

## **Scorecards for new outcomes recommended by the Assessment Committee - August 2019**

### **New Student Outcomes:**

The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

### **Currently on ABET and used for second evaluation cycle**

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Note: The student outcomes used in the first cycle are essentially the same as the ones used in the second cycle. However, those were based on an ABET draft and they have slightly different order. The outcomes used in the first cycle and their relationships to the ones in the second cycle are presented in page 18 of this document.



**New outcome 1  $\equiv$  old outcomes a and e**

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Old

- a) An ability to apply knowledge of science, mathematics and engineering
- e) Ability to identify, formulate, and solve engineering problems

## Outcome 1 – Assessed in CEE 361 and CEE 355

<b>An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria      CONCEPT 1: Problem identification and formulation</b>					
<b>Problem identification and formulation.</b>	Cannot identify or formulate problem correctly.	Major errors in problem formulation that lead to unsafe solution.	Minor errors in problem formulation that do not result in unsafe solution.	Correctly formulates and identifies problem.	
<b>CONCEPT 2: Solve engineering problems</b>					
<b>Analyze and solve engineering problems applying principles of engineering, science, and mathematics.</b>	Incorrect problem analysis leading to incorrect solution.	Major errors in analysis and/or solution of problems leading to unsafe design.	Minor errors in analysis and/or solution of problems resulting in uneconomical but safe design.	Correct analysis and solution arriving at safe, economical design.	
<b>CONCEPT 3: Knowledge of mathematics</b>					
<b>Uses appropriate mathematics to formulate and solve engineering problems</b>	Formulation is riddled with mistakes, unable to solve problems, or uses inappropriate mathematics	Formulates and solves using somewhat appropriate mathematics but with numerous errors	Formulates and solves using mostly appropriate mathematics with few mistakes	Correctly formulates and solves engineering problems using appropriate mathematics without mistakes	

**New outcome 2  $\equiv$  old outcome c**

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

*Old*

- 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

## Outcome 2 – Assessed in CEE 490, CEE 485 and CEE 462/464

<b>An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria      CONCEPT 1: Utilizes Design Process Elements</b>					
<b>Define design problem and project scope</b>	Incomplete understanding of project; scope not well developed	Project understood and defined; project scope defined but not detailed	Project well defined/understood; project scope defined by tasks with timeline	Project clearly defined/understood; project scope defined by detailed tasks and subtasks with accurate timeline that meets all project objectives	
<b>Synthesize and evaluate alternative solutions</b>	No alternatives considered or only cursory consideration without reasonableness test	Generates at least two reasonable alternatives and considers needs	Generates multiple reasonable alternatives; considers factors such as needs and costs to determine best alternative	Generates multiple effective alternatives; explains and uses an evaluation system which explicitly uses multiple relevant factors to determine recommended alternative	
<b>Incorporate regulations, codes, and safety</b>	Cursory consideration of codes and safety without documentation	Regulations and codes incorporated mostly correctly but not well documented	Regulations and codes incorporated, safety considered, compliance documented fairly well	Regulations, codes, and safety considered and incorporated throughout design, compliance thoroughly documented	
<b>CONCEPT 2: Estimation of Engineering Costs</b>					
<b>Engineering fees for design work</b>	Provides lump-sum engineering fees without detailed basis	Provides fees by task and job category without details	Develops engineering fees by task, and hours for all personnel including overhead charges and subcontractors	Provides detailed fee estimate based on tasks performed, hours for each task by duty, considers overhead, other direct charges and subcontractor fees by task	

**New outcome 3  $\equiv$  old outcome g**

3. An ability to communicate effectively with a range of audiences.

*Old*

g) an ability to communicate effectively

### Outcome 3 – Assessed in CEE 444, CEE 489C and CEE 490

<b>An ability to communicate effectively with a range of audiences</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria      CONCEPT 1: Contributes to group discussions/presentations</b>					
<b>Can express opinions effectively</b>	Has no opinions or does not share them intelligibly	Attempts to express opinions, but they are not relevant	Expresses opinions such that others are interested and respond	Convincingly expresses opinions	
<b>Can make effective technical presentations</b>	Presentation is unorganized, not well-planned, or inappropriate for the audience	Presentation is reasonably well-organized, but the oral presentation is poor or inappropriate for the audience	Presentation is well-organized and planned, and oral presentation is acceptable, and appropriate for the audience	Presentation is well-organized and planned, and oral presentation is good and appropriate for the audience	
<b>CONCEPT 2: Values other viewpoints</b>					
<b>Listens to and respects other viewpoints</b>	Does not listen to others or dismisses their views	Listens to others, but has difficulty recognizing value of alternative views	Listens to others and values their views	Encourages others to express their views so as to enrich the discussion	
<b>CONCEPT 3: Speaks effectively</b>					
<b>Speaks clearly and engages the audience</b>	Speaks unintelligibly and/or avoids any eye contact	Speaks relatively clearly with some eye contact, but does not engage the audience	Speaks well, good eye contact and attempts to engage the audience	Speaks well, good eye contact, and involves the audience	

## Outcome 3 (continued)

<b>An ability to communicate effectively with a range of audiences</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria</b>					
<b>CONCEPT 4: Writes Effectively</b>					
<b>Grammar and punctuation</b>	Subjects and verbs do not agree, incorrect use of pronouns, sentence fragments and run-ons, , incorrect use of punctuation	Some subjects/verbs do not agree, mixed use of pronouns, some run-on sentences and/or sentence fragments	All subjects/verbs agree, mostly correct use of pronouns, mostly no run on or sentence fragments, all punctuation is correct	All subjects/verbs agree, correct use of pronouns, no run-on or sentence fragments, all punctuation is correct	
<b>Clarity and composition</b>	Many wordy sentences, all passive verbs, dangling modifiers, repetitive words/ sentences, many misspellings	Some wordy sentences, too many passive verbs, some sentence/word variety, incorrect level of formality, misspellings	Mostly direct sentences, uses active verbs, uses balanced ideas, uses a variety of sentences/ words, no dangling modifiers, correct degree of formality, almost no misspellings	Direct and concise sentences, uses active verbs, no dangling modifiers, uses balanced parallel ideas, uses appropriate voice, no misspellings	
<b>Content and style</b>	Does not fully respond to the assignment, disorganized, few facts or evidence, lack of detail, non-analytical, incomplete thoughts/descriptions, only uses basic ideas, includes clichés	Fairly responsive, some evidence of organization of ideas, some correct facts and evidence, somewhat thoughtful or reflective, incorrect use of terminology/jargon/clichés	Responsive to assignment, mostly organized ideas/arguments, good use of facts and evidence and details, fairly thorough/ analytical, at least somewhat thoughtful/ reflective, correct use of terminology/jargon, no clichés	Fully responsive to question, uses organized arguments, correct use of facts/evidence, provides details, thoughtful/reflective, thorough, analytical, nuanced, correct use of terminology/jargon, no clichés	

**New outcome 4  $\equiv$  old outcomes f and h**

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

*Old*

- f) an understanding of professional and ethical responsibility
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

## Outcome 4 – Assessed in CEE 489C and Fundamentals Exam

<b>An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria</b>					
<b>CONCEPT 1: Can use code of ethics</b>					
<b>Use of ASCE code to guide decisions</b>	Does not correctly reference sections of the ASCE Code of Ethics in an ethics case study	Cites applicable sections of the ASCE Code, but may not correctly use in decision process	Correctly cites applicable sections of the ASCE Code and explains how they guide the decision/choice	Correctly cites several applicable sections of the ASCE Code for each specific dilemma/decision and explains the meaning/implications	
<b>CONCEPT 2: Understands complexity of ethics</b>					
<b>Recognizing ethical issues</b>	Realizes something is not “right” but not able to correctly identify professional/ethical issues at play. Sees mostly “black & white”	Can identify what is legal/illegal, acceptable by the ASCE Code, acceptable to an employer, but not clear on ethics in “gray” areas	Is able to clearly identify/name the inherent ethical choices and implications involved in various engineering decisions	Clearly identifies the inherent ethical choices and implications involved in various engineering decisions. Understands the effects of perspective, context, and personal views, codes, and laws	
<b>CONCEPT 3: Making ethical decisions</b>					
<b>Using ethical decision-making framework</b>	Shows little evidence of use of a systematic decision-making framework	Is able to recognize ethical issues, determine alternatives, and make a decision without reflecting deeply or considering multiple perspectives	Uses a logical, systematic decision process. Recognizes issues, states facts, evaluates alternatives from different perspectives, is able to make a decision	Uses a logical, systematic decision process. Identifies each step, provides reflective data, evaluates alternatives from different perspectives, is able to defend decision	
<b>CONCEPT 4: Understands impact of civil engineering systems in a global, economic, environmental and societal context</b>					
<b>Understands impact of civil engineering systems in a global, economic, environmental and societal context</b>	Does not understand basic impact of civil engineering systems in a global, economic, environmental and societal context	Understands a few impacts	Understands some impacts	Understands most impacts of civil engineering systems in a global, economic, environmental and societal context, and how they affect civil engineering practice	

**New outcome 5  $\equiv$  old outcome d**

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

*Old*

- d) an ability to function on multidisciplinary teams

## Outcome 5 – Assessed in CEE 444 and CEE 490

<b>An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>CONCEPT 1: Makes contributions</b>					
<b>Information gathering, calculations, presentations, reports</b>	Gathered some information, performed few calculations, worked on presentations and reports inconsistently or very little	Gathered some information, performed some calculations, worked on presentations and reports inconsistently	Gathered information, performed calculations, worked on presentations and reports consistently as assigned	Gathered information, performed calculations, led work on presentations and reports consistently	
<b>CONCEPT 2: Takes responsibility</b>					
<b>Reliability, timeliness, attendance, deadlines</b>	Not reliable or timely, misses meetings, misses deadlines	Performs some duties reliably, mostly timely, misses some meetings, meets some deadlines	Performs duties reliably and timely, attends meetings, meets deadlines	Performs all duties reliably and timely, attends all meetings, meets all deadlines, provides leadership	
<b>Leadership, acceptance, collaboration, assistance</b>	Rarely takes leader role, generally accepts assignments, has difficulty collaborating, sometimes willing to assist teammates	Occasionally leads, usually accepts assignments, mostly collaborates, generally willing to assist teammates	Shows an ability to lead when necessary, to accept assignments, to collaborate, and is willing to assist teammates	Takes leadership role, accepts all assignments, is a good collaborator, and always willing to assist teammates	
<b>CONCEPT 3: Values other viewpoints</b>					
<b>Listens, values other perspectives, compromises</b>	Not a very good listener, may not always see or understand others' points of view, not willing to compromise	Fairly good listening skills, can usually appreciate other perspectives, may not be willing to compromise	Good listening skills, values teammate perspectives and experiences, often willing to compromise to complete tasks	Listens to teammates and values their perspectives, knowledge, and experiences. Always willing to compromise to complete tasks	

**New outcome 6  $\equiv$  old outcome b**

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

*Old*

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

## Outcome 6 – Assessed in CEE 320, CEE 330 and CEE375

<b>An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria</b>					
<b>CONCEPT 1: Experimental Procedures</b>					
<b>Conducts an experiment to appropriate test standards</b>	Performs experiments such that results are meaningless	Does not follow test standard procedures, but results are acceptable	Performs test in accordance with most standard procedures	Conducts experiments in compliance with test standards	
<b>CONCEPT 2: Analysis and Interpretation</b>					
<b>Data analysis and interpretation</b>	Incorrectly analyzes or interprets data collected during experiment	Major errors in data analysis and interpretation	Minor errors in data analysis or interpretation	Applies relevant engineering principles to analyze and interpret data correctly	
<b>Comparisons between theoretical and experimental results</b>	No comparison or severely flawed comparison	Graphical representation of comparison, but limited discussion	Graphical comparison and discussion, but with minor flaws	Good comparison and discussion, explaining differences, possible errors, etc.	
<b>Draw conclusions based on engineering judgement</b>	Draws no conclusions	Some conclusions, but with errors	Only minor errors in conclusions drawn from results of the experiment	Appropriate conclusions based on experiment and theoretical results	

**New outcome 7  $\equiv$  old outcome i**

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

*Old*

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

## Outcome 7 – Assessed in CEE 421 and CEE 462/464

<b>An ability to acquire and apply new knowledge as needed, using appropriate learning strategies</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria</b>					
<b>CONCEPT 1: Changing technology</b>					
<b>Recognizes that changing technology will require constant learning</b>	Unaware that future self-study and technical seminars are required	Aware that knowledge acquisition is continuous but expect to be told to do this	Aware that knowledge acquisition is continuous and plans to do this on his/her own	Involves him/herself in learning activities outside the classroom	
<b>Can review and summarize technical material that was not presented in the course</b>	Unable to learn without direct instruction	Has difficulty learning on his/her own	Able to assimilate outside material	Able to synthesize outside material	
<b>CONCEPT 2: Business environment</b>					
<b>Understands that business opportunities will require working in unfamiliar areas</b>	Uncomfortable with new tasks, ideas and large or unfamiliar projects	Can deal with new tasks, ideas and large or unfamiliar projects, but needs support	Handles new tasks, ideas and large or unfamiliar projects	Competent when new tasks, ideas and large or unfamiliar projects are presented to him/her	
<b>Can largely self-learn and apply a new technical or business tool</b>	Uncomfortable with new platforms and tools	Can deal with new platforms and tools, but needs support	Handles new platforms and tools	Competent in use of new platforms and tools	

**Student outcomes used for first cycle – These are documented here to map the evaluations correctly**

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (1)
2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline. (2)
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (6)
4. An ability to communicate effectively with a range of audiences. (3)
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. (4)
6. An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge. (7)
7. An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment. (5)

Note: Numbers in parenthesis at the end of each outcome refer to the corresponding student learning outcomes used in the second cycle and presented in the first page of this document.

## Unassigned old outcomes *j* and *k*

### Outcome *j*

<b>Knowledge of contemporary issues</b>					
	<u>Unsatisfactory</u> 1	<u>Developing</u> 2	<u>Acceptable</u> 3	<u>Good</u> 4	<u>Score</u>
<b>Performance Criteria</b>					
<b>CONCEPT 1: Current events</b>					
<b>Aware of local current events*</b>	Unaware of major local development on politics, law, economy or infrastructure	Aware only of some of the local “headlines”	Partly aware of the issues associated with major local current events	Aware of the issues and ramifications of major local current events	
<b>Aware of national and international (N+I) current events**</b>	Unaware of major N+I development on politics, law, economy or infrastructure	Aware only of the N+I “headlines”	Partly aware of the issues associated with major N+I current events	Aware of the issues and ramifications of major N+I current events	
<b>CONCEPT 2: Impact and consequences of current events</b>					
<b>Conceives how current events can affect CE</b>	Unaware of any linkages between current events and CE	Has some thoughts about a connection between current events and CE	Somewhat aware that many current events can affect CE	Aware of how current events affect CE practice and development	
<b>Conceives how CE can affect current events</b>	Unaware of ways in which CE affects current events	Has some thoughts about a connection between CE and current events	Somewhat aware that CE affects several current events	Aware of how CE practice and development affects some current events	
<b>CONCEPT 3: Values other viewpoints</b>					

\* Example: Major highway project, major taxation for infrastructure, major local election results, local infrastructure calamity, etc.

\*\* Example: Major infrastructure initiative, act of Congress, energy prices, major technological breakthrough, national election results.

