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Challenges of a Professional Issues Course in Civil Engineering: Comparison Across Two Years

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Abstract

There are a number of professional skills that civil engineering students should possess when they graduate with a Bachelor's degree, as articulated in the ASCE Body of Knowledge Second Edition (BOK2) and the civil engineering program specific criteria under ABET EAC-accreditation. An analysis of the curriculum at the University of Colorado Boulder (CU) determined that there were gaps in meeting these professional skill outcomes, and as such a professional issues course was added as a requirement in the senior year. Many other universities offer similar courses, and the content of these courses has been reviewed. At CU, the professional issues course has learning objectives that map to six different BOK2 outcomes: professional and ethical issues, sustainability, contemporary issues, leadership, public policy, and business & public administration. The majority of the topics in the course are often perceived by students to be "soft skills", which they believe are less important than technical outcomes. This and other issues presented obstacles to creating a course that would be well received by students while also meeting the needs of the curriculum and documenting fulfillment of the learning objectives for ABET. A pilot version of the course was first offered in the fall 2015 semester to nineteen students who transferred into the curriculum; a revised version of the course was offered in fall 2016 to 56 students. Although the course provided necessary direct evidence that the learning outcomes were met, it was unpopular with the majority of the students. It is hoped that the paper might stimulate a broader discourse on the role of professional issues courses, versus an infusion model for teaching these topics which is likely to be more successful. Best practices for implementation may emerge if individuals share both successes and failures with regards to these courses.

Introduction

There are a number of professional skills that are important for engineering graduates to possess.[1-10] These skills are particularly important in creating engineers capable of addressing complex global challenges. Professional skills are included among the outcomes in the ABET EAC criterion 3 (Table 1).[11] As well, the American Society of Civil Engineers (ASCE) defined an expanded list of professional outcomes in its Body of Knowledge Second Edition (BOK2).[12] Similar professional skill outcomes can also be found in the ABET accreditation criteria for engineering technology (ABET ETAC)[13] and computing programs (ABET CAC)[14], as well as international accreditation standards.[15-17] Some faculty in engineering refer to professional skills by the somewhat derogatory term "soft skills"; the use of this term denigrates the importance of professional skills outcomes relative to foundational skills in math and natural sciences and technical knowledge outcomes.[18] As such, professional skills may not be given the same level of attention in engineering curricula, in comparison to other outcomes. Welch[19] notes: "These topics are sometimes relegated to the senior seminar during the last semester before graduation if formally covered at all." (pg. 2)

Table 1. Professional Skills

Skill (abbreviation)	ABET Outcome[11]	ASCE BOK2 Outcome[12]
Teamwork (D)	ABET D	BOK 21
Ethics & professionalism (F)	ABET F	BOK 24
Communication (G)	ABET G	BOK16
Engineering in a societal context (H)	ABET H	(BOK 11)
Lifelong learning (I)	ABET I	BOK 23
Knowledge of contemporary issues (J)	ABET J	BOK 11
Public policy (PP)	*None*	BOK 17
Business & public administration (Bu)	*None*	BOK 18
Globalization (Gl)	*None*	BOK 19
Leadership (L)	*None*	BOK 20

There are a number of ways that programs can meet professional skills outcome requirements. The most effective approach may be to infuse and integrate professional skills topics into an array of core technical courses.[19-21] This may help overcome student resistance to these topics, which they sometimes perceive as less important in comparison to "hard" technical skills. However, it appears that a more common approach has been to create a specific Professional Issues or Professionalism course within the curriculum. Sometimes these courses are also named seminar courses. This method places the responsibility for teaching these topics in a more centrally controlled manner, which may be simpler than getting buy-in from a large number of faculty spread across numerous courses. This more centralized approach to teaching professional issues will be reviewed in more depth in the following section.

Benchmarking Other Professional Issues Courses

Three approaches were taken to benchmark professional issues and professionalism courses that are required within engineering or computing degrees. These were: (1) a literature review of papers published in the Proceedings of the American Society for Engineering (ASEE) Annual Conference; (2) exploring civil engineering programs at the 20 institutions who graduate the most undergraduates; and (3) professional issues courses that include ethical and/or social issues. The methods and results from each of these benchmarking activities are described below.

A literature review was conducted on the proceedings of the ASEE Annual Conference. This resulted in gathering 47 papers.[19-65] In some cases, current information for these courses were obtained from online curriculum and catalog sources from the various institutions (December 2016). Content analysis was conducted to evaluate: curricula (major), credits, and topics. Results are summarized in the Appendix, Table A1. Note that in many cases the professionalism course was mentioned within the larger context of the paper, but was not the focus of the paper itself. The content analysis found the most courses in civil engineering (15), followed by various engineering technology programs (6), mechanical engineering (4), chemical engineering (3), and nuclear engineering (3); four institutions required a single professional issues course for all of their engineering majors. The courses examined ranged from no credits, but required for graduation (senior seminars in mechanical engineering at Union College[22] and nuclear engineering at Purdue University[23]) to three credits; in one case, a series of four three-credit

professionalism courses were required (Iron Range Engineering of Minnesota State University Mankato[24]). The majority of the courses were 1 credit (n=20); 10 were 3-credits (sometimes in total across multiple 1-credit requirements) and 7 were 2 credits. Most of the courses were placed in the curriculum in the senior year (and frequently also restricted to seniors in the course catalog; n=32), but some were also in the junior year (n=11), and sophomore year (n=4).

Based on the conference paper and/or content in the institutional course description, approximate mapping to the ABET EAC Criterion 3 A-K outcomes[11] and ASCE BOK2[12] professional outcomes listed in Table 1 was conducted. The most commonly identified topics were ethics (F, n=34), contemporary issues (J, n=26), communication (G, n=24), life-long learning (I, n=20), societal impacts (H, n=15), teamwork (D, n=10), business (Bu, n=10), leadership (L, n=10), global issues (Gl, n=8), and public policy (PP, n=6). Two additional outcomes were noted: discussion of professional licensure (PE; n=8) and review for the NCEES Fundamentals of Engineering (FE) exam (n=6). Other topics commonly found in these courses included transitions to industry (job search, resumes, interviewing) and/or graduate school. Note that the course outcome mappings may be incomplete, since in most cases a full syllabus was not available. Some of the courses counted toward fulfilling general education or core requirements at the university. Some of the courses were noted to be graded pass/fail or satisfactory/fail. Some of the papers noted excellent support materials that could be used in a variety of courses including the ASME's Professional Practice Curriculum E-book training manual and podcasts (http://php.aist.org/ela/training_series.htm) and the EPSA case scenarios and professional skills assessment rubrics[25-27]; the Institute for Professional Practice materials referenced in Clemence & McGinley[28] could not be found using an online search (only the 1992 book by Bucknam[66]). Overall, it appeared that there were many different models that had been successfully applied to teach a range of different professional issues.

However, some papers did note difficulties teaching or assessing these professional issues topics. Koorey et al.[29] noted: "More than other courses, this course demonstrates the gap between students' views on their development and the views of the instructors. The course survey (with an admittedly low 25% return rate) resulted in an overall rating of 2.9/5 in terms of overall quality for 2015, one of the lowest course ratings in engineering. This is similar to course ratings in 2013 (2.2 from 38% return rate) and 2014 (3.0 from 37%) for the course. Comments varied greatly but [a common theme included] The course taught me nothing I didn't know already." (p. 12) The paper goes on to present evidence of student progression and learning, based on the grades for the course assignments. The authors posit: "The completely qualitative nature of this course (there are no numerical calculations needed for any assessment) is at odds with the mostly quantitative assessments found in all of their other curriculum courses. Thus they have been led to believe that technical correctness is the most important part of what "good engineering" is about. This feedback from students has led the Department to consider further whether more "non-technical" content and assessment needs to be introduced to students at an earlier stage, to impress upon them the equal importance of these skills as a professional engineer."

Next, professional issues courses at universities with large civil engineering programs were evaluated. Civil engineering was selected as the target discipline because the literature review found that professional issues courses appeared most common within this discipline. The 20 civil engineering programs with the largest number of Bachelor's degrees awarded in 2014-2015 were

identified from ASEE data.[67] Then the required civil engineering curriculum was found online at the departmental website and/or catalog. Professional issues courses beyond the first year of the curriculum were identified. Then a brief description of the course was found, typically from the university catalog. Among the 20 largest CE programs, 13 required a professional issues type of course within the curriculum and seven did not. More information on the courses from the 13 programs can be found in Table A2 in the Appendix.

Finally, a national online survey to explore where and how ethics and societal impact issues are taught in engineering and computing curricula was conducted in spring 2016.[68] Within this survey, professional issues courses were listed among the potential types of courses where ethical and/or societal issues were taught. Among the 1216 survey respondents who taught ethical/societal impact topics in one or more courses, 209 indicated that they taught these topics in a professional issues course (17%). The engineering disciplines that these individuals reported teaching were: 32% civil, 23% computer, 17% mechanical, 13% electrical, 13% environmental, 12% chemical, 11% engineering management, 9% biomedical, 9% industrial, and less than 7% other disciplines (such as general engineering, engineering technology, materials, architectural, aerospace, nuclear, petroleum). Instructors could indicate more than one discipline, with common examples being both civil/environmental and computer/electrical. Civil engineering predominated among the professional issues courses, mirroring the results from the ASEE proceedings literature search. Among the 209 instructors of professional issues courses, 60 (29%) chose their professional issues course as the one course in which they believed they most effectively taught engineering and/or computing students about ethical/societal issues, and described this course in more detail. Six more individuals described their professional issues course as a second course where they taught students about ethical/societal issues. The disciplines taught among the 66 who described their professional issues-related course in more detail were: 41% civil, 24% computer, 18% mechanical, 17% electrical, 9% engineering management, 8% biomedical, 3% chemical. These individuals represented 59 different institutions (80% public, 20% private; where the highest degree offered was: 14% Bachelor's, 17% Master's, 70% doctoral). Half or more of the professional issues courses included the following topics related to ethics and/or societal impacts (selected from among 18 potential topics listed on the survey): professional practice issues, ethical failures, engineering code of ethics, societal impacts of engineering and technology, ethics in design projects, ethical theories, risk and liability, sustainability, safety, and engineering decisions in the face of uncertainty.

Among the professional issues courses described on the survey, 23 were undergraduate courses required within civil engineering (and 8 also in environmental engineering). Four were courses already identified at institutions that graduate the largest number of civil engineering undergraduate students (described previously). Online information that was found on the additional professional issues courses was added to Table 2A in the Appendix. Upon exploration, a few of these courses were found to be located in the first year of the curriculum; however, they were not classified by the instructors on the survey as first-year introductory courses nor first-year design courses. Therefore, information on these courses was retained within the analysis.

Among the civil engineering professional issues courses explored (Table 2A), the majority were 1 credit courses (n=16), followed by 3 credits (n=10), 2 credits (n=4), no credit (n=2), and 4 credits (two separate 2-credit courses required; n=1). The courses were primarily slated for the

senior year (n=20), followed by junior (n=6), sophomore (n=5), and first year (n=2). The topics commonly evident in the civil engineering professional issues courses were: ethics (F, n=27), professional licensure (PE, n=16), business aspects (Bu, n=13), contemporary issues (J, n=11), lifelong learning (I, n=9), societal impacts (H, n=9), leadership (L, n=7), public policy (PP, n=7), communication (G, n=5), and global issues (Gl, n=3). Figure 1 summarizes the topic frequency found in these civil engineering professional issues courses compared to professional issues courses across any discipline that were found in the published literature search. To ensure quality learning experiences, the types of teaching methods employed in the courses are critical. While the catalog descriptions of the courses rarely explained teaching methods, the courses that were described in the ethics/societal impact teaching survey did include this information. For the 27 civil engineering courses described, the most common methods used to teach ethical/societal issues were: case studies (n=24), lectures (n=21), in-class discussions (n=21), examples of professional scenarios (n=20), guest lectures (n=16), in-class debates/role plays (n=10), reflections (n=9), and videos (n=8). The most common assessment method for ethical/societal impacts knowledge was an individual homework assignment graded with a rubric (n=20), followed by test and/or quiz questions (n=12) and individual reflections (n=10). The benchmarking results indicate that a number of different models are used for civil engineering professional issues courses.

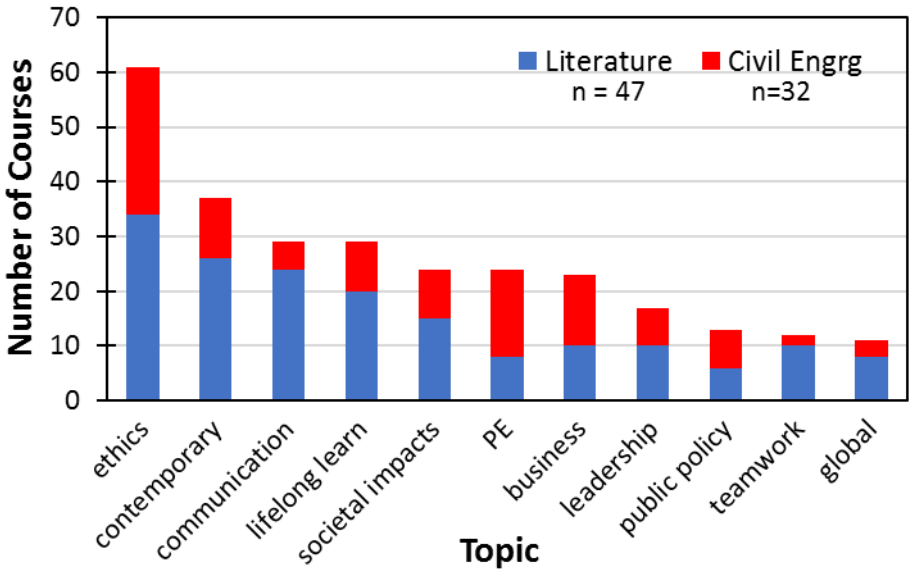

Figure 1. Topics Taught in Professional Issues Courses

Professional Issues Course Case Study

The University of Colorado Boulder (CU) civil engineering curriculum has taken three primary approaches to teaching and evaluating professional skills. From 1980 to 2005, the curriculum included a 1-credit Senior Seminar course. It included review for the FE exam as well as guest speakers and discussion of topics such as ethics and contemporary issues. It also included an extensive senior survey to evaluate the overall program. In 2006 the senior seminar course was removed from the curriculum; the professional issues were included to some extent within the 4-credit capstone design course. However, coverage of the professional topics was initially highly variable based on the course instructor. Once the coordinator of the capstone design course

became stable, the inclusion of professional issues topics became more routine, via five lectures (generally from outside professionals). Topics included in these five fifty-minute lectures were: lifelong learning and professional licensure; resume development; global engineering, environmental and societal issues; ethics; and leadership. These professional issues were assessed via a simple online quiz. However, the instructor did not log the quiz scores mapped to the separate topics, so the assessment results could not be used as a direct measure toward ABET accreditation. Finally, in 2015 a new 2-credit Professional Issues course was introduced into the curriculum. That course is the subject of this section.

The two-credit professional issues course had two main goals: (1) return to helping students prepare for the FE exam, and (2) cover deficiencies in the curriculum in regards to the professional skills outcomes in the ABET EAC program-specific criteria for civil engineering and Criterion 3. All civil engineering students in the program are required to take the FE exam prior to graduation. Student performance on the FE exam during the years without the senior seminar course was much lower than in previous years (2006-2015 average of 75% students passed FE exam; 2000-2005 average 92% of students passed the FE exam); thus, there was a desire to bring back formal exam review. Part of the concern was that student perception of the importance of the exam may have diminished; previously when FE review was part of a graded course it seemed to send a stronger message from the program and its faculty that the exam was important to the students' future career. For example, on the 2011-2012 graduating senior survey, students were asked "how important is it to you whether or not you passed the FE exam?" Among the 56 respondents, 9% selected not at all/not very and 9% answered moderately; we believe that all students should respond moderately or higher. Also, it was felt that the level of knowledge and learning acquired in the senior design course was insufficient for many of the professional skills. For example, the ability of students to analyze issues in professional ethics was not being documented. Therefore, the professional issues course was created with the following learning objectives (mapped to the ASCE BOK2[12] outcomes and targeted Bloom's level of achievement (LOA) shown):

- Explain the importance of **professional licensure** and the path to become a licensed PE
  - Describe the knowledge, skills, and attributes required to become a PE, based on the ASCE BOK2
  - Prepare to pass the Fundamentals of Engineering (FE) exam
    - Review topics, develop test taking strategy
- Analyze a situation involving multiple conflicting **professional and ethical** interests to determine an appropriate course of action (BOK2 outcome 24, LOA4)
- Identify aspects of **sustainability** in civil engineering projects; and the ethical requirement to strive for sustainable development in civil engineering projects (BOK2 outcome 10, LOA2)
- Explain the impact of historical and **contemporary issues** on the identification, formulation, and solution of engineering problems and explain the impact of engineering solutions on the economy, environment, political landscape, and society (BOK2 outcome 11, LOA3)
  - Contemporary issues include: America's infrastructure ratings (ASCE Report Card); design for climate change; globalization; resilient infrastructure
- Define & explain **leadership**, the role of a leader, and leadership principles and attitudes (BOK2 outcome 20, LOA2)

- Describe key information related to **public policy related to civil engineering**; Discuss and explain key concepts and processes involved in public policy (BOK2 outcome 17, LOA2)
- Explain key concepts and processes used in **business and public administration** (BOK2 outcome 18, LOA2)

The initial course offering in 2015 was small with only 19 students (16% females, 63% who had worked at an engineering internship, and 16% non-traditional (older) students). These were students who transferred into the program after the first year and were therefore on the "new" curriculum. This also meant that most of the students were seeing formal ethics education for the first time (since they had missed the large ethics module in the first year civil engineering introductory course). The second course offering included 56 students – these varied from being in their 7th semester to 9th semester of the curriculum (24% females, 75% who had worked at an engineering internship, and 4% non-traditional). Course assessment in 2015 included the direct assessment from the assignments themselves, instructor observations, and the standard anonymous university course evaluations completed near the end of the semester. Course assessment in 2016 included the direct assessment from the assignments themselves, instructor observations, an optional end-of-semester course survey for extra credit, and the standard anonymous university course evaluations completed near the end of the semester.

The following sections of the paper will present each of the core learning goals for the course, how the topic was taught, and the assessment results that document student learning. After these individual elements, an over-arching presentation of data on student satisfaction and discussion of this aspect is presented.

Course Results and Discussion

FE Exam Reviews

The initial learning activities in the course focused around preparation for the FE exam. This began with an online practice exam (100 minutes, 35 questions), that simulated the topics and multiple choice format of the FE exam. After taking the practice exam, students completed a homework assignment where they analyzed their performance and created a study strategy. In 2015, students were left on their own to review various topics of their choice and take associated 10-question, 30-minute multiple choice quizzes to assess their performance. Quiz questions were developed by faculty in the department. The students could elect which quizzes to take and the timing of their review activities over a one month period. Unfortunately, a number of the students did not seem to take this process seriously. Some took assessment quizzes on the topics on which they had already performed well on the practice exam. Some crammed all the quizzes to the last day at the end of the month. The uneven level of study and review was reflected in student performance on the second practice exam. Average exam scores only increased from 49% (range 28-73%)on the first exam to 52% (range 26-68%) on the second practice exam.

In 2016 students were given a more structured FE review process. Over four weeks of class, eight faculty members reviewed topics on the civil engineering FE exam. Attendance was taken to help ensure student participation. Faculty reviews ranged from highly interactive questioning of the students (Jeopardy game-show style) to working example problems to lecture. After the

review, students were required to select among 3 to 4 topics to complete practice quizzes to earn course points during the following week (with a goal to earning 20 quiz points or more each week, where each topic had a 10-question practice quiz). This second approach seemed more successful, with average exam scores increasing from 37% (range 17-56%) on the first exam to 53% (range 33-79%) on the second practice exam. A survey at the end of the semester with 38 responses (68% of the class) found that students' self-reported confidence to pass the FE exam ranged from 30 to 100 (on a scale of 0 to 100) with an average of 79 and a median of 85. Students reported that the guest lectures reviewing topics for the FE exam were more helpful then the practice quizzes (average 5.3 versus 5.0 on Likert scale from 1 = strongly disagree to 7 = strongly agree, 5 = slightly agree).

Whether students in the course went on to pass the FE exam or not is unknown; the 2015 class cohort was a small fraction (about 30%) of students at the institution who would have taken the exam sometime in fall 2015 to fall 2016; the 2016 class cohort would take the FE exam sometime between fall 2016 and fall 2017. Future senior survey data can also be examined to see if students placed a higher personal importance on passing the FE exam.

ASCE Body of Knowledge

The second learning module and homework assignment of the semester asked students to read and reflect on the ASCE BOK2. This included considering how their own course and co-curricular/life experiences contributed to fulfilling the 24 BOK2 outcomes at the various levels of achievement. The students also rated the five outcomes that they believed were the most and least important for their future as an engineer, which three outcomes they considered their personal weakest, and three outcomes they believed should have greater coverage in the courses of their CU civil engineering degree. Results of the student assessment of outcome important and fulfillment relative to the learning outcomes in the course are summarized in Table 2 below.

Table 2. Summary of student ratings of BOK2 outcomes (2016 n=56; 2015 n=19)

Civil Engineering BOK2 Outcome	% students among 5 most important 2016, 2015	% student among 5 least important 2016, 2015	% students included among 3 personal weakest 2016, 2015	% students included among top 3 more needed in CVEN degree 2016, 2015
10. Sustainability	20, 0	6, 16	24, 16	41, 26
11. Contemporary issues & historical perspectives	2, 5	41, 37	15, 32	15, 5
17. Public policy	2, 0	31, 21	33, 21	24, 5
18. Business & public administration	6, 5	24, 11	31, 26	19, 16
20. Leadership	26, 26	2, 11	4, 0	19, 11
24. Professional and ethical responsibility	41, 26	2, 16	4, 11	6, 11

Among the outcomes related to the six learning objectives for the course, in 2016 three were rated above the median for the top five most important among all 24 BOK2 outcomes (sustainability, leadership, and ethics). The other three were rated among the least important. One might expect greater student buy-in to learning about topics that they believe are important.

The BOK2 also describes the additional learning related to the 24 outcomes that is expected to come from a Master's degree (or additional coursework beyond the Bachelor's degree) and on the job from experience. This asks students to consider elements of lifelong learning. Questions on a homework assignment asked students to describe the process to becoming a licensed professional engineer (PE), maintaining a PE license, how and why the process might change in the future, and the importance of licensure. Average student performance on these questions on the homework was generally good, as summarized in Table 3.

A final essay question on the homework assignment asked students to reflect on reading the BOK2. In 2015, 32% indicated that students should not be required to read the BOK2. In 2016, students were given more specific instructions of sections to read within the BOK2; in 2016, only 4 (8%) had largely negative feedback on reading the BOK2. Thus, this more structured approach to asking students to explore the BOK2 was more positive. The 2016 end-of-semester survey results were also generally positive. In response to the statement "Reading the ASCE Body of Knowledge for Civil Engineers (BOK2) helped me understand the knowledge, skills, and attitudes expected of professionally licensed civil engineers" the average agreement was 4.5 (median 5 = slightly agree; 1 to 7 scale). Responses to the statement "Reading the ASCE Body of Knowledge (BOK) increased my motivation to become a professionally licensed civil engineer" averaged 4.3 (median 3 = slightly disagree; 1 to 7 scale).

Ethics and Contemporary Issues

The third module within the course focused on ethics. Students' incoming perceptions of the topic were generally positive (see Table 2). On an optional pre-survey in the course, integrity was the most commonly cited among "top 5 most important attitudes" for professional engineers among the 2016 students. In 2016 the module began with in-class minute papers, where most of the students indicated the importance of ethics.

Ethics instruction in the course included the basic requirements of the code of ethics, as tested via the multiple choice FE-type questions. But it was also aimed to consider ethics more broadly, including ethical theories, macroethical ideas, and social justice. The approach for the ethics module in the 2015 course was previously described.[69] In 2016 a more modest approach to ethics instruction was taken. The structured controversy was removed. However, the case study of New Orleans and Hurricane Katrina as the basis for in-class discussion and the homework was retained. The student performance on the related homework assignment served as a direct assessment, demonstrating students' ability to analyze ethical issues (questions 1 to 4) and understanding of contemporary issues (questions 5 and 6) (Table 3). The students generally perceived that this was an effective teaching method; the 2016 final survey stated "New Orleans and Hurricane Katrina was a helpful case to study ethical issues" and the average level of student agreement was 5.5 (median 6 = agree; 1 to 7 scale). Students at the end of the semester in 2016

also rated their confidence related to analyzing ethical issues and understanding contemporary issues, with reasonably good ratings (average 77-78 out of 100 = fully confident).

Sustainability

The module on sustainability taught students about the Envision rating system for sustainable infrastructure. Students analyzed the rebuilding activities in New Orleans after Hurricane Katrina for sustainability elements. This was intended to prepare the students to include sustainability elements in their senior design projects the following semester. The sustainability knowledge evident from the homework assignments in 2015 was strong (average 95%), but weaker in 2016 (average 83%). Some of the difference in the scores may be attributable to different graders in each year. The students' perception of the effectiveness of the New Orleans case study for sustainability was lower than for ethics; "New Orleans and Hurricane Katrina was a helpful case to study sustainable engineering" average agreement 5.1 (median 5 = slightly agree; 1 to 7 scale). At the end of the semester in 2016, students rated their confidence to "Identify aspects of sustainability in civil engineering projects" at an average of 78 (median 80; 0 to 100 scale). Comparing pre- and post- survey responses on confidence related to six sustainability related items (the social, economic, and environmental elements/risks, interdependency, and overall sustainable engineering), students' confidence increased from an average of 67 to 79 (n=29 pairs, 0 to 100 scale). Thus, the sustainability content in the course appeared to increase students' perceptions of their own knowledge and abilities related to sustainability issues.

Leadership, Public Policy, Business

The modules on leadership, public policy, and business were each one week long. These were fairly conventional, with an assigned reading, an in-class lecture, and a short assignment (50 points, compared to 100 point assignments on ethics and sustainability). This learning method seemed appropriate given that only a Bloom's level of achievement 2 was needed, with students demonstrating the ability to define, explain, and describe. The BOK2 appendix for each topic was used as supporting reading material to explain why each of these areas was important and what they encompassed. An additional reading and/or reference materials were also provided for each topic. Students' incoming level of knowledge on these topics was perhaps the most variable, based on how they mapped their courses and co-curricular experiences as contributing to these outcomes on Homework 2. Some students were pursuing a minor in business, a certificate in leadership, had taken upper-division electives in construction engineering and management, and/or had real-world work experience. It seemed difficult to engage students in class participation during these lectures. Students generally performed very well on the basic assignments related to these topics, as shown in Table 3. In 2015, the average grades earned on each assignment were in the low 90s; the performance was somewhat weaker in 2016 on the public policy and business assignments with average scores in the upper 80s.

Outcomes Assessment Summary

A comparison of the students' achievement of the learning outcomes for the course, as measured by performance on the homework assignments (HW) is shown in Table 3, alongside students' self-assessment of their ability from the end-of-semester survey. Generally good performance of

the students on the assignments was found, based on average homework scores in the upper eighty percent to lower ninety percent range. In addition, students' self-ratings of their confidence to perform each task were generally adequate – business and public administration was somewhat low (average 71).

Given that each assignment was writing intensive, the course could be used to assess individual writing skills. The engineering writing rubric from Parker[70] was given to the students on the large ethics and sustainability assignments, and on each assignment 10% of the grade was based on those elements. The rubric scored content (e.g. objective clearly stated; reader understands why paper was written), organization (topic sentences, paragraph order, transitions), and mechanics and linguistics (word choice, grammar/punctuation/spelling, tone, and formatting). In 2016, the average length of the ethics and sustainability assignments were 2733 words and 1920 words, respectively. Students' demonstrating written communication abilities increased between the two assignments in 2015, but only modest improvement was observed in 2016 (likely because slow grading by the course Teaching Assistant meant the students did not receive feedback on the ethics assignment prior to the submitting the sustainability assignment).

Table 3. Outcomes Assessment by Direct Evaluation from Student Homework Assignments and Self-Assessment by the Students

Outcome	Avg HW % 2015	Avg HW% 2016	2016 avg. confidence on post survey
Lifelong learning			
Explain the importance of professional licensure for engineers	69	88	84
Explain the path to become a licensed PE	87		89
Ethics: Analyze a situation involving multiple conflicting professional and ethical interests to determine an appropriate course of action	90	94	78
Contemporary issues: Explain the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems	95	86	77
Explain the impact of engineering solutions on society	--	--	80
Sustainability: Identify aspects of sustainability in civil engineering projects	95	83	78
Explain the ethical requirement to strive for sustainable development in civil engineering projects			83
Leadership: Define and explain leadership, the role of a leader, and leadership attitudes	94	96	84
Public Policy: Describe key information about how public policy relates to civil engineering	93	88	81
Describe typical processes involved in public policy			72
Business: Explain key concepts in business and public administration	94	87	71
Written communication	93-99	90-93	NA

NA = not asked on the survey

Student Satisfaction

Although the professional issues course was able to demonstrate adequate achievement of the learning outcomes, students generally disliked the course. One week before the end of the semester, the university administers anonymous course evaluations. Hard copies were distributed and collected by a student in the course. Results are summarized in Table 4. The students' average rating of the course overall was very low (2.4-2.5 on a 1-6 scale); one of the lowest rated courses in the department and much lower than the average overall course ratings in the civil engineering department (4.7-4.8). This is also the lowest rated course the instructor has received over a 20-year teaching career. Individual students gave ratings across the entire scale of 1 to 6. In addition, the students' personal interest before enrolled was also quite low (2.1-2.6 on a 1-6 scale); much lower than average courses in the civil engineering department (4.2-4.3). This creates a challenge to be overcome, given what is known about intrinsic student motivation for learning.[71-72]

Table 4. Student evaluations of the civil engineering (CE) professional issues (PI) course and similar professional issues courses in mechanical engineering (ME) at the institution

Course	CE PI	CE PI	ME2000	ME2000	ME2000	ME 1cr	ME 1cr
Year	2015	2016	2016	2015	2014	2016	2015
N enrolled	19	56	283	257	241	28	25
N evaluations	17	40	243	126	146	9	7
Personal interest before enrolled (1-6)	2.1	2.6	3.2	2.9	2.5	3.0	4.1
Course overall (1-6)	2.5	2.4	3.4	2.7	2.8	3.4	4.6
Hour/week inc. class	7-9	4-6	0-3	0-3	0-3	0-3	4-6
Dept Average							
Personal interest	4.2	4.3	4.0	4.0	4.3	4.0	4.0
Course overall	4.8	4.7	4.6	4.7	5.1	4.6	4.7

The professional issues course tried to build in some opportunities for student choice, since self-determination theory indicates that autonomy can help lead to motivation.[73] For example, each week in the first half of the semester the students could select two or more topics from among four to five options to demonstrate their review and proficiency toward the Fundamentals of Engineering exam. The case study around New Orleans and hurricane Katrina allowed students to self-select ethical and sustainability facets to explore. The public policy assignment asked the students to identify a civil engineering project of personal interest to explore relevant policies. The business assignment was the only one of the semester that did not include any personal elements or choice.

Write-in comments on the course evaluation forms indicated that some students wanted more interactive discussions during class. However, attempts to engage students in discussions in the 2016 larger enrollment class were generally unsuccessful. Clicker questions were used to attempt a think-pair-share style, but this also did not seem to work. Other students indicated that the assignments were too long; however, the average amount of time that students reported spending in the course in 2016 was certainly not excessive for a two-credit course (two credit course should require 2-3 hours of outside work per credit hour= 4-6 hours, which was the average

reported time). Thus, it was perhaps perceived importance/benefit of time invested rather than time itself. One student's comment matches the instructor perception: "Leadership, public policy, and ethics should be integrated into every course, not shoved into one unit of one course." However, it has not been possible to get this buy-in from faculty in the program, resulting in the current curriculum design to make up for the deficiency.

A professionalism course in the mechanical engineering (ME) department at the same institution is compared. The ME2000 course is a 1-credit sophomore level course. The course description for "ME Professionalism and Career Seminar" is: "Resumes, effective teamwork, professional communication, and engineering ethics." Here somewhat low (although more variable) course ratings and personal interest before enrolled are also evident. A third 1-credit sophomore level professionalism course (ME 1cr) is also shown; it is offered at a satellite campus of CU. This course was much smaller than the CU ME2000 course, and actually had one good year of course evaluations. However, in that year a very small percentage of the students completed the course evaluations (7 of 25).

Given that two professionalism courses in different disciplines and fairly different formats are experiencing somewhat similar challenges, it may be that the culture in engineering at CU is very "technical"-centric, such that professional topics are perceived as significantly less important. This is perhaps reinforced by the majority of the core courses in civil engineering not integrating any of the professionalism topics. Further, if students have not encountered professionalism topics to a significant degree until the senior year, their concepts of what is "real" engineering have already been formed (and exclude professional issues). The experiences in this civil engineering professional issues course at CU are very similar to that reported in the civil engineering professional issues course at the University of Canterbury by Koorey et al.[29]

Future Plans

Additional changes are planned for the Professional Issues course in Fall 2017. The course will be offered in two 50-minute periods per week, instead of 100-minutes once per week. These shorter periods may be more likely to retain student attention. Faculty who come in to give FE review sessions will be encouraged to work a few example problems, and then give a handout with additional worked examples. The multiple-choice practice quizzes for the FE topics will also be retooled to provide worked solutions after a student completes the quiz. In 2015 and 2016 the students were allowed to repeat the quizzes as often as they chose, which is why solutions were not provided. In addition, starting in July 2017 the NCEES FE exam will include alternative item types, such as multiple correct options and fill in the blank.[74] We will need to create questions that allow students to practice these types of items. The class meeting periods on ethics, sustainability, leadership, public policy, and business will be redesigned to incorporate more active learning; in-class worksheets will be completed by groups of 2-3 students (as an alternative to clicker questions). We may also try to bring in local practitioners and/or professional engineers to lead some of the class sessions. Infusing their real-world experiences may be more convincing to students of the importance of these topics. The homework assignments might be redesigned to allow students more freedom. For example, they could complete the ethics and sustainability assignments on the New Orleans/Katrina case study, or select a topic of their own interest. Giving the students choice should increase their motivation,

and in turn their satisfaction.[73] In addition, we will try to hire a Teaching Assistant (TA) who is able to be more responsive in quickly grading and returning the assignments, with appropriate feedback to students on how to improve.

Summary and Conclusions

A wide variety of courses that focus on professional issues were identified in an array of engineering disciplines across many institutions. The models vary widely, in terms of location in the curriculum (generally sophomore to senior year), number of credits (0 to 3 most common), and learning outcomes being targeted. The Professional Issues course in civil engineering at CU provided evidence of meeting the six educational outcomes that were targeted, but students were generally very unhappy with the course style. Future revisions to teaching methods will be tried. Centralizing the assessment of the outcomes in a single course at CU has been helpful to ensure that documenting these learning outcomes for ABET occurs reliably. But ideally, professionalism topics should be integrated into a number of core courses. Even if not assessed in those courses, touching on professional issues throughout the curriculum could help build students' beliefs of the importance of these topics. This in turn could help improve students' interest and motivation for learning these topics at a deeper level in the professional issues course.

References

1. American Society of Mechanical Engineers (ASME). 2011. Vision 2030: Creating the Future of Mechanical Engineering Education. Phase 1 Final Report. 96 pp.
2. Duderstadt, J.J. 2008. Engineering for a Changing World: A Roadmap to the Future of Engineering Practice, Research, and Education. The Millennium Project, The University of Michigan.
3. Gilbuena, D.M., B.U. Sherrett, E.S. Gummer, A.B. Champagne, M.D. Koretsky. 2015. Feedback on Professional Skills as Enculturation into Communities of Practice. Journal of Engineering Education, 104 (1), 7-34.
4. Lattuca, L.R., P.T. Terenzini, J.F. Volkwein. 2006. Panel – Engineering Change: Findings from a Study of the Impact of EC2000. 36th ASEE/IEEE Frontiers in Education Conference. M2B-1-2. Oct 28-31. San Diego CA.
5. National Academy of Engineering (NAE). 2004. The Engineer of 2020: Visions of Engineering in the New Century. National Academies Press, Washington D.C.
6. Shuman, L.J., M. Besterfield-Sacre, J. McGourty. 2005. The ABET "Professional Skills" – Can They Be Taught? Can They Be Assessed? Journal of Engineering Education, 94 (1), 41-55.
7. Toole, T. M. 2010. A Critical Examination of ASCE's Vision 2025. Working Paper Proceedings of the Engineering Project Organizations Conference (EPOS), South Lake Tahoe, CA, Nov. 4-7. Ed. J.E. Taylor and P. Chinowsky. 16 pp.
8. Trevelyan, J. 2006. Definition of Engineering Roles. Revision 3.2. 207 pp. http://staffhome.ecm.uwa.edu.au/~00006605/eng-work/working-papers/Engineering-roles-060206.pdf Accessed Jan. 29, 2017.
9. Trevelyan, J. 2009. Steps Toward a Better Model of Engineering Practice. Proceedings of the Research in Engineering Education Symposium. Palm Cove, QLD. 9 pp.
10. Ulsoy, A.G. Editor. 2007. Report of The "5XME" Workshop: Transforming Mechanical Engineering Education and Research in the USA. May 10-11. National Science Foundation, Arlington VA.
11. ABET. 2016. Criteria for Accrediting Engineering Programs. Engineering Accreditation Commission (EAC). ABET. Baltimore MD.
12. American Society of Civil Engineers (ASCE). 2008. Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future. 2nd Edition. ASCE, Reston VA.

13. ABET. 2016. Criteria for Accrediting Engineering Technology Programs. Engineering Technology Accreditation Commission (ETAC). ABET. Baltimore MD.
14. ABET. 2016. Criteria for Accrediting Computing Programs. Computing Accreditation Commission (CAC). ABET. Baltimore MD.
15. Engineers Australia. 2013. Stage 1 Competency Standard for Professional Engineer. 6 pp.
16. IPENZ – Engineers New Zealand. 2013. CA 30 – Competency Standards with Revised Indicators (Version 3.2).
17. Engineering Council. 2013. UK Standard for Professional Engineering Competence (UK-SPEC). Third Editions.
18. Slaton, A.E. and D.M. Riley. 2015. The Wrong Solution for STEM Education. Inside Higher Education. July 8. https://www.insidehighered.com/views/2015/07/08/essay-criticizes-proposed-changes-engineering-accreditation-standards Accessed Jan. 29, 2017.
19. Welch, R. 2009. Integrating Professional Topics and Engineering Constraints Across the Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2009-734. 17 pp.
20. Scott, E.P., D. Wilson, R.A. Bates. 2012. Integrating Professional Development Modules in the Engineering Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2012-5006. 7 pp.
21. Davis, W.J., K.C. Bower, R.W. Welch, D.H. Fehrmann. 2013. Developing and Assessing Student's Principled Leadership Skills to Achieve the Vision for Civil Engineers in 2025. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #6943. Atlanta GA, June 23-26. 17 pp.
22. Wilk, R.D. and A.M. Anderson. 2002. Development of Communication Skills Across the Engineering Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 2238. 14 pp.
23. Abulfaraj, W., M. Hassan. 2007. Teaching and assessment of professional ethics in the nuclear engineering education according to the ABET engineering criteria. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2007-938. 14 pp.
24. Habibi, M., M. Alaei, A. Lillesve. 2013. Integrating Professionalism in a Project-Based Engineering Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #6008. Atlanta GA, June 23-26. 7 pp.
25. Schmeckpeper, E.R., A.A. Kranov, S.W. Beyerlein, J.P. McCormack, P.D. Pedrow. 2014. Using the EPSA Rubric to Evaluate Student Work in a Senior Level Professional Issues Course. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #10414. Atlanta GA, June 23-26. 19 pp.
26. Schmeckpeper, E.R., A.A. Kranov, S.W. Beyerlein, P.D. Pedrow, J.P. McCormack. 2015. Using the EPSA Rubric and EPSA Score to Evaluate Student Learning at the Course and Program Level. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #12640. Seattle WA, June 14-17. 23 pp.
27. Schmeckpeper, E.R., M.B. Kelley, A.A. Kranov, S.W. Beyerlein, J.P. McCormack. 2016. Enhancing Student Learning through Using and Writing EPSA Scenarios. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #16962. New Orleans, LA, June 26-29.
28. Clemence, S.P. and D.J. McGinley. 1997. Issues in Professional Practice and Their Implementation in Engineering Curricula. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 2515. 8 pp.
29. Koorey, G.F., M.W. Milke, N. Delatte. 2016. International Collaboration on a Professional Development Course. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #14447. New Orleans, LA, June 26-29. 15 pp.
30. Bhatt, B.L. 1993. Teaching Professional, Ethical and Legal Aspects of Engineering to Undergraduate Students. ASEE/IEEE Frontiers in Educaiton Conference. Session 8B5, p. 415-418.
31. Alenskis, B.A. 1997. Integrating ethics into an engineering technology course: an interspersed component approach. Session 2247. 7 pp.
32. Sepahpour, B. 2015. Serendipitous advantages of a multi-disciplinary senior seminar course for engineering students. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #11982. Seattle WA, June 14-17. 19 pp.
33. Carroll, C.R. 2005. Engr 4001: Engineering Professionalism. Teaching the "Professional Component" of Engineering. American Society for Engineering Education (ASEE) Annual Conference & Exposition. 5 pp.
34. Selby, M.A. 2015. Assessing engineering ethics training. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #14093. Seattle WA, June 14-17. 11 pp.

35. Fraser, J.M., L. Bedoya-Valencia, J.L. DePalma, N.I. Jaksic, A.M. Paudel, H. Sarper, D. Yuan. 2014. Integration of Sustainability in a Multidisciplinary Engineering Department. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #9551. Indianapolis IN, June 15-18. 10 pp.
36. Yuan, D., N. Jaksic, J. Fraser. 2009. Start Earlier, Prepare Better: An Engineering Senior Seminar Course. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2009-309. 11 pp.
37. Wankat, P., K. Haghighi. 2009. Multidisciplinary engineering: Flexibility and ABET Accreditation. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2009-176. 19 pp.
38. Bullard, L., D. Ollis. 2010. Professional development buffet: from banquet to a la carte. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2010-2. 18 pp.
39. Delglass, W.N., P.C. Wankat, F.S. Oreovicz. 2000. Integrating Soft Criteria into the ChE Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 2613. 7 pp.
40. Kauffman, D., R.D. Busch, A.K. Datye, T.L. Ward. 2005. The Minimum Core for Chemical Engineering: How Much Bathwater Can We Throw Out? American Society for Engineering Education (ASEE) Annual Conference & Exposition. 15 pp
41. Fries, R., S.K. Lakkaraju, B. Cross, S.M. Morgan, A.L. Welker. 2012. Survey of Civil Engineering Assessment Changes in Response to Revised ABET CE Program Criteria. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2012-3496. 17 pp.
42. Welch, R. 2010. Single Synergistic Course vs. Modules in Multiple Courses. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2010-1391. 18 pp.
43. Welker, A., F. Falcone. 2008. Professional practices in civil engineering: Meeting and exceeding the new civil engineering program criteria. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2008-1406. 15 pp.
44. Bielefeldt, A.R., B. Amadei, R.S. Summers. 2005. Incorporating Earth Systems Engineering Concepts throughout the Civil Engineering Degree to create the Engineer of the 21st Century. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 3215. 9 pp.
45. Carpenter, D. 2007. Using a hybrid classroom environment for the instruction of ethics and contemporary civil engineering issues. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2007-1724. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2007-1724. 15 pp.
46. Hall, K. 2010. The Challenge of Implementing the Civil Engineering BOK2 at [University A]. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2010-1136. 18 pp.
47. Koehn, E., K.G. Vaska, K. Paruchuri, J. Koehn. 2009. Knowledge of Contemporary Issues Held by Engineering Students. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2009-604. 11 pp.
48. Mattei, N.J. 2005. Is covering ethics in an analysis class effective? American Society for Engineering Education (ASEE) Annual Conference & Exposition. 11 pp.
49. McManis, K. 2010. How the Civil Engineering BOK2 can be implemented at the University of Louisiana. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2010-327. 22 pp.
50. Ressler, S.J. 1999. A structured assessment system for an undergraduate civil engineering program. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 1615. 6 pp.
51. Meyer, F., S. Bert. 2007. A technique for program-wide direct assessment of student performance. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2007-2257. 9 pp.
52. Nixon, W.A., R. Ettema, F.M. Holly, J.W. Stoner. 2003. A Flexible Undergraduate Civil Engineering Curriculum. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 2615. 14 pp.
53. Polikar, R., J.L. Schmalzel, S.A. Madayam, R.P. Ramachandra, R.R. Krchnavek, L.M. Head, P. Jansson, R. Ordonez. 2002. Continuous Development of a New ECE Program. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 2532. 21 pp.
54. Rosenkrantz, P.R. 2011. Transformational leadership 101: What all industrial engineering graduates should know about the six stage of quality management system implementation. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2011-397. 16 pp.
55. Ansari, J., A. Javaheri, S.S Tompkins, K. Williamson. 2008. Outcome assessment process in a manufacturing engineering program. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2008-2236. 11 pp.

56. Jordan, W., M. Corley. 2004. Promoting professionalism in traditional and nontraditional ways. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 3561. 10 pp.
57. Meckl, P.H. 2003. Integrating ethics into an undergraduate control systems course. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 1532. 7 pp.
58. Wilk, R.D., A.M. Anderson. 2001. Designing a senior experience in mechanical engineering: culmination of an undergraduate program, preparation for professional life, and reinforcing the foundation for continued learning. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Session 1566. 10 pp.
59. Naghedolfeizi, M., S. Arora, N.A. Yousif, X. Zeng. 2016. Computer science curriculum redesign at Fort Valley State University. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #17134. New Orleans LA, June 26-29. 8 pp.
60. Segalewitz, S.I. 2013. Seven years of success in implementation of a 3 + 1 transfer program in engineering technology between universities in China and the United States. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper ID #7017. Atlanta GA, June 23-26. 9 pp.
61. Balascio, C., T. Brumm, S. Mickelson. 2010. Competency-based assessment of engineering technology program outcomes. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2010-756. 11 pp.
62. Jones, D.K., S.J. Baran, A. Hsie. 2011. A new course to assess the professionalism skills required by ABET. St. Lawrence Section Conference of the American Society for Engineering Education (ASEE). 7 pp. http://stl.asee.org/papers_2011/Jones.pdf Accessed January 5, 2017.
63. Skvarenina, T. 2006. Triangulating TC2K assessment results by using student surveys. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2006-1920. 22 pp.
64. Cottrell, D. 2006. Integrating TC2K into a multi-disciplinary seminar course: finding a hook for the "soft" outcomes. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2006-2504. 7 pp.
65. Musto, J., W. Howard. 2006. Using the ASME professional practice curriculum within an MET capstone experience. American Society for Engineering Education (ASEE) Annual Conference & Exposition. Paper AC 2006-2176. 7 pp.
66. Bucknam, Ronald E. 1992. Issues in professional engineering practice. University of Washington. Seattle, WA. http://www.worldcat.org/title/issues-in-professional-engineering-practice/oclc/56600444 Accessed March 31, 2017.
67. Yoder, B.L. Engineering By the Numbers. 2014-2015. P. 16. https://www.asee.org/papers-and-publications/publications/college-profiles/15EngineeringbytheNumbersPart1.pdf Accessed March 31, 2017.
68. Bielefeldt, A.R., D. Knight, C. Swan, N. Canney. 2016. "Macroethics Education in Engineering and Computing Courses." Proceedings of the American Society for Engineering Education (ASEE) Rocky Mountain Section Conference. Sept. 30-Oct. 1. Cedar City, UT. 13 p.
69. Bielefeldt, A.R. 2016. Infusing Macroethical Ideas into a Senior Engineering Course. American Society for Engineering Education (ASEE) Annual Conference and Exposition Proceedings. June 26-29. New Orleans, LA. DOI:10.18260/p.25693. 15 pp.
70. Parker, P. 2009. Effect of Type of Writing Instruction on Quality of Student Writing. American Society for Engineering Education Annual Conference, Paper AC 2009-2028, 9 pp.
71. Pintrich, P.R. 1994. Student Motivation in the College Classroom; Chapter 2 in Handbook of College Teaching: Theory and Applications, Eds. E.W. Prichard, R. McLaran Sawyer. Greenwood Press, Westport CT; p. 23-44.
72. Wigfield, A., J.S. Eccles. 2000. Expectancy-Value Theory of Achievement Motivation. Contemporary Educational Psychology, 25 (1), 68-81.
73. Ryan, R.M and E.L. Deci. 2000. Self Determination Theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55 (1), 68-76.
74. National Council of Examiners for Engineering and Surveying, NCEES. Alternative Item Types. http://ncees.org/exams/cbt/ Accessed March 31, 2017.

Table A1. Published Examples of Professional Issues Courses in Engineering

Major(s)	Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year in curriculum; course description [Reference] URL for additional information (frequently course catalog)
All engineering	EG450 Professional Issues	Norwich University	3	F, G, H, I, J, Bu, PE	Senior; ethics, engineering registration, mal-practice and legal responsibilities, business aspects; 2 hrs classroom, 2 hrs recitation; use of EPSA contemporary issues scenario & rubric [25-27] http://catalog.norwich.edu/residentialprogramscatalog/coursedescriptions/eg/
All engineering	EGR 401 Professional Engineering	Oakland U	1	F	Senior; seminar with professional and faculty speakers; professionalism, ethics (theories, disasters, cases, codes of ethics), legal aspects of engineering (liability, risk, contracts, IP); P/F [30] from 31
All engineering majors	ENG 099 Senior Professional Seminar	The College of New Jersey	1	F, G, H, I, J	Senior; aid students in transition from college to graduate school/industry; career planning, resume preparation, interviewing techniques, professional responsibilities, ethics, graduate and continuing education [32]
All engrg majors	ENGR 4001 Engineering Professionalism	University of Minnesota Duluth	3	C, D, F, G, H,	Senior; 2 hr lecture, 2 hr lab; ethics, sustainability, health & safety, society, economics, environment, politics, manufacturability; fulfills advanced writing requirement; multidisciplinary design experience [33]
All engineering majors	Engineering Senior Seminar	Walla Walla University	1Q x 3	F	Senior; ethics; engineering career and professional issues are presented and discussed; integrated with capstone project experience; [34] http://bulletin.wallawalla.edu/en/2014-2015/Bulletin/Courses
Gen Eng, Industrial	Senior Seminar	Colorado State University Pueblo	2	D, F, G, I, J, Bu	Senior; ethics, team work, IP, entrepreneurship, job hunting, graduate study, sustainability, NAE Grand Challenges; prepare for senior project (P/F) https://www.csupueblo.edu/catalog/_doc/Catalog2016-2017.pdf [35-36]
General Engineering	Professionalism I, II, III, IV	Iron Range Engineering Minnesota State U Mankato	3 x 4	D, F, G, H, I, J, L	Junior, Senior; Teamwork evaluation, ethical issues, personal improvement reflection, lifelong learning based on metacognitive memos, knowledge of contemporary issues, leadership [24]
Multi-disciplinary Engineering	IDE 301 Professional Preparation in interdisciplinary engineering	Purdue University	1	D, F, G, H, I, J, L	Junior; Seminar; functioning in teams/MBTI, communication, ethics, global and societal impacts, lifelong learning and how people learn, contemporary issues impacting and impacted by engineering, leadership; homeworks and oral presentations. [37] http://catalog.purdue.edu
Various	Issues in Professional Engineering Practice	48 programs at 45 institutions	Var.	F, Bu	Described a course that includes types of engineering organization, marketing, business; project management; responsibility of engineer to society, ethics [28]
Chemical	CHE 395 Professional Development Seminar	North Carolina State University	1	F, G, H, I, J, PE	Junior; professional registration, interviewing, resumes, student presentations, information literacy, tips on written and oral communication, ethics, graduate school, IP; 6 assignments to assess the 5 ABET learning outcomes [38]

Major(s)	Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year in curriculum; course description [Reference] URL for additional information (frequently course catalog)
Chemical	CHE 20000, 30000, 40000 ChE Seminar	Purdue	0 + 0 + 1	F, G, I	Sophomore, junior, senior; emphasize ethics; importance of communication; Myers-Briggs Type Indicator assessment; learning styles inventory; continuing education [39]
Chemical	CBE 451 Senior Seminar	University of New Mexico	1	J	Senior; reports on selected topics and surveys, presentation and discussion of papers from current technical journals. [40] http://catalog.unm.edu/catalogs/2016-2017
Civil	Various seminar courses &/or professional practice course	14 institutions	unk	Bu, PP, L	Management, business, public policy, and leadership [41]
Civil	CENG 4341 Leadership, Public Policy, Business Pract. and Asset Management	University of Texas Tyler	3	F, H, I, J, L, Bu, PP	Senior; "Civil Engineers are required to be leaders of their communities as well as their firms. Leadership, public policy, business practices and asset management are critical areas that a CE must have skills in" [19, 42] http://www.uttyler.edu/ce/documents/ceng4341.pdf
Civil	CEE 4601 Professional Practice	Villanova	3	D, F, G, H, I, J, L, Bu Gl	Senior; examine self-abilities and interests; leadership and management, organizational structure and theory, communications, team, project management, ethics, marketing, global view; semester long team project with written and oral report [43]
Civil	CVEN 4039 Senior Seminar	University of Colorado Boulder	1	F	Senior; lectures on ethics and professional practice; FE exam review; course no longer in the curriculum [44]
Civil	ECE4051 Ethics and Professional Issues	Lawrence Technol-ogical University	1	F, G, H, I, J, PE	Senior; engineering ethics, history of civil engineering, sustainability, professional licensure, and other professional issues. Oral and written reports required [45] https://www.ltu.edu/sustain/engineering_courses.asp#Ethics and Professional Issues https://www.ltu.edu/registrars_office/online-course-catalog.asp
Civil	CIVL 317 Professional Sustainability	The Citadel	3	D, I, L, PP	Junior; on leadership, lifelong learning, public policy, and project management threads [21] {course no longer required nor offered; see below}
Civil	CIVL 412 Eng Practices & Prof. Licensure	The Citadel	1	(FE)	Seminar; review for the FE exam http://www.citadel.edu/root/images/Academic_Resources/sccc-catalog.pdf
Civil	CVEG 4852 Professional Practice Issues	University of Arkansas	2	F, J, L, Bu, Gl, PP	Senior, professionalism and ethics, leadership, globalization, business & public administration, public policy[46]
Civil	CE 4110 Senior Seminar	Lamar University	1	F, G, J, PE, PP, Gl	Senior; Contemporary issues, ethics, professional licensure, public policy, global issues; presentation of oral and written reports[47] http://catalog.lamar.edu
Civil	ENCN 470 Professional Engineering Development	University of Canterbury, New Zealand	~3	D, F, G, I, J	Senior; engineering history, teamwork, ethics, risk management, and engineering today and tomorrow; group failure case study with written and oral report, professional development plan [29]

Major(s)	Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year in curriculum; course description [Reference] URL for additional information (frequently course catalog)
Civil	ENCE 4399 Civil and Environmental Seminar	University of New Orleans	2	F, G, H, J, PE, Gl	Senior; 1 hr lecture, 3 hr lab; professional, licensure, and ethical responsibilities of CE, communication concepts, contemporary issues to further develop an understanding of the impact of engineering solutions from a global and/or societal context. The ability of students to apply the fundamental knowledge of mathematics, sciences, and engineering will be tested. (FE preparation)[48] http://www.uno.edu/registrar/catalog/
Civil	CIVE 444 CE Senior Seminar	University of Louisiana	1	F, H, J, L, Gl, PP	Senior; ethics, globalization, public policy, leadership, humanities and social sciences aspects of CE, contemporary issues [49]
Civil	CE400 CE Professional Practice	U.S. Military Academy	1	F, I, J, Bu, PE,	Senior; Mead essay, one essay usually on an ethics topic; professional roles and responsibilities, professional registration, continuing education, engineering ethics, procurement of work, competitive bidding, quality-based selection processes, and construction management. Introduced to the design and construction processes used by the U.S. Army Corps of Engineers. The seminar will include presentations by guest lecturers on topics of current interest in the field of civil engineering. Course journal.[50-51] {old curriculum} http://www.usma.edu/curriculum
Civil	CE401 CE Professional Practice	U.S. Military Academy	3	F, G, I, J, K, Bu, PE	Senior; FE Exam Preparation, professional roles and responsibilities, professional registration, continuing education, engineering ethics, procurement of work, competitive bidding, quality-based selection processes, construction management. Presentations by guest lecturers, largely practitioners, on topics of current interest in CE; major reflective essay and several journal entries, to support Writing Goal. Meets IT/Cyber Academic Goal requirements http://www.usma.edu/curriculum
Civil	CEE Practice	University of Iowa	2	J, K, L	Sophomore; overview of CEE inc. history and traditions, contemporary role of CE; engineering drawings, geographical information systems, and elements of surveying [52]
Electrical	Seminar in Engineering Frontiers	Rowan University	1	G, I, J	Senior; practice skills for life-long learning, be aware of state-of-the-art and give oral presentation on this topic[53]
Industrial	IME 460 Senior Seminar	California State University Pomona	1	D, G	Senior; lecture; "preparatory course for senior project; communications, teamwork, project management, Six Stages of Quality Systems Implementation"[54]
Manufactur-ing	MANE 400 Senior Seminar	Virginia State University	1	A, E, F, I	Senior; Written and oral communication, ethics, lifelong learning; assess ABET outcomes A, E, F, I using FE type exam and research project report [55]
Mechanical	Senior Seminar	Louisiana Tech University	1	F, G	Senior; 3 hr/wk seminar; professionalism and ethical behavior, time and life management, career management; outside speakers on IP, financial

Major(s)	Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year in curriculum; course description [Reference] URL for additional information (frequently course catalog)
					planning, experiences in the workforce; requires non-traditional group oral presentations by students[56]
Mechanical	ME 29000 Global Engineering Professional Seminar	Purdue	1	F, G, J, Gl	Sophomore; ethics, practicing engineers describe on-the-job experiences, oral and written communication exercises.[57] Forum on contemporary issues in the global profession of mechanical engineering. Professionalism and ethics. Interactions with engineering faculty and with professionals outside the University. Quizzes on assigned readings in the areas of globalization, cultural difference and collaborating across cultural boundaries. Individually developed professional profiles describe technical interests and convey awareness of ethical responsibilities in global context; mypurdue.purdue.edu/courses
Mechanical	Senior Seminar	Union College	0	F, G	Senior; 1 hr per week for academic year; faculty lectures on engineering ethics, codes of ethics, public safety, case studies (write a paper); codes and standards, IP; outside speakers on career issues; FE exam information; job opportunities and graduate school; senior design presentations[58]
Mechanical	MER 010 ME Senior Seminar	Union College	0	F, G, J	Junior, Senior; engineering ethics and decision making, current engineering practices, codes and standards and IP, non-technical writing, outside speakers from industry and academia[22] catalog.union.edu
Nuclear	NE 400 Senior Seminar	U Tennessee Knoxville	1	F, I, J	Senior; current topics related to nuclear engineering including ethics, contemporary issues, and commitment to life-long learning; P/F [23] http://catalog.utk.edu/
Nuclear	NUCE 310W Issues in Nuclear Engrg	Penn State	2	F, H, J	Junior; societal and technical issues facing nuclear engineers, including safety, operations, waste, regulation, public acceptance, economics, ethics, and radiation [23] http://www.engr.psu.edu/cde/nuce/requirements.html
Nuclear	NUCL 49800 Senior Seminar	Purdue	0	F, I	Senior; lectures on professional ethics, job opportunities, graduate schools, continuing study, and services of professional societies; {also 0 cr. Sophomore seminar and junior seminar} [23] http://catalog.purdue.edu/
Computer Science	CSCI 4000 Senior Seminar	Fort Valley State University	2	UNK	Senior; "Students demonstrate their mastery of core materials covered in previous courses and their ability to apply the same"[59] http://www.fvsu.edu/wp-content/uploads/2015/02/Undergrad-Catalog-2010-2014-v2012-10-05-1335.pdf
Engineering Technology	SET 499 Seminar	University of Dayton	1		Junior or Senior; career planning; job search process, resume preparation, job interview, professional development[60] http://catalog.udayton.edu/allcourses/set/set.pdf
Engineering Technology	BREG 265 BREG 365 BREG 465	University of Delaware	1 + 1 + 1	F, G, L, PE	Sophomore, Junior, Senior; entrepreneurship, professionalism, ethics, certification, licensure, leadership, resume writing, professional practice

Major(s)	Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year in curriculum; course description [Reference] URL for additional information (frequently course catalog)
	ET Soph, Jr, Senior Seminars				issues; ePortfolio development and submittal for evaluation; report writing, oral presentations [61]
Engineering technology – civil, mechanical, industrial	CTC 301, MTC 301 Professionalism in the Workplace	State University of New York Institute of Technology	2	F, G, H, I, J	Junior/Senior; lifelong learning; professional, ethical, and social responsibilities; respect for diversity and a knowledge of contemporary professional, societal, and global issues; and a commitment to quality, timeliness, and continuous improvement. Homework assignments, exams, reports and presentations. [62 cited in 41]
Engineering Technology	ECET 480 Professional Issues	Purdue	unk	unk	Senior; legal issues, student survey related to program outcomes[63] {course no longer found in catalog, replaced by below?}
Engineering technology - electrical	ECET 38001 Global Professional Issues in ET	Purdue	3	F, H, Bu, Gl	Junior; professional ethics, legal issues, professional development, technology transfer, and corporate culture as related to global society; personal job and career choices, resumes, and interviews http://catalog.purdue.edu
Engineering technology - Civil, mech, electrical	ETGR 3071 Engrg Technology Professional Seminar	University North Carolina Charlotte	1	D, F, G, H, I, J, Gl	Junior; teamwork, effective communication, lifelong learning, ethics, contemporary societal and global issues; lectures, guest speakers, group projects, extensive student writing, student group presentations[64]
Engineering Technology - Mechanical	Embedded seminar within capstone design	Milwaukee School of Engineering	NA	D, F, G, J	Senior; Used online ASME Professional Practice Curriculum (PPC) modules – project management, patent law, effective technical presentations, engineering ethics, with associated written assignments and discussion of how linked to capstone project[65]

Table A2. Professional Issues Courses Required in Civil Engineering Curricula

Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year shown in curriculum, course description; if noted to fulfill university general education (GE) requirement
CEE 181 Technological, Social, and Sustainable Systems	Arizona State University	3	F, H, I, J	First; Introduces the importance and role of technological, social, and sustainable systems in the modern world. Provides a framework for the theory and practice of sustainable engineering; (GE) https://webapp4.asu.edu/catalog/courselist?s=CEE
CEE 300 Engineering Business Practice	Arizona State University	3	F, Bu	Junior; Engineering economic principles, cost/benefit analysis, project financing and delivery, management of engineering design, business practices, ethical and professional responsibilities. https://webapp4.asu.edu/catalog/courselist?s=CEE
CIVL-4770-A Civil Engineering Seminar	Benedictine College	1	J, Bu, PP, L, PE	Senior; reports and presentations on current topics in CE related to business, public policy, leadership, and professional licensure; https://catalog.benedictine.edu/Lists/Sections/CustomDispForm.aspx?ID=2498&InitialTabId=Ribbon.Read
EGR 445 Roles of Design Professionals	California State Polytechnic	4 Q	F, H	Senior; "role of design professionals in society, and the associated privileges and responsibilities. Social, economic, historical, legal, and political aspects of professional practice, as well as ethics, social responsibility, regulatory

Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year shown in curriculum, course description; if noted to fulfill university general education (GE) requirement
	University Pomona			requirements, professional liability, and the consequences of failures." (GE) https://catalog.cpp.edu/preview_course_nopop.php?catoid=4&coid=15492
CE 465 CE Professional Practice	California State Polytechnic University San Luis Obispo	1	F, G, I, J, L	Senior; Advising for Senior Design Project and examination of the non-technical and professional issues engineering design professionals regularly encounter. Topics include: communications styles and assertiveness, technical communications (oral and written), lifelong learning, contemporary civil engineering issues, leadership, ethics, and personal and project management. http://catalog.calpoly.edu/coursesaz/ce/
EGR 445 Role of Design Professionals in Society	California State Polytechnic University, Pomona	4Q	F, G, H, I, J , Bu	Senior; synthesizing social, economic, historical, legal, political and ethical aspects of the design professions; includes business elements; significant writing component (30% of grade), draws upon social science courses and promote critical thinking, problem solving, and reasoning; (GE) {also a 4-cr course in ethical considerations in technol} www.cpp.edu/~senate/packet_documents/31004Senate%20Packet/ge005034rep.doc http://www.cpp.edu/~engineering/CE/documents/CE-curriculum_Matrix.pdf
CIVL 495 Professional issues in Engineering	California State University Chico	3	F, G, PE	Senior; history of engrg, professional registration, codes of ethics, management issues, diversity, outsourcing, intellectual property, international development & technology transfer, sustainable design; substantial written project with oral presentation; 2 hrs discussion, 2 hrs activity http://catalog.csuchico.edu/viewer/13/ENGR/CENGNONEBS.html
CE 3530 Professional Seminar	Clemson University	1	F, PE	Junior; skills and techniques for evaluating career opportunities, seeking and obtaining CE employment, career development, professional registration, professional ethics, and other factors necessary for achieving success in a professional career. https://www.clemson.edu/cecas/departments/ce/pdf/Required_CE_Course_Description.pdf
CE 206 Economic Analysis & Professional Issues in CE	Iowa State University	3	F, L, Bu, PP, PE	Sophomore; Engineering/managerial analysis of the economic aspects of project proposals. Alternative sources of funds; time value of money; expenditure of capital funds and methods of evaluating alternative projects. Professionalism, licensure, liability, ethics, leadership, social responsibility, creative and critical thinking, and applications/impacts of regulations in civil engineering. http://catalog.iastate.edu/collegeofengineering/civilengineering/#courseinventory
EG450 Professional Issues for Engineering and Construction Management	Norwich University	3	F, Bu, PE	Junior or senior; 2 hr classroom, 2 hr recitation; prepare students for non-technical aspects of the engineering profession including engineering registration, ethical responsibilities, malpractice and legal responsibilities, business aspects http://catalog.norwich.edu/residentialprogramscatalog/collegeofprofessionalschools/thedavidcrawfordschoolofengineering/enginsci/
CIVILEN 2090 Professional Aspects of CEE	Ohio State University	1	F	Sophomore; Topics in Civil and Environmental Engineering ethics and practice. https://ceg.osu.edu/courses/professional-aspects-civil-and-environmental-engineering-2090

Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year shown in curriculum, course description; if noted to fulfill university general education (GE) requirement
CE 315 Civil and Environmental Engineering Profession	Portland State University	1 Q	F, J, PE	Junior; lecture; engineering registration and ethics; overview of education, training, research, and employment for each area of CEE; https://banweb.pdx.edu/pls/oprd/bwckctlg.p_disp_course_detail?cat_term_in=201701&subj_code_in=CE&crse_numb_in=315
CE 292 Contemporary Issues In CE	Purdue University	2	F, G, J, Gl	Sophomore; 1 hr lecture, 1 hr recitation; professionalism and ethics, entrepreneurship, cultural differences, collaborating globally; students interact with professionals outside the university, information on civil engineering career options; apply written communication in professional setting; delivery of technical and managerial content, compile professional portfolio of communication assignments http://catalog.purdue.edu/preview_program.php?catoid=7&poid=6415
ENGR 401 Engineering senior seminar	Roger Williams University	1	F, J, Bu	Senior; all engineering majors; practicing professionals present seminars on topics of current interest such as: professional ethics, state-of-the-art developments, business practices and procedures; students maintain a journal and participate in professional reading program http://rwu.edu/sites/default/files/coursecatalog.pdf
Civil engineering practice	Rowan University	1	F, Bu	Senior; previously 3 credits; sequence of seminars and workshops, topics related to real-world practice of CE; bid specifications and documents, contracts and performance bonds, engineering estimates and cost engineering, engineering management and project scheduling, professional ethics and responsibilities http://www.rowan.edu/catalogs/pdf/2016-2017-undergraduate-catalog.pdf
CEE 463 Concepts of Professional Practice	South Dakota School of Mines and Tech	2	F, I, J	Senior; lecture and discussion with emphasis on current civil engineering topics, professional, personal, and ethical development http://ecatalog.sdsmt.edu/
CIE 415 Professional Practice	SUNY Buffalo	3	F, Bu, PE	Senior; lecture; ethical issues in CE practice, professional licensure process, project lifecycle, fundamentals of engineering economics, construction contracts and delivery methods, cost estimating, project scheduling, project control http://undergrad-catalog.buffalo.edu/courses/?abbr=CIE&num=415
CVEN 399 Mid Curriculum Professional Development	Texas A&M University	0	I, PE	Junior; participation in approved high-impact learning practice; reflection on professional outcomes from CE BOK; documentation of experience appropriate to eventual professional licensure; self assessment of learning at mid-curriculum point http://catalog.tamu.edu/undergraduate/engineering/civil/bs/#programrequirementstext
CVEN 424 Civil Engineering Professional Practice	Texas A&M University	2	H, I, J, Bu, PP, PE	Senior; 1 lecture hr, 2 lab hrs; professional practice issues; current civil engineering issues that impact design, construction, and operation of the civil engineer facilities; developing engineering solutions that better serve society; business and public policy concerns; life-long learning; problem solving; professional licensure

Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year shown in curriculum, course description; if noted to fulfill university general education (GE) requirement
				http://catalog.tamu.edu/undergraduate/engineering/civil/bs/#programrequirementstext
GE 401 Professional Practice	Trine university	1	F, H, I, J, PE, PP	Senior; career aspects of the profession: job search, grad school, lifelong learning, professional registration, role of professional societies; social responsibilities of practicing professional engineer: professional ethics, role of engineering in public policy, need for knowledge of current affairs, consideration of impact of technology on society http://www.trine.edu/registrar/sps2013_2014spscoursecatalog.pdf
CVEG 2851 Professional Practice Issues	University of Arkansas	1	F, H, PE, Gl	Sophomore; ethics, professionalism, professional licensure, project procurement, social and political issues, globalism, and other legal issues http://catalog.uark.edu/undergraduatecatalog/collegesandschools/collegeofengineering/civilengineeringcveg/#bsincivilengineeringtext
CNMG 4185 Professional Engineering Seminar	University of Arkansas at Little Rock (UALR)	1	D, F, PE	Senior; 3 hr lab; CE BOK, engineering licensure and constructor certification, professional and ethical responsibility, multidisciplinary teams, begin preliminary work on senior design project http://ualr.edu/catalogs/undergraduate-catalog/course-codes/
ECI 190 Civil Engineer in Society	University of California Davis	2 Q	F, H, L, Bu, PP	Junior; 1 hr lecture, 3 hr lab; business, management, public policy, leadership, professional licensure; professional ethical and societal issues (GE) http://catalog.ucdavis.edu/programs/ECI/ECIcourses.html
CIEG 486 Engineering Project Management	University of Delaware	3	D, Bu	Senior; principles of planning, controlling, and evaluating engineering projects; use of tools and techniques on a personal project. Topics include project organization, project budgeting and scheduling, resource allocation and leveling, change control, and communications. https://udapps.nss.udel.edu/CourseDesc/info.action?lastRecordNo=50&yearCode=2015&searchKey=2015%7CCIEG486
CEE 495 Professional Practice	University of Illinois Urbana Champaign	0	H	Senior; Series of lecture by outstanding authorities on the practice of civil engineering and its relations to economics, sociology, and other field of human endeavor; S/U grading only http://catalog.illinois.edu/undergraduate/engineer/departments/civil/
CEE 198 - Ethics and Professional Practice of Engineering	University of Nevada, Las Vegas	1	F, G	First year; oral communication, engineering code of ethics and other requirements for professional practice of engineering studied through textbook material, oral communication workshops, professional society meetings, and journals http://catalog.unlv.edu/preview_course_nopop.php?catoid=4&coid=25798
ENGR 3295 Multi-Disciplinary Professional Development	University of North Carolina at Charlotte	1	F, H, J L, Gl, PE	Senior; seminars and activities to introduce basic concepts of professionalism in engineering: global, societal, and contemporary issues of current interest such as leadership, entrepreneurship, ethics, cultural diversity, professional licensure http://catalog.uncc.edu/preview_program.php?catoid=18&poid=3332
CE 205 & 305 Professional Development I and II	University of Tennessee Knoxville	2 + 2	F, I, L, Bu, PP	Sophomore / Junior; introduction to CE specialties, history, achievements, professional responsibility, communication, organizations; legal and ethical responsibilities, continuous improvement, career planning, business and public policy,

Course Title	Institution	Credits	ABET & BOK outcomes	Course information: year shown in curriculum, course description; if noted to fulfill university general education (GE) requirement
				leadership {separate CE 401 CEE FE Review (1 cr) and EF 402 FE Review (1)} http://catalog.utk.edu/preview_program.php?catoid=1&poid=181
CE 171P Engineering Professionalism	University of Texas Austin	1	F, I, L, Bu, PP, PE	Senior; professional engineering licensure, ethics, leadership, public service, public policy; emphasis on multidisciplinary perspectives, legal and business considerations, and the importance of lifelong learning. Includes participation in a public service project. Two lecture hours a week for one semester, with additional fieldwork hours to be arranged. http://catalog.utexas.edu/undergraduate/engineering/courses/civil-architectural-environmental/
CVE400 CE Professional Licensure	University of Rhode Island	1	I, PE	Senior; lecture; prepare students to take the CE oriented FE exam, CE licensure process and importance. S/U only http://web.uri.edu/catalog/course-descriptions/
CE 410 Civil engineering fundamentals	U Mississippi	1	F	Senior, refresher of core undergraduate courses in the CE curriculum; http://catalog.olemiss.edu/engineering/civil-engineering/c-e-401
CEE 4404 - Professional & Legal Issues in Engineering	Virginia Tech	3	F, PE	Senior; Analysis of the legal, professional, and ethical aspects of engineering practice; introduction to contract law and contract dispute resolution, professional liability, and other aspects of law relevant to engineering practice; professional registration and codes of ethics.
CE 480 Ethics & Professionalism	Washington State University	1	F	Senior; professional aspects of civil engineering {separate 1 cr CE 466 Fe Exam Review, P/F grading} http://www.catalog.wsu.edu/General/Courses/BySubject/CE

* Civil engineering undergraduate programs at the following institutions did not appear to require a professional issues type of course in the curriculum: Pennsylvania State University, Georgia Institute of Technology, North Carolina State University, University of California San Diego, University of Central Florida, New Jersey Institute of Technology, University of Maryland College Park. (based on website information from each program accessed October to December, 2016).