BSEVE-ENVE
Environmental Engineering Assessment Plan 2013-2017
Approved May, 2013

University Mission

The University of Cincinnati (UC) serves the people of Ohio, the nation, and the world as a premier, public, urban research university dedicated to undergraduate, graduate, and professional education, experience-based learning, and research. We are committed to excellence and diversity in our students, faculty, staff, and all of our activities. We provide an inclusive environment where innovation and freedom of intellectual inquiry flourish. Through scholarship, service, partnerships, and leadership, we create opportunity, develop educated and engaged citizens, enhance the economy and enrich our university, city, state and global community.

College Mission

The mission of the College of Engineering and Applied Science (CEAS) is to provide:

- *Excellence in Education → provide a world-class education for our students*
- *Excellence in knowledge creation and transfer in support of education and community → provide the best education featuring new breakthroughs in science and technology and be able to transfer that knowledge of science technology both to our students and to our local community*
- *Accessibility → provide a venue where qualified students who want to come, can come; and provide the support necessary to allow them to be successful*

Program Mission

Housed in the School of Energy, Environmental, Biological and Medical Engineering (SEEBME), the mission of the Environmental Engineering (ENVE) program is *to provide environmental engineering students with the background necessary to bridge the gap between understanding challenging societal problems in the air, water, land, and subsurface environments, and preventing and solving them in a sustainable manner.*

Program Educational Objectives

Within a few years of graduation, we expect that our baccalaureate graduates will

- demonstrate a basic understanding of challenging societal problems in the air, water, land, and subsurface environments, and
- demonstrate an ability to apply the basic tools of environmental engineering towards preventing and solving these problems in an ethical, professional and sustainable manner.

The curriculum is founded on basic sciences and mathematics and strengthened with engineering fundamentals. Upper-level coursework in environmental engineering includes analysis and design of water and wastewater treatment systems, water

resources, air pollution control technologies, and solid waste and hazardous waste management. All students in their senior year participate in a capstone-design experience that fosters interaction and communication between different engineering disciplines while applying environmental engineering principles to a field problem.

Fall Semester 2012 marked the start of a new undergraduate program leading to a Bachelor's of Science in Environmental Engineering. Accreditation from the Engineering Accreditation Commission (EAC) of ABET will be sought as soon as the program is eligible. This plan represents a timely first round of planning for continuous assessment that will assist the program in obtaining the data and documentation needed to prepare a strong application for ABET accreditation. It also represents an opportunity to systematically obtain feedback in the early stages of establishing the program where it will be critical to identify where adjustments may be beneficial. While many of the courses have already been offered for other engineering curricula and are well established, others will be developed specifically for the program. An overview of the current curriculum is shown in Figure 1.

Student Learning Outcomes

By the time students' graduate from the program, they should be able to demonstrate:

(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.

These outcomes map directly to the ABET EAC student outcomes of General Criteria 3 (a)-(k). The way they map to Program Education Objectives is shown in Table 1.

Figure 1.

ENVE Curriculum for Class of 2017

				Autumn 2012 (16)				Spring 2013 (15)			
			CHEM 1040	Gen Chemistry	4		CHEM 1041	Gen Chemistry	4	
			CHEM 1040L	Gen Chemistry Lab	1		CHEM 1041L	Gen Chemistry Lab	1	
			ENED 1020	Engineering Foundations	2		ENED 1030	Statics & SOM	3	
			ENED 1090	Engineering Models	2		ENED 1091	Engineering Models	2	
			ENGL 1001	English Composition	3		MATH 1061	Calculus	4	
			MATH 1061	Calculus	4		PD 1011	COOP for CEAS	1	
	Summer 2013			Autumn 2013 (18)				Spring 2014		
			BoK	Elective	3					
	SUMMER BREAK		BIOL 1081	Biology	3			Co-op 1		
			BIOL 1081L	Biology Lab	1					
			CHE 2064	Mat'l & Energy Balances	4					
			ENFD 2000C	Grand Challenges Engr	2					
			ENVE 2093	Engr Appl Diff Eq	2					
			MATH 2Oxx	Diff Eqns	3					
			COOP 2011	Practice Eval	___					
	Summer 2014 (16)			Autumn 2014				Spring 2015 (15)		
CHEM 2040	Organic Chemistry	4					BoK	Elective	3	
CHEM 2040L	Organic Chemistry Lab	1		Co-op 2			CVEN 3002C	Soil Mech & Lab	4	
ENGL 4092	Technical Writing	3					CHEN 3022	Transport	4	
ENVE 4010	Water & Wastewater Trtmt	3					ENVE 3040	C & E Analysis	3	
ENVE 4010L	Environ (& Lab) Lab	2					ENVE 4011	Air Pollution Control	3	
ENVE 4051	Statistics & Reliability	3					COOP 3011	Practice Eval	___	
COOP 2012	Practice Eval	___								
	Summer 2015			Autumn 2015 (15)				Spring 2016		
			CHE 4071	Proc Dynamics & Cntrl	3					
	Co-op 3		ECON 1001	Microeconomics	3			Co-op 4		
			ENVE 4093	Hydraulic Systems	3					
			ENVE 4093C	Fluid Mech & Hydr Sys Lab	2					
			GEOG 3071C	Geographic Info Systems	3					
			PD 4001	Professional Development	1					
			COOP 4011	Practice Eval	___					
	Summer 2016			Autumn 2016 (15)				Spring 2017 (15)		
			ENVE 3xxx	Program Elective	3		BoK	Elective	3	
	Co-op 3 (optional)		ENVE 3xxx	Program Elective	3		ENVE 3xxx	Program Elective	3	
			ENVE 3001	Senior Capstone Design	2		ENVE 3xxx	Program Elective	3	
			ENVE 3003	Senior Capstone Seminar	1		ENVE 3002	Senior Capstone Design	2	
			ENVE 4014	Solid & Haz Waste Mgmt	3		ENVE 3004	Senior Capstone Seminar	1	
			GEOL 3009	Environ Geochem	3		ENVE 3058C	Environ Instrumentation	3	
			COOP 4012	Practice Eval	___					

Total credit hours: 125 mjk 5/10/13

Table 1. Student Learning Outcomes Mapped to Program Educational Objectives

PROGRAM LEARNING OBJECTIVES → / STUDENT LEARNING OUTCOMES	1) Basic understanding of challenging societal problems in the air, water, land, and subsurface environments	2) Ability to apply the basic tools of environmental engineering towards preventing and solving these problems in an ethical, professional and sustainable manner
(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		√

Continuous Improvement Process

The continuous improvement process for *defining, measuring, analyzing and implementing/improving* program objectives and delivery is summarized in the CEAS Continuous Improvement Model shown in Figure 2.

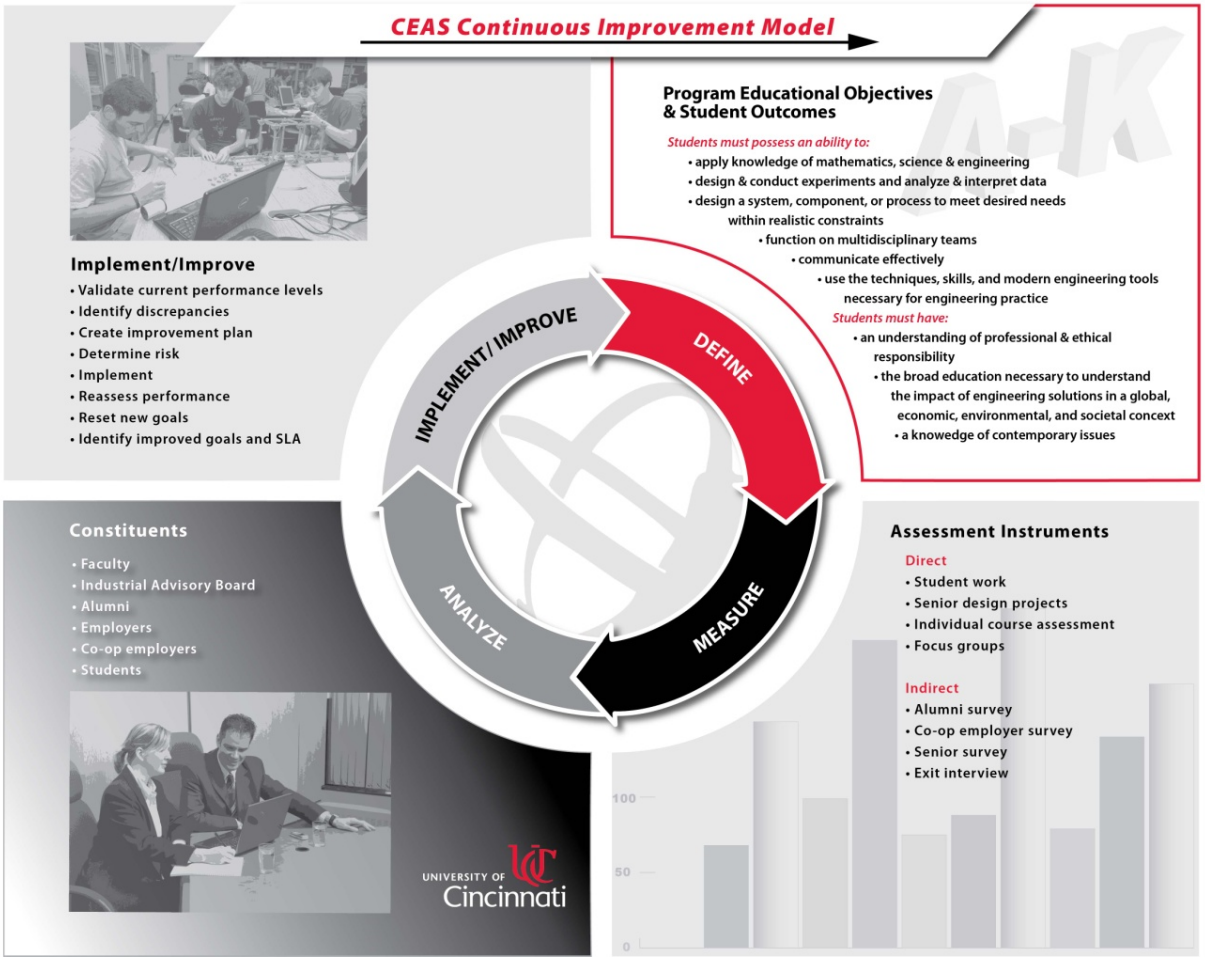

Figure 2. CEAS Continuous Improvement Model

Program education objectives and student outcomes are ***defined*** in this plan and the associated university *e-curriculum* P-1 and P-2 on-line planning as well as more specifically on a course by course basis in the course syllabi and university *e-curriculum* C-1 forms. ENVE program education objectives and student outcomes have been deliberately aligned with ABET EAC requirements not only for consistency with ABET criteria but also for consistency within CEAS.

Assessment instruments will be used to ***measure*** attainment of defined program education objectives and student outcomes. The instruments to be used, frequency of data collection, constituents involved and the reviewers are summarized in Table 2.

Table 2. Assessment Instruments for ENVE Baccalaureate Program

	Assessment Instrument	Frequency of Data Collection	Constituents Involved	Reviewers
Direct Methods	Student work and course assessments	See Table 3; each selected course at least twice in 6-yr cycle	Collected by program faculty from students	ENVE Program Quality Committee*
	Co-op employer assessment of students	Post co-op semesters as shown in curriculum	Collected by professional practice faculty from employers regarding student employees	Prof Practice Faculty and ENVE Program Quality Committee
	Senior design projects	Yearly at end of senior year	Collected by senior design faculty from professional jury of student work	ENVE Program Quality Committee
	Individual course evaluations	Each semester	Collected electronically by college from students for every course	Faculty and ENVE Program Quality Committee
	Focus groups	As needed for program improvement	Constituents involved in outcome requiring improvement	ENVE Program Quality Committee
Indirect Methods	Alumni survey	Twice during 6-year cycle	Collected by Alumni Relations Committee program faculty	ENVE Program Faculty and Quality Committee
	Industrial Advisory Board and employer survey	Twice during 6-year cycle	Collected by Program Chair	ENVE Program Faculty and Quality Committee
	Co-op employer survey (specific to program)	Twice during 6-year cycle	Collected by professional practice faculty from employers	Prof Practice and Program Faculty and ENVE Program Quality Committee
	Senior survey	Annually (spring)	Collected electronically by program UG Director from graduating seniors	ENVE Program Quality Committee
	Graduating senior exit interview	Annually (spring)	Personal interview between student and program chair and/or class advisor	ENVE Program Quality Committee

* ENVE Program Quality Committee = ABET Coordinator, Program Chair, Graduate and Undergraduate Directors and Curriculum Committee members

Faculty members will collect the assessment data for individual student performance and upload results of scheduled assessments to a Blackboard site assigned for this purpose, and a SEEBME staff member will be assigned to track and organize this information together with data from other assessment instruments such as student course evaluations and surveys. The ENVE Program Quality Committee consisting of the

ABET Coordinator, Program Chair and Undergraduate and Graduate Directors and curriculum committee members will ***analyze*** the assessment data collected.

The ENVE Program Quality Committee will meet at least 3 times per year as new data become available for each of the trimesters. Their charge will be to drive the ***implementation/improvement*** cycle by validating current performance levels, identifying discrepancies, creating an improvement plan, determining risk, implementing new measures, reassessing performance, resetting new goals and identifying improved goals and student learning assessments in concert with program faculty and other constituents.

Course Assessment

Table 3 contains a summary of the required program courses selected for assessment at least twice during a 6-year cycle. They are shown as they map to Student Learning Outcomes (a)-(k) along with the rubrics to be used and schedule for assessment. Details of rubrics are shown in Table 4. Note that consideration should be given for the level of performance being assessed (highest for course indicated, I = introduced, D = developed and M = mastered) when assigning rubric scores during an assessment. The expected level of attainment is good or exemplary. A score for each Environmental Engineering student enrolled in the course in the given term will be used to calculate an average achievement score for the outcome at the point in the curriculum.

Table 3. Course Assessment Summary

COURSE NAME	NUMBER	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	TERM**
Grand Challenges Engr	ENFD2000L	M*	I*		D*			M*				D*	FS13/15
Engr App Diff Eq	ENVE2093	M*			M*	M*		I*				M*	FS13/15
Water&Wastewater Trtmt	ENVE4010	D*		D	D*						D	D	US14/16
Environ (&Rad) Lab	ENVE4010L	M*	D*		M*			M*				M*	US14/16
Statistics & Reliability	ENVE4051	D*		D*	D*	M*				D		M*	US14/16
C&E Analysis	ENVE3040	D*		D		D*						D	SS15/17
Air Pollution Control	ENVE4011	D*		D		D*		D*	D			D	SS15/17
Hydraulic Systems	ENVE4093	D*		D		D*						D	FS15/17
Fluid Mech & Hydr Sys Lab	ENVE4093L	D	D*					D*				D	FS15/17
Senior Capstone Design II	ENVE5002	M*	M*	M*	M*	M*	M*	M*	M*	M*	M*	M*	SS17+
Solid & Haz Waste Mgmt	ENVE6014	M*		D*	D*	D*	D*	D*	D*	D	M*	D	FS16+
Environ Instrumentation	ENVE6058C	M*	M*		M*				M*			M*	SS17+

*Assessed in course assignments NOTE: Course instructor has not approved entries in gray as of 5/10/13

**See ENVE Curriculum for Class of 2017 in Figure 1 → FS=Fall, SS=Spring, US=Summer Semester

+Only time will be taught to inaugural Environmental Engineering Class of 2017

Table 4. Course Assessment Rubric Specifics

1 unacceptable	2 poor	3 average	4 good	5 exemplary
(a) an ability to apply knowledge of mathematics, science, and engineering				
• Does not understand the connection between mathematical models relevant to engineering major • Does not understand the application of calculus, discrete math, and/or linear algebra in solving problems • Calculations are not performed or are performed incorrectly by hand and/or does not know how to use math software	mixed aspects of 1 and 3	• Chooses a mathematical model or scientific principle that applies to an engineering problem, but has trouble in model development • Shows nearly complete understanding of applications of calculus, discrete math, and/or linear algebra in problem-solving • Minor errors in calculations by hand and/or applying math software	mixed aspects of 3 and 5	• Combines mathematical and/or scientific principles to formulate models relevant to their engineering discipline • Applies concepts of integral and differential calculus, discrete math, and/or linear algebra to solve problems • Executes calculations correctly by hand and/or using math software
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
• No systematic plan of data gathering; experimental data collection is disorganized, and/or incomplete • Cannot select the appropriate equipment and instrumentation required to run the experiment(s) and/or operates the instrumentation incorrectly or requires frequent supervision • Data are poorly documented and no attempt to relate data to theory is evident	mixed aspects of 1 and 3	• Develops a simplistic experimental plan of data gathering; experimental procedures often followed, but occasional oversight leads to loss of experimental efficiency and/or loss of data • Needs some guidance in selecting and/or using appropriate equipment and instrumentation • Data collected are not all documented or some measurements are missing; applies appropriate theory to data when prompted to do so, but misinterprets or makes minor errors	mixed aspects of 3 and 5	• Formulates, develops, and implements an experimental plan of data gathering to attain a stated objective • Can select and use appropriate equipment and instruments to perform the experiment • Carefully documents data collected and analyzes and interprets data using appropriate 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				
• No design strategy; haphazard approach • No use of computer tools and engineering resources • No consideration of realistic constraints; incomplete design and/or documentation	mixed aspects of 1 and 3	• Uses a design strategy with guidance • Minimal or incorrect use of computer tools and engineering resources • Includes only minor or cursory consideration of realistic constraints, documentation, and/or references	mixed aspects of 3 and 5	• Develops a design strategy and decomposes work into subtasks • Uses computer tools and/or engineering resources effectively • Develops a solution that includes realistic constraints, documentation, and references as appropriate

1 unacceptable	2 poor	3 average	4 good	5 exemplary
(d) an ability to function on multidisciplinary teams				
• Is absent from team meetings or work sessions more than half the time and/or does not contribute substantially to group work • Does not value team work, only participates if strongly encouraged, and/or is hostile to team members' ideas • Has no knowledge of disciplines outside of engineering major	mixed aspects of 1 and 3	• Sometimes absent and/or sometimes depends on others to complete work • Sometimes does not share information, does not help others or interacts to a minor extent, and/or sometimes discourteously criticizes or rejects ideas of others • Has some knowledge of other disciplines, but sometimes does not use it effectively to contribute to achieving team objectives	mixed aspects of 3 and 5	• Routinely present at team meetings or work sessions and contributes a fair share to the project workload • Cooperates with others by sharing information, providing assistance, and encouraging participation of all team members • Has knowledge of technical skills, issues, and approaches for achieving team objectives beyond the student's engineering major
(e) an ability to identify, formulate, and solve engineering problems				
• Demonstrates an incorrect solution and/or does not synthesize previous information and new knowledge correctly • Does not see connection between theory and practical problem solving • Has no coherent strategies for problem solving	mixed aspects of 1 and 3	• Demonstrates a solution synthesizing ideas covered in course concepts • Must be assisted in integrating previous knowledge and relating theoretical concepts to problem solving • The solution is nearly correct	mixed aspects of 3 and 5	• Demonstrates creative synthesis of a correct solution by combining knowledge from the course and other resources • Can relate theoretical concepts to practical problem solving • Uses appropriate resources to locate information needed to solve problems
(f) an understanding of professional and ethical responsibility				
• Does not participate in or contribute to discussions of ethics and professionalism • Has been caught cheating or plagiarizing the work of others • Is frequently absent from class and is generally not collegial to fellow students, staff, and faculty • Evaluate and judges a situation in practice or as a case using a biased perspective without objectivity	mixed aspects of 1 and 3	• Participates intermittently in class discussion and exercises on ethics and professionalism • Sometimes exhibits unprofessional behavior; is sometimes late or absent from class without a reason • Evaluates and judges a situation in practice or as a case study using personal understanding of the situation, possibly applying a personal value system	mixed aspects of 3 and 5	• Fully participate in class discussions and exercises on ethics and professionalism • Is punctual, professional, and collegial; attends classes regularly • Evaluate and judges a situation in practice or as a case study using facts and a professional code of ethics

1 unacceptable	2 poor	3 average	4 good	5 exemplary
(g1) an ability to communicate effectively (written)				
• Text rambles, points made are only understood with repeated reading, and key points are not organized • Graphs, table or diagrams are used, but no reference is made to them • Work is not presented neatly, frequent spelling/grammar errors present throughout the paper, figures or graphics are not used at all, and/or the writing style is inadequate for the assignment	mixed aspects of 1 and 3	• Articulates ideas, generally well-organized, but writing is somewhat disjointed or difficult to follow • Uses graphs, tables and diagrams, but only in a few instances are they applied to support, explain or interpret information • Work is not neatly presented throughout; occasional spelling/grammar errors, some figures are flawed, and/or style is informal or inappropriate	mixed aspects of 3 and 5	• Articulates ideas clearly and concisely by organizing written materials in a logical sequence to enhance the reader's comprehension • Uses graphs, tables and diagrams to support points, interpret and assess information • Written work is presented neatly and professionally, grammar and spelling are correct, uses good professional writing style
(g2) an ability to communicate effectively (oral)				
• Talk is poorly organized, omitting key results, and/or is unclear or incomprehensible • Presentation is excessively long or inappropriately short; major difficulties with content delivery • Does not listen carefully to questions, does not provide appropriate answers, or is unable to answer questions about presentation material	mixed aspects of 1 and 3	• Presents key elements of an oral presentation adequately, but visual aids have minor errors or are not always clearly visible • Presentation contains excessive or insufficient details for time allowed or level of audience • Sometimes misunderstands questions, does not respond appropriately to the audience, or has some trouble answering questions	mixed aspects of 3 and 5	• Plans and delivers a well-organized oral presentation with effective visual aids • Presentation has appropriate detail and technical content for the audience and the time constraint • Listens carefully and responds to questions appropriately, is able to explain and interpret results for various audiences and purposes
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context				
• Demonstrates no awareness of current trends in their engineering discipline • No evidence of understanding the global and societal impact of engineering • Cannot describe either a personal or professional perspective on the impact of engineering in today's world	mixed aspects of 1 and 3	• Demonstrates limited awareness of current trends in their engineering discipline • Reads an article relevant to understanding the global and societal impact of engineering • Can describe either a personal or professional perspective on the impact of engineering in today's world	mixed aspects of 3 and 5	• Demonstrates familiarity with current trends in their engineering discipline • Reads periodicals that are relevant to understanding the global and societal impact of engineering and describes that impact • Can articulate both a personal and professional perspective on the impact of engineering in today's world

1 unacceptable	2 poor	3 average	4 good	5 exemplary
(i) a recognition of the need for, and an ability to engage in life-long learning				
• Requires detailed or step-by-step instructions to complete a task; does not employ any additional resources • Has trouble completing even the minimum required tasks without repeating mistakes • Assumes that all learning takes place within the confines of the class	mixed aspects of 1 and 3	• Requires guidance as to expected outcome of task or project; seldom brings information from outside sources to assignments • Sometimes is able to avoid repeating the same mistakes • Has some trouble using materials and concepts that are in a different format from that taught in class	mixed aspects of 3 and 5	• Demonstrates ability to learn independently and/or brings information from outside sources into assignments • Learns from mistakes and practices continuous improvement • Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class
(j) a knowledge of contemporary issues				
• Has no awareness of current issues and events in the world • Gives an incomplete or unclear description of a contemporary issue • Demonstrates no knowledge of the importance of the issue	mixed aspects of 1 and 3	• Can discuss an example of a current news event relevant to an engineering discipline • States a contemporary issue but omits details needed for full understanding • Demonstrates a limited knowledge of the importance of the issue	mixed aspects of 3 and 5	• Can discuss examples of current news events relevant to their engineering discipline • Describes a contemporary issue clearly and comprehensively, delivering all relevant information necessary for full understanding • Demonstrates importance of the issue clearly
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice				
• Does not use computer-based tools or other resources in assignments or projects • Does not adequately develop or use software packages to solve problems • Does not demonstrate use of techniques or skills to solve problems	mixed aspects of 1 and 3	• Uses computer-based tools or other resources in assignments/projects but requires some guidance • Develops software or uses software packages to solve basic engineering problems • Applies techniques or uses skills acquired in the classroom/lab to solve problems	mixed aspects of 3 and 5	• Uses computer-based tools and other resources effectively in assignments/ projects • Develops software or uses software packages to solve challenging engineering problems • Applies advanced tech-niques and uses skills acquired outside of the classroom/lab to solve problems

Note that the assessor will be asked to select the category in the rubric (1 to 5) that most closely describes each student's performance for the given outcome using a course requirement. The assessor will also be asked to describe and illustrate an example from within members of the class for an "exemplary" rating as well as for an "average" rating and an "unacceptable or poor" rating (where examples exist).