Electrical Engineering
2014–2015 Assessment Report

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Contents

1 Introduction

1.1 Program Goals and Design

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 Wilsonville 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 2014.

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.

Seventy-two students have graduated from the BSEE program since it was first launched in 2007. Nineteen new BSEE students graduated in the Spring term of 2015. Thirteen of those participated in the Spring senior exit survey, with 54% of respondents reporting having found employment in their field, 23% were admitted to graduate school, and 23% are looking for employment after graduation. The reported average annual salary of the first group was $66,273.

1.3 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.

1.4 Program Locations

The BSEE program is located at both Oregon Tech 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 large solar facility, Oregon Renewable Energy Center (OREC), and the affiliated Geo-Heat Center, 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 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.

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, 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 is 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 inquiry 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

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 follow ABET's EAC (a)–(k) student outcomes. The program-specific outcomes (l) and (m) were removed from the list by recommendation of ABET evaluators and subsequent approval by the EERE faculty and the IAB.

The BSEET Student Outcomes are:

(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 lifelong (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

Assessment of the program outcomes is conducted over a three year-cycle. Table 1 shows the minimum outcomes assessed each year. The assessment cycle was changed during the 2014-15 assessment year. This change was implemented at an assessment coordination meeting on February 2, 2014. At this meeting, assessment coordinators representing each program within the Electrical Engineering and Renewable Energy (EERE) Department aligned their assessment cycles so that each program assesses similar outcomes on the same years. The intention for this change is to better organize the assessment process and produce more meaningful data for comparison between different programs in the EERE Department.

Effective the 2014-15 academic year, the assessment cycle begins in the Spring. In previous years, the assessment cycle started in the Fall. This change reflects a shift on an institutional level to begin data collection in the spring term. In 2012-13 the Assessment Commission Executive Committee began recommending that programs begin data collection for the upcoming year during Spring term. This recommendation was based on the fact that many programs found the best courses to embed assessment often fell in Spring term, yet this made it difficult to gather the data, review the results and make recommendations for actions, and generate the assessment report by the end of the academic year.

Table 2: BSEE Outcome Assessment Cycle

Student Outcome	2014-15	2015-16	2016-17
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			●

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

3.2 Summary of Assessment Activities & Evidence of Student Learning

3.2.1 Introduction

The BSEE faculty conducted formal assessment during the 2014-15 academic year using direct measures, such as designated assignments and evaluation of coursework normally assigned. Additionally, the student outcomes were assessed using indirect measures, primarily results from a graduate exit survey.

3.2.2 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 (according to Table 1), 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 quickly 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 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.

If any of the direct assessment methods indicates performance below the established level, that triggers the continuous improvement process, 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, in order 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 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.

3.2.3 2014-15 Targeted Direct Assessment Activities

The sections below describe the 2014-15 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.

3.2.4 Targeted Assessment of Outcome (a): An ability to apply knowledge of mathematics, science, and engineering

This outcome was assessed in EE430 – Linear Systems and Digital Signal Processing, EE321 – Electronics I, and EE341 – Electricity and Magnetism with Transmission Lines.

Assessment (a) 1: Klamath Falls, EE 430, Winter 2015, Prof. Dingman

This outcome was assessed in EE430 – Linear Systems and Digital Signal Processing, in the winter term of 2015 by means of questions on a unit test.

Fifteen students were assessed 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.

Table 3 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. That is, over 80% of students were able to satisfactorily apply knowledge of mathematics, science, and engineering.

Table 3: Targeted Assessment for Outcome (a)

Outcome (a): an ability to apply knowledge of mathematics, science, and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Mathematics	0	8	7	100%
2 - Science	0	10	5	100%
3 - Engineering	0	15	0	100%

Assessment (a) 2: Wilsonville, EE 321, Fall 2014, Dr. Crespo

This outcome was assessed in EE321 - Electronics I in the fall term of 2014 by means of a project. The project consisted of designing, simulating, implementing, and experimentally testing an AC-to-DC power supply and linear regulator with current boosting to provide an adjustable regulated output voltage with short-circuit/overload protection. Students were provided with a series of design specifications and design constraints. Calculation of component values to meet the design specifications, as well as characterization of circuit performance requires the application of mathematical tools. The design, implementation, and integration of the different sub-circuits requires knowledge and application of science and engineering principles. Students were required to write a complete report following the guidelines of the IEEE Transactions Journals (IEEE Transactions Publication-Ready Template and Instructions for Authors).

Twelve students were assessed 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.

Table 4 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome, that is, over 80% of students were able to apply knowledge of mathematics, science, and engineering to the solution of an engineering problem.

Table 4: Targeted Assessment for Outcome (a)

Outcome (a): an ability to apply knowledge of mathematics, science, and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Mathematics	2	5	5	83.3%
2 - Science	2	5	5	83.3%
3 - Engineering	2	5	5	83.3%

<u>Assessment (a) 3: Wilsonville, EE 341, Fall 2014, Dr. Scher</u>

This outcome was assessed in EE 341 - Electromagnetics with Transmission Lines in the fall term of 2014 by means of an in-depth homework assignment on magnetic fields and force. The homework assignment contained nine questions, where students had to select and apply knowledge of mathematics, science, engineering, and technology to applied electromagnetic problems.

A total of seven students were assessed using the performance criteria listed in the Table 5. The minimum acceptable performance level was to have above 80 % percent of the students performing at the accomplished or exemplary level in all performance criteria. The results indicate that the minimum acceptable performance level of 80 % was met on all performance criteria.

Table 5: Targeted Assessment for Outcome (a)

Outcome (a): an ability to apply knowledge of mathematics, science, and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Mathematics	0	3	4	100%
2 - Science	0	2	5	100%
3 - Engineering	0	2	5	100%

3.2.5 Targeted Assessment of 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.

This outcome was assessed in ENGR465 – Capstone Project, EE321 – Electronics I, and EE341 – Electricity and Magnetism with Transmission Lines.

Assessment (c) 1: Klamath Falls, ENGR 465, Spring 2014, Prof. Dignman

This outcome was assessed through the capstone project (senior design). Senior projects involve a variety of typically student-originated projects. The students, with guidance, are responsible for the proposal, budgeting, funding, design, simulation, implementation, test, and characterization of an original product. The assessment of the students' ability to design and implement an electronic system was based on the quality of the overall design, as well as the students' ability to effectively do project definition (establishing needs), design and implementation within realistic constraints, and an evaluation of the performance of their project based on the original specifications. Students were required to present or demo their work to the entire university in an event open to the public.

Nine BSEE students were assessed in the course ENGR 465 — Capstone Project, 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.

Table 6 summarizes the results of this targeted assessment. The results indicate that more than 80% (in fact, 100%) of students were able to perform at the desired level in terms of developing a design strategy. A slightly lower proportion of students were able to successfully demonstrate the recognition of need. Although the number appears to be below 80%, it is within the coarse quantization of percentages for a class of nine: 77.78%. Given the small class size, the faculty agreed that this percentage can be considered sufficiently close to 80%. The third criterion, evaluating the relative value of a feasible solution, displayed insufficient achievement (22.22%, or 2 out of 9 students), and this dominated the closing-the-loop discussion of the program faculty for this outcome

Table 6: Targeted Assessment for Outcome (c)

(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				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Need	2	0	7	77.78%
2 - Design	0	9	0	100%
3 - Evaluation	7	1	1	22.22%

<u>Assessment (c) 2: Wilsonville, EE 325, Spring 2014, Dr. Crespo</u>

This outcome was assessed using a project. The project involved the design, simulation, implementation, and characterization of an electronic circuit. Students were required to select an application of interest, and submit a project proposal. Once the project proposal was approved, the students were to design and simulate their electronic circuit, build it on a PCB layout, and experimentally verify and characterize the functionality of their design. Additionally, the students were required to generate a technical poster presentation, and deliver a 10-minute oral presentation of their design and a working demo to the rest of the class. The assessment of the students' ability to design and implement an electronic system was based on the quality of the overall design, as well as the students' ability to effectively do project definition (establishing needs), design and implementation within realistic constraints, as well as an evaluation of the performance of their project based on the original specifications. Students were required to present/demo their work to the rest of the class.

Seven BSEE students were assessed in the spring term of 2014 in the course EE325: Electronics III 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, except for the one related to evaluation of their project performance, which was slightly below the threshold.

Table 7 summarizes the results of this targeted assessment. The results indicate that more than 80% of students were able to perform recognition of need, and develop an effective design and implementation strategy. A slightly lower proportion of students were able to successfully perform an evaluation of their solution with respect to the original requirements.

Table 7: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Need	1	3	3	85.7%
2 - Design	1	3	3	85.7%
3 - Evaluation	2	2	3	71.4%

Assessment (c) 3: Wilsonville, ENGR 465, Spring 2014, Dr. Scher

This outcome was assessed in the ENGR 465 — Capstone Project, in the spring term of 2014.

Capstone Project is a year-long (three-term) course that students complete in their senior year, and 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 in order 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, deliver an oral presentation, and submit a formal written report. These three deliverables are used to determine the students' ability to design a system, component, or process to meet desired needs within realistic constraints according to the performance criteria listed in the table below.

Two students were assessed using the performance criteria listed in Table 8. The minimum acceptable performance level was to have above 80 % percent of the students performing at the accomplished or exemplary level in all performance criteria. The results indicate that the minimum acceptable performance level of 80 % was met on all performance criteria.

Table 8: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 - Need	0	1	1	100%
2 - Design	0	1	1	100%
3 - Evaluation	0	1	1	100%

3.2.6 Targeted Assessment of Outcome (d): An ability to function on multi-disciplinary teams

This outcome was assessed in EE333 – Advanced Microcontroller Engineering, EE321 – Electronics I, and EE432 – Advanced Digital System Design with HDL.

Assessment (d) 1: Klamath Falls, EE 333, Winter 2015, Prof. Dingman

This outcome was assessed in EE 333 – Engineering Microcontrollers, in the winter term of 2015 by means of a group project. The project consisted of specifying a basic microcontroller for an emerging nation with industrial needs for product development. In the process, students were expected to develop an understanding of the role of microcontrollers in the competitive international market, and an understanding of the most fundamental features of a usable microcontroller. Students were not provided with design specifications because they were expected to determine the specification on their own by researching the competition. Students were required to provide written justifications for the decisions made by their groups regarding the utility of a microcontroller with their unique specifications and the economic benefits of scaling the design appropriately.

Fifteen students in four groups of four or three were assessed 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.

Table 9 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. That is, over 80% of students were able to function satisfactorily in teams. Since the enrolment included EE and dual REE/EE students, we can extend this conclusion to multi-disciplinary teams.

Table 9: Targeted Assessment for Outcome (d)

Outcome (d): an ability to function in multi-disciplinary teams (major project)				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Team participation and communication	0	7	8	100%
2—Developing a group consensus	0	4	11	100%
3—Managing a team effectively	0	15	0	100%

<u>Assessment (d) 2: Wilsonville, EE 321, Fall 2014, Dr. Crespo</u>

This outcome was assessed in EE 321 - Electronics I in the fall term of 2014 by means of five lab assignments. At the beginning of the quarter, student teams were created. Each student team consisted of two or three students. Students were required to work as a team to complete the five lab assignments, covering the design, simulation, and experimental test of various electronic circuits. Teams were required to generate and submit a PPT file with their lab results for each lab. Each team was also assigned to do an oral presentation for one of the labs. The presentations were scheduled on the last lab meeting of the term, and student teams were asked to also evaluate the presentations of other teams. There was a mix of students from different disciplines completing the course (BSEET, BSEE, and BSREE). Student groups were created so that in most groups there would be a mix of students from different disciplines. However, due to the uneven distribution of students across disciplines, not all of the teams were multidisciplinary. Despite this limitation, the results of this assessment are still considered applicable, since they still measure the ability of students to be effective team members regardless of team composition.

Eleven BS EE students were assessed 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.

Table 10 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. In fact, 100% of the students assessed showed the required level of proficiency at being able to function in a multidisciplinary team.

Table 10: Targeted Assessment for Outcome (d)

Outcome (d): An ability to function effectively on multidisciplinary teams				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Team participation and communication	0	3	8	100%
2—Developing a group consensus	0	4	7	100%
3—Managing a team effectively	0	5	6	100%

Assessment (d) 3: Wilsonville, EE 432, Spring 2014, Prof. Almy

This outcome was assessed in EE 432 – Advanced Digital-System Design with HDL, in the spring term of 2014 by means of a group project. The project consisted of designing and implementing a PDP-8 minicomputer in the FPGA, and successfully load (via RS-232) and execute a program that calculates and displays all prime number less than 4096. There were 5-6 students per team. The project was divided into modules, each module assigned to a team member. One student was elected as team leader. The project required students to work as a team to define and complete the individual modules, and finally integrating them into the overall system. There were students in the class form multiple programs (BSEE, BSEET). This assessment summarizes the data obtained for the BSEE students only.

Four BSEE students were assessed 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.

Table 11 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. That is, over 80% of students were able to function satisfactorily in teams. Since the enrolment included EE and dual REE/EE students, we can extend this conclusion to multi-disciplinary teams.

Table 11: Targeted Assessment for Outcome (d)

Outcome (d): an ability to function in multi-disciplinary teams (major project)				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Team participation and communication	0	2	2	100%
2—Developing a group consensus	0	1	3	100%
3—Managing a team effectively	0	3	1	100%

3.2.7 Targeted Assessment of Outcome (j): A knowledge of contemporary issues

This outcome was assessed in EE323 – Electronics II, EE401 – Communication Systems, and EE430 – Linear Systems and DSP.

Assessment (j) 1: Klamath Falls, EE 323, Winter 2015, Dr. Vurkaç

This outcome was assessed in EE323 — Electronics II, by means of a literature-search paper. Students were asked to identify and investigate an issue in connection with analog electronics (preferably) or digital electronics, and the associated technologies. They were presented the rubric for the assignment, showing what aspects of the issue they were to address. These included socio-economic, political, environmental, and temporal aspects of the technology. Students were given feedback on their choice of topics during the latter part of the term.

Seventeen students were assessed 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.

Table 12 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met, although the performance was close to desired in the first criterion.

Table 12: Targeted Assessment for Outcome (j)

Outcome (j): a knowledge of contemporary issues				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Knowledge of contemporary issues	6	4	7	64.7%
2—Recognizing the temporal nature of contemporary issues	7	8	2	58.8%
3— Recognizing the historical context of contemporary issues	8	9	0	52.9%

Assessment (j) 2: Klamath Falls, EE 401, Spring 2014, Dr. Vurkaç

This outcome was assessed in EE 401 – Communication Systems by means of a literature-search paper. Students were asked to write a paper investigating contemporary communications systems. The dimensions to be addressed included socio-economic, political, environmental, and historical aspects of the technology, and the temporal nature of those issues.

Eight students were assessed at the end of the winter term of 2015 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.

Table 13 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on any of the performance criteria for this program outcome, although the performance was close to desired in terms of knowledge of contemporary issues. Students seem to have misunderstood the focus of the assignment, and many turned in technically valuable papers that nonetheless did not address the socio-political, environmental, or historical aspects of the technologies discussed.

Table 13: Targeted Assessment for Outcome (j)

Outcome (j): a knowledge of contemporary issues				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Knowledge of contemporary issues	5	3	0	37.5%
2—Recognizing the temporal nature of contemporary issues	5	3	0	37.5%
3— Recognizing the historical context of contemporary issues	7	1	0	12.5%

Assessment (j) 3: Wilsonville, EE 430, Winter 2015, Dr. Scher

This outcome was assessed in EE 430 – Linear Systems and Digital Signal Processing by means of a written assignment. Students were asked to write a paper investigating the contemporary issue of net neutrality, and to address what net neutrality is, the historical context of net neutrality, the pro- and con- parties in the debate, the social, economic, political, and environmental issues related to net neutrality, the role of the FCC, recent developments, and the student's position.

Eleven students were assessed 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. Table 14 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all of the performance criteria for this program outcome.

Table 14: Targeted Assessment for Outcome (j)

Outcome (j): a knowledge of contemporary issues				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1—Knowledge of contemporary issues	0	2	9	100%
2—Recognizing the temporal nature of contemporary issues	0	3	8	100%
3— Recognizing the historical context of contemporary issues	0	3	8	100%

3.3 Indirect Assessment for 2014–15

In addition to direct assessment measures, the student outcomes (a) through (k) were indirectly assessed through a senior exit survey. Question 16 in the survey asked students "Below are the ABET student outcomes for the BS EE program. Please indicate how well the BS EE program prepared you in each of the following areas". Figures 1 and 2 show the results of the indirect assessment of the BSEE student outcomes for the 2014-2015 graduating class.

Thirteen BSEE graduating seniors (7 from Wilsonville, 6 from Klamath Falls) completed the survey, with 80% or more of the respondents indicating that as a result of completing the BSEE program they feel prepared or highly prepared in each of the student outcomes, except for outcome (j) A knowledge of contemporary issues, where only 77% of the students felt prepared or highly prepared. These results align with the direct assessment results, where outcome (j) had the lowest attainment levels. Potential changes to improve attainment of this outcome were discussed at the Closing-The-Loop meeting, and the results are summarized in the next section.

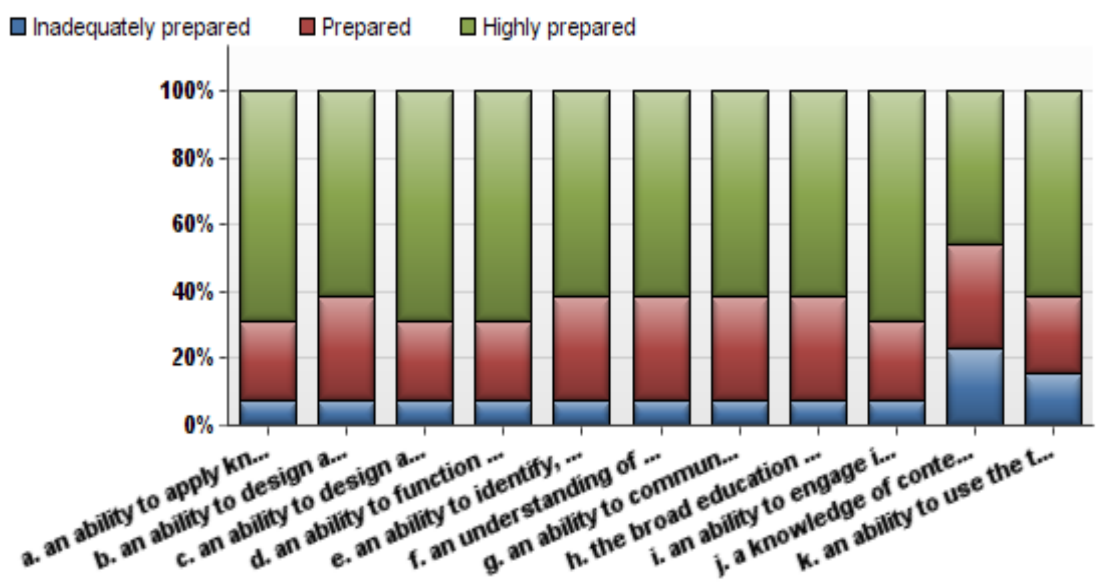

Figure 1 - Graph of results of the indirect assessment for the BSEE Student Outcomes as reported in the Senior Exit Survey (2014-15)

Outcome	Inadequately prepared	Prepared	Highly prepared
a. an ability to apply knowledge of mathematics, science, and engineering	1	3	9
b. an ability to design and conduct experiments, as well as to analyze and interpret data	1	4	8
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	1	3	9
d. an ability to function on multi-disciplinary teams	1	3	9
e. an ability to identify, formulate, and solve engineering problems	1	4	8
f. an understanding of professional and ethical responsibility	1	4	8
g. an ability to communicate effectively	1	4	8
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	1	4	8
i. an ability to engage in independent learning and recognize the need for continual professional development	1	3	9
j. a knowledge of contemporary issues	3	4	6
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	2	3	8

Figure 2 - Results of the indirect assessment for the BSEE Student Outcomes as reported in the Senior Exit Survey (2014-15)

4 Changes Resulting from Assessment

This section describes the changes resulting from the assessment activities carried out during the year 2014-15. It includes any changes that have been implemented based on assessment in previous assessment cycles, from this or last year, as well as considerations for the next assessment cycle.

The BSEE faculty met on June 10, 2015 to review the assessment results and determine whether any changes are needed to the BSEE curriculum or assessment methodology based on the results presented in this document. 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. Table 15 provides a summary of the 2014-15 assessment results for the outcomes which were directly assessed.

Table 14: Summary of BSEE direct assessment for 2014-15

	Total Students	Students >= 2	% Students >=2
(a) Fundamentals (Klamath Falls, EE 430, Winter 2015, Prof. Dingman)			
1- Mathematics	15	15	100%
2- Science	15	15	100%
3- Engineering	15	15	100%
(a) Fundamentals (Wilsonville, EE 321, Fall 2014, Dr. Crespo)			
1- Mathematics	12	10	83.3%
2- Science	12	10	83.3%
3- Engineering	12	10	83.3%
(a) Fundamentals (Wilsonville, EE 341, Fall 2014, Dr. Scher)			
1- Mathematics	7	7	100%
2- Science	7	7	100%
3- Engineering	7	7	100%
(c) Design (Klamath Falls, ENGR465, Spring 2014, Prof. Dingman)			
1- Need	9	7	77.8%
2- Design	9	9	100%
3- Evaluation	9	2	22.2%
(c) Design (Wilsonville, EE325, Spring 2014, Dr. Crespo)			
1- Need	7	6	85.7%
2- Design	7	6	85.7%
3- Evaluation	7	5	71.4%
(c) Design (Wilsonville, ENGR465, Spring 2014, Dr. Scher)			
1- Need	2	2	100%
2- Design	2	2	100%
3- Evaluation	2	2	100%
(d) Teamwork (Klamath Falls, EE333, Winter 2015, Prof. Dingman)			
1- Participation	15	15	100%
2- Decision Making	15	15	100%
3- Team Management	15	15	100%
(d) Teamwork (Wilsonville, EE321, Fall 2014, Dr. Crespo)			
1- Participation	11	11	100%
2- Decision Making	11	11	100%
3- Team Management	11	11	100%

(d) Teamwork (Wilsonville, EE432, Spring 2014, Prof. Almy)			
1- Participation	4	4	100%
2- Decision Making	4	4	100%
3- Team Management	4	4	100%
(j) Contemporary Issues (Klamath Falls, EE323, Winter 2015, Dr. Vurkaç)			
1- Demonstrate Knowledge	17	11	64.7%
2- Recognize Temporal Nature	17	10	58.8%
3- Recognize Historical Context	17	9	52.9%
(j) Contemporary Issues (Klamath Falls, EE401, Spring 2014, Dr. Vurkaç)			
1- Demonstrate Knowledge	8	3	37.5%
2- Recognize Temporal Nature	8	3	37.5%
3- Recognize Historical Context	8	1	12.5%
(j) Contemporary Issues (Wilsonville, EE430, Winter 2015, Dr. Scher)			
1- Demonstrate Knowledge	11	11	100%
2- Recognize Temporal Nature	11	11	100%
3- Recognize Historical Context	11	11	100%

4.1 Changes Resulting from the 2014-15 Assessment

The results of the 2014-15 Assessment indicate that the minimum acceptable performance level of 80% was not met on all performance criteria for all assessed outcomes. Areas of improvement to the curriculum were discussed during the Closing the Loop Meeting in June 2015 with respect to these results. These areas include:

- **Outcome a (Fundamentals):**
  - **Results:** The results show that the threshold of attainment of this outcome was met or exceeded in all performance criteria.
  - **Recommendation:** The faculty identified no problem with this outcome, and therefore recommended no changes at this time.
- **Outcome c (Design):**
  - **Results:** The results show that the threshold of attainment of this outcome was met in the first two performance criteria, and barely missed in the third performance criteria, related to evaluation of the design solution. In the assessment at the Klamath Falls campus, there appears to be a higher proportion of students who missed the last performance criterion.
  - **Recommendation:** Based on the discussion at the Closing-the-Loop meeting, it appears that even though most students are able to evaluate the need for a design solution and implement a design that will meet a required set of specifications, not all students identify the need to evaluate their solution based on other factors such as economic, manufacturability, safety, etc. The discussion emphasized the need to raise the awareness of the students that these factors must be taken into consideration when coming up with a design solution. To this end, the following recommendations were made at the closing-the-loop meeting:

(1) Providing a handout explaining the scope and requirements of the design project, including consideration of a variety of factors (economic, manufacturability, etc.), and explicitly indicating that evaluation of the design solution in light of these factors should be part of the report; and

(2) Including design evaluation as a requirement of junior- and senior-level courses that feature projects, and adding a step where students do self- or peer-evaluation of designs with consideration for these factors.

- **Outcome d (Teamwork):**
  - **Results:** The results show 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 recommended no changes at this time. One suggestion made at the Closing The Loop meeting was to assign areas of responsibility for group projects to different students to be able to better monitor individual ability for team management.

- **Outcome j (Contemporary Issues):**
  - **Results:** The results show that the threshold of attainment of this outcome was not met in all performance criteria. These results are consistent with the indirect assessment results, where this outcome received the lowest score out of all the program outcomes (i.e., only 77% of graduating students felt prepared or highly prepared in this outcome as a result of completing the program). Furthermore, there was a dramatic difference in results across the different campuses. After discussion, the most probable cause for this difference is the phrasing of the assignments, and how clear they make to the students what aspects to cover for proper assessment of the outcome. In the assignments in Klamath Falls, the problem seems to have been more broadly defined, whereas the handout given to the students in Wilsonville included specific questions for students to address. The results show that a large proportion of students in Klamath Falls misunderstood the focus of the assignment.

  - **Recommendation:** based on the results, the following recommendations were made for future improvement on the ability to measure attainment of this outcome:

    (1) Compare assignment descriptions for Klamath Falls and Wilsonville, and try to make the Klamath Falls assignment more specific, so as to provide better guidance to the students as to the objective of the assignment and the expected deliverable.

    (2) Communicate with the committees in charge of the ongoing general-education review to determine what changes are being proposed to the general education requirements, and ensure they are also helping address the coverage of this outcome related to knowledge of contemporary issues.

(3) Ensure the BSEE advisors are familiar with the general education elective courses so that they can make better recommendations to students during the advising process that ensure proper coverage of contemporary issues).