Civil and Environmental Engineering Graduate Program Assessment Plan
2017-2018

This document presents the objective of the Civil and Environmental Engineering (CENE) graduate program as well as the learning outcomes students are expected to achieve and the process by which achievement of these outcomes is assessed and utilized to improve the quality of the program.

Program Objective

The objective of the CENE graduate program is to develop a student's knowledge and expertise in support of their becoming a leader in their area of specialization.

Student Outcomes

The American Society of Civil Engineering (ASCE) Body of Knowledge (BOK2) document released in 2009 [1] outlines 24 different student learning outcomes to be achieved at varying levels of Bloom's Taxonomy (i.e. L1-knowledge, L2-Comprehension, L3-Application, L4-Analysis, L5-Synthesis, and L6-Evaluation) for civil engineers of the future. Although all of the outcomes are achieved at some level through the BS degree, three of the outcomes are expected to be attained at a higher achievement level through additional coursework (i.e. MS or PhD degrees). These outcome include analysis level achievement in problem recognition and solving, synthesis level achievement in the student's area of technical specialization, and synthesis level achievement in selection of experiments and interpreting experimental results. Using the BOK outcomes as the standard, students graduating from the CENE graduate program are expected to achieve the following outcomes.

1. An ability to select and apply appropriate techniques and tools to recognize and solve engineering problems within the student's area of technical specialization.
2. An ability to analyze and design complex systems or processes within the student's area of technical specialization.
3. An ability to identify appropriate experiments and analyze and interpret results to arrive at reasonable conclusions.
4. An ability to effectively communicate technical information (orally and written).

Achievement levels derived from ASCE BOK [1] are shown for each outcome in Table 1 through Table 4. Each table shows what level of Bloom's Taxonomy should be achieved for each academic degree (B-Bachelors, M-Masters, and PhD-Doctor of Philosophy.

Table 1. Outcome 1: ASCE BOK-2 *Problem Recognition and Solving* Achievement Levels

Level of Cognitive Achievement					
1 Knowledge	*2 Comprehension*	*3 Application*	*4 Analysis*	*5 Synthesis*	*6 Evaluation*
Identify key factual information related to engineering problem recognition, problem solving, and applicable engineering techniques and tools. (B)	Explain the key concepts related to problem recognition, problem articulation, and problem solving processes, and how engineering techniques and tools are applied to solve problems. (B)	Develop problem statements and solve well-defined fundamental civil engineering problems by applying appropriate techniques and tools. (B)	Formulate and solve an ill-defined engineering problem appropriate to civil engineering by selecting and applying appropriate techniques and tools (M)	Synthesize the solution to an ill-defined engineering problem into a broader context that may include public policy, social impact, or business objectives. (PhD)	Compare the initial and final problem statements, the effectiveness of alternative techniques and tools, and evaluate the effectiveness of solutions (PhD)

Table 2. Outcome 2: ASCE BOK-2 *Technical Specialization* Achievement Level Rubric

Level of Cognitive Achievement					
1 Knowledge	*2 Comprehension*	*3 Application*	*4 Analysis*	*5 Synthesis*	*6 Evaluation*
Define key aspects of advanced technical specialization appropriate to civil engineering. (B)	Explain key concepts and problem-solving processes in a traditional or emerging specialized technical area appropriate to civil engineering (M)	Apply specialized tools, technology, or technologies to solve simple problems in a traditional or emerging specialized technical area of civil engineering (M)	Analyze a complex system or process in a traditional or emerging specialized technical are appropriate to civil engineering. (M)	Design a complex system or process or create new knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering. (M)	Evaluate the design of a complex system or process, or evaluate the validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering. (PhD)

Table 3. Outcome 3: ASCE BOK-2 *Experiment* Achievement Level Rubric

Level of Cognitive Achievement					
1 Knowledge	*2 Comprehension*	*3 Application*	*4 Analysis*	*5 Synthesis*	*6 Evaluation*
Identify the procedures and equipment necessary to conduct civil engineering experiments in more than one of the technical areas of civil engineering. (B)	Explain the purpose, procedures, equipment, and practical applications of experiments spanning more than one of the technical areas of civil engineering. (B)	Conduct experiments in one of the technical areas of civil engineering according to established procedures and report results. (B)	Analyze the results of experiments and evaluate the accuracy of the results within the known boundaries of the tests and materials in or across more than one technical are of civil engineering. (B)	Specify an experiment to meet a need, conduct the experiment, and analyze and explain the resulting data. (M)	Evaluate the effectiveness of a designed experiment in meeting an ill-defined real-world need. (PhD)

Table 4. Outcome 4: ASCE BOK-2 *Communication* Achievement Level Rubric

Level of Cognitive Achievement					
1 *Knowledge*	*2* *Comprehension*	*3* *Application*	*4* *Analysis*	*5* *Synthesis*	*6* *Evaluation*
List the characteristics of effective verbal, virtual, and graphical communications. (B)	Describe characteristics of effective verbal, written, virtual, and graphical communication. (B)	Apply the rules of grammar and composition in verbal and written communications, properly cite sources, and use appropriate graphical standards in preparing engineering drawings. (B)	Organize and deliver effective verbal, written, virtual, and graphical communications. (B)	Plan, compose, and integrate the verbal, written, virtual, and graphical communication of a project to technical and nontechnical audiences. (M)	Evaluate the effectiveness of the integrated verbal, written, virtual, and graphical communication of a project to technical and nontechnical audiences. (PhD)

Assessment Sources

Assessment data for each outcome will be obtained through specific coursework assignments/exams, qualifying/comprehensive exams, thesis/dissertation, and thesis/dissertation defense. The assessment sources as well as evaluators for PhD, MS thesis, and MS non thesis tracks are shown in Table 5 through Table 7.

Table 5. PhD Assessment Sources and Evaluators

Outcome	Sources	Evaluator
1	Qualifying Exam	Dissertation Committee
2	Qualifying Exam	Dissertation Committee
3	Dissertation	Dissertation Committee
4	Defense/Dissertation	Dissertation Committee

Table 6. MS Thesis Assessment Sources and Evaluators

Outcome	Sources	Evaluator
1	Coursework-Technical Specialization	Instructors
2	Coursework-Technical Specialization	Instructors
3	Thesis	Thesis Committee
4	Thesis/Defense	Thesis Committee

Table 7. MS Non-thesis Assessment Sources and Evaluators

Outcome	Sources	Evaluator
1	Coursework-Technical Specialization	Instructors
2	Coursework-Technical Specialization	Instructors

Assessment Frequency

Coursework assessments data will be collected for two graduate courses each year (Environmental/Water, Geotech/Structures).

Assessment Rubrics

Assessment rubrics for each outcome are given in Table 8 through

Table 12. The expectation is for students to score a 3 or above.

Table 8. Outcome 1: Problem Recognition and Solving Assessment Rubric

Criteria	Exceeds Expectations	Meets Expectations	Below Expectations
	5 4	3 2	1
Problem definition	Questions are probing and help clarify facts, concepts, and relation-ships in regard to problem.	All questions may not be relevant. May have some difficulty formulating questions to better understand the problem.	Few or no questions formulated. Expects others to define the questions. Does not seem to understand the central problem.
Problem formulation	Clearly defines the problem and outlines necessary objectives in an efficient manner.	Problem statement has some ambiguity or misses some important issues.	Problem is defined incorrectly or too narrowly. Key information is missing or incorrect.
Applying techniques and tools	Effectively applies appropriate techniques/tools and solves the problem correctly.	Applies appropriate techniques/tools and solves the problem with minor errors.	Unable to identify or apply appropriate techniques/tools correctly.

Table 9. Outcome 2: Technical Specialization (Design a Complex system or Process) Assessment Rubric

Criteria	Exceeds Expectations	Meets Expectations	Below Expectations
	5 4	3 2	1
Requirements	Design requirements and criteria are fully developed and understood.	Design requirements and criteria are partially developed and understood.	Design requirements and criteria are not understood.
Design	Design guides/tools are understood applied correctly	Design guides/tools are understood and applied with some errors	Design tools/guides are not understood and applied incorrectly
Evaluation	Alternative design solutions are considered and the optimal solution is achieved.	Alternative design solutions are considered however the optimal solution is not achieved.	Alternative design solutions are not considered.

Table 10. Outcome 3: Identify appropriate experiments and analyze and interpret results to arrive at reasonable conclusions

Criteria	Exceeds Expectations		Meets Expectations		Below Expectations
	5	4	3	2	1
Develop/implement an experiment	Selects or develops an appropriate experiment (physical or virtual) for a specific need and understands the limitations of the experiment.		Selects or develops an appropriate experiment (physical or virtual) for a specific need however does not understand the limitations of the experiment.		Unable to identify an appropriate experiment (physical or virtual) to satisfy a specific need.
Analyze results	Complete and correct analysis of the experimental data.		Substantial analysis of the experimental data with minor errors.		Rudimentary analysis of experimental data with errors.
Explain results	Correct conclusions drawn from data analysis including understanding of statistical results.		Reasonable conclusions drawn from data analysis with acceptable understanding of statistical results.		Incorrect conclusions drawn from data analysis with limited understanding of statistical results.

Table 11. Outcome 4a: Verbal Communication Assessment Rubric

Criteria	Exceeds Expectations		Meets Expectations		Below Expectations
	5	4	3	2	1
Organization	Logical flow with clear purpose and support. Demonstrates a thorough understanding of topic and audience.		Occasional lack of logical flow with evidence of incomplete understanding of topic. Purpose is sometimes difficult to discern.		Illogical flow. Ill-defined or no discernable purpose. Reveals basic lack of understanding of topic,
Content	All major topics are covered and supported by relevant data.		Major topics covers, but support lacks specificity, accuracy, or relevance.		No supporting data, or data presented is irrelevant or inaccurate.
Delivery	Exhibits high level of enthusiasm and confidence. Responds fully and accurately to questions.		Exhibits uneven enthusiasm & confidence levels. Some questions are answered more effectively than others.		Exhibits low enthusiasm & confidence levels. Is unable to effectively answer questions.
Technology	Visuals are clear, professional, and reinforce the presentation. No spelling or grammatical errors		Visuals are somewhat distracting (template, font, clip art, etc.). At least one spelling or grammatical error.		Visuals are unclear or unprofessional. Do not support presentation, and contain several spelling and/or grammatical errors.

Table 12. Outcome 4b: Written Communication Assessment Rubric

Criteria	Exceeds Expectations	Meets Expectations	Below Expectations
	5 4	3 2	1
Organization	The written document captures and communicates information accurately and clearly for both direct and indirect audiences.	The written document captures and communicates information accurately and clearly for identified audiences	The written document inadequately captures and communicates information for identified audiences. Little attention is paid to accuracy
Content	All major topics are covered and supported by relevant data.	Major topics covers, but support lacks specificity, accuracy, or relevance.	No supporting data, or data presented is irrelevant or inaccurate.
Visual Clarity	Visuals (Figures and Tables) are clear, concise and have been chosen for their ability to support and extend the written component.	Visuals (Figures and Tables) generally support the written component, but some may be overly complex/simplistic or unclear due to improper resolution.	Visuals (Figures and Tables) are frequently inappropriate, difficult to decipher and may even detract from written communication.
Writing	Writing is polished, professional, and virtually error free.	Errors exist, but do not distract from or misrepresent the content.	Frequent errors obscure and/or misrepresent the content.

References

1. ASCE Body of Knowledge Committee. 2008. Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future, Reston, VA, www.asce.org/publications.