— B. S. in Electrical Engineering —

2019–20 Assessment Report

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Contents

1 Introduction

1.1 Program Design and Goals

The Bachelor of Science in Electrical Engineering program at Oregon Institute of Technology (Oregon Tech) aims to impart a thorough grounding in the theory, concepts, and practices of electrical engineering. Emphasis is on practical applications of engineering knowledge. The goal of our program design is to graduate engineers who require minimal on-the-job training while providing them with sufficient theoretical background to enable success in graduate education in engineering.

1.2 Program History

In 2007, Oregon Tech began offering its new Bachelor of Science in Electrical Engineering (BSEE) program at its Klamath Falls campus. In Fall 2012, the BSEE degree started to also be offered at the Portland Metro campus. The BSEE degree is a traditional EE degree that was created to prepare graduates for careers in various fields associated with Electrical Engineering. These include, but are not limited to, analog integrated circuits and systems, digital integrated circuits and microcontroller systems, signal processing, communication systems, control systems, semiconductors, optoelectronics, renewable energy, and biomedical fields as stated in the Oregon Tech catalogs for 2007 through 2021.

The BSEE program prepares graduates to enter careers in the field of electrical engineering in positions such as design engineers, test engineers, characterization engineers, applications engineers, field engineers, hardware engineers, process engineers, control engineers, power engineers, semiconductor-processing engineers, controls and signal-processing engineers, energy system-integration engineers, analog-systems engineers, digital-systems engineers, and embedded-hardware engineers, among others. Graduates of the program will be able to pursue a wide range of career opportunities, not only within the more traditional areas of Electrical Engineering, but also within emerging fields, such as Renewable Energy Engineering and Optical Engineering.

1.3 Program Enrollment and Salary Data

Table 1 presents the program enrollment data from fall 2016 to fall 2020. Table 2 presents the number of BSEE degrees awarded over the same time span. The reported average annual salary of students who graduated between 2018 to 2020 is $64,000. Over this time span the reported success rate is 87% (Oregon Tech graduates employed, continuing education, or not seeking six months after graduation).

	2016	2017	2018	2019	2020
Klamath Falls	82	75	90	86	76
Portland Metro	115	118	104		85
Total	197	193	194	187	161

Table 1: Electrical engineering enrollment (headcount of both full and part-time students in the fourth week of the fall term) for the last five years.

	2015-16	2016-17	2017-18	2018-19	2019-20
Klamath Falls	16	17	14	18	17
Portland Metro	10	20	25	31	16
Total	26	37	39	49	33

Table 2: BSEE degrees awarded for the last five academic years.

1.4 Industry Relationships

The BSEE program has strong relationships with industry, particularly through its program-level Industry Advisory Board (IAB), and through its alumni. These relationships with our constituents allow the BSEE program to meet the institutional goal of maintaining the currency of our degree programs.

The IAB has been a mainstay in the development of the EE program since its early roots. The IAB provides advice and counsel to the EE program with respect to curriculum content, instructional resources, career guidance and placement activities, accreditation reviews, and professional-development assistance. In addition, each advisory-committee member serves as a vehicle for public relations information and potentially provides a point of contact for the development of specific opportunities with industry for students and faculty.

1.5 Program Locations

The BSEE program is located at both Oregon Tech campuses (Klamath Falls and Portland Metro), serving a large portion of rural Oregon and California, as well as the Portland metropolitan area. Oregon Tech is the only university offering multiple classical engineering degrees at the Bachelor's (and some at the Master's) level in a region ranging from Corvallis, Oregon, in the north, to Chico, California, in the south, and from the Pacific coast in the west to Boise, Idaho, in the east.

The Klamath Falls campus includes a large solar facility and the Oregon Renewable Energy Center (OREC) with exceptional opportunities for students to gain experience in the subfields of power, energy, and renewable energy. OREC, as stated on its website, "promotes energy conservation and renewable[-]energy use in Oregon and throughout the Northwest through applied research, educational programs, and practical information." These resources give students access to research and

practical experience in geothermal, solar, wind, biofuel, waste, fuel-cell, and other sources of green energy.

The Portland Metro campus offers excellent access to internships and other technological collaboration with the Silicon Forest (as the semiconductor industry in the Portland metropolitan area is known). Both the Klamath Falls and Portland-Metro campuses offer students access to the MECOP internship programs.

This arrangement satisfies the needs of the state of Oregon by placing a traditional EE program in the southern, rural part of the state to serve that region as well as providing a small-school EE program to students who desire a low student-to-faculty ratio and small classes.

2 Program Mission, Educational Objectives and Outcomes

2.1 Program Mission

The mission of the Electrical Engineering Bachelor of Science degree program is to provide a comprehensive program of instruction that will enable graduates to obtain the knowledge and skills necessary for immediate employment and continued advancement in the field of electrical engineering. The program will provide high-quality career-ready candidates for industry as well as teaching and research careers. Faculty and students will engage in applied research in emerging technologies and provide professional services to their communities.

2.2 Program Educational Objectives

In support of this mission, the Program Educational Objectives for the BSEE program are:

- The graduates of the BSEE program will possess a strong technical background as well as analytical, critical-thinking, and problem-solving skills that enable them to excel as professionals contributing to a variety of engineering roles within the various fields of electrical engineering and the high-tech industry.
- The graduates of the BSEE program are expected to be employed in electrical engineering positions including (but not limited to) design engineers, test engineers, characterization engineers, applications engineers, field engineers, hardware engineers, process engineers, control engineers, and power engineers.
- The graduates of the BSEE program will be committed to professional development and lifelong learning by engaging in professional or graduate education in order to stay current in their field and achieve continued professional growth.

- The graduates of the BSEE program will be working as effective team members possessing excellent oral and written communication skills, and assuming technical and managerial leadership roles throughout their career.

2.3 Relationship between Program Objectives and the Institutional Mission

The Oregon Tech mission statement is as follows. "Oregon Institute of Technology offers innovative and rigorous applied degree programs in the areas of engineering, engineering technologies, health technologies, management, and the arts and sciences. To foster student and graduate success, the university provides an intimate, hands-on learning environment, focusing on application of theory to practice. Oregon Tech offers statewide educational opportunities for the emerging needs of Oregon's citizens and provides information and technical expertise to state, national and international constituents."

The core themes of Oregon Tech are as follows.

- Applied Degree Programs
- Student and Graduate Success
- Statewide Educational Opportunities
- Public Service

The "strong technical background" of PEO 1 corresponds to the rigor required by the institutional mission of Oregon Tech's degree programs.

PEO 2 is aligned with the institution's core themes of both public service and graduate success. The Oregon Tech BSEE program prepares students to take their place in the work force as design engineers, test engineers, characterization engineers, applications engineers, field engineers, hardware engineers, process engineers, control engineers, and power engineers, serving the needs of Oregon, the nation, and the world.

Furthermore, the institution's mission emphasizes graduate success along with student success, and this is where the commitment to lifelong learning (PEO 3) aligns with the mission. Moreover, the mission statement's specification to "foster student and graduate success, the university provides and intimate, hands-on learning environment, focusing on application of theory to practice" is also in strong alignment with the BSEE program due to the prominence of small classes, the hands-on focus of the program, and faculty-taught laboratories.

2.4 Program Outcomes

Starting with the 2018-19 academic year, assessment was done using the new (1)-(7) ABET student outcomes below

1. an ability to identify, formulate, and solve engineering problems 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, interpret data analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using learning appropriate learning strategies

3 Cycle of Assessment for Program Outcomes

3.1 Introduction, Methodology, and the Assessment Cycle

Starting with the 2018-2019 academic year, assessment transitioned to the new ABET student outcomes (1)-(7) and are shown in Table 3. Assessment of program outcomes is conducted over a three (3) year cycle.

In addition to the outcomes scheduled for a particular year, assessment is also performed for Oregon Tech's Essential Student-Learning Outcomes (ESLOs) that are scheduled for that particular year by the Executive Committee of the Assessment Commission.

Student Outcome	2018-19	2019-20	2020-21	2021-22
(1) Problem Solving			•	
(2) Design			•	
(3) Communication		•		
(4) Ethics	•	KF		•
(5) Teams			•	*
(6) Experimentation	•	KF		•
(7) Learning		•		

Table 3: BSEE Outcome Assessment Cycle. Bullets (•) indicate standard assessment outcomes. Asterisk (*) indicates assessment moved to 2021-22 due to COVID-19 pandemic in 2020-21. KF indicates that this assessment was missed in the previous year and is included in this report.

3.2 Summary of Assessment Activities & Evidence of Student Learning

The BSEE faculty conducted formal assessment during this academic year using direct measures, such as designated assignments and evaluation of coursework normally assigned. Additionally, the student outcomes were assessed using indirect measures, based on an exit survey of graduating seniors.

3.3 Methodology for Assessment of Student Outcomes

At the beginning of the assessment cycle, an assessment plan is generated by the Assessment Coordinator in consultation with the faculty. This plan includes the outcomes to be assessed during that assessment cycle (refer to Table 3), as well as the courses and terms where these outcomes will be assessed.

The BSEE mapping process links specific tasks within BSEE course projects and assignments to program outcomes and on to program educational objectives in a systematic way. The program outcomes are evaluated as part of the course curriculum primarily by means of assignments. These assignments typically involve a short project requiring the student to apply math, science, and engineering principles learned in the course to solve a particular problem requiring the use of modern engineering methodology and effectively communicating the results.

The mapping process aims to systemize the assessment of engineering coursework, and to provide a mechanism that facilitates the design of engineering assignments that meet the relevant outcomes, particularly those that are more distant from traditional engineering coursework. Rather than considering how the outcomes match the assignment, the assignment is designed to map to the program outcomes.

A systematic, rubric-based process is then used to assess the level of attainment of a given program outcome, based on a set of performance criteria. The work produced by each student is evaluated

according to the different performance criteria, and assigned a level of 1-developing, 2-accomplished, or 3-exemplary. The results for each outcome are then summarized in a table, and reviewed by the faculty at the annual closing-the-loop meeting.

The standard acceptable performance level is to have at least 80% of the students obtain a level of accomplished or exemplary in each of the performance criteria for any given program outcome. It has been accepted in past closing-the-loop meetings that faculty can set a different threshold if required by the type of assignment or outcome, but must do so prior to the assessment.

If any of the direct assessment methods indicates performance below the established level, that triggers the process of continuous improvement where all the direct and indirect assessment measures associated with that outcome are evaluated by the faculty, and based on the evidence, the faculty decides the adequate course of action. The possible courses of action are these:

- Collect more data (if there is insufficient data to reach a conclusion as to whether the outcome is being attained or not); this may be the appropriate course of action when assessment was conducted on a class with low enrollment, and it is recommendable to re-assess the outcome on the following year, even if it is out-of-cycle, to obtain more data.
- Make changes to the assessment methodology (if the faculty believe that missing the performance target on a specific outcome may be a result of the way the assessment is being conducted, and a more proper assessment methodology may lead to more accurate numbers); for example, this could be the suggested course of action if an outcome was assessed in a lower-level course, and the faculty decide that the outcome should be assessed in a higher-level course before determining whether curriculum changes are truly needed.
- Implement changes to the curriculum (if the faculty conclude that a curriculum change is needed to improve attainment of a particular outcome). A curriculum change will be the course of action taken when the performance on a given outcome is below the target level, and the evidence indicates that there is sufficient data and an adequate assessment methodology already in place, and therefore there is no reason to question the results obtained.

If the faculty decide to take this last course of action and implement curriculum changes, the data from the direct assessments is analyzed and the faculty come up with a plan for continuous improvement, which specifies what changes will be implemented to the curriculum to improve outcome performance.

In addition to direct assessment measures, indirect assessment of the student outcomes is performed on an annual basis through a senior exit survey.

The results of the direct and indirect assessment, as well as the conclusions of the faculty discussion at the closing-the-loop meeting are included in the annual BSEE assessment report, which is reviewed by the department chair and the director of assessment for the university. The suggested changes to the curriculum are presented and discussed with all the department faculty at the annual convocation

meeting in the fall, as well as with the Industry Advisory Board at the following IAB meeting. If approved, these changes are implemented in the curriculum and submitted to the University Graduate Council (if catalog changes are required) for the following academic year.

3.4 Targeted Direct Assessment Activities

The sections below describe the targeted assessment activities and detail the performance of students for each of the assessed outcomes. Unless otherwise noted, the tables report the percentage of students performing at a developing level, accomplished level, and exemplary level for each performance criteria, as well as the percentage of students performing at an accomplished level or above.

The target attainment level for all outcomes is 80% of students at level ≥ 2.

3.4.1 Outcome (3) Communication

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

Klamath Falls and Portland Metro, ENGR 465, Spring 2020

A targeted direct assessment of this outcome was done in ENGR 465 Senior Capstone (Fall 2020 through Spring 2020) . Five Portland Metro BSEE majors were assessed by Chitra Venugopal. Twenty Klamath Falls BSEE majors were assessed by Amr Metwally and Aaron Scher.

The capstone project is a year-long (three-term) project that students complete in their senior year, which involves a major design experience. Throughout the year, students are required to complete the definition, design, implementation, and verification of a major engineering design project. During the initial stage, students work under the supervision of their capstone project advisor to select a project of adequate scope, and submit a project proposal. The proposal typically includes an explanation of the project relevance, a project definition or specification, a timeline with major milestones, a list of resources needed to complete the project, and a projected cost analysis.

Once the proposal is approved by the academic advisor, students go through the different phases of design, implementation, and verification of their project. During this time, students have regular meetings with their project advisor to report progress, notify of plan changes if needed, present results, and perform prototype demonstrations. Once the design, implementation, and verification process is completed, and there is a final working prototype, students are required to generate a poster for inclusion in the annual Student Project Symposium (the public presentation at the symposium was cancelled this year due to the COVID-19 pandemic), deliver an oral presentation (the oral presentations were delivered remotely this year due to the COVID-19 pandemic), and submit a formal written report. The students were assessed based on their ability to effectively communicate the project's design and outcomes of this project to a range of audiences (professional and public).

Outcome	Campus	Performance Criteria	1 Developing	2 Accomplished	3 Exemplary	Students ≥2
3.1	PM	Oral	0	5	0	100%
3.2	PM	Written	0	5	0	100%
3.3	PM	Graphical	0	5	0	100%
3.4	PM	Audience	0	5	0	100%
3.1	KF	Oral	—	—	—	—
3.2	KF	Written	3	12	5	85%
3.3	KF	Graphical	1	12	7	95%
3.4	KF	Audience	2	13	5	90%

Table 4: ENGR 465 assessment of Outcome (3). The Oral performance criteria was not assessed at KF due to campus shutdowns related to the COVID-19 pandemic.

3.4.2 Outcome (4) Ethics

(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.

Klamath Falls, EE 335, Spring 2020, Dr. Eve Klopf

A targeted direct assessment of this outcome was done in EE 335 *Advanced Microcontrollers*. Twelve students were assessed.

The assignment was for the students to use their knowledge of microcontrollers and various peripherals to make a device that would be useful during the COVID-19 pandemic.

Outcome	Criteria	1 Developing	2 Accomplished	3 Exemplary	Students ≥ 2
4.1	Recognize	2	10	2	100%
4.2	Identify	—	—	—	83%
4.3	Judge	—	—	—	83%

Table 5: EE 335 assessment of Outcome (4): Ethics.

3.4.3 Outcome (6) Experimentation

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

Klamath Falls, EE 221, Fall 2019, Dr. Amr Metwally

This outcome was assessed in EE 221 — *Circuits I*. The assignment was to build and simulate a Wheatstone bridge in isolation and when combined with an open-loop op-amp. Students were expected to analyze the circuit, make basic measurements, and then form conclusions about the operation of the circuit.

Five students were assessed in Fall 2019 using the performance criteria listed in the table below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

		1	2	3	
Outcome	Criteria	Developing	Accomplished	Exemplary	Students ≥ 2
6.1	Develop and Conduct	0	5	0	100%
6.2	Analyze and Interpret	0	5	0	100%
6.3	Engineering Judgement	0	4	1	100%

Table 6: EE 221 assessment of Outcome (6) Experimentation.

3.4.4 Outcome (7) Learning

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

Klamath Falls and Portland Metro, ENGR 465, Spring 2020

A targeted direct assessment of this outcome was done in ENGR 465 *Senior Capstone* on both campuses. Five Portland Metro BSEE majors were assessed by Chitra Venugopal in winter and spring of 2020. Twenty Klamath Falls BSEE majors were assessed by Amr Metwally in spring of 2020.

A general description of the capstone project is provided in the description of Outcome (3) Communication above. For Outcome (7) Learning students were assessed based on how well they acquired and applied new knowledge to their capstone projects as needed, using appropriate learning strategies. Particular attention was focused on students' critical thinking and decision-making skills, ability to accept new challenges, independent learning skills, and ability to integrate and extend knowledge, skills, and perspectives gained through previous coursework.

Outcome	Campus	Performance Criteria	1 Developing	2 Accomplished	3 Exemplary	Students ≥2
7.1	PM	Acquire	0	5	0	100%
7.2	PM	Apply	0	5	0	100%
7.1	KF	Acquire	0	6	14	100%
7.2	KF	Apply	3	15	2	85%

Table 7: ENGR 465 assessment of Outcome (7) on both campuses.

3.5 Indirect Assessments

In[1] addition to direct assessment measures, student outcomes were indirectly assessed through a senior exit survey of graduating students. The specific areas assessed by the Office of Academic Excellence in the 2019-20 Student Survey were:

- Tools: An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline.
- Design: An ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline.
- Communication: An ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature.
- Experiments: An ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes;
- Teamwork: An ability to function effectively as a member as well as a leader on technical teams.

These outcomes in the above list do not exactly match exactly outcomes (1) through (7). This is due to a miscommunication between the EERE Department and the Office of Academic Excellence which created and administered the survey. Indeed, the five outcomes listed above are the new (1) through (5) ABET ETAC outcomes (not the ABET EAC outcomes). This error has been brought to the attention of the EERE Department Chair, and it is the intention of the department to use student outcomes (1) through (7) for indirect assessment in future Senior Exit Surveys. Fortunately, as both EAC and ETAC outcomes are similar, the indirect assessment data does provide useful data for understanding the student experience and assessing the effectiveness of the BSEE program.

[1]This section was added after the 2020-21 Closing-the-Loop meeting in which we discovered that indirect assessments had not been included in this report. At that point we discovered that the Student Survey questions used the ETAC and EAC student outcomes. The Office of Academic Excellence now has the correct survey questions for academic year 2021-22.

Fifteen BSEE graduating seniors (PM=9, KF=6) completed the Senior Exit Survey. In this survey, question Q BEE 1 asked students to rate their proficiency in the five indirect assessment outcomes. Question Q BEE 2 asked students to rate how much their experiences at Oregon Tech contributed their knowledge, skills, and personal development in the five indirect assessment outcomes. The results are presented in the tables below.

As Table 8 shows, all students rate their proficiency level as "High proficiency" or "Proficiency" in all indirect assessment outcomes. Furthermore, as Table 9 shows, the majority (from 93% to 100%) of students rate that Oregon Tech contributed "Very much" or "Quite a bit" to their knowledge, skills, and personal development in all indirect assessment outcomes. Overall, these results correlate well with the direct assessment results.

Indirect Outcome	High proficiency	Proficiency	Some proficiency	Limited proficiency
Tools	9 (60%)	6 (40%)	0 (0%)	0 (0%)
Design	9 (60%)	6 (40%)	0 (0%)	0 (0%)
Communication	10 (67%)	5 (33%)	0 (0%)	0 (0%)
Experiments	6 (40%)	9 (60%)	0 (0%)	0 (0%)
Teamwork	8 (53%)	7 (47%)	0 (0%)	0 (0%)

Table 8: Student survey results showing how students rate their proficiency for each of the five listed outcomes.

Indirect Outcome	Very much	Quite a bit	Some	Very little
Tools	10 (67%)	5 (33%)	0 (0%)	0 (0%)
Design	9 (60%)	6 (43%)	0 (0%)	0 (0%)
Communication	5 (33%)	9 (60%)	1 (7%)	0 (0%)
Experiments	7 (50%)	7 (50%)	1 (7%)	0 (0%)
Teamwork	7 (50%)	7 (50%)	1 (7%)	0 (0%)

Table 9: Student survey results showing how students rate how much their experiences at Oregon Tech contributed their knowledge, skills, and personal development for each of the five listed outcomes.

4 Summary

More than 80% of the students were accomplished or exemplary in all criteria assessed.

4.1 Evaluation and Continuous Improvement

The BSEE faculty met on 10 October 2019 to review the assessment results and determine whether any changes were needed to the BSEE curriculum or assessment methodology based on the results presented in this document. This Closing-the-Loop meeting provides faculty a chance to reflect and assess data and trends with regards to continuous improvement.

The objective set by the BSEE faculty was to have at least 80% of the students perform at the level of accomplished or exemplary in all performance criteria of the assessed outcomes. This level was met for both outcomes (3) and (7) assessed this academic year.

Table 10 shows how these assessments relate to those from previous assessment cycles.

Due to shutdowns related to the COVID-19 pandemic, the oral performance criterion for Outcome (3) Communications was not assessed in Klamath Falls. However the threshold of attainment was exceeded in all other performance criteria for this outcome.

Starting academic year 2018–19, the assessment was transitioned to the present (1)-(7) ABET student outcomes. To compare with historical data, we mapped the current ABET outcomes with the old ones using Table 11.

4.2 Outcome (3) Summary

The evidence from the assessment results (Table 4) shows that the threshold of attainment of this outcome was exceeded in all performance criteria. Recommendation: The faculty identified no problem with this outcome, and therefore recommend no changes at this juncture.

4.3 Outcome (4) Summary

The evidence from the assessment results (Table 5) shows that the threshold of attainment of this outcome was exceeded in all performance criteria. Recommendation: The faculty identified no problem with this outcome, and therefore recommend no changes at this juncture.

	2015–16	2016–17	2017–18	2018–19	2019–20
(3) Communication			$N = 43$		$N = 12$
			outcome (g)		
Oral			98%		100%
Written			98%		83%
Graphical			—		83%
Audience			—		83%
(4) Ethics	$N = 18$	$N = 5$		$N = 12$	$N = 12$
	outcome (f)	*outcome (f)*			
Recognize	94%	100%		100%	100%
Identify	80%	100%		83%	—
Judge	—	—		83%	—
(6) Experimentation	$N = 56$	$N = 8$		$N = 17$	$N = 5$
	outcome (b)	*outcome (b)*			
Design and Conduct	71% or 84%	100%		82%	100%
Analyze and Interpret	64%	100%		82%	100%
Engineering Judgement	—	—		82%	100%
(7) Learning			$N = 38$		$N = 17$
			outcome (i)		
Acquire			84%		82%
Apply			98%		82%

Table 10: Historical record of the percentage of students scoring 2 (accomplished) or 3 (exemplary)Sample size and results includes combined total of students for each outcome evaluated within the assessed year. In prior years, old ABET outcomes are matched with new ones as shown in Table 11.

Old outcomes	Current outcome
(a) + (e)	(1)
(c)	(2)
(g)	(3)
(f) + (h) + (j)	(4)
(d)	(5)
(b) + (k)	(6)
(i)	(7)

Table 11: Mapping between old ABET student outcomes (a)-(k) and current ABET student outcomes (1)-(7).

4.4 Outcome (6) Summary:

The evidence from the assessment results (Table 6) shows that the threshold of attainment of this outcome was exceeded in all performance criteria assessed. Recommendation: The faculty identified no problem with this outcome, and therefore recommend no changes at this juncture.

4.5 Outcome (7) Summary:

The evidence from the assessment results (Table 7) shows that the threshold of attainment of this outcome was exceeded in all performance criteria assessed. Recommendation: The faculty identified no problem with this outcome, and therefore recommend no changes at this juncture.

5 Rubrics

EAC RUBRIC: OUTCOME (1) – PROBLEM SOLVING

Outcome (1) An ability to identify, formulate, and solve complex engineering problems[1] by applying principles of engineering, science, and mathematics

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY TO IDENTIFY A COMPLEX ENGINEERING PROBLEM	An engineering problem is not identified, or the identification is too vague or unclear.	An engineering problem of reasonable complexity is adequately identified and its significance minimally explained.	A complex engineering problem is properly identified and clearly stated. Its significance is thoroughly explained.	
ABILITY TO FORMULATE A COMPLEX ENGINEERING PROBLEM BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS	A complex engineering problem is not properly formulated in engineering, scientific, and/or mathematical terms. Most of the assumptions and specifications are either missing or unclear.	A complex engineering problem is adequately formulated in engineering, scientific, and/or mathematical terms, but some of the assumptions and specifications may be missing or not clearly presented.	A complex engineering problem is clearly formulated with a valid and complete set of assumptions and specifications.	
ABILITY TO SOLVE A COMPLEX ENGINEERING BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS	The solution to a complex engineering problem is not developed according to engineering, scientific, and mathematical principles, or it does not follow the original set of assumptions and specifications.	The solution to a complex engineering problem is developed according to engineering, scientific, and mathematical principles. The solution reasonably meets most of the original set of assumptions and specifications.	The solution to a complex engineering problem is very well developed according to engineering, scientific, and mathematical principles. The solution meets or exceeds the original set of assumptions and specifications.	

[1] As defined by ABET, complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts.

EAC RUBRIC: OUTCOME (2) – BROADER FACTORS

Outcome (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

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY TO APPLY ENGINEERING DESIGN TO PRODUCE SOLUTIONS THAT MEET SPECIFIED NEEDS	Does not follow the engineering design process, or the designed solution does not meet the specified need(s).	Reasonably follows the engineering design process to produce a solution that adequately meets the specified need(s).	Methodically follows the engineering design process to produce a solution that thoroughly meets the specified need(s).	
ABILITY TO DESIGN SOLUTIONS ACCOUNTING FOR BROADER CONSIDERATIONS, SUCH AS PUBLIC HEALTH, SAFETY, AND WELFARE, AS WELL AS GLOBAL, CULTURAL, SOCIAL, ENVIRONMENTAL, AND ECONOMIC FACTORS	The solution provided does not take into account broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	The solution provided takes into account and partially addresses some of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	The solution provided takes into account and thoroughly addresses several of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	

EAC RUBRIC: OUTCOME (3) – COMMUNICATION

Outcome (3) An ability to communicate effectively with a range of audiences

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY FOR EFFECTIVE ORAL COMMUNICATION	The main ideas are not clearly presented. Low volume or monotonous tone make it hard for audience to engage. Speaker does not transmit any interest or enthusiasm about the topic.	The main ideas are clearly presented. Adequate volume and dynamic tone are used to engage audience. Speaker occasionally transmits interest and enthusiasm about the topic.	Speaker is an excellent communicator. The main ideas are clearly presented. Speaker is eloquent and dynamic, effective at engaging the audience. Speaker displays and transmits a strong interest and enthusiasm about the topic.	
ABILITY FOR EFFECTIVE WRITTEN COMMUNICATION	Content is disorganized, the main ideas are not clearly stated and developed. Writing style is rough or imprecise. Frequent grammar/spelling errors. Document presentation and format rough or inconsistent.	Content is well organized and the main ideas are clearly stated and reasonably developed. Writing style is adequate for purpose and readable. Grammar/spelling mostly correct. Document presentation and format adequate and consistent.	Content is very well organized and easy to follow, main ideas are clearly presented and thoroughly developed. Writing style is adequate for purpose, readable, and tailored to intended audience. Grammar/spelling correct. Work is professionally presented and very well formatted.	
ABILITY FOR EFFECTIVE GRAPHICAL COMMUNICATION	Inadequate use of figures, charts, and/or tables to display data. Figures are not well placed, many figures, charts, and tables missing key formatting elements, such as titles, labels, units, captions, etc. Overall, figures do not contribute to a better understanding of key ideas or results.	Adequate use of figures, charts, and tables to display data. Figures are well placed, most figures, charts, and tables are properly labeled and formatted. Figures moderately contribute to a better understanding of key ideas or results.	Excellent use of figures, charts, and tables to display data. All figures, charts, and tables properly labeled and formatted, easy to read and interpret. Figures substantially and effectively contribute to a better understanding of key ideas or results.	
ABILITY TO ADDRESS A RANGE OF AUDIENCES	Does not address target audience. Content is too technical or too superficial to be understood by and of interest to a wide range of audiences.	Adequately addresses the target audience. Content has a reasonable balance of technical and non-technical information to be understood by and of interest to a wide range of audiences.	Effectively addresses the target audience. Content has the right balance of technical and non-technical information to be understood by and of interest to a wide range of audiences.	

EAC RUBRIC: OUTCOME (4) – ETHICS

Outcome (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

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY TO RECOGNIZE ETHICAL AND PROFESSIONAL RESPONSIBILITIES IN ENGINEERING SITUATIONS	Description of ethical and professional responsibilities is limited or rudimentary.	Description of ethical and professional responsibilities is substantive.	Description of ethical and professional responsibilities is complete and thorough.	
ABILITY TO IDENTIFY GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS IN ENGINEERING SITUATIONS	Identifies a single context area relevant in an engineering situation. Explanation of the context is rudimentary.	Identifies most context areas relevant in an engineering situation. Explanation of the contexts is substantive.	Identifies all context areas relevant in an engineering situation. Explanation of contexts is complete and thorough.	
ABILITY TO JUDGE THE IMPACT OF ENGINEERING SOLUTIONS ON GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS	Analysis and judgement of the impact of engineering solutions on contexts is rudimentary.	Analysis and judgement of the impact of engineering solutions on contexts is substantive.	Analysis and judgement of the impact of engineering solutions on contexts is complete and thorough.	

EAC RUBRIC: OUTCOME (5) – TEAMS

Outcome (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				
CRITERIA	1—DEVELOPING	2—ACCOMPLISHED	3—EXEMPLARY	SCORE
ABILITY TO PROVIDE TEAM LEADERSHIP	Lacks adequate ability to resolve problems and conflicts. Lacks ability to provide adequate leadership in decision making, planning, and goal setting. Does not show appreciation for other team members' contributions. Exhibits poor team communication skills (e.g., interrupts others, gets defensive, does not ask questions, gets distracted). Does not motivate others or lead by example.	Capable of resolving problems and conflicts. Demonstrates adequate leadership ability in decision making, planning, and goal setting. Occasionally shows appreciation for other team members' contributions. Exhibits reasonable team communication skills. Capable of motivating others. Willing to share problems and progress. Mainly does assigned work instead of willingly taking on additional responsibilities.	Proficient in resolving problems and conflicts and exhibits proficient leadership ability in decision making, planning, and goal setting. Appropriately recognizes and shows appreciation for other team members' contributions. Exhibits proficient team communication skills including good body language and active listening. Transparent about expectations and objectives. Motivates others and leads by example. Willing to share problems and take on additional responsibilities and help others when necessary.	
ABILITY TO CREATE A COLLABORATIVE AND INCLUSIVE ENVIRONMENT AS A TEAM MEMBER	Rarely uses respectful language or show cooperative communication skills. Does not demonstrate mutual respect and tends to dismiss others' unique perspectives, opinions, or ideas. Does not demonstrate ability and willingness to compromise with other group members.	Generally, uses respectful language and shows cooperative communication skills. Does not disrespect other group members or dismiss their unique perspectives, opinions, or ideas. Demonstrates adequate ability and willingness to compromise with other group members. Does not dismiss the sharing of ideas.	Uses respectful language and shows cooperative communication skills. Actively demonstrates mutual respect and welcomes others' unique perspectives. Demonstrates high ability and willingness to compromise with other group members. Makes other group members feel safe and valued through openly encouraging the sharing of ideas.	
ABILITY TO ESTABLISH GOALS, PLAN TASKS, AND MEET OBJECTIVES AS A TEAM MEMBER	Lacks basic awareness of team duties and responsibilities. Lacks basic awareness of the links between project goals and tasks. Fails to identify risks to meet project deadlines.	Capable of performing most team duties and responsibilities. Capable of establishing goals and performing necessary talks on time to meet project deadlines and identifies most issues impacting project success.	Proficient execution of all team duties and responsibilities. Proficient in establishing goals and performing necessary tasks on time to meet project deadlines and identifies issues impacting projects success.	

EAC RUBRIC: OUTCOME (6) – EXPERIMENTATION

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

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY TO DEVELOP AND CONDUCT AN EXPERIMENT	Demonstrates inadequate knowledge and abilities for conducting experiments with standard test and measurement equipment to collect experimental data. May not observe lab safety and procedures.	Demonstrates adequate knowledge and abilities for conducting experiments. Able to use standard test and measurement equipment to collect experimental data. Reasonably capable of troubleshooting to overcome measurement problems. May require supervision and steering in the right direction. Overall, observes lab safety plan and procedures.	Demonstrates comprehensive knowledge, exceptional abilities, and resourcefulness for conducting experiments. Selects appropriate equipment and measuring devices and methodology for conducting experiments. Demonstrates a proficient ability to troubleshoot, predict and overcome measurement problems. Observes established lab safety plan and procedures. Proposes improvements as necessary.	
ABILITY TO ANALYZE AND INTERPRET DATA	Demonstrates inadequate knowledge and abilities for analyzing and interpreting experimental results. Reporting methods are unsatisfactory.	Demonstrates adequate abilities for experimental data analysis, interpretation, and visualization. Able to draw some reasonable conclusions based on experimental results. Demonstrates an awareness for measurement error. Reporting methods are satisfactorily organized, logical, and complete	Demonstrates exceptional ability for experimental data analysis, interpretation, and visualization. Able to draw insightful conclusions based on experimental results. Analyzes and interprets data using appropriate theory, accounts for measurement error into analysis and interpretation, reporting methods are well-organized, logical, and complete.	
ABILITY TO USE ENGINEERING JUDGEMENT TO DRAW CONCLUSIONS	Lacks the ability and awareness for interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions using of appropriate scientific/engineering principles, standards, and practices. Not adept at navigating complexity, open ended problems, or ambiguous data.	Adequately capable of interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. May require significant guidance in the face of complexity, open ended problems, or ambiguous data.	Proficient in interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. Able to make quality engineering decisions/conclusions, especially in the face of complexity, open-ended problems, or ambiguous data.	

EAC RUBRIC: OUTCOME (7) – LEARNING

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

CRITERIA	1-DEVELOPING	2-ACCOMPLISHED	3-EXEMPLARY	SCORE
ABILITY TO ACQUIRE NEW KNOWLEDGE USING APPROPRIATE LEARNING STRATEGIES	Shows poor ability and little openness to acquire new knowledge and diagnosing their learning needs. Does not identify proper opportunities or resources to expand knowledge and skills. Unable or uninterested to find new information without significant guidance and prompting. Lacks awareness at one's current knowledge and skills for identifying basic gaps in understanding. Lacks the strategies and motivation necessary for self-directed learning.	Shows sufficient ability and openness to acquire new knowledge and diagnosing their learning needs. Able to identify some opportunities or resources to expand knowledge and skills. Able and interested to find new information, perhaps with some prompting. Uses current knowledge and skills to identify basic gaps in understanding. Exhibits adequate strategies and motivation necessary for self-directed learning.	Demonstrates proficient ability and openness to acquire new knowledge and diagnosing their learning needs. Independently identifies and uses a diverse range of resources to expand knowledge and skills. Able and interested to find new information with minimal prompting. Uses current knowledge and skills to identify key gaps in understanding. Exhibits exemplary strategies and motivation necessary for self-directed learning.	
ABILITY TO APPLY NEW KNOWLEDGE AS NEEDED	Inadequately unmotivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Insufficiently understands and determines the significance or relevance of the learned information needed for the task.	Adequately motivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Partially understands and determines the significance or relevance of the learned information needed for the task.	Proficiently skilled and motivated at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Understands and determines the significance or relevance of the learned information needed for the task.	