Electrical Engineering
2013–2014 Assessment Report

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Contents

1 Introduction

1.1 Program Goals and Design

Electrical Engineering at Oregon Institute of Technology (Oregon Tech) aims to impart a thorough grounding in the theory, concepts, and practices of electrical and electronics engineering. Emphasis is on practical applications of engineering knowledge. The hands-on student projects undertaken by all program graduates include real-world applications like innovative medical-technology products (such as an automated ultrasound-gel dispenser), electric, hybrid, and fuel-cell cars, and a multi-mode professional-grade instrument amplifier (all part of a three-term multidisciplinary senior project that includes design, implementation, and test, not just simulation), as well as NASA's high-altitude balloon and rocket projects. 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, Enrollment & Graduates

In 2007, Oregon Tech began offering its new Bachelor of Science in Electrical Engineering (BSEE) program at its then main campus in Klamath Falls, Oregon (KF). The BSEE degree is a traditional EE degree that has replaced the BSEET program that was previously offered in Klamath Falls, and it 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 2014.

The program's first graduating class was in June 2010 with a class size of five. Total enrollment has increased to 112 (headcount, including dual-majors and post-baccalaureate students) as of the spring of 2014. Enrollment for 2007 through 2014 is shown in Table 1.

Table 1: Enrollment (student headcount), Fall 2007 through Fall 2013

2007	2008	2009	2010	2011	2012	2013
36	38	53	48	55	68	112

We anticipate that all BSEE graduates will enter careers in electrical engineering 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, embedded-hardware engineers, and other electrical engineers. 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 the emerging fields of Renewable Energy Engineering and Smart Grid.

59 students have graduated from the BSEE program since the beginning. Eleven new BSEE students graduated Spring 2014 (including one dual-major with BSREE). The status of Oregon Tech EE graduates in terms of employment and graduate studies is summarized in Table 2 for graduates of 2010, 2011, 2012, 2013, and 2014.

In 2010, three out of six graduates went on to graduate programs, two at the University of Oregon Applied Physics industrial-internship program that Oregon Tech is a partner in, and one in ocean engineering at Florida Atlantic. The remaining three graduates went onto engineering jobs.

In 2011, two out of fifteen graduates continued onto graduate school, one in computer science and one in power engineering, with eleven of the remaining thirteen graduates getting engineering jobs. Two graduates in 2011 got other employment, namely one as a technician and one as a manager.

In 2012, Oregon Tech's EE program had six graduates, with one continuing onto graduate studies and five finding jobs as engineers.

In 2013, 5 of the 11 graduates of the EE program have reported whether they are employed or not. The overall results are summarized in Table 2.

Table 2: BSEE Program Graduates

Identifier, Grad Year	Company (or Graduate School)	Job Title	Industry (or Major)
1, 2010	Micron	Industrial Production Engineer	Semiconductor Memory
2, 2010	Weyerhaeuser	Industrial Production Engineer	Paper, and Building Products
3, 2010	JELD~WEN	QC Engineer	Building Products
4, 2010	University of Oregon	Graduate Student	Materials Science
5, 2010	University of Oregon	Graduate Student	Materials Science
6, 2010	Florida Atlantic Univ.	Graduate Student	Ocean Engineering
1, 2011	Advanced Technology & Research Corp.	Junior Engineer	Military & Automation
2, 2011	Leviton Manufacturing	Electrical Engineer	Networking, Energy & Renewable Energy

3, 2011	JELD~WEN	Manufacturing Project Manager	Building Products
4, 2011	Alyrica Networks	Technician	Clean-Energy Networking
5, 2011	Novellus	Product Engineer	Manufacturing Equipment for Semiconductor Industry
6, 2011	Novellus	Product Engineer	Manufacturing Equipment for Semiconductor Industry
7, 2011	Novellus	Product Engineer	Manufacturing Equipment for Semiconductor Industry
8, 2011	Biotronix	Test Engineer	Biomedical
9, 2011	Schweitzer Eng.	Design Engineer	Automation, Telecommunications & Power
10, 2011	US Air Guard	Comm. Engineer	Military
11, 2011	PCM Sierra	Design Engineer	Networking & Telecommunications
12, 2011	Black & Veatch	Power Engineer	Infrastructure
13, 2011	SEL	Process Engineer	Power Systems
14, 2011	University of Idaho	Graduate Student	Computer Science
15, 2011	Colorado School of Mines	Graduate Student	Power Engineering
1, 2012	POWER Testing and Energization	Field Test Engineer	Power Engineering
2, 2012	Black & Veatch	Electrical Engineer 1	Infrastructure
3, 2012	Black & Veatch	Electrical Engineer	Infrastructure
4, 2012	POWER Testing and Energization	Field Engineer	Power Engineering
5, 2012	Novellus Systems	Field-Service Engineer	Manufacturing Equipment for Semiconductor Industry
6, 2012	University of California, Santa Barbara	Graduate Student	Computer Engineering

1, 2013	Koam Engineering Systems, Inc., Gig Harbor, WA	Electronics/Electrical Engineer	Systems Engineering & Software Development
2, 2013	Fluent Engineering, Inc., Salem, OIR	[undisclosed]	Project Management
3, 2013	Intel, Hillsboro, OR	Analog Engineer	IC Design & Manufacturing
4, 2013	Black & Veatch, Lake Oswego, OR	Electrical Engineer I	Infrastructure
5, 2013	Intel, Hillsboro, OR	Failure-Analysis Technician	IC Design & Manufacturing
6, 2013	Elcon, Beaverton, OR	Electrical Engineer	Consulting
7, 2013	The Cadmus Group, Portland, OR	Engineering Technician	Consulting
8, 2013	Vanguard EMS, Inc., Beaverton, OR	Test Operator	Military and Aerospace
9, 2013	Vanguard EMS, Inc., Beaverton, OR	Test Supervisor	Military and Aerospace
10, 2013	POWER Testing & Energization, Vancouver, WA	Field Engineer	Power Engineering
11, 2013	POWER Testing & Energization, Vancouver, WA	Engineer I	Power Engineering
12, 2013	POWER Testing & Energization, Vancouver, WA	Engineer I	Power Engineering
13, 2013	USACE Hydroelectric Design Center, Portland, OR	Electrical Engineering-in-Training	Hydroelectric Power
14, 2013	SolenSphere Renewables, Inc., Klamath Falls, OR	CEO	Renewable Energy
15, 2013	ESC Automation, Tigard, OR	Field-Service Engineer	Automation

16, 2013	Nippon Paper Industries, Port Angeles, WA	Electrical Engineer Planner	Paper
17, 2013	TriQuint, Hillsboro, OR	Product-Development Engineer	Semiconductors
18, 2013	POWER Engineers, Portland, OR	Substation Engineer	Power Engineering
19, 2013	ESC Automation, Tigard, OR	Application Engineer	Automation
20, 2013	Puget Sound Energy, Bellevue, WA	Senior Engineer	Power Engineering
21, 2013	[undisclosed]	Technician	[unknown]
1, 2014	National Instruments	Application Engineer	Instrumentation
2, 2014	POWER Testing & Energization	Field Engineer	Power Engineering
3, 2014	Microtech Instruments, Inc.	Engineer	Scientific Instruments
4, 2014	Vanguard EMS, Inc., Beaverton, OR	Engineering Technician	Military and Aerospace
5, 2014	Nippon Paper Industries, Port Angeles, WA	Electrical Engineer	Paper
6, 2014	Black and Veatch	Electrical Engineer I – Substation Design	Infrastructure
7, 2014	MacDonald-Miller Facility Solutions	Service Special Projects Account Manager	Facility Solutions
8, 2014	Department of the Navy	Electrical Engineer	Military
9, 2014	Pretec	Controls Engineer	Semiconductor and Computing Peripherals
10, 2014	Intel	R&D Test Engineer	IC/Semiconductor
11, 2014	University of Oregon	Master's student	Graduate Studies in Applied Physics - Optics
12, 2014	undisclosed	undisclosed	undisclosed

1.3 Industry Relationships

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

The IAC has been a mainstay in the development of the EE program since its early EET roots. The IAC 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.

1.4 Program Locations

The BSEE program is located at both main campuses (Klamath Falls and Wilsonville), 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 leading geothermal research facility, a large solar facility, and a center for applied research in renewable energy, offering exceptional opportunities for students to gain experience in the subfields of power, energy, and renewable energy. These resources allow students access to research *and* practical experience in geothermal, solar, and other sources of green energy.

The Wilsonville 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).

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. The EE program also supports the shift at the institution from four-year technology degrees to four-year engineering degrees. The addition of EE completes the College of ETM (Engineering, Technology & Management) along with Oregon Tech's Civil Engineering, Mechanical Engineering, Manufacturing Engineering Technology, and Renewable Energy Engineering programs.

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.

2.2 Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. The PEOs of Oregon Tech's Bachelor of Science in Electrical Engineering program are:

- PEO 1: 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.

- PEO 2: 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.

- PEO 3: 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.

- PEO 4: 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, a member of the Oregon University System, 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 "strong technical background" of PEO 1 corresponds to the rigor required by the institutional mission of Oregon Tech's degree programs.

The innovative aspect of our degree programs are reflected in the commitment to critical-thinking and problem-solving skills evident in the variety of courses offered and innovative teaching techniques employed throughout the institution as well as within the EE program. Critical thinking is built into the lectures, student work, assignments, and exams of many EE courses like the introductory circuit-analysis sequence, the junior electronics sequence, and senior courses like Communication Systems, as well as general-education courses like SPE 314: Argumentation, HUM 207: Informed Decision Making, and PSY 201/2: Psychology. Likewise, problem-solving is a pervasive aspect of the BSEE from the interdisciplinary course on the introduction to engineering to the often-interdisciplinary senior project.

PEO 2 is aligned with the institution's mission to fulfill the emerging technology needs of Oregon as the BSEE 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.

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. Furthermore, the mission statement's specification that "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

The BSEE student outcomes include ABET's EAC (a)–(k) student outcomes. The program-specific outcomes (l) and (m) are de-emphasized this year by recommendation of ABET evaluators. What this means is that ABET evaluators have recommended that we focus on the outcomes (a)–(k), but because past assessment plans and reports have included certain commitments to assessing student learning in the areas addressed by outcomes (l) and (m), we will phase these outcomes out once we have completed out prior commitments to assessing them (2014–15 being the only remaining planned assessment of these outcomes).

Having said that, the graduates of our Bachelor of Science in Electrical Engineering program must have:

(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 multi-disciplinary 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 independent learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

3 Cycle of Assessment for Program Outcomes

3.1 Introduction, Methodology, and the Assessment Cycle

Table 3 shows the *minimum* set of student outcomes assessed during each academic year. Typically, many more are assessed per year than shown, some due to the process of continuous improvement (following up on recommendations by the faculty made at prior years' closing-the-loop meetings), some due to the ISLO (Institutional Student-Learning Outcomes) assessment cycle, and some due to the department's or individual faculty members' further assessment questions.

Assessment of the student outcomes is conducted over a three-year cycle. During the 2010–11 academic year, nine outcomes were assessed to establish a baseline. It was expected that, at this point, the number of students enrolled in the program would be sufficient to gather a substantial amount of data, and that the assessment process would have matured to a stable final version. In prior years, the assessment effort was in its trial-and-error phase as the faculty practiced student-learning assessment and discussed their findings of how to carry out the assessment process. There were slight changes made to the original assessment cycle proposed in 2007–08, as the assessment cycle and process were being fine-tuned based on additional experience gathered from previous year's assessment, as well as from ABET visits for other programs in the department. The columns for 2011–12 and on represent the current stable three-year assessment cycle.

Table 3: The Development of the BSEE Outcome-Assessment Cycle

	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15
(a) Fundamentals		•		•	•			•
(b) Experimentation	•		•	•		•		
(c) Design		•			•			•
(d) Teamwork	•	•	•	•		•		
(e) Problem-solving	•			•			•	
(f) Ethics			•	•		•		
(g) Communication	•			•			•	
(h) Impact			•			•		
(i) Independent learning				•			•	
(j) Contemporary issues			•	•		•		
(k) Engineering tools	•			•			•	

Table 4: Upcoming Three-Year Assessment Cycle, Synchronized with ISLO Assessment

Student Outcome	**Year 1†**	**Year 2**	**Year 3**
(a) Fundamentals	•		
(b) Experimentation		•	
(c) Design	•		
(d) Teamwork	•		
(e) Problem-solving			•
(f) Ethics		•	
(g) Communication			•
(h) Impact		•	
(i) Independent learning			•
(j) Contemporary issues	•		
(k) Engineering tools			•

†: Year 1 corresponds to the assessment period from Spring 2014 to Winter 2015.

3.2 Summary of Assessment Activities & Evidence of Student Learning

3.2.1 Introduction

The BSEE faculty have conducted formal assessment since the 2007–08 academic year using direct measures such as exams, lab projects, presentations, and research papers. Additionally, the student outcomes are assessed using indirect measures, namely results from student evaluations based on methodology developed by the IDEA Center[1], and data from exit surveys of seniors.

3.2.2 Methodology for Assessment of Student Outcomes

The BSEE conducts direct and indirect assessments. The direct assessment process using assignments specifically designed to measure ABET-style outcomes as well as regularly occurring student work (such as exams and homework). As these assessments become regular parts of the courses in which they are used, they become *embedded assessment*.

The indirect assessment process derives assessment data from course evaluations and student surveys.

Direct Measure: ABET Assignments

This direct assessment process links specific tasks within engineering course assignments to EE program outcomes and then to PEOs in a systematic way based on rubrics for the EE student outcomes and a mapping of program-level student outcomes to the PEOs. The program outcomes are evaluated as part of the course curriculum primarily by means of comprehensive assignments. Some of these are standard assignments (embedded assessment for both program-level and course-level outcomes) while others are specifically designed to measure program-level outcomes. These assignments typically involve a project or lab experiment requiring the student to apply principles of mathematics, science, and engineering, as learned in the course (or throughout their student career), to solve a particular problem requiring the use of modern CAE tools and engineering equipment, working in teams, and writing a project report or giving an oral presentation.

Evaluations of these outcomes are then gathered in outcome-specific tables, analyzed and then summarized. Summaries for all student outcomes are then compiled into a comprehensive summary. This summary is evaluated for relevance with respect to the PEOs, and included in documentation for ABET.

The mapping process aims to systemize the assessment of engineering student outcomes, and to provide a mechanism that facilitates the design of engineering assignments that meet the ABET-general outcomes, (a)–(k), particularly focusing on those that are atypical for traditional engineering coursework. Rather than considering how the outcomes match the assignment, the assignment is designed to map to the student outcomes.

[1] www.theideacenter.org

Indirect Measure: KSU IDEA Evaluations

At OIT, course evaluations are conducted using the course evaluation form developed by the IDEA Center[2], an organization originating from Kansas State University. From collected student evaluation forms, an IDEA Center diagnostic report is generated and returned to the instructor.

Methodology for this indirect assessment was detailed under Criterion 3 of the 2011–12 BSEE ABET Self-Study.

Indirect Measure: Senior Exit Survey

This measure was developed and deployed during the spring term of 2012. Sample questions and an analysis of the first set of results are given in the appendices at the end of this document.

3.2.3 2013–14 Targeted Assessment Activities

The sections below describe the 2013–14 targeted assessment activities, and give a summary of student performance for each of the assessed outcomes. Unless otherwise noted, the tables report the percentage of students performing at developing, accomplished, and exemplary levels[3] for each performance criterion, as well as the percentage of students performing at an accomplished level or above.

The minimum acceptable performance level for any outcome is to have 80% or more of the students (taking part in that assessment activity) performing at the accomplished or exemplary level for *all* performance criteria (for that assessment activity)[4].

The following is a set of tables for the outcomes assessed during the 2013–14 academic year. The outcomes are (e), (g), (i), and (k).

Each table is a summary of the various course assignments used to assess the outcomes with the rubric for that outcome. For each rubric, the targeted outcome and the performance criteria are fixed, but faculty have academic freedom to make adjustments to the descriptors of levels of achievement, which they are required to share with their assessment coordinator.

[2] www.theideacenter.org

[3] Performance below the developing level is possible, although rare, and would correspond to little or no sign in the work sample for demonstrating understanding or accomplishment in that criterion.

[4] As of the end of the 2011–12 faculty reviews of assessment results at the closing-the-loop meetings, faculty have the option of setting the minimum percentage of students at a value other than 80, either for the entire rubric–assignment pair for an outcome, or for a specific performance criterion within the rubric. It is, however, paramount that any such change in the targeted level be made prior to the execution of the corresponding assessment activity.

3.2.4 Targeted Assessment of Outcome (e)

An ability to identify, formulate, and solve engineering problems

Assessment (e) 1: EE 323, Winter 2014, Klamath Falls Campus

This outcome was assessed via a lab assignment. The class was given a basic 2-stage CS NMOS–CMOS amplifier circuit with a series-shunt feedback. No values of resistors, biasing voltages or feedback details were given. The exercise was to design the system to achieve specific closed-loop gain, input and output impedances, as well as feedback gain. Two 3-hour lab periods were allotted for the project, the first to simulate the designs with LT SPICE, and the second to implement on a breadboard using a CA4007 CMOS-array IC chip. No help was given by the instructor, as students were expected to figure out all parameters amongst themselves. This same exercise was utilized two years before towards criterion (a).

The exercise had reasonable success in that the students really reviewed the various circuit criteria in order to figure out what was needed (this showed up in good results on the next exam).

12 students were assessed in the winter term of 2014 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for one of the performance criteria for this program outcome. Strengths are that cooperation and reviewing the parameters via discussion were established. Weaknesses are that the students did not have any awareness of the constraints that the chip itself would impose on the problem.

Table 5: Targeted Assessment for Outcome (e)

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
B: An ability to design and conduct experiments as well as analyze and interpret data				
E1: Identify & define an engineering problem	8%	75%	17%	92%
E2: Articulate the problem in engineering terms	25%	58%	17%	75%
E3: Develop solutions appropriate for the problem	75%	8%	17%	25%

Recommendations based on the End-of-Year Faculty Review of Outcome (e)

We recommend that next time this outcome is assessed the students are given extensive procedural guidance (as to what the constraints of the components are).

3.2.5 Targeted Assessment of Outcome (g)

An ability to communicate effectively

Assessment (g) 1: EE 401, Spring 2013, Klamath Falls Campus

This outcome was assessed via in-class presentations of topics central to the course. A separate topic, approved by the instructor, was chosen by each student.

Nine students were assessed in the spring term of 2013 using the performance criteria listed below. The minimum acceptable performance level was customized to 75% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 75 % was met on three out of five assessed criteria, and not met on two criteria. Strengths are in content, organization, and communication style, with content being the strongest point (100% proficiency). Weaknesses were only in delivery and visuals, with delivery being the weakest point for about a third of the class.

Table 6: Targeted Assessment for Outcome (g)

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% students at level 2 or 3
Oral communication: Content	0	7	2	100 %
Oral communication: Organization	2	3	4	77 %
Oral communication: Style	1	7	1	89 %
Oral communication: Delivery	5	3	1	44 %
Oral communication: Visuals	6	3	0	33 %
Acquiring information from various sources	NA	NA	NA	NA
Written communication	NA	NA	NA	NA

<u>Assessment (g) 2: ENGR 465, Winter 2014, Klamath Falls Campus</u>

This outcome was assessed via group presentations. Individual students were assessed to the extent possible.

Using the performance criteria listed below, ten students were assessed Fall 2013 (five individually, three in a group, and the remaining two in a group). The minimum acceptable performance level was the usual 80 % of the students performing at the accomplished or exemplary level in each of the performance criteria for this assessment run.

The table below summarizes the results of this targeted assessment. The target performance level was met (and exceeded) in two of the three criteria: 'orally communicating information' and 'acquiring information from many sources'. Performance was below 80% in written communication. The graphical aspect of the students' presentations were mostly excellent, 8 out of 10 students performed at the exemplary level in the graphical aspect.

Table 7: Targeted Assessment for Outcome (g)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% students at level 2 or 3
Orally communicating information	1	3	6	90%
Acquiring information from various sources	1	0	9	90%
Written communication	6	0	4	40%

<u>Recommendations based on the End-of-Year Faculty Review of Outcome (g)</u>

Substantial improvement was observed in the area of oral communication. However, written communication scores still below the threshold of attainment.

In order to improve written communication skills, especially in terms of organization and presentation, it was recommended that students be required to use the IEEE style guide. This was implemented in other EERE programs with positive results in the quality of the written reports. Reassess following standard cycle

3.2.6 Targeted Assessment of Outcome (i)

A recognition of the need for, and an ability to engage in independent learning

Assessment (i)1: EE 419, Fall 2013, Klamath Falls Campus

This outcome was assessed during the fall term of 2013 via a research project and the accompanying paper.

Six EE students (in a larger class of EE and REE students) were assessed using the performance criteria listed below. The minimum acceptable performance level was set to have above 80 % of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80 % was met on every criterion.

Table 8: Targeted Assessment for Outcome (i)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% students at level 2 or 3
Demonstrating an awareness that knowledge must be gained	0	0	6	100 %
Identifying, gathering and analyzing information	0	3	3	100 %
Recognizing that the acquisition of knowledge is a continuous process	0	6	3	100 %

<u>Assessment (i)2: EE 355, Winter 2014, Klamath Falls Campus</u>

This outcome was assessed via the responses to a presentation by a prospective employer, PRE-TEC, a custom robotics and controls company (based in Eugene, Oregon) during an available block of time (a portion of a lab session). The class was given a full description of the company, its products, and projects via a website video section showing the actual process of a customized robotics manufacturing solution for a client company. The students were free to ask questions, seek details on specific background needs for employment in the company, and relate the details of the company expectations to the Control Theory class topics covered in EE 355. The exercise had considerable success in that the majority of students recognized the need for an engagement in life-long learning directly from a description of the career path of the presenter, a product-development engineer with a background in Manufacturing Technology (obtained from this institution about 15 years ago). Several students followed up in the next few weeks by making appointments to tour the plant in Eugene, and one received a job offer from PRE-TEC, which he accepted. The students were assessed about a week after the presentation via a verbal discussion of the impact of the presentation to their career expectations as far as a lifetime of always learning new topics, techniques and methodologies in engineering.

13 students were assessed in the winter term of 2014 using the performance criteria listed below. Criterion 2, *identifying, gathering and analyzing information*, was deemed to not be applicable in this assessment. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for both of the performance criteria for this program outcome. Strengths are that the subject of the assessment came from actual examples of topics that were recently covered in class, as well as assurances from the presenter that the learning never stops in an engineering career, which really sparked the students' enthusiasm. Weaknesses are that some of the students, while showing interest in the discussions, chose not to contribute.

Table 9: Targeted Assessment for Outcome (i)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% students at level 2 or 3
Demonstrating an awareness that knowledge must be gained	2	8	3	85 %
Recognizing that the acquisition of knowledge is a continuous process	2	9	2	84 %

Recommendations based on the End-of-Year Faculty Review of Outcome (i)

Outcome met. No further recommendations.

3.2.7 Targeted Assessment of Outcome (k)

An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Assessment (k)1: ENGR 465, Winter 2014, Klamath Falls Campus

This outcome was assessed visual observations of students working in the labs (with hardware, software, and firmware—usually at least two of the three) continually throughout the winter term of their senior projects.

Ten students were assessed using the performance criteria listed below. The minimum acceptable performance level was set to have above 80 % of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80 % was met on criteria 1 and 2. Criterion 3 was addressed to a great extent in the other targeted assessment in ENGR 465 during the same term, and thus was left out of this assessment activity. Our students especially have significant technical strengths in microcontroller programming (firmware) and interfacing, as well as mechanical skills.

Table 10: Targeted Assessment for Outcome (k)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Using techniques, skills, and tools: Proficiency with engineering software	0	3	7	100 %
Using techniques, skills, and tools: Engineering hardware (test equipment and prototyping)	0	0	10	100 %
Using techniques, skills, and tools: Communication tools and skills	NA	NA	NA	NA

Assessment (k)2: EE 431, Fall 2013, Klamath Falls Campus

This outcome was assessed via the final exam during the fall term of 2013.

Nine students were assessed using the performance criteria listed below. The minimum acceptable performance level was set to have above 80 % of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80 % was met on criteria 1 and 2, but not on criterion 3.

Table 11: Targeted Assessment for Outcome (l)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Using techniques, skills, and tools: Proficiency with engineering software	0	2	7	100 %
Using techniques, skills, and tools: Engineering hardware (test equipment and prototyping)	0	2	7	100 %
Using techniques, skills, and tools: Communication tools and skills	2	4	3	77 %

Recommendations based on the End-of-Year Faculty Review of Outcome (k)

Students' performance in engineering skills and tools is adequate. Improvement should be made in communication skills. We recommend, in concert with the communication-outcome recommendations above, that instructors provide clear guidance as to the criteria for good professional communication.

Even though the attainment of the last performance criteria was slightly below the 80% mark on the second assessment, due to the small sample size there is consensus by the faculty that more data should be collected before it is concluded that the outcome is not sufficiently attained.

3.3 Summary of Direct-Measure Assessment for 2013–14

All program faculty participated in direct-assessment activities during this pass through the assessment cycle for BSEE. Please note that it was decided at the institution level to adjust the starting and ending terms of upcoming assessment years, starting with this year. As a result, the spring term of 2014 was not part of this assessment cycle. Hence, this report only concerns the fall term of 2013 and the winter term of 2014.

The findings and recommendations from this year's direct assessment activities are summarized in two categories below.

Recommendations

The recommendations are divided into three groups.

1. In terms of assessment practices, the departmental faculty in charge of assessment, under the leadership of chair Dr. Crespo, has determined that for greater reliability, a given outcome should be consistently assessed in the same course (or set of courses), and that this should be the case for both campuses. The following table maps the BSEE outcomes assessed each year to the corresponding courses where assessment for the specific outcome is performed.

Table 11: Assessment Cycle Starting Fall 2014, with Course Names

Student Outcome	Year 1	Year 2	Year 3
(a) Fundamentals	EE321, EE430		
(b) Experimentation		EE323, EE419	
(c) Design	EE325, ENGR465		
(d) Teamwork	EE321, EE331[K], EE432[W]		
(e) Problem-solving			EE419, ENGR465
(f) Ethics		EE401, EE 355	
(g) Communication			EE355, ENGR465
(h) Impact		EE323[W], EE401[K], EE elective	
(i) Independent learning			EE401[K], EE430[W]
(j) Contemporary issues	EE401[K], EE423		
(k) Engineering tools			ENGR267, EE321

Note: [K] indicates Klamath Falls only assessment; [W] indicates Wilsonville only assessment.

2. In terms of program improvement through curriculum and pedagogy, the EE-program faculty agree that a promising solution to the weaknesses of some of our junior- and senior-level

students in written communication may be in placing consistent program-wide emphasis on careful use of the *IEEE Style Guide* by both faculty and students. It was emphasized that this resource conforms to the highest level of American English editorial standards, as well as presenting all examples in a technical, specifically EE and ECE, context. We recommend that the use of the guide start as early as possible in the program, and we emphasize the need for coordination with other programs and faculty that have classes in common with the BSEE program.

Another recommendation in terms of pedagogy is that while we believe circuit-design aspects should remain open-ended in the addressing of the ABET outcome (e), *an ability to identify, formulate, and solve engineering problems*, the procedures to be followed by students in the process of identifying, formulating, and solving problems requires greater guidance from the instructor. Instructors should challenge the students to understand the original problem, retracing their steps if necessary so as to make sure students are not blindly applying tools or techniques. These are intended as general pedagogical recommendations for the program as a whole, not only for courses in which this assessment is taking place.

The faculty also recommend, by taking a cue from our own recommendations regarding outcome (e), that instructors provide students with clear guidance as to the criteria for good professional communication as well.

Appendix A: Indirect Assessment: Results of the Senior Exit Survey

Thirteen BSEE senior-level students took the senior exit survey in 2014. (Twelve graduated.) The results follow.

Figure 1: Graduates' Status After Graduation: Six have employment; two plan to continue their education; five were seeking employment as of the survey. (According to reported employment by the students, this has improved since the survey.)

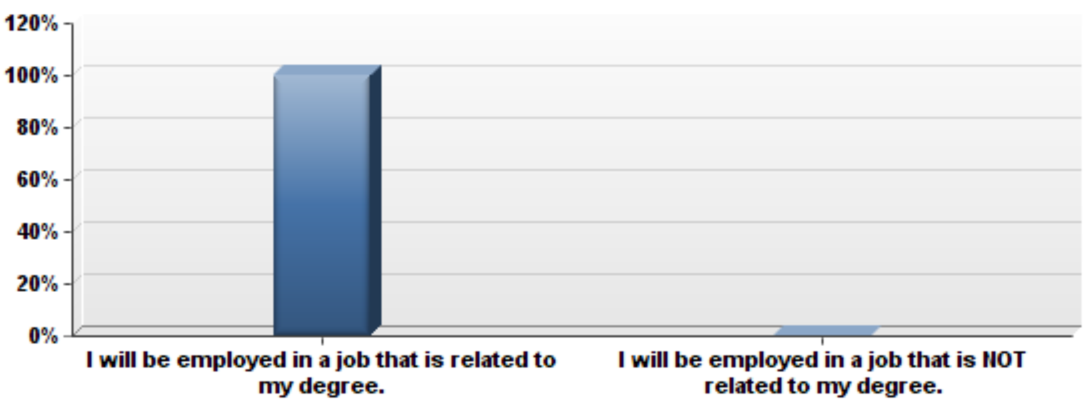

Figure 2: Of the six who have accepted employment, all six are employed in a position related to their degree (although other entries suggest five out of six).

Figure 3: Of those employed already, all six are employed full-time.

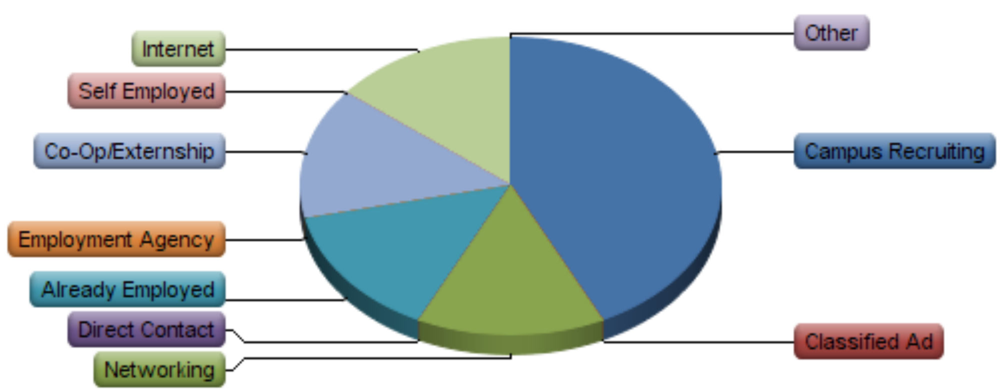

Figure 4: How graduates found their jobs: Three through campus recruiting, one through networking, one through an internship, and one through the Internet. (Another was already employed.)

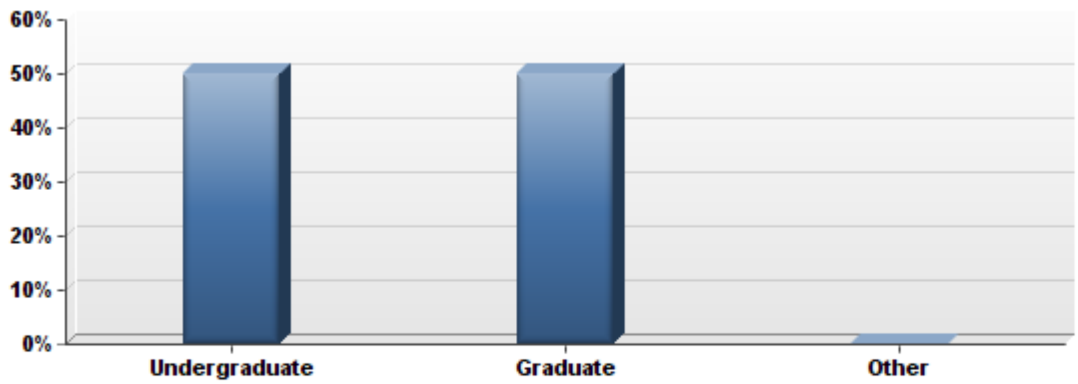

Figure 5: Of those continuing their education, one reported that s/he will be pursuing graduate education, and one reported further undergraduate studies. The intended majors are "Applied Physics – Optics" and "Electrical Engineering" with both students already admitted to their programs. The latter appears to be continuing as a fifth-year senior in BSEE at Oregon Tech.

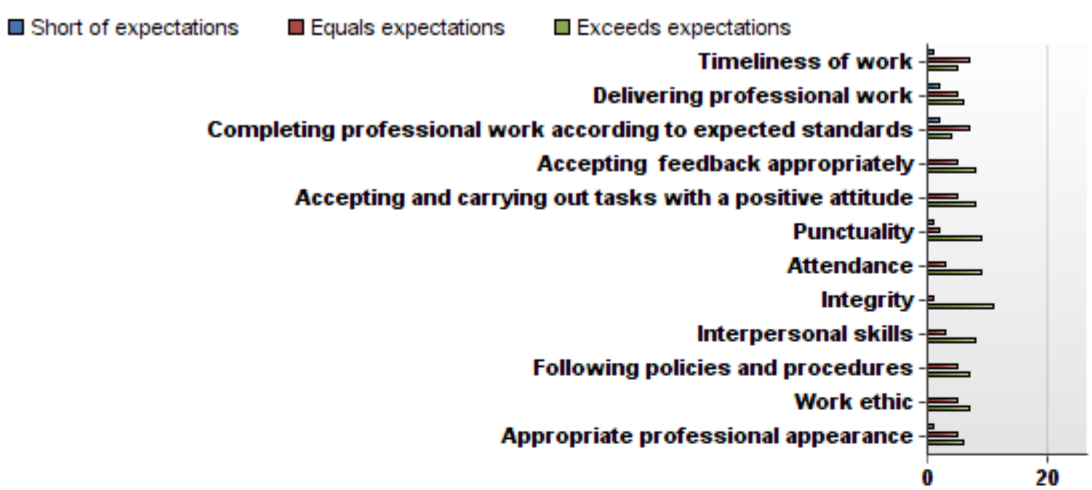

Figure 6: Students rated themselves as mostly meeting or exceeding expectations in terms of their professionalism.

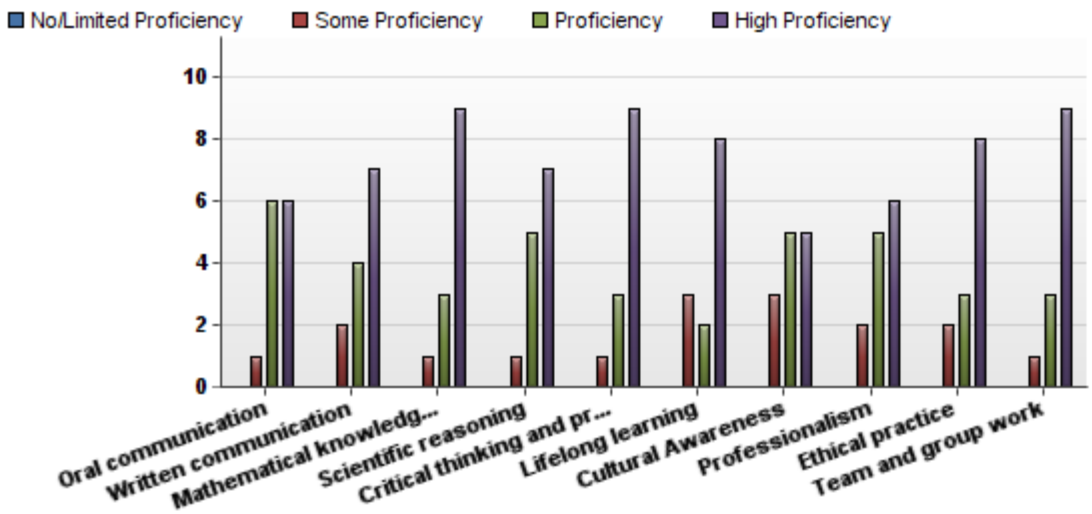

Figure 7: Students' self-reported proficiency in ABET outcomes: Five or more rated themselves at high proficiency in every outcome.

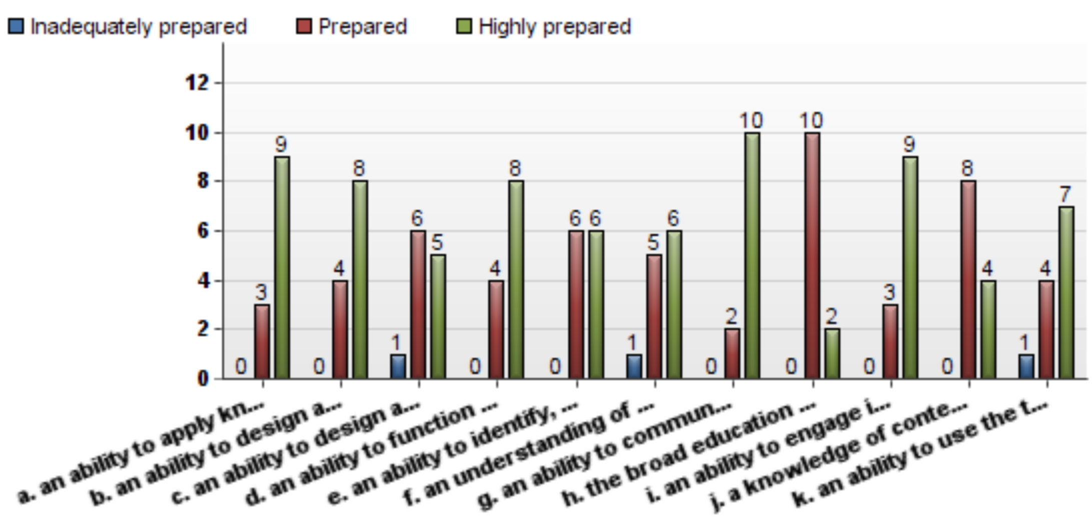

Figure 8: All but one of the students report that the Oregon Tech BSEE Program prepared them for all the ABET outcomes. One student has reported inadequate preparation in three of the areas: constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; ethics; and modern engineering tools. (This student has accepted employment in the Navy.)

Appendix B: Course-to-Outcome Mapping

OUTCOMES COURSES	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
CHE 201: General Chemistry	X	X											
CHE 204: General Chemistry Laboratory	X	X											
ENGR 101: Introduction to Engineering I	X		X	X	X		X	X		X	X		
MATH 251: Differential Calculus	X												
WRI 121: English Composition							X			X			
CHE 202: General Chemistry	X	X											
CHE 205: General Chemistry Lab	X	X											
ENGR 102: Introduction to Engineering II	X	X	X	X	X		X	X		X	X		
MATH 252: Integral Calculus	X												
PHY 221: General Physics with Calculus	X	X					X						
WRI 122: English Composition							X			X			
EE 131: Digital Electronics I	X		X	X	X		X				X		
MATH 254N: Vector Calculus I	X												
PHY 222: General Physics with Calculus	X	X					X						
SPE 111: Fundamentals of Speech							X	X					
EE 133: Digital Electronics II	X		X	X	X		X				X		

EE 221: Circuits I	X	X		X	X		X				X		
[Social-Science Elective]		X						X				X	
CST 116: C++ Programming I	X	X			X						X		
EE 223: Circuits II	X	X		X	X		X				X		
MATH 321: Applied Differential Equations I	X												
MATH 341: Linear Algebra I	X												
EE 225: Circuits III	X	X		X	X		X				X		
MATH 253N: Sequences and Series	X												
WRI 227: Technical Report Writing							X	X		X			
[Humanities Elective]								X					
[Social-Science Elective]		X						X				X	
EE 321: Electronics I	X	X	X	X	X		X		X		X		
EE 331: Digital System Design with HDL	X		X	X	X		X				X		
EE 341: Electricity and Magnetism with Transmission Lines	X				X		X		X		X		
MGT 345: Engineering Economy	X							X					
EE 323: Electronics II	X	X	X	X	X		X		X		X		
EE 333: Microcontroller Engineering	X		X	X	X		X				X		
EE 343: Solid-State Electronic Devices	X				X		X		X			X	
WRI 327: Advanced Technical Writing				X		X	X	X	X	X			
EE 311: Signals and Systems	X		X	X	X		X				X		
EE 325: Electronics III	X	X	X	X	X		X		X		X		
EE 335: Advanced Microcontroller Engineering	X		X	X	X		X				X		

EE 411: Senior Project I	X	X	X	X	X	X	X	X	X	X	X	X	X
EE 431: Digital Signal Processing	X		X	X	X		X				X		
SPE 321: Small Group and Team Communication				X			X	X					
[Social-Science Elective]		X						X				X	
EE 412: Senior Project II	X	X	X	X	X	X	X	X	X	X	X	X	X
EE 423: CMOS Digital Integrated-Circuit Design	X		X		X		X	X			X		X
MATH 465: Mathematical Statistics	X												
[Social-Science Elective]		X						X				X	
EE 401: Communication Systems	X	X		X	X		X				X	X	X
EE 413: Senior Project III	X	X	X	X	X	X	X	X	X	X	X	X	X
[Humanities Elective]								X					
[Social-Science Elective]		X						X				X	

Appendix C: Mapping the IDEA Center Objectives to BSEE Outcomes for Indirect Assessment

At Oregon Tech, course evaluations are conducted using the course evaluation form developed by the IDEA Center[5], an organization originating from Kansas State University in the 1960s. Using the course-evaluation forms, an IDEA Center Diagnostic Report is generated and returned to the instructor. The report provides feedback from the students over a range of topics. Of interest in this indirect assessment is the "Progress on Relevant Objectives" section of the evaluation. These objectives are listed in Table 3-2. Note that IDEA Center uses the adjective "relevant" to indicate that the instructor selects which of the IDEA Center objectives are relevant to the course. Hence, not all the objectives in the list of "Relevant Objectives" are necessarily the relevant objectives for a given course.

The BSEE faculty uses these diagnostic reports as a means for collecting data for indirect assessment of program outcomes. Table 3-2 shows how the IDEA Center objectives map (loosely) to the ABET-based (a)-through-(k) program outcomes. Note this mapping does not allow for assessment of all fourteen ABET outcomes; only outcomes (a), (d), (e), (g), (i) and (k) may be reasonably mapped to the IDEA Center objectives.

The IDEA Center objectives are scored using a Likert scale (one-through-five numbering scheme), with the student asked to rate the amount of progress made on each objective. A score of one indicates no apparent progress, while a five indicates exceptional progress. For each course, the faculty member selects which "Relevant Objectives" are pertinent to the course. Typically, only three or four are indicated as essential. For the purposes of assessing program outcomes, the faculty assumes an average score of 3.5 (between moderate and substantial progress) on these objectives as indicating success in meeting the related program outcomes.

KSU IDEA Center Relevant Objectives	**BSEE Program Outcomes**
Gaining factual knowledge	(i), (j), (l), (m)
Learning fundamental principles, generalizations or theories	(l), (m)
Learning to *apply* course material	(a), (c), (e), (k)
Developing specific skills, competencies and points of view needed by professionals	(b), (c), (e), (k)
Acquiring skills in working with others as a team	(d)
Developing creative capacities (writing, etc.)	(g)
Gaining a broader understanding and appreciation of intellectual / cultural activity	(h), (j)
Developing skills in expressing oneself orally or in writing	(g)
Learning how to find and use resources for answering questions or solving problems	(e), (i)
Developing a clearer understanding of, and commitment to, personal values	NA
Learning to *analyze* and *critically evaluate* ideas,	(h)

[5] The IDEA Center, www.theideacenter.org

arguments and points of view	
Acquiring an interest in learning more by asking questions and seeking answer	(i)

Mapping the IDEA Center Relevant Objectives to program outcomes is justified as follows:

Program Outcome (a), *an ability to apply knowledge of mathematics, science, and engineering*, maps to one IDEA Center objective.

- *Learning to apply course material*: Assuming the course material is math-, science- or engineering-based, students who identify with having made progress on learning to apply course material should have the ability to apply that material.

Program Outcome (b), *an ability to design and conduct experiments, as well as to analyze and interpret data*, maps to one IDEA Center objective.

- *Developing specific skills, competencies and points of view needed by professionals*: Analyzing and interpreting data from experiments having to do with engineering design, development, or testing is one of the skills needed in the engineering professions.

Program Outcome (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*, maps to two IDEA Center objectives.

- *Learning to apply course material*: The design of systems, components, or processes to meet certain realistic constraints is an excellent example of the application of course material to engineering practices.
- *Developing specific skills, competencies and points of view needed by professionals*: The design of systems, components, or processes to meet certain realistic constraints is one of the fundamental and critical skills engineers must possess.

Program Outcome (d), *an ability to function on multi-disciplinary teams*, maps to one IDEA Center objective.

- *Acquiring skills in working with others as a team*: Though not specific to *multi-disciplinary* teams, this objective does ask students whether they have made progress in acquiring the skills need to function on teams. Students who report having made progress are developing the ability to function on teams. ABET takes this outcome further by requiring evidence of competence in multidisciplinary teamwork, which is captured in much of the department's assessment of senior-projects.

Program Outcome (e), *an ability to identify, formulate, and solve engineering problems*, maps to two IDEA Center objectives.

- *Learning to apply course material*: The formulation and solution of engineering problems is an application of course material to engineering problems.
- *Developing specific skills, competencies and points of view needed by professionals*: The formulation and solution of engineering problems is another of the fundamental and critical skills engineers must possess.

Program Outcome (g), *an ability to communicate effectively*, maps to two IDEA Center objectives.

- *Developing creative capacities*: Writing is explicitly identified by the IDEA Center as one of the "creative capacities" applicable to this objective. Whether technical writing qualifies as a creative capacity is debatable, so the correlation between this objective and program outcome (g) is weak. Nevertheless, students who identify with having made progress towards developing writing capacities, though not directly stated by the objective, are gaining the ability to communicate effectively.
- *Developing skills in expressing myself orally or in writing*: Students who identify with having made progress towards developing oral-presentation and/or writing skills are gaining the ability to communicate effectively.

Program Outcome (h), *the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*, maps to two IDEA Center objectives.

- *Gaining a broader understanding and application of intellectual / cultural activity*: Engineering is an intellectual activity, and it may also be argued to constitute its own culture. The phrases "broad education necessary to understand the impact…" and "broader understanding" both refer to the need for engineers to be well-rounded in their exposure to and understanding of global, economic, environmental and societal issues.
- *Learning to analyze and critically evaluate ideas, arguments and points of view*: Understanding the impact of engineering solutions in the contexts listed above necessarily requires the ability to analyze and critically evaluate ideas, arguments, and points of view.

Program Outcome (i), *a recognition of the need for, and an ability to engage in independent life-long learning*, maps to three Relevant Objectives.

- *Gaining factual knowledge*: Students who identify with having made progress towards gaining factual knowledge have noted their ability to engage in learning. While this is not necessarily *life-long* learning, the propensity to learn is a prerequisite to continued learning.
- *Learning how to find and use resources for answering questions or solving problems*: Finding resources for answering questions and solving problems is a direct example of *independent* learning, which is an indicator of life-long learning since post-college learning will likely and mostly take place independently.
- *Acquiring an interest in learning more by asking one's own questions and seeking answers*: Acquiring an interest in learning suggests—though does not demonstrate explicitly—that the student has recognized the need for learning. Further, noting that learning is done by "asking questions" and "seeking answers," students are showing that they have made progress on gaining the ability to engage in independent learning.

The potential to employ an indirect assessment of program outcome (i) is notable, since effective assessment of this outcome has shown to be problematic using the ABET-assignment direct-assessment method. Much of this difficulty has to do with assessing a student's understanding of the need to engage in a life-long process of learning by using coursework that spans no more than ten weeks, and a degree program that takes place (typically) during the early years of a student's life and career.

Program Outcome (j), *a knowledge of contemporary issues*, maps to two IDEA Center objectives.

- *Gaining factual knowledge*: In perhaps a trivial way, the gaining of knowledge of what contemporary issues exist (which is prerequisite to gaining knowledge of such contemporary issues overall) is a form of gaining factual knowledge.
- *Gaining a broader understanding and application of intellectual / cultural activity*: As established above, engineering is an intellectual—and possibly also cultural—activity. The knowledge of contemporary issues within and related to engineering is precisely the broadening of one's understanding and application of engineering.

Program Outcome (k), *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice*, maps to two IDEA Center objectives.

- L*earning to apply course materials*: Assuming that the course curriculum covers the techniques, skills and modern engineering tools necessary for engineering practice, students who note they have made progress towards learning to apply course material should have the ability to apply them in practice.
- *Developing specific skills, competencies and points of view needed by professionals*: Students who identify with having made progress towards developing skills and competencies needed by professionals should have the ability to use those skills and competencies (in other words, "techniques" and "modern engineering tools") in professional engineering practice.

Program Outcome (l), *knowledge of differential and integral calculus and advanced mathematics including differential equations, linear algebra, vector calculus, complex variables, sequences and series, Laplace transforms, Fourier transforms, and probability and statistics with appropriate applications*, maps to two IDEA Center objectives.

- *Gaining factual knowledge*: The mathematical specialties listed in outcome (l) are factual knowledge (of the mathematical kind).
- *Learning fundamental principles, generalizations or theories*: Similarly, these are fundamental principles of mathematics, and hence, engineering.

Program Outcome (m), *in addition to mathematics, knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronics devices, software, and systems containing hardware and software components, as appropriate to program objectives*, maps to the same two IDEA Center objectives as outcome (l).

- *Gaining factual knowledge*: The broad scientific background required by outcome (l) constitutes factual knowledge central to engineering.
- *Learning fundamental principles, generalizations or theories*: Similarly, these are fundamental principles of science, computer science, and engineering.

<u>Assignment of Tasks relating to the Assessment of Course Outcomes:</u>
The EERE faculty meet during Fall Convocation (one week before each fall term) to evaluate the previous year's collection and make recommendations for program improvement. During this meeting, the faculty discuss and assign course outcomes for assessment during the upcoming school year. The assignments are based on the program outcomes assigned in the three-year timeline and courses that map to the program outcomes defined in the course-mapping matrix. The course-mapping matrix is reviewed for modification every three years with input from other faculty. There are various factors used to determine the actual mappings, including:

- the need to conduct assessment in various courses, not just one course for all outcomes,
- the need to involve all program faculty in the assessment process, and
- the need to obtain a mixture of student class levels (freshman, sophomore, etc.) for outcome assessment.

Appendix D: Relationship of Outcomes to Program Educational Objectives

The mission and program educational objectives (POEs) describe the capabilities of the graduates after they have entered their chosen career. The program outcomes are, then, used to develop the necessary foundation of knowledge and skills that a graduate will need to accomplish these objectives as they mature in their disciplines. The outcomes are mapped to the educational objectives. It is the student-learning outcomes that allow graduates to excel at the educational objectives.

The program outcomes provide the basis for the educational objectives and map to the objectives as shown in Table E-1:

Table D Mapping between Program Outcomes (a)–(m) and Program Educational Objectives (PEO1, PEO2, PEO3, PEO4)

	PEO1	PEO2	PEO3	PEO4
(a)	X	X		
(b)	X	X		
(c)	X	X		
(d)		X		X
(e)	X	X		X
(f)			X	
(g)		X		X
(h)	X		X	X
(i)		X	X	X
(j)		X	X	
(k)	X	X		
(l)	X	X		
(m)	X	X		

Appendix E: Relationship of Courses in the Curriculum to the Program Outcomes

The course listing and program outcome mapping is shown in Table F-1. This table shows when and where the outcomes are assessed. The outcomes are assessed on a three year cycle and in specific courses as determined by the department. All of the required courses are mapped to at least one assessable outcome, and most map to more than one.

Table E Mapping between BSEE engineering courses and the PEOs. X marks indicate that the faculty has identified the outcome as assessable in a particular class.

	PEO1	PEO2	PEO3	PEO4
CHE 201: General Chemistry	X			
CHE 204: General Chemistry Laboratory	X			
ENGR 101: Introduction to Engineering I	X	X		
MATH 251: Differential Calculus	X			
WRI 121: English Composition				X
CHE 202: General Chemistry	X			
CHE 205: General Chemistry Lab	X			
ENGR 102: Introduction to Engineering II	X	X		
MATH 252: Integral Calculus	X			
PHY 221: General Physics with Calculus	X			
WRI 122: English Composition				X
EE 131: Digital Electronics I	X	X		
MATH 254N: Vector Calculus I	X			
PHY 222: General Physics with Calculus	X			
SPE 111: Fundamentals of Speech				X
EE 133: Digital Electronics II	X	X		
EE 221: Circuits I	X	X		
PHY 223: General Physics with Calculus	X			
[Social-Science Elective]	X			
CST 116: C++ Programming I	X	X		
EE 223: Circuits II	X	X		
MATH 321: Applied Differential Equations I	X			
MATH 341: Linear Algebra I	X			
EE 225: Circuits III	X	X		

MATH 253N: Sequences and Series	X			
WRI 227: Technical Report Writing		X		X
[Humanities Elective]	X			
[Social-Science Elective]	X			
EE 321: Electronics I	X	X		
EE 331: Digital System Design with HDL	X	X		
EE 341: Electricity and Magnetism with Transmission Lines	X	X		
MGT 345: Engineering Economy	X			X
EE 323: Electronics II	X	X		
EE 333: Microcontroller Engineering	X	X		
EE 343: Solid-State Electronic Devices	X	X		
WRI 327: Advanced Technical Writing				X
EE 311: Signals and Systems	X	X		
EE 325: Electronics III	X	X		
EE 335: Advanced Microcontroller Engineering	X	X		
[Engineering Elective]	X	X		
EE 411: Senior Project I	X	X		X
EE 431: Digital Signal Processing	X	X		
SPE 321: Small Group and Team Communication				X
[Engineering Elective]	X	X		
[Social-Science Elective]	X			
EE 412: Senior Project II	X	X		X
EE 423: CMOS Digital Integrated-Circuit Design	X	X		
MATH 465: Mathematical Statistics	X			X
[Engineering Elective]	X	X		
[Social-Science Elective]	X			
EE 401: Communication Systems	X	X		
EE 413: Senior Project III	X	X		X
[Humanities Elective]	X			
[Social-Science Elective]	X			