 Basic performance on the final exam met expectations. Minimum competence should not be confused with mastery, i.e., A-level performance. Rather this cohort of students demonstrated poor performance in the prior course (Statics) and continued to demonstrate weak performance in the follow-on course (Strengths).</td>
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<td>students to learn the last portion of the course content such as buckling and combined loading. (5) Add supplemental material (video, demonstration aids, etc.) that demonstrate testing apparatus, etc.</td>
<td>(5) At instructor discretion, no action required by committee.</td>
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<td>(1) No major changes to the course outcomes, grade formula, performance rubric, nor flow of course content (2) If there is a text that presents more tension test information and stress-strain models, I encourage a switch. BJDM appears not to be accessible to the students. (3) Add supplemental material (videos, demonstration aids, etc.) that demonstrate testing apparatus, etc.</td>
<td>(1) No action required (2) At instructor discretion, no action required by committee.</td>
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<td>(1) No action required</td>
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<td>(2) At instructor discretion, no action required by committee.</td>
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<td>(3) At instructor discretion, no action required by committee.</td>
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<tr>
<td>CVEEN 3100</td>
<td>fall 2010</td>
<td>CLEAR and CVEEN</td>
<td>Outcomes d, g, h addressed, no summary presented</td>
<td>(1) To create better balance of labor [CLEAR TA] should grade one individual and one team assignment and CvEEN professor should grade other individual &amp; team assignment (2) Communicate to CvEEN faculty that CLEAR instructors are not responsible for general course administration or all of the lectures and grading</td>
<td>(1) At instructor discretion, no action required by committee. (2) CvEEN met with CLEAR instructors</td>
</tr>
<tr>
<td>CVEEN 3100</td>
<td>Sp. 2011</td>
<td>CLEAR and CVEEN</td>
<td>Outcome d addressed, no summary presented</td>
<td>(1) Repeat the Team Working Agreement assignment and ongoing support for updating and enforcing it (2) Streamline the process for developing the technical problem for the Team Projects (3) Ensure that CLEAR instructors…are designated as section designers and instructors…so that [they] can manage files</td>
<td>(1) At instructor discretion, no action required by committee. (2) At instructor discretion, no action required by committee. (3) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>CVEEN 3100</td>
<td>fall 2011</td>
<td>CLEAR and CVEEN</td>
<td>Outcome g addressed, no summary presented</td>
<td>(1) With a three-person instructor team, this conversion [from T/R to M/W/F format] has been more laborious than one might Due to student</td>
<td>(1) A new assignment [was initiated] …the Individual Team Contribution Report</td>
</tr>
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<td>Course</td>
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<td>Instructor</td>
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<tr>
<td>CVEEN 3100</td>
<td>Sp. 2012</td>
<td>CLEAR and CVEEN</td>
<td>Outcomes d, g, h addressed, no summary presented</td>
<td>(1) At times [CVEEN faculty’s] manner of speaking and emailing [CLEAR TAs] and to students was not consistent with the audience-centered approach to communication</td>
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<td>(2) [CLEAR TA] developed and delivered a new unit…Cross-Cultural Communication</td>
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<td>(3) Continue to urge Engineering faculty to maintain and updated pass-off folder</td>
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<tr>
<td>CVEEN 3100</td>
<td>Sp. 2013</td>
<td>CLEAR and CVEEN</td>
<td>Outcomes g, h addressed, no summary presented</td>
<td>(1) Continue having the instructor team meet weekly or bi-weekly to discuss lesson plans and address issues before they become</td>
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<td>The instructional team assignment this semester was to</td>
<td>(2) At instructor discretion, no action required by committee</td>
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<td>(3) Pass off folder still in progress and improving, no action my CVEEN committee required</td>
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<td>Instructor</td>
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<tr>
<td>CVEEN 3100</td>
<td>fall 2013</td>
<td>CLEAR and CVEEN</td>
<td>Outcome g addressed, no summary presented. This was a somewhat difficult semester...the members of the instructor team had different visions of how the class should be taught, and the engineering instructor attempted to take over some of the CLEAR instructors’ assignments and duties</td>
<td>(1) CLEAR writing instructor needs to have clearly defined tasks that are under his or her control, without interference from the engineering instructor. This reduces student confusion and conflict between the instructors</td>
<td>(1) This issue was solved in fall 2014 by introducing a new CLEAR model with a dedicated instructor to the CVEEN program provided by CLEAR (see Section 4A3).</td>
</tr>
<tr>
<td>CVEEN 3100</td>
<td>Sp. 2014</td>
<td>CLEAR and CVEEN</td>
<td>Outcome g addressed, no summary presented. This was a successful semester...students appeared to improve in their understanding and practice of technical communication skills</td>
<td>(1) Work with LEAP to eliminate redundancy between LEAP and CLEAR classes</td>
<td>(1) In progress</td>
</tr>
<tr>
<td>CVEEN 3100</td>
<td>fall 2014</td>
<td>CLEAR</td>
<td>Outcomes d, g, h, f, i, j addressed but not assessed New CLEAR model piloted (see Section 4A3).</td>
<td>(1) No major changes to course outcomes (2) To facilitate greater continuity between the</td>
<td>(2) In progress</td>
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</tbody>
</table>

**Notes:**
- Use Travel Wise to focus on...the way real-world civil engineering projects are structured.
- Engineering consultant was an engaged instructor team member whose industry expertise and attitude complemented the skills and demeanors of CLEAR TAs.
- Problems (2)
- Have the instructor team continue to strive for well-articulated expectations and grading criteria (2)
- Streamline the syllabus in order to make it easier to understand (3)
- At instructor discretion, no action required by committee (2)
- At instructor discretion, no action required by committee (3)
- In progress
- No action required
- In progress
- CLEAR instructor is now part of CVEEN UG committee
<table>
<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Instructor</th>
<th>Outcome Assessment</th>
<th>Evaluation / Recommendations</th>
<th>Status of Recommendation</th>
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</thead>
<tbody>
<tr>
<td>CVEEN 3100</td>
<td>Sp. 2015</td>
<td>CLEAR</td>
<td>Outcomes d, g, h met. Outcomes d = 97 percent at mastery or proficiency level; Outcome g = 94 percent at mastery or proficiency level; Outcome h = 78 percent at mastery or proficiency level</td>
<td>CLEAR Program and CvEEN, involve CLEAR instructor more thoroughly in departmental development - potentially teaching another elective course AND becoming a member of the undergraduate committee</td>
<td>(1) Under consideration by CVEEN UG committee. No action taken yet.</td>
</tr>
<tr>
<td>CVEEN 3210</td>
<td>fall 2011</td>
<td>Ibarra</td>
<td>No outcomes assessed</td>
<td>(1) Modifications made to course including handouts, changing the weight of the final exam, reduction of the review of strength of materials, student team working.</td>
<td>(1) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>CVEEN 3210</td>
<td>fall 2012</td>
<td>Ibarra</td>
<td>Outcomes a &amp; k generally met Based on the assessment, 46 percent of student reached mastery level and 30 percent had marginal results.</td>
<td>(1) No recommendations for change made</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 3210</td>
<td>fall 2013</td>
<td>Weber</td>
<td>Student work products only</td>
<td>No recommendations</td>
<td>None</td>
</tr>
<tr>
<td>CVEEN 3210</td>
<td>fall 2014</td>
<td>Ibarra</td>
<td>(1) Outcomes a &amp; k generally met Based on assessment 69 percent achieved mastery level and 15 percent achieve marginal level.</td>
<td>(1) No changes recommended (2) Recommend requiring a textbook for F2015</td>
<td>(1) No action required (2) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>CVEEN 3310</td>
<td>Sp. 2011</td>
<td>Bartlett</td>
<td>(1) Outcomes b and e met. Outcome b = 95 percent of the students meet the</td>
<td>(1) No changes recommended to courses and grading</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>Course</td>
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<td>Outcome Assessment</td>
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<tr>
<td>CVEEN 3310</td>
<td>Sp. 2013</td>
<td>Bartlett</td>
<td>desired proficiency goal (i.e., mastery level). Outcome e = Proficiency goal almost met. 87 percent of students obtained mastery for this outcome. The proficiency goal was 90 percent.</td>
<td>(2) Create pdf file for each chapter of course notes. (3) Adding more examples to notes. (4) Make TA more available for instruction and questions.</td>
<td>(2) At instructor discretion, no action required by committee. (3) At instructor discretion, no action required by committee. (4) At instructor discretion, no action required.</td>
</tr>
<tr>
<td>CVEEN 3310</td>
<td>Sp. 2015</td>
<td>Lawton</td>
<td>Outcome b met. 98 percent of students met the desired proficiency goal (i.e., mastery level). Outcome e almost met. 80 percent of the students obtained mastery level.</td>
<td>(1) No changes recommended to course and grading. (2) Recommended by geotechnical faculty to split the laboratory from the course. This will aid in better diagnostics of course performance and allow for not repeating the lab, when an acceptable grade has been obtained, but the course needs repeating.</td>
<td>(1) No action required (2) CVEEN 3315 (Lab) created. Implemented in Sp. 2014.</td>
</tr>
<tr>
<td>CVEEN 3410</td>
<td>Fall 2012</td>
<td>Burian</td>
<td>Outcome a = almost met. 83 percent achieved mastery, 90 percent was</td>
<td>(1) No changes recommended to course outcomes and grading. (2) Potential underlying issues regarding students’ substandard performance for outcome e: (a) students ill-prepared for class, (b) working homework in groups when class policy forbade this, (c) students not challenged in freshman and sophomore year, (c) sense of entitlement by students.</td>
<td>(1) No action required (2) Under consideration by UG committee, suggested topic for fall 2015 Faculty retreat. (See Section 4A1d)</td>
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<tr>
<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
<td>Outcome Assessment</td>
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<tr>
<td>CVEEN 3410</td>
<td>Fall 2014</td>
<td>Burian</td>
<td>goal. Outcome b = met. All 71 students attained mastery level Outcome e = met. 95 percent obtained mastery. Outcome k = met. 90 percent obtained mastery.</td>
<td>(1) No changes recommended to course outcomes and grading</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 3510</td>
<td>Sp. 2011</td>
<td>Romero</td>
<td>(1) Outcome a – not assessed, Outcome b – met, all students were assessed by participation in laboratory reports Outcome c – not directly assessed, Outcome d – all students were required to act as a team leader. Outcome e – not assessed, Outcome k – not assessed.</td>
<td>(1) No changes to the course are planned. (2) Laboratories facilities continue to improve (3) Textbook updated to 3rd edition</td>
<td>(1) No action required. (2) No action required. (3) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>CVEEN 3510</td>
<td>Sp. 2012</td>
<td>Bordelon</td>
<td>(2) Outcome b met - all students participate in labs and demonstrated knowledge about experiments (3) Outcome d met - all student worked in groups for assignments</td>
<td>(1) No change (2) No change</td>
<td>(1) No action required   (2) No action required</td>
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<td>Course</td>
<td>Semester</td>
<td>Instructor</td>
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<tr>
<td>CVEEN 3510</td>
<td>fall 2012</td>
<td>Bordelon</td>
<td>Student work products only</td>
<td>No evaluation or recommendation</td>
<td>None</td>
</tr>
<tr>
<td>CVEEN 3510</td>
<td>fall 2014</td>
<td>Bordelon</td>
<td>(1) Outcome e generally met – 61 percent achieved a mastery level and 83 percent of the students achieved a marginal level on the assignment, laboratory exercise or exam question.</td>
<td>(1) No major changes to course outcomes, grade formula, performance rubric, nor flow of course content.</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 3520</td>
<td>fall 2013</td>
<td>Liu</td>
<td>(1) Outcomes c and h met, but no proficiency goal stated. The general feedback for students is positive.</td>
<td>(1) More emphasis can be made on advanced mathematical formulation of transportation problems (e.g., queing theory)</td>
<td>(1) At instructor discretion, no action required by committee.</td>
</tr>
<tr>
<td>CVEEN 3520</td>
<td>fall 2014</td>
<td>Liu</td>
<td>(1) Outcomes c and h met – Proficiency goal of 90 percent at mastery level. 92 percent of the students obtained mastery level.</td>
<td>(1) No recommendations for change made.</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 3610</td>
<td>fall 2011</td>
<td>Goel</td>
<td>(1) Students were evaluated through homework, in class quizzes and exams.</td>
<td>(1) No recommendations for change made</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 4221</td>
<td>Sp. 2011</td>
<td>Tikalsky</td>
<td>(1) Outcome a = 80 percent, Outcome c = met as assessed through final project, homework and grades Outcome f= met through a series of question Outcome I met through use of ACI code Outcome K met using final project and computer</td>
<td>(1) Course was deemed excellent and scope appropriate (2) Recommend change in textbook with more examples</td>
<td>(1) No action required (2) At instructor’s discretion, not action required by committee</td>
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<tr>
<td>CVEEN 4221</td>
<td>fall 2012</td>
<td>Johnson</td>
<td>(1) Student work products only, no assessment</td>
<td>(1) No recommendations</td>
<td>(1) No action required</td>
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<tr>
<td>CVEEN 4221</td>
<td>Sp. 2013</td>
<td>Johnson</td>
<td>(1) Student work products only</td>
<td>(1) Intent to use prototype building for the introduction of complete structural systems (2) Focus on the theory behind the development of the design (3) Take more advantage of automated design by using computer software</td>
<td>(1) At instructor’s discretion, not action required by committee (2) At instructor’s discretion, not action required by committee (3) At instructor’s discretion, not action required by committee</td>
</tr>
<tr>
<td>CVEEN 4221</td>
<td>fall 2013</td>
<td>Johnson</td>
<td>(1) Student work products only, no assessment</td>
<td>(1) No recommendations</td>
<td>(1) No action required</td>
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<tr>
<td>CVEEN 4222</td>
<td>Sp. 2013</td>
<td>Chambers</td>
<td>(1) Outcome c and e met. Assessment made on student course grades, 25 out of 31 students (81 percent) received a B- or better grade</td>
<td>(1) No recommendations</td>
<td>(1) No action required</td>
</tr>
<tr>
<td>CVEEN 4222</td>
<td>Sp. 2014</td>
<td>Chambers</td>
<td>(1) Student work products only</td>
<td>(1) No recommendations</td>
<td>(1) No action required</td>
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<tr>
<td>CVEEN 4410</td>
<td>Sp. 2013</td>
<td>McPherson</td>
<td>(1) Outcome c – students required to complete a design or analysis of a drainage system. Each student prepared a report and instructor feedback was given. (2) Outcome e – This outcome was assessed using homework assignments. Each assignment was graded.</td>
<td>(1) No recommendations</td>
<td>(1) No action required</td>
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<tr>
<td>CVEEN 4910</td>
<td>Sp. 2013</td>
<td>Bartlett</td>
<td>(1) Outcomes c, d, f, l met</td>
<td>(1) No changes recommended to outcomes and course grading</td>
<td>(1) No action required.</td>
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<td>Course</td>
<td>Semester</td>
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<td>CVEEN 4910</td>
<td>fall 2014</td>
<td>Schmucker</td>
<td>(1) Outcome c and d not met – Team mid-term report was unsatisfactory, Team final report was minimal, Team revised final report was deemed proficient</td>
<td>(2) Some administrative issues arose within instructional team</td>
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<td>(2) Outcome f – Professional skills portfolio (Exemplary = 4 out of 11; Proficient = 4 out of 11, Minimal = 3 out of 11). Ethics (Exemplary = 0 out of 11; Proficient = 11 out of 11; Minimal = 0 out of 11)</td>
<td>(2) See CVEEN 4910 fall 2014 (below) about changes to this course.</td>
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<td>(3) Outcome l – ASCE BOK Exemplary = 9 out of 11; Proficient = 0 out of 11; Minimal = 0 out of 11; two students not assessed.</td>
<td>(1) In progress, see fall 2014 - Changes in format to CVEEN 4910 due to CLEAR support being withdrawn (see Sections 4B2xii and 4B2xiii)</td>
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<tr>
<td>CVEEN 4910</td>
<td>Sp 2015</td>
<td>Bartlett</td>
<td>(1) Outcomes c, d, f, l met</td>
<td>(1) No changes to outcomes or course grading recommended.</td>
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<td>(2) Continue to improve the content and assessment of outcome (l) ASCE</td>
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<td>(1) No action required</td>
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<td>(2) At instructor’s discretion, no action required by committee</td>
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<tr>
<td>CVEEN 5110</td>
<td>fall 2013</td>
<td>Dudley-Murphy</td>
<td>(1) Outcomes g,i,k were met; however from the student feedback, the class could be a bit more challenging. Student work was assessed by the lab and final project. In cases where the outcome was not met, students were given extra opportunities to submit</td>
<td>(1) Recommendation to add text to the course.</td>
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<td>(2) Add more complexity to the lab assignments</td>
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<td>(1) At instructor’s discretion, no action required by committee</td>
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<td>(2) At instructor’s discretion, no action required by committee</td>
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<td>Instructor</td>
<td>Outcome Assessment</td>
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<tr>
<td>CVEEN 5210/6210</td>
<td>Sp 2014</td>
<td>Schmucker</td>
<td>Updated products. Feedback was given to every student.</td>
<td>Outcomes a,e,g were met. 80 percent of the student met minimum competency</td>
<td>No recommendations made</td>
</tr>
</tbody>
</table>
2. Assessment of Outcomes from Exit Interview Questionnaires

In addition to individual course assessments summarized above, CVEEN uses exit interviews to gain information for continuous improvement. CVEEN seniors participate in the review of the CVEEN program, courses and instructors. This is done during spring term of each year using senior exit interviews held by the Chair. These interviews are generally completed by all graduates and consist of a written questionnaire and meeting with the Chair. In this interview, feedback is sought regarding students’ satisfaction regarding course work, instruction, laboratories and faculty advising. Students’ suggestions for improvements are reviewed and summarized annually by the CVEEN Chair and given to the CVEEN undergraduate committee for discussion and potential action by the faculty, as appropriate. The questionnaire can be found in Attachment 5, or at: (http://www.civil.utah.edu/files/2015/03/Exit-Interview.pdf). The student outcome rankings from these exit interviews have been tallied and evaluated for the 2013-2014 and 2014-2015 academic years. The tabulated values can also be found in Attachment 5.

The exit interview questionnaire requests that students rank the overall CVEEN curriculum in terms of how it addresses each student outcome (A-L). For example, a ranking of 5 means that the student strongly agrees that the student outcome has been met by the CVEEN curriculum. Likewise a ranking of zero means that the student strongly disagrees that the student outcome has been met. A graphical representation of the tabulated results of the exit surveys is shown in Figures 4A2-1 and 4A2-2 for the 2013-2014 and 2014-2015 academic years, respectively. These figures show the mean value for each outcome as a bar graph and the mean minus one standard deviation response value as a line graph. In addition, an average rating of 2.5 is considered to be a neutral score in that it indicates neither agreement nor disagreement that the outcome has been adequately covered by the curriculum.

Based on this information it is clear that, on average, CVEEN students believe that the curriculum is covering the student outcomes in an adequate manner. The average rating for all outcomes ranges from about 3.5 to 4.3. However, an “adequate” average ranking may not be a desirable performance goal in that it only represents a mean value. Perhaps a more useful measure is to select a performance goal based on an 80 to 90 percent favorable ranking. Such a goal would suggest that 80 to 90 percent of the students believe that the outcome has been adequately addressed by the CVEEN curriculum.

To this end, the mean minus one standard deviation value represents a 84th percentile value in that 84 percent of the data will be found above this critical value and 16 percent will be found below. Hence, the mean minus one standard deviation value represents a value where 84 percent of the ratings are found above this value, or in other words, 84 percent of the students gave a favorable ranking. The figures presented below show that the mean minus one standard deviation line generally falls on the favorable side of the outcome rating (i.e., rating is higher than 2.5). This suggests that most (i.e., 84 percent, or more) of the students have a favorable impression that the outcome is met for these cases where this line falls above 2.5 neutral line.
However, this conclusion is not strictly true for all outcomes. It is not true for outcomes K and L during the 2013-14 academic year and for outcome L during the 2014-2015 academic year. These have mean minus one standard deviation values which fall slightly below 2.5. Outcome K deals with the application of engineering tools and outcome L is an outcome addressing ASCE criteria such as management, business, policy and leadership topics. These preliminary data suggest that CVEEN should look into strengthening the topics that address these outcomes in the curriculum.

Figure 4A2 – 1 Results of student outcome ranking from exit interviews (2013-2014)
Figure 4A2-2 Results of student outcome ranking from exit interviews (2014-2015)
3. Assessment and Improvements to CLEAR program and CVEEN 3100

a) Overview

From its inception, the CLEAR Program has maintained an archive of student assignments (written and oral), course evaluations, and end-of-semester reports written by former CLEAR instructors. This section accounts for developments made to CVEEN 3100 from the last ABET review (fall 2009) until this review (fall 2015) and satisfies the Continuous Improvement criterion as discussed below. The discussions and issues identified in this section were generated using end-of-semester reporting data from CLEAR Program instructors over this time period and summarizes how the continuous improvement process has evolved since the last review.

b) Key Milestones in Improvements

At the end of every semester, CLEAR instructors submit a report detailing their collaboration with the Department of Civil and Environmental Engineering, which includes: a) an explanation of instructional activities, b) strength of collaboration, and c) recommendations for areas of improvement in the course. In addition to instructors’ reports, information from end-of-semester meetings with faculty members as well as course evaluation data is compiled and archived with the CLEAR Program and distributed to the CVEEN chair to help guide future collaboration.

The key milestone highlighting continuous improvement in the Department occurred in fall 2014. Prior to this semester, CVEEN 3100 was co-taught between a CVEEN faculty member and a CLEAR Program teaching assistant(s) (TAs). Beginning in fall 2014, however, an associate instructor (Joshua B. Lenart, PhD) with the CLEAR Program was hired full-time and became the sole instructor of record for this course. This development has directly affected the development of students’ technical communication skills while executing more effective multidisciplinary team work, and encouraging the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Evaluations contained in the next section accounts for how many of past instructors’ teaching and course design recommendations have been addressed and corrected with this new course model. The most significant improvement is a dedicated CVEEN 3100 instructor, which has greatly improved the continuity and quality of this course.

c) Semester-by-Semester Improvements to CVEEN 3100

In response to the fall 2009 ABET review, CLEAR Program TAs continued to partner with CVEEN faculty to co-instruct CVEEN 3100. While the course benefitted overall from the partnership between the College of Engineering and the College of Humanities, continuity difficulties surfaced among course objectives and learning outcomes; assessment and evaluation procedures; and course themes, trends, and teaching materials. Figure 4A1-1 highlights instructor recommendations during this time period. The general
tenor of these semester reports demonstrates general improvement and success overall, but a deepening sense of frustration among CLEAR TAs and CvEEN faculty due to complications associated with: teaching authority, uneven workloads and evaluation responsibility, and miscommunication between incoming and existing instructors. For example in spring 2013, shortly before the decision was made to redesign the course model, one CLEAR instructor recommends:

[S]upport the creation of a pass-off folder and process for the engineering instructor so that valuable information and gains aren’t lost from semester to semester, allowing the CLEAR Writing Instructor to focus on making improvements to lessons, materials, and delivery formats.

While a “pass-off” folder was created to address the issue, its use and updating were inconsistent among CvEEN faculty members. Table 4-3 accounts for the course-level instructor recommendations which, ultimately, led to the departmental-level change (F2014) to continually improve student-learning outcomes.
Timeline of CLEAR Instruction in CvEEN 3100

- **Fall 2009**: Study Begin
- **Spring 2010**: ABET Review
- **Fall 2010**: Report Unavailable
- **Spring 2011**: Recommend: Designate CLEAR TAS Course Designers/Assignment & Lecture Consistency
- **Fall 2011**: Unresolved Tensions: Grading Inconsistency/Poor Continuity Between CEVEEN Faculty
- **Spring 2012**: Industry Consultant as Co-Instructor/Academic Authority Confusion Persists
- **Fall 2012**: Request: Standardization Across All Levels
- **Spring 2013**: Study Begin
- **Fall 2013**: UNRESOLVED TENSIONS: 3 INSTRUCTORS/UNEVEN TEACHING LOAD
- **Spring 2014**: Study Begin
- **Fall 2014**: New CLEAR Model Piloted
- **Spring 2015**: Study End
- **Fall 2015**: ABET Review

Figure 4A1-1
B. Continuous Improvement

1. CVEEN Continuous Improvement Process

Other than the CLEAR program, which is jointly administered between CVEEN and COE, the primary individuals, groups and committees of CVEEN involved in the continuous improvement process of the CVEEN curriculum and program are: (1) course instructors, (2) discipline groups (i.e., Infrastructure, Transportation, Water and Environmental), (3) Undergraduate Committee (UG), (4) CVEEN Chair and the CVEEN EXCOM committee, (5) CVEEN students and (6) CVEEN IAB.

Motions to make changes to the CVEEN program, or its courses, come from these various individuals, groups and committees. For example, an individual course instructor, based on a course-level assessment and evaluation may make a recommendation for potential changes to course content by discussing the potential motion within their discipline group. The recommendation, or motion, if favorable, is in turn brought by the discipline group representative to the UG committee for further deliberations and potential action. If approved, the UG committee brings the recommendation to the full faculty body for additional discussion, potential approval and implementation.

In addition, each CVEEN course is considered by the respective discipline group that has the appropriate expertise for the subject matter. Course syllabi are reviewed and integrated with the expectations of prerequisite knowledge and with the expected outcomes necessary to serve more advanced courses in the Program. A course coordinator/instructor is assigned to each course to assist in selecting textbooks and course activities (e.g., lectures, lab and field experiences, etc.). At the end of each semester, courses are evaluated using course data, student evaluations, peer evaluations, exit interviews, etc. When improvements in quality are identified, efforts are made to immediately improve the course and structural changes are considered using the processes described in the previous paragraphs.

The UG Committee meets monthly and serves as the primary vehicle for evaluating the CVEEN undergraduate program with respect to developing or modifying degree requirements. Activities of this committee often include: offering improvements to the curriculum, reviewing academic requirements, assisting in the accreditation process and reviewing petitions submitted to the Department by undergraduate students.

The discipline groups with CVEEN meet on a monthly basis to discuss various issues brought forth by group members, or by CVEEN IAB, or by the department chair. These groups also review graduate student applications for admissions into the University.

The CVEEN Executive Committee (EXCOM) has the responsibility of identifying and advancing opportunities to improve departmental operations including, but not limited to, developing new and modifying existing departmental policies and procedures with respect to faculty and students consistent with College and University guidelines.
The faculty meet as a body once a month to discuss and approve or deny motions brought forth by other groups or committees. In the case of curriculum modifications, these are approved by a majority vote of the faculty. (See also Criterion 6.E). All faculty body actions are documented in monthly faculty meeting minutes, which are available to the review team upon request.

2. Continuous Improvements Actions by CVEEN

This section describes continuous improvement actions made by CVEEN since the 2009 ABET visit. These items have been categorized by chronological order according to the following categories for convenience: (1) Students, (2) Program Educational Objectives, (3) Student Outcomes, (4) Curriculum, (5) Faculty, (6) Facilities, and (7) Institutional Support. The associated continuous improvement forms can be found in Attachment 3. Summaries of these actions are provided in the following section.

Because CVEEN has an “open door” policy in terms of potential changes or suggestions to the Program, the motion for change may also originate from individual course assessments / evaluations, senior exit interviews, or recommendations or motions made by various other committees (e.g., CVEEN undergraduate committee, EXCOM, IAB, CVEEN’s student advisory council (SAC), and other COE committees). These motions are reviewed and voted on by the faculty before any implementation.

CVEEN uses a continuous improvement form to organize and tabulate these suggestions, recommendations or motions originating from these various sources. This form is available to faculty at the following: http://www.civil.utah.edu/~bartlett/ABET/ABET%20improvements%20form.doc. The recommendations and actions contained on these forms have been summarized in the following section. Copies of these forms are also found in Attachment 3.

Also, a few of the actions (i.e., Sections 4B2bii and 4B2dix) have undergone an evaluation (Section 4B3a and 4B3b) which examines the potential consequences of these recent changes to the CVEEN program. The first section deals with the adoption of the COE math sequence and the second deals with changes in graduation policy regarding the FE exam.
a) Students

i. Fall 2010 - Revision to minimal acceptable course grades for major status

Prior to 2010, the requirement for major status in the department allowed a C- or better grade in the following 1000 and 2000 level courses.

MATH 1220 Calculus II
MATH 2210 Calculus III
MATH 2250 Ordinary Differential Equations & Linear Algebra
PHYS 2210 Physics for Scientists & Engineers I
CHEM 1220 or CHEM 2310 or PHYS 2220
General Chemistry II or Organic Chemistry or Physics for Scientists & Engineers II
CVEEN 1000 Introduction to Civil & Environmental Engineering
CVEEN 2010 Statics
CVEEN 2140 Strength of Materials
ME EN 2020 Particle Dynamics
CP SC 1000 or CH EN 1703 or Numerical Methods
MG EN 1050 Technical Communication (Auto-CAD)
MG EN 2400 Introductory Surveying
LEAP 1100 Community as Ideas Experience: America Prospective

The requirement was changes so that all math courses require a C or better in the following list. The remaining courses must be passed with a C- or better

MATH 1220 Calculus II
MATH 2210 Calculus III
MATH 2250 Ordinary Differential Equations & Linear Algebra
PHYS 2210 Physics for Scientists & Engineers I
CHEM 1220 or CHEM 2310 or PHYS 2220
General Chemistry II or Organic Chemistry or Physics for Scientists & Engineers II
CVEEN 1000 Introduction to Civil & Environmental Engineering
CVEEN 2010 Statics
CVEEN 2140 Strength of Materials
ME EN 2020 Particle Dynamics
CP SC 1000 Engineering Computing
MG EN 1050 Technical Communication (Auto-CAD)
MG EN 2400 Introductory Surveying
LEAP 1500 LEAP Seminar in Humanities for Engineers

This change to the math course minimum grade requirement was done to raise the performance and quality of student entering into the CVEEN program. The undergraduate committee and faculty felt that this was necessary in order for students to reasonably maintain a minimum GPA of 2.50 (departmental requirement) and to improve students’ preparation.
Prior to 2012, the requirement for major status in the department allowed a C- or better grade in the following 1000 and 2000 level courses. In addition, all math courses require a C or better.

MATH 1220 Calculus II
MATH 2210 Calculus III
MATH 2250 Ordinary Differential Equations & Linear Algebra
PHYS 2210 Physics for Scientists & Engineers I
CHEM 1220 or CHEM 2310 or PHYS 2220
General Chemistry II or Organic Chemistry or Physics for Scientists & Engineers II
CVEEN 1000 Introduction to Civil & Environmental Engineering
CVEEN 2010 Statics
CVEEN 2140 Strength of Materials
ME EN 2020 Particle Dynamics
CP SC 1000 Engineering Computing
MG EN 1050 Technical Communication (Auto-CAD)
MG EN 2400 Introductory Surveying
LEAP 1500 LEAP Seminar in Humanities for Engineers

This was changed in fall semester 2012 to require a grade of C or better must be achieved in Math, Physics, Chemistry. All other courses remained with a C- or better requirement (see list below).

CHEM 1210 General Chemistry I
CVEEN 1000 Introduction to Civil Engineering
CVEEN 2010 Statics
LEAP 1501 Engineering LEAP
MATH 1210* Calculus I
MATH 1220** Calculus II
PHYS 2210 Physics for Scientists & Engineers I
WRTG 2010 or ESL 1060
CS 1000 Engineering Computing
CVEEN 2140 Strength of Materials
LEAP 1500 Engineering LEAP
MATH 2210 Calculus III
CVEEN 2130 Statistics/Economics
MATH 2250 ODE’s
MG EN 2020 Particle Dynamics
MG EN 1050 Technical Communication
MG EN 2400 Surveying
The change in the minimum grade requirement was done to raise the performance and quality of student entering into the CVEEN program. The undergraduate committee and faculty felt that this was necessary in order for students to reasonably maintain a minimum GPA of 2.50 (departmental requirement) and to improve students’ preparation.

Sponsored by the CVEEN undergraduate committee

Implemented fall semester 2012

iii.  **Fall 2014 - CVEEN Academic Misconduct Policy**

It is recommended that CVEEN adopted its own academic misconduct policy that is consistent with that of the University ([http://regulations.utah.edu/academics/6-400.php](http://regulations.utah.edu/academics/6-400.php)).

The U of U defines academic misconduct as disreputable activities involving cheating, plagiarizing, research conductivity, misrepresenting one’s work, and inappropriate collaboration.

The draft policy includes: (i) definition of Academic misconduct, (ii) sanctions and appeals, (iii) instructor responsibilities, (iv) student responsibilities, (v) acknowledgement form.

Sponsored by Ad-hoc subcommittee of the undergraduate committee worked on this policy with input from Chair.

Draft document was discussed in Dec. 2014 faculty meeting. Revisions are being considered, but a final version has not been approved.

**b) Program Educational Objectives**

i.  **Fall 2014 - Revision of CVEEN program education objectives**

Based on recommendations by CVEEN undergraduate committee and the COE ABET committee, it was decided that the CVEEN program objectives developed in 2009 needed to be updated. It was felt that the objectives need to reflect the changes in CVEEN and eliminate some of the unclear language used in the 2009 version. Draft objectives were presented to the faculty in fall semester 2014 retreat, and voted on and approved. These were also presented to the IAB in spring semester 2015.

Sponsored by CVEEN undergraduate committee and COE ABET committee

Implemented fall semester 2014.

ii.  **Fall 2014 - Revision to FE graduation requirement**
The Dean and the College of Engineering made the recommendation that all departments consider dropping the passing of the F.E. as a requirement for graduation. The 2008-2010 and the 2010-2012 handbooks list the following requirement.

“The Department faculty considers the passing of the FE exam to be an important step in an individual’s progress towards professional practices. The faculty also considers the pass of this exam as a demonstration of the quality of the basic engineering capabilities of each student. The Department requires that prior to graduation each student either pass the FE exam or demonstrate a serious attempt to pass the exam by taking it at least 3 times and submit a copy of all exam results with the Academic Program Specialist (2008-10, 2010-2012 and 2012-2014 Handbooks).”

This proposal was sponsored by the COE. The Dean discussed the COE recommendation with CVEEN faculty and a vote was held by CVEEN faculty during fall semester 2014, which revised the policy. The revised policy given below was implemented during fall semester 2014 semester.

“The Department faculty considers the passing of the FE exam to be an important step in an individual’s progress towards professional practice. The faculty also considers the passing of this exam as a demonstration of the quality of the basic engineering capabilities of each student. The Department highly encourages students to take the exam prior to graduation, as it is an important step for a career in civil engineering (2014-16 CVEEN handbook).”

c) Student Outcomes

i. Fall 2014 - Revision of CVEEN Outcome Assessment Matrix

The CVEEN assessment matrix adopted as part of the 2009 ABET review cycle has a number of course with repetitive assessments. In order to simplify this and to decrease the faculty burden regarding assessment a simpler matrix was adopted as part of 2014 Faculty Retreat.

CVEEN undergraduate committee and COE ABET committee

Implemented fall semester 2014.

d) Curriculum

i. Fall 2009 - Splitting of Concrete and Steel I (CVEEN 3320) into Two Courses

It was recommended to split the four semester hour CVEEN 3320 Concrete and Steel course into two separate 3-semester hour courses. CVEEN 3320 had too much course content to be counted as a 4 semester hour course and the topics were somewhat unrelated. In addition, CVEEN 3220 was required of all CVEEN students. However, it was recommended that the new courses (i.e., Concrete I and Steel I) become technical
electives in the program at the 4000-level. Structural Analysis I (CVEEN 3210) was retained as a required course for all CVEEN graduates and the entry level required course for all structural emphasis students.

Sponsored by: student exit interviews and course evaluations

Discussed in fall semester 2009 Faculty Retreat and implement in fall semester 2010. The new course designations are CVEEN 4221 (Concrete I) and CVEEN 4222 (Steel I).

**ii. Fall 2010 - Addition of Courses to Meet Additional Science Requirement**

The list of additional science courses was expanded from:

- CVEEN 5110 GIS in Civil Engineering
- CVEEN 5630 Ecological Systems and Engineering
- CVEEN 5700 Nuclear Engineering I, with Lab
- CVEEN XXXX Environmental Microbiology

Stated in fall semester 2010 - Addition of Courses to Meet Additional Science Requirement

- CVEEN 5110 GIS in Civil Engineering
- GEO 1110 Introduction to Earth Systems
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- NUCL 3000 Nuclear Principals in Science
- NUCL 3200 Radiochemistry

Sponsored by undergraduate committee and taken to faculty

The new list was approved by faculty and adopted into the CVEEN 2010 – 2012 Handbook.

**iii. Fall 2010 - CVEEN 3310 (Geo 1) Course Changes**

The 2nd Edition of Introduction to Geotechnical Engineering was released in Oct. 2010. It was recommended that CVEEN 3310 adopt this new edition and adjust its curriculum to be consistent with this textbook.

Sponsored by Geotechnical faculty within Infrastructure Group

The 2nd Edition textbook was adopted into the curriculum in spring semester 2011. The course content was slightly adjusted to better match the new content of this edition. The adjusted curriculum can be found at: [http://www.civil.utah.edu/~bartlett/CVEEN3310/](http://www.civil.utah.edu/~bartlett/CVEEN3310/)

**iv. Fall 2010 - Revision to programming languages taught in CS 1000**

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Exit interview indicate that students’ were dissatisfied with part of CS 1000 curriculum. In specific, there was criticism regarding the teaching of C programing language that was taught during the second part of the semester. Civil engineering students saw little value in learning C, especially since it was not used or reinforced in any significant in the remainder of the CVEEN curriculum.

The undergraduate committee discussed the issue and decided that it would be more appropriate if calculations were taught using spreadsheets during the 2nd part of this course. It agree that CS 1000 should continue in the teaching of MATLAB during the first part of this course.

Sponsored by exit interviews, the Chair and the Undergraduate Committee

The curriculum was changed in 2011 by the CS department. The following is the 2011 revised course description. This course is an Introduction to programming principles and engineering problem solving via computational means using MATLAB and Spreadsheets. This course teaches how to apply programming to solve Engineering problems (e.g., data visualization, stochastic simulation, selected numerical techniques, image manipulation ...). Students will be taught how to transform real world problems into programs using proper data representations, functions, and control structures. Clean programming practices will be emphasized.

v. **Summer 2012 - Faculty Lead Study Abroad – CVEEN 5920**

Offer the first ever faculty lead study abroad class in the college of engineering.

Sponsored by the Water and Environmental Group

A seed grant was requested to and granted by the Office of International Studies in 2011 to develop a faculty lead study abroad course during the summer term. The instructors, Pedro Romero and Steve Burian, traveled to Costa Rica where they studied their sustainability practices then incorporate their learning and contacts into a study abroad program. The curriculum was developed for the class and voted by the faculty to count as a one-time technical elective. During the summer term of 2012, the instructors and 24 students (18 of which were civil engineers) traveled to Costa Rica for over 3 weeks where they visited the power generating infrastructure, their transportation network, and a few examples of self-sustainable communities.

vi. **Fall 2012 - Addition of Courses to Meet Additional Science Requirement**

The list of additional science courses was expanded from:

- CVEEN 5110 GIS in Civil Engineering
- GEO 1110 Introduction to Earth Systems
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- NUCL 3000 Nuclear Principals in Science
- NUCL 3200 Radiochemistry

to
- BIOL 2010 Evolution & Diversity of Life
- BIOL 3460 Global Environmental Issues
- GEO 1110 and GEO 1115 Introduction to Earth Systems & Introduction to Earth Systems Lab
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- MSE 2160 Elements of Material Science & Engineering
- NUCL 3000 Nuclear Principals in Science
- NUCL 3200 Radiochemistry

Sponsored by the undergraduate committee

These changes were made to offer basic science course options to students that are consistent with the program objectives.

The new list was approved by faculty and adopted into the CVEEN 2010 – 2012 Handbook.

vii. **Summer 2013 – Changes to CVEEN 1000 Team Historic Projects**

The primary course project will be the student team-based research and presentation of a term-length project focused on an assigned historic civil engineering project. This new student project replaces small “design” projects. The course schedule will be refocused to enable in-class presentations (30 minutes each for 16 teams; 4 to 5 weeks of presentations) and to enable in-class time in the first half of the semester for teams to work together and receive feedback on the drafts of their work.

Sponsored by Faculty discussion

Implemented in fall 2013.

viii. **Fall 2013 - Adding ECON 2010 and ECON 2020 to Gen Ed Requirements**

Add ECON 2010 and ECON 2020 (Micro and macro Economics) as the recommended General Education, Intellectual Exploration courses recommend for civil engineering students.

Sponsored by general faculty discussion based on feedback from exit interviews and course evaluations.
A review was made of the curriculum and it was decided that recommending ECON 2010 and ECON 2020 as the preferred Gen Ed classes was appropriate. Students can still opt out and take other general education courses; however, those that follow the Handbook recommendation would take these two classes.

This recommendation was approved by faculty in spring semester 2014 and implemented in the 2014-2016 CVEEN Handbook.

ix.  **Fall 2013 - Adoption of COE Math Sequence**

The College of Engineering Math Committee has been working for the past few years to improve the quality and content of the calculus sequence. In conjunction with the math department, a new sequence of courses is now recommended for all engineering students.

The COE math sequence is: Math 1310 (Calc. I), Math 1320 (Calc. II), Math 2250 (Calc. III w/ ODEs), Math 3140 (Vector Calc. and PDEs).

The sequence replaces the previous sequence of: Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III) and Math 2250 (ODEs).

However, transfer students still have the option of completing the regular math sequence. In addition, if they have not had PDEs then they also must enroll in Math 3150 (PDEs).

Sponsored by the College of Engineering Math Committee
The new COE math sequence was implemented in the CVEEN 2014 Handbook

x.  **Spring 2014 - Addition of Materials Sustainability Class – CVEEN 5550**

Create a new course to introduce students to the concepts of sustainability in civil engineering applications.

Sponsored by the University Sustainability curriculum initiative and general faculty discussions

A special topic class was offered on spring semester 2014. Based on the student feedback and the instructor’s assessment of the class, changes were made and a new curriculum was developed and reviewed by both the infrastructure group and the transportation group. Also, a University-level group meets once a month to discuss the incorporation of sustainability instruction at different levels also provided feedback about the class. Based on this input, CVEEN 5550 was created and approved by the faculty during fall semester 2014 to count as a primary technical elective in the area of Materials.

xi.  **Summer 2014 – Changes to CLEAR support for CVEEN 4910 and CVEEN 3100**
The College of Engineering restructured the CLEAR program. It was decided to remove CLEAR support from the instruction of CVEEN 4910. CLEAR would be the sole instructor of CVEEN 3100.

Sponsored by COE recommendation/initiative

**Brief discussion of implementation strategy and timeline:**

The curriculum of CVEEN 4910 was restructured to include more design content in the course. This was done because of two reasons: (1) more design content could be added because some of the writing and presentation exercises sponsored by the CLEAR instructors have been reduced, (2) student feedback from the exit interviews suggest that there was some overlap between the content of CVEEN 3100 (technical communication) and CVEEN 4910. This duplication has been eliminated.

**xii. Fall 2014 - Changes to CVEEN 4910 due to CLEAR support being withdrawn**

The College of Engineering withdrew CLEAR instructional support for CVEEN 4910 course starting the 2014-2015 academic year. Hence, the teaching intensive writing and presentation skills were reallocated and reformatted.

Change required as mandated by the COE

Effective in fall 2014.

Without CLEAR support, the instructional team has been reduced by 50%. The project requirements for Proposal, Feasibility Study, and Preliminary Engineering Report will be re-focused. The course will become far less structured in the sense that the prior format required a highly tight schedule of moving pieces and parts in order to move students through three very fast moving products in one semester. In the new format, the students will be focused on developing a variety of design concepts (alternatives) and begin to flesh them out. In essence, they will be doing the same thing as before but without as much formal structure to the process and without near as much pressure to produce a product for which they have little background, preparation, and experience.

**xiii. Spring 2015 - Splitting of CVEEN 2130 into 2 courses**

This proposal recommends the splitting of CVEEN 2130 into two separate courses. One would focus on Engineering Economics and the other would deal with topics related to engineering statistics.

Sponsored by Student feedback, course evaluations, discussion amongst undergraduate committee

In spring semester 2015, the faculty approved the splitting of the 4-semester hour course CVEEN 2130 (Statistics and Economics) into two separate courses. As currently constituted, each of these topics is taught during one block (i.e., during one-half of the
semester). However, the new courses consist of 2-semester hours each, and will be taught for the full duration of the semester. This change will be implemented during the 2015-2016 academic year.

e) Faculty

i. Fall 2013 - ABET Workshop for Faculty

A workshop was recommended for training of faculty about the ABET review process, assessment and evaluation.

Sponsored by the undergraduate committee

An ABET workshop was held during fall semester 2014. This was held in two sessions. The course material can be found at:

http://www.civil.utah.edu/~bartlett/ABET/ABET%20CVEEN%20presentation.pdf

ii. Fall 2014 - Establishment of CVEEN Faculty Mentoring Committee

The University Retention, Promotion and Tenure (RPTP Standards Committee has adopted the below statement as a guide for departments in determining their criteria and indicators of good teaching for use in RPT decisions.

Evaluation of teaching effectiveness should not consist solely of student evaluations, though student satisfaction with teaching methods and course administration is one component of effective teaching. The University of Utah and Faculty Senate recently elected to amend policy to make Peer Review of Teaching Effectiveness required. Expert review of teaching effectiveness is also recommended.

Sponsored by the University RPT Standards Committee and CVEEN EXCOM

CVEEN established a mentoring committee to help in instruction and RPT process. This committee was established spring semester 2015.

f) Facilities

i. Spring 2010 - Allocation of teaching space for 3510 Materials Lab

Provided a dedicated space for the instruction of CVEEN 3510 Materials lab.

HEDCO room 110 was cleared and remodeled to provide a dedicated space for the materials lab. Counter space was made available for students to work in groups, discuss
calculation, use their laptops, etc. The equipment was set up in one place so it is readily available.

Sponsored by student feedback from course evaluations

Once the space was cleared, classes are held on the space every year.

**ii. Summer 2010 - Upgrading of Equipment in CVEEN 3310 Lab**

The recommendation entails upgrading some of the laboratory equipment in the Geotechnical Laboratory

Sponsored by student feedback obtained from course evaluations and from exit interviews. Also sponsored by the geotechnical faculty.

Grant monies were obtained from the College of Engineering to purchase select new equipment. The instructors identified the follow items for replacement.


Items 1 through 6 were purchased and installed in the CVEEN 3310 Lab in fall semester 2010; Item 7 was installed in fall semester 2012.

**iii. Fall 2010 - New Facilities in Meldrum Civil Engineering Building**

The EMRL building was modified with a new addition to host CVEEN. It was named the Meldrum Civil Engineering Building (MCE). This new addition added new department and faculty offices, student study areas and conference rooms.

The MCE Building was constructed in part from a $3.3 million lead gift for its department of civil and environmental engineering. The gift, from U of alumnus Floyd Meldrum and his wife Jeri, of Las Vegas, Nevada, was the cornerstone in a $5 million campaign to strengthen civil engineering.

The new addition was occupied in fall semester 2010.
3. Evaluation of Select Continuous Improvement Actions

a) Evaluation CVEEN FE Exam Pass Rate

The changes to the CVEEN policy regarding the use of the FE exam as a graduation requirement (Section 4B2bii) constitute an important change in policy within CVEEN. The discussion in this section offers a very preliminary evaluation of the possible effects of this policy change.

Prior to 2014, CVEEN pass rates for the FE exam ranged from slightly to somewhat lower than the national average, as indicated by Figure 4B2-1. However, as a result of the change to the FE exam graduation requirement in 2014, the CVEEN FE pass rate is comparable to the national average. However, the number of students attempting the exam has significantly decreased due to removal of the graduation requirement (Figure 4B2-2).

In faculty discussions about the interpretation of these data, the following ideas have been put forth:

1. CVEEN students may be less prepared to pass the exam than their counterparts at other universities.
2. The lower CVEEN FE exam scores prior to 2014 might be a result of the 2009 to 2014 CVEEN policy of requiring the students to take the exam at least 3 times. Some CVEEN students, in order to meet this 3-attempt requirement, may have been taking the exam rather early in their academic career before they were fully prepared to pass the exam.
3. Marginal students, attempting to meet the CVEEN 2009 to 2014 policy, may have been taking the exam; whereas at other Universities similar students at other institutions would not be attempting the exam because it was not a graduation requirement.

More temporal data and in-depth evaluations are required to see the effects of the policy change on the students’ performance. However, one thing is clear the CVEEN must continue to emphasize the importance of taking the FE exam as part of career development and encourage more students to complete this exam while at the University.
Figure 4B2-1 CVEEN FE Pass Rate Compared with National Average

Figure 4B2-2 Number of CVEEN Students Attempting FE Exam
b) Evaluation of COE Math Sequence

The following section is an evaluation of the new COE math sequence, as completed by the U of U Math Department. It concludes that the COE engineering and traditional math sequences have roughly similar grade distributions and pass rates, with grades and pass rates just moderately higher for the engineering track.

Professor Will Nesse of the U. of U. Department of Mathematics has been largely responsible for staffing, monitoring, improving, and assessing the engineering math track used by the COE. It was originally hoped that the engineering track would include engineering applications. These applications were to be the focus of the labs or recitation sections and were initially developed by a handful of faculty in engineering. It soon became apparent, however, that the engineering examples required background that most students did not have. For this reason the applications for the engineering track have been chosen primarily from physics. This approach works better because the students are generally taking PHYS 2210 and 2220 at the same time they are taking 1320 and 2250. The text chosen for 1310 and 1320 (James Stewart, Calculus: Concepts and Contexts, 4 ed. (2010)) also emphasizes applications to physics.

Professor Nesse’s evaluation of the engineering sequence is summarized here. His analysis ignores honors students, includes transfer students, and covers the fall semester 2012 to summer 2014 semesters. It includes engineering students from multiple departments, not just CVEEN. He tracked all of the courses listed in Table A – 1 and looked at pass rates, grade distributions, the time to go from 1210/1310 (Calc I) thru 2250 (LA & DEs), and the time to go from 1210/1310 (Calc I) thru 3140/3150 (PDEs). His results are summarized in Figures A – 1 to A – 3 and are discussed below.
In general, the pass rates for the engineering track are better than or equivalent to those for the traditional track. Figure A – 1 shows that in 1210/1310 (Calc I) the pass rates (grade of C or better) are 70% and are similar for the two tracks, but in 1220/1320 (Calc II) the pass rates in the engineering track are significantly higher: 88.1% versus 72.6%. The grade distributions in 1210/1310 are nearly identical but in 1220/1320 there are significantly more A’s and B’s in 1320. This may be because the topics in 1320 partially overlap with those in PHYS 2210 (Physics for Scientists and Engineers I) so that the students in 1320 are being exposed to some topics twice.
Figure A – 2. Pass rates and grade distributions for MATH 2250 (LA & DEs), 2210 (Calc III), and 3140/3150 (PDEs).

The pass rates and grade distributions for 2250 (LA & DEs) are given in Figure A – 2. This course is shared by the traditional and engineering tracks; the grade distributions are quite similar but the pass rates are 94% for students in the engineering track and 85% for those in the traditional track. The pass rates for 2210 (Calc III) are also given in Fig. A – 2. This course is not part of the engineering track but is commonly taken by transfer students in engineering who do not have access to the engineering track before transferring to the U of Utah. The pass rate is 78%. The pass rates and grade distributions for 3140 (Vector Calc & PDEs) and 3150 (PDEs) are given in Figure A – 2. The pass rates are similar but the grades are considerably higher in 3140.

The number of consecutive semesters from 1210/1310 through 2250 is shown on the left in Figure A – 3. For the traditional track it takes 4.9 semesters while for the engineering track it takes 4.0 semesters. This difference is probably due to the elimination of Calc III (2210) from the engineering sequence. Preliminary data for the number of consecutive semesters from 1210/1310 through 3140/3150 is shown on the right in Figure A – 3. This graph is based on just one year of 3140 students and is therefore provisional in nature. It suggests, however, that there is a large decrease in the time to finish the entire engineering math sequence relative to the traditional sequence.
The puzzling feature of Figure A – 3, showing that a handful of students go through the entire sequence in one or two semesters, is due to students repeating an earlier course for a better grade. In some cases it also happens when students who are returning from two years of an LDS mission decide to take an earlier course as a refresher. These actions cause a bit of confusion in the analysis summarized in Fig. A – 3.

In conclusion, the engineering and traditional math sequences have roughly similar grade distributions and pass rates, with grades and pass rates just moderately higher for the engineering track. Students in the engineering sequence, however, tend to finish their math in one less semester. This is partly due to the elimination of Calc III (2210) from the engineering sequence as shown in Table A – 1. Although these results are not specifically for chemical engineering students, they suggest that the engineering math sequence is providing an effective and efficient route to satisfying the mathematics portion of Outcome (a): an ability to apply knowledge of mathematics. The applications are primarily to problems in physics and there is a nice overlap of mathematical topics in MATH 1320 and PHYS 2210. This overlap is so significant that Math and Physics are exploring braiding the two courses via their recitation sections.
C. Additional Information

Copies of the course folders referenced in Sections 4.A. and 4.B will be available for review at the time of the visit. Other information such as meeting minutes regarding discussions of the evaluations and the corresponding recommendations for action will also be made available.
CRITERION 5. CURRICULUM

A. Program Curriculum

In general, CVEEN delivers its courses on the semester system, except for a few courses taught on a term basis during summer term. There is only one curricular path; however students are allowed to enroll in technical electives, which are primarily taken during the senior year of study. Details about the curriculum can be found in Table 5-1 and in Figure 5-1 and at http://www.civil.utah.edu/ug_program.

The alignment of the Program educational objectives, student outcomes and CVEEN curriculum is shown below (see also Table 4-1). This table shows how the student outcomes support the overall program objectives and how the CVEEN curriculum is structured to support the attainment of the student outcomes.

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Student Outcomes</th>
<th>CVEEN CURRICULUM Supporting Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN graduates will be prepared for the profession of civil and environmental engineering, or related fields, and to apply their knowledge in engineering practice or research</td>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>(a) Application of mathematics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MATH 1310 (Calc. 1), MATH 1320 (Calc. 2), MATH 3140 (Vector Calc. and (PDEs) or MATH 1210 (Calc. 1), MATH 1220 (Calc. II), MATH 2210 and MATH 3150).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Application of Science CHEM 1210, CHEM 1215, PHYS 2210; CHEM 1220 or PHYS 2220 or CHEM 2310; PHYS 2225 or CHEM 1225 or CHEM 2215</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Application of Engineering CVEEN 2010 (Statics), CVEEN 2130 (Statistics and Economics), CVEEN 2140 (Strength of Materials), ME EN 2020 (Dynamics), CVEEN 3210 (Structural Analysis), CVEEN 3310 (Geo I), CVEEN 3410 (Hydraulics), CVEEN 3510 (CE Materials), CVEEN 3520 (Trans I), CVEEN 3610</td>
</tr>
<tr>
<td>(b)</td>
<td>an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>an ability to function on multidisciplinary teams</td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>an ability to identify, formulate, and solve engineering problems</td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td>an ability to communicate effectively</td>
<td></td>
</tr>
<tr>
<td>(k)</td>
<td>an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td><strong>Experimentation</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVEEN 2130 (Statistics and Eng. Economics), CVEEN 3315 (Geo I Lab); CVEEN 3415 (Hydraulics Lab), CVEEN 3510 (CE Materials), CVEEN 3520 (Transportation Eng.).</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td><strong>Design</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVEEN 1000 (Intro), (CVEEN 3410 (Hydraulics), CVEEN 3520 (Trans. Engineering), CVEEN 3610 (Enviro Eng.), CVEEN 4910 (Prof. Practice and Design)</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td><strong>Multidisciplinary Teams</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVEEN 3100 (Technical Communication); CVEEN 3510 (CE Materials), CVEEN 4910 (Prof. Practice and Design)</td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td><strong>Engineering Problems</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All of CVEEN courses except for CVEEN 2/3/4000 (Seminar) and CVEEN 3100 (Technical Communications) (Refer to Table 4-1)</td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td><strong>Communications</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVEEN 1000 (Intro), CVEEN 2010 (Statics), CVEEN 3100 (Technical Communications), CVEEN 3315 (Geo I lab), CVEEN 3415 (Hydraulics Lab), CVEEN 3510 (CE Materials), CVEEN 3520 (Transportation Eng.), CVEEN 4910 (Professional Practice and Design)</td>
<td></td>
</tr>
<tr>
<td>(k)</td>
<td><strong>Engineering Tools</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CVEEN 2130 (Statistics and Economics), CVEEN 3210 (Structural Analysis), CVEEN 3140 (Hydraulics),</td>
<td></td>
</tr>
</tbody>
</table>
| CVEEN graduates are encouraged to seek professional licensure, when appropriate, and to be active in professional organizations, seek opportunities for life-long learning and participate in the betterment of their profession. | (f) an understanding of professional and ethical responsibility | (f) Professional and Ethical Responsibility
CVEEN 1000 (Intro.), CVEEN 2/3/4000 (Seminar), CVEEN 3100 (Tech Comm.), CVEEN 3520 (Trans. Engineering), CVEEN 3610 (Enviro Eng.), CVEEN 4910 (Prof. Practice and Design) |
| --- | --- | --- |
| (i) a recognition of the need for, and an ability to engage in life-long learning | (i) Life-long Learning
CVEEN 1000 (Intro.), CVEEN 2/3/4000 (Seminar), CVEEN 3100 (Tech. Comm.), CVEEN 3520 (Trans. Engineering), CVEEN 3610 (Enviro Eng.), CVEEN 4910 (Prof. Practice and Design) |
| (l) explain the importance of professional licensure | (l) Professional Licensure
CVEEN 1000 (Intro.), CVEEN 2/3/4000 (Seminar), CVEEN 4910 (Prof. Practice and Design) |
| CVEEN graduates are encouraged to seek leadership roles and to be advocates for their profession in solving complex societal issues for the broader good of the community. | (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context | (h) Impact of Solutions
CVEEN 1000 (Intro.), CVEEN 2/3/4000 (Seminar), CVEEN 3100 (Tech. Comm.), CVEEN 3520 (Trans. Engineering), CVEEN 3610 (Enviro Eng.), CVEEN 4910 (Prof. Practice and Design) |
| (j) a knowledge of contemporary issues | (j) Contemporary Issues
CVEEN 1000 (Intro.), CVEEN 2/3/4000 (Seminar), CVEEN 4910 (Prof. Practice and Design) |
Some of the strengths of the technical curriculum are all students must take the following courses as a minimum requirement:

- mathematics through ordinary and partial differential equations and linear algebra
- chemistry, calculus-based physics, a second chemistry or calculus-based physics course and two related labs
- engineering statistics and economics courses
- an additional science course
- at least one 3000-level, or higher, course in 6 areas of civil engineering: structural, geotechnical, water resources, transportation, and environmental engineering, and civil engineering materials. Three of these courses include laboratories.
- at least one additional 3000-level or higher course in four of the above disciplines, except for students engaged in the FASTRAX M.S. degree program
- a capstone professional practice and design course (CVEEN 4910) which is based on learning in numerous previous courses and previous completion of two design technical electives courses
- other design technical and non-design technical electives to ensure a broad experience in more than one civil engineering context

The importance of technical preparation cannot be overemphasized, but leaders in society must have other dimensions that are provided by the professional training experiences related to student outcome L. In this area, the CVEEN program is robust for the following reasons:

- Incorporation of the E-LEAP sequence as a requirement for our entering freshmen. The Learning Engagement Achievement Program (E-LEAP for engineers) is a very successful University College program designed to welcome freshmen into the University community. The E-LEAP sequence consists of a social science foundation course with significant ethics content, that is tailored to engineering and ABET student outcomes, and a humanities/diversity course. In the first course, instructors for all of the departments in the College of Engineering discuss their disciplines with the students. Both courses have a writing emphasis and most students earn an additional credit for “Methods and Technologies for Library Research” The final assignment for the second course requires each student to write a paper on how the E-LEAP courses contribute to the students’ growth towards becoming engineers.
• It is important to set high standards for CVEEN students from the time they enter as freshmen. As a consequence, Pulitzer Prize-winning author, David McCullough’s, seminal history of the Panama Canal, *The Path between the Seas*, is the text for the CVEEN 1000 course. By studying one of the greatest achievements of Civil Engineering, with its failures, successes and global perspective, the entering students are immediately immersed into the importance of professional practice. In this course, the students do most of their assignments as members of teams. Although they do not have the tools that are necessary for engineering design, they are thrust into role-playing design experiences that show them that by teamwork and using their common sense, they can achieve success during their careers. This is done in conjunction with introducing them to the disciplines of civil engineering.

• Inclusion of the College of Engineering’s Communication, Leadership, Ethics, and Research (CLEAR) Program in the instruction of CVEEN 3100. This program provides a Ph.D. instructor to help with instruction, assessment, and evaluation of students in the areas of verbal and written communication, teamwork, and leadership. This program provides support to CVEEN’s undergraduate program.

• Professional practice and design is emphasized in CVEEN 4910. This course is discussed in more detail in item 6 below.

Details of the CVEEN curriculum flow chart are presented in Figure 5-1. This chart shows the sequencing and elements of the curriculum. The CVEEN curriculum is designed to accomplish the CVEEN program education objectives, which are in short to graduate effective civil engineers who will contribute to society as highly educated, licensed professionals and leaders. To this end, the CVEEN technical curriculum has 25% of courses in math and basic sciences and 52.5% in engineering topics. Both of these areas meet the ABET minimum requirements of 25 and 37.5%, respectively.

CVEEN 4910 (Professional Practice and Design) is the capstone and major design experience offered to CVEEN students in their senior year. This course is taught by faculty who are licensed professional engineers (P.E.) or structural engineers (S.E.). Students entering this course have successfully completed CVEEN 3100 (Technical Communications) and two design technical electives. In addition, many have additional professional training provided by CVEEN 1000. The sequencing of these courses (CVEEN 1000, 3100 and 4910) with high standards for mentoring, coupled with the knowledge gained in other technical 3000, 4000 and 5000-level courses instills confidence and an expanding perspective within the students. Further, CVEEN 4910 students receive additional topics to aid them in becoming effective civil engineers and contribute to society as highly educated, licensed professionals and leaders. This design and professional practice training sequenced through the curriculum is consistent with CVEEN program educational objectives.

CVEEN 4910 is designed to require that students take a very loosely defined problem statement, and synthesize it into a series of problem statements that can be idealized and explored with alternative solutions. Out of these alternatives, selected solutions are developed upon which the final engineering report is based. The projects are selected from actual cases where the students
can participate in a Service Learning activity involved with interactions with a real client and the subsequent feedback. It is worthy to note that many CVEEN 4910 projects have been or will be implemented by the governmental entity served as part of the learning activities of this class.

Every project selected in CVEEN 4910 has a real world need to be addressed, which is defined in a request for proposal (RFP). At the beginning of the project, the students are divided into discipline or functional teams usually consisting of three to four members. There is also a project management team which manages the project deliverables and interactions with the discipline teams and the client. Each team has a designated team leader that works with the project management team to execute the various phases of the project. Prior to the start of every semester, a specific project is identified that has a scope suitable for the course. An owners representative is identified that is willing to play that role, and that is motivated to work with the students periodically throughout the semester. These individuals are generally professional engineers that may be employees of a city, a consulting engineering that works for a city, or other interested parties. With the owner’s representative, a Request for Proposal (RFP) is written that outlines the scope of the project. The course is divided into three parts. The first part is that of writing and presenting a response to the RFP. The students are required to carefully respond to the RFP stating what it is that they intend to accomplish. The oral presentation that is made is done by a collection of individuals from the various teams. All class members are required to present once during the semester. The second part is to prepare a feasibility / alternatives study for the project. The third part is to prepare a preliminary engineering report that takes a selected option from the alternatives study and more fully develops the design of the project. Each stage of the project requires that a presentation team develops an oral presentation for that section of the work. To accomplish all of this, there are generally 30 meetings of the class during the fall semester and spring semesters. (The summer term session may have a few less meetings.) Each session is three hours long, and takes place on Tuesday and Thursday of each week. During the three hour block of time many different activities take place that prepare the students for the completion of an upcoming deliverable, communications with team members, and other teams, presentation practices, and formal presentations. Student attendance is mandatory for these sessions.

Representative student work products from this course will be available for the evaluation team. These work products include: proposals with scope of work, feasibility / alternative studies and preliminary engineering reports.

**B. Course Syllabi**

Course syllabi are found in Appendix A. Syllabi are included for each course used to satisfy the mathematics, science, and CVEEN undergraduate requirements as further discussed in this section.
## Table 5-1 Curriculum

Civil Engineering at the University of Utah

<table>
<thead>
<tr>
<th>Course</th>
<th>Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.¹</th>
<th>Subject Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered. Year and, Semester, or Quarter</th>
<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered²</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVEEN 1000, Intro to Civil and Environmental Engineering</td>
<td>R</td>
<td></td>
<td>fall 2013, fall 2014</td>
<td>96, 96</td>
</tr>
<tr>
<td>LEAP 1501, Social and Ethical Engineering (Intellectual Exploration)</td>
<td>R</td>
<td>2</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>CHEM 1210, General Chemistry I</td>
<td>R</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>CHEM 1215, General Chemistry I Lab</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>MATH 1310, Calculus I</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>WRTG 2010 or ESL 1060, Intermediate Writing, or Expository Writing for ESL</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>PHYS 2210, Physics for Scientists and Engineers I</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>LEAP 1500, Humanities for Engineers</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>*CHEM 1220, General Chemistry II or CHEM 2310, or PHYS 2220</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>*PHYS 2215, Physics I Lab or CHEM 1225 lab or CHEM 2315 lab</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>MATH 1320, Calculus II</td>
<td>R</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>CVEEN 2010, Statics</td>
<td>R</td>
<td>3</td>
<td>fall 2014, spring 2015</td>
<td>50, 50</td>
</tr>
<tr>
<td>CVEEN 2130, Engineering Statistics/Economics</td>
<td>R</td>
<td>4</td>
<td>fall 2014, spring 2015</td>
<td>40, 40</td>
</tr>
<tr>
<td>*MSE 2170, Elements of MSE or *ECE 2200, Electrical Engineering for Civil Engineers</td>
<td>SE</td>
<td>1.5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MG EN 2400, Surveying</td>
<td>R</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MATH 2250, ODEs</td>
<td>R</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>CVEEN 2140, Strength of Materials</td>
<td>R</td>
<td>3</td>
<td>fall 2014, spring 2015</td>
<td>30, 50</td>
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</tbody>
</table>

¹ SE is a Selected Elective

² Maximum Section Enrollment

- R: Required
- E: Elective
- SE: Selected Elective

- Math & Basic Sciences
- Engineering Topics Check if Contains Significant Design (√)
- General Education
- Other

- Last Two Terms
- Maximum Section Enrollment for the Last Two Terms
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Type</th>
<th>Credits</th>
<th>Units</th>
<th>Terms</th>
</tr>
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<tbody>
<tr>
<td>CS 1000, Engineering Computing</td>
<td>R</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
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<tr>
<td>*CH EN 2300, Thermodynamics or *ECE 2200, Electrical Engineering for Civil SE</td>
<td>2.0</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>MG EN 1050, Tech. Communication</td>
<td>R</td>
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<td>N/A</td>
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<tr>
<td>MATH 3140, Vectors and PDEs</td>
<td>R</td>
<td>4</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>ME EN 2020, Particle Dynamics</td>
<td>R</td>
<td>2</td>
<td>N/A</td>
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</tr>
<tr>
<td>CVEEN 3000, Junior Seminar</td>
<td>R</td>
<td>.5</td>
<td>fall 2013, fall 2014</td>
<td>85, 85</td>
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</tr>
<tr>
<td>CVEEN 3100, Technical Communication</td>
<td>R</td>
<td>3</td>
<td>fall 2014, spring 2015</td>
<td>37, 40</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3210, Structural Analysis I</td>
<td>R</td>
<td>3</td>
<td>fall 2014, spring 2015</td>
<td>74, 50</td>
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</tr>
<tr>
<td>CVEEN 3410, Hydraulics</td>
<td>R</td>
<td>3</td>
<td>fall 2013, fall 2014</td>
<td>80, 80</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3415, Hydraulics Lab</td>
<td>R</td>
<td>1</td>
<td>fall 2013, fall 2014</td>
<td>60, 60</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3510, Materials</td>
<td>R</td>
<td>4</td>
<td>fall 2013, fall 2014</td>
<td>78, 74</td>
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</tr>
<tr>
<td>CVEEN 3520, Transportation Engineering I</td>
<td>R</td>
<td>3</td>
<td>fall 2014, spring 2015</td>
<td>65, 50</td>
<td></td>
</tr>
<tr>
<td>CVEEN 3310, Geotechnical Engineering I</td>
<td>R</td>
<td>3</td>
<td>spring 2014, spring 2015</td>
<td>88, 50</td>
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<td>CVEEN 3315, Geotechnical Engineering I Lab</td>
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<td>1</td>
<td>spring 2014, spring 2015</td>
<td>86, 50</td>
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</tr>
<tr>
<td>CVEEN 3610, Environmental Engineering I</td>
<td>R</td>
<td>3</td>
<td>spring 2014, spring 2015</td>
<td>80, 60</td>
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</tr>
<tr>
<td>Additional Science Requirement</td>
<td>SE</td>
<td>3</td>
<td>N/A</td>
<td>N/A</td>
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</tr>
<tr>
<td>**Technical Elective</td>
<td>SE</td>
<td>3</td>
<td>See Below</td>
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<tr>
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<td><strong>NUCL 3100, Neutron Based Engineering</strong></td>
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<td><strong>NUCL 4000, Nuclear Science and Engineering</strong></td>
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<td><strong>CVEEN 5820, Project Scheduling</strong></td>
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<td>SE</td>
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<tr>
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</table>

Add rows as needed to show all courses in the curriculum.

**TOTALS-ABET BASIC-LEVEL REQUIREMENTS**

| Minimum Semester Credit Hours | 32 Hours | 67.5 | 24 Hours | 4 Hours |

**OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM**

| 127.5 |

**PERCENT OF TOTAL**

| 25.1% | 52.5% | 18.8% | 3.6% |

Total must satisfy either credit hours or percentage

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.
2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.
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<th>Course</th>
<th>Name</th>
<th>Prerequisites</th>
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<td>CVEEN 1000</td>
<td>Intro to Civil and Enviro Eng.</td>
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<tr>
<td>CVEEN 2000</td>
<td>Sophomore Seminar</td>
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<tr>
<td>CVEEN 2010</td>
<td>Statics</td>
<td>MATH 1210 or MATH 1310 or MATH 1311</td>
</tr>
<tr>
<td>CVEEN 2130</td>
<td>Statistics/Economics</td>
<td>MATH 1210 or MATH 1310 or MATH 1311</td>
</tr>
<tr>
<td>CVEEN 2140</td>
<td>Strength of Materials</td>
<td>CVEEN 2010</td>
</tr>
<tr>
<td>CVEEN 3000</td>
<td>Junior Seminar</td>
<td>none</td>
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<tr>
<td>CVEEN 3100</td>
<td>Tech. Communications</td>
<td>WRTG 2010 or ESL 1060</td>
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<td>CVEEN 3210</td>
<td>Structural Analysis I</td>
<td>CVEEN 2140</td>
</tr>
<tr>
<td>CVEEN 3310</td>
<td>Geotechnical Engineering I</td>
<td>CVEEN 2140, CVEEN 3310 (Co.)</td>
</tr>
<tr>
<td>CVEEN 3410</td>
<td>Hydraulics</td>
<td>CVEEN 2140, CVEEN 3415 (Co.)</td>
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<td>Materials</td>
<td>CVEEN 2140</td>
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<td>CVEEN 3520</td>
<td>Transportation Engineering</td>
<td>CVEEN 2140</td>
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<tr>
<td>CVEEN 3610</td>
<td>Introduction to Enviro Eng. I</td>
<td>CVEEN 2140</td>
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<td>CVEEN 4000</td>
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<td>CVEEN 4221</td>
<td>Concrete Design I</td>
<td>CVEEN 3210</td>
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<tr>
<td>CVEEN 4222</td>
<td>Steel Design I</td>
<td>CVEEN 3210</td>
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<tr>
<td>CVEEN 4410</td>
<td>Engineering Hydrology</td>
<td>CVEEN 3410</td>
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<tr>
<td>CVEEN 4910</td>
<td>Professional Practice &amp; Design</td>
<td>CVEEN 3100, 2 CVEEN Design Courses</td>
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<tr>
<td>CVEEN 5110</td>
<td>GIS Applications</td>
<td>MG EN 1050 and MG EN 2400</td>
</tr>
<tr>
<td>CVEEN 5210</td>
<td>Structural Analysis II</td>
<td>CVEEN 3210</td>
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<tr>
<td>CVEEN 5220</td>
<td>Concrete Design II</td>
<td>CVEEN 4221</td>
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<tr>
<td>CVEEN 5230</td>
<td>Steel Design II</td>
<td>CVEEN 4222</td>
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<tr>
<td>CVEEN 5240</td>
<td>Reinforced Masonry/Timber</td>
<td>CVEEN 3210</td>
</tr>
<tr>
<td>CVEEN 5305</td>
<td>Intro. To Foundation Eng.</td>
<td>CVEEN 3310</td>
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<tr>
<td>CVEEN 5420</td>
<td>Open-Channel Flow</td>
<td>CVEEN 4410</td>
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<td>Highway Design</td>
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<td>CVEEN 5560</td>
<td>Transportation Planning</td>
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<td>CVEEN 5570</td>
<td>Pavement Design</td>
<td>CVEEN 3510, CVEEN 3520</td>
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<td>Water and Waste Water Treat.</td>
<td>CVEEN 3610</td>
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<td>CVEEN 5610</td>
<td>Water Chem. &amp; Lab Analysis</td>
<td>CVEEN 3610</td>
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<tr>
<td>CVEEN 5700</td>
<td>Nuclear Eng. I</td>
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<td>CVEEN 5810</td>
<td>Cost Est./Proposal Writing</td>
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<td>CVEEN 5820</td>
<td>Project Scheduling</td>
<td>CVEEN 3100</td>
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<td>CVEEN 5830</td>
<td>Proj. Mang./Contract Admin.</td>
<td>CVEEN 3100</td>
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<td>CVEEN 5850</td>
<td>Eng. Law</td>
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# Civil Engineering Undergraduate Program—Engineering Math

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<th>Junior</th>
<th>Senior</th>
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<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
</tr>
<tr>
<td>1000* Intro</td>
<td>PHYS 2210*</td>
<td>2010* Statics</td>
<td>3000* Seminar</td>
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<tr>
<td>LEAP 1501* Social &amp; Ethical Engineering</td>
<td>LEAP 1500* Humanities for Engineers</td>
<td>2140* Strength</td>
<td>3310/3315 Geotech I</td>
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<tr>
<td>CHEM 1210* General Chemistry I</td>
<td>CHEM 1220* General Chemistry II</td>
<td>2130* Statistics/Econ.</td>
<td>CS 1000 Eng. Computing</td>
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| CHEM 1215* General Chemistry Lab I | PHYS 2215* Phys for Sci & Engineers Lab I | MSE 2170* Elements of MSE | CH EN 2300* Therm.
| MATH 1310 Eng Calculus I | MATH 1320 Eng Calculus II | MG EN 2400 Surveying | MG EN 1050 Tech. Comm. |
| WRTG 2010 or ESL 1060 | MATH 2250 ODE's | MATH 3140 Engr Vet Calc & PDEs | 3410/3415 Hydraulics |
|                  | ME EN 2020 Particle Dynamics |                | 3510 Materials |
|                  |                   |                 | 3520 Transportation |
|                  |                   |                 |                 |

*LEAP 1501—Fulfills a Social and Behavioral Science requirement. LEAP 1500-Fulfills a Humanities & Diversity requirements. All transfer students must take these courses unless they have 2 or more Humanities and Social & Behavioral Science Courses.

* Students must take CHEM 1210, CHEM 1215, and PHYS 2210 (after MATH 1310). Students must take one additional lab course and it is recommended to take PHYS 2215 but they can take CHEM 1225 or CHEM 2315. Additionally, students must take CHEM 1220, or CHEM 2310, or PHYS 2220. Students should check with their faculty advisors to see which of these options is best for their program.

*This course is only for students who complete the Engineering Math Sequence.

For a list of Technical Elective requirements, see the handbook.

* Additional Science Requirement, see the handbook.

* Must be taken once in a Fall, Spring, or Summer semester.

All students must take 2 Fine Arts, 2 Humanities, and 2 Social & Behavioral Science courses to fulfill the Intellectual Exploration requirements. Associates degrees do not fulfill the department’s requirements automatically.

Updated September 3, 2014

Figure 5-1 CVEEN Undergraduate Program Flow Chart
CRITERION 6. FACULTY

A. Faculty Qualifications

The competency and expertise of the CVEEN faculty constitutes the core to the success of the Program (http://www.civil.utah.edu/faculty). CVEEN faculty are accomplished, dedicated instructors that teach and mentor undergraduate students. Their expertise encompasses a broad spectrum of civil engineering in areas of: structural engineering and mechanics, transportation, water resources and hydrology, environmental engineering, geotechnics, construction materials and engineering management.

In structural engineering and mechanics, the department has 4 core faculty and 1 faculty emeritus. Drs. Pantelides, Chambers, Ibarra and Schmucker have many years of experience in structural analysis and design pertaining to steel and concrete structures. In addition Drs. Pantelides, Bartlett, Ibarra and Schmucker have expertise in seismic design with respect to critical facilities such as nuclear reactors, systems and interim waste storage facilities. Associate instructor Dr. Johnson, S.E., provides expertise in masonry and timber design and is a principal engineer with Reaveley and Associates in Salt Lake City, Utah (http://www.reaveley.com/team.php?id=1). Dr. Reaveley was granted emeritus standing in spring semester 2015 and is no longer instructing courses with CVEEN.

In transportation engineering and planning, the department has 3 core faculty: Drs. Porter, Liu and Fagnant. These faculty have expertise in transportation operations, safety, and planning; systems, transit and highway design.

In water resource and environmental engineering, CVEEN has 6 core faculty: Drs. Barber, Burian, McPherson, Pomeroy, Hong and Goel. The water resource faculty provide expertise in fluid mechanics, hydraulics, surface and groundwater hydrology, and water management and sustainability. The environmental faculty provide expertise in wastewater treatment, bioremediation, tertiary treatment, soil and brownfield remediation and environmental assessment.

In geotechnical engineering and construction materials, CVEEN has 4 core faculty: Drs. Lawton, Bartlett, Romero and Bordelon. The geotechnical faculty have expertise in soil mechanics, geotechnical investigations, design and construction of foundation systems, soil improvement and seismic design. The materials faculty have expertise in material characterization (i.e., concrete and asphalt), evaluations, sustainable infrastructure and design.

Dr. Elizabeth Dudley-Murphy is a Research Assistant Professor affiliated with the Energy Geoscience Institute (EGI) (http://www.civil.utah.edu/murphy). She instructs multiple sections of CVEEN 5110 (GIS) to students interested in spatial analyses, systems and operations.

Lastly, 12 of the 17 CVEEN full-time faculty have professional registrations (e.g., S.E. or P.E.). Of the tenured faculty (associate and full professors), all but two members have professional
registrations. These faculty members have various levels of professional experience with consulting engineering firms, construction companies, public agencies and industry.

**B. Faculty Workload**

CVEEN full-time faculty members are expected to teach at least three 3-semester hour courses during an academic year (Table 6-2). However, some junior faculty members are assigned a lower teaching workload in the first few years of their career. In addition, some tenured faculty members have been assigned a higher instructional obligation, depending on the level of research activity, as assessed annually by the Chair in the faculty activity report (FAR). In addition to undergraduate instruction, tenure-track faculty members conduct extramural funded research and provide service to the profession and community.

**C. Faculty Size**

CVEEN faculty consists of 17 full-time equivalents (FTE), one vacant FTE position (Water and Environmental group) and 3 FTE positions associated with the NEUP (Table 6-1). In addition to these, CVEEN 3100 (Technical Communication) is currently taught by Dr. Joshua Lenart, who is an instructor in the COE CLEAR program. Also, there are other adjunct lecturers, professors and instructors who instruct CVEEN undergraduate technical electives (i.e., non-required 4000-to 5000-level) courses on an as-needed basis. These are: Dr. Jared Johnson, Associate Instructor (CVEEN 5240 – Timber and Masonry), Dr. Elizabeth Dudley-Murphy, Research Assistant Professor (CVEEN 5110 – GIS), Dr. Denis Petersen, Associate Instructor (CVEEN 5280 - Project Scheduling, CVEEN 5830 – Project Management,), Dr. Craig Coburn, Adjunct Associate Professor (CVEEN 5830 – Engineering Law and Contracts) and Ken Ament, Associate Instructor (CVEEN 5810 – Cost Estimating and Proposal Writing).

**D. Professional Development**

All faculty members are engaged in state, national and international professional service through technical committees, training of licensed engineers and professional leadership roles. Many of the younger faculty members have participated in the ASCE ExCEED program (http://www.asce.org/exceed/), which focuses on helping young faculty to become better teachers.

Table 6D1 below shows a tally of the professional development activities completed by the faculty during this review cycle. Additional discussion of CVEEN support for faculty development activities is provided in Section 8E.
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<th>Conference Attendance</th>
<th>Conference Presenter</th>
<th>Workshop/Seminar Attendance</th>
<th>Workshop/Seminar Presenter</th>
<th>Instructional Training</th>
<th>Educational Development</th>
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E. Authority and Responsibility of Faculty

The academic program in civil engineering at the University of Utah is the responsibility of the members of faculty of the Department of Civil and Environmental Engineering (U of U Policy 6-100) (http://regulations.utah.edu/academics/6-100.php) consistent with the mandate by the faculty senate approved program. On an annual basis, CVEEN faculty and staff conduct a review and evaluation of the existing undergraduate curriculum, resources and goals of the program. Pedagogical advances, student ratings, exit interview comments and technical changes in the profession are considered in this review and evaluation. The review and subsequent discussions in the annual fall semester Faculty Retreat lead to improvements in existing courses, greater horizontal and vertical integration of course content, addition of new technical electives and the evaluation of existing standards for progress and graduation.

Where course modification, creation or deletion is desired, the faculty members submit a request to the Department’s Undergraduate Committee. Upon approval of the Undergraduate Committee, the potential changes are considered and approved or denied by faculty vote. If a new course is being created or significant changes to the course are being considered, then the CVEEN approval is forwarded by the chair with these endorsements to the College curriculum committee. This body considers the merits of the new listing or modifications and votes to approve/disapprove the new course or modifications. These actions are then forwarded to the faculty senate for final approval.
<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Highest Degree Earned- Field and Year</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>FT or PT</th>
<th>Years of Experience</th>
<th>Govt./Ind. Practice</th>
<th>Teaching</th>
<th>This Institution</th>
<th>Professional Registration/Certification</th>
<th>Level of Activity</th>
<th>Professional Organizations</th>
<th>Professional Development</th>
<th>Consulting/summer work in industry</th>
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<td>AST</td>
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1. Code:  P = Professor  ASC = Associate Professor  AST = Assistant Professor  I = Instructor  A = Adjunct  O = Other
2. Code:  TT = Tenure Track  T = Tenured  NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.
### Table 6-2. Faculty Workload Summary

**Civil Engineering at the University of Utah**

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT</th>
<th>Classes Taught (Course No./Credit Hrs.) Term and Year</th>
<th>Program Activity Distribution</th>
<th>% of Time Devoted to the Program</th>
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<td>FT</td>
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<td>Bartlett, Steven</td>
<td>FT</td>
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<td>30 45 25 100</td>
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<tr>
<td>Bordelon, Amanda</td>
<td>FT</td>
<td>fall 2014: 3510 (3)</td>
<td>45 45 10 100</td>
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<tr>
<td>Burian, Steven</td>
<td>FT</td>
<td>fall 2014: 3410 (3), 3415 (1)</td>
<td>45 45 10 100</td>
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<td>Chambers, Janice</td>
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<td>Conroy-Ben, Otakuye</td>
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<td>FT</td>
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<td>FT</td>
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<tr>
<td>Faculty Member (name)</td>
<td>PT or FT¹</td>
<td>Classes Taught (Course No./Credit Hrs.) Term and Year²</td>
<td>Program Activity Distribution³</td>
<td>% of Time Devoted to the Program³</td>
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<td>Research or Scholarship</td>
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<td>Peterson, Denis</td>
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1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
CRITERION 7. FACILITIES

A. Offices, Classrooms and Laboratories

1. CVEEN Offices and Facilities

The Department of CVEEN is housed in the Meldrum Civil Engineering (MCE) Building within the COE campus at the University of Utah. CVEEN also has laboratories in the adjacent HEDCO Building and the Merrill Engineering Building (MEB) and instructional classrooms in the Warnock Engineering Building (WEB). In 2010 CVEEN moved into the MCE Building, which is an 11,400 square foot facility that was added on to the Energy and Materials Research Laboratory, i.e., formerly named (EMRL).

This MCE Building was constructed in part from a $3.3 million lead gift to CVEEN. The gift, from CVEEN alumnus Floyd Meldrum and his wife Jeri, of Las Vegas, Nevada, was the cornerstone in a $5 million campaign to strengthen civil engineering. Their gift helped fund a 14,500 square foot expansion of an existing laboratory and office building. The expanded building was renamed the Floyd and Jeri Meldrum Civil and Environmental Engineering Building, in recognition of their total giving to the University which exceeded $3.5 million. In making the gift, Meldrum credited the education he received at the University of Utah and its outstanding faculty.

The MCE Building has two floors, part of which house CVEEN. Facilities and offices within MCE consist of department offices, faculty offices, undergraduate student study areas. CVEEN administrative offices are located on the 2nd floor of MCE in room 2000B. Individual offices for faculty are also located on the 2nd floor of this building. In addition to these, there are conference rooms for faculty and student meetings (Lund Faculty Conference Room and Tikalsky Department Chair Conference) also located on the 2nd floor.

The first floor of the MCE Building is primarily undergraduate study and meeting areas consisting of the: Geneva Rock Study Room (undergraduate study area), CRS Design Center (capstone design), Kiewit Mentoring Room (graduate TA desks and undergraduate advising rooms), Dunn’ Commons Lounge (student lounge area), Layton Conference Room (capstone design) and the CVEEN traffic laboratory.
Meldrum Civil Engineering Building (MCE) North Entrance

Meldrum Civil Engineering Building (MCE) South Entrance
Warnock Engineering Building (WEB)

Geneva Rock Study Room in MCE Bldg.
CRS Design Center for Capstone Design in MCE Bldg.

Kiewit Mentoring Center in MCE Bldg.
Dunn’s Commons Student Lounge in MCE Bldg.

Layton Conference Room (Capstone Design) in MCE Bldg.
2. Classrooms in the Warnock Building

The majority of the College of Engineering undergraduate classes are held in classrooms located in the Warnock Engineering Building (WEB) or the Merrill Engineering Building (MEB). The two buildings are adjacent to one another and connected via an underground tunnel. The capacity of the classrooms varies between 20 students, for more intimate classroom settings, to 262 students for larger lectures. The Warnock Building is a premier teaching facility that has enabled our faculty to advance pedagogy and deliver a higher quality education.

WEB Classrooms

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<td>Audio Visual: LCD Projector, VCR, Overhead, Microphone</td>
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<td>Wireless: Yes</td>
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<td>Audio Visual: 2 LCD Projectors, VCR, Overhead, Microphone</td>
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</tr>
</thead>
<tbody>
<tr>
<td>Capacity: 40-60</td>
<td></td>
</tr>
<tr>
<td>Audio Visual: LCD Projector, VCR, Overhead</td>
<td></td>
</tr>
<tr>
<td>Wireless: Yes</td>
<td></td>
</tr>
</tbody>
</table>

In general, the classrooms largely fall semester into three separate categories shown in the Table above. The majority of engineering classes are held in the lower level of the WEB. This lower level was part of the old Engineering and Mines Classroom Building (EMCB) structure, which was designed solely for use as a classroom building. When WEB was constructed, the two buildings were integrated into a single building. The WEB classrooms
all have air conditioning, carpeting, data projectors, disabled access, video projection, and chalkboards and/or whiteboards. Many of the rooms include TV and VCR projection and tiered seating. Lecture halls are provided with a network computer connection, a public address system, a projection booth, an overhead projector, a videotape player, and a ceiling-mounted LCD projector.

There were concerns in the past about scheduling conflicts for classrooms that required some classes to be held in other buildings other buildings on campus. Such issues were largely mitigated after WEB was constructed and became available years ago. Renovation of MEB and other buildings on campus has also added classrooms, and ongoing construction of new buildings on campus will further increase classroom availability, as non-engineering classes move into these new buildings and out of the engineering buildings.

3. **CVEEN Undergraduate Laboratories**

CVEEN laboratories are located in 3 separate buildings. The HEDCO Building contains the undergraduate laboratory for Construction Materials (CVEEN 3510), Geotechnical Engineering (CVEEN 3310), and various demonstrations conducted in Structures I (CVEEN 3210) in the High Bay Area. The MCE Building houses the Transportation Operation Center and laboratory. (This lab was moved to a newly renovated space in MCE Building during the summer term of 2009.) The Merrill Engineering Building (MEB) houses our undergraduate hydraulics and fluid mechanics laboratory (CVEEN 3410). Each of these areas is extensively used and contributes greatly to the quality of education at the undergraduate level. The equipment used in the Materials, Geotechnical, and Hydraulics Laboratories and the High Bay Area have been listed in Appendix C. Research laboratories are largely separate from undergraduate laboratories in these buildings. However, where students benefit from seeing more advanced research equipment or experiments, the research labs serve to enhance the undergraduate education.

![CVEEN Materials Laboratory in HEDCO Bldg.](image)
CVEEN Geotechnical Laboratory in HEDCO Bldg.

CVEEN Hydraulics Laboratory in Merrill Eng. Bldg.
High Bay Area in HEDCO Bldg.

Traffic Laboratory in MCE Bldg.
B. Computing Resources

1. CVEEN Computing Resources

CVEEN has implemented a wireless platform for all computing and printing needs. It does not operate or maintain a computer laboratory. However, the College of Engineering and the University of Utah have such laboratories, as highlighted in the subsequent sections. Nonetheless, CVEEN requires all junior and seniors to own a laptop computer for use in their engineering courses. This decentralized platform best represents the nature of the civil engineering profession and allows students to connect to terminal servers for more high-performance computing.

The wireless network used by CVEEN is called U-Connect, which is available throughout campus. The University of Utah provides two campus wireless networks: UConnect, a secure network for students, faculty, and staff; and UGuest, an unsecured network for visitors. In addition, the University of Utah is part of the eduroam network, and offers secure wireless access to visitors from other participating institutions. More information can be obtained at: https://uofu.service-now.com/cf/kb_view.do?sysparm_article=KB0000928

Software available to CVEEN students includes:

- AASHTO Ware Pavement ME Design 2.0.19
- ArcGIS 10.1 with SP1
- EPA SWMM 5.1.005
- EPANET 2.0
- EverFE 2.25
- FLOWNETZ 1.0
- HEC-GeoRAS 10.1 (for ArcGIS 10.1)
- HEC-GeoHMS 10.1 (for ArcGIS 10.1)
- HEC-HMS 4.0 HEC-RAS 4.1
- Interactive Groundwater 4.7
- JMP Pro 2015 (Only on 3 lab computers)
- LPILE 2013.7.07
- PERFORM 3D 4.0.4
- REAME 2012 R 3.1.0 x64
- SAP2000 15.1.0 WS
- West Point Bridge Designer 2015
- Autocad 2013
- Maya 2014
- Ansys 15
- Solidworks 2014-15
- Culvertmaster 03.03.00.04 (CRS Design Center)
- Hammer v8i 08.11.03.19 (CRS Design Center)
In August of 1990, the College of Engineering opened a shared computing resource called CADE. A significant number of engineering courses have used the lab as a lecture facility for class instruction as well as a computing facility for students, faculty, and staff. The CADE is the central location for instructional computing in the College of Engineering. It is available for use by any faculty, staff, or student in any of the College departments. The CADE lab is a general-use computer facility for engineering students. CADE provides support for a broad category of engineering applications and programs and maintains several open-access student labs. The CADE Lab supports all of the following platforms needed by any class:

- Linux on x86 hardware
- Windows 7 on x86 hardware
- OS X on x86 hardware.

The CADE Lab also provides some of the core computer services for the College, which include mail routing, pop mail access, and web services. In addition, the CADE Lab provides support for networking for the various departments as well as limited support for UNIX workstations in the College. The CADE resources, listed in Table 7.2, are available both in the lab and remotely 24 hours a day, seven days a week.

<table>
<thead>
<tr>
<th>Location</th>
<th>Access</th>
<th>Computers</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEB 224 (CADE)</td>
<td>24 / 7</td>
<td>40</td>
<td>Linux</td>
</tr>
<tr>
<td>WEB 226 (CADE)</td>
<td>24 / 7</td>
<td>35</td>
<td>Linux</td>
</tr>
<tr>
<td>WEB 226 (CADE)</td>
<td>24 / 7</td>
<td>30</td>
<td>Windows</td>
</tr>
<tr>
<td>WEB 208 (CADE)*</td>
<td>24 / 7</td>
<td>24</td>
<td>Windows</td>
</tr>
<tr>
<td>WEB 210 (CADE)</td>
<td>24 / 7</td>
<td>91</td>
<td>Windows</td>
</tr>
<tr>
<td>WEB L128 (CADE)</td>
<td>24 / 7</td>
<td>31</td>
<td>Mac OS X</td>
</tr>
</tbody>
</table>

* This lab is also occasionally used as a classroom and is for general use when classes are not in session.

There are currently 135 Windows desktop computers, 31 Apple Macintosh, and 75 Linux desktop computers that are available through the four general usage CADE computer labs. The College also maintains five computational servers and five Windows terminal servers for remote access computing. In addition, there are 28 support servers that provide services such as web hosting, email, and authentication. The college currently has over 10 terabytes of disk storage available to students and faculty for project storage.

The CADE computing facilities provide a comprehensive collection of software that is available for instructional use. Some of the software packages that are provided include LabView, Maple,
Matlab, Ansys, ProEngineer, Abaqus, Cadence, SolidWorks, FEMLab, and the full industrial VLSI tools of Cadence, Synopsys, and Mentor Graphics. The CADE lab supports all of the platforms needed by any class. Presently CADE supports the following environments: (1) Linux on i386 hardware, (2) Windows 7 on i386 hardware, and (4) OS X on i386 hardware. The CADE Lab also provides some the core computer services for the College, which include mail routing, pop mail access, and web services. In addition, the CADE provides support for networking and provides network connectivity for the various departments, as well as limited support for UNIX workstations in the College.

The CADE resources are available both in the lab and remotely 24 hours a day, seven days a week. All access to CADE computer systems are tracked and logged in an accounting information database. During the spring 2014 semester, there were 4806 unique logins and 63354 actual logins into CADE labs. During the fall semester 2014 semester, there were 4984 unique logins and 64673 total logins into CADE labs. Thus, there was an increase of 178 active accounts and 1319 logins into the lab machines between spring and fall semester of 2014.

The CADE Lab is staffed Monday-Friday from 9:00 a.m. to 5:00 p.m. Electronic support is provided during the evening hours and on weekends. All CADE labs require UCard swipe-access to enter the physical lab space and the computers require active accounts. Network events are monitored in a log file for any suspicious activity. CADE staff is funded through both state and departmental support.
3. University-Wide Computing Resources

Marriott Library

Over 350 software packages, including the ones with Engineering applications, on the right: Besides major software suites from major software publishers such as Microsoft and Adobe, the library purchases many specialty software programs to enhance all stages of knowledge creation and presentation. This is a small selected list of specialty software supporting engineering.

ENGINEERING RELATED SPECIALTY SOFTWARE

- Autodesk 3ds Max - 3D modeling & animation
- Autodesk AutoCAD - Computer-aided design & drafting
- Autodesk Inventor - 3d mechanical CAD
- Autodesk Maya - 3D modeling & animation
- Autodesk Mudbox - Digital sculpting tool
- Blender - 3D modeling
- Bricksmith - Virtual Lego modeling
- Cantor - Statistical analysis
- ChemBioDraw - Chemical structure modeling
- Dia Diagram Editor - Diagramming, charting, & visualization
- FlatRedBall - Game development platform
- GameMaker: Studio - Game development platform
- IBM SPSS - Statistical analysis
- IBM SPSS Amos - Structural equation modeling
- Integrated Data Viewer (IDV) - Geoscience data analysis & visualization
- KaleidaGraph - Graphing & statistical analysis
- KAlgebra - Graph calculator
- Kalzium - Periodic table of elements
- Keynote - Presentation creation
- LabVIEW - Graphical development environment
- MakerBot Desktop - G-code generator for 3D printing
- Maple - Computer algebra system
- Mathematica - Automated computation system
- Mendeley Desktop - Organize & share research
- Microsoft Project - Project management
- Minitab - Statistical analysis
- Mplus - Statistical analysis
- NVivo - Qualitative analysis
- OmniGraffle Professional - Diagramming, charting, & visualization
- OmniPlan - Project management
- Paraview - Scientific data visualization
- Phase Equilibria Diagrams Database - Ceramic & inorganic phase diagrams
- POWERPREP II - GRE test preparation
- Prezi Desktop - Presentation creation
- PSPP - Statistical analysis
- ReadCube - Reference manager, Nature Group
- SAS - Statistical analysis
- SketchUp - 3D modeling
- Slic3r - G-code generator for 3D printing
- SolidWorks - 3D mechanical CAD
- Stata - Statistical analysis
- StatPlus - Statistical analysis
- STELLA - Modeling & simulation
- Unreal Engine - Game development platform
- Vectorworks - CAD & Building Information Modeling
- Wings3D - 3D modelling
The Union computer lab is an extension of the Marriott Library Student Computing Labs and provides easy access to 92 PCs, 34 Macs, 2 ADA computers, 4 scanners, 2 black and white printers, and a color printer. It is located in the lower level of the Union Building. A wide variety of software is available to support most student needs. Wireless network access is available in and around the lab via 802.1x authentication or unencrypted access. The Remote Software Access service allows students, staff, and faculty to use select software from any supported computer or device, on or off campus. The Union lab is open daily from 7:00 a.m. to approximately 10:30 p.m.

This lab is located on the 1st floor of the Benchmark Plaza residential housing area. They have 39 workstations and are open daily 8:00 a.m. to 10:45 p.m.

Located on Level 2 of the the Marriott Library, Knowledge Commons contains a main service desk for research and technology assistance; over 250 computers with a variety of software; printing, scanning, and video editing support; laptop and mobile device wireless setup; group study rooms and classroom support; and equipment and devices available for checkout. Knowledge Commons is open 7 a.m. to 1:00 a.m. daily.
Center for High Performance Computing (CHPC)

Research Computing Support for the University: In addition to deploying and operating high performance computational resources and providing advanced user support and training, CHPC serves as an expert team to broadly support the increasingly diverse research computing needs on campus. These needs include support for big data, big data movement, data analytics, security, virtual machines, Windows science application servers, protected environments for data mining and analysis of protected health information, and advanced networking. The CHPC computational resources are available 24/7. Staff work 8:00 a.m. to 5:00 p.m. during the week but are available for crisis management outside of normal hours.

Computing Support for Achieving Program Outcomes and Objectives

C. Guidance

1. Computing Resources

Instruction for the use of software listed in Section 7B1 is primarily done at the course level by the respective instructor or teaching assistant.

However, there is curriculum-wide software training that is required for all students. In the introductory engineering computing course (CS 1000) all students obtaining general training in
the use of software packages. This includes an introduction to programming principles and engineering problem solving via computational means using MATLAB™ and EXCEL™ spreadsheets. This course teaches how to apply programming to solve Engineering problems (e.g., data visualization, stochastic simulation, selected numerical techniques, image manipulation). In addition student receive additional course instruction in computer aided drafting in MG EN 1050. This course is an introduction to drafting techniques using engineering standards and software, including CAD software (e.g., Autodesk Civil 3D™). This course includes semester design project and presentation with an emphasis on intro-software communication.

Lastly, students have the option to receive further training in Geographic Information Systems (GIS) software as a technical elective during the junior or senior year in CVEEN 5110). This course introduces GIS as an engineering analysis tool, focusing on the development of simple GIS using ArcView™ Software. The course covers spatial data characteristics, the fundamentals of spatial data analysis, spatial data sources for engineering applications, and the fundamentals of generating and managing spatial data. The course focuses on GIS applications of the power and capability of GIS, including the role of GIS professionals in solving engineering problems. A laptop is required for this course.

For CVEEN students using the computer laboratories offered by the College of Engineering (e.g., CADE and Engman Labs), IT Support is available during most business hours http://www.cade.utah.edu/.

2. Laboratory and Equipment Resources

CVEEN students are instructed in the use, operation and handling of tools and equipment by the course instructors, teaching assistants and CVEEN safety and laboratory manager (Mark Bryant). Laboratory procedures have been developed for each major laboratory exercise. These are assigned reading for the students and the instructor or laboratory T.A. reviews these procedures with the students prior to conducting the exercise. An example laboratory procedure is attached in Attachment 6.

D. Maintenance and Upgrading of Facilities

The three undergraduate laboratories in CVEEN are supported by three major sources. The laboratory courses have a lab fee that supports the consumables for the lab experience, state provided funds cover the maintenance of existing capital equipment, and an annually state Equipment Fund (BEEF) component provides up to $100k in new capital equipment per year provided 33% matching funds are provided by external sources. The laboratory maintenance and consumables budget is managed by the laboratory manager, Mark Bryant. Capital equipment is proposed by faculty in charge of specific undergraduate laboratories, endorsed by the chair/executive committee and funds requested from the COE Dean’s office.

E. Library Services
The University of Utah has three libraries on its campus: S. J. Quinney Law Library, Spencer S. Eccles Health Sciences Library, and J. Willard Marriott Library. The Marriott Library is the library used most by engineering faculty and students.

The Marriott Library currently has more than 3.5 million books and over 11,000 serial subscriptions. Through the regional “Utah Academic Library Consortium” students, faculty, and staff have reciprocal borrowing privileges at other colleges and universities throughout the state of Utah. The library is five to ten minutes walking distance from the main engineering building. The library is open 111 hours per week as follows: M-Th 7am-1am, Friday 7am-9pm, Saturday 9am-9pm, and Sunday noon-1am.

Marriott Library provides access to numerous online resources. These resources include article and physical-property databases, digital full-text journals, and a growing collection of e-books to support campus and distance education. The library’s e-book collection, including many online handbooks, is currently being developed among several products: EbscoHost, EBL, ebrary, Knovel, CRC, and Safari. Engineering related books are found in all of these collections.

The library’s Interlibrary Loans Department will borrow almost anything the user might need to support their academic program. The library offers the “Utah Article Delivery Service”, which will quickly deliver requested articles to a researcher’s desktop. It also has a policy of quickly obtaining copies of almost any engineering standard needed by faculty or graduate students (ASTM, ANSI, ASME, ISO, etc.). Engineering standards are purchased as needed with either faculty or librarian approval.

The library’s Education Services Department exists to promote information and computer literacy among students, faculty, and staff. Numerous special short courses are taught each term to cover basic library skills, research strategies, use of the online catalog, widely used software programs, and other electronic resources. The Education Services Department has teamed with the university’s Writing Program to offer E-LEAP (Liberal Education Advanced Program) specifically for engineers. This program provides in-depth study of engineering ethics and their application to situations involving engineering failures.

Librarians provide in-class instruction for library research and writing assignments, and have created many dozens of online guides to assist students with all aspects of library research and the use of information technology. Each department has a guide directing students to the best resources in that discipline. Examples of library support include the semi-annual Dissertation Bootcamp for students writing theses or dissertations, creation of the quiet Graduate Reading Room and presentation practice rooms, and numerous one-on-one consultations.

The library has provided space to create a Faculty Center for programs that serves faculty and students. The Writing Program, the Digital Scholarship Lab and the Statistics Consultation Service provide support for student projects. Faculty are supported by the Center for Teaching and Learning Excellence, the Teaching and Learning Technologies Center and the Grant Development Service. A Large-Data Repository is currently under development to archive and share faculty research data.
Through its Faculty Center the library provides teaching faculty with technical assistance in creating online course content. Due to the cost of equipment and software this is not a free service but grant money encouraging the development of online courses, and online reserve materials for regular courses, is available. The Faculty Center works with faculty to create the exact course content requested, including content from new audio and video studios. It helps instructors with all course-related uses of Canvas (the online-course software of the university).

The “Knowledge Commons” in the Marriott Library offers audiovisual and computing resource and assistance. More than 500 networked computers give electronic access to information held worldwide. Additionally, hundreds of software packages are available to students including AutoCAD, LabVIEW, Maple, Mathematica, SAS and others.

The Knowledge Commons offers many specialty software packages of interest to engineering students and faculty. The library also operates three campus computing labs located in residence halls. The Marriott Library and all computing labs work closely with faculty to purchase media-materials and software to support course curricula (ChemCAD, Maple, CADvance, Programming Language software, etc.).

Engineering related video and CD-ROM resources are requested in the Knowledge Commons where equipment for these formats is available. Microfiche are also requested at the Knowledge Commons for the same reason. Some databases, such as Ceramics Phase Diagrams, are loaded on student computers for use with class assignments. The library has completed a digital authoring studio to aid student groups and faculty in their digital authoring endeavors. This studio has high-end audio and video authoring tools.

The Knowledge Commons is operated by 9 librarians, as well as numerous technical support personnel. All librarians provide reference help for patrons at the desk, quick assistance over the phone, online assistance via Chat Reference, or in-depth consultations by appointment. The librarians are available for course-integrated instruction sessions, and specialty classes tailored to the college’s specific needs. A patent specialist is available in the library for instruction and one-on-one assistance.

Each academic department is assigned a librarian as a liaison, instructor and general problem solver. Five librarians directly serve the departments of the College of Engineering, while another 2-3 librarians are also involved in instruction and collection development.

The last five years has seen considerable movement among publishers to offer much more content in electronic formats. Publishers are now packaging both their serials and book collections for purchase. In response to the marketplace, the library has reorganized its individual department liaisons into teams that make decisions on packaged content. The current selection team for the College of Engineering also oversees collection development for the Colleges of Science and Health.

Books

Below are the Total Book Holdings of the Marriott Library.
The total, counting free resources, is approximately 5,000,000 books. This total does not include HathiTrust’s 4,977,612 public domain volumes, which is also provided by the library.

<table>
<thead>
<tr>
<th>Total Books Added (5-Yr)</th>
<th>232,241</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Physical Titles</td>
<td>2,699,654</td>
</tr>
<tr>
<td>Total eBook Titles</td>
<td>817,263</td>
</tr>
<tr>
<td><strong>Total Library Books</strong></td>
<td>3,516,917</td>
</tr>
</tbody>
</table>

**NEW BOOKS ADDED**

<table>
<thead>
<tr>
<th>Physical Titles</th>
<th>2014</th>
<th>2013</th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
<th>5-Yr Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Titles</td>
<td>5,444</td>
<td>7,550</td>
<td>7,553</td>
<td>9,588</td>
<td>11,006</td>
<td>41,141</td>
</tr>
<tr>
<td>eBooks Titles</td>
<td>32,095</td>
<td>38,537</td>
<td>40,092</td>
<td>38,384</td>
<td>41,992</td>
<td>191,100</td>
</tr>
</tbody>
</table>

While the figures above represent holdings for all collections, below are total physical books and ebooks added to the collection in Engineering, and supporting disciplines, during the last five years.

<table>
<thead>
<tr>
<th>BOOKS ADDED</th>
<th>Engineering</th>
<th>Chemistry</th>
<th>Math</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2,459</td>
<td>195</td>
<td>2,273</td>
<td>402</td>
</tr>
<tr>
<td>2013</td>
<td>2,919</td>
<td>273</td>
<td>2,623</td>
<td>518</td>
</tr>
<tr>
<td>2012</td>
<td>2,980</td>
<td>279</td>
<td>1,589</td>
<td>537</td>
</tr>
<tr>
<td>2011</td>
<td>2,643</td>
<td>291</td>
<td>1,146</td>
<td>550</td>
</tr>
<tr>
<td>2010</td>
<td>3,057</td>
<td>303</td>
<td>1,816</td>
<td>550</td>
</tr>
<tr>
<td><strong>5 Year Total</strong></td>
<td><strong>14,058</strong></td>
<td><strong>1,341</strong></td>
<td><strong>9,447</strong></td>
<td><strong>2,557</strong></td>
</tr>
</tbody>
</table>

**Serials**

The Library subscribes to over 11,000 journals and has full or partial access to over 50,000 serials. Of journal subscriptions, roughly 3,500 are in engineering subjects. This means approximately 25-30% of library serials subscriptions support engineering and related disciplines.

During the past five years, publishers have moved to packaging serials subscriptions. Now it is no longer possible to determine the real cost of individual journals and calculate spending by department or college. Below are the Journal Packages that are currently purchased for Engineering and supporting disciplines. Library subscriptions to print serials are currently negligible.

**Ejournals Packages Supporting the College of Engineering**
### ONLINE PACKAGES

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS American Chemical Society</td>
<td>$97,060.00</td>
</tr>
<tr>
<td>American Mathematical Society</td>
<td>$2,918.00</td>
</tr>
<tr>
<td>Association for Computing Machinery ACM</td>
<td>$4,813.00</td>
</tr>
<tr>
<td>Cambridge University Press</td>
<td>$61,572.00</td>
</tr>
<tr>
<td>Elsevier Package</td>
<td>$773,915.51</td>
</tr>
<tr>
<td>Freedom Collection Elsevier</td>
<td>$104,753.00</td>
</tr>
<tr>
<td>GeoScience World</td>
<td>$13,738.00</td>
</tr>
<tr>
<td>IOP Science</td>
<td>$110,518.00</td>
</tr>
<tr>
<td>Nature Publishing Group</td>
<td>$131,977.00</td>
</tr>
<tr>
<td>Oxford University Press</td>
<td>$60,975.83</td>
</tr>
<tr>
<td>RSC Gold Package Upgrade</td>
<td>$71,126.64</td>
</tr>
<tr>
<td>SPIE Digital Library</td>
<td>$13,252.00</td>
</tr>
<tr>
<td>Wiley Online Collection</td>
<td>$537,998.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,984,616.98</strong></td>
</tr>
</tbody>
</table>

### Article Delivery

This includes both physical and electronic delivery of materials, primarily through Interlibrary Loans which operates a Document Delivery Service to the desktop (print) or mailbox.

### 2013/2014 ARTICLE DELIVERY EXPENDITURES

<table>
<thead>
<tr>
<th>Service</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyright Clearance Center for ILL</td>
<td>$11,134.00</td>
</tr>
<tr>
<td>Elsevier Direct Articles</td>
<td>$462.00</td>
</tr>
<tr>
<td>Multi-Science Publishing ($5 ea.)</td>
<td>$760.00</td>
</tr>
<tr>
<td>ReadCube ($5000.00) Nature Group</td>
<td>$3,434.99</td>
</tr>
<tr>
<td>Reprints Desk</td>
<td>$130.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$15,921.49</strong></td>
</tr>
</tbody>
</table>
Databases

**Fiscal Year**
**2013/14**

<table>
<thead>
<tr>
<th>DATABASE EXPENDITURES for ENGINEERING and SUPPORTING DISCIPLINES</th>
</tr>
</thead>
</table>

### Engineering

<table>
<thead>
<tr>
<th>Database</th>
<th>Cost</th>
<th>Ebook pkg. purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeoRef</td>
<td>$8,625.00</td>
<td>Synthesis 6 $7,200.00</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>$4,242.00</td>
<td></td>
</tr>
<tr>
<td>BIOSIS</td>
<td>$37,502.00</td>
<td></td>
</tr>
<tr>
<td>IEEE Xplore</td>
<td>$144,395.00</td>
<td></td>
</tr>
<tr>
<td>MADCAD</td>
<td>$1,206.00</td>
<td></td>
</tr>
<tr>
<td>NTIS</td>
<td>$7,285.00</td>
<td></td>
</tr>
<tr>
<td>Knovel</td>
<td>$41,515.00</td>
<td></td>
</tr>
<tr>
<td>Metadex</td>
<td>$4,242.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$249,012.00</strong></td>
<td><strong>$7,200.00</strong></td>
</tr>
</tbody>
</table>

### Chemistry

<table>
<thead>
<tr>
<th>Database</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge Structural Database</td>
<td>$3,350.00</td>
</tr>
<tr>
<td>ChemNetBase</td>
<td>$7,275.00</td>
</tr>
<tr>
<td>Kirk-Othmer Encyc. Of Chemical Technology</td>
<td>$4,561.37</td>
</tr>
<tr>
<td>Merck Index</td>
<td>$2,400.00</td>
</tr>
<tr>
<td>SciFinder Scholar</td>
<td>$116,354.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td><strong>Total</strong></td>
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**Total for All Resources listed** $670,736.37
F. Overall Comments on Facilities

Proper use and operation of facilities and laboratory safety are emphasized by CVEEN. The overall safety of the department laboratories is overseen by Mark Bryant in conjunction with the laboratory supervisors associated with each laboratory (i.e., Dr. Bartlett – Geotechnical Laboratory, Dr. Romero (Materials Laboratory), Dr. Burian (Hydraulics Laboratory), and Dr. Ibarra (High Bay Area). At the beginning of each semester, students enrolled in the laboratories are given a safety briefing and are required to certify that they have had such briefing. This includes:

- planning and conducting operations in accordance with practices and procedures established in the Safety Plan
- using equipment for its designed purposes only
- being familiar with emergency procedures, including knowledge and location of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency
- knowing the type of protective equipment available and using the proper type for each procedure
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made a soon as possible

Attachment 7 is an example safety plan used by CVEEN to promote a culture of safety and appropriate use of equipment in its laboratories.
CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The department has established different tiers of leadership within the program. The top level of leadership consists of the Executive Committee. The committee is compiled of the chair of the three teaching/research groups, Undergraduate and Graduate Directors, Associate Chair, and Chair of the Department. This committee is where new ideas are brought forth, discussed and determined what can be done with it. The answer is typically one of three responses: take to faculty for a vote, send to a committee for more discussion, or no further action.

The next level of leadership comes through in the form of the Undergraduate and Graduate Studies Committees. These groups consist of members of all the teaching/research groups and have a chair of the committee. The committee evaluates curriculum, student petitions, determines best practices for the program, and work toward any directive that the Chair or larger committee has ask for assistance on.

The base tier of leadership comes the Teaching/Research Group. The groups (Environmental and Water Resources, Pavement Materials and Transportation, and Structures and Geotechnical) meet to discuss topics affecting their areas. This includes, but is not limited to, recommending course offerings and instructors to the Chair, review ABET outcomes and course criteria’s, Graduate Admissions, course curriculum evaluation, and work toward any directive that the Chair or larger committee has ask for assistance on.

Teaching/research groups, and all department committees can bring ideas up to the faculty in Executive Committee meetings as well as faculty meetings. Faculty meetings are held monthly during the academic year and allow for dissemination of University changes or events. This is also used to help discuss items that the committees need to be voted on by the faculty.

Having the tiered structure of leadership enables all faculty to contribute to the progress of the department. Faculty will be able to give input at the group level, and depending on the topic at their committee meeting and finally at faculty meeting, when a vote or additional discussion occurs. The tiers of leadership has allowed the faculty to go into very detailed discussions for the issues that are going to affect the program.

B. Program Budget and Financial Support

The primary support for instructional programs is derived from legislative appropriations, student tuition payments, and special fees. Each year, as a result of the state-wide legislative process, increases in base funding and allowable increases in tuition are approved and funding authorizations are passed to each institution in the State.
The Senior Vice President for Academic Affairs passes a portion of these increases to each academic college, which in turn provide allocations to individual departments (usually in mid-March of each year). Each department head is responsible for evaluating their units and for recommending faculty and staff raises and for requesting other changes in budget allocations to their departments. These recommendations are reviewed and either modified or approved by the college dean, the SrVPAA and the President. Final approval is usually communicated by the end of May of each year and the approved budget is posted at the beginning of the fiscal year (usually in July, although some modifications may occur in response to changes that may arise throughout the fiscal year).

The unit budget is made up of several components: (1) base funds are augmented by (2) productivity funding that is computed using changes in SCH taught (these funds can increase or decrease, depending on the number of students taking courses) or by (3) other special allocations from the administration (i.e., funding made available to support minority hires, reward top teachers, help with promotion increases, etc.). The college also provides (4) funding to help equip undergraduate teaching labs (Basic Engineering Equipment Funds, or BEEF), and distributes (5) Engineering Differential Tuition funding. Another major source of funding expected in 2015-16 will come from (6) Engineering Initiative Funds, described below.

Finally, units are able to offset some costs through the assessment of (7) special lab fees, collected throughout the year. Since our prior accreditation visit, another source of funding has come from (8) the USTAR initiative, which allowed the hiring of additional faculty in many of our units and provided new facilities in support of our engineering programs (Sorensen Molecular Biotechnology Building).

Chart 1 shows the breakdown of this funding for Civil and Environmental Engineering for the year just ending (2014-15). Since expenditures of budget tend to illustrate the actual level of activity, a summary of expenditures on salaries and other support costs are show in Chart 2 (with the exception of BEEF and INITIATIVE one-time equipment funding; these are shown in Chart 3).
Chart 1: 2014-15 Budget by Source

Total Budget: $3.0 million

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<th>Source</th>
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<td></td>
<td>Base</td>
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<td>Special Fees</td>
<td>Other</td>
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<td>McPherson</td>
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</tbody>
</table>

in thousands of dollars
Chart 2: State Appropriation Expenditures*

* excludes USTAR faculty salaries, which are funded separately

Chart 3: BEEF / Initiative Equipment Funds

<table>
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<td>BEEF awards</td>
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<td>185.2</td>
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<td>120.4</td>
<td>106.6</td>
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In addition, Chart 4 shows cumulative, on-going Engineering Initiative funding of new faculty lines, Teaching Assistants and other support, and Chart 5 reflects tenured-tenure track faculty by rank (as reported in the ASEE Faculty Salary Survey for the years shown).
In Fiscal Year 2009-10, the College of Engineering also implemented an Engineering Differential Tuition for all students taking engineering courses, regardless of their major (to help offset the impact of significant budget cuts that year). As part of this arrangement, ALL differential tuition collected is returned to the department that teaches the course, with no skim taken by the college. The initial amount assessed was $35 per credit hour for upper division courses and $50 per credit hour for graduate courses.

The amounts for each fiscal year are shown below, in Chart 6.

In March 2015, the Utah Legislature passed the largest statewide Engineering Initiative ever funded. The University of College of Engineering will likely receive the largest share of these significant funds. The actual totals will be known later this summer.

Charts 7a (on-going funds) and 7b (one-time funds) shows past initiatives and the amounts awarded to the University of Utah, as well as the most recent allocation that is in the process of being distributed.
The Department receives some teaching assistant (TA)/grader support through state appropriation. The majority of the TA/grader funds come through differential tuition. Differential tuition is charged to upper level engineering students (3000 and higher) when enrolling in courses. This is a per credit fee that is charged according to being an undergraduate or graduate students.

The Chairman assigns TAs to courses that have over 25 students enrolling in the course, with first priority of assigning TA’s to the larger classes. Graders are an alternative to helping faculty who has a high enrollment but the faculty would not be needing assistance in class or help with office hours.

The Department supports the faculty in continuing their teaching practices by assisting them to attend conferences, workshops, and webinars in how to establishing good teaching practices. All new faculty are encouraged to apply to the ExCEEd Teaching Workshop and if selected the Department supports their travel while there. We also support faculty to attend the ASEE workshops and conferences.

The University also supports better teaching through the Center for Teaching & Learning Excellence (CTLE) where they provide different resources for faculty. This includes how to bring technology into the classroom, how to do lesson planning, to coming into the courses and videotaping the faculty and helping them address possible issues with their presentations.

To help the TA students the department registers international students into the International Teaching Assistant Program (ITAP) where they are tested for their English proficiency. If they are lacking in some areas they are required to enroll in a 1 credit course for fall and/or spring semester. All students, even if they are not required to enroll in a course, participate in a 2 day workshop where the US classroom is explained as well as best practices are reviewed. All graduate students, including TA’s, are also eligible to receive training through CTLE to help prepare them to be teachers after their education.

In addition to the BEEF and Initiative equipment funding, Student Computing Fees are also provided in support of department and college computing resources. The total funding provided to the college is provided in Chart 8.
With the growth in faculty and students, developing adequate space has been a real challenge; however, using open position funding, other reserves and donor gifts, the College of Engineering has seen the following major facility additions since our last review.

**Floyd and Jeri Meldrum Civil Engineering Building**
The 14,500 square-foot-addition, completed in the fall of 2010, provides departmental administrative space, faculty offices, student study rooms and a large classroom and home to the Utah Traffic Lab. The $5.5 million-dollar project was supported by a generous $3.3 million dollar gift from Floyd and Jeri Meldrum, other important donors, and other non-state funds.
**Sorenson Molecular Biotechnology Building (USTAR)**
Construction of the 200,000 square foot facility was substantially completed in 2012. It houses much of the Department of Bioengineering, faculty from the Department of Electrical and Computer Engineering, Mechanical Engineering, and faculty in Chemical Engineering, and provides a state-of-the art home for our Nanofabrication and Micron Microscopy Core Facilities.

**Rio Tinto Kennecott Mechanical Engineering Building**
Phase 1 of a seismic renovation of the south wing and high bay area was completed in 2013.

Phase 2, completed in May 2015, fully renovates and expands the East and North wings of the building, and includes an exciting new four-story atrium space, a new, large classroom, as well as a student computing lab, faculty offices, administrative areas, support spaces and a cafe. The aesthetic of this 39,000 square-foot project includes exposing much of the infrastructure and systems of the building to promote natural experiential learning by the mechanical engineering
students that use the facility. A LEED gold certification is anticipated due to energy savings and other innovated design features.

This phased building renovation and expansion will begin to fill the need The College of Engineering has for facilities to house their growing academic and research programs. More significant renovation and expansion phases are planned for the future.

This project also includes a separate stair tower and elevated walkway that will connect the newly renovated building and a new major bus stop serving downtown with the main Engineering campus, allowing safe passage over North Campus Drive. The connecting element should be completed before the beginning of fall semester, 2015.

North Campus Drive – Rio Tinto Kennecott Mechanical Engineering Building and main Engineering campus connecting element.

C. Staffing
The faculty and staff in CVEEN is primarily located on the second floor of the MCE Building. The offices houses the Department Chair (Michael Barber), Administrative Program Coordinator (Ashley Arpero), Graduate Academic Advisor (Bonnie Ogden), Undergraduate Academic Advisor (Alexi Crabb) and Departmental Administrative Office (Tiffany Horton). This office staff of 4 assistants and 2 laboratory technicians (Mark Bryant and graduate student), in conjunction with the Chair, is sufficient to administer the Department and Program.

The administrative staff provides logistical support along with services related to budgets, payroll, contract management, proposal generation, and purchasing. As the faculty size and student body have increased in the last decade so have the demands on the front office staff.

Administrative staff members are provided training opportunities for continuing education through University Administration. Several types of classes are offered throughout the year for staff to maintain existing knowledge and to be introduced to new University practices and policies. The administrative staff receives on-line training on the Family Educational Rights and Privacy Act (FERPA) and they are required to pass an associated test. The staff also attends Research Administrative Support Training (RATS) on Export Controls (once a year) to get updates on all policies and to stay compliant with federal guidelines. The staff also meets with the Office of Sponsored Projects (OSP) to discuss best practices and to streamline proposal/grant procedures. Three of the staff members (S. Olson, M. Esmaeili, and K. Schmidt) are currently being trained for a new on-line purchase system (UShop) being introduced by the University Administration. The Human Resources Department has various trainings that are offered and staff are encouraged to attend classes and trainings to stay engaged and broaden their skillsets for possible advancement.

**D. Faculty Hiring and Retention**

The CVEEN Strategic Planning Committee discusses and selects the specific areas for each search. These results of these meetings are transparent and discussions with faculty are held in the discipline group and in general faculty meetings. The selected areas with desired research qualifications are presented to the entire faculty for discussion and vote at the monthly faculty meeting. With the approval of the faculty, a search committee of 3 to 4 faculty members is created, a position description is written and ads are placed in national and international publications and web sites.

The search committees are instructed on permitted and prohibited pre-employment questions, strategies on application assessment, strategies for conducting a Skype interview, and the expectations for on-campus interviews. The application process is managed using a University on-line Application Tracking System. All applicants submit the required documents through the on-line system. Application review begins in early December and a short list of 10 – 15 candidates is selected for Skype interviews, which typically take place in January. Letters of recommendation are requested for each person on the short list; those letters are also directly uploaded to the on-line system. Using all available data, three candidates are selected for on-campus interviews.
On campus interviews for each candidate take two days. Activities planned for each candidate include: 1) breakfast with the Chair on day one, 2) present a research seminar, 3) meet with students and present a short lecture to demonstrate teaching competency, 4) meet with all Department faculty members one-on-one or in small groups, 5) meet with the Dean, 6) meet with possible collaborators outside the department, 7) have an exit interview with the Chair. On-campus interviews for all three candidates in a specific search are scheduled to take place within a two-week period.

Feedback from all individuals that have met a candidate is solicited. The search committee prepares a report that summarizes the pros and cons of each candidate, the feedback they received, and their ranking of the candidates. This report is presented at a faculty meeting and a vote of the full faculty is taken. By policy, the faculty must vote on the “acceptability” of each candidate, the rank order of the acceptable candidates, and the rank (assistant, associate, or full professor) of the position that can be offered to each candidate. The ranking of the acceptable candidates is a recommendation to the Chair. Following the faculty meeting, the Chair begins the process of negotiating terms with a candidate for a formal offer.

Strategies used to retain current qualified faculty members include creating an environment that is open, collegial, supportive, and inclusive and by providing resources to facilitate their success.

- Teaching load – the typical teaching load is three courses per year. Research active faculty members typically have their teaching load reduced to two courses per year.
- Raises - High achieving faculty members are rewarded with raises well above the percentage provided in the raise pool.
- Junior faculty workload – non-tenured faculty members have a reduced teaching and service load, as determined by the Department Chair.
- Resources – start-up packages are at the national average. Lab space is not shared and is viewed by the chair as adequate for all research active faculty members.
- Collegial atmosphere – considerable effort has gone into creating and maintaining a collegial atmosphere. Collaboration is encouraged. A supportive and collegial positive workplace is a major factor in faculty members having a positive attitude toward the department.
  - Shared governance – a shared governance administration has been cultivated. Faculty, either individually or through committees, are involved in all major decisions.
  - Administrative transparency – the Chair has operated with as much transparency as is possible. Budgets, including income sources and expenditures, are presented to the faculty each year and in an as-need basis at other times.
  - Achievement recognizing – major accomplishments, such as honors, awards, and new grants, are recognized through announcements, publications, and on-line articles. The intent is to create a positive atmosphere within the faculty.

E. Support of Faculty Professional Development

Faculty in the Department of Civil Engineering at the University of Utah is expected to grow their professional interests and expertise throughout their careers. There is an expectation that
they use good pedagogy in teaching and develop their teaching techniques to keep pace with the profession and the best standards of practice.

Each faculty member annually submits a plan for developing their expertise as a faculty member, professional career and expectations for the coming year. This is submitted with Faculty Activity Report (FAR). The faculty members are provided a written evaluation from the chair annually which evaluates their teaching, mentoring, and research and other service activities. The evaluation and developmental plan is discussed in a 30 to 45-minute long meeting with the chair and resources are allocated for professional development in this meeting. Other requests are granted throughout the year.

In addition, the University Retention, Promotion and Tenure (RPT) Standards Committee has adopted guidelines for departments in determining their criteria and indicators of good teaching for use in RPT decisions. “Evaluation of teaching effectiveness should not consist solely of student evaluations, though student satisfaction with teaching methods and course administration is one component of effective teaching. The University of Utah and Faculty Senate recently elected to amend policy to make Peer Review of Teaching Effectiveness required. Expert review of teaching effectiveness is also recommended.” In response, CVEEN has established a mentoring committee to help in improving classroom instruction and the RPT process. This committee was established spring semester 2015.

In addition, a percentage of the overhead on research grants is returned to the faculty. This percentage is 6% currently. This returned overhead provides discretionary funds to the faculty for professional development and other activities.

The Center for Teaching and Learning Excellence (http://ctle.utah.edu/) at the University offers resources on all aspects of teaching, including assessment. Faculty members are also eligible to apply for teaching grants from the Teaching Committee at the University of Utah.

A comprehensive sabbatical leave program allows faculty to pursue teaching and research interests in locations outside of the University.
PROGRAM CRITERIA

The following is the program criteria for Civil and Similarly Named Engineering Programs. The lead society for these criteria is the American Society of Civil Engineers (ASCE). These program criteria apply to engineering programs that include "civil" or similar modifiers in their titles.

1. 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.

2. 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.

In regards to criterion 1, the following curriculum and student outcomes are offered to show that CVEEN meets this criterion.

- Prepare graduates to apply knowledge of mathematics through differential equations.
  - This is met by CVEEN curriculum which includes the following mathematics sequence: Engineering Calculus I (Math 1310, or Math 1210 or Math 1311, as alternatives), Engineering Calculus II (Math 1320, or Math 1220, or Math 1321, as alternatives), Ordinary Differential Equations (ODE) Calculus III (Math 2250), Engineering Vector Calculus and Partial Differential Equations (PDE) (Math 3140).

- Apply knowledge of calculus-based physics and chemistry
  - This requirement is met by CVEEN curriculum which includes the following sequence and options. Students must take CHEM 1210, CHEM 1215, and PHYS 2210 (after MATH 1210). Students must take one additional lab course and it is recommended to take PHYS 2215 but they can take CHEM 1225 or CHEM 2315. Additionally, students must take CHEM 1220, or CHEM 2310, or PHYS 2220. Students are advised to check with their faculty advisor to see which of these options is best for their curriculum development plan.

- Additional basic science requirement
  - CVEEN students have the option to take one of the following basic science courses. The courses on this list been reviewed and approved by faculty vote as consistent with our program educational objectives.
Apply knowledge of four technical areas appropriate to civil engineering

- CVEEN students have the requirement to take technical courses in at least six areas of civil engineering. The required courses are: (1) Structures I (CVEEN 3210), (2) Hydraulics (CVEEN 3410 includes CVEEN 3415 (lab)), (3) Engineering Materials (CVEEN 3510 includes lab), (4) Transportation Engineering (CVEEN 3520), (5) Geotechnical Engineering (CVEEN 3310 includes CVEEN 3315 (lab)), (6) Environmental Engineering (CVEEN 3610).

- In addition to these required courses, CVEEN students must complete more advanced training in at least 3 different disciplines at the 5000-level. The disciplines offering courses at this level are: Environmental, Structures, Geo/Materials, Transportation and Water Resources. The primary technical electives in these areas are shown in the Section 1 below. Courses indicated with a “(D)” in Section 1 are courses that contain significant design content.

### Section 1: Primary CVEEN Technical Electives

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Structures</th>
<th>Geo/Materials</th>
<th>Transportation</th>
<th>Water Resources</th>
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<td>CVEEN 4221</td>
<td>CVEEN 5305</td>
<td>CVEEN 5510</td>
<td>CVEEN 4410</td>
</tr>
<tr>
<td>Water and Wastewater Treatment Design (D)</td>
<td>Concrete I (D)</td>
<td>Intro to Foundations (D)</td>
<td>Highway Design (D)</td>
<td>Engineering Hydrology (D)</td>
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<td>CVEEN 5570</td>
<td>CVEEN 5560</td>
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<td></td>
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<tr>
<td>Steel I (D)</td>
<td>Pavement Design (D)</td>
<td>Transportation Planning</td>
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The students have the option to fulfill the remainder of their program of study using 4000 and 5000-level technical electives from Section 2 below.

Section 2: Other CvEEN Technical Electives

<table>
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<th>Other</th>
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<td>CVEEN 5210</td>
<td>NUCL 3100</td>
<td>CVEEN 5810</td>
<td>CVEEN 5110</td>
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<tr>
<td>Water Chemistry</td>
<td>Structural Analysis II</td>
<td>Neutron Based Engineering</td>
<td>Cost Estimation &amp; Proposal Writing</td>
<td>GIS in Civil Engineering</td>
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<td>NUCL 4000</td>
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<tr>
<td>Concrete II</td>
<td>Nuclear Science &amp; Engineering</td>
<td>Project Scheduling</td>
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<td>CVEEN 5230</td>
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<td>CVEEN 5830</td>
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<tr>
<td>Steel II</td>
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<td>Project Management &amp; Contract Administration</td>
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<td>CVEEN 5240</td>
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<td>CVEEN 5850</td>
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<tr>
<td>Timber/ Masonry</td>
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<td>Engineering Law &amp; Contracts</td>
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- Conduct civil engineering experiments and analyze and interpret the resulting data
  - The requirement is addressed by Student Outcome B (see Criterion 3 of this report) which states: “conduct civil engineering experiments and analyze and interpret the resulting data.”

- Design a system, component, or process in more than one civil engineering context:
  - This requirement is address by the design technical electives that CVEEN students must complete in order to meet our graduation requirements. CVEEN requires that all students complete at least two design courses, as indicated by D in Section 1 above.
  - The faculty assigned to instruct the primary CVEEN technical electives with significant design content (see courses with “(D)” designation from Section 1 – above) are usually licensed structural or professional engineers except for CVEEN 5605 (Water and Wastewater Design) and CVEEN 4410 (Engineering Hydrology). Nonetheless, the instructors assigned to these courses have specific and detailed training and research in these areas. CVEEN 5605 has been recently taught by Dr. Conroy-Ben, who has left the University after the end of spring semester 2015. Dr. Conroy-Ben has research experience in areas including water/wastewater treatment and reuse, endocrine disruption, analytical and environmental chemistry, and metal resistance systems in bacteria. She received her Ph.D. from the University of Arizona in Chemical and Environmental Engineering, as well as Master’s degrees in Environmental Engineering and Chemistry. She has also completed a postdoctoral co-appointment in the departments of Chemistry and Biochemistry and Soils, Water, and
Environmental Science at the University of Arizona. Prior to that, Otakuye was a project engineer at the County Sanitation Districts of Los Angeles County, where she studied odor control in wastewater treatment systems. CVEEN 4410 has been recently taught by Dr. McPherson. Dr. McPherson has research experience in groundwater hydrology, petroleum and energy resources engineering, numerical modeling of groundwater flow and coupled processes (including coupled stress-strain-fluid flow, coupled heat flow-fluid flow, coupled reactive transport and fluid flow), rock mechanics measurements and modeling, analysis and engineering of subsurface CO2 sequestration for greenhouse gas reduction and climate change mitigation.

- In addition, all CVEEN students must complete CVEEN 4910 – Professional Practice and Design before graduation. This is a capstone design experience where students apply their technical experience to formulate, evaluate and design a civil engineering project in the context of multi-disciplinary teams.

- Explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

  - The requirement is addressed by Student Outcome L (see Criterion 3 of this report) which states: “an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.”

  - CVEEN 4910 has instructional material, presentations and reading assignments that address Student Outcome L. Each class member is required to complete quizzes or memos during the semester on these topics. These essays are reviewed by the CLEAR writing consultant that works with the class that semester, or by the course T.A. or instructor.
APPENDICES

Appendix A – Course Syllabi
CH EN 2300, Thermodynamics I

1. Credits and contact hours: 2 semester hours and 1.67 contact hours per week
2. Instructor: Geoffrey D. Silcox
4. Course information
   a. Catalog Description: Thermodynamic properties, open and closed systems, equations of state, heat and work, first law of thermodynamics, second law of thermodynamics, Carnot cycle, introduction to power and refrigeration cycles.
   b. Prerequisites or co-requisites: Prerequisites: C or better in (PHYS 2210 AND (MATH 1320 OR MATH 1321))
   c. Curriculum category: Required course.
5. Specific goals
   a. Learning outcomes
      i. Demonstrate effective approaches to solving homework problems and presenting solutions.
      ii. Convert between the United States Customary, SI, and metric units systems.
      iii. Define the concepts of (a) system, (b) surroundings, (c) intensive and extensive properties, (d) equilibrium, (e) heat, (f) work, (g) state (point) functions, and (h) path functions.
      iv. Apply the rate and accumulation forms of the accounting equation to the extensive properties mass, energy, and entropy, in order to solve practical engineering problems.
      v. Analyze and solve thermodynamic problems involving ideal gases, phase change fluids, and incompressible substances.
      vi. Draw and label processes on standard thermodynamic diagrams.
      vii. Apply the concept of efficiency to calculate actual work input or output.
      viii. Define reversible and irreversible processes and state what makes a process irreversible.
      ix. State the significance of entropy and entropy generation.
      x. Calculate the change in entropy of a system and its surroundings as it changes from one state to another.
      xi. Analyze steady, reversible flow processes using the combined energy and entropy balance.
      xii. Use the concept of adiabatic efficiency in the specification of process equipment.
      xiii. Apply energy and entropy balances to analyze power and refrigeration cycles.
      xiv. Critically analyze proposed processes to determine whether they are thermodynamically and economically feasible.
   b. Criterion 3 outcomes and other outcomes addressed by course
      i. Outcome (a): an ability to apply knowledge of mathematics, science, and engineering
      ii. Outcome (c): an ability to design a system, component, or process to meet desired needs
      iii. Outcome (e): an ability to identify, formulate, and solve engineering problems
iv. Outcome (g): an ability to communicate effectively
v. Outcome (h): the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context

6. **List of topics to be covered:** Thermodynamic properties, open and closed systems, equations of state, heat and work, first law of thermodynamics, second law of thermodynamics, Carnot cycle, introduction to power and refrigeration cycles.
CHEM 1210 General Chemistry I

Department: Chemistry
Course Number: CHEM 1210
Designation: Required

General Catalog Course Description: Fundamentals of chemistry emphasizing descriptive and modern applied chemistry for science and engineering majors. Topics include atomic theory, molecular bonding, and reaction chemistry.

Prerequisites: CHEM 1200, or MATH 1050 or equivalent, or placement.

Zumdahl and Zumdahl, Chemistry an Atoms First Approach
Cengage Learning OWL access

Topics covered in the course:
1. Chemical foundations
2. Atomic structure and periodicity
3. Atoms to molecules
4. Bonding: general concepts
5. Molecular structure and orbitals
6. Chemical energy
7. Gases
8. Liquids and solids
9. Stoichiometry
10. Types of chemical reactions and solution stoichiometry

Class/laboratory schedule: Three 50-minute lectures per week; discussion sections

Contribution of course to meeting the requirements of ABET Criterion 5: College-level basic science

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering
b. Ability to conduct experiments and interpret data
k. Ability to use techniques, skills and modern engineering tools necessary for engineering practice
7. A capability to solve the problems at the interface of engineering and biology by applying SCIENCE (hypothesis driven research)

Prepared by: Alexis Ulrich, March 17, 2015
CHEM 1215, General Chemistry Laboratory I

Department: Chemistry  
Course Number: CHEM 1215  
Designation: Required  
General Catalog Course Description: One lecture and one 3 hour lab per week. Must be taken concurrently with CHEM 1210.

Prerequisites: N/A  
Text: Chemistry 1215 lab manual, *Experiments in General Chemistry Featuring MeasureNet®, 2nd edition*

Course Learning Outcomes:

1. Enhance your understanding of core general chemistry concepts through hands-on, tangible laboratory experiments (This course should be taken concurrently with CHEM 1210)
2. Introduce you to common laboratory techniques and safe laboratory practices

Class/laboratory schedule: One 50-minute lecture per week; one 3-hour lab per week  
Contribution of course to meeting the requirements of ABET Criterion 5: College-level basic science  
Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering  
b. Ability to conduct experiments and interpret data  
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Alexis Ulrich Date: 3/18/15
**CHEM 1220, General Chemistry II**

Department: Chemistry  
Course Number: CHEM 1220  
Designation: Required

**General Catalog Course Description:** Chemistry 1220 is a four-credit course that consists of three lectures (sections 1 and 4) per week. Chemistry 1225 is the companion one-credit lab course. Chemistry 1225 meets one three-hour period per week. CHEM 1220/1225 are general chemistry courses that are comparable to any science majors’ sequence taught at major state universities in the United States. As a student, you are expected to perform at a level that is commensurate with students from other institutions such as Pennsylvania State University, University of Arizona, University of Wisconsin-Madison, and University of California-Berkeley. We expect excellence from you as well as from ourselves.

**Prerequisites:** N/A  
**Text:** Zumdahl and Zumdahl, *Chemistry an Atom’s First Approach, 1st edition*

**Course Learning Outcomes:**
- Understanding the time, length, and energy scales on which chemical processes occur
- Understanding the differences between classical and quantum mechanics
- Connecting operators to observables
- Distinguishing probabilities, amplitudes, averages, expectation values, and observables
- Understanding the origin and implications of quantum coherence
- Interpreting spectra
- Connecting common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals)
- Developing molecular-level critical thinking skills

**Topics covered in the course:**
1. Solids, Liquids, Phase Changes  
2. Properties of Solutions  
3. Chemical Kinetics  
4. The Nucleus: A Chemist’s View  
5. Chemical Equilibrium  
6. Acids and Bases  
7. Acid-Base Equilibria  
8. Solubility and Complex Ion Equilibria  
9. Spontaneity, Entropy, and Free Energy  
10. Electrochemistry

**Class/laboratory schedule:** Three 50-minute lectures per week, discussion sections

**Contribution of course to meeting the requirements of ABET Criterion 5:** Basic college-level science
Relationship of the course to the Program Outcomes:
a) an ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 4/22/2015
**CHEM 1225, General Chemistry Laboratory II**

Department: Chemistry  
Course Number: CHEM 1225  
Designation: Required

**General Catalog Course Description:** One lecture per week, one three-hour laboratory/discussion per week. (Must be taken concurrently with Chem. 1220.)

**Prerequisites:** N/A  
**Text:** Chemistry 1225 lab manual *Experiments in General Chemistry Featuring MeasureNet, 2nd edition*

**Course Learning Outcomes:**
1) Enhance your understanding of core general chemistry concepts through hands-on, tangible laboratory experiments (This course should be taken concurrently with CHEM 1220)
2) Introduce you to common laboratory techniques and safe laboratory practices

**Class/laboratory schedule:** One 50-minute lecture per week; one 3-hour lab per week

**Contribution of course to meeting the requirements of ABET Criterion 5:** College-level basic science  

**Relationship of the course to the Program Outcomes:**
Outcome:

a. Ability to apply knowledge of mathematics, science, and engineering  
b. Ability to conduct experiments and interpret data  
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice  
7 A capability to solve the problems at the interface of engineering and biology by applying SCIENCE (hypothesis driven research)

**Prepared by:** Alexis Ulrich  
**Date:** 4/22/15
**CHEM 2310, Organic Chemistry I**

**Department:** Chemistry  
**Course Number:** CHEM 2310  
**Designation:** Required  

**General Catalog Course Description:** Topics include reactions of organic molecules, shapes of molecules, and spectroscopic methods of identifying organic molecules.

**Prerequisites:** CHEM 1220 or 1221  
**Text:** Smith, *Organic Chemistry* (any edition)  
Smith, *Study Guide and Solutions Manual*  
Klein, *Organic Chemistry as a Second Language*

**Topics covered in the course:**
1. Structure and bonding  
2. Acids and bases  
3. Organic molecules and functional groups  
4. Infrared spectroscopy, $^{13}$C NMR Spectroscopy  
5. Alkanes  
6. Stereochemistry  
7. $^{1}$H NMR Spectroscopy  
8. Organic reactions  
9. Nucleophile substitution  
10. Elimination  
11. Alcohols, epoxides, and ethers  
12. Alkenes  
13. Alkynes  
14. Oxidation and reduction

**Class/laboratory schedule:** Three 50-minute lectures per week; discussion sections

**Contribution of course to meeting the requirements of ABET Criterion 5:** College-level basic science

**Relationship of the course to the Program Outcomes:**
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering  
b. Ability to conduct experiments and interpret data  
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

**Prepared by:** Alexis Ulrich  **Date:** 3/18/15
CHEM 2315, Organic Chemistry Laboratory I

Department: Chemistry
Course Number: CHEM 2315
Designation: Required

General Catalog Course Description: The purpose of the laboratory is to give students hands-on experience with the scientific method, teach critical thinking and writing skills as well as important techniques to prepare students for advanced work in chemistry and related science and engineering fields, and to introduce certain concepts that are well-suited to hands-on discovery. Students need either to have taken, or be taking concurrently, CHEM 2310 or CHEM 2311, in order to succeed in this course.

Prerequisites: N/A

Lab notebook

Class/laboratory schedule: One 50-minute lecture per week; one 3-hour lab per week

Contribution of course to meeting the requirements of ABET Criterion 5: College-level basic science

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering
b. Ability to conduct experiments and interpret data
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Alexis Ulrich Date: 3/18/15
**CS 1000, Engineering Computing**

**Department:** Computer Science

**Course Number:** CS 1000

**Designation:** Required

**General Catalog Course Description:** Introduction to programming principles and engineering problem solving via computational means using MATLAB (during the first half of the semester) and C (during the second half of the semester). Decomposition of programs into data representation, functions, and control structures. Clean programming practices are emphasized. The MATLAB portion of the course focuses on the implementation of physically-based models, data visualization via plotting and selected numerical techniques. The C portion of the course introduces basic syntax and special features of the language to engineering implementations.

**Prerequisites:** None

**Textbooks and/or other required material:**

*Online notes*

**Course Learning Outcomes:**

1. Understand how to think logically and algorithmically.
2. Understand the basic programming concepts (iterations, branching, function calls, etc).
3. Understand the power and syntax of the Matlab Programming Environment.
4. Understand the basic syntax and how to program in the C language.
5. Understand how to write, compile, test, and debug programs.
6. Understand how to apply programs to engineering related problems

**Topics covered in the course:**

- **Programming and Computing Topics:**
  - Variables and Symbolic Computing
  - Data Types, including characters, numbers (double/integers), Booleans, arrays (and matrixes), and structures.
  - Expressions: Boolean and Mathematical
  - Program Flow, including loops and if statements
  - Function Use and Creation

- **General Computing Ideas**
  - Random Numbers
  - Efficiency
  - Data Visualization, e.g., Plotting
  - File input/output
- Tool Usage: including Matlab and Spreadsheets (mainly Excel)
- Algorithm Development, including introductions to data fitting, stochastic processes, and numerical methods.
- Problem Solving
- Debugging, Reading and Understanding Computer Programs
- Data Transformation
- Vector Math

- Matlab specific topics:
  - Simulink
  - Symbolic Toolkit

- Sample Assignment Types* (vary from year to year)
  - Smoothing Data
  - Monte Hall Simulation
  - Text Analysis
  - Image Analysis
  - Numeric and Symbolic Computations
  - Statistical Simulation

Class/laboratory schedule: There are two 80-minute lectures and one 50 minute laboratory each week. CS 1000 is a 3-credit-hour course.

Contribution of course to meeting the requirements of ABET Criterion 5: Engineering Computing is an engineering science course.

Relationship of the course to the Program Outcomes:

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Expected Level of Achievement Based on Bloom’s Taxonomy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>Program-level by graduation: Application</td>
</tr>
<tr>
<td></td>
<td>Course-level: Application (desired)</td>
</tr>
</tbody>
</table>

*Bloom’s Taxonomy considers the following six levels of achievement: knowledge, comprehension, application, analysis, synthesis, and evaluation. It is expected that instructors will perform informal assessments of desired criteria to the extent that they feel is necessary to support achievement of the Program outcomes through the overall curriculum. Required criteria, if any, should be assessed at the course level because they directly support the Program level outcome evaluation required by ABET.

Prepared by: Ajay Nahata
Date: 06/12/2015
CVEEN 1000 – Introduction to Civil and Environmental Engineering

2. Credits and contact hours: Credits: 2; Contact Hours: 2 120-minutes classes per week

3. Instructor’s or course coordinator’s name: Douglas Schmucker


5. Specific course information
   a. Catalog Description: An overview of the profession of civil and environmental engineering, including the major elements of the profession, a basic understanding of the core disciplines, and ideas surrounding design. Emphasis is placed on improvements of writing, speaking, and teamwork skills.

   b. Prerequisite(s): none

   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction

      1. Describe the core disciplines that comprise the civil and environmental engineering professions.
      2. Discuss the relationship of the practice of the profession to society, the inherent service nature of the profession, and how the nature of that service influences the nature of practice.
      3. Define the attributes of a profession and how a profession differs from an occupation.
      4. Define the characteristics of effective teams and team members.
      5. Discuss the role and type of communication skills required in the profession.
      6. Define the knowledge, skills, and attitudes necessary for success in the profession.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d) an ability to function on multidisciplinary teams</td>
<td>Groups of 4 to 6 students are assigned an historic and/or significant heritage civil engineering project. Students both prepare an intensive engineering research report and orally present the work. This is a term-length project.</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>Requires individual students to select a USGS river gage, collect the data, and follow prescribed steps to estimate the 100-year flow magnitude. Requires individual students to complete a &quot;design&quot; using the Bridge Designer software</td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td>Summative Assessment Data collected via individual assignments regarding the requirements for licensure, curricular requirements from at least three ABET accredited programs, final exam essay questions about the ethical responsibilities of engineers, and earning Professional Development points by attending and participating in professional society meetings and organizations (student chapter and/or local branches).</td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>Summative Assessment data collected via the team project reports and oral presentations conducted by each student (in a team format).</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>Summative Assessment data collected via the team project reports and oral presentations conducted by each student (in a team format).</td>
</tr>
<tr>
<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
<td>Indirect measurement by the pure nature that the team projects required the students to develop their own research sources and develop a model of adequacy of the data that they discovered.</td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td>Indirect data obtained from the team project reports in regards to the current significance of their assigned project and discussion of the long-term impacts of that project.</td>
</tr>
<tr>
<td>(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td>Summative Assessment data collected via individual essays that discuss these topics as they emerge from a study of a natural disaster and society's and engineering's contribution to that disaster: The 1927 Flood on the Lower Mississippi.</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Disciplines of civil and environmental engineering (CvEEN)
   2. Professional organizations associated with CvEEN
   3. Professional licensure
   4. Professional service, ethics, and obligations to society
   5. Body of Knowledge (required knowledge, skills, and aptitudes) for successful practice
   6. The business of professional practice
   7. Civil engineering history and heritage
   8. Contemporary issues
   9. Team skills, metrics, and responsibilities

Prepared by: S. Bartlett, Date 6/17/2015
**CVEEN 2000, 3000, 4000, Soph, Jr. and Sr. Seminar**

2. **Credits and contact hours:** Credits: 0.5; Contact Hours: 1 50-minute classes per week

3. **Instructor’s or course coordinator’s name:** Michael Barber

4. **Text book:** none

5. **Specific course information**
   - **Catalog Description:** Selected presentations from individuals who deal with different aspects of the practice of civil and environmental engineering.

   - **Prerequisite(s):**
     - none

   - **Elective** – none

6. **Specific goals for the course**
   - **Outcomes of instruction**

   - **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 2000, 3000, 4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td></td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td></td>
</tr>
<tr>
<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
<td></td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td></td>
</tr>
<tr>
<td>(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td></td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Professional practice,
   2. construction administration,
   3. value engineering, professional
   4. ethics and responsibilities,
   5. technical communications,
   6. job skills and opportunities,
7. advising,
8. academic requirements,
9. leadership opportunities,
10. public policy
11. professional development.

Prepared by: S. Bartlett, Date 6-17-2015
**CVEEN 2010 - Statics**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 3 50-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Douglas Smucker


5. **Specific course information**
   a. **Catalog Description:** Forces, moments and couples; resultants and static equilibrium of general force systems; statically equivalent force systems, center of gravity and center of pressure; friction; free body method of analysis; trusses and frames; internal forces (shearing forces and bending moments); tensile and compressive axial forces; applications to simple engineering problems

   b. **Prerequisite(s):** C or better in ((MATH 1210 OR MATH 1310 OR MATH 1311) OR AP Calc AB score of 4 or better OR AP Calc BC score of 4 or better) AND Intermediate Major Status in Civil Engineering. Corequisites: C or better in PHYS 2210

   c. **Elective** – none

6. **Specific goals for the course**
   1. Outcomes of instruction Develop free body diagrams for bodies in static equilibrium
   2. Calculate the external reactions for bodies in static equilibrium
   3. Determine internal forces and pin reactions in trusses, beams, frames, and machines
   4. Calculate centroids and moments of inertia of cross-sectional areas, determine the center of gravity, find the center of pressure
   5. Determine the effect of friction between connecting parts or at support surfaces

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Summative Assessment data collected via directly linked items on a minimum competency-based final exam. Formative Assessment data collected via interim exam items. Assessment uses competency-based metric/rubric to determine performance level.</td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Forces, moments and couples;
   2. Resultants and static equilibrium of general force systems;
3. Statically equivalent force systems, center of gravity and center of pressure;
4. Friction;
5. Free body method of analysis;
6. Trusses, frames, and machines;
7. Internal forces (shearing forces and bending moments); tensile and compressive axial forces; applications to simple engineering problems.

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 2130 – Statistics and Economics

2. **Credits and contact hours:** Credits: 4; Contact Hours: two 50-minute classes and one 80-minute class per week

3. **Instructor’s or course coordinator’s name:** Daniel J. Fagnant


5. **Specific course information**
   a. **Catalog Description:** Introductory probability and statistics topics that are relevant to civil and environmental engineering, including set terminology and theory, fundamental axioms of probability, conditional probability, statistical independence, Bayes’ theorem, deMorgan’s rule, random variables, probability mass, density and distribution functions, moments, measures of central tendency and dispersion, common discrete and continuous probability functions, data compression, frequency distributions, point estimation, and confidence intervals. Fundamental engineering economics topics, including equivalence, compound interest and discount rate factors, nominal and effective interest rates, cash flow diagrams, capitalized cost, net present worth analysis, equivalent uniform annual cost, internal rate of return, benefit-cost analysis, basic microeconomics, cost estimation, and cost indexes.

   b. **Prerequisite(s):**
      MATH 1210 – Calculus I, OR MATH 1310 – Engineering Calculus I, OR MATH 1311 - Accelerated Engineering Calculus I OR AP Calc AB score of 4 or better OR AP Calc BC score of 4 or better

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      1. Understand the role of probability, statistics and economics for broad use across civil engineering disciplines.
      2. Understand meanings of and how to calculate statistical measures such as standard deviation, variance, covariance, correlation, and confidence intervals.
      3. Understand meanings of and how to calculate discrete and continuous probabilities, including union and intersections, cumulative distribution, and conditional probability.
      4. Understand properties of statistical distributions including binomial, Poisson, normal and lognormal.
5. Understand how to conduct and interpret hypothesis testing and analysis of variance (ANOVA).
6. Understand how to estimate linear regression models and analyze their results.
7. Understand how to conduct present worth, future worth, annual worth and internal rate of return valuations.
8. Apply benefit-cost analysis methods to identify optimal project selection.
9. Understand the role of discount rates and depreciation.

b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 2130</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Homework, and exams teach principles of solving statistics, probability and economics problems. These principles are taught and reinforced at the application level using applied problems.</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>Lecture, homework and exams in course introduce students to the concepts of statistical hypothesis testing, t-statistics, z-statistics, and p-values. Additionally, statistical measures such as mean, variance, standard deviation, confidence intervals, and analysis of variance are introduced, all of which are critical for analyzing and interpreting any statistical dataset.</td>
</tr>
<tr>
<td>(k) an ability to apply engineering tools</td>
<td>The class familiarized students with Excel’s Solver tool and Excel’s built-in functions for statistical and engineering economic analysis. Students used these tools in a course project to generate normal and lognormal statistical distributions using in-depth real-world toll modeling scenarios, then adjusted toll-rates using Solver with a goal of toll road operator profit maximization.</td>
</tr>
</tbody>
</table>

7. Topics:
   a. Statistics
      1. Probability and Statistics in Engineering
      2. Data Types and Methods of Describing Data
      3. Bivariate data, Correlation and Covariance
      4. Probability Density and Cumulative Density Functions
      5. Conditional Probability
      6. Probability Distributions
      7. Confidence Intervals
      8. Hypothesis Testing
      9. Analysis of Variance
      10. Building Empirical Models - Linear Regression
   b. Economics
      11. Engineering Economic Analysis
      12. Time Value of Money
      13. Choosing the Best Alternative – Evaluating Alternative Investments
      14. Present Worth Analysis
15. Annual Worth Analysis
16. Future Worth Analysis
17. Rate of Return Analysis
18. Replacement Analysis
19. Depreciation Methods
20. After-Tax Economic Analysis
21. Break-Even Analysis

Prepared by: Daniel J. Fagnant, May 26, 2015
CVEEN 2140 – Strength of Materials

2. Credits and contact hours: Credits: 3; Contact Hours: 3 50-minutes classes per week

3. Instructor’s or course coordinator’s name: Douglas Schmucker


5. Specific course information
   a. Catalog Description: Concept of stress, axial stress and strain, torsion, pure bending, transverse loading, transformations of stress and strain, design of beams and shafts for strength, deflection of beams, columns
   b. Prerequisite(s): C or better in CVEEN 2010 AND Intermediate Major Status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      1. Develop and apply basic models of stress and strain for mechanical or structural components.
      2. Model the state of stress at a point and determine maximum normal and shear stresses.
      3. Design and assess the adequacy of axially, transversely, and/or torsionally-loaded transverse members.
      4. Calculate elastic, plastic and thermal strains and deflections of a member.
      5. Analyze basic statically indeterminate members.
   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 2140</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Summative Assessment data collected via directly linked items on a minimum competency-based final exam. Formative Assessment data collected via interim exam items. Assessment uses competency-based metric/rubric to determine performance level.</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>Summative Assessment data collected via directly linked items on a minimum competency-based final exam. Formative Assessment data collected via interim exam items.</td>
</tr>
</tbody>
</table>
Assessment uses competency-based metric/rubric to determine performance level.

7. **Topics:**
   1. Concept of stress and strain
   2. Deformations of
      a. Axially loaded members
      b. Torsionally loaded members
      c. Members in bending and transverse shear
   3. Transformations of stress and strain
   4. Combined loading
   5. Thin-walled pressure vessels
   6. Plane stress and plane strain
   7. Design of beams, shafts, columns, and truss members
   8. Applications to simple statically indeterminate problems.

Prepared by: S. Bartlett, Date 6/17/2015
CvEEN 3100: Technical Communications for Civil Engineers

2. Credits and contact hours: Credits: 3; Contact Hours: 2 80-minutes classes per week

3. Instructor’s or course coordinator’s name: Joshua B. Lenart, PhD (FA 2014 & SP 2015)


5. Specific Course Information
   a. Catalog Description: Learning to communicate orally and in writing is an essential component of undergraduate engineering education. This course addresses the fundamentals of writing and reviewing technical documents, presenting scientific information through graphs and tables, and preparing technical presentations.
   b. Prerequisite(s): (WRTG 2010 OR ESL 1060) AND Full Major Status in Civil Engineering.
   c. Elective: N/A

6. Specific Goals for the Course
   a. Outcomes of Instruction
      1. Learn best practices for communicating engineering work and research in an empirically-grounded and logical fashion while maintaining attention to discrete content and organization details.
      2. Gain knowledge of social, ethical, and practical dimensions of industry communication.
      3. Explore meta-level aspects of professional communications to foster and develop engineering judgment required to practice civil and environmental engineering.
      4. Apply this knowledge to reason and argue about familiar things in new ways.
      5. Train students to write and speak more effectively introducing them to rhetoric as a method for analyzing, evaluating, and communicating multiple layers of technical information.
      6. Utilize context-sensitive constraints to highlight the complexity and multidimensionality of an engineering issue.
      7. Raise sophisticated questions, synthesize information, and apply ideas to engineering-related topics.
      8. Analyze and present informed research on contemporary civil and environmental engineering issues germane to the field and an engineer’s role in a global society.

   b. Student Outcomes Addressed by this Course

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 3100</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d) An ability to function on</td>
<td>Homework, proposals, feasibility reports, and oral presentations</td>
</tr>
</tbody>
</table>
multidisciplinary teams teach principles of team research, writing, editing, and project coordination.

(f) An understanding of professional and ethical responsibility

Supplementary course text introduces students to environmental engineering ethics and requires them to conduct an in depth study of an ethical issues from a multidimensional perspective.

(g) An ability to communicate effectively using verbal, written, and graphical skills.

The lecture and writing components of this course emphasize the goal of critically training students to reason, argue, and communicate technical information in a more informed and persuasive manner.

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Students are expected to solve applied problems; write and argue on ethical, logical, and social issues related to civil and environmental engineering; and understand, interpret, and research local/global contemporary engineering issues.

(i) A recognition of the need for, and an ability to engage in life-long learning

The course syllabus, reading, and assignments are designed to familiarize students with the concepts of public intellectualism and civic responsibility.

(j) A knowledge of contemporary issues

Students are required to consult local media outlets to generate the most up-to-date content on regional issues, including: engineering firms, public policy, and legislative action.

7. Topics
   1. Professionalization
   2. Technical Documentation, including: Memos, Cover Letters, and Resume/CVs
   3. Rhetorical Analysis, including: Audience, Purpose, and Content/Context
   4. Effective oral presentation strategies
   5. Crafting arguments drawn from quantitative and qualitative research results
   6. Technical research and report generation
   7. Feasibility Studies
   8. Grant writing
   9. Team writing
   10. Engineering Ethics, including related fields of: sustainability, land and resource management, and large-scale, civil infrastructure projects
   11. Translating technical information for use in public policy, management, and resource analysis.

Prepared by: Joshua B. Lenart, PhD

Date: 21 May 2015
CVEEN 3210 – Structural Loads and Analysis

2. **Credits and contact hours:** Credits: 3; Contact Hours: 3 50-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Luis Ibarra, Fall, 2015


5. **Specific course information**
   a. **Catalog Description:** Structural design loads with emphasis on application of specifications, analysis of cables and arches, influence lines for beams and trusses, deflection of structures by double-integration, moment-area, conjugate-beam, and virtual-work methods, introduction to indeterminate structural analysis using slope-deflection, moment-distribution, and approximate techniques.

   b. **Prerequisite(s):** CVEEN 2140 – Strength of Materials

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**

      The goal of structural analysis is to determine the effects of external loads on structures. At the end of the course, you should be able to:

      1. Understand the fundamentals of structural loads.
      2. Calculate deflections of beams and trusses.
      3. Compute axial, shear, and moment forces on members of statically determinate beams and frames.
      4. Compute axial, shear, and moment forces on members of statically indeterminate beams and frames.
      5. Use structural analysis software to analyze structural systems.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Primary outcomes</th>
<th>Role of CVEEN 3210</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>The students apply the concepts learnt in the classroom by solving a weekly homework, two midterm exams, and a final exam. They also have an assessment quiz during the first week of classes. In several classes they also solve short exercises (from two to five minutes) during lecture time.</td>
</tr>
<tr>
<td>(k) an ability to use the techniques, Skills, and modern engineering</td>
<td>The students learn how to use a commercial structural analysis software, SAP2000, during the course. The instructor and the TA offer a couple of workshops early in the semester to get students started. There are three or</td>
</tr>
</tbody>
</table>
design tools necessary for engineering practice. Four homework during the semester that require the use of this software. Usually the students have to solve the exercises by hand calculation, solve the same exercise using the computer software, and then evaluate the effect of variations on element characteristics, and/or boundary conditions.

<table>
<thead>
<tr>
<th>Other outcomes</th>
<th>Role of CVEEN 3210</th>
</tr>
</thead>
<tbody>
<tr>
<td>(g) an ability to communicate effectively using verbal, written, and graphical skills</td>
<td>In several classes, the students are asked to discuss concepts in teams and then response to instructor questions. In a lot of HW assignments, the students are required to describe parameters controlling the system’s performance, and write conclusions.</td>
</tr>
<tr>
<td>(i) a recognition of need for, and ability to engage in life-long learning.</td>
<td>During the semester, the students are reminded several times of the technical electives related to structural engineering. The first couple of sessions, and the end of the course, they learn about the activities they can perform after graduation in the area of structural engineering. We usually have a field trip to a construction site to observe how structures are built, and understand the staff roles in the construction site.</td>
</tr>
</tbody>
</table>

**Topics:**
1. Introduction to Structural Analysis
2. Dead and live Loads
3. Snow Loads
4. Wind Loads
5. Seismic Loads
6. Stability and static determinacy
7. Analysis of statically determinate trusses
8. Axial, shear and moment diagrams for beams
9. Axial, shear and moment diagrams for frames
10. Influence lines and highway loads
11. Deformation of Beams and Trusses
12. Double integration method
13. Moment area method
14. Virtual work method
15. Moment distribution method for beams
16. Moment distribution method for frames
17. Approximate methods
18. Cables
19. Arches

2. **Credits and contact hours:** Credits: 3; Contact Hours: 3 50-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Steven F. Bartlett, Spring, 2015


5. **Specific course information**
   a. **Catalog Description:** An introduction to the fundamental geologic and engineering properties of silts and basic soil mechanics. Topics include geologic soil processes, phase relations, grain-size distribution, clay mineralogy, clay-water interaction, consistency limits, fabric and structure, classification, compaction, swelling, shrinkage, slaking, collapse, permeability, one- and two-dimensional flow, liquefaction, consolidation and settlement, and shearing strength of cohesionless soils.

   b. **Prerequisite(s):**
   CVEEN 2140 – Strength of Materials

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**

   1. Understand how geologic processes form soil deposits.
   2. Gain knowledge of soil as a geotechnical material.
   3. Understand how to help foster and develop the engineering judgment required to practice geotechnical engineering.
   4. Understand index and classification properties of soils.
   5. Apply this knowledge to the soil classification.
   6. Understand clay mineral and the structure and how this structure affects their properties.
   7. Understand compaction and how to apply it to relative compaction.
   8. Understand other soil-water interactions (i.e., capillarity, shrinkage, swelling, frost action).
   9. Understand, apply and analyze topics related to seepage, effective stress, consolidation and time rate of consolidation.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 3310</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Homework, quizzeses and exams teach principles of solving 1 and 2 D flow equation by using examples of flow nets and consolidation calculations. These principles are taught and reinforced at the application level by applied problems.</td>
</tr>
<tr>
<td>(b) an ability to design</td>
<td>The lecture and laboratory component of this course emphasise the</td>
</tr>
</tbody>
</table>
and conduct experiments, as well as to analyze and interpret data

| Conducting of a series of experiments design to teach principles of geotechnical engineering. Each student group is expected to perform a series of experiments, evaluate the obtained data, including using statistical techniques and interpret the results in a laboratory report. |
| (e) an ability to identify, formulate, and solve engineering problems |
| The students are expected to solve applied problems dealing with consolidation theory and its application to settlement of embankment and footings. This involves interpretation of laboratory data, understanding soil loadings and calculating the subsequent consolidation settlement. |

7. **Topics:**
   1. Geologic soil processes
   2. Phase relations
   3. Grain-size distribution
   4. Clay mineralogy
   5. Clay-water interaction
   6. Consistency limits
   7. Soil fabric and structure
   8. Soil classification
   9. Compaction
   10. Swelling, shrinkage, slaking, collapse
   11. Permeability
   12. One- and two-dimensional flow
   13. Liquefaction,
   14. Consolidation and settlement
   15. Shear strength of cohesionless soils

Prepared by: Steven F. Bartlett, December 2014
**CVEEN 3410 – Hydraulics**

1. **Credit and contact hours:** Credits: 4.0; Contact Hours: 3 classroom, 3 lab per week

2. **Instructor’s or course coordinator’s name:** Steve Burian


4. **Specific course information**
   a. **Catalog Description:** Fundamental fluid mechanics with focus on hydraulic design of civil engineering systems. Topics include hydrostatics, kinematics, energy and momentum principles, flow through pipes and networks, pumps, and open channel flow.
   
   b. **Prerequisite(s):** CVEEN 2140 – Strength of Materials and MATH 2210 – Calculus III
   
   c. **Elective:** none

5. **Specific goals for the course**
   a. **Outcomes of instruction:**
      1. Knowledge of fluid properties including density, specific weight, and viscosity
      2. Application of hydrostatics and buoyancy and stability.
      3. Application and synthesis of closed-conduit hydraulic pipeline system analysis and design methods.
      4. Application of open channel uniform and rapidly varying flow.
   
   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of 3410</th>
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</thead>
</table>
| a. an ability to apply knowledge of mathematics through differential equations, science and engineering. The science should include calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives. | Program-level by graduation: Application  
Course-level: Application (required)  
Homework and exams are used to assess this outcome with problems requiring physics to be applied. |
| b. an ability to design and conduct civil engineering experiments and analyze and interpret the resulting data. | Program-level by graduation: Synthesis  
Course-level: Synthesis (Required)  
Laboratory experiments are used to assess this outcome. In particular there is one experiment |
that requires students to design the experiment to produce a hydraulic jump, record correct observations, and complete a calculation.

c. an ability to design a system, component, or process in more than one civil engineering context to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.

Program-level by graduation: Synthesis
Course-level: Synthesis (desired)

A question on the final exam and the team project are used to assess this outcome. The final exam provides an opportunity to perform the hydraulic calculations used in a design, while the team project provides more realistic constraints.

e. an ability to identify, formulate, and solve engineering problems by applying knowledge of four technical areas appropriate to civil engineering.

Program-level by graduation: Application
Course-level: Application (required)

Homework and questions on the final exam are used to assess this outcome. The focus is water resources engineering.

g. an ability to communicate effectively using verbal, written, and graphical skills.

Program-level by graduation: Analysis
Course-level: Comprehension (desired)

Laboratory reports require writing and graphical skills to be applied. The team project report includes a presentation component that requires each student to make a presentation and be evaluated.

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

Program-level by graduation: Application
Course-level: Application (Required)

One of the labs and one homework assignment requires students to apply a computer model to analyze a water distribution network.

6. **Topics covered in the course:**

1. Fluid properties and pressure
2. Hydrostatics, buoyancy and stability
3. Conservation of mass and energy
4. Bernoulli and energy equations
5. Linear momentum
6. Friction loss
7. Pipeline system design
8. Water network computer modeling
9. Pumps, Pump Selection and Operation, Pumping System Design
10. Open Channel FPlow
11. **Prepared by:** Steven Burian

**Date:** December 2014
CVEEN 3510 – Civil Engineering Materials

2. Credits and contact hours: Credits: 3; Contact Hours: 6 (two 50-minutes lectures + one 3-hour lab per week)

3. Instructor’s or course coordinator’s name: Amanda Bordelon, Fall 2014


5. Specific course information
   a. Catalog Description: Fundamental behavior and properties of various civil engineering materials. Topics include introduction to mechanical behavior of materials, characteristics of metals, characteristics of wood, evaluation of aggregates, design of Portland cement concrete and asphalt concrete, and introduction to materials testing.
   
   b. Prerequisite(s):
      CVEEN 2140 – Strength of Materials
   
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      
      1. Identify available types of steel (including alloys and treatments) which can be selected to be corrosion-resistant or meet desired yield strength.
      2. Explain how different selected material components which can be added to concrete will affect the fresh and hardened properties of the concrete.
      3. Design a concrete mixture to achieve specified design criteria.
      4. Explain asphalt Superpave design choices for a given pavement traffic loading or climate.
      5. List factors affecting properties of wood/timber.
      6. Evaluate properties statistically for variability or equivalence between data.
      7. Follow safety and cleanliness measures in the laboratory.
      8. Communicate effectively using written and graphical skills to prepare technical reports.
      9. Analyze and interpret data obtained from laboratory experiments.
      10. Present the application(s) and description of production and properties for a “new” civil engineering material.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 3510</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Homework, quizzes and exams teach principles of proportioning a mixture and calculated volumetrics.</td>
</tr>
</tbody>
</table>
(b) an ability to design and conduct experiments, as well as to analyze and interpret data

The lecture and laboratory component of this course emphasizes the conducting of a series of experiments designed to teach practice of mixing, constructing and evaluating properties of construction materials. Each student group is expected to perform a series of experiments, evaluate the obtained data, including using statistical techniques and interpret the results in a laboratory report.

(d) an ability to function on multi-disciplinary teams.

Each student works with a group of their peers to perform the experiments, write reports, as well as research and present on their final project.

(e) an ability to identify, formulate, and solve engineering problems

The students are expected to solve mixture design and proportioning problems. The students must also interpret laboratory data to calculate statistical results.

(g) an ability to communicate effectively using written, graphical, and verbal skills.

Each student works with a group of their peers to write reports, generate graphs and tables of the laboratory data, creates a poster and verbally presents their research findings regarding their final project.

(j) a knowledge of contemporary issues that are affecting our infrastructure and environment.

Students are expected to do perform research online related to sustainability and carbon footprint of materials production. Students also have an option to visit with a local construction materials plant to ask questions regarding current issues with production and sustainability.

(k) an understanding of and ability to use the techniques and skills, including engineering economics, and modern engineering tools necessary for professional civil engineering practice.

Students learn about and have the hands-on opportunity to use the latest state-of-the-art engineering tools and equipment for determining properties of materials in the laboratory.

7. Topics:
   1. Specifications and methods for material testing
   2. Production and characteristics of steel sections
   3. Aggregate properties and their use as a construction material
   4. Origin and characteristics of portland cement
   5. Characteristics and design of portland cement concrete
   6. Type of concrete reinforcement
   7. Origin and characteristics of asphalt cement
   8. Characteristics of and design of asphalt concrete based on Superpave concepts
   9. Basic properties of wood

CVEEN 3520 – Transportation Engineering

2. Credits and contact hours: Credits: 3.0; Contact Hours: 3 50-minutes classes per week

3. Instructor’s or course coordinator’s name: Richard J. Porter (course coordinator and instructor for Fall 2009, Fall 2010, Fall 2011 and Fall 2012)


5. Specific course information
   a. Catalog Description: Introduction to the design, analysis, and planning of road transportation systems: road vehicle performance; highway geometric design; traffic flow and queuing theory; traffic forecasting.
   b. Prerequisite(s): C or better in CVEEN 2140 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      • Identify the role and significance of transportation engineering in society and within the civil engineering profession;
      • Define theoretical concepts that underpin current highway and traffic engineering practice;
      • Apply calculus, geometry, differential equations, physics, and probability and statistics to solve highway and traffic engineering problems; and
      • Solve highway and traffic engineering problems similar in scope to problems encountered on the transportation portions of the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) exams.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 3520</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Topics 2-10 outlined in the next section require students to apply knowledge of mathematics, science, and engineering. Student outcomes in these areas are assessed through homework assignments, exams, and in-class example problems.</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>Selected homework problems are presented in the context of actual experiments or field studies. Students collect and analyze real data related to traffic impact analysis, speed, and freeway performance, analyze the data, and interpret the data to draw meaningful conclusions.</td>
</tr>
<tr>
<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic,</td>
<td>In-class presentations demonstrate the context of various technical calculations associated with course topics in the broader project development process. At least one applied problem per semester uses data from a recently completed or ongoing project</td>
</tr>
<tr>
<td>environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
<td>for which an environmental impact statement is available online so students can see the broader project context of various technical calculations and decisions.</td>
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<tr>
<td>e) an ability to identify, formulate, and solve engineering problems</td>
<td>Homework assignments, including applied problems, are designed to promote these outcomes. The applied problems are different than typical homework assignments and are intended to replicate challenges encountered on real-life highway projects with multiple problem solving approaches and solutions possible.</td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>Selected assignments required written evaluation of reports. Selected homework problems and applied problems require data to be plotted and analyzed. Detailed technical communication guidelines are provided early in the semester.</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>The introductory systems look at transportation, as well as selected in-class problems and homework assignments on geometric design and capacity and quality of service analysis use case studies from across the U.S. to demonstrate design and construction impacts on the environment, economy, and traveler behavior.</td>
</tr>
<tr>
<td>(i) a recognition of the need for, and an ability to engage in lifelong learning</td>
<td>In-class discussion of emerging research aimed at changing or supplementing current practice is conducted throughout the semester. References are made to professional short courses available that go beyond the amount of material that can be presented in a class. The need to keep professional registration current once obtained is also discussed.</td>
</tr>
<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>Widely-used standards, policies and manuals are routinely discussed and applied. Students are asked to develop spreadsheet programs and models to perform certain calculations.</td>
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</tbody>
</table>

7. **Topics:**
   1. Introductory systems look at transportation
   2. Vehicle dynamics and road vehicle performance
   3. Geometric design: stopping sight distance, vertical alignment, horizontal alignment, cross section definitions
   4. Traffic stream parameters
   5. Traffic flow theory
   6. Traffic detection systems
   7. Capacity and quality-of-service
   8. Queuing theory
   9. Intersection traffic control
   10. Traffic signal timing design
   11. Transportation planning and the four-step travel demand forecasting model
   12. Intelligent transportation systems and future transportation technologies

1. **CREDITS AND CONTACT HOURS:** Credits: 3; Contact Hours: 3 50-minutes classes per week

2. **INSTRUCTOR:** Dr. Otakuye Conroy-Ben, Ph. D.

3. **TEXTBOOK & REQUIRED MATERIALS:** Introduction to Environmental Engineering and Science, 3rd Edition, Masters and Ela; engineering paper; calculator, graphing calculator is acceptable; access to mathematical software (Excel, Matlab, SigmaPlot, etc.) and Powerpoint.

4. **SPECIFIC COURSE INFORMATION**
   a. **Catalog description:** Overview of the environmental engineering profession, environmental quality measurements, regulatory overview, water and wastewater quality, environmental chemistry, air quality, design of municipal water treatment systems.
   b. **Prerequisites:** "C" or better in CVEEN 2140 AND Full Major status in Civil Engineering.
   c. **This course is required for the CVEEN major.**

5. **SPECIFIC GOALS FOR THE COURSE:**
   a. **Outcomes of instructions:**
      i. Perform a chemical/microbial mass balance on a natural or engineered system
      ii. Identify chemical, biological, and physical contaminants in soil, water, and air
      iii. Define major water, wastewater, hazardous waste, solid waste, and air pollution regulations
      iv. Identify how oxygen, carbon, nitrogen, and phosphorus impact surface water quality
      v. Determine groundwater flow direction, magnitude, and how it affects the transport of contaminants
      vi. Apply basic water and wastewater design calculations
      vii. Describe remediation options for hazardous waste sites
      viii. Define individual components of integrated solid waste management
      ix. Determine fate and transport of priority air pollutants
   b. **Student outcomes addressed by this course**

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<thead>
<tr>
<th>CVEEN 3610</th>
<th>Me</th>
<th>f CVEEN 3610</th>
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</thead>
<tbody>
<tr>
<td>(a)</td>
<td>an ability to apply knowledge of mathematics, science, and engineering</td>
<td>its apply basic chemistry, biology, and mathematical growth equations in the areas of water quality and treatment in engineered systems</td>
</tr>
<tr>
<td>(e)</td>
<td>an ability to identify, formulate, and solve engineering problems</td>
<td>its are assessed on the ability to solve environmental programs through homework and exams.</td>
</tr>
</tbody>
</table>
an ability to communicate effectively

t groups present a hazardous waste technology not covered in class.

the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Specifically, students are presented with environmental regulation, life-cycle assessment, and climate change.

a recognition of the need for, and an ability to engage in life-long learning

Specifically, students are shown how environmental engineering is related to the various sub-disciplines of civil engineering.

a knowledge of contemporary issues

Instructor presents one environmental topic of the week, relevant to today’s issues.

6. MAJOR TOPICS: The course is divided into 10 modules, covering major subjects in environmental engineering. Topics are listed below, with associated reading assignments found in Masters and Ela.

1. Mass balance: units and conversions, mass flux, reactors, reaction rates (Reading: 1.1 – 1.3)
2. Environmental chemistry: stoichiometry, chemical equilibria, organic chemistry, nuclear chemistry (Reading: 2.1 – 2.2; 2.4 – 2.6)
3. Population growth: exponential growth, population growth (Reading: 3.1 – 3.2; 3.4)
4. Surface water quality: Clean Water Act, water resources, pollutants, oxygen demanding wastes, surface water quality (Reading: 5.1 – 5.7)
5. Groundwater pollution and transport: groundwater, Darcy’s law, contaminant transport, cone of depression, capture zone curves, groundwater contaminants, groundwater remediation technologies (Reading: 5.8 – 5.17)
6. Drinking water treatment: Safe Drinking Water Act, sedimentation, coagulation, flocculation, filtration, hardness, alkalinity, softening, membranes (Reading: 6.1 – 6.4)
7. Wastewater treatment: primary treatment, secondary treatment, anaerobic digestion (Reading: 6.2; 6.5)
8. Hazardous waste: hazardous wastes, hazardous waste legislation, treatment technologies (Reading: 6.6 – 6.9)
10. Air pollution: Clean Air Act, criteria and toxic air pollutants, pollution sources, meteorology, Gaussian plume model, indoor air pollution (Reading: 7.1 – 7.6; 7.9 – 7.12)
**CVEEN 4221 - Concrete Design I**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 160 minutes per week, 2 classes per week

3. **Instructor’s or course coordinator’s name:** Jerod G. Johnson, PhD, SE

   ACI 318-14 Building Code Requirements for Structural Concrete

5. **Specific course information**
   a. **Catalog Description:** Design of concrete structural elements: Concrete and reinforcing bar properties, design of beams and slabs for flexure and shear. Design of columns, footings, and retaining walls. Evaluation of deflections and serviceability. Extensive use of the American Concrete Institute building code.

   b. **Prerequisite(s):** C- or better in CVEEN 3210 AND Full Major status in Civil Engineering.

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      The objective of the course is to provide the student with a solid background in the fundamentals of design using reinforced concrete for typical civil engineering structures such as beams, columns, slabs walls and footings. The course addresses the design of individual structural elements, the interface of structural elements, and the assemblage of elements and connections into complete structural configurations. At the end of this course the successful student will be able to size basic concrete elements and assemble typical complete concrete structures. The stated objective will be accomplished through instruction and practice in the areas listed in the topics below.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 4221</th>
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</thead>
<tbody>
<tr>
<td>(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</td>
<td>This course presents many common civil engineering design scenarios where reinforced concrete is the material best suited to resist prescribed loads. Students are instructed accordingly and given the opportunity to design reinforced concrete systems with consideration not only to loads but to the economic constraints, constructability and other aspects of common construction.</td>
</tr>
</tbody>
</table>
(e) an ability to identify, formulate, and solve engineering problems

The course presents engineering problems on the basis of theoretical loads imposed on structures as prescribed by current building codes. The student then determines suitable geometries and reinforcement of concrete elements and systems to resist the loads. The student then communicates the resulting design sufficient that someone else can build the engineered system.

7. Topics:

1. Overview and Prototype Concrete Building
2. Loads and Strengths
3. Load Combinations, \( \phi \) Factors, Load Paths
4. Concrete and Concrete Reinforcement Strengths and Properties
5. Bar Development, Bar Hooks, Clear Cover, Computer Aided Design
6. Flexural Design and Flexural Failure Mechanisms
7. Net Tensile Strain and \( \phi \) Factor Calculation
8. Compression Reinforcement in Beams
9. One-Way Slab Design
10. T-Beam Design
11. Shear Design and Shear Load Envelope
12. Limit States – Strength vs. Serviceability, Compression Reinforcement
13. Long Term Deflections and Simplified Methods
14. ACI Design Coefficient Method
15. Concrete Column Concepts and Interaction Diagrams
16. Concrete Column Interaction Diagram Development
17. Round Concrete Columns, Computer Aided Design
18. Simple Footings & Eccentrically Loaded Footings
19. Continuous Footings & Mat Footings
20. Retaining Walls
21. Braced Foundation Walls, Counterforts
22. Diaphragms
23. Concrete Walls & Slender Concrete Walls
24. Concrete Shear Walls
25. Concrete Shear Walls for Seismic Applications
26. Simplified & Approximation Methods
27. Introduction to Advanced Topics

Prepared by: Jerod G. Johnson, Date: June 11, 2015
CVEEN 4222 – Steel Design I

2. Credits and contact hours: Credits: 3; Contact Hours: ? ??-minutes classes per week

3. Instructor’s or course coordinator’s name: Janice Chambers


5. Specific course information
   b. Prerequisite(s): C- or better in CVEEN 3210 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction: Application of ACI 318-08 to the design of beams, one-way slabs, and columns. Application of Steel Construction Manual, 13th Ed. to the design of beams, tension members, compression members and columns.
   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 4222</th>
</tr>
</thead>
<tbody>
<tr>
<td>(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</td>
<td>(a) an ability to design steel structural systems using steel construction manual</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>(e) an ability to solve engineering problems in steel evaluation and design.</td>
</tr>
</tbody>
</table>

7. Topics:
   1. History, composition, and material properties of steel.
   2. Beam design
   3. Tension member design (steel)
   4. Compression member design (steel)
   5. Beam-column design (steel)

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 4410 - Engineering Hydrology

2. Credits and contact hours: Credits: 3; Contact Hours: 3 x 50 minutes classes per week, plus minimum of 180 minutes consultation hours offered for design project assistance

3. Instructor’s or course coordinator’s name: B.J. McPherson

   Philip B. Bedient, Rice University
   Wayne C. Huber, Oregon State University
   Baxter E. Vieux, University of Oklahoma
   - See details at http://goo.gl/Aw9BdU

5. Specific course information
   a. Catalog Description: Hydrologic cycle and its elements including precipitation, interception, infiltration, evapotranspiration, runoff; flood and drought analysis; unit-hydrographs, probability and frequency analysis, routing methods; groundwater, hydrologic design procedures, watershed models.
   b. Prerequisite(s): C- or better in CVEEN 3410 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      1. Interpret design constraints, determine design data, consider alternative designs, justify design choices, and critique designs for general watershed-scale hydrologic engineering. This overall goal objective encompasses the following outcomes, among others:
      2. Describe and measure the components of the hydrologic cycle.
      3. Define and delineate watersheds and aquifers and determine hydrologically-relevant characteristics.
      4. Describe and compute design storms, evapotranspiration, infiltration, peak discharge, and runoff hydrographs.
      5. Perform basic channel and reservoir routing.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 4410</th>
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</thead>
<tbody>
<tr>
<td>(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</td>
<td>This course includes a comprehensive design project involving development of a regional scale (square miles) watershed stormwater drainage model using HEC-HMS, a state-of-the-art watershed model considered an industry standard for hydrologic design. Students must characterize actual hydrologic elements for a designated site, synthesize, integrate and implement those elements</td>
</tr>
</tbody>
</table>
in the quantitative HEC-HMS model, forecast storm hydrographs and design drainage structures to accommodate those storm (runoff) volumes for the watershed. The upshot: students develop a meaningful, practical engineering design for stormwater runoff (flood) management.

(e) an ability to identify, formulate, and solve engineering problems

For sake of developing an effective ability to design and analyze a stormwater drainage model (see (c) above), an extensive series of practical homework assignments are required. Each problem serves to practice a specific engineering skill required to develop individual elements of that broader hydrologic stormwater drainage design. The upshot: students develop specific hydrologic engineering skills (problem-solving abilities) via homework assignments in concert with the term project discussed in (c) above.

7. Topics:

1. Intro: the Hydrologic Cycle, watersheds, hydrographs, hyetographs
2. Precipitation Mechanisms and Rainfall Averaging Methods
3. Frequency Analysis
4. HEC-HMS Session: Intro
5. HEC-HMS and Term Project Initiation Session: Design Storms
6. Abstractions and Mass Balance
7. Abstractions: ET (Penman Approach)
8. Abstractions: Infiltration (general)
10. Abstractions: Infiltration – Green Ampt Method
11. Watersheds and Watershed Delineation
12. Watershed Characteristics, Runoff/Discharge, Peak Discharge (rational method)
13. HEC-HMS/Term Project Session: Watersheds, Basins and Sub-basins
14. Hydrographs – hydrograph anatomy, baseflow separation
15. HEC-HMS/Term Project Session: Presenting and Discussing Hydrographs
16. Unit Hydrographs
17. Unit Hydrograph Convolution
18. Curve Number Hydrology
19. HEC-HMS/Term Project Session: SCS Unit Hydrograph and Curve Number Assignment
20. Tabular Hydrograph Method
21. Time of Concentration
22. HEC-HMS/Term Project Session: Time of Concentration and Lag Time
23. Cowan’s Method for Time of Concentration
24. Channel Routing
25. Reservoir Routing (Modified Puls) 1 - Calibration
26. Reservoir Routing 2
27. HEC-HMS/Term Project Session: Stage-Storage-Discharge
28. Detention Basin Design
29. HEC-HMS/Term Project Session: Detention Basins and Outlet Structures
30. Drainage Design and Allowable Spread
31. Inlet Sizing
32. Pipe Sizing

**CVEEN 4910 – Professional Practice and Design**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 2 180-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Douglas Smucker


5. **Specific course information**

   a. **Catalog Description:** Comprehensive capstone design project. To be taken in the last year of the program after a minimum of two design technical electives have been completed.

   b. **Prerequisite(s):** Senior Standing within the Civil Engineering Department AND a minimum of 2 Design Technical Elective courses completed AND Full Major Status.

   c. **Elective** – none

6. **Specific goals for the course**

   a. **Outcomes of instruction**
      1. Describe the civil engineering design process, its phases, and provide examples of project delivery schemes.
      2. Prepare an engineering design report and orally present an engineering project.
      3. Identify characteristics of effective team members, leaders, and organizations.
      4. Demonstrate self-sufficiency to learn a new topic.
      5. Discuss the five dimensions of consulting practice including: marketing, finance, management, business development, and technical.
      6. Identify the connections between civil engineering projects, public policy, licensure, ethics, service, and professional responsibility.
      7. Identify contemporary issues in civil engineering and describe how these issues are incorporated in or influence the practice of civil engineering including risk and uncertainty, sustainability, and safety.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 4910</th>
</tr>
</thead>
<tbody>
<tr>
<td>(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</td>
<td>Groups of students work together to complete a pseudo-authentic civil engineering design project with a pseudo-client. Students both prepare intensive engineering reports and orally present the work. This is a term-length project.</td>
</tr>
<tr>
<td>(d) an ability to function on multidisciplinary teams</td>
<td>Groups of students work together to complete a pseudo-authentic civil engineering design</td>
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<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>Groups of students work together to complete a pseudo-authentic civil engineering design project with a pseudo-client. Students both prepare intensive engineering reports and orally present the work. This is a term-length project.</td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td>Summative data collected via individual student reports that summarize the State of Utah's definition of their responsibilities.</td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>Summative data collected via individual student reports that summarize the State of Utah's definition of their responsibilities.</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>Summative data collected via individual student reports that illustrate the definition and application of these concepts.</td>
</tr>
<tr>
<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
<td>Summative data collected via individual student reports where the students must identify and explain a specific task, skill, or aptitude that they acquired on their own during the project but that they did not possess prior to the course.</td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td>Summative data collected via individual student reports that illustrate the definition and application of these concepts.</td>
</tr>
<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>Indirectly measured by the performance of each team and their individual contributions to that the team product.</td>
</tr>
<tr>
<td>(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td>Summative data collected via individual student reports that illustrate the definition and application of these concepts.</td>
</tr>
</tbody>
</table>

7. Topics:
   1. The design process and its various stages
   2. Team organizational structure and functioning
   3. Development of reports
   4. Consulting practice
   5. Project management and administration
   6. Project execution

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 5110 – GIS Applications in Civil and Environmental Engineering

2. Credits and contact hours: Credits: 3; Contact Hours: 80-minutes classes per week

3. Instructor’s or course coordinator’s name: Elizabeth Dudley-Murphy

4. Text book: Course website

5. Specific course information
   a. Catalog Description: Meets with CVEEN 6110. Geographic Information Systems are used extensively by Civil Environmental Engineers. This course introduces GIS as an engineering analysis tool, focusing on the development of simple GIS using ArcView Software. The course covers spatial data characteristics, the fundamentals of spatial data analysis, spatial data sources for engineering applications, and the fundamentals of generating and managing spatial data. The course focuses on GIS applications of the power and capability of GIS, including the role of GIS professionals in solving engineering problems. A laptop is required for this course.

   b. Prerequisite(s): C- or better in (MG EN 1050 AND MG EN 2400) AND Full Major status in Civil Engineering.

   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction:
      Upon completion, students will have a working knowledge of the following:
      1. Cartographic principals
         a. Understanding maps
         b. Map design
         c. Datums and projections
      2. Data
         a. ArcGIS file types
         b. Data amenable to GIS development
         c. Data processing and input
         d. Data Analysis
         e. Incorporation of hyperlinks
      3. Incorporating imagery
         a. Remote Sensing
      4. Georeferencing
      5. Research project design

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5110</th>
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</thead>
<tbody>
<tr>
<td>(k) an ability to use the techniques, skills.</td>
<td>(k) an ability to use tools (ArcGIS) software</td>
</tr>
</tbody>
</table>
7. **Topics:**
   1. Cartographic principals
   2. Understanding Data Types
   3. Data processing and input
   4. Remote Sensing
   5. Georeferencing
   6. Project design

Prepared by: S. Bartlett, Date 6/17/2015
CVEEN 5210 – Structural Analysis II

2. **Credits and contact hours:** Credits: 3; Contact Hours: 3 50-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Janice Chambers


5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6210. Reviews the analytical techniques presented in Structural Analysis I pertaining to truss and beam structures, and expands them to structures with several redundancies. A major portion of the course is devoted to linear analysis of truss and frame structures using the stiffness method.

   b. **Prerequisite(s):** C- or better in CVEEN 3210 AND Full Major status in Civil Engineering

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**

   1. Application of compatibility conditions in relating displacements of joints in the global coordinate system and members in the local coordinate system.
   2. Analysis of the force-displacement relationships for truss, beam, and frame members.
   3. Application of joint equilibrium to develop a set of simultaneous equations.
   5. Application of developing computer models and conducting analysis using SAP2000 software.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5210</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>(e) an ability to identify, formulate, and solve problems relate to structural analysis</td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Analysis of trusses, beams
   2. 2-D frames and 3-D frames based on the stiffness method
   3. Computer application on the analysis using SAP2000 software

Prepared by: S. Bartlett, Date 6/15/20015
CVEEN 5220 – Concrete Design II

2. Credits and contact hours: Credits: 3; Contact Hours: Three 50-minutes classes per week

3. Instructor’s or course coordinator’s name: Chris P. Pantelides


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6220. Advanced topics in concrete design; strut-and-tie models and deep beams; design of two-way slabs, torsional resistance design; concrete structural systems; slender columns; design of structural walls; seismic design considerations using the ACI code.

   b. Prerequisite(s): C- or better in CVEEN 4221 AND Full Major status in Civil Engineering.

   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      The instruction stresses advanced analysis and design methods for reinforced concrete structures.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5220</th>
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</thead>
<tbody>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>Exposure to open-ended design problems in reinforced concrete</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Design of beams for flexure and shear
   2. Design of two-way slabs
   3. Design of beams for torsion
   4. Design of columns with slenderness effects
   5. Design of beam-column joints
   6. Principles of strut-and-tie models
   7. Numerical methods for constructing column interaction diagrams and moment-curvature diagrams
   8. Design of deep beams and shear walls
   9. ACI Code provisions for seismic resistant design.

Prepared by: Chris P. Pantelides, Date 6/11/2015
CVEEN 5230 – Steel Design II

2. Credits and contact hours: Credits: 3; Contact Hours: 3 50-minutes classes per week

3. Instructor’s or course coordinator’s name:


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6230. Behavior and design of bolted and welded tension members, beams, compression members in frames, beam-columns, concentrically and eccentrically loaded bolt and weld groups, simple connections, moment resistant connections, and structural systems. Extensive use of the current AISC-LRFD design code.

   b. Prerequisite(s): C- or better in CVEEN 4222 AND Full Major status in Civil Engineering.

   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5230</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>(e) an ability to identify, formulate problems in steel design and construction</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Accounting for P-Delta Effects, unity check equation
   2. High strength bolts, methods of tightening
   3. Direct shear connections
   4. Bolts groups subject to eccentric shear
   5. Bolts in tension
   6. Bolt groups subject to shear and tension (concentrically and eccentrically loaded)
   7. Welding, weld strength, weld symbols, prequalified welds
   8. Plug, Slot and Groove Welds
   9. Concentrically and eccentrically loaded fillet welds
   10. Single plate shear connections
   11. Prying
   12. Double angle connections: fully bolted, fully welded, welded & bolted
   13. Coped members
   14. Pre- & Post- Northridge moment-resistant connections

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 5240 – Reinforced Masonry/Timber Design

2. Credits and contact hours: Credits: 4; Contact Hours: 300 minutes per week, 2 classes per week

3. Instructor’s or course coordinator’s name: Jerod G. Johnson, PhD, SE

   National Design Specification (NDS) for Wood Construction

5. Specific course information
   a. Catalog Description: Meets with CVEEN 6240. Reinforced masonry design, including properties and performance of masonry materials, design criteria and methods in reinforced masonry, and design examples including reinforced masonry walls, masonry columns and pilasters, and rectangular beams. Design of beams, columns, trusses, and diaphragms in wood. Design of glue-laminated beams. Design of wood connections. Use of timber design codes and uniform building code
   b. Prerequisite(s): C- or better in CVEEN 3210 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      This is a design oriented course. At the course conclusion, each student produces and submits a unique, complete design of a 4-story structure with calculations. The fundamental purpose of the course is to equip students with the necessary skills to effectively design typical masonry and wood structures for compliance with contemporary building codes. The objectives will be realized through instruction, homework, in class discussion, development of the course project and through formal and informal review.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5240</th>
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</thead>
<tbody>
<tr>
<td>(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</td>
<td>This course presents common civil engineering design scenarios using reinforced masonry or wood as the primary material. Students are instructed accordingly and given the opportunity to design masonry and wood systems with consideration not only to loads</td>
</tr>
</tbody>
</table>
but to the economic constraints, constructability and other aspects of common construction. Students are instructed to design and to communicate the intent of their design through careful detailing of their work product.

| (e) an ability to identify, formulate, and solve engineering problems | As a design oriented course, each student is given a project of unique geometry. Then, using the skills learned in the class, each must produce an appropriate design using wood and reinforced masonry. Students must articulate the intent of their designs by producing drawings and details sufficient to enable construction of their design. Detailing the project provides an essential opportunity to identify and solve conflicts. |

7. **Topics:**
   1. Project overview
   2. Soils report review
   3. Loads and Load Combination Review
   4. Review of Texts and Codes
   5. Masonry Design Principals & Materials
   6. Flexural Design of Masonry
   7. Wood Design Principals & Materials
   8. Flexural Design for Wood
   9. Masonry Column Design
   10. Load Path Development
   11. Prototype Drawing Review
   12. Typical Details
   13. Masonry Ties & Confinement
   14. Masonry Beam Deflection
   15. Wood Column Design & Examples
   16. Masonry Slender Wall Design & Examples
   17. Wood Panels – In-Plane and Out-of-Plane Forces
   18. Wood Shear Walls and Shear Wall Deflections
   19. Computer Assisted Design
   20. Wood Diaphragms and Diaphragm Deflections
   21. Masonry Shear Walls
   22. Masonry Shear Wall Rigidity
   23. Anchorage to Masonry
   24. Wood Connectors – Screws, Bolts, Plates
   25. Perforated Wood Shear Walls
   26. Engineered Wood
   27. Wood/Masonry Detailing & Review
**CVEEN 5305 – Introduction to Foundation Engineering**

2. **Credits and contact hours:** Credits: 3; Contact Hours: two 80-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Steven F. Bartlett, Fall, 2011


5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6305. An introduction to the field of foundation engineering concentrating on the geotechnical background necessary for foundation analysis and design. Topics include shear strength of granular, cohesive and partially saturated soils; subsurface exploration and testing; lateral earth pressures and retaining walls; slope stability; settlement and ultimate bearing capacity of shallow foundations; seepage forces and filters.

   b. **Prerequisite(s):**
      C- or better in CVEEN 3310 (Introduction to Geotechnical Engineering AND Full Major status in Civil Engineering.

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      1. Evaluate strength of soil from common geotechnical laboratory and in situ tests
      2. Understand how shear strength affects the design of geotechnical structures
      3. Learn how to obtain shear strength parameters from in situ tests
      4. Perform bearing capacity and settlement calculations for shallow foundations
      5. Calculate lateral earth pressures for buried structures
      6. Assess stability of retaining walls
      7. Evaluate slope stability for simple slopes

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5305</th>
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<tbody>
<tr>
<td>(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</td>
<td>CVEEN 5305 focuses on the theory and calculation methods required to design shallow foundation and footings, earth retaining structures and slopes. The design of shallow foundations is achieved through the application of bearing capacity theory to the evaluation of footings. The design of earth retaining structures is achieved through the application of bearing capacity theory to the evaluation of retaining walls, and the evaluation and design of embankments and engineered slopes is obtained through the application of general shear strength theory and method of slices to the evaluation of embankments and slopes.</td>
</tr>
</tbody>
</table>
7. **Topics:**
   1. Coulomb failure theory for soils, factor of safety
   2. Direct shear and triaxial shear strength tests, stress paths
   3. Stress-strain-strength characteristics of cohesionless soil
   4. Ko conditions in cohesionless soil
   5. Stress-strain-strength characteristics of cohesive soil
   6. Consolidated Drained (CD) strength behavior of cohesive soil
   7. Consolidated Undrained (CU) strength behavior of cohesive soil
   8. Unconsolidated Undrained (UU) strength behavior of cohesive soil
   9. CD, CU, UU Stress paths
   10. Ko for clays, Skempton Pore Pressure Parameters
   11. Subsurface investigation: Exploration and sampling
   12. Standard Penetration Test (SPT) and correlation
   13. Cone Penetration Test (CPT) and correlations
   14. Borehole Shear Test (BST)
   15. Introduction to foundations, settlement of granular soils
   16. Schmertmann's method (continued), intro bearing capacity
   17. Ultimate BC: Terzaghi's method, Meyerhof's method
   18. Lateral earth pressures: At-rest, active, passive; Rankine, Columb
   19. Equivalent fluid pressure, effect of E/Q loads
   20. Slope stability: Factor of safety, infinite slopes, finite slopes
   21. Slope stability: Finite slopes in sands and saturated clays
   22. Slope stability: Slice methods (method of slices)

Prepared by: Steven F. Bartlett, December 2014
CVEEN 5420 – Open Channel Flow

2. Credits and contact hours: Credits: 3; Contact Hours: 2 80-minutes classes per week

3. Instructor’s or course coordinator’s name: Steven Burian


5. Specific course information
   a. Catalog Description: Open channel flow theory, flow resistance, uniform and gradually varied flow calculations. Control structures in open channel flow. Numerical methods
   b. Prerequisite(s): C- or better in CVEEN 4410 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction:
      1. Knowledge of the conditions that represent steady, unsteady, uniform, and gradually varying flow.
      2. Application of procedures for calculating flows in open channels under a variety of conditions.
      3. Evaluation of water surface profiles under a range of flow conditions.
      4. Synthesis of design procedures for open channels for specified flow and/or energy conditions.
   b. Student outcomes addressed by this course:

<table>
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<tr>
<th>Outcome</th>
<th>Role of CVEEN 5420</th>
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<tbody>
<tr>
<td>(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</td>
<td>c) an ability to design an open channel hydraulic system</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>(e) an ability to identify, formulate and solve engineering problems related to channel, weir and spillway design</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Flow Classification
   2. Conservation of Mass
   5. Uniform Flow: Manning Equation, Gravity Sewer Design, Stable Channel Design

Prepared by: S. Bartlett, Date 6-17-2015
**CVEEN 5510 – Highway Design**

2. **Credits and contact hours:** Credits: 3.0; Contact Hours: 3 50-minutes classes per week

3. **Instructor’s or course coordinator’s name:** Richard J. Porter


5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6510. Design and layout of highway systems: horizontal and vertical alignment, phasing, design of intersections, earthwork optimization

   b. **Prerequisite(s):** C- or better in CVEEN 3520 AND Full Major status in Civil Engineering.

   c. **Elective** – yes: design elective

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      - Identify and describe technical topics and decision processes associated with the design of highway facilities.
      - Explain the theoretical concepts and historical practices that underpin current highway design principles.
      - Solve highway design problems similar to and advanced of those encountered on the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) exams.
      - Analyze transportation outcomes and societal tradeoffs associated with highway design decisions.
      - Demonstrate effective written communication skills.

   b. **Student outcomes addressed by this course:**

<table>
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<tr>
<th>Outcome</th>
<th>Role of CVEEN 5510</th>
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<tbody>
<tr>
<td>(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</td>
<td>Students execute a one-half semester design problem that replicates preliminary design/alternatives analysis (sometimes called the environmental process) and portions of final design. As part of the design problem, students are required to quantify and consider impacts and trade-offs associated with their design decisions, including transportation performance (e.g., mobility, safety, quality-</td>
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</table>
of-service) outcomes as well as broader project and societal outcomes. Technical topics and calculations associated with course topics are linked to the broader project development process throughout the semester. The course content also includes the National Environmental Policy Act (NEPA) and Section 4(f) of the DOT Act, 1966. Selected homework assignments focus on quantifying expected user safety effects of design decisions.

(e) an ability to identify, formulate, and solve engineering problems

CVEEN 5510 homework assignments build on the problem solving skills developed as part of the CVEEN 3520 “applied problems,” replicating challenges encountered on real-life highway and street projects with multiple problem solving approaches and solutions possible. All homework assignments require students to clearly identify given information, provide a problem sketch, state any assumptions, and cite relevant literature, standards, or relevant supporting policies for the approach taken. Solutions are assessed based on procedure; accuracy (computational and descriptive) and precision; organization, presentation, and format; and appropriate assumptions and citations.

7. Topics:
   1. Introduction and definitions; changing role of highway and street designers
   2. Functional classification
   3. Overview/review of alignment and stationing
   4. Design controls
   5. Speed
   6. Horizontal alignment
   7. Sight distance
   8. Vertical alignment
   9. Cross section
   10. Earthwork calculations and balance
   11. Operational analysis of design alternatives
   12. Design consistency
   13. Intersection design fundamentals
   14. Safety analysis of design alternatives

Prepared by: Richard J. Porter, June 2015
CVEEN 5560 – Transportation Planning

2. Credits and contact hours: Credits: 3; Contact Hours: 3 50-minutes classes per week

3. Instructor’s or course coordinator’s name: Xiaoyue Cathy Liu, Spring 2015


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6560. Examination of the tools, techniques and processes that lead to decisions on transportation projects, policies and programs. The emphasis is on urban transportation institutions and issues, but the analytical techniques can be applied in any appropriate context. Overview of transportation planning characteristics, institutions, regulations and issues. Review of traffic, pedestrian and network analysis tools. Exploration of decision-making processes and introduction to transportation systems. Analysis of the environmental and socioeconomic impacts of transportation systems. Study of transportation data collection methods and performance measurement. Introduction to transportation demand forecasting, including trip generation, trip distribution, mode choice, traffic assignment, and activity-based modeling. Investigation of the transportation -land use relationship and associated models. Estimation of transportation costs, prioritization of projects, programming and implementation.

   b. Prerequisite(s): Meets with CVEEN 6560. Examination of the tools, techniques and processes that lead to decisions on transportation projects, policies and programs. The emphasis is on urban transportation institutions and issues, but the analytical

   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      1. To enable students to understand the fundamental principles of transportation planning and data collection processes.
      2. To apply those principles and analytical skills to the solution of real-world planning problems.
      3. To introduce students to relevant software packages for modeling travel demand and network analysis
      4. To develop an understanding of the decision making process of transportation planning projects.
      5. To enhance students’ ability to work both independently and in teams.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5560</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e) an ability to identify, formulate, and</td>
<td>Homework is assigned to promote these</td>
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<tr>
<td>solve</td>
<td></td>
</tr>
<tr>
<td>Engineering problems</td>
<td>concepts. Group projects are very open-ended with teams coming up with different analytical solutions to the same problems. Students are asked to explain their assumptions with respect to which demand models, subset of data, or analytical method they used.</td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Transportation planning process
   2. Network Optimization
   3. Characteristics of urban travel
   4. Traffic network development
   5. Traffic network analysis
   6. Trip generation
   7. Trip distribution
   8. Mode split
   9. Trip assignment

Prepared by: Xiaoyue Cathy Liu, Date: June 11th, 2015
CVEEN 5570 – Pavement Design

2. Credits and contact hours: Credits: 3; Contact Hours: 50-minutes classes per week

3. Instructor’s or course coordinator’s name: Pedro Romero, Ph.D., P.E.


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6570. Presents the concepts of mechanistic pavement design for flexible and rigid pavements. It introduces the students to the analysis of stresses and deflections in multi-layered pavement systems. Evaluates existing pavement design methods including Mechanistic Empirical Pavement Design Guide (MEPDG) and reviews factors that affect pavement performance
   
   b. Prerequisite(s): CVEEN 3510 AND CVEEN 3520 AND Full Major status in Civil Engineering.
   
   c. Elective – yes

6. Specific goals for the course
   a. Outcomes of instruction
      This is a ‘design’ course. Its purpose is to prepare students for the design of pavement structures given a set of conditions. To pass this course, students must demonstrate that they can:
      1. Explain the different pavement systems and their function; give examples.
      2. Calculate the stresses and deformations in rigid and flexible pavements.
      3. Describe the relation between material selection and pavement performance.
      4. Design a pavement system using mechanistic methods.
      5. Recognize common pavement distresses and their cause.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5570</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>(e) ability to identify, formulate, and solve engineering problems in pavement design</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Introductions, Pavement Types
   2. History of Pavements, Road Tests
   3. AASHTO Design Methods
   4. Stresses and Deflection in Single Layers
   5. Stresses and Deflection in n-layers
   6. Tire Pressure, Moving Loads
   7. Computer Programs
   8. Distresses in Flexible Pavements
9. Factors in pavement Design
10. Traffic Counts, Truck Factors
11. Equivalent Load Factors
12. Load Spectra
13. Overlays and Rehabilitation
14. Distresses in Rigid Pavements
15. Environmental Stresses
16. Load-induced Stresses
17. Joints
18. Drainage
19. Economic Analysis
20. AASHTO Pavement
21. Rigid Pavement Construction
22. NDT and Backcalculations

Prepared by: Pedro Romero, Date June 15, 2015
1. **CREDITS AND CONTACT HOURS:** Credits: 3; Contact Hours: 3 50-minutes classes per week

2. **INSTRUCTOR:** Otakuye Conroy-Ben, Ph.D.

3. **TEXTBOOK:** *Water and Wastewater Engineering, Design Principles and Practice*, Mackenzie Davis, (required); *[Unit Operations and Processes in Environmental Engineering, 2nd Ed.]*, Reynolds & Richards (optional)

4. **SPECIFIC COURSE INFORMATION**
   a. **Catalog description:** This course will discuss principles and practice of water and wastewater treatment. Focus will be placed on system design. Main objectives of the course are to provide students a basic understanding of the processes employed in water and wastewater treatment plants, and the skills to analyze and design treatment systems utilizing physical, chemical, and biological processes.

   b. **Pre-requisites:** "C-" or better in CVEEN 3610 AND Full Major status in Civil Engineering.

   c. This course is a design technical elective.

5. **SPECIFIC GOALS FOR THE COURSE**
   a. **Outcomes of instruction**
      i. Review basic environmental chemistry, biology, reactor, and population growth
      ii. Apply equations for the design of water and wastewater treatment unit operations
      iii. Design a treatment train for the removal of common drinking water contaminants
      iv. Design a wastewater treatment train that protects the receiving water from excess nutrients, pathogens, and emerging contaminants

   b. **Student outcomes addressed by this course**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5605</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>Basic environmental engineering concepts are reviewed that serve as design fundamentals</td>
</tr>
<tr>
<td>(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</td>
<td>Design constraints are built into engineering problems the student must solve.</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve</td>
<td>Students are assessed on design ability via</td>
</tr>
</tbody>
</table>
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Students are assessed on design ability via homework and exams.

6. TOPICS
   a. Environmental Engineering Review
      i. Chemistry, biology, mass balances, reactors, [Ch. 1 – 3, Reynolds and Richards]
      ii. Population growth and prediction, [Ch. 4 Reynolds and Richards]
      iii. Water Quality, [Ch. 4 Reynolds and Richards]
   b. Drinking Water
      i. Drinking water treatment plants, Ch. 6
      ii. Screening, Pre-sedimentation, Aeration, Adsorption, Pre-chlorination, Ch. 7
      iii. Coagulation and Flocculation, Ch. 3; [Ch. 8 Reynolds and Richards]
      iv. Sedimentation, Ch. 7; [Ch. 9 Reynolds and Richards]
      v. Filtration, Ch. 8; [Ch. 10 Reynolds and Richards]
      vi. Disinfection, Ch. 10; [Ch. 24 Reynolds and Richards]
      vii. Ion Exchange, Ch. 5; [Ch. 13 Reynolds and Richards]
      viii. Membrane Processes, Ch. 6 & 9; [Ch. 14 Reynolds and Richards]
      ix. Solids Handling, Ch. 11; [Ch. 21 Reynolds and Richards]
   c. Wastewater
      i. Wastewater Treatment, Ch. 12; [Ch. 5 Reynolds and Richards]
      ii. Headworks and preliminary treatment, Ch. 13; [Ch. 7 Reynolds and Richards]
      iii. Wastewater microbiology, Ch. 15
      iv. Primary treatment, Ch. 14
      v. Activated Sludge, Ch. 16; [Ch. 15 Reynolds and Richards]
      vi. Secondary Treatment by Attached Growth and Hybrid Biological Processes, Ch. 17; [Ch. 17 & 18 Reynolds and Richards]
      vii. Secondary sedimentation, Ch. 18; Disinfection, Ch. 18; [Ch. 24 Reynolds and Richards]
      viii. Post-aeration, Ch. 18
      ix. Solids Handling, Ch. 20; [Ch. 19-21 Reynolds and Richards]
      x. Advanced Wastewater Treatment, Ch. 19
2. **Credits and contact hours:** Credits: 3; Contact Hours: 1 60-minutes class 1-90 min lab per week

3. **Instructor’s or course coordinator’s name:** Andy Hong


5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6610. Fundamental principles of general, analytical, physical, and equilibrium chemistry applicable to water- and wastewater-treatment systems.

   b. **Prerequisite(s):** C- or better in CVEEN 3610 AND Full Major status in Civil Engineering.

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**

      1. Understand the significance of key environmental quality parameters, which will allow them to communicate with other professionals in the field;
      2. Understand how these parameters are measured, the strength and potential weaknesses of these procedures;
      3. Perform basic laboratory analyses and obtain quality parameters following published procedures; and
      4. Further develop and improve their skill in writing formal technical reports.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5610</th>
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</thead>
<tbody>
<tr>
<td>b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>b) Perform basic laboratory analyses and obtain quality parameters following published procedures</td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Turbidity
   2. pH, Ionic strength, and Electroneutrality
   3. Alkalinity Determination by Acidimetric-Potentiometric Titration
   4. Hardness
   5. Solid Determination by Gravimetric Analysis
   6. Chemical Oxygen Demand (COD) and Nitrogen Measurement
   7. Biochemical Oxygen Demand (BOD)
8. Chlorine Disinfection and Chlorine Demand
9. Activated Carbon Adsorption-Adsorption isotherms
10. Gas Transfer and Kinetic Analysis
11. Analyses of Organics by Gas Chromatograph (GC/FID or GC/MS)
12. Determination of Trace Metals by Atomic Absorption Spectrophotometry (AA)
13. Determination of Inorganics by Ion Chromatograph with Conductivity Detector (IC/CD)

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 5810 – Cost Estimating and Proposal Writing

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150 minute classe per week

3. Instructor’s or course coordinator’s name: K. Ament


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6810. Quantity take-off; cost indexing; determination of construction, project, and indirect costs; development of bid proposals. Development of cost proposals for engineering project management services. Survey of cost estimating/project management software tools.
   b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      1. The student will be able to explain basic concepts in marketing that lead to successful proposal writing.
      2. The student will use written, and graphical communication skills to develop an effective proposal.
      3. The student will comprehend basic construction cost estimation skills.
      4. The student will practice proposal writing and construction cost estimation under realistic constraints such as economic, environmental, constructability, and sustainability constraints.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5810</th>
</tr>
</thead>
<tbody>
<tr>
<td>(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td>(l) students will be able to explain basic concepts in marketing and management related to cost estimating and proposal writing.</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Marketing professional services to include ethical issues
   2. Contemporary marketing for the design and construction professional
   3. Sales and business development
   4. Marketing strategies
   5. Proposal writing
   6. Marketing image and communications
   7. Marketing management
8. Introduction to estimating
9. Measuring quantities, site work, utilities, landscaping and such
10. Construction materials and configurations
11. Internal climate, mechanical and electrical functioning, and other considerations.
12. Other aspects of general building – pricing the estimate

Prepared by: S. Bartlett, Date 6-18-2015
**CVEEN 5820 – Project Scheduling**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 1 150-minute classe per week

3. **Instructor’s or course coordinator’s name:** D. Petersen

4. **Text book:** Text: Mubarek, Saleh, *Construction Project Scheduling and Control*
   Software: *Microsoft Project 2007 Standard Edition*

5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6820. Critical path methods, resource balancing, influence of probability on time and cost (PERT), network techniques, case studies, computer applications.
   
   b. **Prerequisite(s):** C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.

   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      The students will become familiar with the methodology, processes, and tools used in project scheduling as well as the different methods of scheduling and the pro’s and con’s of each.

   b. **Student outcomes addressed by this course:**
      | Outcome                                                                 | Role of CVEEN 5820                        |
      |------------------------------------------------------------------------|--------------------------------------------|
      | (l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure. | (l) an ability to explain and apply basic concepts in management related to project scheduling and cost control |

7. **Topics:**
   1. Activity sequencing and basic networks
   2. Resource allocation and activity duration estimating
   3. Critical path method
   4. Bar charts
   5. Float and resource leveling
   6. Schedule control
   7. Schedule updating
   8. Schedule compression
   9. Earned Value Analysis
   10. PERT, GERT and LSM
   11. Project presentations

Prepared by: S. Bartlett, Date 6-17-2015
CVEEN 5830 – Project Management and Contract Administration

2. Credits and contact hours: Credits: 3; Contact Hours: 1 150-minute classe per week

3. Instructor’s or course coordinator’s name: D. Petersen


5. Specific course information
   a. Catalog Description: Meets with CVEEN 6830. Construction management processes; basic time and cost methodologies for planning; scheduling and controlling the use of labor, equipment, and materials; financial and accounting systems used in the construction industry.
   b. Prerequisite(s): C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.
   c. Elective – none

6. Specific goals for the course
   a. Outcomes of instruction
      Students will learn how to initiate, plan, execute, control and close engineering and construction projects. Students will become proficient at putting together project plans and will learn how to follow those plans during engineering and construction processes. Emphasis will be placed on leadership, teambuilding and communication throughout the course.

   b. Student outcomes addressed by this course:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5830</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td>(1) an ability to explain basic concepts in management and business related to project management and contract administration.</td>
</tr>
</tbody>
</table>

7. Topics:
   1. Introduction to project management/definitions
   2. Working with project teams
   3. Developing project plans
   4. Defining scope and work breakdown structures
   5. Schedule management
   6. Cost management
   7. Quality management
   8. Risk management
   9. Communications management
10. Procurement management and contracting methods
11. Engineering and Design management
12. Construction management
13. Monitoring progress
14. Closing projects

Prepared by: S. Bartlett, Date 6-18-2015
**CVEEN 5850 – Engineering Law and Contracts**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 1 150-minute class per week

3. **Instructor’s or course coordinator’s name:** C. Coburn

4. **Text book:** none

5. **Specific course information**
   a. **Catalog Description:** Meets with CVEEN 6850. Designed to provide science and engineering students with a sufficient knowledge of law to enable them to recognize and deal with legal problems which may arise in the fields of science, engineering, or technical management. Topics covered include courts, trial procedures, evidence, contract law, engineering contracts, agency, patents, trademarks, copyrights, trade secrets, product liability, employer/employee law, business law including corporations, partnerships, joint ventures, etc.
   
   b. **Prerequisite(s):** C- or better in CVEEN 3100 AND Full Major status in Civil Engineering.
   
   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      1. The students will become sensitized to the legal environment in which consulting engineers practice their profession.
      2. The students will learn the fundamental principles of risk management.
      3. The students will learn the legal principles applicable to professional liability claims.
      4. The students will learn how these principles apply to the practice of consulting engineers.
      5. The students will obtain a practical knowledge on managing liability risks inherent in design professional practice.

   b. **Student outcomes addressed by this course:**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5850</th>
</tr>
</thead>
<tbody>
<tr>
<td>(l) an ability to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.</td>
<td>(l) an ability to explain basic concepts in management, business as related to contracts and contract law.</td>
</tr>
</tbody>
</table>

7. **Topics:**
   1. Risk management fundamentals
   2. Theories of design professional liability (contract, tort, and agency law)
   3. Licensing
   4. Business organization.
5. Client/project selection
6. Procurement of design professional services
7. Owner-engineer agreements
8. Engineer-subconsultant agreements
9. Insurance
10. Construction project organization and delivery
11. Procurement of construction labor and materials
12. Contract documents
13. Changed conditions
14. Changes
15. Contract/project time: delay, disruption, suspension, and acceleration
16. Contract price and payment
17. Default; termination
18. Construction defects, warranties
19. Construction bonding
20. Project administration, communication, and documentation
21. Dispute resolution
22. Statutes

Prepared by: S. Bartlett Date 6-18-2015
**CVEEN 5920 Sustainable Materials**

2. **Credits and contact hours:** Credits: 3; Contact Hours: 2 80-minute classes per week

3. **Instructor’s or course coordinator’s name:** Pedro Romero


5. **Specific course information**
   a. **Catalog Description:** This course presents the concepts necessary to evaluate, select, and design materials in civil engineering applications to be energy-, cost-, and eco-efficient while durable and high performing
   
   b. **Prerequisite(s):** CVEEN 3510 or equivalent
   
   c. **Elective** – none

6. **Specific goals for the course**
   a. **Outcomes of instruction**
      1. Explain how materials impact energy use and the environment
      2. Critically analyze a material or energy resource in terms of time to exhaustion
      3. Perform streamlined life-cycle analysis to calculate the energy use and CO₂ footprint of a material (Eco-audit) and relate to economic benefits
      4. Use available material information (CES database) to select the ‘best’ material for an infrastructure component (e.g., least mass, cost, volume, energy, while meeting strength and stiffness requirements)
      5. Select materials for optimum thermal performance of infrastructure
      6. Design and evaluate ‘green’ materials used in civil engineering applications
      7. Justify the feasibility and benefits of sustainability in civil engineering applications

   b. **Student outcomes addressed by this course:**

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<table>
<thead>
<tr>
<th>Outcome</th>
<th>Role of CVEEN 5920</th>
</tr>
</thead>
<tbody>
<tr>
<td>(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</td>
<td>(c) an ability to design a system within the constraints of sustainability</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>(h) an ability to understand the impact of engineering solution in a global, economic, environment and societal context.</td>
</tr>
</tbody>
</table>
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7. **Topics:**
   1. How materials impact the environment (0.5 week)
   2. Sustainability concepts (1 week)
   3. Evaluation of recourse criticality (1 week)
   4. Material recycling (1 week)
   5. Life-cycle assessment (LCA) (2 weeks)
   6. Eco-selection of materials (2 weeks)
   7. Efficient material design (2 weeks)
   8. Efficient thermal performance (1 week)
   9. CES Software (if available) (1.5 weeks)
  10. Green concrete materials (2 weeks)
  11. Case studies (1 week)

Prepared by: S. Bartlett, Date 6-18-2015
**ECE 2210: Electrical and Computer Engineering for Nonmajors**

**Credits and Contact Hours:** 3.0 Credit Hours  
15 weeks: Two 50-minute lectures + one 3-hour lab per week

**Instructor’s Name:** Arn Stolp

**Text Book(s) and/or Required Material:**

**Catalog Description:** Fundamentals of electrical and computer engineering topics for non-electrical and computer engineers. Covers fundamentals of DC and AC circuit theory, active semiconductor devices (diodes, transistors, amplifiers), 60 Hz-power circuits and equipment (2 and 3 phase circuits, transformers, motors), transducers and actuators, safety considerations.

**Prerequisites:** C- or better in PHYS 2210: Physics for Scientists and Engineers I  
**Corequisites:** C- or better in Math 2250: Differential Equations and Linear Algebra

**Designation:** Required for some majors, Mechanical Engineering in particular

**Contribution of Course to Meeting the Requirements of ABET Criterion 5:** This course teaches electrical engineering science and familiarizes the student with electrical parts and electrical engineering design.

**Specific Outcomes of Instruction:** To take students from near-zero grasp of electricity and give them basic, practical knowledge of parts and circuits and a little about the uses of these circuits. Students learn and apply fundamental circuit theory in class and learn and apply construction and measurement techniques in the lab. The study of these devices and circuits gives the students a base from which they can learn more complex electrical, electronic, and electro-mechanical subjects in following classes or in the field and also helps prepare them to pass the FE examination.

**Relationship of the Course to the Program Outcomes:**

(a) An ability to apply knowledge of mathematics, science, and engineering. Students learn and apply fundamental DC, steady-state AC, and transient circuit theory. They practice these skills by solving homework and exam problems and working in the lab.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data. Students use experimental techniques and basic engineering instruments to observe the workings of circuits and to take data which they record in a laboratory notebook. They interpret this data and compare it to theory.

(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. Students are exposed to a variety of devices, circuit
designs, and analysis methods. They learn the characteristics of basic building blocks so that they can later use them to meet desired needs in more complex designs.

(d) An ability to function on multidisciplinary teams. Most students work in teams of two for the labs.

(e) An ability to identify, formulate, and solve engineering problems. Students learn about basic building blocks and methods used to solve electrical engineering problems.

(g) An ability to communicate effectively. The results of the labs are submitted in written form. Some exam questions require short answers.

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Students practice analysis techniques and skills as they learn them. In the labs they use standard lab equipment.

Topics Covered in the Course:

- **Basics**: Electrical units, Kirchhoff’s laws, Ohm’s law, resistors in parallel and series, voltage and current dividers, power, nodes, grounds, branches, and meters.
- **DC Circuit Analysis**: Practical voltage and current sources, max power transfer, Thevenin and Norton equivalent circuits, superposition, nodal analysis, inductors and capacitors.
- **AC Circuit Analysis**: Power, audio and video signals; scope; resonance; phasors; impedance; AC circuits filters and bode plots; RMS and AC power; transformers 3 phase; Y; delta; safety.
- **Transient Analysis**: First-order transients, second-order transients, Laplace impedance, transfer functions, complete response, introduction to negative feedback systems.
- **Semiconductors**: Diodes, LEDs, diodes in AC circuits, rectification, transistors and amplifiers, operational amplifiers and circuits.
ESL 1060, Advanced Expository Writing (for ESL Speakers)

Department: English Second Language  
Course Number: ESL 1060  
Designation: Required  

General Catalog Course Description: Emphasis is on writing 7-8 page expository papers with citations.  

Prerequisites: ESL 1050  

Text:  
- Smalley, Ruetten, & Kozyrev, Refining Composition Skills: Academic Writing and Grammar, 6th edition  
- Walker, English Vocabulary for Academic Success  
- Graff & Birkenstein, They Say, I Say, 2nd edition  

Course Learning Outcomes:
1. Continue to engage in critical reading through annotation and Academic Word List vocabulary, but also start to make inferences and form opinions using reading  
2. Evaluate ideas and arguments presented in articles based on evidence in the article  
3. Develop new ideas and viewpoints based on personal knowledge, experience and information from readings  
   - Summarize and respond to articles  
   - Analyze ideas among multiple articles, personal knowledge and experience to explain a topic  
   - Synthesize ideas to create new argument
4. Use the writing process to prepare, write, and revise:  
   - Practice brainstorming, outlining, drafting, revising, editing and proofreading writing assignments
5. Identify and use American academic standards of writing including:  
   - write thesis that includes topic, controlling idea and offers an argument  
   - explain thesis through appropriate and relevant sub-topics using proper essay format that includes an introduction, thesis declaration, background information, paragraphs explaining sub-topics, and conclusion  
   - use APA citation style, including use of in-text and Reference citations  
   - recognize difference between scholarly and popular sources  
   - evaluate a source for credibility, relevance, and purpose
6. Continue to develop grammar and mechanics of Academic English:  
   - subject-verb agreement and proper verb tense  
   - correct word forms  
   - appropriate word order  
   - clear sentences based on grammatical rules for variety of sentence types  
   - correct word choice throughout revision process

Class/laboratory schedule: Three 50-minute lectures per week; discussion sections
Relationship of the course to the Program Outcomes:
Outcome:
(g) an ability to communicate effectively

Prepared by: Alexis Ulrich Date: 3/18/15
LEAP 1500, LEAP Seminar in Humanities for Engineers

Department: LEAP Program  
Course Number: LEAP 1500  
Designation: Required

General Catalog Course Description: In this class we will study diversity in urban American spaces, focusing explicitly on Salt Lake City, but also veering into social media, film and television. The course is predicated on a definition of diversity that includes such identity categories as cultural, ethnic, religious, racial, gendered, economic, political, physiological, and neurological, though it does center mainly on cultural influences. Its main focus is on the fact that in urban spaces we are continually surrounded by diverse cultural influences in art, music, food, film, and religion. These influences carry with them both inferred importance and traditional importance, extending from a tradition with a history in the US and forming new social significances in US urban spaces.

Prerequisites: N/A 
Text: All readings available online via Canvas

Course Learning Outcomes:

1. To be able to define social construction of communal identities, hegemony, intersectionality, microaggressions, absolutism, structuralism, deconstruction, and facets of critical race theory.
2. To be able to identify and analyze points of tension concerning cultural Humanities in urban, media and virtual spaces in US communities.
3. To research and delineate the historical experience of cultural groups in the US, articulating them in writing and in an oral presentation.
4. To identify, research and analyze the differences between inferred urban influence and traditional influence in cultural artifacts.
5. To organize and deliver a team oral presentation.
6. To apply teamwork skills in a team project.
7. To demonstrate library research skills in a directed research project.
8. To plan, compose and integrate written communication skills into a formal report on the inferred and traditional influences of a cultural artifact, as well as the history of its founding tradition in the US.
9. To evaluate the effectiveness of integrated verbal, written and graphic communication demonstrated in the team project and presentation.

Topics covered in the course: 
- Primer on the Humanities
- 17th-century linguistic philosophy, Saussurean structuralism, Derridean deconstruction
- Critical race theory
- Cultural artifacts in US urban, media and virtual spaces

Class/lab schedule: Three 50-minute lectures per week, library instruction sessions

Relationship of the course to the Program Outcomes:
Outcome:
g. an ability communicate effectively
j. a knowledge of contemporary issues

Prepared by: Alexis Ulrich Date: 4/1/15
**LEAP 1500, LEAP Seminar in Humanities for Engineers**

**Department:** LEAP Program  
**Course Number:** LEAP 1500  
**Designation:** Required

**General Catalog Course Description:** In the second semester of E-LEAP students will focus on how concepts of "community" have developed and been implemented in the American experience, chiefly by studying the way individuals have perceived their relationships with an obligations to community and how they have defined who counts as members of their communities. In other words, students analyze how we define and value community in America.

**Prerequisites:** N/A

**Text:** McBride, *The Color of Water. A Black Man’s Tribute to His White Mother*  
Spiegelman, *Maus I. A Survivor’s Tale: My Father Bleeds History*  
Spiegelman, *Maus II. A Survivor’s Tale: And Her My Troubles Began*  
Alvord, *The Scalpel and the Silver Bear*  
Alexie, *The Absolutely True Diary of a Part-Time Indian*

**Course Learning Outcomes:**

1. Fostering a critical understanding of beliefs about community-building, rights and responsibilities in American society from a humanities perspective
2. Exploring the meaning of diversity and its application to American society
3. Learning to succeed in a University class through networking with students, faculty members, and LEAP peer mentors
4. Adapting to the University environment by actively participating in a learning community composed of primarily first-year students entering the University
5. Acquiring knowledge of library technologies
6. Developing written and oral professional communication skills
   a. By learning to identify and use effective strategies for oral presentations and written assignments
   b. By integrating library resources into a research project
   c. By understanding the appropriate use of intellectual property
7. Developing critical thinking skills
   a. By learning how to read for main ideas
   b. By reading with an open mind to weigh and evaluate ideas
   c. By actively participating in discussions with the entire class and in small teams
   d. By organizing ideas for effective verbal and written responses
8. Learning to work effectively in teams
   a. By negotiating tasks within teams
   b. By completing team research projects
   c. By planning and executing effective team presentations based on research

**Topics covered in the course:**

- How is identity formed in America? Is it imposed from the outside or is it generated from within?
What does it mean to be American? Can anyone be an American or are particular values synonymous with the term? How does one come to feel American?

How do individuals in one community learn about the other? How does one overcome or deal with the biases, prejudices, and stereotypes one holds towards the other?

How does this person’s story broaden or alter in any way, my perception of what it means to be American, human, Black, Jewish, and/or Native American?

How do individuals deal with difference and disagreement and misunderstanding? Do they become closer or more alienated?

How do individuals bridge the gap as they move between communities in America? Is it important to bridge the gap at all? How do they decide what values and beliefs to retain? How or why do they adapt or change? What are the barriers to adapting or the reasons to choose not to adapt?

Class/laboratory schedule: Three 50-minute lectures per week, library instruction sessions

Relationship of the course to the Program Outcomes:
Outcome:
g. an ability communicate effectively
j. a knowledge of contemporary issues

Prepared by: Alexis Ulrich Date: 4/1/15
LEAP 1501, Social and Ethical Implications of Engineering

Department: LEAP Program
Course Number: LEAP 1501
Designation: Required

General Catalog Course Description: This course provides the student with an understanding of the role of ethics in the engineering professional by focusing on specific issues set out by the Accreditation Board for Engineering and Technology (ABET). Students engage in a discussion of community by examining how the world of social science studies human institutions, cultures, and behaviors. Students then apply the concepts learned to engineering ethics and decision-making processes in national and global communities.

Prerequisites: N/A
Text: All readings available online via Canvas

Course Learning Outcomes:

1. Assess the social and ethical implications of creation and constructions of technology and its uses in the United States and in a global setting by using social science methods of inquiry
2. Acquaint yourself with the LEAP learning community, one in which students know each other, the E-LEAP faculty members, peer mentors, and the College of Engineering faculty
3. Acquire a more sophisticated knowledge of library technologies
   a. By being introduced to databases in the social sciences, applied sciences, and engineering
   b. By being introduced to research methodologies specific to their discipline
   c. By learning how to evaluate internet sources
4. Develop sophisticated writing and oral communication strategies which allow the student to:
   a. Demonstrate critical thinking skills in crafting written and oral assignments
   b. Analyze professional communication skills
   c. Assess levels of technical expertise in audiences
   d. Use quantitative information in visual aids such as graphs and charts
   e. Integrate library resources into a final, team-based research project
5. Explored a variety of campus activities and organizations in order to become part of the larger University community.

Topics covered in the course:
- Contextualizing Engineering and Technology within Social Sciences
- Social context of Engineering
- Engineering Failures – Explaining disasters, A global context – Bhopal Gas Tragedy, The Challenger Explosion
- Engineering ethics and professionalism
- Engineering and sustainability
• Environmental Policy

Class/laboratory schedule: Three 50-minute lectures per week, library instruction sessions

Relationship of the course to the Program Outcomes:
Outcome:
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
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively

Prepared by: Alexis Ulrich Date: 3/30/15
MATH 1210, Calculus I

Department: Mathematics
Course Number: MATH 1210
Designation: Required

General Catalog Course Description: Functions and their graphs, differentiation of polynomial, rational and trigonometric functions. Velocity and acceleration. Geometric applications of the derivative, minimization and maximization problems, the indefinite integral, and an introduction to differential equations. The definite integral and the Fundamental Theorem of Calculus.

Prerequisites: MATH 1050 & 1060, or MATH 1080
Text: Varberg, Purcell, & Ridgon, *Calculus with Differential Equations, 9th edition*

Course Learning Outcomes:

- Take limits of algebraic and trigonometric expressions of the form 0/0 (that simplify), non-zero number over 0, including limits that go to (positive or negative) infinity, limits that don't exist and limits that are finite.
- Use the limit definitions of derivative and definite integral for polynomial, rational and some trigonometric functions; understand definition of continuity.
- Differentiate all polynomial, rational, radical, and trigonometric functions and compositions of those functions; perform implicit differentiation and compute higher order derivatives.
- Use differentiation to find stationary, singular and inflection points, as well as domain and limit information to determine vertical and horizontal asymptotes, and then use all of that information to sketch the graph of a curve, \( y = f(x) \).
- Apply differentiation to optimization and related rates problems.
- Compute indefinite and definite integrals, using the power rule and basic u-substitution and the Fundamental Theorems of Calculus.
- Apply the definite integral to compute area between two curves, volumes of solids of revolutions, arc length, surface area for surfaces of revolution and center of mass.

Topics covered in the course:

1. Functions and their graphs, differentiation of polynomial, rational and trigonometric functions
2. Velocity and acceleration
3. Geometric applications of the derivative, minimization and maximization problems, the indefinite integral, and an introduction to differential equations
4. The definite integral and the Fundamental Theorem of Calculus.

Class/laboratory schedule: Four 50-minute lectures per week.

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics
Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 3/23/15
MATH 1220, Calculus II

Department: Mathematics
Course Number: MATH 1220
Designation: Required

General Catalog Course Description: Geometric applications of the integral, logarithmic, and exponential functions, techniques of integration, conic sections, improper integrals, numerical approximation techniques, infinite series and power series expansions, differential equations (continued).

Prerequisites: MATH 1210 or equivalent
Text: Varberg, Purcell, & Rigdon, Calculus with Differential Equations, 9th edition
Rigdon, Student Solutions Manual for Calculus

Course Learning Outcomes:
- Compute derivatives and integrals for exponential, logarithmic, hyperbolic functions, and inverse trigonometric functions
- Integrate integrable functions using integration by parts, u-substitution, trigonometric substitutions, rationalizing substitutions, partial fraction decomposition, and trigonometric identities. This includes knowing which techniques to apply to a given integral
- Use L’Hopital’s Rule to calculate indeterminate-type limits and also know what limits are the non-indeterminate forms and how to compute those limits
- Compute improper integrals
- Understand the difference between an infinite sequence and infinite series and determine if a sequence converges or diverges
- Determine whether or not an infinite series of numbers converges or diverges using a variety of tests
- Understand what it means for a Power Series to converge or diverge and be able to find the Taylor Series for a given function
- Differentiate and integrate functions in polar coordinates

Topics covered in the course:
1. Transcendental Functions
2. Techniques of Integration
3. Indeterminate forms and improper integrals
4. Infinite Series
5. Conics & Polar Coordinates

Class/laboratory schedule: Four 50-minute lectures per week

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 3/23/15
**MATH 1310 Engineering Calculus I**

**Department:** Math

**Course Number:** Math 1310

**Designation:** Required

**General Catalog Course Description:** Differential and integral calculus with a focus on engineering applications and projects: functions and models; rates of change in science and engineering, limits and derivatives; related rates; derivatives and shapes of graphs; optimization; Newton’s method; definite integrals, anti-differentiation and Fundamental Theorem of Calculus; techniques of integration; numerical and symbolic integration with software; arclength, area and volumes via integration.

**Prerequisites:** C or better in ((MATH 1050 AND MATH 1060) OR MATH 1080) OR AP Calc AB score of 3 or higher OR Accuplacer CLM score of 90 or higher OR ACT Math score of 28 or higher OR SAT Math score of 630 or higher.

**Textbooks and/or other required material:** Stewart, *Calculus: Concepts and Contexts, Fourth Edition*

**Course Learning Outcomes:**
1. Understand how to transform functions into other functions.
2. Understand concept of a limiting value of a function
3. Understand how to use limits to compute the derivative
4. Understand how to utilize the derivative in applied contexts
5. Gain ability to read and understand problem descriptions, then be able to formulate equations modeling the problem by applying geometric or physical principles

**Topics covered in the course:**
1. Functions, Compositions, Exponentials, Logarithms, Inverses
2. Parametric Curves, Velocity, Limits, Limit Laws
3. Continuity, Derivatives, Rate of Change
4. Relationship between a Function and its Derivative
5. Derivatives of Polynomials, Exponentials, Products and Quotients
6. Derivatives of Trig Functions, Chain Rule, Implicit Differentiation
7. Inverse Trig Functions, Logs and their Derivatives, Applications
8. Linear Approximation, Differentials, Related Rates, Max/Min
9. Shapes of Curves, Graphing, l'Hopital's Rule
10. Optimization, Newton's Method, Anti-derivatives
11. Areas, Distances, Evaluating Definite Integrals
12. Fundamental Theorem of Calculus, Substitution, Integration by Parts
13. Integration Techniques, Approximate Integration
14. Improper Integrals, Areas Between Curves, Volumes
Class/laboratory schedule: Four 50-minute lectures per week; one problem session per week

Contribution of course to meeting the requirements of ABET Criterion 5: College-level math

Relationship of the course to the Program Outcomes:
Outcome a: Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Ajay Nahata
Date: 06/12/2015
MATH 1311, Accelerated Engineering Calculus I (Honors Course)

Department: Mathematics
Course Number: MATH 1311
Designation: Required

General Catalog Course Description: Math 1311 and 1321 together are equivalent to the three semester sequence Math 1210, Math 1220, and Math 2210. This sequence is intended for engineering majors. Review of introductory calculus, applications of differential and integral calculus, introduction to differential equations, conic sections and polar coordinates, numerical approximation, sequences and series, power series.

Prerequisites: N/A


Course Learning Outcomes:
1. Understand how to transform functions into other functions.
2. Understand concept of a limiting value of a function
3. Understand how to use limits to compute the derivative
4. Understand how to utilize the derivative in applied contexts
5. Gain ability to read and understand problem descriptions, then be able to formulate equations modeling the problem by applying geometric or physical principles

Topics covered in the course:

1. Functions, Compositions, Exponential Function, Logarithms, Inverse Functions, Parametric Curves
2. Velocity, Limits, Limit Laws, Continuity
3. Derivatives, Relationship between a Function and its Derivative
4. Product and Quotient Rules, Derivatives of Trig Functions, Chain Rule, Implicit Differentiation, Inverse Trig Functions
5. Log Functions, Log Derivatives, Linear Approximation, Differentials, Applications, Linear Approximation
6. Derivatives and Shapes of Curves, L'Hopital's Rule
8. The Definite Integral, Evaluating Definite Integrals, Fundamental Theorem of Calculus, Substitution Rule
9. Integration by Parts. Additional Techniques of Integration. Approximate Integration
10. Improper Integrals, Areas Between Curves, Volumes
11. Volumes, Volumes by Shells, Arc Length
12. Average Values; Applications to Physics and Engineering
14. Exponential Growth and Decay, Sequences and Series

Class/laboratory schedule: Four 50-minute lectures per week; one problem session per week

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics
Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Ajay Nahata
Date: 06/12/2015
MATH 1320, Engineering Calculus II

Department: Mathematics
Course Number: MATH 1320
Designation: Required

General Catalog Course Description: Differential and Integral Calculus II, with a focus on applications and projects for engineers: integral expressions for moments, centers of mass, and work; modeling with first order differential equations; infinite series and sequences; power series and Taylor series; vectors, dot and cross products, and the geometry of space; the calculus of vector functions and particle motion in space; differential calculus for functions of several variables, including linear approximation, partial and directional derivatives, chain rule, and multi-variable optimization.

Prerequisites: MATH 1310
Text: Stewart, Calculus: Concepts and Contexts

Course Learning Outcomes:

- Students will be able to utilize methods of integration to compute volumes of objects with circular-shaped aspects, and compute lengths of curves. These applications introduce a higher-level concept of integration, involving the summation of small volume segments dV or small length segments ds, which are computed by performing an appropriate parameterization to a real-number-line integral in terms of dx.

- Students will be skilled in using integration to compute problems important in physics and engineering. Students will know how to compute an average value of a function using the mean value theorem for integrals, the center of mass for objects, and the computation of energy as a force integrated over a distance. Students will also be able to utilize physical laws to formulate differential equations that solve for the motion of masses by forces of gravitation, friction, electrostatics, to name a few. Students will also become familiar with the phenomenon of exponential growth and decay in science and engineering contexts.

- Students will become skilled in computations and applications of infinite sequences and sums. Students will become familiar with the properties of infinite sums to either converge to a finite value or diverge to an infinite value, and will learn about methods to determine convergence. Students will be able to represent functions as series and approximate functions using Taylor’s theorem.

- Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- and 3-dimensional coordinate systems, vectors and vector operations including the dot and cross product, and equations of lines, planes, and other surfaces. Students will also learn how to represent motion of objects in 3D using vector functions, how to represent velocity and acceleration using vector projections into tangential and centripetal coordinates of acceleration, and how to characterize curves in space by computing arc length and curvature. For functions of 3D surfaces, students will be able to characterize aspects of surfaces and volumes using partial derivatives and the gradient vector. Partial derivatives will also be used to describe approximating tangent
planes to points on surfaces, and how to compute derivatives of multi-dimensional function compositions can be performed using a multi-dimensional version of the chain rule.

**Topics covered in the course:**
1. Volumes, shells, cylinders, arc length
2. Average Values, Applications of Integration to Engineering, Modeling with Differential Equations
3. Direction Fields, Differential Equations, Exponential Growth and Decay
4. Sequences, Series, Convergence Tests for Series
5. Sums, Power Series, Representing Functions with Power Series
6. Taylor and Maclaurin Series, Applications of Taylor Polynomials
7. Three Dimensional Coordinates, Vectors, Dot Product
8. Cross Product, Equations of Lines and Planes
9. Functions and Surfaces, Vector Functions, Space Curves
10. Derivatives and Integrals of Vector Functions, Arc Length, Curvature
11. Velocity, Acceleration, Parametric Surfaces
12. Functions of Several Variables, Limits, Partial Derivatives
13. Tangent Planes, Linear Approximation, Chain Rule
14. Directional Derivative, Gradient Vector, Maximum and Minimum Values
15. Lagrange Multipliers

**Class/laboratory schedule:** Four 50-minute lectures per week; lab section.

**Contribution of course to meeting the requirements of ABET Criterion 5:** College-level mathematics

**Relationship of the course to the Program Outcomes:**
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

**Prepared by:** Alexis Ulrich **Date:** 3/23/15
MATH 1321, Accelerated Engineering Calculus II (Honors Course)

Department: Mathematics
Course Number: MATH 1321
Designation: Required

General Catalog Course Description: Completion of Math 1321 is equivalent to completing the entire three semester Calculus I, II, II sequence. Vectors in the plane and in 3-space, differential calculus in several variables, integration and its applications in several variables, vector fields, and line, surface and volume integrals, Green's and Stokes Theorems.

Prerequisites: MATH 1311

Topics covered in the course:
1. Sequences, Series, Convergence tests for series, Estimating sums
2. Power series, Representing functions with power series
3. Taylor and Maclaurin series, Applications of Taylor Polynomials three dimensional coordinates
4. Vectors, Dot product, Cross product, Equations of lines and planes, Functions and surfaces
5. Vector functions, Space curves, Derivatives and integrals of vector functions, Arc length, Curvature, Velocity, Acceleration
6. Parametric surfaces, Functions of several variables, Limits, Partial derivatives, Tangent planes
7. Linear approximation, Chain rule, Directional derivative, Gradient vector, Maximum and minimum values
8. Lagrange multipliers, Double integrals, Iterated integrals, Integration over general regions
9. Integrals in polar coordinates, Applications, Surface area, Triple integrals
10. Cylindrical/Spherical coordinate integrals, Change of variables, Jacobians
11. Vector fields, Line integrals, Fundamental Theorem of Line integrals
12. Green’s Theorem, Curl and Divergence, Surface integrals
13. Stokes’ Theorem, Divergence Theorem

Class/laboratory schedule: Three 50-minute lectures per week, one 50-minute lab section

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 3/17/15
**MATH 2210, Calculus III**

Department: Mathematics  
Course Number: MATH 2210  
Designation: Required  

**General Catalog Course Description:** Vectors in the plane and in 3-space, differential calculus in several variables, integration and its applications in several variables, vector fields and line, surface, and volume integrals. Green's and Stokes' theorems.

**Prerequisites:** MATH 1220 or equivalent  
**Text:** Varberg, Purcell, and Rigdon, *Calculus with Differential Equations, 9th edition*

**Course Learning Outcomes:**

- Compute dot and cross products of two vectors, projection of one vector onto another vector.
- Convert between cylindrical, rectangular and spherical coordinates.
- Determine the equation of a plane in 3D, including a tangent plane to a surface in 3D.
- Find the parametric equations of a line in 3D.
- Perform calculus operations on functions of several variables, including limits, partial derivatives, directional derivatives, and gradients; understand what the gradient means geometrically.
- Find maxima and minima of a function of two variables; use Lagrange Multipliers for constrained optimization problems.
- Compute double and triple integrals in rectangular, spherical and cylindrical coordinates; proper use of double or triple integrals for finding surface area or volume of a 3D region.
- Compute line and surface integrals.

**Topics covered in the course:**

1. Parametric Curves, Three Dimensional Coordinates, Vectors  
2. Dot Product, Cross Product  
3. Vector Valued Functions, Curvilinear Motion, Three Dimensional Lines and Tangent Lines, Three Dimensional Surfaces  
4. Spherical and Cylindrical Coordinates  
5. Functions of Several Variables, Partial Derivatives, Limits and Continuity  
6. Differentiability, Directional Derivative, Gradients  
7. Chain Rule, Tangent Plane, Approximations, Maxima and Minima  
8. Lagrange Multipliers  
9. Double Integrals, Iterated Integrals, Integration over General Regions  
10. Double Integrals in Polar Coordinates, Surface Area, Triple Integrals  
11. Integrals in Cylindrical/Spherical Coordinates, Change of Variables, Jacobian  
12. Line Integrals  
13. Independence of Path, Green’s Theorem, Surface Integrals  
14. Gauss’s Divergence Theorem, Stokes’ Theorem
Class/laboratory schedule: Three 50-minute lectures per week.

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 3/23/15
MATH 2250, Differential Equations and Linear Algebra

Department: Mathematics
Course Number: MATH 2250
Designation: Required

General Catalog Course Description: This is a hybrid course which teaches the allied subjects of linear algebra and differential equations. These topics underpin the mathematics required for most students in the Colleges of Science, Engineering, Mines & Earth Science.

Prerequisites: MATH 1210-1220 (single-variable calculus). Understanding of vectors and parametric curves. Recommended multivariable calculus (MATH 1260 or equivalent) taken prior to this course.

Edwards, Penny,, & Haberman, Linear Algebra and Differential Equations with Introductory Partial Differential Equations and Fourier Series
Edwards and Penney, Elementary Linear Algebra

Course Learning Outcomes:
- Use general principles to model a phenomenon and derive the relevant governing differential equations;
- Learn solution techniques and visualization tools for first order separable and linear differential equations;
- Learn matrix algebra techniques, in order to be able to compute the solution space to linear systems and understand its structure;
- Be able to use the basic concepts of linear algebra such as linear combinations, span, independence, basis and dimension, to understand the solution space to linear equations, linear differential equations, and linear systems of differential equations;
- Understand the natural initial value problems for first order systems of differential equations, and how they encompass the natural initial value problems for higher order differential equations and general systems of differential equations;
- Learn how to solve constant coefficient linear differential equations via superposition, particular solutions, and homogeneous solutions found via characteristic equation analysis;
- Learn how to use Laplace transform techniques to solve linear differential equations;
- Understand the concepts of eigenvalues and eigenvectors and be able to compute them. Apply them to find the general solution space for first and second order constant coefficient homogeneous linear systems of differential equations;
- Understand and be able to use linearization as a technique to study the behavior of nonlinear autonomous dynamical systems near equilibrium solutions;
- Develop your ability to communicate modeling and mathematical explanations and solutions, using technology and software such as Maple, Matlab or internet-based tools as appropriate.

Topics covered in the course:
1. Differential equations, mathematical models, integrals as a general or particular solution, slope field, separable differential equations
2. Linear differential equation, LR and RC circuits, mixture model, population model, cascades, equilibrium solution, stability, acceleration-velocity models
3. Escape velocity, Jules Verne problem, numerical solutions
4. Linear systems, matrices, Gaussian elimination, reduced row echelon form
5. Matrix operations, matrix inverses, determinants
6. Vector spaces, linear combinations in $\mathbb{R}^n$, span and independence, subspaces
7. Bases and dimension, abstract vector spaces and solution space of a DE, second-order linear DE, general solutions, superposition
8. Constant coefficients, mechanical vibrations, pendulum model, particular solutions to non-homogeneous problems, circuits
9. Forced oscillations, resonance and mechanical vibrations, Laplace transforms, solving a DE with transforms
10. Partial fractions and translations, unit step, ramp, convolution, impulse response
11. Eigenvalues and eigenvectors, diagonalization, power method, first-order systems of ODE
12. Matrix systems of DE, eigenanalysis method, spring systems, forced undamped systems
13. Systems and practical resonance, equilibria, stability, phase portraits for non-linear systems
14. Populations and ecological models, nonlinear mechanical systems

Class/laboratory schedule: 3 50-minute lectures per week; lab session

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Alexis Ulrich Date: 3/25/15
MATH 3140, Vector Calculus and Partial Differential Equations for Engineers

Department: Mathematics
Course Number: MATH 3140
Designation: Required

General Catalog Course Description: Integration and its applications in several variables, vector fields and line, surface, and volume integrals. Green's and Stokes' theorems. Fourier series and boundary-value problems for the wave, heat, and Laplace equations, separation of variables.

Prerequisites: MATH 2250 and MATH 1320, 1321, 2210, or 1260.

Edwards, Penney, & Haberman, Differential Equations and Linear Algebra with introductory Partial Differential Equations and Fourier Series

Course Learning Outcomes:

• You will be introduced to the tools of integration of multivariate functions over areas and volumes and will learn the use of iterated multiple integration. Similar to single-variable integration, you will learn the technique of multidimensional change-of-variables to transform the coordinates over which integration proceeds by utilizing the Jacobian. Specifically, you will learn how to transform between an integral over an area or volume in Cartesian coordinates to polar or spherical coordinates, respectively.

• You will become familiar with vector functions that define vector fields in the plane and 3D space, particularly conservative vector fields, represented by the gradient of a scalar function, which are important for gravitation and electrostatics. When masses or charged particles are pushed through fields such as these along curved paths, the work done can be computed as a line integral. You will learn how the fundamental theorem for line integrals for conservative vector fields reduces the integral to valuation of the potential at the endpoints of the path.

• You will learn the fundamental vector calculus integral theorems of Green, Stokes', and Gauss'. The notion that one-dimensional integrals of functions can be computed from evaluation of a related function (e.g., an antiderivative or a potential function) on the endpoints of the interval of integration generalizes to integration over areas, surfaces and 3D domains. Integration over these domains can be computed by evaluation on the boundary of an area, surface, or volume of the appropriate function. You will learn meaning and computation of the curl and divergence of a vector field and utilize them to compute area and volume integrals using Green's and Stokes', and Gauss' theorems, respectively. You will also learn how these theorems represent conservation principles for physical vector fields important in gravitation and electric fields.

• You will become knowledgeable about partial differential equations (PDEs) and how they can serve as models for physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer, and electrostatics. You will be able to derive heat and wave equations using the divergence theorem.
• You will master how solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.
• You will be able to understand and use inner product spaces and the property of orthogonality of functions to determine Fourier coefficients, and solution of PDEs using separation of variables. You will master the method of separation of variables to solve the heat and wave equation under a variety of boundary conditions.
• You will also master the use of the Fourier transform and integral convolution to solve the heat equation on the real line using the heat kernel.

Topics covered in the course:
1. Double integrals, iterated integrals, integration over general regions, integrals in polar coordinates
2. Applications, surface area, triple integrals
3. Cylindrical/spherical coordinate integrals, change of variables, Jacobians
4. Vector fields, line integrals, fundamental theorem of line integrals
5. Green’s theorem, curl and divergence
6. Surface integrals, Stokes’ theorem, divergence theorem
7. Applications of vector calculus to EM, fluids, heat/diffusion equation, conduction/transport in 1D
8. Boundary conditions, equilibrium temperature, derivation of heat equation in 2-3D using the divergence theorem
9. Orthogonal vectors, inner product, inner product space, inner product on a function space, orthogonal projection onto a subspace with orthogonal basis, Fourier coefficients, solving 1D heat equation with zero-endpoint temperatures
10. 1D heat equation with insulated ends, periodic ends, Laplace equation in a rectangle and disk
11. Mean value theorem, maximum condition, uniqueness, net-zero boundary flux via divergence theorem, Fourier series
12. Convergence theorem, Sine and cosine series, term-by-term differentiation
13. Derivation of wave equation in 1D, boundary conditions, solution with fixed ends, vibrating rectangular membrane
14. Heat equation on infinite 1D domain, Fourier transform pairs, transforming the heat equation, heat kernel

Class/laboratory schedule: Four 50-minute lectures per week; lab session.

Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics

Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering

Prepared by: Alexis Ulrich Date: 3/25/15
**MATH 3150, Partial Differential Equations for Engineering Students**

Department: Mathematics  
Course Number: MATH 3150  
Designation: Required  

**General Catalog Course Description:** Fourier series and boundary-value problems for the wave, heat, and Laplace equations, separation of variables in rectangular and radial geometries, Fourier transform.  
**Prerequisites:** MATH 2250 or equivalent and MATH 2210, 1260, 1280, or 1321.  
**Text:** Edward, Penney, & Haberman, *Linear Algebra and Differential Equations with Introductory Partial Differential Equations and Fourier Series*

**Course Learning Outcomes:**
- Students will become knowledgeable about partial differential equations (PDEs) and how they can serve as models for physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer and electrostatics. Students will be able to derive heat and wave equations in 2D and 3D using the divergence theorem.
- Students will master how solutions of PDEs is determined by conditions at the boundary of the spatial domain and initial conditions at time zero.
- Students will be able to understand and use inner product spaces and the property of orthogonality of functions to determine Fourier coefficients, and solution of PDEs using separation of variables. Students with master the method of separation of variables to solve the heat and wave equation under a variety of boundary conditions. Students will be familiar with the use of Fourier series for representation of functions, and the conditions for series convergence.
- Students will be able to solve for the electric potential in an area or volume region by specifying the charge distribution on the boundary of the region (i.e., boundary conditions) and use separation of variables to obtain the solution. Students will be able to derive basic properties of these electric potentials, including points of minimum/maximum potentials, and use Stokes’ theorem to determine work done moving charges in a closed path through the potential.
- Students will also master the use of the Fourier transform and integral convolution to solve the heat equation on the real line using the heat kernel.
- Students will also improve their problem solving skills. Students will practice reading and interpreting problem objectives, selecting and executing appropriate methods to achieve objectives, and finally, be able to interpret and communicate results.

**Topics covered in the course:**
1. Heat/diffusion equation, conduction/transport in 1D, boundary conditions, equilibrium temperature, derivation of heat equation in 2-3D using the divergence theorem
2. Orthogonal vectors, inner product, inner product space, inner product on a function space, orthogonal projection onto a subspace with orthogonal basis
3. Fourier coefficients, solving 1D heat equation with zero-endpoint temperatures, 1D heat equation with insulated ends, periodic ends, Laplace equation in a rectangle and disk, mean value theorem, maximum condition, uniqueness, net-zero boundary flux via divergence theorem
4. Fourier series, convergence theorem, sine and cosine series, term-by-term differentiation
5. Derivation of wave equation in 1D domain, Fourier transform pairs, transforming the heat equation, heat kernel

Class/laboratory schedule: Three 50-minute lectures per week
Contribution of course to meeting the requirements of ABET Criterion 5: College-level mathematics
Relationship of the course to the Program Outcomes:
Outcome:
a. Ability to apply knowledge of mathematics, science, and engineering
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice
Prepared by: Alexis Ulrich Date: 3/25/15
**ME EN 2020 Particle Dynamics**

**Department:** Mechanical Engineering  
**Course Number:** ME EN 2020  
**Designation:** Required

**General Catalog Course Description:**  
(2) Kinematics and kinetics of particles, including: position, velocity, acceleration, moving frames of reference, Newton's laws, conservation of energy and momentum, impact. Meets with ME EN 2080 the first half of the semester.

**Prerequisites:**  
Prerequisite: CVEEN 2010 or ME EN 1300 and PHYS 2210  
Corequisite: MATH 2250

**Text:** MERIAM :ENGR.MECH.:DYNAMICS (V.2)  

**Course Objectives:**
1. Analyze rectilinear and curvilinear motion (kinematics) of particles  
2. Solve problems involving the kinetics (relation of forces, mass and motion) of single particles  
3. Apply the concepts of energy and momentum, both linear and angular, to the motion of particles  
4. Have some understanding of the flow of systems of particles

**Topics Covered:**
1. Vectors  
2. Kinematics  
3. Kinetics  
4. Numerical methods  
5. Coordinates  
6. Polar & Cylindrical  
7. Work and & Energy  
8. Conversation of Energy  
9. Impulse & Momentum  
10. Angular Impulse & Momentum  
11. Orbital Mechanics  
12. Relative Motion  
13. Normal & Tangential  
15. Impact  
16. Vibration of Particles  
17. Mass Flows
Class/Laboratory Schedule: 4 days a week, 50 minutes per class, no lab.
Contribution to the Professional Component: This class is entirely Engineering and Science.

Relationship of the course to the Program Outcomes:
Student outcome high coverage: 5, 12, 13, 15
Student outcome moderate coverage: 1, 4, 6, 7, 10, 11

**MG EN 1050 -- TECHNICAL COMMUNICATIONS**

**Designation:** Required

**Catalog**

**Description:**
Elements of communication in an engineering setting. Introduction to drafting techniques using engineering standards and software, including CAD software. Course includes semester design project and presentation with an emphasis on intra-software communication.

**Prerequisite(s):** None

**Textbook(s):**
*AutoCAD 2014 / AutoCAD LT 2014: Essentials AOTC*
Autodesk, Inc., San Rafael, CA 94903

**Course objectives:**
1. Develop skill in using AutoCAD to communicate technical information graphically.
2. Use PowerPoint in making a presentation.
3. Understand function of scale and dimensions on drawings.
4. Learn design skills in AutoCAD.
5. Use AutoCAD and PowerPoint to complete design project.

**Topics Covered:**
1. AutoCAD Introduction
2. Creating Drawings
3. Manipulating Objects
4. Creating Objects
5. Drawing Organization and Inquiry Commands
6. Altering Objects
7. Layouts
8. Annotation
9. Hatching
10. Dimensioning
11. Reusable Content
12. Plotting
13. Drawing Templates
14. Introduction to PowerPoint

**Class/laboratory schedule:**
One day a week. Integrated 3.5 hour lecture / lab.

**Design Projects:**
Determine the location of a road subject to grade and curvature restrictions. Topographic base, starting road and end location are provided by instructor. Hard copy and presentation required.

**Professional Design Component**
0.5 credits or 25%
Components: Other 1.5 credit or 75%

Relationship of course to program outcomes:

Outcomes and Corresponding Course Objectives:

<table>
<thead>
<tr>
<th>Engineering programs must demonstrate that their graduates have:</th>
<th>Corresponding Course Goals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>4</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td></td>
</tr>
<tr>
<td>(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</td>
<td>4</td>
</tr>
<tr>
<td>(d) an ability to function on multi-disciplinary teams</td>
<td></td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>4</td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td></td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td></td>
</tr>
<tr>
<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
<td></td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td></td>
</tr>
<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td>(l) an understanding the principles of science and engineering as applied to mining methods and practices</td>
<td></td>
</tr>
</tbody>
</table>

254
MG EN 2400 -- INTRODUCTORY SURVEYING

Required Course, 3 credits

Instructor: M. K. McCarter

2014/15 Catalog
Description: 2400 Introductory Surveying (3) Fulfills Quantitative Reasoning
Use of level, total station, GPS, and other equipment in field
surveying. Practical astronomy, calculation procedures, state plane
coordinates, public land division and introduction to Global Position
Systems (GPS) and Geographic Information Systems (GIS). Field
demonstration and use of surveying equipment illustrate concepts
presented in lecture. Laboratory fee assessed.

Prerequisite(s): Math 1060 (Trigonometry) or Math 1080 or higher and MG EN 1050.

Textbook(s): Recommended resource (not required) Surveying, Moffitt, F. H. and J.
D. Bossler, 10th Edition, Addison-Wesley. Lecture notes provided by
the instructor and presented on WEBCT.

Course objectives: 1. Formulate and solve surveying problems (spatial relationships,
measurement of areas and volumes, earth moving, road construction)
2. Become proficient in use of surveying instruments
3. Understand and apply methods for reducing or eliminating error.
4. Function on teams where team members perform different tasks
5. Analyze data from field measurements using hand and computer
methods
6. Calculate location of points in space (coordinates and elevation)
7. Determine direction of lines from astronomical observation and state
plane coordinates
8. Understand advantages and disadvantages of standard surveying
techniques.
9. Calculate horizontal curves for road construction
10. Demonstrate discipline and consistency in data computations
11. Write letters of transmittal for field results including map drawing

Topics Covered: 1. Leveling field procedures and calculations
2. Distance measurement and sources of error
3. Angle measurement and determination of direction of lines
4. Traverse field procedures and calculations
5. Adjustment of traverses and area calculations
6. Earth work and volume estimates
7. Establishing the meridian using astronomical methods
8. State plane coordinate calculations and applications
PHYS 2210, 2215 Physics for Scientists and Engineers I, Physics for Scientists and Engineers I Laboratory

Department: Physics

Course Number: PHYS 2210, PHYS 2215

Designation: Required

General Catalog Course Description:
Phys 2210: Three lectures and two recitations weekly. Designed to give science and engineering students a thorough understanding of the basic physical laws and their consequences. Classic mechanics will be introduced, including methods of energy, momentum, angular momentum, and Newtonian gravity. Applications will include mechanical oscillations, sound, and wave motion.

Phys 2215: Teaches laboratory skills needed by scientists and engineers. Measurement, data analysis, computer graphics display, experimental design and report writing, experimental procedures and results. Experiments in mechanics and waves. Laboratory designed to accompany PHYS 2210.

Prerequisites: MATH 1210

Textbooks and/or other required material: Gladding, Selen, and Stelzer, smartPhysics: Classical Mechanics

Course Learning Outcomes:
1. Help students understand and solve problems in a broad range of scientific and engineering fields.
2. Teach students the fundamental principles of physics
3. Teach student how to describe real world phenomena quantitatively
4. Teach problem-solving skills that can be applied to other areas of science, engineering, and life.

Topics covered in the course:
1. Kinematics
2. Dynamics and statics
3. Motion in multiple dimensions
4. Forces and the laws of motion
5. Energy
6. Momentum
7. Rotational Momentum
8. Gravitation
9. Constraints
10. Oscillations and waves
Class/laboratory schedule: Three 50-minute lectures per week; two 50-minute discussion sections; laboratory

Contribution of course to meeting the requirements of ABET Criterion 5: College-level basic science

Relationship of the course to the Program Outcomes:
Outcome:
  a. Ability to apply knowledge of mathematics, science, and engineering
  b. Ability to conduct experiments and interpret data
  k. Ability to use techniques, skills and modern engineering tools necessary for engineering practice.

Prepared by: Ajay Nahata
Date: 06/12/2015
**PHYS 2220, 2225 Physics for Scientists and Engineers II, Physics for Scientists and Engineers II Laboratory**

**Department:** Physics  
**Course Number:** PHYS 2220  
**Designation:** Required


**Prerequisites:** PHYS 2210 and MATH 1110 & 1220

**Text:** Serway & Jewett, Jr., *Physics for Scientists and Engineers (with Modern Physics), 9th edition*

**Course Learning Outcomes:**

1. Help students understand and solve problems in a broad range of scientific and engineering fields.
2. Teach students the fundamental principles of physics
3. Teach student how to describe real world phenomena quantitatively
4. Teach problem-solving skills that can be applied to other areas of science, engineering, and life.

**Topics covered in the course:**

1. Electric fields
2. Electric currents
3. Magnetic fields
4. Induced currents
5. Electromagnetic waves and optics

**Class/laboratory schedule:** Three 50-minute lectures per week; two discussion sections

**Contribution of course to meeting the requirements of ABET Criterion 5:** College-level basic science

**Relationship of the course to the Program Outcomes:**

**Outcome:**

a. Ability to apply knowledge of mathematics, science, and engineering
b. Ability to conduct experiments and interpret data
k. Ability to use techniques, skills, and modern engineering tools necessary for engineering practice

**Prepared by:** Ajay Nahata  
**Date:** 06/12/2015
**WRTG 2010, Intermediate Writing: Academic Writing and Research**

Department: Writing & Rhetoric Studies  
Course Number: WRTG 2010  
Designation: Writing Requirement 2

**General Catalog Course Description:** Writing in undergraduate academic contexts. Students practice analytical and persuasive writing that addresses various academic audiences in a research university. Emphasis on writing for learning, textual analysis, writing from research, and collaborative writing. To be taken Freshman year.

**Prerequisites:** WRTG 1010 or placement into 2010

**Text:** Barnett and Bedau, *Current Issues and Enduring Questions, 9th edition*  
Jordan, *Open2010*  
Alkon and Agyeman, *Cultivating Food Justice: Race, Class, and Sustainability*  
Graff, Birkenstein, and Durst, *They Say, I Say, 3rd edition*

Selected essays on e-reserve, WebCT, by handout, or online

**Course Learning Outcomes:**

1. Write Academic Arguments
   - Write for a particular purpose, context, and audience
   - Situate an argument in current research on the topic of the paper
   - Synthesize the current research on the topic
   - Contribute to an ongoing conversation
   - Develop an argument using good evidence
   - Edit and proofread according to the conventions of Standard Written English

2. Develop Information Literacy
   - Conduct secondary research to write in an academic context
   - Use research databases and other online search tools
   - Identify and use reliable sources that are appropriate to the topic and audience
   - Demonstrate flexibility using a variety of online genres and source types
   - Write using digital media appropriate to the rhetorical context

3. Develop Strategies for Working with Genre and Academic Conventions
   - Compose in multiple genres, both academic to nonacademic
   - Use visual elements to support the purpose and/or argument of the text
   - Write well-formed sentences, with strong clausal organization that follow the expectations of Standard Written English
   - Write paragraphs that are structured to develop ideas and make connections between the paragraphs
   - Use a citation style consistently, attributing words and/or ideas to the appropriate author

4. Collaborate
   - Collaborate with peers to research a problem or topic
   - Write collaboratively to create persuasive and informative messages

**Class/laboratory schedule:** Three 50-minute lectures per week; discussion sections
Relationship of the course to the Program Outcomes:
Outcome:
G2. An ability to communicate effectively in a written format
Prepared by: Alexis Ulrich Date: 3/17/15

Topics Covered
9. GPS methods and applications
(Continued) 10. Circular curve calculations and applications
11. Division of public lands
12. Introduction to GIS and applications

Class/laboratory
Fall Semester - Lectures 10:45 a.m. Tuesday and Thursday, Laboratory

Schedule:
one day per week 2:00 p.m. to 5:00 p.m. Summer Semester – Lectures
3:00 pm and two laboratory periods per week.

Design Projects:
Not applicable

Professional
Engineering Topics 3 credits or 100%

Components
Design Component 0 credit or 0%

Relationship of course to program outcomes

Outcomes and Corresponding Course Objectives:

<table>
<thead>
<tr>
<th>Engineering programs must demonstrate that their graduates have:</th>
<th>Corresponding Course Goals:</th>
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<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>1, 3, 5, 6, 7, 9</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>2, 3, 5, 8</td>
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<td>(c) an ability to design a system, component, or process to meet desired needs</td>
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<td></td>
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<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>2, 8</td>
</tr>
</tbody>
</table>

Prepared by: M. K. McCarter, 8June2015
Appendix B – Faculty Vitae
Faculty Resume

Michael E. Barber
Professor and Chairman of Civil & Environmental Engineering

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>University of Texas</td>
<td>Environmental &amp; Water Resources</td>
<td>1991</td>
</tr>
<tr>
<td>M.S.C.E</td>
<td>Purdue University</td>
<td>Hydrology/Hydraulics</td>
<td>1983</td>
</tr>
<tr>
<td>B.S.C.E</td>
<td>University of New Hampshire</td>
<td>Constructed Systems</td>
<td>1981</td>
</tr>
</tbody>
</table>

3. YEARS of ACADEMIC SERVICE

<table>
<thead>
<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
<th>Original Appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 – present</td>
<td>Professor &amp; Chairman (1)</td>
<td>University of Utah</td>
<td>August 1, 2013</td>
</tr>
<tr>
<td>2008 – 2013</td>
<td>Professor</td>
<td>Washington State University</td>
<td>August 2008</td>
</tr>
<tr>
<td>1999 – 2008</td>
<td>Associate Professor</td>
<td>Washington State University</td>
<td>August 1999</td>
</tr>
<tr>
<td>1994 – 1999</td>
<td>Assistant Professor</td>
<td>Washington State University</td>
<td>August 1994</td>
</tr>
<tr>
<td>1991 – 1994</td>
<td>Assistant Professor</td>
<td>Tulane University</td>
<td>August 1991</td>
</tr>
</tbody>
</table>

4. OTHER RELATED EXPERIENCE

Director, State of Washington Water Research Center (December 2001 to July 2013)
Director, Center for Environmental, Sediment and Aquatic Research (May 2008 to May 2009)
Project Engineer, KKBNA Inc. (June 1983- July 1988)
Civil Engineer, US Cold Resions Research and Engineering Laboratory (CRREL) (Summer 1980 and 1981)

5. REGISTRATION

Professional Engineer, Colorado No. 24415

6. MEMBERSHIPS (in past 5 years)

American Society of Civil Engineers
American Geophysical Union

7. HONORS AND AWARDS (in past 5 years)

8. PROFESSIONAL SERVICE (in past 5 years)

9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)


10. PROFESSIONAL DEVELOPMENT (in the past 5 years)
Faculty Resume

Steven F. Bartlett
Ph.D., P.E.

2. EDUCATION

<table>
<thead>
<tr>
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<th>Field</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Brigham Young University</td>
<td>Civil Engineering</td>
<td>1992</td>
</tr>
<tr>
<td>B.S.</td>
<td>Brigham Young University</td>
<td>Geology</td>
<td>1983</td>
</tr>
</tbody>
</table>

3. YEARS of ACADEMIC SERVICE

<table>
<thead>
<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 – present</td>
<td>Associate Professor – full time</td>
<td>University of Utah</td>
</tr>
<tr>
<td>2000 – 2007</td>
<td>Assistant Professor – full time</td>
<td>University of Utah</td>
</tr>
</tbody>
</table>

4. OTHER RELATED EXPERIENCE

Research Project Manager, Utah Department of Transportation, 1998 – 2000
Woodward-Clyde Consultants, Salt Lake City, Utah, 1996 – 1998

5. REGISTRATION (in past 5 years)
Registered Professional Engineer, Utah, No. 176935-2202.

6. MEMBERSHIPS (in past 5 years)
American Society of Civil Engineers
Earthquake Engineering Research Institute

7. HONORS AND AWARDS (in past 5 years)
American Council of Engineering Companies, Utah, Engineering Excellence Grand Award, 2011
American Public Works Association, National Project of the Year, 2010, ASCE 2010 Local Outstanding Civil Engineering Achievement Awards - Geotechnical Category – Outstanding Award SR 519 / I-90 to Dean’s Recognition, placed among top instructors, College of Engineering, 2010, 2007
ACEC Arizona Grand Award, Rockfall Containment and Safety, SR 264 at 2nd Mesa, 2006
ASCE Outstanding Civil Engineering Achievement (OPAL) Award, 2002 Wasatch Constructors I-15

8. PROFESSIONAL SERVICE (in past 5 years)
Organizing Committee EPS 2017, Istanbul Turkey, 2014-2017
Member, Next Generation Liquefaction Triggering Database, PEER, 2014
Participating Member, National Research Council of the National Academies, Liquefaction, 2014.
Director, Earthquake Engineering Research Institute, Utah Chapter, 2012-2013.
Committee on Pre and Post-Disaster Mitigation, ASCE Council on Disaster Reduction and Management, 2009 to 2011 (chair).
Led ASCE CDRM Reconnaissance Team Investigation of L’Aquila, Italy Earthquake, 2009.
Earthquake Engineering Research Institute/Western States Seismic Policy Committee Annual Meeting Planning Committee, 2009 (member).
Advanced National Seismic System, Intermountain West Regional Advisory Council (alternate)
Steering Committee, EPS 2011 (member).

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)

- Speaker at EPS 2011 in Oslo, Norway.
- Sabbatical Fall Semester 2013 with Norwegian Public Roads Administration, Oslo Norway.
- Keynote address, Conference on Geosynthetic Uses and Applications, Bogazici University, Istanbul Turkey, May 29th, 2014.
- Participation in the NRC liquefaction workshop, Tempe, Arizona, 2014.
- Keynote Address, 1st Geofoam Conference in Latin America, Mexico City, Mexico, February, 24th 2015.
Faculty Resume

Amanda Bordelon
Assistant Professor

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>University of Illinois, Urbana-Champaign</td>
<td>Transportation</td>
<td>2011</td>
</tr>
<tr>
<td>M.S.</td>
<td>University of Illinois, Urbana-Champaign</td>
<td>Transportation Facilities</td>
<td>2007</td>
</tr>
<tr>
<td>B.S.</td>
<td>University of Illinois, Urbana-Champaign</td>
<td>Transportation Facilities &amp; Construction Materials</td>
<td>2005</td>
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</table>

3. YEARS of ACADEMIC SERVICE

<table>
<thead>
<tr>
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<th>Institution</th>
<th>Original Appointment</th>
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</thead>
<tbody>
<tr>
<td>2011 – present</td>
<td>Assistant Professor (1)</td>
<td>University of Utah</td>
<td>August 16, 2011</td>
</tr>
</tbody>
</table>

4. OTHER RELATED EXPERIENCE

Technische Universitaet, Intern (Summer 2003)
Webster, McGarth & Ahlberg, Surveyor and Drafter (Summer 2002, Winter 2003)

5. REGISTRATION

Professional Engineer, Utah

6. MEMBERSHIPS (in past 5 years)

American Concrete Institute (ACI) International and Intermountain Chapter
International Society for Concrete Pavements (ISCP)
Transportation Research Board (TRB) Affiliate Member
Chi Epsilon

7. HONORS AND AWARDS (in past 5 years)

Bengt Friberg Award for Best Paper by a Younger Author. International Society for Concrete Pavements (July 2012)

8. PROFESSIONAL SERVICE (in past 5 years)

Member for Transportation Research Board
  Subcommittee AF000 Design and Construction Group's Young Members (Spring 2011 – Present)
  Committee AFD70 Pavement Rehabilitation (Spring 2008 – Spring 2017)
  Committee AFN10 Basic Research and Emerging Technologies Related to Concrete (Spring 2008 – Spring 2017)

Voting Member for American Concrete Institute
  Committee 240 Natural Pozzolans (Spring 2015 – Present)
  Committee 446 Fracture Mechanics (Fall 2013 – Present)
  Committee 544 Fiber-Reinforced Concrete (Spring 2014 – Present)

Associate Member for American Concrete Institute
  Committee 224 Cracking (Fall 2010 – Present)
  Committee 232.0A Natural and Processed Pozzolans (Spring 2014 – Spring 2015)
  Committee 446 Fracture Mechanics (Fall 2008 – Fall 2013)
  Committee 544 Fiber Reinforced Concrete (Fall 2008 – Fall 2013)

Editor-in-Chief of e-Newsletter for International Society for Concrete Pavements (Spring 2008 – Summer 2011)
9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)

Kim, Min Ook, Amanda Bordelon. “Determination of Total Fracture Energy for Fiber-Reinforced Concrete”, American Concrete Institute Special Publication-300CD (CD-ROM) Fracture Mechanics Applications in Concrete, Eds. C. Gaedicke and A. Bordelon, ACI Committee 446, Farmington Hills, MI, 2015.


Bordelon, Amanda, Chris Pantelides, Min Ook Kim, and Uma Ramasa my. Impact Loading and Shear Brittle Failure Analysis of Galvanized Steel Light Pole, Interim Reports #1-4, Research Report for the Utah Department of Transportation, Department of Civil and Environmental Engineering, University of Utah, May-August 2013.


Bordelon, Amanda, and Jeffery Roesler. “Distribution of Fiber-Reinforcement in Thin Concrete Overlays,” Proceedings from the 10th International Conference on Concrete Pavements, International Society for Concrete Pavements, Quebec City, Quebec, July 2012, pp 545-564.


10. PROFESSIONAL DEVELOPMENT (in the past 5 years)

Conference Involvement
Host Annual Concrete Spring Symposium in Salt Lake City, UT (March 2012 – March 2015)

Research Development
NIST Concrete Modeling Workshop (June 2014)
NSF CAREER Workshop (April 2014)
Research Administration Training Series: Proposal Course (October 2011), Cayuse Course (December 2011), and Pre-Award Workshop (February 2012)
Grant Writing Crash Course: Faculty Partnering with Faculty to Develop Successful Proposals (October 2012)

Teaching Development
Felder Teaching Workshop (February 2012 and October 2013)
Center for Teaching & Learning Excellence Annual Teaching Workshop (August 2013)
ASCE Structural Condition Assessment and Evaluation Course (April 2013)
ASCE ExCEEd Participant and Graduate (July 2012)

Management and Growth
Do Babies Matter? Women’s Week Presentation and Workshop (February 2014)
Women in Science faculty luncheons (March 2012 – Present)
Safe Zone LGBT Community (March 2013)
Teaching and Advising International Students (January 2013)
Taking Care of Yourself (November 2012)
How to Run a Meeting (October 2012)
Faculty Resume

Steven J. Burian
Ph.D., P.E.

2. EDUCATION

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<tr>
<td>Ph.D.</td>
<td>The University of Alabama</td>
<td>Civil Engineering</td>
<td>1999</td>
</tr>
<tr>
<td>M.S.E.</td>
<td>The University of Alabama</td>
<td>Environmental Engineering</td>
<td>1995</td>
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<tr>
<td>B.S.</td>
<td>University of Notre Dame</td>
<td>Civil Engineering</td>
<td>1993</td>
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3. YEARS of ACADEMIC SERVICE

<table>
<thead>
<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
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<tbody>
<tr>
<td>2009 – present</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<tr>
<td>2003 – 2009</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
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<tr>
<td>2000 – 2003</td>
<td>Assistant Professor</td>
<td>University of Arkansas</td>
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</table>

4. OTHER RELATED EXPERIENCE

- Associate Director, Global Change and Sustainability Center, University of Utah, SLC, UT
  - http://environment.utah.edu/ (4/12-present)
- Co-director, Sustainability Curriculum Development, University of Utah, SLC, UT (1/11-present)
- NASA/ASEE Faculty Fellow, Mesoscale Atmospheric Processes Branch, NASA Goddard Space Flight Center, Greenbelt, MD (4/02-8/02)
- Visiting Faculty, Energy and Environmental Analysis Group, Los Alamos National Laboratory, Los Alamos, NM (6/01 – 8/01)
- Visiting Scientist, Energy and Environmental Analysis Group, Los Alamos National Laboratory, Los Alamos, NM (5/00 – 8/00)

5. REGISTRATION (in past 5 years)

6. MEMBERSHIPS (in past 5 years)

- American Geophysical Union (AGU)
- American Meteorological Society (AMS)
- American Society of Civil Engineers (ASCE)
- American Society for Engineering Education (ASEE)
- American Water Resources Association (AWRA)
- American Water Works Association (AWWA)
- Chi Epsilon (National Civil Engineering Honor Society)
- International Association for Urban Climate (IAUC)
- International Association of Hydrological Sciences (IAHS)
- Water Environment Federation (WEF)

7. HONORS AND AWARDS (in past 5 years)

- 2013 Kingfisher Bend Ranch Excellence in Teaching Award, University of Utah College of Engineering
- 2013 Outstanding Paper Award
- 2012 University of Utah Center for Teaching and Learning Faculty Fellow
- 2012 American Water Resources Association Utah Section, Outstanding Service in the Academic Sector
- 2012 Chi Epsilon Excellence in Teaching Award for the Rocky Mountain District
- 2011 Glen L. Martin Best Paper Award for the Civil Engineering Division of American Society for Engineering Education (ASEE)
- 2010 Department of Civil and Environmental Engineering Outstanding Researcher
- 2009 American Society of Civil Engineers Utah Engineering Educator of the Year
8. PROFESSIONAL SERVICE (in past 5 years)

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)

10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
   Mentor, ASCE ExCEEd Teaching Workshop, 23-29 June 2012, Ft. Myers, FL.
   Mentor, ASCE ExCEEd Teaching Workshop, 10-15 July 2011, Tyler, TX.
   Mentor, ASCE ExCEEd Teaching Workshop, 16-23 July 2010, Boulder, CO.
   Asst. Mentor, ASCE ExCEED Teaching Workshop, 12-17 July 2009, Flagstaff, AZ
   Sustainability Policy Implementation, 3-day module at the United Nations Summer School on Sustainability Transition Policies and Practices, Yonsei University International Campus, Incheon, Republic of Korea, August 2013.
Faculty Resume

Janice J. Chambers

2. EDUCATION

<table>
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<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>University of Colorado</td>
<td>Civil Engineering</td>
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<tr>
<td>M.S.</td>
<td>University of Colorado</td>
<td>Civil Engineering</td>
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<tr>
<td>B.S.</td>
<td>University of Missouri</td>
<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

<table>
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<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
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<td>1996 – present</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<td>1989 – 1996</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
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<td>2001 – 2002</td>
<td>Visiting Professor</td>
<td>Tokyo Institute of Technology, Japan</td>
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<tr>
<td>1984 – 1989</td>
<td>Research Assistant</td>
<td>University of Colorado</td>
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4. OTHER RELATED EXPERIENCE

- Associate Structural Engineer, Flour Daniel, Inc., Irvine, California, 1980 – 1984

5. REGISTRATION (in past 5 years)

Registered Professional Civil Engineer, PE, in the states of California and Utah.
Registered Structural Engineer, SE, in the state of Utah.

6. MEMBERSHIPS (in past 5 years)

- American Society of Civil Engineers
- American Welding Society
- American Institute of Steel Construction
- Structural Engineers Institute
- Chi Epsilon Civil Engineering Honor Society

7. HONORS AND AWARDS (in past 5 years)

8. PROFESSIONAL SERVICE (in past 5 years)

- Member of the National Council - Rocky Mountain District Councillor of the Chi Epsilon Civil Engineering Honor Society (Spring 2010 - current)
- Organized and hosted the 2014 Chi Epsilon Civil Engineering Honor Society's Biennial Conclave

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)

Consulting: Arcmatic® Welding Solutions, Vallejo, CA, patent review and revision, general consulting - on going.
Faculty Resume

Otakuye Conroy-Ben
Ph.D.

2. EDUCATION

<table>
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<tr>
<td>Ph.D.</td>
<td>University of Arizona</td>
<td>Environmental Engineering</td>
<td>2006</td>
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<tr>
<td>M.S.</td>
<td>University of Arizona</td>
<td>Environmental Engineering</td>
<td>2004</td>
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<td>M.A.</td>
<td>University of Arizona</td>
<td>Analytical Chemistry</td>
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<td>B.S.</td>
<td>University of Notre Dame</td>
<td>Chemistry</td>
<td>1998</td>
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3. YEARS of ACADEMIC SERVICE

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<td>University of Utah</td>
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<td>2011 – 2012</td>
<td>Writing Instructor</td>
<td>University of Montana</td>
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<tr>
<td>2008 – 2009</td>
<td>Adjunct Faculty – Mathematics</td>
<td>Pima Community College, Tucson, AZ</td>
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4. OTHER RELATED EXPERIENCE

- Post-doctoral Research Associate (co-appointment) 09/07 – 06/09
  - Department of Soil, Water, & Environmental Sciences
  - Chemistry and Biochemistry, University of Arizona, Tucson, AZ
- Project Engineer 09/06 – 08/07
  - Los Angeles County Sanitation Districts, JWPCP Wastewater Research Section, Carson, CA
- Graduate Research Assistant 08/00 – 8/06
  - Department of Chemical & Environmental Engineering, University of Arizona, Tucson, AZ
- Research Technician 06/05 – 07/05
  - U.S. Geological Survey National Water Quality Laboratory, Denver, CO
- Professional Research Assistant 01/99 – 07/00
  - Department of Pharmacology, University of Colorado Health Sciences Center, Denver, CO
- Science Teacher 07/98 – 08/98
  - Arizona State University – East American Indian Programs, Mesa, AZ
- Professional Research Assistant 06/98 – 07/98
  - South Dakota School of Mines & Technology SKILL Program, Rapid City, SD

5. REGISTRATION (in past 5 years)

- Engineering in Training (EIT), CA
- Professional Engineer, UT (application submitted)

6. MEMBERSHIPS (in past 5 years)

- American Indian Science and Engineering Society (AISES), Board of Directors
- Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)
- Society of Environmental Toxicology and Chemistry (SETAC)
- American Society of Civil Engineers (ASCE)
- Water Environment Foundation

7. HONORS AND AWARDS (in past 5 years)

8. PROFESSIONAL SERVICE (in past 5 years)

- Sustainability certificate committee, University of Utah, 2013 – present
- Advisor, American Indian Science and Engineering Society University of Utah Chapter, 2012 – present
- Undergraduate Studies Committee, University of Utah, 2011-2013
- Search Committee, Nuclear Engineering Faculty Search, University of Utah, 2009-2010
- Scholarship Committee, Civil & Environmental Engineering, University of Utah, 2010-2011, 2013 – present
- Institutional Biosafety Committee, University of Utah, 2012-2013
Faculty awards committee, Civil & Environmental Engineering, University of Utah, 2014 – present
PE Environmental Engineering instructor, ASCE Utah Young Member Forum, 10/2014, 03/2015
Chair, Education & Professional Development Committee, American Indian Science and Engineering Society, 2011
Advisory Board – Indigenous Women in Science, 2010 - present
Board of Directors, Secretary, American Indian Science and Engineering Society, 2009-2012
Recruitment Director & Vice-Chair, Native American Alumni of Notre Dame, 2007-2011
Intern, National Congress of American Indians, 2009
Interstate Technology and Regulatory Council, Metal Bioreactor Team, 2011

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)

COACHing Strong Women in the Art of Strategic Persuasion, American Chemical Society, Denver, CO 03/15.
ExCExEd Teaching Workshop, American Society of Civil Engineers, University of Colorado, 07/10.
Student to Academic Professoriate for American Indians Faculty Prep Program, National Science Foundation, University of Montana/Salish Kootenai Tribal College, 08/09.
Faculty Resume

Daniel J. Fagnant
Assistant Professor

2. EDUCATION

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<th>Institution</th>
<th>Field</th>
<th>Date</th>
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<tr>
<td>Ph.D.</td>
<td>University of Texas</td>
<td>Civil Engineering</td>
<td>2014</td>
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<tr>
<td>M.S.</td>
<td>University of Texas</td>
<td>Civil Engineering</td>
<td>2011</td>
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<tr>
<td>B.S.</td>
<td>Gonzaga University</td>
<td>Computer Engineering</td>
<td>2002</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
<th>Original Appointment</th>
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<tr>
<td>2014 – present</td>
<td>Assistant Professor (1)</td>
<td>University of Utah</td>
<td>August 16, 2014</td>
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4. OTHER RELATED EXPERIENCE

Alaska Department of Transportation and Public Facilities
- 2004 – 2009  Engineering Assistant  January 2004

Boreal Controls
- 2003 – 2004  Engineer  June 2009

5. REGISTRATION

6. MEMBERSHIPS (in past 5 years)

Transportation Research Board
- Vehicle Highway Automation Committee (AHB30), 2013 – Present.
- Motorcycle and Moped Committee (ANF30), 2012 – Present.
- Safety and System Users Group, Young Member Council, 2012 – Present

Intelligent Transportation Society of America

7. HONORS AND AWARDS (in past 5 years)

Urban Land Institute, Keynote speaker, October 2014

Dr. William J. Harris Award to the Outstanding Doctoral Students, Southwest University Transportation Center, 2013

University of Texas Engineering Foundation Endowed Graduate Presidential Scholarship, 2013

Dwight D. Eisenhower Transportation Fellowship, 2012- 2013 and 2013-2014

Eno Center for Transportation Leadership Fellow, 2012

Outstanding Institute of Transportation Engineers Member of the Year, University of Texas Student Chapter, 2011

Thurst 2000 Cockrell School of Engineering Fellowship, 2009- 2013

Advanced Institute for Transportation Infrastructure and Management Fellowship, 2009- 2014

Texas Intelligent Transportation Society Scholarship, 2010

8. PROFESSIONAL SERVICE (in past 5 years)

Institute of Transpiration Engineers, Student Chapter Faculty Advisor (2014 – present)

Automated Vehicles Symposium, Lead Transit & Shared Mobility breakout session organizer (2015)

Automated Vehicles Symposium, Transit & Shared Mobility breakout session organizer (2014)

9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)

Fagnant, D.J. and Kockelman, K.M. “A Direct-Demand Model for Bicycle Counts: The Impacts of Level of Service & Other Factors.” Accepted for publication in Environment and Planning B.
Fagnant, D.J., Kockelman, K.M. and Bansal, P. “Operations of a Shared Autonomous Vehicle Fleet for the Austin, Texas Market.” Accepted for publication in Transportation Research Record.
Fagnant, D.J. and Kockelman, K.M. “Dynamic Ride-Sharing and Optimal Fleet Sizing for a System of Shared Autonomous Vehicles.” Accepted for publication in Transportation.
Fagnant, D.J. and Kockelman, K.M. “Preparing a Nation for Autonomous Vehicles: Implications, Barriers and Policy Recommendations.” Accepted for publication in Transportation Research Part A.

10. PROFESSIONAL DEVELOPMENT (in the past 5 years)

National Science Foundation Grant Writing Workshop, November 2014.
Faculty Resume

Ramesh K. Goel
Ph.D.

2. EDUCATION

<table>
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<th>Institution</th>
<th>Field</th>
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<tr>
<td>Ph.D.</td>
<td>University of South Carolina</td>
<td>Environmental Engineering</td>
<td>2003</td>
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<td>M.S.</td>
<td>Jadavpur University</td>
<td>Civil Engineering</td>
<td>1996</td>
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<td>B.S.</td>
<td>Jadavpur University</td>
<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<tr>
<td>2011 – present</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<td>2006 – 20011</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
</tr>
<tr>
<td>7/2014-12/2014</td>
<td>Visiting Professor</td>
<td>ETH/EAWAG-Zurich</td>
</tr>
<tr>
<td>1/2014-5/2014</td>
<td>Visiting Professor</td>
<td>Nijmegen University</td>
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4. OTHER RELATED EXPERIENCE

5. REGISTRATION (in past 5 years)

6. MEMBERSHIPS (in past 5 years)
  - Member- AEESP
  - Member – American Society for Microbiology
  - Member-Water Environment Federation
  - Associate Member- American Society of Civil Engineers
  - Member-American Society for Engineering Education
  - August 2010-July 2013- Chair-Utah Wastewater certification program
  - August 2013-present- Associate Editor- Water Environment Research Journal
  - August 2014-till date- Elected chair-WEFTEC Research symposium committee.
  - 2009- till date- Director, Inter Mountain Junior Humanity and Science Symposium for k12 research dissemination

7. HONORS AND AWARDS (in past 5 years)
  - NSF-CAREER Award - 2010-2015
  - Outstanding Researcher award- Civil & Environmental Engineering Department, University of Utah- 2008-2009
  - Indo-US Professorship to India by American Society for Microbiology

8. PROFESSIONAL SERVICE (in past 5 years)
  - Associate Department Chair (2014 – Present)
  - Director of Undergraduate Advising (2012 – Present)
  - Member, University Parking Appeals Committee (2012 – Present)
  - Member, Department Undergraduate Curriculum Committee (2005 – 2007, 2010 - present)
  - Member Department Graduate Committee (2012 – Present)
  - Member, College of Engineering Council (2010 – 2013)
  - Member, Department Chair search Committee (2013)
  - Member, Department Scholarship Committee (2004 – 2006 and 2010-2012)
  - Faculty Advisor, American Society of Civil Engineers Student Chapter (2001 – 2012)
  - Faculty Advisor, Association of General Contractors Student Chapter (2004 – 2012)

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


Racz, L., Muller, J.G. and Goel R. (2012) Fate of selected estrogens in two laboratory scale sequencing batch reactors fed 3 with different organic carbon sources under varying solids retention times. Bioresource Technology. 110: 35-42


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)

Biological Nitrogen Removal- a training workshop at North Davis Sewer District, June 2009

Chemical Phosphorus removal- presented at the training workshop conducted by Water Association of Utah, St George, UT, April 2009 ASCE ExCEED Teaching Workshop, 11-17 July 2009, Flagstaff, AZ.

Nitrogen mass balance and filamentous bulking- a training workshop at North Davis Sewer District-planned for August 2010
Faculty Resume

P.K. Andy Hong
Ph.D., P.E., BCEE

2. EDUCATION

<table>
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<th>Field</th>
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<tr>
<td>Ph.D.</td>
<td>California Institute of Technology</td>
<td>Environmental Engineering Science</td>
<td>1988</td>
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<tr>
<td>M.S.</td>
<td>California Institute of Technology</td>
<td>Environmental Engineering Science</td>
<td>1982</td>
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<td>B.S.</td>
<td>California Institute of Technology</td>
<td>Chemistry</td>
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3. YEARS of ACADEMIC SERVICE

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<td>2006 – present</td>
<td>Professor</td>
<td>University of Utah</td>
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<td>2007 – 2008</td>
<td>Visiting Professor</td>
<td>National Taiwan University</td>
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<td>1995 – 2006</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<tr>
<td>1987 – 1995</td>
<td>Assistant Professor</td>
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4. OTHER RELATED EXPERIENCE

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<th>Institution</th>
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<tr>
<td>1994 – 1995</td>
<td>IPA Researcher</td>
<td>USACE WES, Vicksburg, MS</td>
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5. REGISTRATION (in past 5 years)

Licensed Professional Engineer, Utah Registration No. 2774501
Board Certified Environmental Engineer (Sustainability), AAEES

6. MEMBERSHIPS (in past 5 years)

American Society of Civil Engineers
American Chemical Society
Association for Environmental Health and Sciences

7. HONORS AND AWARDS (in past 5 years)

Top 15% Commendation in College of Engineering, Fall 2012

8. PROFESSIONAL SERVICE (in past 5 years)

Editor, Sustainable Environment Research, 2011 – present
Editorial Board, soil & Sediment Contamination – An Internal Journal, 2002 – present
Editorial Board, Advances in Environmental Research, 2012 – present
Reviewer on NIH and EPA panels
Board of Director, CAPEE
Consulting and technical support to engineering firms (US, China, Taiwan)

9. PUBLICATIONS/ENGINEERING REPORTS (42 journal papers last 5 years; selected topics below)

C.-C. Lin, P.K.A. Hong. “A new processing scheme from algae suspension to collected lipid using sand filtration

Five patents issued last 5 years.

10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
   Personal study of sustainability issues in engineering
Faculty Resume

Luis Ibarra
Assistant Professor

2. EDUCATION

<table>
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<th>Degree</th>
<th>Institution</th>
<th>Field</th>
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<tr>
<td>Ph.D.</td>
<td>Stanford University</td>
<td>Civil &amp; Environmental Eng</td>
<td>2004</td>
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<tr>
<td>M.S.</td>
<td>National Autonomous</td>
<td>Structural Engineering</td>
<td>1999</td>
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<td>University of Mexico</td>
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<td>B.S.</td>
<td>University of Sonora</td>
<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<tr>
<td>2010 – present</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
<td>August 16, 2010</td>
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<td>1993 – 1996</td>
<td>Adjunct Professor</td>
<td>University of Sonora</td>
<td>Spring 1993</td>
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4. OTHER RELATED EXPERIENCE

Consultant, Salt Lake City, Utah; June 2011-Present.
Senior Research Engineer, Center for Nuclear Waste Regulatory Analyses (CNWRA) in Southwest Research Institute (SwRI), San Antonio, TX, January 2004 – July 2010.
Consultant, Mexico City, Mexico; September 1996 – February 1998.
Structural Design Engineer, Grupo Puebla, Mexico; March 1993 – July 1996.
Structural Engineer, IMPSA, Mexico; August 1992 – February 1993.

5. REGISTRATION
Professional Engineer, Texas No. 102132

6. MEMBERSHIPS (in past 5 years)
Member of the Earthquake Engineering Research Institute (EERI) and EERI Utah Chapter
Member of the American Society of Civil Engineers (ASCE)
Member of American Concrete Institute (ACI). Voting member of ACI 374, and associate member of ACI-349
Member of the American Institute of Steel Construction (AISC)
Member of the American Society for Engineering Education (ASEE)

7. HONORS AND AWARDS (in past 5 years)
Outstanding Teacher of the Year. CvEEN Department at the University of Utah (2013)
AISC Milek Fellowship (2013)
Outstanding Teacher of the Year. CvEEN Department at the University of Utah (2014)
College of Engineering Top 15% in teaching evaluations at undergraduate and/or graduate level (2012-2014)

8. PROFESSIONAL SERVICE (in past 5 years)
NSF Network for Earthquake Engineering Simulation (NEES) Reviewer Panelist.
Reviewer of NEUP pre-proposals and proposals from 2011 to 2015.
Reviewer of SBIR/STTR DOE proposals
9. SELECTED PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)


10. PROFESSIONAL DEVELOPMENT (in the past 5 years)

Irradiation Experimenter's Course (November 2010) Las Vegas, NV.

University of Utah Annual Teaching Symposium (August 2011). Salt Lake City, UT.

Effective Teaching Workshop (February 6-7, 2012) by Professor Richard M. Felder. Salt Lake City, UT.


SAP Course on Emergency Disasters (2012). Salt Lake City, UT.


SMiRT Conference (August 2013) San Francisco, CA.

Effective Teaching Workshop (October 14-15, 2013) by Professor Richard M. Felder. Salt Lake City, UT.

Career NSF Workshop (March 2012), Reno, NV.

BISON Workshop (June 2014) Idaho National Laboratory. Idaho Falls.

Tenth National Conference on Earthquake Engineering, Anchorage, AK. July 2014

MOOSE Workshop (January 2015) Idaho National Laboratory. Salt Lake City, UT.

ACI Conventions. Six conventions from April 2011 to March 2014.

NASCC Conferences. Three conferences from April 2013 to April 2015.
Faculty Resume
Tatjana Jevremovic
Ph.D.

2. EDUCATION

<table>
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<tr>
<td>Ph.D.</td>
<td>The University of Tokyo, Japan</td>
<td>Nuclear Engineering</td>
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<td>M.S.</td>
<td>The University of Belgrade, Serbia</td>
<td>Nuclear Engineering</td>
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<td>B.S.</td>
<td>The University of Belgrade, Serbia</td>
<td>Nuclear Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<td>Endowed Chair Professor/Director Nuclear Engineering</td>
<td>University of Utah</td>
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<td>2006 – 2009</td>
<td>Associate Professor of Nuclear Engineering</td>
<td>Perdue University</td>
</tr>
<tr>
<td>2006 – 2009</td>
<td>Associate Professor of Health Sciences</td>
<td>Perdue University</td>
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<tr>
<td>2006 – 2009</td>
<td>Adjunct Faculty Environmental &amp; Ecological Engineering</td>
<td>Perdue University</td>
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<td>2001 – 2006</td>
<td>Assistant Professor of Nuclear Engineering</td>
<td>Perdue University</td>
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<tr>
<td>2004 – 2006</td>
<td>Assistant Professor of Health Sciences</td>
<td>Perdue University</td>
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<tr>
<td>1993 – 1996</td>
<td>Lecturer Quantum Engineering and Systems Sciences</td>
<td>University of Tokyo, Japan</td>
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4. OTHER RELATED EXPERIENCE
1998 – 1999 *Visiting Researcher*, The University of California at Berkeley (UCB); Collaboration between the UCB and NFI Ltd.
1983 – 1993 *Project Manager, Design Engineer*, Energoprojekt Holding Co., Belgrade, Serbia

5. REGISTRATION (in past 5 years)
None at the moment.

6. MEMBERSHIPS (in past 5 years)
Member, American Nuclear Society (ANS)
Member, Japanese Atomic Energy Society (AESJ)
Member, Women in Nuclear Engineering (WIN)
Member, American Association for Engineering Education, (AAEE)
Member, Society for Nuclear Medicine, (SNM)
Member, American Indian Science and Engineering Society (AISES)

7. HONORS AND AWARDS (in past 5 years)
2009 *Who is Who in America*, 2009

8. PROFESSIONAL SERVICE (in past 5 years)
2005 – 2009 Member, Purdue ENGR2020 Committee, Undergraduate Curriculum Review for the 21st Century
2006 – 2009 Member, Purdue Global Engineering Program Team
2008 – present Expert participant to IAEA Workshops, Meetings and Reports
2009 – Chair Search Committee
2012 – present Member Search Committees in Department of Chemical Engineering
2013 – present Reviewer for Qatar National Research Fund
2014 – present RPT Chair, Department of Civil and Environmental Engineering
2014 – present COE Faculty Counsel
2014 – present University Women in Engineering Counsel

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)
Yang, X. & Jevremovic, T. Revisiting the Rosenbrock Numerical Solutions of The Reactor Point Kinetics

10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)

Active: in developing novel approaches for numerical modeling of nuclear reactor physics parameters and reactor designs (molten salt and small modular systems); developing new cancer treatment modalities based on nuclear medicine principles; in developing new concrete mixes for applications in nuclear industry (low activation shielding materials with higher strength); in developing numerical models for radiation transport in open environments; developing design for cube-sat with neutron activation analysis system; developing numerical models to assess radiation exposures during man-missions to moon.

Established in the Nuclear Engineering Program and the facility: the safety culture training and educational paradigm under the corrective action program based on DevonWay intelligent system.

Regular attendance/participation in professional conferences: paper author; reviewer; session chair; invited speaker.
Faculty Resume

Evert C. Lawton
Ph.D., P.E., Professor

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Washington State University</td>
<td>Civil Engineering: Geotechnical</td>
<td>1986</td>
</tr>
<tr>
<td>M.S.</td>
<td>San Diego State University</td>
<td>Civil Engineering: Geotechnical</td>
<td>1983</td>
</tr>
<tr>
<td>M.E.</td>
<td>University of Virginia</td>
<td>Civil Engineering: Structural</td>
<td>1980</td>
</tr>
<tr>
<td>B.S.</td>
<td>University of Virginia</td>
<td>Civil Engineering: Structural</td>
<td>1977</td>
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3. YEARS of ACADEMIC SERVICE

<table>
<thead>
<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
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<tbody>
<tr>
<td>2002 – present</td>
<td>Professor</td>
<td>University of Utah</td>
</tr>
<tr>
<td>2012 – present</td>
<td>Associate Chair</td>
<td>University of Utah</td>
</tr>
<tr>
<td>1994-2002</td>
<td>Associate Chair</td>
<td>University of Utah</td>
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<tr>
<td>1994-2002</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<tr>
<td>1991-1994</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
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<tr>
<td>1987-1991</td>
<td>Assistant Professor</td>
<td>University of Miami</td>
</tr>
<tr>
<td>1984-1986</td>
<td>Teaching &amp; Research Assistant</td>
<td>Washington State University</td>
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4. OTHER RELATED EXPERIENCE

Construction Manager, Schnabel Foundation Co., Dallas, Texas, Summer 1985
Geotechnical Engineer Bridge Division, Virginia Department of Highways and Transportation, Richmond, Virginia, 1982 – 1984
Structural Engineer, Bridge Division, Virginia Department of Highways and Transportation, Richmond, Virginia, 1977 – 1981

5. REGISTRATION (in past 5 years)
California Professional Engineer License No. C039328
Florida Professional Engineer License No. 37850 (currently inactive)
Utah Professional Structural Engineer License No. 190745-2203
Virginia Professional Engineer License No. 13774 (currently inactive)
Washington Professional Engineer License No. 22069

6. MEMBERSHIPS (in past 5 years)
American Society of Civil Engineers, Member
International Society for Soil Mechanics and Geotechnical Engineering, Member

7. HONORS AND AWARDS (in past 5 years)
University Distinguished Teaching Award, University of Utah, 2012

8. PROFESSIONAL SERVICE (in past 5 years)

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Faculty Resume

Joshua B. Lenart
Associate Instructor

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
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<th>Field</th>
<th>Date</th>
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<tr>
<td>Ph.D.</td>
<td>University of Utah</td>
<td>English—Rhetoric &amp; Writing Studies</td>
<td>2013</td>
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<tr>
<td>M.A.</td>
<td>Montana State University</td>
<td>English—Composition &amp; Rhetoric</td>
<td>2005</td>
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<tr>
<td>B.A.</td>
<td>The Ohio State University</td>
<td>English—Minority Literatures</td>
<td>2001</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Dates</th>
<th>Rank (FTE)</th>
<th>Institution</th>
<th>Original Appointment</th>
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<tr>
<td>2014 – present</td>
<td>Associate Instructor</td>
<td>University of Utah</td>
<td>August 2014</td>
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<tr>
<td>2007 – 2013</td>
<td>Teaching Assistant</td>
<td>University of Utah</td>
<td>July 2007</td>
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<tr>
<td>2003 – 2005</td>
<td>Teaching Assistant</td>
<td>Montana State University</td>
<td>August 2003</td>
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4. OTHER RELATED EXPERIENCE

Owner/Operator, JBL Custom, LLC., Salt Lake City, UT, 2013-Present, part-time.

5. REGISTRATION (in past 5 years)

N/A

6. CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS (in past 5 years)

Center for Infrastructure Transformation and Education (CIT-E)
College Composition and Communication
National Council of Teachers of English
Rhetoric Society of America
Theodore Roosevelt Conservation Partnership

7. HONORS AND AWARDS (in past 5 years)

Received Chair’s Award for Best Information Design. Research presentation titled: Ecocritical Discourse Analysis: Where Rhetoric, Writing, & the Environment Meet, Conference on College Composition and Communication: 2015.
Co-founding member of the J. Willard Marriott Sustainability Working Group with grant monies received from the Chevron Corporation: 2012.
Research/Travel Grant awarded from University of Utah CLEAR Program. Traveled to the University of Miskolc (Miskolci Egyetem) to meet with Vice Dean of the Faculty of Materials Science and Engineering, to consult on establishing a Technical Communications Program: 2010.

8. PROFESSIONAL SERVICE (in past 5 years)

Stage 1 Proposal Reviewer, 67th Conference on College Composition and Communication, May 2015.
Candidate Interviewer, Real Food Rising Program: Utahans Against Hunger, April 2015 (continuous).


CLEAR Program Faculty Orientation, 2011-2012 (organizer/presenter)


Lenart, Joshua. *Rethinking the Corporate-Liberal Arts Complex in Professional Writing Instruction*. Conference on College Composition and Communication: Louisville, KY, April 2010. (presenter)

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (representative sample selected from past year)


Center for Teaching and Learning Excellence (CTLE) Mid-semester Teaching Performance Review and In-class Observation. Salt Lake City, UT: October 2014.
Faculty Resume

Azaree Lintereur
Assistant Professor

2. EDUCATION

<table>
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<th>Degree</th>
<th>Institution</th>
<th>Field</th>
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<tr>
<td>Ph.D.</td>
<td>University of Florida</td>
<td>Biomedical Engineering, Nuclear</td>
<td>2013</td>
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<tr>
<td>M.S.</td>
<td>University of Florida</td>
<td>Nuclear Engineering</td>
<td>2008</td>
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<tr>
<td>B.S.</td>
<td>U. of Wisconsin, Stevens Point</td>
<td>Physics</td>
<td>2006</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Institution</th>
<th>Original Appointment</th>
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<tr>
<td>2014 – present</td>
<td>Assistant Professor (1)</td>
<td>University of Utah</td>
<td>August 16, 2014</td>
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<tr>
<td>2008 – 2011</td>
<td>Graduate Research Fellow</td>
<td>University of Florida</td>
<td>August 16, 2006</td>
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4. OTHER RELATED EXPERIENCE

Pacific Northwest National Laboratory
- 1/2014 – 7/2014    Postdoctoral Research Associate
- 5/2011 – 12/2013   Post Maters Research Associate

5. REGISTRATION

6. MEMBERSHIPS (in past 5 years)

Institute of Electrical and Electronics Engineers
Institute of Nuclear Materials Management

7. HONORS AND AWARDS (in past 5 years)

National Science Foundation Graduate Research Fellowship, Aug. 2007 – August 2010

8. PROFESSIONAL SERVICE (in past 5 years)

IEEE Nuclear Science Symposium, Session Chair (2014)
INMM Student Chapter Faculty Advisor

9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)


10. PROFESSIONAL DEVELOPMENT (in the past 5 years)
Faculty Resume

Xiaoyue Cathy Liu
Assistant Professor

2. EDUCATION

<table>
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<tr>
<td>Ph.D.</td>
<td>University of Washington</td>
<td>Transportation Engineering</td>
<td>2013</td>
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<tr>
<td>M.S.</td>
<td>Texas Southern University</td>
<td>Transportation Planning &amp; Mgt.</td>
<td>2009</td>
</tr>
<tr>
<td>B.S.</td>
<td>Beijing Jiaotong University</td>
<td>Electronics and Electrical Eng.</td>
<td>2006</td>
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3. YEARS of ACADEMIC SERVICE

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<tbody>
<tr>
<td>2013 – present</td>
<td>Assistant Professor (1)</td>
<td>University of Utah</td>
<td>July 1, 2013</td>
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<tr>
<td>2011 – 2012</td>
<td>Guest Lecturer/ Instructor</td>
<td>University of Washington</td>
<td>August 2011</td>
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4. OTHER RELATED EXPERIENCE

Smart Transportation Applications and Research (STAR) Laboratory, University of Washington
- 2013 Research Associate June 2013
- 2009- 2013 Graduate Research Assistant April 2009


5. REGISTRATION (in past 5 years)

6. MEMBERSHIPS (in past 5 years)

- Transportation Research Board
- Institute of Transportation Engineers
- American Society of Civil Engineers

7. HONORS AND AWARDS (in past 5 years)

- 2nd Best Paper Award for the 54th Annual Transportation Research Forum Student Paper Contest, TRF, 2013
- WTS Puget Sound Chapter Helen M. Overly Memorial Graduate Scholarship, 2013
- ITE Daniel B Fambro Student Paper Award, 2012
- ITE Western District Outstanding Graduate Student Award, 2012
- Washington ITE Outstanding Graduate Student Scholarship, 2012
- Western ITE Best Student Paper Award, 2012
- Boeing Academic Achievement Awards, Spring, 2011

8. PROFESSIONAL SERVICE (in past 5 years)

- Associate Editor, IEEE ITS Conference (2015)
- NSF Graduate Research Fellowship Program, Panel (2014)
- ITS America University Partner Workshop, Invited Panel (2014)
- Area Editor, 14th COTA International Conference of Transportation Professionals, 2014
- ITE University of Utah Student Chapter, Faculty Advisor (2013- present)
- Highway Capacity Quality of Service (HCQS) Committee, Transportation Research Board, Member (2013-2014)
- Salt Lake City Transportation Advisory Board, Member (2013- present)
- TRB Committee on Managed Lanes (AHB35), Member (2010- present)
- Organizing Committee, Pacific Northwest Transportation Consortium Launching Summit (2012)
- Organizing Committee Chair, Student Affair and Media Outreach, IEEE Intelligent Vehicle (2010)
- Editorial Board for the International Conference of Chinese Transportation Professionals (ICCTP) (2009)

9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the past 5 years)
Faculty Resume

Luther W. McDonald, IV
Assistant Professor

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>Washington State University</td>
<td>Radiochemistry</td>
<td>2013</td>
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<tr>
<td>B.S.</td>
<td>University of West Florida</td>
<td>Chemistry</td>
<td>2009</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Institution</th>
<th>Original Appointment</th>
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<tr>
<td>2014 – present</td>
<td>Assistant Professor (1)</td>
<td>University of Utah</td>
<td>January 1, 2014</td>
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<tr>
<td>2013</td>
<td>Adjunct Professor</td>
<td>Washington State University (Tri-Cities)</td>
<td>January 2013</td>
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4. OTHER RELATED EXPERIENCE

- Pacific Northwest National Laboratory
  - 2013 Postdoctoral Fellow May 2013
  - 2010 Graduate Research Assistant January 2010
- Commissariat à l’énergie atomique (CEA), May 2012- August 2012
- Pacific Northwest National Laboratory, SULI Intern, January 2009- August 2009

5. REGISTRATION

6. MEMBERSHIPS (in past 5 years)
- American Chemical Society
- American Nuclear Society
- Institute of Nuclear Material Management
- Society of Petroleum Engineers

7. HONORS AND AWARDS (in past 5 years)
- Outstanding Teaching Award (Top 15% for College of Engineering) Spring 2014
- National Technical Nuclear Forensics Center Postdoctoral Fellow 2013
- Distinguished WSU/PNNL Graduate Fellow of Radiochemistry 2010 - 2013
- Awarded ACTINET-i3 Proposal 2012
- ACS Division of Inorganic Chemistry Undergraduate Award in Inorganic Chemistry 2009
- Chemistry Department award, SEASTAR poster symposium, UWF 2009

8. PROFESSIONAL SERVICE (in past 5 years)
- American Chemical Society, Division of Nuclear Science and Technology, Secretary (2014 - present)

9. PUBLICATIONS/ENGINEERING REPORTS (in past 5 years)


**10. PROFESSIONAL DEVELOPMENT (in the past 5 years)**

Oak Ridge National Laboratory, NGSI: Nuclear Forensics for Nonproliferation Workshop, 2014

Pacific North West National Laboratory, Intensive Introduction to International Safeguards, 2011
Faculty Resume

Brian J.O.L. McPherson
Ph.D.

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Field</th>
<th>Date</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>University of Utah</td>
<td>Geophysics</td>
<td>1996</td>
</tr>
<tr>
<td>M.S.</td>
<td>University of Utah</td>
<td>Geophysics</td>
<td>1992</td>
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<tr>
<td>B.S.</td>
<td>University of Oklahoma</td>
<td>Geophysics</td>
<td>1989</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Institution</th>
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<tr>
<td>2013 – present</td>
<td>Professor</td>
<td>University of Utah</td>
</tr>
<tr>
<td>2006 – 2013</td>
<td>Associate Professor</td>
<td>University of Utah</td>
</tr>
<tr>
<td>2002 – 2006</td>
<td>Associate Professor</td>
<td>New Mexico Institute of Mining Technology</td>
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<tr>
<td>1996 – 2001</td>
<td>Assistant Professor</td>
<td>New Mexico Institute of Mining Technology</td>
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4. OTHER RELATED EXPERIENCE

Staff Member, Energy & Geoscience Institute at the University of Utah, 2006 – present
Senior Scientist, New Mexico Tech Petroleum Recovery Research Center (still employed in part-time joint position with New Mexico Tech), 2000 – present
Research Hydrologist, 1996 - 2006, Geophysical Research Center, New Mexico Institute of Mining and Technology
Postdoctoral Fellow, 1996, The Johns Hopkins University, Baltimore, MD

5. REGISTRATION (in past 5 years)

6. MEMBERSHIPS (in past 5 years)

American Geophysical Union
Geological Society of America
American Association of Petroleum Geologists

7. HONORS AND AWARDS (in past 5 years)

8. PROFESSIONAL SERVICE (in past 5 years)

Associate Editor and Editorial Advisory Board Member, Hydrogeology Journal 2006 - 2010
Chairperson, Advisory Board for the Pacific Northwest National Laboratory Carbon Sequestration Initiative, 2009 - 2013
Member, Advisory Board for the Institute of Geophysics and Planetary Physics at Los Alamos National Laboratory, 2010 - 2015 (http://institute.lanl.gov/igpp/)
Member, External Scientific Advisory Board for AltaRock Energy, Inc., 2008 - 2015
Chairperson, Risk Analysis and Simulation for Geologic Carbon Storage Workgroup, National Regional Carbon Sequestration Partnerships, 2010 - 2014
Chairperson, U.S. Committee on Carbon Sequestration Modeling Research 2007-2014

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)

McPherson, B., 2010, Development and application of carbon dioxide (CO2) storage for improving the


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Faculty Resume

Chris P. Pantelides
Ph.D., P.E., S.E.

2. EDUCATION

<table>
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<th>Degree</th>
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<th>Field</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>University of Missouri-Rolla</td>
<td>Civil Engineering</td>
<td>1987</td>
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<td>M.S.</td>
<td>University of Missouri-Rolla</td>
<td>Civil Engineering</td>
<td>1983</td>
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<tr>
<td>B.E.</td>
<td>American University of Beirut</td>
<td>Civil Engineering</td>
<td>1980</td>
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3. YEARS of ACADEMIC SERVICE

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<td>1999 – present</td>
<td>Professor</td>
<td>University of Utah</td>
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<tr>
<td>2012 – 2013</td>
<td>Professor &amp; Interim Chair</td>
<td>University of Utah</td>
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<tr>
<td>2001 – 2012</td>
<td>Professor &amp; Associate Chair</td>
<td>University of Utah</td>
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<tr>
<td>1995 – 1999</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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<tr>
<td>1991 – 1995</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
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<tr>
<td>1998 – 1991</td>
<td>Assistant Professor</td>
<td>University of Missouri-Rolla</td>
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4. OTHER RELATED EXPERIENCE

Design Structural Bridge Engineer, Dar-Al-Handasah Consultants, Beirut, Lebanon, 1980 – 1980

5. REGISTRATION (in past 5 years)

Utah

6. MEMBERSHIPS (in past 5 years)

American Concrete Institute
American Society of Civil Engineers
Earthquake Engineering Research Institute

7. HONORS AND AWARDS (in past 5 years)


8. PROFESSIONAL SERVICE (in past 5 years)

Interim Chair of Civil & Environmental Engineering, 7/2012-7/2013
Associate Chair of Civil & Environmental Engineering, 2002-2012
University Promotion and Tenure Advisory Committee, 2012
Academic Senate, 2011-2012
TRB Committee AFF50, Seismic Design and Performance of Bridges, 2012-present
American Concrete Institute Committee 374 Performance Seismic Design, 2004-present

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
American Concrete Institute Committee 349-0C Concrete Nuclear Structures – Nuclear Anchorage, 2013-present.
American Association of State and Highway Transportation Officials – Subcommittee of Bridge Structures 2014-present.
Faculty Resume

Christine A. Pomeroy
Ph.D., P.E.

2. EDUCATION

<table>
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<th>Degree</th>
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<th>Field</th>
<th>Date</th>
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<tr>
<td>Ph.D.</td>
<td>Colorado State University</td>
<td>Civil Engineering</td>
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<td>Colorado State University</td>
<td>Civil Engineering</td>
<td>2004</td>
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<tr>
<td>B.S.</td>
<td>Michigan State University</td>
<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<tr>
<td>2007 – present</td>
<td>Associate Professor</td>
<td>University of Utah</td>
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4. OTHER RELATED EXPERIENCE

Project Manager, CDM, Detroit, Michigan, 5/1995 – 8/2001

5. REGISTRATION (in past 5 years)

Professional Engineer, State of Michigan

6. MEMBERSHIPS (in past 5 years)

Member, American Society of Civil Engineers – Environmental Water Resources Institute
Member, Water Environment Federation

7. HONORS AND AWARDS (in past 5 years)

8. PROFESSIONAL SERVICE (in past 5 years)

Member, Planning Committee (Conference Coordinator), 2013 EWRI Congress held in Cincinnati, Ohio.
Co-chair of joint WEF/ASCE task force to update the Manual of Practice for Design of Urban Runoff Controls
Member, Urban Water Resources Research Council (UWRRC); LID, Stream Restoration Education, Bioretention, and Water Resources Education subcommittees, ASCE/EWRI
Chair, Urban Streams Subcommittee (UWRRC), ASCE/EWRI
Member, Watershed Management Committee, WEF
Member, WEF Technical Practice Committee Control Group, Watershed Subcommittee Chair
Review Panelist, Environmental Engineering, National Science Foundation
Member, State of Utah Nutrient Advisory Committee

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Faculty Resume

Richard Jon Porter
Ph.D., P.E.

2. EDUCATION

<table>
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<tr>
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<td>The Pennsylvania State University</td>
<td>Civil Engineering</td>
<td>2007</td>
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<td>M.Eng.</td>
<td>The Pennsylvania State University</td>
<td>Civil Engineering</td>
<td>2000</td>
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<td>B.S.</td>
<td>The Pennsylvania State University</td>
<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<tr>
<td>2009 – present</td>
<td>Assistant Professor</td>
<td>University of Utah</td>
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4. OTHER RELATED EXPERIENCE

Assistant Research Scientist [post-doctoral], Texas Transportation Institute, The Texas A&M University System, College Station, TX, 8/2007 – 5/2009

Research Assistant [full-time research faculty during Ph.D. program], Thomas D. Larson Pennsylvania Transportation Institute, The Pennsylvania State University, University Park, PA, 1/2002 – 7/2007

Associate Graduate Faculty Member, North Dakota State University, Transportation and Logistics, Fargo, ND, 2/2014 – present

5. REGISTRATION (in past 5 years)

Professional Engineer, Utah (7824077-2202)

6. MEMBERSHIPS (in past 5 years)

Member, American Society of Civil Engineers, March 2010 – present

Member, Human Factors and Ergonomics Society, December 2009 – December 2014

Member, American Society for Engineering Education, October 2009 – present

Member, American Association for the Advancement of Science, November 2008 – November 2014

Member, Institute of Transportation Engineers, May 2008 – present

7. HONORS AND AWARDS (in past 5 years)

Educator of the Year, Institute of Transportation Engineers (ITE) – Utah Chapter, 2014

National Award, ExCEEd New Faculty Excellence in Teaching Award, American Society of Civil Engineers, 2014

Ben Jacobsen Kingfisher Bend Ranch Award for Exceptional Effectiveness in Teaching, Department of Civil and Environmental Engineering, 2011-2012

Outstanding Faculty Award, Department of Civil and Environmental Engineering, University of Utah, 2011-2012

Best Paper (out of 39 papers), Transportation Research Board’s Geometric Design Committee (AFB10), 2013 Annual Meeting of the Transportation Research Board -Wood, J.S.* and Porter, R.J. “Safety Impacts of Design Exceptions on Non-Freeway Segments.”


8. PROFESSIONAL SERVICE (in past 5 years)


Member, Standing Joint Subcommittee on Future Directions in Safety Analysis [ANB20/ANB25], 2013 – present

Member, Safety Data, Analysis, and Evaluation Committee [ANB20], 2011 – present

Member, Expert Panel for NCHRP 20-05/42-04: Recent Geometric Design Research and Practice for Improved
9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)
Musunuru, A.* and Porter, R.J. “Reliability-Based Geometric Design Approach for Selecting Basic Number of Freeway Lanes,” In Transportation Research Record, Journal of the Transportation Research Board No. 2436, 2014, pp. 70-80
Park, E.S., Carlson, P.J., Porter, R.J., and Andersen, C.K. “Safety Effects of Wider Edge Lines on Rural, Two-Lane Highways,” In Accident Analysis and Prevention 48, 2012, pp. 317-325
Fitzpatrick, K., Porter, R.J., Pesti, G., Chu, C.L., Park, E.S., and Le, T.Q.* “Guidelines for Spacing between Freeway Ramps,” In Transportation Research Record, Journal of the Transportation Research Board No. 2262, 2011, pp. 3-12

10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Transportation Research Board Webinar, NCHRP 3-88/Report 687: Guidelines for Ramp and Interchange Spacing, December 14, 2011 [registered continuing education]
Faculty Resume

Lawrence D. Reaveley
Ph.D., P.E.

2. EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
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<th>Field</th>
<th>Date</th>
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<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Institution</th>
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<tr>
<td>2006 – present</td>
<td>Professor</td>
<td>University of Utah</td>
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<tr>
<td>1993 – 2006</td>
<td>Professor &amp; Dept. Chair</td>
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<tr>
<td>1975 – 1993</td>
<td>Adjunct Professor</td>
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<tr>
<td>1970 – 1972</td>
<td>Visiting Assistant Professor</td>
<td>University of Utah</td>
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4. OTHER RELATED EXPERIENCE

Consultant, Reaveley Engineers and Assoc., Inc., Salt Lake City, Utah, 1974 – present
Vice President, Reaveley Engineers and Assoc., Inc., Salt Lake City, Utah, 1974 – 1993
Research Assistant, University of New Mexico, Albuquerque, New Mexico, 1967 – 1970
Structural Design Engineer, J.F. Patrick Structural Consulting Engineers, Salt Lake City, Utah 1964 - 1967
Materials Engineer, Utah Department of Transportation, Salt Lake City, Utah, 1963 – 1964
Intern, Precast/Material Division, Utah Sand & Gravel, Salt Lake City, Utah, 1959 - 1962

5. REGISTRATION (in past 5 years)
Registered Professional Engineer, Utah

6. MEMBERSHIPS (in past 5 years)
  - American Concrete Institute
  - American Society of Civil Engineers
  - American Society of Engineering Education
  - Chi Epsilon Civil Engineering Honor Society
  - Earthquake Engineering Research Institute
  - Structural Engineers Association of Utah

7. HONORS AND AWARDS (in past 5 years)
2011 Civil Engineering Distinguished Alumni, University of Utah

8. PROFESSIONAL SERVICE (in past 5 years)
Structural Engineers Association of Utah, Program Committee member

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Pedro Romero
Ph.D., P.E.

2. EDUCATION

<table>
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<td>Civil Engineering</td>
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3. YEARS of ACADEMIC SERVICE

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<td>Associate Professor</td>
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<td>2000 – 2007</td>
<td>Assistant Professor</td>
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4. OTHER RELATED EXPERIENCE

On-site Manager, Soil and Land Use Technology, Beltsville, Maryland, 1999 – 2000
Laboratory Technical Manager, EBA Engineering, Baltimore, Maryland, 1995 – 1997

5. REGISTRATION (in past 5 years)

Registered Professional Engineer (PE) in the state of Maryland (200343)

6. MEMBERSHIPS (in past 5 years)

American Society of Civil Engineers

7. HONORS AND AWARDS (in past 5 years)

Voted most supportive professor by Student Advisory Committee for 2009 and 2010
Named Outstanding Mentor, 2013
Awarded the Ben Jacobsen Kingfisher Ranch Award for Exceptionally Effective Teaching, 2013
Candidate for University of Utah Distinguish Teaching Fellowship (Fall 2014)

8. PROFESSIONAL SERVICE (in past 5 years)

Associate Department Chair (2014 – Present)
Director of Undergraduate Advising (2012 – Present)
Member, University Parking Appeals Committee (2012 – Present)
Member, Department Undergraduate Curriculum Committee (2005 – 2007, 2010 - present)
Member Department Graduate Committee (2012 – Present)
Member, College of Engineering Council (2010 – 2013)
Member, Department Chair search Committee (2013)
Member, Department Scholarship Committee (2004 – 2006 and 2010-2012)
Faculty Advisor, American Society of Civil Engineers Student Chapter (2001 – 2012)
Faculty Advisor, Association of General Contractors Student Chapter (2004 – 2012)

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Utah Asphalt Conference (2010 – 2015) participant and organizer
Faculty Resume

Douglas G. Schmucker
Associate Professor – Lecturer

2. EDUCATION

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<th>Date</th>
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<td>M.S.C.E.</td>
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<td>B.S.C.E.</td>
<td>Valparaiso University</td>
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3. YEARS of ACADEMIC SERVICE

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<th>Institution</th>
<th>Original Appointment</th>
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<td>2013 – present</td>
<td>Assoc. Prof.-Lect. (#)</td>
<td>University of Utah</td>
<td>Jul 1, 2013</td>
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<tr>
<td>2006 – 2009</td>
<td>Assoc. Prof. (1)</td>
<td>Trine Univ.</td>
<td>Jan 1, 2013</td>
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4. OTHER RELATED EXPERIENCE

Full-time Consultant
Structural Engineer and Educational Consultant, Self-employed, 2011 – 2013
Senior Project Manager, Zahl-Ford Structural Consultants, Inc., OK, 2009 – 2011

Description
Structural Services include investigative engineering, forensic engineering, structural condition assessments, damage studies, litigation support, expert witness testimony, design of repairs and renovations, seismic evaluation, peer review, etc. Representative Projects in the past 5 years are included in the Publications section.

Educational Services include development and delivery of online courses, e.g., IE6200 Probability and Statistics for the MS(Eng) program in the Graduate School of the Department of Mechanical and Industrial Engineering at Northeastern University.

Part-time Consultant
Structural Engineer and Educational Consultant, Self-employed, 1998 – 2009

5. REGISTRATION (in past 5 years)
Professional Engineer, Indiana and Oklahoma (Utah: pending)
NCEES Records

6. REGISTRATION (in past 5 years)
American Concrete Institute (Member)
American Institute of Steel Construction (Member)
American Society of Civil Engineers (Member)
American Society for Engineering Education (Member)

7. HONORS AND AWARDS (in past 5 years)
Premier Award for Excellence in Engineering Education Courseware for CATME/Team-Maker (2009)
Tri-State (Trine) University McKetta-Smith Teaching Award (2007)

8. PROFESSIONAL SERVICE (in past 5 years)
American Concrete Institute-Oklahoma (ACI-OK), Chapter President 2011 – 2012
American Society for Engineering Education, ERM Division (Director) 2009 – 2012
Zahl-Ford, Seismic Evaluation of Existing Buildings (Presenter; in-house training workshop) 2011
NCEES Fundamentals of Engineering Exam Committee (Member) 2007 – present
AIA Oklahoma, Archi-Treasure Hunt (Founding Chair) 2011
ACI-OK, April Meeting (Presenter) 2011
ACI-OK, February Meeting (Presenter) 2011
ASME, Central Oklahoma Section, March Meeting (Presenter) 2010
AIA Oklahoma, Annual Legislative Conference (Presenter) 2010
AIA Oklahoma, ARE Structures Review (Presenter) 2009
TSU/Trine, University, College, and Department Committees (e.g., Educational Resources, ASCE Student Chapter Faculty Advisor, Tau Bet Pi Faculty Advisor, Graduate Coordinator, Instructional Technology Liaison) 2006 – 2009

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)
Evaluation of tilt-up wall panels, ALDI Food Distribution Facility, Denton, TX
Expert witness testimony, Archbald residence, Arcadia, OK
Investigation of post-tensioned water storage tank, Medicine Park, OK
Building enclosure investigation, Boy Scouts of America, Oklahoma City, OK
Investigation of structural movements, Mercy Hospital Cancer Center, Ardmore, OK
Condition Assessment and Seismic Evaluation of Buildings 213, 331, and 333, Altus AFB, OK
Condition Assessment and Seismic Evaluation of India Shrine Temple Building, Oklahoma City, OK
Condition Assessment of 19-story Office Building, Oklahoma City, OK
Preliminary design concepts for renovation of Mayport Fitness Center, Jacksonville, FL
Structural investigation and design review of Westlake Retail Center, Oklahoma City, OK
Thin-shell Hyperbolic Paraboloid Design Feasibility Study (EMI, TSCGlobal)
Kijabe, Kenya: Structural inventory, condition assessment, and seismic evaluation of hospital complex (EMI)
Wind-related roof design review, Panhandle State University, Ft. Supply, OK
Snow load design review, Great White Energy Services, Catoosa, OK
Design of rail conveyor system in bologna slicing room, Bar-S, Altus, OK
Design of crane lift beams, NW Crane Logistics, Oklahoma City, OK
Design of elevated oil storage tank platform, TRES Management, Oklahoma City, OK
Design of roof repairs and preliminary renovation concepts of Sperry Van Ness warehouse, Oklahoma City, OK

10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
SEA-OK Monthly PD Seminars (2009 – 2012)
NCEES FE Committee Quarterly Meetings (2007 – 2013)
Ethics and Legal Issues Online Course (2012)
Faculty Resume

Milan Zlatkovic
Research Assistant Professor

2. EDUCATION Date
Ph.D. University of Utah  Civil & Environmental Engineering  2012
M.S. University of Utah  Civil & Environmental Engineering  2009
B.S. University of Belgrade, Serbia  Transport & Traffic Engineering  2005

3. YEARS of ACADEMIC SERVICE

<table>
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<tr>
<th>Dates</th>
<th>Rank (FTE)</th>
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<tr>
<td>2013 – present</td>
<td>Research Assistant Professor</td>
<td>University of Utah</td>
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<tr>
<td>2012 – 2013</td>
<td>Postdoctoral Fellow</td>
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<td>2008 – 2012</td>
<td>Research/Teaching Assistant</td>
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4. OTHER RELATED EXPERIENCE
2005 – 2007 Traffic & Transit Engineer  DOT, City of Nis, Serbia

5. REGISTRATION (in past 5 years)
Utah PE License pending (PE exam passed in October 2014)

6. REGISTRATION (in past 5 years)
Institute of Transportation Engineers – ITE (Member)

7. HONORS AND AWARDS (in past 5 years)
2012 ITE Intermountain Section Ellis Mathes Scholarship
Winner of the Utah Chapter ITE student paper competition, 2011
Winner of the Utah Chapter ITE student paper competition, 2009
University of Utah, Department of Civil and Environmental Engineering scholarships 2008, 2009, 2010

8. PROFESSIONAL SERVICE (in past 5 years)
Search Committee Member/Applicant Reviewer for the position of Post-Doctoral Fellow, Department of Civil and Environmental Engineering, University of Utah  2014 – present
Assistant Director, National Summer Transportation Institute, University of Utah  July 14 – 18, 2014
Technical faculty advisor for the University of Utah ITE Student Chapter  2012 – present
President of the University of Utah ITE Student Chapter  2010 - 2012
Member of the University of Utah Graduate Student Advisory Committee  2009 – 2012

9. PUBLICATIONS/ENGINEERING REPORTS (representative sample selected in past 5 years)


10. PROFESSIONAL DEVELOPMENT (Sample Selected from the Last Five Years)
Appendix C – Equipment

Materials/Concrete Lab

Instron 400 Compression Machine
Test Mark, Compression Machine
20’ Drop Hammer
Troxler, Gyratory Compactor
Concrete Mixers (5) 3.6cuFt
water curing tanks
air meters
slump and unit weight
mortar cube molds
Controlled relative humidity cabinet
Mary Ann sieve shaker
digital balances
asphalt concrete portable mixers
corelock specific gravity device
specific gravity setup
ignition oven
penetration grading of asphalt cement
ovens
Hamburg rut testing machine
core dry
rotating viscometer
bending beam rheometer
linear kneading compactor
freezer/warm bath unit
turning movement counters
classifiers - plates
pneumatic tube road runner

Geotechnical/Soil Mechanics Lab

ELE Triaxial Compression Apparatus
ELE Direct Shear Machine Apparatus
Drying Ovens
Sieve Shakers
Digital scales
Hydrometer test equipment
manually operated unconfined compression, and CBR system
Bench top oedometers
compression frame
Procter hammers and molds
Liquid Limit Devices
Bench top permeameters
Tremble GHX GPS Survey System
Sokkia SDL50 Digital Level and Rod
Cirrus CR800A Sound Level Meter

Hydraulics Lab

Armfield, Hydraulic Bench
Armfield, Water Flume
hydrostatic pressure apparatus
energy losses in pipes apparatus
centrifugal pumps
energy loss in bending apparatus
flow channel apparatus
Bernoulli’s Theorem demonstration apparatus
orifice and free jet flow apparatus
flow over weirs apparatus

HEDCO High Bay Area

MTS servo-hydraulic testing system
hydraulic pump
high bay structure
high bay structure with 500k tension/compression actuator
MTS TestStar II control system
Vishay scanners

Misc.

Humidified concrete curing room
MTS FlexTest 40, 50 kip Hydraulic Frame
radar gun
video camera
Elmo - document camera
picture tel
smart board
Appendix D – Institutional Summary

The Institution

Institutional Address
University of Utah
201 Presidents Circle, Room 201
Salt Lake City, UT 84112

President
David W. Pershing
President
Office of the President
Park Building
201 S. President’s Circle, Room 203
Salt Lake City, UT 84112

Chief Academic Officer
Ruth Watkins
Senior Vice President, Academic Affairs
Park Building
201 S. President’s Circle, Room 205
Salt Lake City, UT 84112

Submission of Self-Study Report
Richard B. Brown, Dean
College of Engineering
72 S. Central Campus Drive, Room 1692
Salt Lake City, UT 84112

Institutional Accreditation
The University of Utah is accredited by Northwest Association of Schools and Colleges; the initial accreditation was April 6, 1932. The most recent accreditation of the University of Utah and its component schools, colleges and departments was completed in October 2012.

Type of Control

The University of Utah is a state institution under the jurisdiction of the Utah State Board of Regents, whose members are appointed by the Governor of the State of Utah and confirmed by the Legislature. The Regents appoint a Commissioner of Higher Education who, with his staff, has the responsibility of coordinating policy, programs and budgets for higher education state-
The President of the university reports to the Board of Trustees, which reviews and approves the policies, programs, budgets and personnel actions of the University.

**Educational Unit**

From an organizational standpoint, the college consists of a college level administration and seven academic units including the Departments of Bioengineering, Chemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, Materials Science and Engineering, Mechanical Engineering and the School of Computing.

**Academic Support Units**

**Mathematics:** Peter Trapa, Chair; Nick Korevaar, Associate Chair  
**Physics:** Carleton DeTar, Chair; Christoph Boehme, Associate Chair  
**Chemistry:** Cynthia Burrows, Chair; Jon Rainier, Associate Chair

**Non-Academic Support Units**

**Library Support for the College of Engineering** (Michael Noe, Associate Librarian)  
The University of Utah has three libraries on its campus: S. J. Quinney Law Library, Spencer S. Eccles Health Sciences Library, and J. Willard Marriott Library. In additional to these, a graduate mathematics library, which is operated by the Marriott Library, is located in the Mathematics Department. Only the Marriott Library is discussed in this self-study, since it is the library used most by engineering faculty and students.

**Computer Facilities** (Steven Dean, Director): The College of Engineering maintains four general usage computer labs that provide access to academic software and file storage for instructional usage. The college computing facility also provides a comprehensive collection of software that is available for instructional use.

**Tutoring** (Dianne Leonard, Academic Program Manager): The Engineering Tutoring Center offers help for all engineering students, particularly freshman and sophomores. The goal of the tutoring center is to help our engineering students through difficult engineering classes, so that they will be better prepared for junior and senior level coursework. For engineering courses, fellow Engineering students serve as tutors, so students can get help and information from peers who have "been there and done that." In addition, Faculty and teaching assistants from the Department of Math hold extensive office hours in the Tutoring Center. Not only do students receive help completing homework, but also have the opportunity to gain a better understanding as to how that subject actually fits into their engineering coursework and future profession.

**The Living and Learning Community** (Amanda May, Academic Program Coordinator): The College of Engineering offers three Living & Learning Communities for our students. The College of Engineering Living & Learning Community is open to all first-year engineering

312
students. Resident selection is done by the College of Engineering Dean’s Office. Preference will be given to Engineering Scholars, members of the Honors in Engineering Program, and high-achieving first-year students. There are activities and value-added programming for the Engineering Floor.

The College of Engineering Living & Learning Community opened fall 2005 in the University of Utah Residence Halls. Located on the fourth floor of Building 813 in Sage Point, this community offers residents the opportunity to live with other students in the College of Engineering who share their academic and career goals. This community is open to first year students who appreciate the benefit of living in a community, which fosters academic excellence within the rigorous engineering curriculum. Mentoring: There are two Resident Advisors (RA) who live on the floor. These RA’s are upper division engineering students selected by the College. The RA’s help with any problems or concerns while providing leadership and mentoring, as well as a connection to the College of Engineering Dean’s Office. Study sessions and tutoring help ensure academic success, while interaction with engineering faculty, staff, and alumni help further professional development. The Floor: A total of 44 engineering students are selected to live in the community in single, single-deluxe, double and double-deluxe suites. A large and well-equipped study room is available on the floor, providing an ideal setting for group study, teamwork, and collaboration. To view floor plans, please visit the Housing and Residential Education website at http://www.housing.utah.edu/sage.html.

The Kennecott House in Officers’ Circle houses 12 students. The RA for this community is an upper-division engineering student and residents have the opportunity to participate in programming offered in conjunction with the Dean’s Office. The students living in this community participate in faculty presentations, field trips and alumni dinners. Students are selected to live in the community by the College of Engineering Dean’s Office. Priority is given to Kennecott Scholars and students from the College of Engineering. To view information about the Kennecott House, please visit the Housing and Residential Education website at http://housing.utah.edu/options/living-learning-communities/officers-circle/611/.

In fall of 2012, the Donna Garff Marriott Honors Community welcomed its first students. The Honors Community provides the opportunity for students admitted to the Honors College to live and learn with their peers. Living in a community that provides not only a place to live, but also a place to take classes, attend seminars, and engage with faculty on a regular basis. The College of Engineering shares a floor in this building and admits 16 engineering students to live in an apartment style residential hall. The Resident Advisor (RA) for this community is an engineering student actively pursuing an Honors Degree and students are required to participate in engineering sponsored activities. Students are selected to live in the community by the College of Engineering Dean’s Office. Students must be admitted to the University of Utah Honors College. To view information about the Donna Garff Marriott Honors Community, please visit http://housing.utah.edu/options/undergraduate/honors-community/

The CLEAR Program (Communication Leadership, Ethics, And Research) (Ajay Nahata, Associate Dean): The CLEAR program was designed to ensure that engineering graduates can communicate clearly in both oral and written form, participate on teams productively, recognize ramifications of decisions they will make in the global marketplace, and develop a sophisticated
understanding of ethical dilemmas which regularly follow engineering industry trends. The CLEAR Program is unique and innovative due to its: (1) emphasis on speaking, writing, teamwork, and ethics, (2) integrated professional skills instruction, and (3) situated, developmental approach to teaching and learning. In short, engineering undergraduates at the University of Utah are continually exposed to communication and ethics throughout their engineering training. As a result, students are better prepared for the transition from the university to the workplace.

University College Advising Center (Sharon Aiken-Wisniewski, Associate Dean): At the University College Advising Center undeclared and pre-major students learn about academic programs, University policies and procedures, selecting classes, exploring majors, and other education-related concerns.

Career Services (Stan Inman, Director): Career Services has an office in the Warnock Engineering Building (within the Dean’s Office), where career counselors meet with undergraduate and graduate students four days a week. This arrangement allows them to interact with a larger number of students, since the Warnock Building is also where a large fraction of engineering classes are held. Career Services also hosts an official database, UCareerPath, that helps students and employers find one another. It also allows Career Services to communicate with students about events such as career fairs, job postings, and interview schedules.

Counseling Center (Lauren Weitzman, Director): The University has a Counseling Center to assist students, staff, and faculty with a variety of personal, academic and career concerns. Its approach is collaborative, goal-oriented, and multi-culturally sensitive. The center attempts to help individuals develop more personal awareness and to learn skills necessary for success at the University of Utah.

Disability Center (Scott McAward, Director): The Center for Disability Services provides accommodations and support for the educational development of students with disabilities. It strives to improve understanding and acceptance of students with disabilities throughout the University community. The center gives direct assistance to students to encourage and enhance their independence, works continually to develop and maintain an accessible physical environment, and endeavors to create a supportive psychological environment so that students can achieve their educational objectives.

Credit Unit

One semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations.

Further, in cases where the Criteria specify curricular content in terms of years, the credit equivalent of one year is determined by dividing the number of credits required for graduation by the nominal length of the program in years. For example, if a four-year bachelor’s program
requires 130 credit hours for graduation, then $130/4 = 32.5$ is the number of credit hours equivalent to one year.
### Table D-1. Program Enrollment and Degree Data

**Civil Engineering at the University of Utah**

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<th>Academic Year</th>
<th>Enrollment Year</th>
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*FT—full time, PT = part time*
Table D-2. Personnel

Civil & Environmental Engineering

Year\(^1\): __fall 2014____

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<td>2</td>
<td>16.89</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td>1</td>
<td>5</td>
<td>2.60</td>
</tr>
<tr>
<td>Student Teaching Assistants(^4)</td>
<td>16</td>
<td>5</td>
<td>9.06</td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>2</td>
<td>2</td>
<td>2.16</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>4</td>
<td>2</td>
<td>3.92</td>
</tr>
<tr>
<td>Others(^5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Report data for the program being evaluated.

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc.

5. Specify any other category considered appropriate, or leave blank.
**Signature Attesting to Compliance**

By signing below, I attest to the following:

That Civil Engineering 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*.

---

**Ajay Nahata**  
Dean's Name (As indicated on the RFE)

---

[Signature]

June 24, 2015  
Date
Attachment 1 - Industrial Advisory Boards (IABs)

CVEEN Industry Advisory Board

Objective
The Industrial Advisory Board (IAB) consists of 15 industry professionals that meet four times a year. They help advise the Department Chair on what the professional needs and outlook of private enterprise and governmental agencies to help meet the needs of public, government, industry, and the State. They also help in fundraising, serve as a public relations medium, and helps disseminate information on the Department’s status to the legislature, state agencies, cities, and counties.

If you are interested in becoming a member of the IAB please contact Ashley Arpero.

<table>
<thead>
<tr>
<th>Member</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todd Adams</td>
<td>Todd D. Adams is the Deputy Director at the Utah Division of Water Resources. Todd directs the Planning Branch and oversees the Division’s and day to day operations, budget and serves as the Legislative Liaison. Todd has been with the Utah Division of Water Resources since September 1990. Before being promoted to Deputy Director in November 2013 he served as the: Assistant Director and managed the Planning Branch (7 years), Section Chief of the Hydrology and Computer Applications Section and the operational Cloud Seeding Coordinator for the State of Utah (6 years). He is a member of the Bear River Commission Technical Advisory Committee, Virgin River Interstate Technical Committees and the Virgin River Resource Management and Recovery Program, University of Utah Civil Engineering Department Industrial Advisory Board, State of Utah’s Resources Development Coordinating Committee and the Utah Water Users Association – Workshop Planning Committee. Todd was raised in Logan, Utah where he graduated from Utah State University with Bachelor and Master Degrees in Civil Engineering with emphasis in Water Resources. Todd is a Registered Professional Engineer in the State of Utah. Todd is married and has 3 daughters.</td>
</tr>
<tr>
<td>Bill Baranowski</td>
<td>Bill Baranowski P.E., is the president of RoundaboutsUSA located in Salt Lake City, Utah. Bill is the City Traffic Engineer for West Jordan, Utah. Bill received his B.S. Degree ('86) in Civil Engineering from the University of Utah. He also received an M.S. Degree ('89) in Civil Engineering from Brigham Young University. Mr. Baranowski has worked in engineering since 1983 when he got his start as a sandbag and engineering intern for Salt Lake City Public Works.</td>
</tr>
</tbody>
</table>
during the spring floods of ’83 and ’84. He has nearly 20 years experience in the planning, design and construction of roundabouts in the USA. He has been involved with roundabout design and analysis at local, state and national levels in the USA and in Mexico. He has conducted all stages of roundabout projects and helped to design over 100 roundabouts constructed since 1995. His signature project is the roundabout constructed in 2003 at the main entrance to the University of Utah campus that incorporates a modern roundabout with a light rail train running through the center. Bill has also published several papers on roundabout design, pedestrian safety and traffic calming through his affiliation with the Transportation Research Board and the Institute of Transportation Engineers.

Michael Buehner, SE, is a Salt Lake City native, a licensed professional structural engineer, and Principal with Reaveley Engineers + Associates. He received a BUS degree in Asian Studies from the University of Utah in 1988 and worked in Tokyo, Japan, for 5 years before returning to Utah to earn a second degree from the U in Civil and Environmental Engineering in 1997. Mike has been a board member of the Structural Engineers Association of Utah, is a past Chairman of the Utah Engineers Council, and currently serves on the Structural Advisory Board to the Uniform Building Code Commission for the State of Utah. Mike is the design engineer or project manager for several notable projects at the University of Utah including the LeRoy Cowles Building seismic upgrade and addition, Marriott Library seismic upgrade and addition, Warnock Engineering Building, Huntsman Cancer Institute Phases 2 and 3, The Orthopaedic Center, Health Sciences College North Parking Terrace & Helipad, Donna Garff Marriott Residential Scholars Community, and the Ambulatory Parking Structure.

Matthew Cassel is currently the Park City Engineer. Cassel has been an engineer for 25 years starting with the City of Indianapolis and most recently with Park City. Between stints with the City of Indianapolis and Park City, he worked 15 years for three different engineering consulting firms. Originally from Ohio (Go Indians! Go Browns!), he graduated from the University of Utah in Civil Engineering. In 1995, he returned to school (Butler University for two years) and ultimately earned his MBA from Westminster College in Salt Lake City.
Ronald H. Dunn, Founder and President of Dunn Associates, Inc. a Salt Lake City based privately held Structural Engineering Company. Dunn Associates, Inc. was founded in 1995 and has grown to one of the top revenue producing consulting engineering firms in the State. Ronald Dunn has been practicing as a professional engineer for over 30 years. Mr. Dunn is a licensed Professional Structural Engineer in over 40 States and is a participating member of several other Professional Organizations. A significant majority of Dunn Associates, Inc.’s projects are with private clients who include developers who reside both in the State of Utah and new clients moving to the State. Notable projects at the University of Utah include; Quinney School of Law, Museum of Natural History, Sutton Geology, Skaggs Pharmacy and the David Eccles School of Business. Ron has based his career on building client relationships. His philosophy is that we are in the business to make our clients successful. This philosophy is mirrored in Ron’s community and philanthropic activities as well. Five percent of his personal time is usually geared towards “giving back”. Mr. Dunn has served as President of The Structural Engineers Association of Utah, past Chair for the Engineers/Architects Committee for Utah Seismic Safety Commission, Chairman Ethics Committee SEAU. Currently Mr. Dunn serves as Chairman of the Industrial Advisory Board for the Civil Engineering Department at the University of Utah, Industry Advisory Board.

Jeff Heden is the President and CEO of J. C. Heden and Associates, Inc. in San Diego, California. He has over 31 years of planning and design experience in the private and public engineering sectors with specific emphasis on water and wastewater facilities, water supply systems, transient flow pipe network modeling, wastewater force mains, large diameter water transmission pipelines, water and wastewater master plans, water pump stations, wastewater lift stations, potable and irrigation wells, reclaimed water delivery systems and closed-conduit hydraulics.
Mathew Hirst is the Executive Vice President & Chief Operations Officer for Caldwell Richards Sorensen in Salt Lake City, Utah, and is a registered Professional Engineer in six states. Hirst received his B.S. ('99) and M.S ('07) from the University of Utah. As a Professional Engineer, Matt has been active in the engineering community for more than a decade. Matt has become an industry leader in several areas of civil engineering including: Infrastructure relocation from design to construction management, pavement management, and computer aided technology applied to engineering. Mr. Hirst has lead the infrastructure work on Legacy Parkway Phase I & II ($650M), the Access Utah County Program ($1B total value) and the I-15 CORE ($1.1B) which are some of the Utah Department of Transportation’s highest profile projects since 2001. Mr. Hirst has been leading a cutting edge pavement management project with Union Pacific Railroad since 2004, having worked with them on this project since 1995. With a team of programmers, engineering designer and engineering planners, Matt is helping the UPRR to plan and effectively rehabilitate well over 2000 acres of pavement located in over 23 states found in just over 50 facilities. Since 1994, Mr. Hirst has lead and pushed the boundaries of GIS and GPS technology. Having consulted with over a dozen agencies and supported their infrastructure mapping and asset management, Matt’s IT/GIS team is poised to release ground breaking web-based software that will manage municipal infrastructure, location marking, customers and work orders.

Scott P. Lawson is currently Senior Vice President, Technical Services for Newmont Mining Corporation. He joined Newmont and was elected to this role in December 2012. Prior to joining Newmont, Mr. Lawson served as Senior Vice President, Engineering Services, Peabody Energy responsible for global engineering and technical services support. Mr. Lawson also spent 22 years with international miner Rio Tinto including executive roles with Rio Tinto Alcan – Bauxite and Alumina where he directed a global technology team responsible for mining, refining, engineering, technology and business improvement; Rio Tinto Technology and Innovation group as Global Practice Leader for asset management; and as Vice President Engineering & Technical Services for Kennecott Utah Copper. He has also served on the Utah Air Quality Board and the Utah Safety Council Board. Mr. Lawson began his career with Barrick Gold Corporation.

Mr. Lawson holds a Bachelor of Science degree in Civil Engineering from the University of Utah and Master of Business Administration degree from the University of Phoenix in Salt Lake City.
Michael Marchant

Mike Marchant, PE, PMP, MPM, graduated from the University of Utah in 1987 with a BSCE. Upon graduation, he accepted a position with the Westinghouse Electric Corporation working at the Naval Reactors Facility in Idaho falls, Idaho where he was responsible for designing and overseeing the construction of capital projects at a nuclear fuels handling facility. After five years, he shifted his career and spent the next 18 years working for consulting and engineering/constructors organizations. He is currently the Engineering Business Manager, for Savage Services. He is a licensed PE in 6 States and is a certified Project Management Professional with PMI and a Master Project Manager with AAPM. His customer base includes federal, municipal, and industrial customers. His project experience includes railroads, radioactive/hazardous waste landfills, training facilities, pipelines, water and wastewater treatment facilities, environmental restoration, and numerous other civil engineering based projects. He has served on a number of advisory committees including the State of Utah’s Plumbing Advisory Committee and is currently serving on the City of Riverton’s Citizen Utility Stormwater Advisory Committee and the U of U’s Civil and Environmental Engineering Industrial Advisory Board. During his career, he has been supported and encouraged by his Wife of 28 years, 4 children and 1 grandchild.

Rachel McQuillen

Mr. Milner serves as Vice President and General Manager of Burns & McDonnell’s Chicago regional office. As office manager he is the Principal-In-Charge of more than 170 professionals (including electrical, chemical, mechanical and civil engineers along with geologist, biologists and other scientists) who provide the following technical services:

- Energy
- Aviation & Facilities
- Infrastructure (transportation and water/wastewater)
- Environmental Remediation Services
- Business & Technology Services
- Construction Design Build

Hi personal experience is in the field of environmental investigation and remediation. Mr. Milner was instrumental in developing Burns & McDonnell’s largest environmental practice outside of its Kansas City corporate headquarters. He is a licensed professional engineer with over 20 years of construction and engineering experience. Mr. Milner is a recognized leader in the environmental industry and has more than two-dozen publications/presentations and awards related to his industry.
Jim Nordquist, P.E., is the founder, president and CEO of Applied Geotechnical Engineering Consultants, Inc. (AGEC) located in Sandy, St. George and Cedar City, Utah. Jim received his B.S. Degree ('77) in Civil Engineering from the University of Utah (U of U). He also received an S.M. Degree ('79) in Civil Engineering from the Massachusetts Institute of Technology (MIT). Under Jim’s leadership, AGEC has become one of the most respected geotechnical/geologic/construction materials engineering consulting firms in the area. Projects have included the Energy Solutions Center, the LDS Conference Center, the City Creek Center, Procter & Gamble facility in Bear River City, I.M. Flash Lehi facility, Intermountain Medical Center, and the Meldrum Engineering Building addition.

Don Ostler is the Executive Director and Secretary of the Upper Colorado River Commission comprised of representatives from the Governor’s of Utah, Colorado, Wyoming and New Mexico and one person appointed by the President. In this capacity, Don fulfills the Commission responsibilities of administering the use of waters in the Upper Colorado River Basin and in complying with delivery requirements to California, Arizona and Nevada as well as the Government of Mexico. Don has been instrumental in establishing drought management plans for the entire Colorado River Basin and Mexico. Prior to this time Don served as Director of the Utah Division of Water Quality in an appointed position serving 3 of Utah’s Governors. Don has also served as President of the national Association of State and Interstate Water Pollution Control Administrators in Washington DC; Chairman of the Western States Water Council Water Quality Committee, a member of the Utah Soil Conservation Commission and other professional groups. Don is a registered professional engineer in Utah and received his bachelors degree (71) and masters degree (75) in civil engineering from the University of Utah. Don continues to employ student interns from the Civil Engineering Department at the University of Utah in his work at the Commission.
Joshua J. Sletten, S.E. is the Bridge Management Engineer for UDOT’s Structures Division; he has served in this capacity for nearly a year. Prior to his current role, Josh also served as the Structures Design Manager and the Structures Division Project Manager for UDOT.

Prior to working at UDOT, he spent eight years working as a bridge design engineer and project manager for the transportation engineering consultants LJB, Inc in Dayton, Ohio and HNTB Corp. in Salt Lake City, Utah. He is a member of the AASHTO Subcommittee on Bridges and Structures and serves on the Technical Committee for Software and Technology (T-19) as well as the Technical Committee for Bridge Preservation (T-9). He earned a bachelor’s degree in Civil Engineering from the South Dakota School of Mines and Technology in 2001 and a master’s degree in Structural Engineering from Purdue University in 2002.

Phillip Solomon P.E. was born and raised in Salt Lake City, Utah. He graduated from University of Utah—degree in Civil Engineering (1984) He also obtained a Masters in Business Administration from Utah State University (1997). He currently is the Energy Services Director for the City of St. George, Utah. He has 29 years with the City and has worked in several positions with in the City’s water and energy utility. He has been involved with several large water and power infrastructure projects throughout the City. Prior to joining the City of St. George, Phillip worked for Bechtel National, Inc., in San Francisco, California as a structural engineer. He also has been an adjunct professor at Dixie State University in the Business Department. He is currently serving on the American Public Power Association Public Power Reliability Committee. He is a registered professional engineer in Utah and Arizona. He is married and has 3 children.
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Attachment 2 – Examples of Course Assessment and Evaluation
Course Number and Title: CVEEN 2140 Strengths of Materials Spring 2015

Department: Civil & Environmental Engineering

Designation: Required

General Catalog Course Description:
Concept of stress, axial stress and strain, torsion, pure bending, transverse loading, transformations of stress and strain, design of beams and shafts for strength, deflection of beams, columns; applications to simple engineering problems.

Prerequisites: “C” or better in CVEEN 2010 Statics AND Intermediate Major Status in Civil Engineering

Textbooks and/or other required material:
Mechanics of Materials, 6/E, Beer, Johnston, DeWolf, Mazurek

Course Learning Outcomes:
Upon successful completion of this course, the student will be able to:
8. Develop and apply basic models of stress and strain for mechanical or structural components.
9. Model the state of stress at a point and determine maximum normal and shear stresses.
10. Design and assess the adequacy of axially, transversely, and/or torsionally-loaded members.
11. Calculate elastic, plastic, and thermal strains and deflections of a member.
12. Analyze basic statically indeterminate members.

Topics covered in the course:
- Concept of stress and strain
- Deformations of
  - Axially loaded members
  - Torsionally loaded members
  - Members in bending and transverse shear
- Transformations of stress and strain
- Combined loading
- Thin-walled pressure vessels
- Plane stress and plane strain
- Design of beams, shafts, columns, and truss members
- Applications to simple statically indeterminate problems.

Class/laboratory schedule: 3-0-3 (Lecture-Lab-Total) (3) 50-minute lectures each week.

Contribution of course to meeting the requirements of ABET Criterion 5:
Engineering Science
Connection to the Curriculum: Strengths of materials is a foundational study to a deep and broad set of courses in the civil engineering curriculum. In essence, it is the second in a sequence of three courses in solid mechanics (Statics, Mechanics of Materials, and Structural Analysis). In turn, that sequence is pre-requisite to each of the structural design courses as well as additional analysis courses.

Relationship of the course to the Program Outcomes:

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>Expected Level of Achievement Based upon Bloom’s Taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. an ability to apply knowledge of mathematics through differential equations,</td>
<td>Program-level by graduation: Application</td>
</tr>
<tr>
<td>science and engineering. The science should include calculus- based physics,</td>
<td>Course-level: Application</td>
</tr>
<tr>
<td>chemistry, and at least one additional area of science, consistent with the</td>
<td></td>
</tr>
<tr>
<td>program educational objectives.</td>
<td></td>
</tr>
<tr>
<td>c. an ability to design a system, component, or process in more than one civil</td>
<td>Program-level by graduation: Synthesis</td>
</tr>
<tr>
<td>engineering context to meet desired needs within realistic constraints such</td>
<td>Course-level: Application</td>
</tr>
<tr>
<td>as economic, environmental, social, political, ethical, health and safety,</td>
<td></td>
</tr>
<tr>
<td>constructability, and sustainability.</td>
<td></td>
</tr>
<tr>
<td>e. an ability to identify, formulate, and solve engineering problems by</td>
<td>Program-level by graduation: Application</td>
</tr>
<tr>
<td>applying knowledge of four technical areas appropriate to civil engineering.</td>
<td>Course-level: Application</td>
</tr>
<tr>
<td>g. an ability to communicate effectively using verbal, written, and graphical</td>
<td>Program-level by graduation: Analysis</td>
</tr>
<tr>
<td>skills.</td>
<td>Course-level: Application</td>
</tr>
</tbody>
</table>

Bloom's Taxonomy considers the following six levels of achievement: (1) Knowledge, (2) Comprehension, (3) Application, (4) Analysis, (5) Synthesis, and (6) Evaluation. It is expected that instructors will perform informal assessments of desired criteria to the extent that they feel is necessary to support achievement of the Program outcomes through the overall curriculum. Required criteria, if any, should be assessed at the course level because they directly support the Program level outcome evaluation required by ABET.

Prepared by: Doug Schmucker Date: 9 June 2015
COURSE ASSESSMENT FORM

Course: CVEEN 2140 Strengths of Materials

Term: Spring 2015       Completed by: Doug Schmucker       Date: 9 June 2015

Assessment Means
- Student Performance as measured by competency-based rubric
- Review of Pre-requisite Knowledge, Skills, and Aptitudes

Description of Student Work used in the Assessment
- Interim Examinations: Formative Assessment (data not presented here)
- Final Examination: Summative Assessment
- Interim exams are comprised of typical homework style items, e.g., given a structure and loading, calculate reactions, etc.
- The final exam is a Fundamentals of Engineering (FE) Exam-based test, i.e., minimum competency-based, multiple-choice items. It differs from the FE Exam in that work is required for any credit; partial credit is awarded based upon work shown. The exam contains 20 items. The level of difficulty of each item is geared towards minimum competency in the subject matter and is not geared towards differentiating between A, B, and C-level performance, etc. In order to earn a C or better in the course, the student must earn a C or better on the final exam.

Pre-Requisite Knowledge, Skills, and Aptitudes
- Students are required to have passed Statics with a “C” or higher and are typically nearly complete with their math sequence through differential equations (often taken concurrently).

Course Materials
- The BJDM text contains broad coverage of the course topics. It specifically includes plastic behavior at the specimen level (material behavior), at the member level, and at the system level (multiple members). Most other texts stop at the specimen level.

Course Study Notes developed by the instructor. These are gap, or fill-in-the blank, style student notes that include lesson objectives, text references, supplemental content, sample problems, and lesson examples. Videos of solved problems from prior exams.
Assessment Rubric

Performance of student work is assessed by the following rubric:

<table>
<thead>
<tr>
<th>Level</th>
<th>Letter Grade Equiv.</th>
<th>Percent Equiv.</th>
<th>Numeric Equiv.</th>
<th>Qualitative Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exemplary</td>
<td>A</td>
<td>&gt; 90%</td>
<td>4</td>
<td>No to minor mistakes.SIGNIFICANT ADDITIONAL QUALITY BEYOND MINIMUM</td>
</tr>
<tr>
<td>Proficient</td>
<td>B</td>
<td>&gt; 80%</td>
<td>3</td>
<td>Several minor mistakes; almost no conceptual mistakes.ADDITIONAL QUALITY BEYOND MINIMUM</td>
</tr>
<tr>
<td>Minimally Competent</td>
<td>C</td>
<td>&gt; 70%</td>
<td>2</td>
<td>Several mistakes, some major; conceptual mistakes.MINIMUM COMPETENCY</td>
</tr>
<tr>
<td>Marginal</td>
<td>D</td>
<td>&gt; 60%</td>
<td>1</td>
<td>Many significant mistakes and conceptual errors.FAILED TO ACHIEVE MINIMUM COMPETENCY BUT DEMONSTRATES SOME GENERAL KNOWLEDGE</td>
</tr>
<tr>
<td>Unsatis.</td>
<td>E</td>
<td>&lt; 60%</td>
<td>0</td>
<td>Non-response or completely incorrect response.</td>
</tr>
</tbody>
</table>

Assessment Data

Data were collected from the final examination items that directly corresponded to one of the course outcomes. Each student’s performance on each relevant item was scored according to the assessment rubric. Where a course outcome was supported by more than one item, the student’s performance level was averaged across those relevant items. The table below indicates which items were used to evaluate a student’s performance for each course outcome. Other items on the examination included lower level performance skills, e.g., finding components of a force.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Description</th>
<th>Final Exam Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Stress and Strain Models</td>
<td>Items: 1, 2, 3, 4, 10, 11, 15</td>
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As seen in the graph and the table, the average performance met or exceeded the requirement of meeting minimum competence in three directly measured areas: Basic Stress and Strain, State of Stress at a Point, and Design. The other three areas had average performances just below minimum competence (averages ranged from 1.76 to 1.95).
Observations and Conclusions
The following observations and conclusions are developed:

Student Performance
- Basic performance on the final exam met expectations. Minimum competence should not be confused with mastery, i.e., A-level performance. Rather this cohort of students demonstrated poor performance in the prior course (Statics) and continued to demonstrate weak performance in the follow-on course (Strengths).
- The performance in the Design category should perhaps be disregarded. There were only two items on the final exam in the category and those items were only indirectly related to design (shear and moment diagrams and a buckling item). The interim exams contained items related to factors of safety and selecting the size of members. Students performed sufficiently on those that the content was not repeated at depth on the final exam.
- Shear and moment diagrams are pre-requisite material to this course. In past years, the content was repeated as though it were original material. This term, it was not. And, the student performance appeared adequate on the final exam. Likely, it would be wise to create video reviews of this important concept.

Course Materials
- The BJDM text appears to have only nominal appeal to the students.
- BJDM does not present tension tests and corresponding data in sufficient depth; it also does not present much in the way of different typical stress-strain curves for typical civil engineering materials.
- Many students decided to find a different resource for reading about the material. I recommend that a study be performed to select another author, such as Philpot, Goodnoe and Gere, Hibbeler, etc.

Pre-Requisite Knowledge, Skills, and Aptitudes
- The students have not had and do not enroll concurrently in a materials course that contains a lab. Hence, they are not familiar with tensile tests, etc., and this makes setting the context for the theoretical models difficult. A series of videos showing the various tests would be quite helpful.

Means of Assessments
- Mini-tests were added prior to spring break (stress transformation) and for beam deflections and for buckling. These appear to be effective if not popular.

Recommendations
- No major changes to the course outcomes, grade formula, performance rubric, nor flow of course content.
- If there is a text that presents more tension test information and stress-strain models, I encourage a switch. BJDM appears not to be accessible to the students.
- Add supplemental material (videos, demonstration aids, etc.) that demonstrate testing apparatus, etc.
CIVIL AND ENVIRONMENTAL ENGINEERING  
(Course Level Assessment of Student Outcomes)

COURSE NO: CVEEN 3310 – Spring 2011  
COURSE TITLE: Introduction to Geotechnical Engineering  
INSTRUCTOR: Steven F. Bartlett, P.E., Ph.D., Associate Professor

ABET Student Outcomes addressed by this course

e. an ability to identify, formulate, and solve engineering problems by applying knowledge of four technical areas appropriate to civil engineering. Course-level: Application (required) (flow net calculations).

Performance Indicator (as Related to Course Objective)

Students will show application level of solving engineering problems by performing flow net and/or consolidation calculations.

Proficiency Levels

Mastery = 3 – Ability to complete the assignment or exam problem with no significant conceptual errors. Errors can be made in algebra, trigonometry or calculus (no more than two). (70 percent or higher score received for exam or homework assignment.)

Marginal = 2 – Ability to complete the assignment with minor conceptual errors. Errors are made in algebra, trigonometry or calculus (more than two) (60 to 79 percent credit received for exam or homework assignment.)

Deficient = 1 – Significant conceptual errors made when completing problem or problem is not finished (less than 60 percent received on exam or homework assignment).

Proficiency Goal

Ninety (90) percent of the students achieving mastery level on the assignment, laboratory exercise or exam question.
Assessment Tool

The students were evaluated regarding the ability to perform flow net calculations as part of the final exam (see problem below.)

Flow Net Problem

Mid Term #3 CVEEN 3310, May 2, 2011 Name: KEY

Open Book Portion (Time Limit = 50 minutes, 50 points possible)

1. A flow net showing the 2D cross-section flow underneath a dam is shown below. The elevation datum (x = 0) is located at the base of the sand/rock interface. From this diagram, perform the following:

   - Calculate the head value (elevation + pressure head) of each equipotential line. Label each equipotential line with the calculated head on the above figure. (20 points)
   - Calculate the cross-sectional flow (m³/d) underneath the dam assuming that the hydraulic conductivity of the sand is 1 x 10⁻⁴ m/s. (2 points)
   - Calculate the vertical total stress at the base at point A. Neglect any influence of the concrete dam on the vertical total stress. Assume the saturated density of the sand is 2.2 Mg/m³ and that the dry density is 1.9 Mg/m³ and that the moisture content of the saturated sand is 15.79 percent (2 points)
   - Calculate the vertical effective stress at the base of the sheet pile cutoff (i.e., point A). (2 points)
   - Calculate the exit gradient at the toe of the dam. The distance between the equipotential lines is 1 m at this location. (2 points)
   - Calculate the critical gradient at the toe of the dam. (10 points)
   - Calculate the factor of safety against piping at the toe of the dam. (2 points)
Evaluation
There were 81 students in this class, two of which did not attempt the final exam. Of the 79 remaining students, 69 achieved mastery level which is 87 percent (see data below). Thus, the proficiency goal was almost met for this outcome.

Recommendations
Performance goal met. No changes in course content or course delivery are recommended.
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Attachment 3 – Continuous Improvement Forms
CRITERION 1 – STUDENTS
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2010

Course(s) affected (as applicable): Math Courses

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Revision to minimal acceptable course grades for major status

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Prior to 2010, the requirement for major status in the department allowed a C- or better grade in the following 1000 and 2000 level courses.

- MATH 1220 Calculus II
- MATH 2210 Calculus III
- MATH 2250 Ordinary Differential Equations & Linear Algebra
- PHYS 2210 Physics for Scientists & Engineers I
- CHEM 1220 or CHEM 2310 or PHYS 2220
- General Chemistry II or Organic Chemistry or Physics for Scientists & Engineers II
- CVEEN 1000 Introduction to Civil & Environmental Engineering
- CVEEN 2010 Statics
- CVEEN 2140 Strength of Materials
- ME EN 2020 Particle Dynamics
- CP SC 1000 or CH EN 1703 or Numerical Methods
- MG EN 1050 Technical Communication (Auto-CAD)
- MG EN 2400 Introductory Surveying
- LEAP 1100 Community as Ideas Experience: America Prospective

The requirement was changes so that all math courses require a C or better in the following list. The remaining courses must be passed with a C- or better

- MATH 1220 Calculus II
This change to the math course minimum grade requirement was done to raise the performance and quality of student entering into the CVEEN program. The undergraduate committee and faculty felt that this was necessary in order for students to reasonably maintain a minimum GPA of 2.50 (departmental requirement) and to improve students’ preparation.

**What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)**

CVEEN undergraduate committee

**Brief discussion of implementation strategy and timeline:**

Implemented fall 2010
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2012

Course(s) affected (as applicable): Math Courses

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Revision to minimal acceptable course grades for major status

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Prior to 2012, the requirement for major status in the department allowed a C- or better grade in the following 1000 and 2000 level courses. In addition, all math courses require a C or better.

MATH 1220 Calculus II
MATH 2210 Calculus III
MATH 2250 Ordinary Differential Equations & Linear Algebra
PHYS 2210 Physics for Scientists & Engineers I
CHEM 1220 or CHEM 2310 or PHYS 2220
General Chemistry II or Organic Chemistry or Physics for Scientists & Engineers II
CVEEN 1000 Introduction to Civil & Environmental Engineering
CVEEN 2010 Statics
CVEEN 2140 Strength of Materials
ME EN 2020 Particle Dynamics
CP SC 1000 Engineering Computing
MG EN 1050 Technical Communication (Auto-CAD)
MG EN 2400 Introductory Surveying
LEAP 1500 LEAP Seminar in Humanities for Engineers

This was changed in fall 2012 to require a grade of C or better must be achieved in Math, Physics, Chemistry. All other courses remained with a C- or better requirement (see list below).
CHEM 1210 General Chemistry I  
CVEEN 1000 Introduction to Civil Engineering  
CVEEN 2010 Statics  
LEAP 1501 Engineering LEAP  
MATH 1210* Calculus I  
MATH 1220** Calculus II  
PHYS 2210 Physics for Scientists & Engineers I  
WRTG 2010 or ESL 1060  
CS 1000 Engineering Computing  
CVEEN 2140 Strength of Materials  
LEAP 1500 Engineering LEAP  
MATH 2210 Calculus III  
CVEEN 2130 Statistics/Economics  
MATH 2250 ODE’s  
MG EN 2020 Particle Dynamics  
MG EN 1050 Technical Communication  
MG EN 2400 Surveying

The change in the minimum grade requirement was done to raise the performance and quality of student entering into the CVEEN program. The undergraduate committee and faculty felt that this was necessary in order for students to reasonably maintain a minimum GPA of 2.50 (departmental requirement) and to improve students’ preparation.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

CVEEN undergraduate committee

Brief discussion of implementation strategy and timeline:

Implemented fall 2012
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2014

Course(s) affected (as applicable): All

Group/Committee/Person(s) making recommendation: Faculty subcommittee

Short title for recommendation: CVEEN Academic Misconduct Policy

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

It is recommended that CVEEN adopt its own academic misconduct policy that is consistent with that of the University (http://regulations.utah.edu/academics/6-400.php).

The U of U defines academic misconduct as disreputable activities involving cheating, plagiarizing, research conductivity, misrepresenting one’s work, and inappropriate collaboration.

The draft policy includes: (i) definition of Academic misconduct, (ii) sanctions and appeals, (iii) instructor responsibilities, (iv) student responsibilities, (v) acknowledgement form.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Add hoc subcommittee of the undergraduate committee worked on this policy with input from Chair

Brief discussion of implementation strategy and timeline:

Draft document was discussed in Dec. 2014 faculty meeting. Revisions are being considered.
CRITERION 2 – PROGRAM EDUCATIONAL OBJECTIVES
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2014

Course(s) affected (as applicable): _______________

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Revision of CVEEN program education objectives

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Based on recommendations by CVEEN undergraduate committee and the COE ABET committee, it was decided that the CVEEN program objectives developed in 2009 needed to be updated. It was felt that the objectives need to reflect the changes in CVEEN and eliminate some of the unclear language used in the 2009 version. Draft objectives were presented to the faculty in fall 2014 retreat, and voted on and approved. These were also presented to the IAB in spring semester 2015.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

CVEEN undergraduate committee and COE ABET committee

Brief discussion of implementation strategy and timeline:

Implemented fall 2014.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2014

Course(s) affected (as applicable):

Group/Committee/Person(s) making recommendation: Chair / Dean /Faculty

Short title for recommendation: Revision to FE graduation requirement

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The Dean and the College of Engineering made the recommendation that all departments consider dropping the passing of the F.E. as a requirement for graduation. The 2008-2010 and the 2010-2012 handbook list the following requirement.

The Department requires that prior to graduation each student either pass the FE exam or demonstrate a serious attempt to pass the exam by taking it at least 3 times and submit a copy of all exam results to the Academic Program Specialist (2012 MCE).

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

COE recommendation discussed and voted on in faculty meeting during fall 2014 retreat.

Brief discussion of implementation strategy and timeline:

The revised policy stated below was implemented during fall 2014 semester. The Department faculty considers the passing of the FE exam to be an important step in an individual’s progress towards professional practice. The faculty also considers the passing of this exam as a demonstration of the quality of the basic engineering capabilities of each student. The Department highly encourages students to take the exam prior to graduation, as it is an important step for a career in civil engineering (2014-16 CVEEN handbook).
CRITERION 3 – STUDENT OUTCOMES
Date of recommendation or suggestion: fall 2014

Course(s) affected (as applicable): _______________

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Revision of CVEEN Assessment Matrix

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The CVEEN assessment matrix adopted as part of the 2009 ABET review cycle has a number of course with repetitive assessments. In order to simply this and to decrease the faculty burden regarding assessment a simpler matrix was adopted as part of 2014 Faculty Retreat.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

CVEEN undergraduate committee and COE ABET committee

Brief discussion of implementation strategy and timeline:

Implemented fall 2014.
CRITERION 5 – CURRICULUM
Date of recommendation or suggestion: fall 2009

Course(s) affected (as applicable): CVEEN 3320

Group/Committee/Person(s) making recommendation: Infrastructure Group

Short title for recommendation: Splitting of Concrete and Steel into Two Courses

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

**Brief discussion of the recommendation:**

It was recommended to split the four semester hour CVEEN 3320 Concrete and Steel course into two separate 3-semester hour courses. CVEEN 3320 had too much course content to be counted as a 4 semester hour course and the topics were somewhat unrelated. In addition, CVEEN 3220 was required of all CVEEN students. However, it was recommended that the new courses (i.e., Concrete I and Steel I) become technical electives in the program at the 4000-level. Structural Analysis I (CVEEN 3210) was retained as a required course for all CVEEN graduates and the entry level required course for all structural emphasis students.

**What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)**

Student exit interviews and course evaluations

**Brief discussion of implementation strategy and timeline:** Discussed in fall 2009 Faculty Retreat and implement in fall 2010. The new course designations are CVEEN 4221 (Concrete I) and CVEEN 4222 (Steel I).
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2010

Course(s) affected (as applicable): _______________

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Addition of Courses to Meet Additional Science Requirement

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The list of additional science courses was expanded from:

- CVEEN 5110 GIS in Civil Engineering
- CVEEN 5630 Ecological Systems and Engineering
- CVEEN 5700 Nuclear Engineering I, with Lab
- CVEEN XXXX Environmental Microbiology

...to

- CVEEN 5110 GIS in Civil Engineering
- GEO 1110 Introduction to Earth Systems
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- NUCL 3000 Nuclear Principals in Science
- NUCL 3200 Radiochemistry

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Recommendation coming from undergraduate committee to faculty

Brief discussion of implementation strategy and timeline:
The new list was approved by faculty and adopted into the CVEEN 2010 – 2012 Handbook.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2010

Course(s) affected (as applicable): CVEEN 3310

Group/Committee/Person(s) making recommendation: Infrastructure Group

Short title for recommendation: Change of CVEEN 3310 Textbook

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The 2nd Edition of Introduction to Geotechnical Engineering was released in Oct. 2010. It was recommended that CVEEN 3310 adopt this new edition and adjust it curriculum to be consistent with this textbook.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Infrastructure Group Recommendation

Brief discussion of implementation strategy and timeline:

The 2nd Edition textbook was adopted into the curriculum in spring semester 2011. The course content was slightly adjusted to better match the new content of this edition. The adjusted curriculum can be found at: http://www.civil.utah.edu/~bartlett/CVEEN3310/
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2011

Course(s) affected (as applicable): CS 1000

Group/Committee/Person(s) making recommendation: Undergraduate Committee / Exit Interviews

Short title for recommendation: Revision to programming languages taught in CS 1000

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Exit interview indicate that students’ were dissatisfied with part of CS 1000 curriculum. In specific, there was criticism regarding the teaching of C programing language that was taught during the second part of the semester. Civil engineering students saw little value in learning C, especially since it was not used or reinforced in any significant in the remainder of the CVEEN curriculum.

The undergraduate committee discussed the issue and decided that it would be more appropriate if calculations were taught using spreadsheets during the 2nd part of this course. It agree that CS 1000 should continue in the teaching of MATLAB during the first part of this course.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Exit interviews / Undergraduate Committee

Brief discussion of implementation strategy and timeline:
The curriculum was changed in 2011 by the CS department. The following is the 2011 revised course description.

1000  Engineering Computing  (3) Corequisites: MATH 1210 OR MATH 1250 OR MATH 1270 OR AP Calc AB score of 4 or better OR AP Calc BC score of 3 or better. This course is an Introduction to programming principles and engineering problem solving via computational means using MATLAB and Spreadsheets. This course teaches how to apply programming to solve Engineering problems (e.g., data visualization, stochastic simulation, selected numerical techniques, image manipulation ...). Students will be taught how to transform real world problems into programs using proper data representations, functions, and control structures. Clean programming practices will be emphasized.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: __Summer 2012______

Course(s) affected (as applicable): ___CVEEN 5920________

Group/Committee/Person(s) making recommendation: ___Pedro Romero and Steve Burian__

Short title for recommendation: __Faculty Lead Study Abroad _____

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Offer the first ever faculty lead study abroad class in the college of engineering.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

General faculty discussions

Brief discussion of implementation strategy and timeline:

A seed grant was requested to and granted by the Office of International Studies in 2011 to develop a faculty lead study abroad course during the summer term. The instructors, Pedro Romero and Steve Burian, traveled to Costa Rica where they studied their sustainability practices then incorporate their learning and contacts into a study abroad program. The curriculum was developed for the class and voted by the faculty to count as a one-time technical elective. During the summer term of 2012, the instructors and 24 students (18 of which were civil engineers) traveled to Costa Rica for over 3 weeks where they visited the power generating infrastructure, their transportation network, and a few examples of self-sustainable communities.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2012

Course(s) affected (as applicable): _______________

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Addition of Courses to Meet Additional Science Requirement

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The list of additional science courses was expanded from:

- CVEEN 5110 GIS in Civil Engineering
- GEO 1110 Introduction to Earth Systems
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- NUCL 3000 Nuclear Principals in Science
- NUCL 3200 Radiochemistry

to

- BIOL 2010 Evolution & Diversity of Life
- BIOL 3460 Global Environmental Issues
- GEO 1110 and GEO 1115 Introduction to Earth Systems & Introduction to Earth Systems Lab
- GEOG 3110 Remote Sensing
- GEOG 3330 Urban Environmental Geography
- GEOG 5210 Global Climate Change
- MSE 2160 Elements of Material Science & Engineering
- NUCL 3000 Nuclear Principals in Science
What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Recommendation coming from undergraduate committee to faculty

Brief discussion of implementation strategy and timeline:

These changes were made to offer basic science course options to students that are consistent with the program objectives.

The new list was approved by faculty and adopted into the CVEEN 2010 – 2012 Handbook.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: summer 2013; Date of Documentation: 10 April 2015

Course(s) affected (as applicable): CvEEN 1000

Group/Committee/Person(s) making recommendation: Larry Reaveley

Short title for recommendation: Integration of Team Historic Projects

Please mark applicable ABET criteria affected by recommendation:

1. Students
3. Student Outcomes
4. Continuous Improvement
5. Curriculum

Brief discussion of the recommendation:
The primary course project will be the student team-based research and presentation of a term-length project focused on an assigned historic civil engineering project. This new student project replaces small “design” projects. The course schedule will be refocused to enable in-class presentations (30 minutes each for 16 teams; 4 to 5 weeks of presentations) and to enable in-class time in the first half of the semester for teams to work together and receive feedback on the drafts of their work.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Faculty discussion

Brief discussion of implementation strategy and timeline:

Effective in fall 2013.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: __fall 2013____

Course(s) affected (as applicable): ___________________________

Group/Committee/Person(s) making recommendation: ___Michael Barber and Pedro Romero__

Short title for recommendation: __Adding ECON 2010 and ECON 2020 to Gen Ed Requirements

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Add ECON 2010 and ECON 2020 (Micro and macro Economics) as the recommended Ged Ed courses for civil engineering students

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

General faculty discussions

Brief discussion of implementation strategy and timeline:

A review was made of the curriculum and it was decided that recommending ECON 2010 and ECON 2020 as the preferred Ged Ed classes was appropriate. Students can still opt out and take other Gen Eds; however, those that follow the Handbook recommendation would take these two classes.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2013

Course(s) affected (as applicable): Math 1210, 1220 2220 and 2250

Group/Committee/Person(s) making recommendation: College of Engineering

Short title for recommendation: Adoption of COE Math Sequence

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The College of Engineering Math Committee has been working for the past few years to improve the quality and content of the calculus sequence. In conjunction with the math department, a new sequence of courses is now recommended for all engineering students.

The COE math sequence is: Math 1310 (Calc. I), Math 1320 (Calc. II), Math 2250 (Calc. III w/ ODEs), Math 3140 (Vector Calc. and PDEs).

The sequence replaces the previous sequence of: Math 1210 (Calc. I), Math 1220 (Calc. II), Math 2220 (Calc. III) and Math 2250 (ODEs).

However, transfer students still have the option of completing the regular math sequence. In addition, if they have not had PDEs then they also must enroll in Math 3150 (PDs)

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

College of Engineering Math Committee

Brief discussion of implementation strategy and timeline:

The new COE math sequence was implemented in the CVEEN 2014 Handbook.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: __spring 2014______

Course(s) affected (as applicable): ___CVEEN 5550__________

Group/Committee/Person(s) making recommendation:
___Infrastructure________________

Short title for recommendation: __Addition of Materials Sustainability Class______

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

Create a new course to introduce students to the concepts of sustainability in civil engineering applications.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

University Sustainability curriculum initiative. General faculty discussions

Brief discussion of implementation strategy and timeline:

A special topic class was offered on spring semester 2014. Based on the student feedback and the instructor’s assessment of the class, changes were made and a new curriculum was developed and reviewed by both the infrastructure group and the transportation group. Also, a University-level group meets once a month to discuss the incorporation of sustainability instruction at different levels also provided feedback about the class. Based on this input, CVEEN 5550 was created and approved by the faculty during fall 2014 to count as a primary technical elective in the area of Materials.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: Summer 2014

Course(s) affected (as applicable): CVEEN 4910 and CVEEN 3100

Group/Committee/Person(s) making recommendation: COE

Short title for recommendation: CLEAR support for CVEEN 4910 and CVEEN 3100

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The College of Engineering restructured the CLEAR program. It was decided to remove CLEAR support from the instruction of CVEEN 4910. CLEAR would be the sole instructor of CVEEN 3100.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

COE recommendation

Brief discussion of implementation strategy and timeline:

The curriculum of CVEEN 4910 was restructured to include more design content in the course. This was done because of two reasons: (1) more design content could be added because some of the writing and presentation exercises sponsored by the CLEAR instructors have been reduced, (2) student feedback from the exit interviews suggest that there was some overlap between the content of CVEEN 3100 (technical communication) and CVEEN 4910. This duplication has been eliminated.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: Summer 2014; Date of Documentation: 10 April 2015

Course(s) affected (as applicable): CvEEN 4910

Group/Committee/Person(s) making recommendation: Doug Schmucker

Short title for recommendation: Change in format due to instructional support being withdrawn

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Outcomes
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Professional Communication
7. Institutional Support
8. Institutional Support

Brief discussion of the recommendation:

1) The College of Engineering has withdrawn CLEAR instructional support for the 4910 course. Hence, the teaching intensive writing and presentation skills will need to be reallocated and reformatted.

2) The students’ “final” presentation will be a public presentation.

3) Students will review self-selected ethics case studies from ASCE and present them to the class.

4) Instead of daily memo’s prepared by each student that capture that day’s learning activities, student participation in the class will be measured by a portfolio to be presented at the end of the semester. That portfolio represents their self-directed inquiry and documentation of that inquiry into the professional skill sets required for success in the profession. (These skill sets align with ASCE’s BOK).

To make those changes: the course will be re-focused
What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

A. Dean’s decree.
B. Faculty discussion

Brief discussion of implementation strategy and timeline:

Effective in fall 2014.

Without CLEAR support, the instructional team has been reduced by 50%. The project requirements for Proposal, Feasibility Study, and Preliminary Engineering Report will be re-focused to a Conceptual Design Report. Proposals and Feasibility Studies will be discussed as concepts and focused on lower level aspects (e.g., defining what they are and what role they play in the process of professional practice and design) rather than on simulating the development of these products by having students attempt to create them.

The course will become far less structured in the sense that the prior format required a highly tight schedule of moving pieces and parts in order to move students through three very fast moving products in one semester. In the new format, the students will be focused on developing a variety of design concepts (alternatives) and begin to flesh them out. In essence, they will be doing the same thing as before but without as much formal structure to the process and without near as much pressure to produce a product for which they have little background, preparation, and experience.

The new schedule will look like:

**COURSE CALENDAR/SCHEDULE:**
Due to the collaborative nature of the course both in its design and its execution, the following schedule should be treated as guidelines and not as contractual expectations.

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<td>3</td>
<td>9-Sep</td>
<td>5</td>
<td>Team Meetings</td>
<td>T1, T2, T3</td>
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<td>11-Sep</td>
<td>6</td>
<td>Team Meetings</td>
<td>T4, Weekly Report</td>
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<td>4</td>
<td>16-Sep</td>
<td>7</td>
<td>The Non-Verbal Professional</td>
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<td>8</td>
<td>Team Meetings</td>
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<tr>
<td>5</td>
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<td>25-Sep</td>
<td>10</td>
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<td>6</td>
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<td>11</td>
<td>CATME Training Scenario</td>
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<td>9-Oct</td>
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<td>Mid-term Project Status Report</td>
<td>T5</td>
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<td>14-Oct</td>
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<td>21-Oct</td>
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<td>Legal and Ethical Responsibilities in Utah</td>
<td>DGS</td>
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<td>23-Oct</td>
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<td>Contemporary Issues Presentation</td>
<td>I2 Students</td>
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<td>Life Cycle Cost Analysis</td>
<td>DGS, BF</td>
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<td>Alternative Analysis, Decision Matrix</td>
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<td>I3, T7 Oral Presentation B. Leonard</td>
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<td>2-Dec</td>
<td>26</td>
<td>PER Revision 1 due</td>
<td>I5</td>
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<td>9-Dec</td>
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<td>Public Presentation</td>
<td>T8 Public Presentation Students</td>
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<td>11-Dec</td>
<td>29</td>
<td>Summary and Wrap-Up</td>
<td>I6 In-class Essay; Surveys DGS</td>
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<td>16-Dec</td>
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<td>Final Revisions if Needed</td>
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**INDIVIDUAL ASSIGNMENTS**
Each student is responsible for each of the following assignments. Details, submission requirements, schedules and deadlines are provided on the course web page.

- **IA 0  ASCE Membership (50 points).** Obtain your free ASCE student membership from the national organization. Go to www.asce.org/join and scroll to the bottom of the page. The form is the same for both professionals and students. Submit your membership number via the course web site along with a screenshot of your membership profile.

- **IA 1  Ethics Case Study (100 points).** Select from a provided list and present an ASCE News monthly ethics case study.
• **IA 2 Contemporary Issues (200 points).** Select from a provided list and present a contemporary issue associated with the practice of civil engineering.

• **IA 3 Professional Skill Sets Documentation (300 points).** Prepare a portfolio that documents your comprehension of professional skill sets relevant to the practice of civil engineering.

• **IA 4 CATME Formative Peer Review (50 points).** Complete a formative assessment of yourself and each team member via the online instrument CATME (you will be sent an email with the link when the survey is active).

• **IA 5 CATME Summative Peer Review (50 points).** Complete a summative assessment of yourself and each team member via the online instrument CATME (you will be sent an email with the link when the survey is active).

• **IA 6 Summative Wrap-Up (50 points).** Attendance at the last day of class is required. A number of wrap-up surveys and essays will be conducted during class. The points here are associated with participation in those activities (not for the quality or quantity of information provided so long as a good faith effort is provided.)

**TEAM PROJECT COMPONENTS**
Each team prepares both a written report and oral presentation of the project. Team deliverables include but are not necessarily limited to the items described as follows:

**T1 Draft team charter (100 points).** Prepare a charter with the following information regarding the organization of your team: Team Organization (Roles of Responsibility), Schedule for Rotation of Roles, Ground Rules, Enforcement Policy. Include the roles of responsibility that your team will use, the tasks associated with each role, the means by which performance will be measured internally in the team, and how those roles will be rotated throughout the semester. Ground Rules should include specific reasons constituting firing of a member. Firing should be used as a last resort and can only happen after consultation with the instructor. The enforcement policy must specifically address the Ground Rules and must also include an "undersigned" statement. Only create pragmatic rules that you can live with and enforce. This charter is focused on the overall perspective of how the team will function, e.g., how the team will conduct meetings, expectations of performance. Your group will create a different document that will outline the specific engineering tasks, schedules, etc.

**T2 Draft Project Scope of Work and Plan (100 points).** In consultation with the instructional team, create a project-oriented scope of work and plan (schedule) with details regarding engineering and project management tasks.
T3  Project Resources (100 points). Develop a detailed list of resources that you plan to use for your project. Although your group will inevitably add to these sources, there should be a substantial list provided.

T4  Final Project Scope of Work and Plan (100 points). Present a final plan that reflects interview with the client’s representative and feedback from the instructional team.

T5  Mid-term Project Status Report and Briefing (100 points)

T6  Project Engineering Report (300 points) Opportunities for revision will be possible but the T6 deliverable must be complete and of sufficient depth to be eligible for enhancement points.

T7  In-class Presentation (100 points) Provide a copy of the slides of your oral presentation project. The copy should be in the form of 6 slides per page and in pdf format. Animations need not be indicated nor printed.

T8  Public Presentation (200 points).
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: spring semester 2015

Course(s) affected (as applicable): CVEEN 2130

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: Splitting of CVEEN 2130 into 2 courses

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

This proposal recommends the splitting of CVEEN 2130 into two separate courses. One would focus on Engineering Economics and the other would deal with topics related to engineering statistics.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Student feedback, course evaluations, discussion amongst undergraduate committee

Brief discussion of implementation strategy and timeline:

In spring semester 2015, the faculty approved the splitting of the 4-semester hour course CVEEN 2130 (Statistics and Economics) into two separate courses. As currently constituted, each of these topics is taught during one block (i.e., during one-half of the semester). However, the new courses consist of 2-semester hours each, and will be taught for the full duration of the semester. This change will be implemented during the 2015-2016 academic year.
CRITERION 6 – FACULTY
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2013

Course(s) affected (as applicable):

Group/Committee/Person(s) making recommendation: Undergraduate Committee

Short title for recommendation: ABET Workshop for Faculty

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

A workshop was recommended for training of faculty about the ABET review process, assessment and evaluation.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Undergraduate committee

Brief discussion of implementation strategy and timeline:

An ABET workshop was held during fall 2014. This was held in two sessions. The course material can be found at:

http://www.civil.utah.edu/~bartlett/ABET/ABET%20CVEEN%20presentation.pdf
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2014

Course(s) affected (as applicable): none

Group/Committee/Person(s) making recommendation:

Short title for recommendation: Establishment of CVEEN Faculty Mentoring Committee

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The University Retention, Promotion and Tenure (RPT) Standards Committee has adopted the below statement as a guide for departments in determining their criteria and indicators of good teaching for use in RPT decisions.

Evaluation of teaching effectiveness should not consist solely of student evaluations, though student satisfaction with teaching methods and course administration is one component of effective teaching. The University of Utah and Faculty Senate recently elected to amend policy to make Peer Review of Teaching Effectiveness required. Expert review of teaching effectiveness is also recommended.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

University RPT Standards Committee

Brief discussion of implementation strategy and timeline:

CVEEN established a mentoring committee to help in instruction and RPT process. This committee was established spring semester 2015.
CRITERION 7 – FACILITIES
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: __spring 2010____

Course(s) affected (as applicable): ___3510____________

Group/Committee/Person(s) making recommendation: ___Infrastructure____________

Short title for recommendation: __Allocation of teaching space for 3510 Materials Lab____

Please mark applicable ABET criteria affected by recommendation:

- Students
- Program Educational Objectives
- Student Outcomes
- Continuous Improvement
- Curriculum
- Faculty
- Facilities
- Institutional Support

Brief discussion of the recommendation:

Provide a dedicated space for the instruction of CVEEN 3510 Materials lab.

HEDCO room 110 was cleared and remodeled to provide a dedicated space for the materials lab. Counter space was made available for students to work in groups, discuss calculation, use their laptops, etc. The equipment was set up in one place so it is readily available.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

Student feedback

Brief discussion of implementation strategy and timeline:

Once the space was cleared, classes are held on the space every year.
Date of recommendation or suggestion: May, 2010

Course(s) affected (as applicable): CVEEN 3310 Lab

Group/Committee/Person(s) making recommendation: Infrastructure / Student Exit Interviews

Short title for recommendation: Upgrading of Equipment in CVEEN 3310 Lab

Please highlight applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The recommendation entails upgrading some of the laboratory equipment in the Geotechnical Laboratory.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

The suggestions for improvement originated from student feedback obtained from course assessments and from exit interviews.

Brief discussion of implementation strategy and timeline:

Grant monies were obtained from the College of Engineering to purchase select new equipment. The instructors identified the follow items for replacement.


Items 1 through 6 were purchased and installed in the CVEEN 3310 Lab in fall 2010; Item 7 was installed in fall 2012.
CVEEN - ABET Continuous Improvements Form

Date of recommendation or suggestion: fall 2010

Course(s) affected (as applicable): _______________

Group/Committee/Person(s) making recommendation: _______________

Short title for recommendation: New Facilities in Meldrum Civil Engineering Building

Please mark applicable ABET criteria affected by recommendation:

1. Students
2. Program Educational Objectives
3. Student Outcomes
4. Continuous Improvement
5. Curriculum
6. Faculty
7. Facilities
8. Institutional Support

Brief discussion of the recommendation:

The EMRL building was modified with a new addition to host CVEEN. It was named the Meldrum Civil Engineering Building (MCE). This new addition added new department and faculty offices, student study areas and conference rooms.

What process was used to identify the need for the improvement (e.g., course assessment, faculty discussions, student feedback, group or committee recommendations or actions, etc.)

This MCE Building was constructed in part from a $3.3 million lead gift for its department of civil and environmental engineering. The gift, from U of alumnus Floyd Meldrum and his wife Jeri, of Las Vegas, Nevada, was the cornerstone in a $5 million campaign to strengthen civil engineering

Brief discussion of implementation strategy and timeline:

The new addition was occupied in fall 2010.
### Table 1 How the Civil Engineering Courses in the Curriculum are related to the Program Outcomes (source: 2009 CVEEN self-study report)

| Program outcomes (a) through (l), and the Bloom’s Taxonomy expected level of achievement by graduation [comprehension (Co), application (Ap), analysis (An), and synthesis (Sy)] are shown to the right. Courses are shown below. Matrix entries are (P) for the primary courses where students are expected to meet the graduation-levels of achievement, and (s) for supporting courses. |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CVEEN 1000, Intro to CvEEN | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 2/3/4000, Seminar | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 2010, Statics | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 2130, Statistics & Eng. Econ. | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 2140, Strength of Materials | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 3100, Tech. Comm. For Eng. | s | s | P | s | P | P | P | P | P | s | s | s | s |
| CVEEN 3210, Structural Analysis I | P | P | s | P | P | P | P | P | P | P | P | P | P |
| CVEEN 3220, Intro. Concrete & Steel | s | P | P | P | P | P | P | P | P | P | P | P | P |
| CVEEN 3410, Hydraulics | P | P | P | P | P | P | P | P | P | P | P | P | P |
| CVEEN 3420, Hydrology | P | P | P | P | P | P | P | P | P | P | P | P | P |
| CVEEN 3510, CE Materials | s | P | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 3520, Transportation Eng. | s | s | P | s | P | s | s | s | s | s | s | s | s |
| CVEEN 34910, Prof. Practice & Design | P | P | P | P | P | P | P | P | P | P | P | P | P |
| One additional science courses: CVEEN 5110, GIS | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 5700, Nuc. I with lab | s | s | s | s | s | s | s | s | s | s | s | s | s |
| Two out of three tech. electives (One for FASTRAX masters program) | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 5305, Geotech. II | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 5560, Transportation II | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 5605, Environmental II | s | s | s | s | s | s | s | s | s | s | s | s | s |
| Two design tech. electives | s | s | s | s | s | s | s | s | s | s | s | s | s |
| CVEEN 5220, Concrete Design II | P | P | P | P | P | P | P | P | P | P | P | P | P |
| CVEEN 5230, Steel Design II | s | P | s | s | s | s | s | s | s | s | s | s | s | s |
Program outcomes (a) through (l), and the Bloom’s Taxonomy expected level of achievement by graduation [comprehension (Co), application (Ap), analysis (An), and synthesis (Sy)] are shown to the right.
Courses are shown below. Matrix entries are (P) for the primary courses where students are expected to meet the graduation-levels of achievement, and (s) for supporting courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>(a) math, sci., engr. (Ap)</th>
<th>(b) experimentation (Sy)</th>
<th>(c) design (Sy)</th>
<th>(d) teams (Ap)</th>
<th>(e) engr. problems (Ap)</th>
<th>(f) prof. &amp; ethical (Co)</th>
<th>(g) communications (An)</th>
<th>(h) impact of solutions (Co)</th>
<th>(i) life-long learning (Ap)</th>
<th>(j) contemp. issues (Co)</th>
<th>(k) engr. tools (Ap)</th>
<th>(l) from criterion 9 (Co)</th>
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<td>CVEEN 5240, Masonry/Timber Des.</td>
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<td>One other tech. elective (None for FASTRAX masters program)</td>
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Attachment 5 – CVEEN Exit Interview Questionnaire
CIVIL & ENVIRONMENTAL ENGINEERING
Graduating Student Assessment Form

Please complete this form prior to your exit interview. Your candid, thoughtful comments are valued and needed.

1. **General Overview**
   1. Were you satisfied with the course work in the department? ________ If not, why? ________________

2. Were you satisfied with the laboratories in the department? ________ If not, suggestions for improvement:

3. Please comment on the advising that you received at the various stages of your academic career.
   a) Entering Freshman

   b) Transfer Student

   c) Career Guidance

4. List one or two of your best experiences in the department:

5. Did you have any bad experiences that you would like to comment about?

6. What single suggestion can you make for the improvement of the CVEEN department?
7. Are there any other items not covered above that you wish to address? __________________________________________
   __________________________________________
   __________________________________________

8. Did you participate in leadership opportunities at the University of Utah? If yes, please name and describe what you did with the organization (this includes but is not limited to Student Groups, SAC, CVEEN 4910 Group Leader).
   __________________________________________
   __________________________________________
   __________________________________________

II. Instructor Evaluation

From a broad personal standpoint, which CVEEN professor(s):
- Provided an acceptable or better level of advising
- Made you feel that your success was important
- Provided a vision of the profession
Please provide your opinion of the instructors in the CVEEN department compared to all other University instructors that you have encountered.

Key: 0 = Poor, 1 = Below Average, 2 = Average, 3 = Above average, 4 = Well above average

<table>
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*The number of courses you used from the university
### III. Curriculum

1. How would you rank the following basic courses in the Civil & Environmental Engineering curriculum?
2. What was your rank based upon (in comments section)?

**Key:** 0 = Poor, 1 = Below Average, 2 = Average, 3 = Above average, 4 = Well above average

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Where Taken</th>
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Department of Civil & Environmental Engineering Curriculum Evaluation

(Please circle the corresponding number that ranks the over all curriculum addressed by the particular program outcome.)

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<tr>
<th>Desired Program Outcome / Ranking</th>
<th>IV. Suggestions for Improvement</th>
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<tbody>
<tr>
<td>a. An ability to apply knowledge of mathematics through differential equations, science and engineering. The science should include calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<tr>
<td>b. An ability to design and conduct civil engineering experiments and analyze and interpret the resulting data.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<tr>
<td>c. An ability to design a system, component, or process in more than one civil engineering context to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, contractability, and sustainability.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>d. An ability to function on multi-disciplinary teams.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>e. An ability to identify, formulate, and solve civil engineering problems by applying knowledge of four technical areas appropriate to civil engineering.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>f. An understanding professional and ethical responsibility, and ability to explain the importance of professional licensure.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>g. An ability to communicate effectively using verbal, written and graphical skills.</td>
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<tr>
<td>h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>i. A recognition of the need for, and ability to engage in life-long learning.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>j. A knowledge of contemporary issues.</td>
<td>High 5 4 3 2 1 0 Low</td>
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<td>k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
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<tr>
<td>l. An ability to explain basic concepts in management, business, public policy, and leadership.</td>
<td>High 5 4 3 2 1 0 Low</td>
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*Please assess your own capabilities as a graduating senior relative to our desired program outcomes.
Civil & Environmental Engineering Department Exit Interview Information

Please provide all of the requested information
(Please separate this page from the questionnaire at time of interview)

Name ________________________________                      ________________________________
Last                                                      First

Address ____________________________________________
Street
__________________________________________________
City                      State                      Zip

Telephone ( ) Home ( )
( ) Cell Phone

Employment
Company
Company Address

E-mail Address (not U of U)

Transfer Student
If Yes, What School

If you had an internship and/or Part-time work, please provide:

Company

Length of Engagement

Duties Performed

After Graduation Plans:

Tentative Emphasis Area:

Job
Company
Location
Salary

Graduate School

Degree Pursued

Other

Permanent Address (Parent of other who will know where to locate you should you move, ABET needed)

Name ________________________________                      ( )

Relation to You

Address

Home Phone Number

Note: As you pursue your plans in the future, we would appreciate you taking the time to visit the Civil & Environmental Engineering website (www.civil.utah.edu) and you taking the time to update your information.
### Civil & Environmental Engineering

#### Student Outcomes A-L

46 students interviewed, 44 requested to rate A-L.

#### Rating of Student Outcomes (2013-2014)

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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>48</td>
</tr>
</tbody>
</table>

#### Ratings Analysis

- **Agreement Levels:**
  - 5: Strongly agree
  - 4: Agree
  - 3: Somewhat agree
  - 2: Somewhat disagree
  - 1: Disagree

#### Graphical Representation

- **Rating of Student Outcomes by Senior Students**

- **Rating Comparison:**
  - Avg.
  - Avg. minus 1 st. dev.

- **Agreement Disagreement**

- **Student Outcomes (A-L)**

---

395
| Course   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|    |
| B        | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| C        | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| D        | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| E        | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| F        | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| G        | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| H        | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| I        | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| J        | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| K        | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| L        | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |

| Course   | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| A        | 2  | 2  | 3  | 3  | 3  | 3  | 3  | 3  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  |    |
| B        | 3  | 3  | 4  | 4  | 4  | 4  | 4  | 4  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  | 3  |    |
| C        | 4  | 4  | 5  | 5  | 5  | 5  | 5  | 5  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  |    |
| D        | 5  | 5  | 6  | 6  | 6  | 6  | 6  | 6  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  |    |
| E        | 6  | 6  | 7  | 7  | 7  | 7  | 7  | 7  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  |    |
| F        | 7  | 7  | 8  | 8  | 8  | 8  | 8  | 8  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  |    |
| G        | 8  | 8  | 9  | 9  | 9  | 9  | 9  | 9  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  |    |
| H        | 9  | 9  | 10 | 10 | 10 | 10 | 10 | 10 | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  | 9  |    |
| I        | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |    |
| K        | 12 | 12 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |    |
| L        | 13 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |    |

<table>
<thead>
<tr>
<th>Course</th>
<th>Avg.</th>
<th>Avg. minus 1 st. dev.</th>
<th>5% diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.19</td>
<td>3.35</td>
<td>0.16</td>
</tr>
<tr>
<td>B</td>
<td>4.29</td>
<td>4.34</td>
<td>0.05</td>
</tr>
<tr>
<td>C</td>
<td>5.39</td>
<td>5.47</td>
<td>0.08</td>
</tr>
<tr>
<td>D</td>
<td>6.49</td>
<td>6.56</td>
<td>0.07</td>
</tr>
<tr>
<td>E</td>
<td>7.59</td>
<td>7.61</td>
<td>0.02</td>
</tr>
<tr>
<td>F</td>
<td>8.69</td>
<td>8.69</td>
<td>0.01</td>
</tr>
<tr>
<td>G</td>
<td>9.79</td>
<td>9.79</td>
<td>0.00</td>
</tr>
<tr>
<td>H</td>
<td>10.89</td>
<td>10.89</td>
<td>0.00</td>
</tr>
<tr>
<td>I</td>
<td>11.99</td>
<td>11.99</td>
<td>0.00</td>
</tr>
<tr>
<td>J</td>
<td>12.99</td>
<td>12.99</td>
<td>0.00</td>
</tr>
<tr>
<td>K</td>
<td>13.99</td>
<td>13.99</td>
<td>0.00</td>
</tr>
<tr>
<td>L</td>
<td>14.99</td>
<td>14.99</td>
<td>0.00</td>
</tr>
</tbody>
</table>


- **Agree**
- **Disagree**

**Student Outcomes (A - L)**
Attachment 6 – Example Laboratory Procedure
1-D Compression Tests

Geo I Lab #9

1. General Notes
   - This Lab will take **two weeks** to complete all the readings. You will be required to come to the Geo lab at odd times for the next two weeks.
   - When taking readings, take no readings after 5:30pm or on weekends. TA will take readings over the weekend.
   - When coming back to the lab to take readings, DO NOT leave food, drinks, or other garbage in the lab. Litter will be cause for reduction in grade.
   - While waiting between readings, DO NOT play with tools, equipment, or other tests running in the lab. Several classes and research for graduate students are going on concurrently. Messing with stuff in the lab because you are bored may be cause for a reduction in your grade.
   - All stations, benches, and tables must be cleaned before group leaves the lab.

2. Procedures
   2.1 Several groups will work together to gather readings. This will help to ease the burden of taking time rate readings. Each group leader is responsible to correlate information with other groups you are working with.

2.2 Set Up
   2.2.1 The TA will step you through the set up process. Please do not talk so everyone can hear the instructions.
   2.2.2 Find the consolidation ring. Weigh it and measure it. Record on the data sheet.
   2.2.3 TA will provide an undisturbed Shelby Tube sample of Bonneville Clay or a remolded clay sample.
2.2.4 Take ring and push gently into the clay so that there is clay above and below the ring.
2.2.5 Use a wire cutter to trim the specimen flush with the ring. Use a spatula to “butter” the surface on both sides to create a perfectly flat, flush surface.
2.2.6 Weigh the ring + soil gently.
2.2.7 Weigh a moisture tare and use the cuttings as a moisture sample.
2.2.8 Place a pore stone and filter paper on the base of the containment chamber. Place the confinement ring and soil on the base along with the rubber O-ring.
2.2.9 Assemble the rest of the containment chamber including another filter paper and pore stone.
2.2.10 Place containment chamber on odeometer apparatus as in the swell and collapse lab.
   2.2.10.1 Put a load cap on the pore stone and place load screw in female connection.
   2.2.10.2 Make sure load arm is level and supported by the pin.
   2.2.10.3 Place dial gauge on the top of the load screw.
   2.2.10.4 Take a zero reading
   2.2.10.5 Fill the containment chamber with distilled water.
2.3 Apply fist load.
2.4 Start stop watch and release support pin simultaneously. Take readings of the dial gauge as instructed on the lab data sheet.
2.5 Loads

2.5.1 The load increments will be 1/12, 0.25, 0.5, 1, 2, 4, 8, 2, 1, 1/12 tsf.
2.5.2 Load plates are found on the floor by your odeometer.
2.5.3 When applying loads, do not remove previous plates, add the appropriate additional plates. Make sure to slide new plates on gently. Start stop watch as soon as new plates are applied. Take readings as before.
2.6 Minimum times to take readings?

2.6.1 TA will demonstrate way to know when load is ready to be changed.

2.6.2 1/12, 0.25 tsf loads: Take readings for **at least** ½ hr before adding next plate.

2.6.3 0.5, 1 tsf, let run **at least** 4 hours before adding new plates.

2.6.4 2, 4 tsf plates, let run **at least** 24 hours.

2.6.5 8 tsf, run a minimum of 48 hours (no more than 72hr is necessary though).

2.6.6 Unloading 2, 1, and 1/12 loads, let run 8 to 16 hours. For unloading, no time rate calcs are necessary.

2.6.7 All these times are minimums. TA will instruct how to know if it is appropriate to change loads. You may need to let the early loads go longer. Longer is **betterer**, so be patient.

2.7 After test

2.7.1 After last 1/12tsf load is done, remove from containment chamber. Return pore stones to staging area.

2.7.2 Dry the clay puck to obtain a final moisture content.

2.7.3 Dry all metal rings and equipment with paper towels and return to staging area.

3.0 Calculations

- Estimate the initial void ratio of the soil.
- Construct consolidation curves using strain and void ratio (2 separate plots).
- Calculate the in-situ unit weights of your specimen, dry, moist, and saturated.
- Calculate the compression ratio for the soil ($C_c$) as well as ($C_{c\varepsilon}$).
- Calculate the recompression ratio ($C_R$) as well as ($C_{R\varepsilon}$).
- Calculate the Preconsolidation pressure ($\sigma'_{p}$) using strain and void ratio plots and compare.
- If the soil was located 36 feet below ground surface and the average unit weight of the soil is the same as your specimen, calculate the vertical effective stress on your specimen in the field. GWT at 6.0 feet below ground surface.
Calculate the OCR of the soil with your calculated overburden.

Find \( t_{50} \) \( t_{100} \) and \( t_{90} \) for the 1, 2, 4, and 8 tsf loads.

Find \( C_v \) for the soil for the 1, 2, 4 and 8 tsf loads using \( t_{50} \) and \( t_{90} \).

Calculate permeability of the soil.

If we are to add a 25 foot embankment \( (\gamma = 135 \text{pcf}) \) over the 36’ of soil from above, estimate the settlement we can expect to see for this soil if the soil layer extends from ground surface to the sample location. The soil is homogeneous and isotropic.

4.0 Questions

- Why did we use strain and void ratio in our calculations?
- Is the settlement the same underneath the embankment as opposed to underneath the toe of the embankment?
- How does permeability affect Coefficient of Consolidation \( (C_v) \)?
- Why do we contain the soil horizontally during the test?
- What compressed during the test…. Voids or soil particles? Why or why not?
- What controls settlement and consolidation, Total or Effective stress, why?
- Is the settlement you calculated for the embankment acceptable? Why?
# 1-D Consolidation Data Sheet

**Group Member Names:**

<table>
<thead>
<tr>
<th>Test Date:</th>
<th>Load (tsf):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Ring Weight =</th>
<th>Cup Weight =</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Moist Soil + Ring =</th>
<th>Moist soil + cup =</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Moist Soil Weight =</th>
<th>Dry soil + cup =</th>
</tr>
</thead>
</table>

**Soil Description:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Elapsed Time Recommended (min)</th>
<th>Reading Time</th>
<th>Actual Elapsed Time (min)</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 - 1 hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120 - 2 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>240 - 4 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>960 - 16 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1440 - 24 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2880 - 48 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Use first dial reading as \( e_{100} \).

\[ e_v (\text{equilibrium} = e_{100}) = \frac{\Delta H_{100}}{H_o} \left(\frac{0.1057 - 0.0087}{0.10} + 0.37\right) \]

**Loading Increment 0 to 0.25 tsf**

\[ e = e_o + \Delta e_{100} \]

\[ \Delta e_{100} = \frac{\Delta H}{H_o (1 + e_o)} \]

\[ = \frac{(0.1057 - 0.0087)(1 + 0.37)}{100} \]

\[ e_{100} = 0.925 - 0.025 = 0.902 \]

- Best-fit straight line

\[ c_k = -0.025 \]

\[ \frac{\Delta H}{\Delta (\log t)} = \frac{1 + e_o}{H_o} \]

\[ \Delta e = \frac{\Delta H}{H_o (1 + e_o)} \]

\[ C_k = \frac{-0.025}{0.00735} \]

\[ c_k = \frac{-0.025}{0.00735} = 0.0014 \]
Loading Increment 0 to 0.25 tsf

Square Root of Time (Sqrt min.)

Dial Reading (in.)

0.000
0.092
0.094
0.096
0.098
0.100
0.102
0.104
0.106
0.108

Page 2 of 5
$D_e = 0.1724$

$D_{mo} = 0.6336$

$D_{e0} = \frac{1}{2} (D_e + D_{mo}) = 0.1795$

$C_{ne} = \frac{-\Delta d}{\Delta (\log t)}$

$\Delta c = \frac{\Delta h}{H_o} (1 + \epsilon_o)$

$H_o = 1.5$ in.

Avg. Hdr. $\frac{1}{2} (0.9132) = 0.4566$ in.

$c_0 = \frac{1}{2} (0.4566)^2$

$t_{1/2} = \frac{0.019}{2.2} = 0.019$ in/min

$= 68$ lb/yr

$= 6.3$ m/yr

Logarithm of Time (log of min.)

$C_{ne} = \frac{-\Delta h}{H_o}$

$\Delta c (H_o) = \frac{-0.1457}{1} c_{0.927} = -0.040$

$\Delta (\log t) = \frac{\Delta h}{H_o} (1 + 0.927) = 0.190$

$C_{ne} = \frac{-\Delta h}{\Delta (\log t)} = \frac{-0.1457}{0.190} = 0.0033$

Page 5 of 5
Determination of Initial Dial Reading for 4-8 tsf Loading Increment

The data for this loading increment is as follows:

<table>
<thead>
<tr>
<th>t (min)</th>
<th>D (in.)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0.1657</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1740</td>
</tr>
<tr>
<td>0.25</td>
<td>0.1750</td>
</tr>
<tr>
<td>0.5</td>
<td>0.1759</td>
</tr>
<tr>
<td>1</td>
<td>0.1776</td>
</tr>
<tr>
<td>2</td>
<td>0.1792</td>
</tr>
<tr>
<td>4</td>
<td>0.1808</td>
</tr>
<tr>
<td>8</td>
<td>0.1826</td>
</tr>
<tr>
<td>15</td>
<td>0.1837</td>
</tr>
<tr>
<td>30</td>
<td>0.1848</td>
</tr>
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<td>60</td>
<td>0.1860</td>
</tr>
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<td>120</td>
<td>0.1868</td>
</tr>
<tr>
<td>240</td>
<td>0.1878</td>
</tr>
<tr>
<td>480</td>
<td>0.1883</td>
</tr>
<tr>
<td>1800</td>
<td>0.1892</td>
</tr>
<tr>
<td>3600</td>
<td>0.1900</td>
</tr>
</tbody>
</table>

See pp. 429-430 in the textbook for reference on how to determine the initial dial reading for the log of time method. (Note: $D$ is used here for dial reading, whereas in the textbook $R$ is used.)

Select pairs of dial readings in the early curved portion of the graph where the values of the times are in the ratio of 4 to 1. Usually you will want to find at least three pairs of data to use for this process and then average the calculated values of initial dial reading, $D_0$. However in this case, the initial curved section is small, so only two pairs of data will be used. The value of the dial reading for $t = 0.4$ min must be carefully scaled from the graph since a reading was not taken at this time. The calculation of $D_0$ is done in the table below.

<table>
<thead>
<tr>
<th>$t_1$ (min)</th>
<th>$D_1$ (in.)</th>
<th>$t_2$ (min)</th>
<th>$D_2$ (in.)</th>
<th>$D_2 - D_1$ (in.)</th>
<th>Estimated $D_0$ (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.1740</td>
<td>0.40</td>
<td>0.1757</td>
<td>0.0017</td>
<td>0.1723</td>
</tr>
<tr>
<td>0.25</td>
<td>0.1750</td>
<td>1.00</td>
<td>0.1776</td>
<td>0.0026</td>
<td>0.1724</td>
</tr>
</tbody>
</table>

Estimated $D_0 = 0.1724$ in.

So the estimated value of $D_0 = 0.1724$ in.
\[ t_{90} = (z+c)^2 = 6.8 \text{ min.} \]

\[ C_v = \frac{t_{90} - t_{x90}}{t_{90}} = \frac{0.247 (0.456)^2}{c-v} = \frac{0.026 \text{ in}^2/\text{min}}{c-v} = 95 \text{ ft}^2/\text{yr} = 8.8 \text{ m}^2/\text{yr} \]

**Loading Increment 4 to 8 tsf**
Attachment 7 – Example Laboratory Safety Plan
INTRODUCTION

The University of Utah and the Civil and Environmental Department encourages and supports all programs which promote safety, good health, and well being of University faculty, staff, students, participants in University sponsored programs, and visitors. It is the policy of the University of Utah and the Civil and Environmental Engineering Department to provide safe and healthful conditions and to reduce injuries and illnesses to the lowest possible level. No task is so important and no service so urgent that it cannot be done safely. In keeping with this commitment, this Laboratory Safety Plan has been developed.

The Laboratory Safety Plan is designed to protect laboratory personnel from potential hazards associated with the use of soil mechanics laboratory. The University requires that general standard operating procedures are outlined for all laboratories. Specific standard operating procedures developed by each lab for operations posing a special hazard must be developed by each department.

EMERGENCY CONTACTS

<table>
<thead>
<tr>
<th>Contact</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire/Ambulance/Police</td>
<td>585-2677</td>
</tr>
<tr>
<td>Utility Failure</td>
<td>581-7221</td>
</tr>
<tr>
<td>Utility Failure (off hours)</td>
<td>581-8101</td>
</tr>
<tr>
<td>Poison Control</td>
<td>581-2151</td>
</tr>
<tr>
<td>University Hospital Emergency Department</td>
<td>581-2291</td>
</tr>
<tr>
<td>Spill Control</td>
<td>585-2677</td>
</tr>
</tbody>
</table>

You are located at HEDCO Room 109. The nearest telephone is in the hallway of the EMRO building 1st Floor by the elevators.

Stay on the telephone line if possible with the dispatcher. If you cannot stay on the line, tell the dispatcher the exact location of the emergency and the type of help needed.
I. GENERAL INFORMATION AND PROCEDURES

Maintaining a safe and healthy environment in the laboratory is ultimately the responsibility of the Supervisor of the Laboratory or Principal Investigator using the laboratory. However, each individual is expected to conduct all operations and procedures in a safe and prudent manner.

A. ROLES AND RESPONSIBILITIES

Lab Supervisor: Dr. Steven F. Bartlett phone: 435-841-9837 (mobile)
Alternate: Mark Bryant phone: 801-581-7057 (office)
Alternate: Dr. Evert Lawton phone: 801-585-3947 (office)
Alternate: Civil Engineering Admin. phone: 801-581-6931 (office)

The laboratory supervisor has responsibility for implementation of the Safety Plan in his/her laboratory. The laboratory supervisor shall:

- ensure that workers are trained and follow the plan outlined in this document;
- ensure that the necessary protective and emergency equipment is available, in working order, and that appropriate training has been provided;
- ensure that periodic laboratory inspections are performed;
- know current legal requirements concerning regulated substances;
- review and evaluate the effectiveness of the laboratory specific Standard Operating Procedures (SOP) at least annually and update as necessary.

The laboratory employees or students are responsible for:

- planning and conducting each operation in accordance with practices and procedures established in this Safety Plan.
- using equipment only for its designed purpose;
- being familiar with emergency procedures, including knowledge of the location and use of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency;
- knowing the types of protective equipment available and using the proper type for each procedure;
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible.

B. INFORMATION AND TRAINING

The laboratory supervisor shall ensure that information and training are provided at the time of an employee's or student's initial assignment to a hazardous work area. Refresher information and training shall be conducted at least annually and documented.

Information
All laboratory personnel shall be informed of:

- Requirements of the OSHA Standard, "Occupational Exposure to Hazardous Chemicals in Laboratories",
- The location of reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets (MSDS's).

Training

Employee training or student training shall include:

- The physical and health hazards associated with devices, materials or chemicals stored and used in their work area,
- The contents of this Chemical Hygiene Plan, (if applicable)
- Methods and observations that may be used to detect the presence or release of a hazardous chemical; e.g., exposure monitoring conducted by the CHO, visual appearance or odor of hazardous chemicals when being released, etc. (if applicable)

C. PRIOR APPROVAL CIRCUMSTANCES

Employees and students must obtain prior approval to proceed with a laboratory task from the laboratory supervisor or his/her designee when:

- Devices with open flames or combustible materials are used,
- Radioactive materials are used,
- Hazardous chemicals are used,
- Safety equipment has failed or is not present,
- Other hazardous or unsafe conditions are noted

II. STANDARD OPERATING PROCEDURES

General Rules

A. Laboratory Experiment Procedures

Employees and students are required to follow laboratory procedures as outlined in ASTM (American Society of Testing and Materials) or other procedures given to them by the Laboratory Supervisor or his or her designee.

B. Incident Reporting

All injuries shall be reported to the Lab Supervisor or Teaching Assistant using the University Incident Report. The form is available on Environmental Health and Safety Web site (http://ehs.utah.edu/hazard-report-form).
All “near misses” shall be reported to the Lab Supervisor and shall be analyzed by the affected personnel to determine the cause of the event and what controls, equipment or procedures should be implemented to prevent future occurrences.

C. Personal Protective Equipment and Dress

Carefully inspect all protective equipment prior to use. Do not use defective equipment.

Eye protection (safety glasses) shall be worn at all times when operating laboratory equipment or when standing near operating equipment. This includes visitors. Ordinary prescription glasses are not considered effective eye protection since they lack necessary shielding.

When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of material known to be resistant to permeation by the substance shall be worn. Leather gloves shall be worn when handling items from the ovens.

Low-heeled shoes with fully covered uppers shall be worn at all times in the laboratory. Shoes or sandals with open toes shall not be worn.

Long pants and long sleeves should be worn when working with or around chemicals.

Long hair should be held in place behind the head.

Loose clothing, especially loose trouser legs and sleeves, should not be worn in the laboratory.

A full-body-length rubber, plastic, or neoprene apron appropriate for the material being handled should be worn if there is risk of chemical splash or spill.

Employees and students are required to wear safety glasses while operating equipment in the laboratory. Gloves shall be worn when working with items stored in the drying ovens.

Jewelry and loose clothing shall not be worn while operating equipment with moving parts.

Shoes, shirts, pants and/or shorts shall be worn at all times in the laboratory.

Safety glasses, protective gowns, overalls and gloves will be made available upon request by the laboratory supervisor.

D. Personal Conduct
Horseplay or practical jokes will not be tolerated in the laboratory. Such actions are grounds for dismissal from the laboratory or termination.

E. Crush and Pinch Hazards

- Know the procedure and methods for correct use of all tools that you will be using in the laboratory. Do not operate tools and equipment that you are not familiar, or for which you have had no training.

- Know the pinch points and crush hazards for laboratory equipment that you will be operating.

- Establish a safety zone around equipment with a pinch or crush hazard. Do not allow others to infringe the safety zone while the equipment is operating.

F. Cuts

Cuts from broken glass objects or cutting instruments are among the most common injury in laboratories. Cuts can be minimized by the use of correct procedures, appropriate use of personal protective equipment, and by paying careful attention to handling and manipulations.

- Glass ware must be stored properly on shelf or in containers

- Broken glass ware and sharp objects must be disposed in designated containers to prevent injury to lab personnel and custodial staff.

G. Electrical Safety

- Do not operate electrical equipment that has frayed or damaged power cords or connectors.

- All electrically operated equipment should be grounded.

- All strip outlets and surge protectors shall be UL listed and electrical equipment shall not exceed the amperage rating.

- Extension cords are only permissible for hand tools and cannot be placed near water or where they create a trip hazard.

- Except when running an experiment, computers and data acquisition systems should be turned off.

H. Fire Prevention and Safety

- Know the location of the nearest fire alarm. The nearest fire alarm is located in the ramp hallway between the HEDCO building and the EMRO building
If an alarm occurs, evacuate immediately. Close the doors to the lab as you leave. Ask visitors and guests to leave also.

Know the location of the nearest fire extinguisher. The nearest fire extinguishers are located in the structural laboratory, just outside the soil mechanics room. You must be educated in the proper use before using a fire extinguisher. Do not attempt to extinguish a chemical fire. Evacuate the lab and call 5COPS (52677).

If you have determined that you are capable of fighting the fire (no chemicals and the fire is not larger than trash can size), activate the fire alarm before attempting to fight the fire.

I. Chemical and Soil Handling and Disposal

No reactive, toxic or gaseous chemicals shall be used in the soil mechanics laboratory with the approval of the laboratory supervisor and the development of a chemical hygiene plan for the specific use of the chemical.

No flammable liquids shall be stored within the laboratory.

Handle reactive chemicals with all proper safety precautions. This includes designating a separate storage area, monitoring periodically for degradation, and using appropriate personal protection.

For chemicals they are working with, all employees and students should know: (1) the chemical's hazards, as determined from a MSDS and other appropriate references; (2) appropriate safeguards for using that chemical, including personal protective equipment; (3) how to properly store the chemical when it is not in use; (4) proper chemical waste disposal procedures, (5) proper personal hygiene practices; (6) Appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures.

Chemical containers should be regularly monitored for proper labeling and container integrity. Labels which are fading, falling off, or deteriorating must be promptly replaced. If abbreviations are used, they should be kept to a minimum and clearly identify the contents of the container as well as hazards associated with use. Improperly labeled or unlabeled chemicals make hazard identification and disposal difficult, and may create a hazard.

Soil and chemicals shall not be washed down the sink, but shall be disposed of in approved containers.

All equipment and chemicals should be placed in their proper storage areas at the end of each workday. Equipment and chemicals shall not be stored on desks, laboratory bench tops, floors, fume hoods or in aisles.

E. Spills
Mercury, which is contained in thermometers, is a hazardous chemical and prompt action is required if released by dropping a thermometer. In addition to mercury, the following should be followed if a spill of a hazardous substance is suspected:

- Attend to anyone who may have been contaminated.
- Notify occupants in the immediate area about the spill.
- Evacuate all nonessential personnel from the spill area.
- If the spilled material is flammable, turn off all ignition and heat sources; this includes magnetic stirrers.
- Avoid breathing vapors of the spilled material.
- Evacuate and contact EHS at x1-6590 or call University Police at 5-COPS (5-2677) after 5:00pm.
- Open windows where possible to increase exhaust ventilation.
- Secure cleanup supplies.
- Ensure protective apparel is resistant to the spill material.
- Confine or contain the spill to a small area.

F. Operating Hours

- Operating hours are 8:00 to 5:00 p.m., unless prior approval has been obtained from the laboratory supervisor.
- Employees and students should avoid working alone. Arrangements should be made between individuals working in separate laboratories outside of regular working hours to cross check each other periodically. Experiments known to be hazardous should not be undertaken by an employee who is alone in the laboratory.

G. Personal Hygiene

- Wash promptly whenever a chemical has contacted your skin. Flush for at least 15 minutes prior to seeking medical attention.
- Avoid inhalation of chemicals. Do not "sniff" to test chemicals.
Do not use mouth suction to pipette anything. Pipetting aids must be used at all times.

Do not bring food (including gum and candy), beverages, tobacco, or cosmetic products into chemical storage or use areas.

Eating, drinking, and applying cosmetics is allowed in desk or study areas only.

Smoking is prohibited in all University facilities.

Wash well with soap and water before leaving the laboratory. Avoid the use of solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals.

H. Housekeeping

Housekeeping is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents. Laboratory personnel must adhere to the following:

Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers shall never be blocked or obstructed.

Laboratory glass where (hydrometers and thermometers) must have a puncture resistant (e.g., cardboard) container specifically designated for glassware disposal.

At the end of each workday, the contents of all unlabeled containers are to be considered waste and disposed of appropriately.

Collection containers for wastes must be clearly labeled including hazard identification.

All work areas, especially laboratory bench tops, should be kept clear of clutter.

All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.

Food and drink for human consumption shall not be kept in the same refrigerator used to store chemicals and laboratory samples. Eating and office areas must be clearly separated from laboratory and chemical storage areas.

I. Compressed Gas Cylinders

Use of compressed gases in the laboratory requires anticipating chemical, physical, and health hazards. Cylinders that are knocked over or dropped can be very dangerous. If a valve is knocked
off, the cylinder can become a lethal projectile. Accidental releases may result in an oxygen depleted atmosphere or adverse health effects. In short, improper handling and use can cause structural damage, severe injury, and possibly death. The following guidelines will help ensure safe handling, use, and storage of compressed gas cylinders.

1. Receiving and Storage

   Be sure to arrange a return agreement with suppliers prior to purchase since disposal of compressed gas cylinders is difficult and very expensive.

   Cylinders should not be accepted unless the cylinder contents are clearly labeled. Color code only should not be accepted, since it does not constitute adequate labeling.

   Do not accept cylinders which are damaged or do not have a valve protection cap.

   All gas cylinders in use shall be secured in an upright position in racks, holders, or clamping devices. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the neck area.

   Oxygen cylinders shall never be placed near highly combustible materials, especially oil and grease, or near stocks of carbide and acetylene or other fuel gas cylinders, nor near any other substance likely to cause or accelerate a fire. Systems and components used for other gases and purposes must never be used for oxygen or interconnected with oxygen.

   Cylinders should have current hydrostatic test date (normally less than 5 years old for steel and 3 years old for aluminum) engraved on the cylinder. Cylinders should be returned to the supplier for servicing prior to the expiration date.

   Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.

   Do not store cylinders in exit corridors or hallways.

2. Handling and Use

   Only Compressed Gas Association fittings and components are permitted for use with gas cylinders. Only use regulators approved for the type of gas in the cylinder. Do not use adapters to interchange regulators.

   Open cylinder valves slowly and away from the direction of people (including yourself). Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.

   No attempt shall be made to transfer gases from one cylinder to another, to refill cylinders, or to mix gases in a cylinder in the laboratory.

   All cylinders are to be considered full unless properly identified as empty by the user.
Empty cylinders must be returned to the supplier and not accumulated.

- Compressed gases must not be used to clean your skin or clothing.

- Never heat cylinders to raise internal pressure.

- Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.

- Always leave at least 30 psi minimum pressure in all "empty" cylinders.

- Do not leave an empty cylinder attached to a pressurized system.
The course instructor or laboratory teaching assistant has given me a safety briefing regarding safe conduct and my responsibilities to promote and ensure safety within the laboratory.

This has included:

- planning and conducting operations in accordance with practices and procedures established in the Safety Plan
- using equipment for its designed purposes only
- being familiar with emergency procedures, including knowledge and location of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency
- knowing the type of protective equipment available and using the proper type for each procedure
- being alert to unsafe conditions and actions and calling attention to them so corrections can be made a soon as possible

_______________________________   _____________________________
Student’s Name       Student’s Signature