Engineering Science Department

Electrical Engineering Self-Study Report

Executive Summary

The BS Electrical Engineering (EE) program started in Fall 2005 with 14 students at the Engineering Science Department and the first group of students graduated in 2010. The number of students in the EE program has grown throughout the years. Currently, there are 117 students enrolled in the program. The EE program has been taught successfully with three tenured and tenure-track faculty plus half a dozen adjunct professors. Lack of sufficient number of TTF has been a key limiting factor in growth of the program, in spite of its significant potentials. The current faculty includes a full-time associate professor (the ES Department Chair), a tenure-track faculty (recently joined), and eight highly qualified adjunct professors, most of whom have distinguished backgrounds in high-tech industries. Many of the BS EE graduates have been hired in the local high-tech companies. In AY F2015-S2016, the FTES[1], FTEF[2], and the Student-to-Faculty ratio were 65.73, 3,93, 16.71, respectively. Nineteen senior students graduated in Spring 2016.

ES Department conducted an extensive evaluation of the EE program in Fall 2012 to Fall 2014 for the accreditation by ABET (Accreditation Board For Engineering and Technology, an international standard accreditation organization for engineering and technology) and presented a detailed draft of Self-Study Report with extensive **Direct and Indirect quantitative assessment** of the program. The report was submitted for comments to ABET at the end of October 2014. In spite of lack of sufficient resources, the department did so to adopt thorough assessment and evaluation of the program and get accustomed to Continuous Improvement of the EE Program per ABET requirement. We received many constructive comments on our first draft of Self-Study Report. However, due to its insufficient number of FT faculty, the department decided to delay its request for accreditation until sufficient number of TTF are hired. We are happy to report that the department is expected to start the search for two new TT faculty members.

This BS EE program review report is based on the study report we wrote in 2013-14 that addresses the continuous improvement of the courses, the student outcomes, and the program educational objectives. In this extended document we have included additional information, such as the assessment results from the F2015-S2016 course assessment reports, the May 2015 and 2016 Exit Surveys of the graduating students, and the latest SETE results. The course assessments report includes the direct assessments of the assignments, quizzes and exams, projects and reports for the Student Outcomes (SOs), and indirect assessments of the surveys from the employers, alumni, seniors, and juniors, and exit surveys of the graduating students for the Program Educational Objectives and the whole program. The PEOs and Student Outcomes are listed in the report and can be accessed at http://www.sonoma.edu/engineering/bsee/

Some of the important achievements in the past 5 years include:

- *Eight Units of Reduction* - Successful conversion from 128- to a 120-unit cap in the degree requirement as demanded by CSU. Dr. Ravikumar was the champion of this effort.
- *Curriculum improvement* - Improving the content and delivery of courses (e.g., ES 400, ES 345, ES 465) and adding laboratory component to a few courses, including ES 110, ES 112, and ES 330.

[1] FTES = Full-Time Equivalent Students
[2] FTEF = Full-Time Equivalent Faculty

- *ABET Accreditation* – The faculty of EE program spent considerable efforts to introduce and adhere to the ABET Criteria and put together the draft self-study report as a good exercise for continuous improvement of the program. Dr. Kujoory was the champion of such efforts.
- *Industry Advisory Board* – Dr. Rahimi is the champion to establish the IAB. He worked hard to communicate with the local industry leaders and engage industry experts in the engineering program. The department has had two fruitful meetings with IAB and has received many constructive comments from participants.
- *Improvement of the Senior Design Project Course* – Dr. Farahmand has invested a huge amount of time during the past 3-4 years to improve ES492/493 capstone courses by introducing a system for the students to present project proposals that are practical, engaging, community-based or sponsored by the industry. He has introduced several forms and formats for creating the design, component ordering, presentations, special assessment forms, delivery, and advisory/mentoring team from SSU faculty and industry to streamline the two courses.
- *ES Lecture Series* – Dr. Kujoory has been successful in inviting expert speakers from industry and academia to share with the students the trend of technologies in various electrical engineering areas.
  - The ES497/CES597 "ES Colloquium" course is based on the ES lecture series where the students are required to write a technical summary report on each lecture to improve their technical writing communications skill.
  - Per students' feedback, sessions on job-hunting were introduced for the students to improve their resume writing and interview skill building.
  - To improve the technical presentation and communication skills, the students are required to develop a slide set on a technical subject and present to their classmates.
- *Course Improvements* – Over the past few years the department has offered several new EE courses and improved the content of some of the senior-level courses:
  - *ES444,* Introduction to RF Design – new 3-unit EE elective course introduced and taught by Dr. Loren Betts from Keysight (formerly Agilent) Technologies in S2016.
  - *ES485,* Selected Topics in Engineering Science, VLSI – new 3-unit EE elective course introduced and taught by Mr. Ryan Hirth from Broadcom in S2016.
  - *ES442,* Analog and Digital Communications – revised 3-unit EE required course by Dr. Don Estreich and Mr. Derek Derick improved the course and added a lab with several communications experiments in S2016.
  - *ES432,* Physical Electronic – revised 3-unit EE elective course and taught by Dr. Rahimi in F2016.
  - *ES443,* Introduction to optical fiber communications – revised 3-unit elective course and taught by Dr. Hamel-Bissell in F2016.
- *Recruitment* - Over the past several years the department has been systematically establishing connections with different local, national, and international institutions. For example the department has created a new pipeline to facilitate for engineering students transferring from Santa Rosa Junior College (SRJC) to the EE program.
- The Department has also established partnership with the following institutions to strengthen its graduate MSCES program: Ansal University in India, South Ural State University – Technical Faculty, Electro-technical Department South Ural State University, Russia, and Universidade da Beira Interior, Portugal.
- *Engineering Summer Academy* – To encourage hands-on research and team-work experience of the students, we have had two summers in which the faculty mentors worked with 20+ students (from SSU,

UC, SRJC, and local high schools) on various research projects. Summer research events were sponsored by faculty grants, student grants, scholarships and the foundation funds.

- *EE Student Club* – Dr. Haider Khaleel in 2013-15 and Dr. Sara Kassis (2015-16) were advisors of the Engineering Club and helped grow the club membership.
- *Society of Women Engineers* – Hanan Sedaghat-Pisheh, a CES graduate student, established and chaired SWE in AY 2015-16 to bring the female students together and grow the number of female students in engineering. Dr. Kassis advised and helped the SWE group. Cristin Faria is currently the chair of SWE.
- *New Hire* – Dr. Brendan Hamel-Bissell joined the ES Department as a TT Assistant Professor.
- *ES Department Website* – Mr. Shahram Marivani has improved the website significantly for the students and faculty to access various resources and categories of information. http://www.sonoma.edu/engineering/

And, all this has happened because of hardworking and dedicated faculty under the leadership of Dr. Su who was the department chair in 2012-15 and Dr. Farid Farahmand the current ES Department chair.

Strengths of the EE Program:

- The program is based on hands-on projects and lab practices - there are already 10 courses with lab experience in the $4M CERENT Engineering Science Complex; also the capstone senior projects are practical and real.
- There are eight relatively well-equipped labs for the students and faculty to use for teaching and research.
- The students enjoy a relatively low Student-to-Faculty Ratio and the caring faculty can help and advise the students one-to-one when needed.
- The local industry knows the ES department since the start and has been very helpful in providing financial aid, equipment, and internship experience for the student and sometime jobs.

Weaknesses and Short Comings:

- The program does not have a reasonable number of **core full-time faculty** to accomplish the following:
  - Bring in enough funded research projects and offer research assistantship for undergrad and graduate students.
  - Keep continuous improvement and the delivery of the courses. Each faculty needs to teach a course for a few times to have a good handle for improvement in content and delivery.
  - Reach out to high schools in order to establish a greater connection to the community.
  - Allow each student be advised by the same instructor throughout the four years in the program.

With a good core, the adjunct professors can help in the senior projects, the graduate courses, and graduate thesis.

Action Plan Starting Spring 2017 (For details, please see **Section J** at the end of this report).

- Reflect on comments from **External Reviewer** regarding the ways to improve the program.
- Complete the search for two TTF.
- Improve tutoring and advising process: (a) Ensure mandatory advising for all freshman, Senior, and new transfer students. (b) Provide tutoring for students needing extra assistance in Math and Physics.
- Establish more collaboration with the surrounding junior colleges.
- Establish more industry sponsored funded research projects.
- Add two lab-based laboratories: (1) FPGA and (2) DSP.
- Prepare for ABET accreditation.

Engineering Science Department

Self-Study Program Review

for the

BS in Electrical Engineering

at

Sonoma State University

1801 East Cotati Ave, Rohnert Park, CA 94928

Draft date: October 18, 2016

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School of Science and Technology

Table of Contents

APPENDIXES

Appendix 1. BSEE Degree Requirements
Appendix 2. EE Minor Degree Requirements, Electives, and Support Courses
Appendix 3. Course Descriptions and Syllabi of EE Program
- Appendix 3.a. Course Descriptions of the EE Program (ES 4xx)
- Appendix 3.b. EE Course Syllabi
- Appendix 3.c. GE Course Syllabi
- Appendix 3.d. Engineering Science in SSU Catalog

Appendix 4. Faculty Vitae and Industry Advisory Board
- Appendix 4.a. Faculty Vitae
- Appendix 4.b. Industry Advisory Board
- Appendix 4.c. Lists Department and Curriculum Meetings

Appendix 5. Assessment Report of Courses
- Appendix 5.a. Assessment Report of Courses (High Level)
- Appendix 5.b. ES492/493 Assessment forms
- Appendix 5.c. A Course Assessment form

Appendix 6. Samples of the Surveys for:
- Appendix 6.a. Employers
- Appendix 6.b. Alumni
- Appendix 6.c. Senior
- Appendix 6.d. Junior
- Appendix 6.e. Assessment Calculations
  - Appendix 6.e.1. Assessment Calculations for Employers and Alumni
  - Appendix 6.e.2. Assessment Calculations for Senior students
  - Appendix 6.e.3. Assessment Calculations for Junior students
- Appendix 6.f. Exit Survey for Senior Students
  - Appendix 6.f.1. 2015 Exit Survey for Senior Students
  - Appendix 6.f.2. 2016 Exit Survey for Senior Students
- Appendix 6.g. Companies that Have Hired Our Graduated Students

Appendix 7. List of Senior Projects
Appendix 8. List of Labs and Major Equipment
- Appendix 8.a. The Laboratories
- Appendix 8.b. Equipment in Various Labs including RF and Microwave Equipment

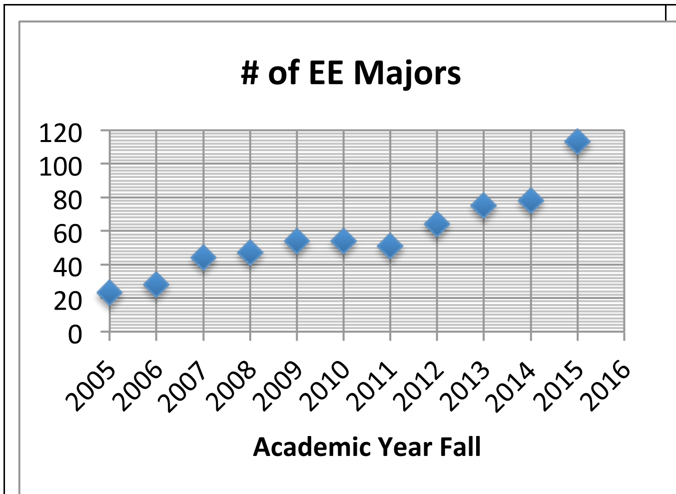
Appendix 9. SSU Library Services
- Appendix 9.a. Library Services in Support of the EE and CES Programs
- Appendix 9.b. Liaison Program
- Appendix 9.c. Instruction
- Appendix 9.d. Research Services
- Appendix 9.e. The Library Acquisitions and Expenditures
- Appendix 9.f. Monographs, Manuals, and Handbooks
- Appendix 9.g. Journals and e-Resources
- Appendix 9.h. Interlibrary Loan Services

A. BACKGROUND AND TERMINOLOGIES

A.1. Program History

The first engineering program at Sonoma State University (SSU) started in the form of a Master's of Science program in Computer and Engineering Science (MS-CES) in 2001. The graduate CES program was initiated with substantial grants and donations from the local high-tech community. Eight well-equipped laboratories, classrooms and offices were constructed to accommodate the program and its high-level instruments with an eye for future expansion of the program. Subsequent to the establishment of the engineering infrastructure, which was heavily focused in the areas of electronics and telecommunications, an undergraduate program in engineering science was proposed and approved by SSU in 2004 and started in the Fall of 2005. The first student graduated with a B.S. degree in May 2010. Since the program curriculum was modeled after electrical engineering program, in 2011, the name of the program was approved and changed to Electrical Engineering with B.S.E.E. degree. The initial proposal and approval process was initiated and led by Dr. Saeid Rahimi who is currently teaching introductory electronics and "electronic and optoelectronic devices" at the department.

There are currently 117 EE students including 6 EE minor students (please see Table B.1) in the department and we project this number to grow to 150 soon. A good majority of the EE graduates are currently either employed in industries (including North Bay) or continuing in graduate studies. Figure A.1 shows the number EE major students and the EE BS degree granted throughout the years.



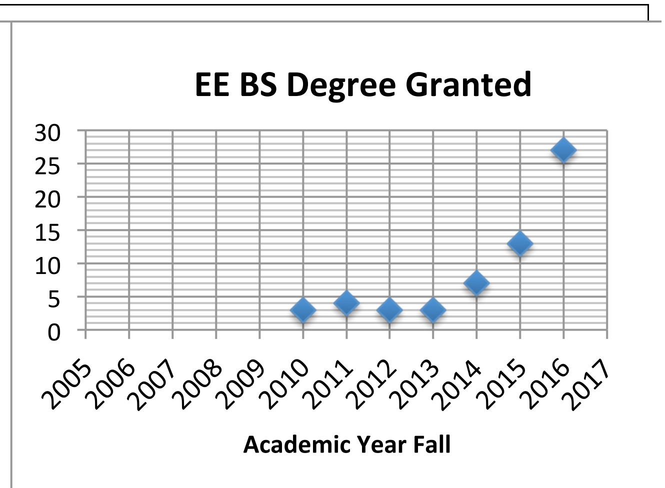


Figure A.1: The number of EE majors and EE BS degrees granted till fall 2016

Regarding the undergraduate electrical engineering (EE) program evaluation, the ES Department did an extensive evaluation in Fall 2013 to Fall 2014 for the accreditation by ABET (Accreditation Board For Engineering and Technology) and drafted a **self-study report** with extensive **quantitative assessment** of the program and sent it for comment to ABET end of October 2014. *ABET has currently accredited 3,569 programs at 714 colleges and universities in 29 countries.* The ABET comments in Dec 2014, were mainly minor. However, the ES Department, decided not to submit the "Readiness for Evaluation" in January 2015 and submit a Self-Study Report to ABET in June 2015. The *ES Department realized that the very low number of TT faculty can be a big shortcoming and the chance of getting final accreditation would be low.* With the approval for two additional TT searches the department feels encouraged to resume the ABET accreditation process soon.

The department wanted to get the ABET accreditation for several reasons including:

- ABET requires solid continuous assessment, evaluation, and improvement of the program, and if the department adopts the process and gets addicted to Continuous Improvement, the program would be more acceptable to the student and the community. As a result of program improvement, the student population could increase.
- The program would be more acceptable for the industry.
- The program would receive the CSU accreditation automatically. It should be noted that CSU accepts the ABET accreditation since ABET assessments are more complete than the CSU accreditation in both quantitative and qualitative measures.

A.2. The Program Educational Objectives (PEO)

The program educational objectives are broad statements that describe what the graduates are expected to attain within a few years of graduation. PEOs are based on the needs of the program's constituencies including the students, faculty, and the Industry Advisory Board (IAB). The ES Department defined the program educational objectives for the EE program in 2005 and revised them since then with the suggestions of the faculty and IAB for better positioning the department's EE graduates for employment in relevant high-tech industries. The EE Program Educational Objectives for the graduating students are: http://www.sonoma.edu/engineering/bsee/

1. Be successful engineers in electrical engineering and related fields, including graduate studies
2. Maintain and enhance their professional skills continuously through life-long learning
3. Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world

A.3. Student Outcomes

Student outcomes describe what the students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. The EE program student outcomes are based on the ones recommended and required by ABET.org as follows: http://www.sonoma.edu/engineering/bsee/

The Students will attain:

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. a 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 life-long learning

j. a knowledge of contemporary issues

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

l. a knowledge of probability and statistics, including applications appropriate to Electrical Engineering program.

m. a knowledge of advanced mathematics through differential and integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics as appropriate to Electrical Engineering program.

n. a knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components as appropriate to Electrical Engineering program.

A.4. Assessment

To continuously improve a program and its components three steps are needed: *Assessment, Evaluation, and Improvement*. These steps need to be performed systematically and periodically.

Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes and the program. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome and the program being measured[3].

A.4.1. Assessment Methods for PEOs and Student Outcomes

There are basically two methods to assess a program and its related parameters such as the program educational objectives, the student outcomes, and the student learning and performance in each course. These are the **direct** and **indirect** methods (or measures) that are in turn based on the direct data and indirect data that are accumulated in time and provide analytical and quantitative assessment results. We use both the direct and indirect methods in the assessment of the program, the PEOs, student outcomes, and the performance of the student. The following tables summarize the definitions, usage, and examples of direct and indirect methods[4, 5, 6].

Definition of **Direct Measure**	Definition of **Indirect Measure**
Direct Measures (data) show sample of the student's actual work and come from the grades of homework assignments, quizzes, exams, and projects in the course (mainly the major courses), contacts and discussions with the students in different levels, esp., junior and senior students, in or outside the classroom.	**Indirect Measures (data)** report the perceived student learning and inform the reviewers their perceptions of their learning experience. Indirect data is obtained primarily from survey questionnaire results from the faculty, alumni, employers, and the IAB, the course performance evaluations and self-assessment data from junior and senior students, the

[3] http://www.abet.org/network-of-experts/for-current-abet-experts/refresher-training/module-4-quality-improvement-of-student-learning/

[4] "Direct vs. indirect assessment measures https://www.ccaurora.edu/getting-started/testing/direct-indirect

[5] "Direct Versus Indirect Assessment of Student Learning" http://resources.depaul.edu/teaching-commons/teaching-guides/feedback-grading/Pages/direct-assessment.aspx

[6] "Direct and Indirect Methods of Assessment" http://www.llcc.edu/wp-content/uploads/2014/10/Direct-and-Indirect-Methods-of-Assessment.pdf

The direct method is mainly used for course performance assessment and student learning and is provided by the instructor/course coordinator of the course periodically and is based upon student performance (i.e., assignments, quizzes/exams and course project).	team self-evaluation in the projects. Indirect method is mainly used in the assessment of the program and is provided by the faculty, the alumni, and employers, and based on the indirect data (i.e., feedback of stakeholders and self-evaluations).

Examples of **Direct Measures**	Examples of **Indirect Measures**
• Assignments • Discussions with the student • Exams (quizzes, midterm and final) • Oral exams • Presentations • Projects and case studies • Reports and term papers • Standardized tests	• Faculty feedbacks (survey) • Current student feedbacks • Exit reviews (graduate feedback and survey) • Alumni feedbacks • Internship feedbacks • Employer feedbacks • Job placement statistics

From the tables below, it can be seen that each method has its advantages, disadvantages, and limitations. The direct and indirect measures complement each other and it is sometimes necessary to combine the two methods from various sources to improve the student learning and the program.

Advantages of **Direct Method**	Advantages of **Indirect Method**
• Instructors can determine how the students are doing in each subject of the course, especially the weak and strong points, and area of improvements for next time. • In the case of the project, the instructor can see whether the student has completed the work and how much learned. • The methods are generally quick and efficient in measuring a single learning outcome. • The grade measure can result in improvements of behavior in the case of unexcused absences or trying to learn more in the case of extra credit for extra work.	• The stakeholders can learn how the program is doing and weakness and strengths of the program, whether the program educational objectives are achieved and how the program should be administered. • In the case of students' opinion how much they have learned, one can identify how satisfied the students are. • In the case of teaching evaluation, the students can indicate how much they have learned. • It can assess certain implicit qualities of student learning, such as values, feelings, perceptions, and attitudes, from a variety of perspectives.

Disadvantages of **Direct Method**	Disadvantages of **Indirect Method**
• It cannot measure implicit qualities such as values, perceptions, feelings, and attitudes.	• It cannot identify specific knowledge and skills deficiencies.

• In certain circumstances the evidence of learning may not be as clear, e.g., the result of multiple choice quizzes.	• It can measure implicit qualities such as values, perceptions, feelings, and attitudes.

A.5. Evaluation

Evaluation is one or more processes for interpreting the data and evidences accumulated through assessment processes. We use both the direct and indirect data to evaluate and determine the extent to which student outcomes are being attained.

A.6. Improvement

Using the evaluation results we can decide what needs to be done and take actions for any course and the program for **improvement**.

We follow the three steps of "**Assessment, Evaluation, and Improvement**" to improve the components of the EE program including the program educational objectives and the student outcomes and the courses consistently and in a cyclical fashion.

B. STUDENT

B.1. Student Admission Requirements

The requirement for admission to the EE program at SSU follows a general guideline for admission into the university. Admission to the program is granted based on the applicants' **Eligibility Index** (EI)[7], which is a combination of students' GPA and their English and Mathematics SAT scores (EI = GPA* 800 + Math SAT + English SAT). The minimum EI for local students is 2,900 and for "out of area" students a minimum of 3,502 is required. In a recent planning retreat, the department Chair and faculty have identified the goal of a significant increase in EI with the goal of admitting more prepared students. This goal can be achieved after the EE program is designated as an impacted program, which would be a direct result of reaching an enrollment cap. The EE enrollment is currently 117 and the department expects to reach its cap of about 150 within a year or two.

B.2. Degree Completion Requirements

http://www.sonoma.edu/engineering/bsee/bsee_requirements.html

EE students are currently required to complete a minimum of 120 units for graduation, which includes:

- 54 units in major courses (including technical electives),
- 29 units in support courses (physics, Computer Science and mathematics)
- 37 units in General Education (GE) courses (excluding units in support courses.)

The 120-unit requirement is a significant reduction from the **former** 128 units and the department spent lots of discussions and efforts to meet this unit reduction challenge without minimal impact on the knowledge and education of electrical engineering students. For more details, please see Curriculum, Section F.

B.3. Options

The Bachelor of Science in Electrical Engineering program at SSU offers no options at the current time. However, the EE students can take a variety of **elective courses** to learn more about various areas of electrical engineering before they graduate. These courses are listed in Curriculum, Section F.

B.4. Career Paths and Opportunities

The BSEE program has been designed to prepare students for an exciting career in industries or pursue graduate degrees. The graduates will find opportunities in the industries in the areas such as: http://www.sonoma.edu/engineering/bsee/

- Designing and manufacturing of electronic systems
- Communications systems
- Networking
- Computer engineering
- Telecommunications

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[7] http://www.sonoma.edu/admissions/ts/eligiblity_index.html

- Optical fiber communications
- Integrated circuits
- Research and development in the above areas, or
- Technical sales, marketing and management in the above areas

Some examples of the corresponding job titles are: *Electronics Engineer, Computer Engineer, Hardware Designer, Systems Engineer, Communications Engineer, Communications Analyst, Telecommunications Engineer, Network Engineer, Network Analyst, Sales Engineer, Applications Engineer, Field Engineer, Test Engineer*.

Graduate degrees could be pursued in any one of the many fields such as electronics, communications, networking, computer engineering and computer science.

B.5. Program Delivery Modes

The Bachelor of Science in Electrical Engineering program at SSU is offered mostly in a traditional lecture and laboratory mode. The EE department strongly emphasizes hands on education through a strong focus on hardware and software laboratories as well as simulation applications. Extensive use of online resources is routine in teaching all EE courses.

B.6. Transfer Students and Transfer Courses

SSU facilitates transfer of students from other universities and junior colleges to the EE program. For example, SSU allows the students from other CSU campuses to transfer to the EE program and additionally provides a 2-year transfer plan for Santa Rosa Junior College (SRJC) students. Transfer students can transfer up to 70 units toward the BSEE degree and must complete at least 30 units at SSU as per residency requirement. For further information refer to http://www.sonoma.edu/engineering/bsee/transfer/

B.7. Diversity

Table B.1 shows the ethnicity in the enrollment for the major and minor students in the EE program from spring 2013 though fall 2016. There are four quadrants in the table:

The **top left quadrant** shows the semesters in the first column followed by the total number of incoming **EE major** students admitted, the freshmen ACT and SAT averages, the number of first time incoming freshmen enrolled, number of first time transfer students enrolled, followed by the total number of male, female, and Hispanics. Column 10, Enrolled/Admitted% shows the percentage of the students who enrolled out of the students who were admitted. Zero% means no one was enrolled (generally the case for spring).

The **bottom left quadrant** shows the number of students graduated each semester followed by the number of male, female, and Hispanics graduated in the EE program. In column 6-10 of this quadrant, the total number of African male, African American female, American Indian, Asian Pacific Islander, and White Non-Hispanic students are shown.

The **top right quadrant** shows the total number of **EE major** students enrolled in the first column followed by the total number of **EE major** male, female, and Hispanics. In column 6-10 of this quadrant, the total number of African male, African American female, American Indian, Asian Pacific Islander, and White Non-Hispanic students are shown.

The **bottom right quadrant** shows similar data for the **minor EE** students.

Table B.1 Ethnicity of Major and Minor EE Students from S2013 through F2016

Semesters	Total Admission	Enrolled incoming freshman AVG ACT	Enrolled incoming freshman AVG	1st Time Freshman	First Time Transfer Enrolled	Total Male	Total Female	Hispanic	Enrolled/Admitted %	Majors Enrolled in EE: Enrolled Major	Total Male	Total Female	Male Hispanic	Female Hispanic	Male African American/Black	Female African American/Black	American Indian	Asian/Pacific Islander	White Non-Hispanic
S_2013	1	N/A	N/A	0	1	1	0	0	50%	36	32	4	9	0	2	1	0	3	17
F_2013	32	20	991	24	10	29	5	14	12%	65	59	6	17	1	3	1	0	5	33
S_2014	1	N/A	N/A	0	1	1	0	0	10%	63	55	8	16	3	4	1	0	4	30
F_2014	30	23	1048	14	15	24	5	10	12%	84	72	12	25	2	4	1	0	5	44
S_2015	0	N/A	N/A	0	0	0	0	0	0%	86	74	12	26	1	4	1	0	7	40
F_2015	33	20	988	23	13	32	4	13	11%	112	97	15	37	3	4	1	0	16	44
S_2016	3	N/A	N/A	0	2	2	0	0	21%	100	83	17	34	4	4	1	0	16	36
F_2016	37	19	966	24	12	35	2	13	13%	111	98	13	38	1	3	1	1	17	42
S_2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Granted Degree	Male	Female	Hispanic	Male African American/Blac	Female African American/Blac	American Indian	Asian/Pacific Islander	White Non-Hispanic	Minors Enrolled in EE: Enrolled Minors	Total Male	Total Female	Male Hispanic	Female Hispanic	Male African American/Blac	Female African American/Blac	American Indian	Asian/Pacific Islander	White Non-Hispanic
S_2013	1	1	0	0	0	0	0	0	1	7	7	0	0	0	1	0	0	1	4
F_2013	0	0	0	0	0	0	0	0	0	10	8	2	0	1	1	0	0	1	5
S_2014	3	3	0	0	0	0	0	1	2	10	8	2	0	1	1	0	0	1	5
F_2014	3	3	0	2	0	0	0	0	1	9	7	2	0	1	1	0	0	1	5
S_2015	5	4	1	1	0	0	0	0	1	10	8	2	0	1	1	0	0	1	5
F_2015	4	3	1	0	0	0	0	0	1	10	7	3	0	2	1	0	0	0	6
S_2016	14	12	2	4	1	0	0	3	5	8	5	3	0	2	1	0	0	0	5
F_2016	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6	3	3	0	2	0	0	0	0	4
S_2017	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

It is observed that although electrical engineering and high technology have been advancing quickly in the past few decades, the female half of the world's population is currently under-represented in this field. The EE program has had a total four female students graduated so far. The ES department would like to have more female student representation in the program and plan to recruit more female students.

In S2015, the department supported the establishment of the Society of Women Engineers (SWE) and was chaired by Miss Hanan Sedaghat-Pisheh, one of the CES graduate students. The SWE Chair is Cristin Fariar since F2016.

B.8. Advising and Career Guidance

SSU has extensive advising services for its students and parents from the first day students are admitted to the university. A campus-wide advising website at http://www.sonoma.edu/aa/us/advising/advising-central.html provides academic advising and support to all new and current SSU students as well as faculty advisors.

Besides academic advising, the career services, in Salazar 1070, is available to assist all students with the transition from academics to career. Career counseling and advising is available for the following topics: career exploration and planning, creating a resume and cover letter, interviewing assistance, graduate school planning and preparation, and job and internship searching. Information about career advising is available at http://www.sonoma.edu/career/.

Freshmen applicants who are accepted for admission to SSU are required to attend a two-day orientation program. More information about the freshmen orientation can be found at http://www.sonoma.edu/aa/us/orientation/freshmen.html.

Each EE student is assigned a Major Advisor for curricular and career advice. Students are advised once a semester. Students are strongly encouraged to meet with his/her major advisor prior to registration. Each student is assigned a **folder** that is kept at the Engineering department. Students are asked to sign up for a one-on-one advising session with his/her advisor. Each student is asked to stop by the department office and pick up the advising folder before the advising session. *The role of the advisor is to help each advisee develop a plan and determine the expected date of graduation.* At the end of advising session, the student returns the folder to the department. Students are asked to report any registration difficulties to their major advisor.

Transfer students are asked to come to the campus before the first day of school to develop a graduation plan with their assigned advisor. Each transfer student is required to attend a mandatory half-day transfer orientation program at Engineering Department, in addition to the transfer student orientation held by the university. Transfer students are given a transfer student orientation package during the department orientation. Each package includes a welcome letter, abbreviated course description, articulation agreement, four-year roadmap, as well as other resources the department has assembled.

B.9. Internship of the EE Program

A good number of our EE students find internship in the local community or in other companies across the country. The 2016 Exit survey shows that 21% of the senior students had EE internship and 15.8% of the internship was through the ES department.

B.10. Job Status of Our EE Graduated and Graduating Students

The students that graduated in our EE program are all employed in technology companies. The 2016 Exit survey shows that 10.5% of the senior students had already job offers from the EE companies. **Appendix 6.g.** lists the companies that have hired our graduated students.

C. PROGRAM EDUCATIONAL OBJECTIVES

C.1. The Mission of SSU

The mission of Sonoma State University is reproduced below http://www.sonoma.edu/about/mission.html:

SSU Mission is to prepare students to be learned men and women who:

- have a foundation for life-long learning,
- have a broad cultural perspective,
- have a keen appreciation of intellectual and aesthetic achievements,
- will be active citizens and leaders in society,
- are capable of pursuing fulfilling careers in a changing world, and
- are concerned with contributing to the health and well-being of the world at large.

To achieve its mission, SSU recognizes that its first obligation is to develop and maintain high quality programs of undergraduate instruction grounded in the liberal arts and sciences. Instructional programs are designed to challenge students not only to acquire knowledge but also to develop the skills of critical analysis, structured reasoning, creativity, and self-expression. Excellence in undergraduate education requires that students participate in a well-designed program providing both a liberal education and opportunities for specific career preparation.

C.2. The Vision and Mission of Engineering Science Department

The Engineering Department has developed its vision and mission with participation from faculty, students, staff, alumni, and industry. The department's vision and mission are published on its website http://www.sonoma.edu/engineering/mission_vision.html as reproduced below:

Engineering Science Department Mission:
The mission of the Engineering Science Department at Sonoma State is to impart high quality education and training to a diverse group of students who will excel in the electrical engineering profession, play leadership roles in advancing the technology, remain engaged in life-long learning and be responsible citizens.

Engineering Science Department Vision:
To achieve international recognition for outstanding and innovative education in the selected electrical engineering areas at the bachelor's level and electrical engineering and computer science areas at the master's level; dynamic as the rapidly changing world today.

C.3. Program Educational Objectives

The current set of EE Program Educational Objectives (PEOs) is posted on the EE Department website at http://www.sonoma.edu/engineering/bsee/ as presented below:

1. Be successful engineers in electrical engineering and related fields, including graduate studies
2. Maintain and enhance their professional skills continuously through life-long learning
3. Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world

C.4. Consistency of the Program Educational Objectives with Institutional Mission

The EE Program Educational Objectives (PEOs) directly provides specific skills-development and knowledge-development components of the university mission. The PEOs 1 and 3 provide our graduates with the knowledge and required skills in their chosen career paths in their service to society. Our PEO 2 enables our graduates to maintain and expand their knowledge as well as to update their professional skills, and PEO 3 encourages our graduates to develop leadership skills for their future roles and to contribute to professionalism while behaving ethically in their community and society in general. The EE PEOs are also directly linked to the mission of the Engineering Department at Sonoma State "*to impart high quality education and training to a diverse group of students who will excel in the electrical engineering profession, play leadership roles in advancing the technology, remain engaged in life-long learning and be responsible citizens.*"

C.5. Program Constituencies

The Program Educational Objectives are generated and evaluated through a consultation and examination process involving four core constituents: *Students, Alumni, Industry, and Faculty*. The determination and evaluation of the PEOs by these constituents will automatically guarantee that the PEOs meet the needs of these constituents. Our alumni and local industry are two important participants in the assessment of our PEOs; but inputs from all **four constituents** are utilized in the analysis and evaluation process.

Students: Student input is obtained through faculty advisors, representatives from student organizations (such as the students of the Engineering Club), student presentations in regular faculty meetings, exit interviews with graduating students, and student evaluations.

Alumni: Alumni input is obtained through discussions with alumni representatives, survey responses from the department alumni list, and survey responses and discussions with student graduates who have completed the BSEE degree from SSU.

Industry: Industry input is obtained through surveys with industry participants at the Industrial Advisory Board (IAB) meetings, employer surveys, and discussions with participants in the Departmental IAB Committee. Membership of the Department's Industrial Advisory Board (see **Appendix 4.b.**) including executives and key individuals from major Sonoma County companies such as *Keysight Technologies (formerly Agilent Technologies), National Instruments, Cyan, Micro-Vu, Intelenex, Trivascular, Parker Hannifin Corporation, and LEMO USA, Inc*. These companies represent a critical component of the local economy and are key employers in the local technical workforce. They were selected and invited to serve because they are supporters of the Engineering Department and it educational objectives. They are also the employers of our alumni and representatives of Sonoma County's primary industry groups.

Faculty: Faculty inputs are obtained mainly through retreats/meetings, bi-weekly **Department meetings** led by Dr. Farid Farahmand, and informal meetings that generate new ideas and strategies that are then fully vetted through our regular department meetings. The department also runs the **Curriculum meetings** every other week to review and revise the PEO and monitor and implement curriculum improvement. Proposals are initiated by faculty and presented to other program participants for discussion and feedback.

Please refer to **Appendix 4.c.** that lists Department and Curriculum Meetings. Recommendations from other participants are discussed during **Retreats** and/or faculty meetings and the PEOs are approved by faculty votes. Retreats occur every semester for the faculty to share their experiences throughout the semester and conclude and plan for the following semester. The frequency of involvement of the program constituencies in the department assessment and evaluation processes can be viewed in Figure E.1, "The Overall Assessment, Evaluation, and Enhancement Process" in this self-study report.

C.6. Process for Review of the Program Educational Objectives (PEOs)

EE PEOs reviews are based on the periodic input or feedback from our constituencies that is collected both informally (indirect methods such as survey questionnaires to the alumni and their employers) and formally (direct methods such as exams and assignment results from courses). The data and their sources for reviewing the PEOs are mainly from faculty, including the "Assessment, Evaluation, and Improvement" (AEI) group, and advisors that use the results from the survey questionnaire from alumni and their employers, faculty interviews of the graduate students and faculty advisors that are in touch with their students and their representatives. The faculty also follows the mission statements of the ES Department, the School of Science and Technology, and SSU to be sure our EE PEOs are consistent and support each other. Figure C.1 shows the closed-loop process used for revising the PEOs which consists of assessment, evaluation, and improvement (AEI) phases.

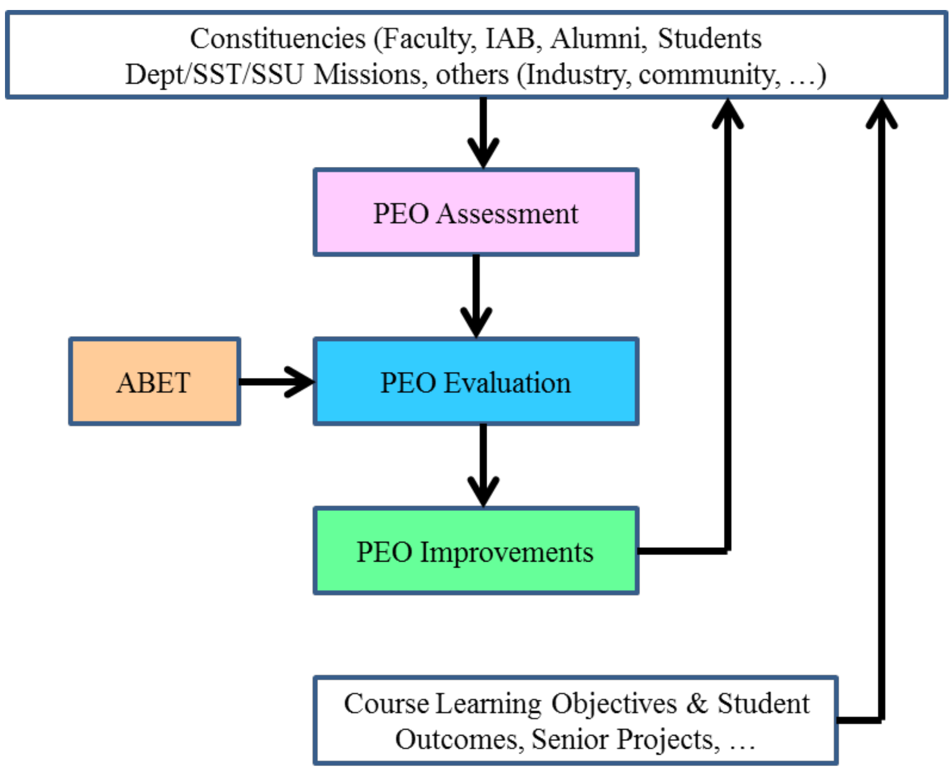

Figure C.1: The PEOs Revising Process

Additional inputs to the PEO Evaluation process are received from ABET (Accreditation Board for Engineering and Technology). We use ABET as a standardized guide for the various criteria, such as student outcomes, for engineering program evaluation and accreditation. As explained before, we put together a self-study program report in fall 2014 and sent it to ABET experts to review. Their comments provided us with constructive inputs for improvement. The process loops shown in Figure C.1 are performed periodically in a cyclical form as indicated in Figure C.2. From this schedule, student outcomes are assessed per 3-year cycles whereas Program Educational Objectives are assessed per 6-year cycles as recommended by ABET. We discuss this schedule again in Section E under Continuous Improvement.

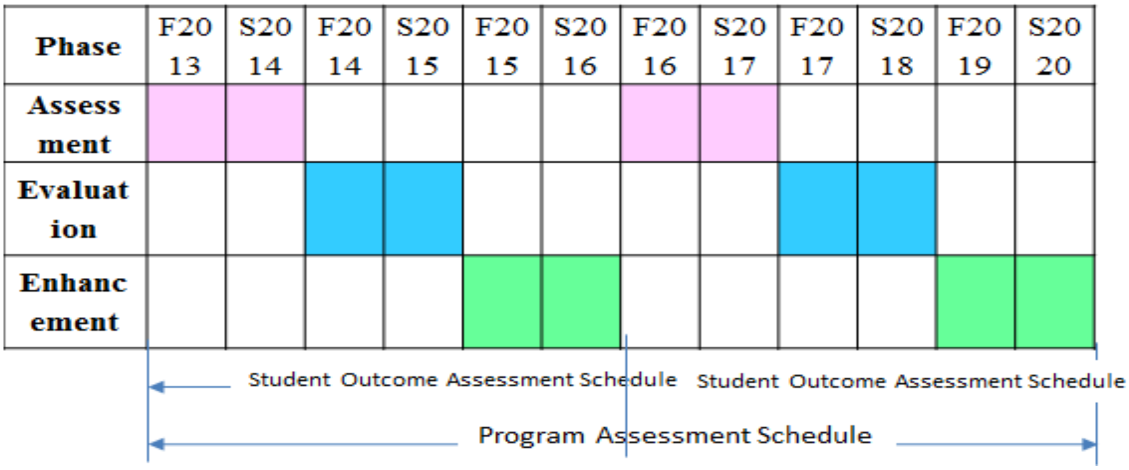

Figure C.2: The Current and Future Program Assessment Schedule

C.7. Assessment and Evaluation of the Existing Program Educational Objectives

The data for the assessment phase comes from several sources including survey questionnaires sent to our constituencies and assessing student outcomes in the courses taught in the semesters as shown. Table C.1 summarizes the methods we have used and continue to use in the assessment phase.

Table C.1: PEO Assessment Methodology and Data

Cycle Length	Indirect Assessment Method	Assessment Results	Evaluation Method	Achievement
6 years	Industry Advisory Board meetings	Meeting minutes	Discussion	Agreement among faculty and IAB
	Employer Surveys	Survey results	Analysis	Levels of support and Ranking
	Alumni Surveys	Survey results	Analysis	Levels of support and Satisfaction

The data in the **indirect method of assessment** is obtained from the assessment data of junior and senior student surveys, alumni and employer surveys, self-evaluation of teamwork in the projects, course performance self-evaluations, and the faculty and IAB meetings. In the evaluation phase, the data is analyzed to generate inputs for PEO improvement.

We find the responses to the survey questionnaires from our alumni and their employers to be the most valuable indirect data. Employers are at the forefront of technology and employ our alumni in actual electrical engineering positions to successfully provide products and services to their customers. The sample survey questionnaire forms (for employers, alumni, and students) and their results are located in **Appendixes 6.a, b, c, and d**. These questions are not directly in the form of the PEO statements, but rather each group of questions addresses the PEO capabilities required in the program.

The questions in the **employer** form consist of four columns: the sequence numbers of the question in Column 1, the question itself in Column 2, how **important** the related objective is in Column 3, and the level of **satisfaction** achieved in Column 4, respectively. The third column addresses how important the educational objective is to the employer. The fourth column addresses how well an employer finds the alumnus offers that capability. In the same way, the survey form for our alumni addresses how important an objective is which is captured in column 3. Also, the satisfaction level in the job of the alumni is captured there.

In the Importance column there are six choices for each question ranging from Very important = 6, Important = 5, Moderately important = 4, Limited important = 3, Very limited important = 2, and Not important = 1. Each employer, or alumnus, chooses a value from this range for each question on the survey.

In the satisfaction column (fourth column) again there are six choices for each question ranging from Very satisfied = 6, Satisfied = 5, Moderately satisfied = 4, Limited satisfied = 3, Very limited satisfied = 2, and Not satisfied = 1. Each employer, or alumnus, chooses a value from this range for each question on the survey.

Since both the **employer** and the **alumni** are dealing with the same product or project, we find the responses in the Importance column to be generally consistent with each other as we would expect. Likewise, we find that the Satisfaction column in both forms is consistent.

Table C.2 shows the PEOs objectives versus the survey question number. PEO 1 captures the practical aspects of electrical engineering in designing successful products. It includes writing and understanding technical requirements, design and developing the prototype, fabrication, testing, working in a team, and so on. The majority of questions (5) focus on PEO 1; two questions address PEO 2 and one question for PEO 3, respectively. There are fewer qualifications related to PEOs 2 and 3, so the number of questions is fewer.

Table C.2: Shows the PEOs versus the survey Questions

PEO	**Program Educational Objectives**	Survey Questions to **Alumni** and **Employers**
1	Be successful engineers in electrical engineering and related fields, including graduate studies	1-5
2	Maintain and enhance their professional skills continuously through life-long learning	7-8
3	Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world	6

We will summarize the results of the responses to these survey questions from the alumni and the employers in Table C.4. However, before we discuss the data and results we first review the process for making the table.

The survey questions described above were sent to our alumni and their immediate employers in early fall 2014 and we collected their responses. *For the Importance column we added the numerical values of the choices for each question, divided the sum by the number of responses to obtain the average value of the choice. Next we divided this average by the maximum value of the choice (=6), and multiplied by 100 to obtain a percentage value. In this case, because questions 1 through 5 were related to PEO 1, we took the average of the percentages for these five questions. Furthermore, questions 7 and 8 were related to PEO 2, so we again calculated the average value for the percentages obtained.*

The goal is to have a high level of %Importance for the PEOs from both employers and our graduates to measure the importance of our PEOs to both groups.

- *Having a high level of %Satisfaction for the PEOs from the employers confirms they are satisfied with our alumni.*
- *Having a high level of %Satisfaction for the PEOs from the alumni confirms that they feel they have achieved the objectives for what they learned in the program.*
- *The Engineering Department considers that the acceptable percentage for both the %Importance and %Satisfaction is **75%** or greater.* This is summarized in Table C.3 showing the expected level of achievement for the objective goals. In this table %Difference = %Importance - % Satisfaction.

Table C.3: Our Desired Goals for Achievements of PEOs

PEO	Employers		Alumni	
	%Importance	%Difference	%Importance	%Difference
1	>75	<25	>75	<25
2	>75	<25	>75	<25
3	>75	<25	>75	<25

The results from the survey responses received from eight graduates and four employers are shown in Table C.4, where Column 1 lists the PEOs 1 through 3. Original data and calculation is given in **Appendix 6.e.1** under the Assessment Calculations.

Table C.4: Results of Employers and Alumni Survey Questions for PEO

PEO	Employers			Alumni		
	%Importance	%Satisfaction	%Difference	%Importance	%Satisfaction	%Difference
1	85%	85%	0%	88%	76%	12%
2	71%	75%	-4%	89%	71%	18%
3	83%	92%	-8%	92%	81%	11%

Column 2 in Table C.4 gives the final average percentages of the % Importance from employers for PEO 1 to PEO 3. The **percentage Importance** value for each PEO is 71% and above. PEO 2 is "Maintain and enhance their professional skills continuously through life-long learning" and that may not be as important for some employers with their focus upon specified projects at the time. However, the result over all indicates that employers believe our PEOs are important for them.

Column 3 in Table C.4 shows the average percentages for employer satisfaction agree well with the performance of our graduates on PEOs 1-3. **For PEOs 1 and 3, the satisfaction levels of employers are 75% or above meaning that our graduates perform satisfactorily by over 75% as their employers expect.**

Another way to evaluate the effectiveness of our program is to compare the level of satisfaction of our graduates versus the importance of each PEO. For that we examine the difference between the average importance and satisfaction values for each PEO. Column 4 in Table C.4 shows the *percentages of the* *differences between the importance and satisfaction* values of employers for each PEO. *Since the percentage difference is less than 25%, we conclude that our graduates have generally met the EE PEOs satisfactorily within the acceptable importance limit (by less than 25%) for these PEOs.*

In the survey responses we received from employers, the **%Difference** for PEO 2 and PEO 3 in Column 4 is **negative**. The reason for this is that two of the employers had marked higher levels for satisfaction than the importance levels. This makes the %Difference negative. It is possible that these employers found alumni employees outperforming the level of importance.

We applied the same process to the alumni data and the results are as shown in columns 5 through 7 under the alumni column in Table C.4. Again, the %Importance for all PEOs being greater than 75% means that the importance levels of our PEOs seem to be on target. In the satisfaction column the attainment of any PEO greater than 71% implies our alumni is generally satisfied with what they learned and their ability to apply it at work.

Evaluation Conclusions for the PEOs:

- *The %Importance for PEOs 1 and 3 being above 75% generally indicates these PEOs are valued by the employers and can stay as they are at this time.*
- *The %Satisfaction for PEO 1 and PEO 3 being 75% or above, indicate that the graduated students learning has satisfied the desired levels for the employer.*
- *This process of assessing the PEOs using the survey results, provide a quick way of evaluating and improving the program. However, much bigger number of responses from employers and alumni would provide more reliable results.*

In the following sections we discuss other inputs that provide additional information toward continuous improvement of our program.

A valuable information source is input received from our Industry Advisory Board (IAB). **Appendix 4.b** lists the members of IAB. The ES Department has gathered knowledgeable members from industrial enterprises in the North Bay spanning a wide range of electrical engineering disciplines. The SSU President has said, *"The main role of the IAB is to build a conduit between the engineering department and the community and local high-tech industry that would provide opportunities for curriculum improvement, student internship and employment, research collaborations and service to the community."* To date the ES department has held two meetings with the IAB largely composed of local industry executives. In the first meeting, the SSU President and the Dean of School of Science emphasized the importance of industry support for the EE program, our graduate programs and department support in training engineers for the local industry. *The majority of the IAB representatives echoed the fact that ABET accreditation will help program in many ways including more student applicants giving the department greater selectivity in recruiting better students.* Mark Pierpoint, Vice President of Keysight Technologies, and one of the active IAB members, distributed a questionnaire among all IAB members present to identify the attributes of successful graduates, how to better prepare our students to be successful, how we can assess and evaluate our graduates, and to get an idea how many engineers they are locally planning to hire in 2017.

We discuss in the next section how student outcomes affect PEO assessment and continuous improvement.

C.8. Revising the Program Educational Objectives

The above described the process of assessment and evaluation of EE PEOs that can result in improvement of the EE PEOs and the program. The employers' feedback prove to be quite valuable. Since only few of the employers initially responded to the survey questionnaire and the number of responses were less than what we expected, *we plan to send out the surveys to employers again and to strongly urge them to respond* *thereby, allowing us to collect a larger set of responses. We will do the same for the alumni survey. With a larger set of responses we believe the results will be more conclusive and we can better ascertain which PEOs need attention.*

We plan to also discuss splitting the PEO 1 questions to improve the depth of the questions to allow the responses to be more explicit. We hope this will sharpen the feedback content from these surveys, thereby strengthening our improvement process.

D. STUDENT OUTCOMES

D.1. Student Outcomes

The student outcomes of the EE program at SSU are based on the ABET Student Outcomes (a) through (k) as stated in the ABET document, “Criteria for Accrediting Engineering Programs – Effective for Reviews During 2016-17 Accreditation Cycle”. These are in fact the **general student outcome criteria** that are required for all engineering fields (*e.g.*, civil engineering, electrical engineering, and mechanical engineering). The Student Outcomes are required to be listed on all course syllabi and are posted on the EE Department website at http://www.sonoma.edu/engineering/bsee/. The student outcomes are as reproduced below:

The students will attain:

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) *a 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 life-long learning*

j) *a knowledge of contemporary issues*

k) *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice*

It is to be noted that each course offers only a limited number of the above student outcomes. However, the totality of the required courses in the EE program covers all the outcomes. *The syllabus of each course includes a table that indicates the specific student outcomes covered by the course learning objectives.*

As stated earlier, the above criteria apply to all the engineering fields. There are three other student outcomes, required by ABET and these are called “Program Specific Criteria”. These are **Specific to the Electrical Engineering Program** and provide both breadth and depth across the range of electrical engineering areas. These are:

The students attain:

l) *a knowledge of probability and statistics, including applications appropriate to EE program*

m) *a knowledge of advanced mathematics through differential and integral calculus, linear algebra,* *complex variables, and discrete mathematics as* appropriate to Electrical Engineering program

n) *a knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components as appropriate to EE program*

The Student Outcomes l) and m) include probability and statistics, mathematics through differential and integral calculus and sciences as necessary to analyze and design complex electrical and electronic devices. The Student Outcome n) includes systems containing hardware and software components and their associated processes as required in electrical engineering.

D.2. Relationship of Student Outcome to Program Educational Objectives

The Assessment, Evaluation, and Improvement (AEI) processes constitute the major mechanism for the improvement of the Student Outcomes and the Program Educational Objectives (PEOs). Student Outcomes are assessed while the student is still in school. These outcomes are intended to prepare the student to become a productive engineer. The end result should be an engineer who is able to work in various fields such as design, research, testing, manufacturing, and to engage in lifelong learning to maintain and enhance his/her professional skills.

To assess the contribution of Student Outcomes to the achievement of the Program Educational Objectives we map one or more Student Outcomes to each PEO together with their levels of support during the assessment and evaluation of the PEOs and the Student Outcomes. For that, the faculty defined the relative importance levels between the three PEOs and the levels of support from several Student Outcomes to a particular PEO.

Table D.1 shows the relationship between the Student Outcomes and the Program Educational Objectives, where Y = "Yes" indicates support of the PEO, but a "blank" means no PEO support.

Table D.1: PEOs versus Student Outcomes

Program Educational Objectives	Student Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
1. Be successful engineers in electrical engineering and related fields, including graduate studies	Y	Y	Y	Y	Y			Y				Y	Y	Y
2. Maintain and enhance their professional skills continuously through life-long learning								Y	Y	Y	Y			
3. Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world				Y		Y	Y							

E. CONTINUOUS IMPROVEMENT

E.1. The Total Program Assessment Process

As described in Section C.6, the Program Educational Objectives (PEOs) are assessed and evaluated every six years (a full Assessment/Evaluation/Improvement cycle) by directly drawing constituency inputs as well as by assessing the student outcomes. Feedback regarding the PEOs is collected from constituencies both indirectly and directly. Input from current students is obtained indirectly through faculty advisors and student representatives based upon advisor and student conversations during their regular activities. The information is shared with the department faculty during the process of reviewing the PEOs.

In this section we discuss how the student outcomes and improvement of the student outcomes affect and provide input to the PEOs and the improvements in combination with other inputs as covered in Section C. Figure E.1 shows the integrated process for the PEO assessment together with the inputs from the student outcomes. Box (1), marked by dashed line and labeled “Course Learning Objectives and Student Outcomes, and Senior Projects” is the expanded version of the box in Figure C.1. This box comprises three boxes numbered (2), (3), and (4). The following explains the function of each box and the relating arrows between them.

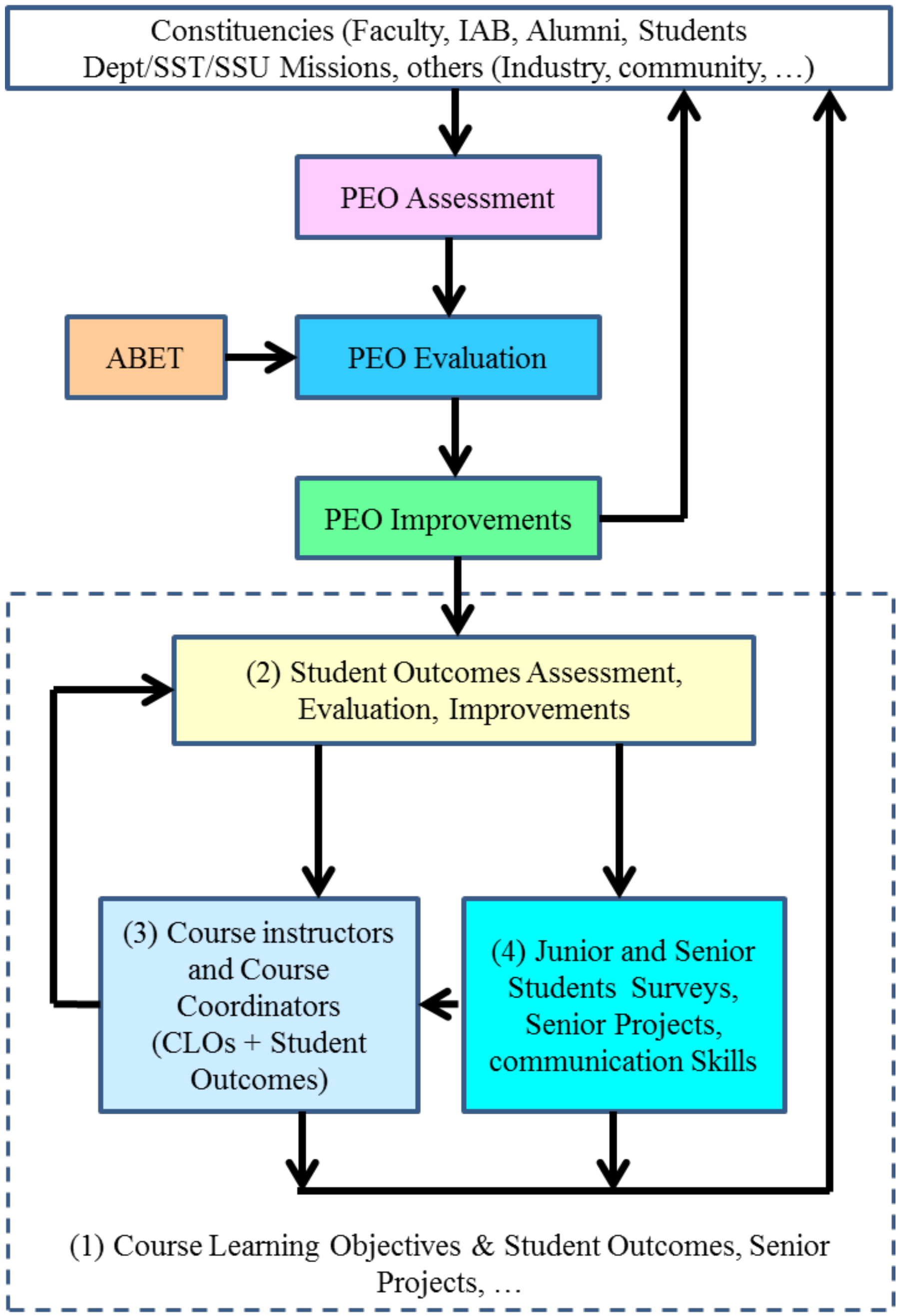

Figure E.1: Overall Process for PEO Assessment together with Student Outcomes

Box (2), labeled "Student Outcomes Assessment, Evaluation, and Improvement (AEI)" operates in a loop and feeds the constituencies. As mentioned in Figure C.2, the student outcome assessment process has its own 3-year cycle comprising of three 1-year periods for each assessment, evaluation, and improvement phase. The student outcomes are used by the components of boxes (3) and (4) through the course learning objectives (CLOs). These are defined and handled by the instructors through courses, homework, exams, the evaluation of the projects, and discussions with the students.

Box (3) addresses the role of the course coordinators and instructors and how they deal with the improvements of the CLOs and courses. Basically, the course coordinators and course instructor assess their courses every semester, evaluate and apply the necessary changes in the following semester. The data are discussed during the evaluation period of the student outcomes. The changes to the courses and their contents are saved for later changes in the program.

Box (4) addresses the role of the students in responding to surveys and the handling of their projects, their presentations and discussions with the instructors. The arrow going from Box (4) to Box (3) represents the inputs/feedbacks from students to the faculty.

Figure E.1 shows the feedback of the course coordinators to Box (2) Student Outcome AEI and the overall loopback from the faculty Box (3) and the students Box (4) to the box of the constituencies at the top of the figure.

E.2. The Student Outcome Assessment Responsibilities

The above process is handled by the "Course Coordinators", the "Student Outcomes Champions", and the "Program Champion". First, the faculty has been assigned the responsibility in coordinating one or more courses to assure that each course covers one or more student outcomes properly. The course coordinators in the EE program are basically the course instructors. Also, each faculty member is assigned the responsibility for championing one or more student outcomes. This assures that the student outcomes are achieved in support of the EE program educational objectives. Table E.1 lists the responsibilities of the faculty members to address "Assessment, Evaluation, and Improvement" for the courses, student outcomes, and the PEOs.

Table E.1: Responsibilities of the Course Coordinators, Student Outcomes Champions, and Program Champion

Course Coordinators (CCs)	Student Outcomes (SOs) Champions	Program Champion (Department Chair)
• Assures course learning objectives (CLO) and student outcomes are explicitly explained in the course website for all sections. • Checks that the course assessment methods are explained and used. • Maps student outcomes against CLOs. • Specifies what portion of the course satisfies each student outcome claimed. • Collects samples of assignments, student exams and solution and documents these in the course binder.	• Examines the SO to assure that it supports and contributes the PEOs claimed. • Works with CCs to assure the CLOs, syllabi and materials of each course support the SOs claimed. • Collects and prepares documents to prove that the SO is achieved. • Provides methods to quantitatively assess the SO to obtain results. • Recommends how to improve program effectiveness to meet the SO. • Recommends program improvements to the faculty.	• Assigns the course coordinators and student outcomes champions. • Applies for ABET evaluation and communicates with ABET organization. • Checks all ABET requirements are met. • Prepares/sends Self-Study Report to ABET. • Communicate with ABET and Review Team for the accreditation activities. • Manages the collection of the course materials and prepares for review team.

Table E.2 lists the current faculty champions of the student outcome in the EE program.

Table E.2: List of the Current Student Outcome Champions

Student Outcome	Champion
a) an ability to apply knowledge of mathematics, science, and engineering.	Kujoory
b) an ability to design and conduct experiments, as well as to analyze and interpret data.	Farahmand
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.	Decker
d) an ability to function on multidisciplinary teams.	Kujoory
e) an ability to identify, formulate, and solve engineering problems.	Kujoory
f) an understanding of professional and ethical responsibility.	Estreich
g) an ability to communicate effectively.	Rahimi
h) a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Farahmand
i) a recognition of the need for, and an ability to engage in life-long learning.	Kujoory
j) a knowledge of contemporary issues.	Kujoory
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Hamel-Bissell
EE Program Specific Student Outcomes (Criteria)	**Champion**
l) a knowledge of probability and statistics, including applications appropriate to Electrical Engineering program appropriate.	Kassis
m) a knowledge of advanced mathematics through differential and integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics as appropriate to Electrical Engineering program.	Kujoory
n) a knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components as appropriate to Electrical Engineering program.	Farahmand

The description and syllabus for each course (See **Appendix 3**) describes the Course learning Objectives (CLOs) and a table that shows how each CLO supports the student outcomes. This table shows the relationship between the course learning objectives (CLO) and the student outcomes. Table E.3.a is a sample selected from the ES497 course that lists the CLOs and Table E.3.b shows how the CLOs may support each student outcome. This table also indicates the level of CLO support for the student outcome with a scale ranging from 0 to 5, where 5 = Highest, 1 = Lowest Support, and 0 = Not Applicable.

Table E.3.a: List of the Course learning Objectives of ES497 (a Sample)

Course Learning Objectives (ES497, Intro. to Engineering and Lab Experience):
A. Expand the scope of student in various trends of science and technology and the impact of engineering on nature and human life. B. Improve student communication skills in effective technical writing and presentation. C. Recognize the need for life-long learning.

Table E.3.b: Course learning Objectives Support of Student Outcomes in ES497 (a Sample)

Course Learning Objectives (CLOs) Support of Student Outcomes Support Level 0-5: 5=Highest Support), 1= Least Support, 0=Not Applicable		
ABET Student Outcomes	**CLOs**	**Support Level**
(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		
(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	B	4
(h) a broad education necessary to understand the impact of engineering solutions in a global and societal context	A	4
(i) a recognition of the need for, and an ability to engage in life-long learning	C	3
(j) a knowledge of contemporary issues	A	3
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice		

Table E.4 lists all courses in the EE program and their level of support for each student outcome. For the assessment of the student outcomes we use only the technical courses that are required (i.e., mandatory). Since the General Education courses are not taught by the EE faculty, we have used a "Y" for the student outcomes that we believed each GE may support each student outcome according to the course description.

Table E.4: EE Program Courses with their Level of Support of the Student Outcomes
(Support Level 0-5: 5 = Highest Support), 1 = Least Support, 0 = Not Applicable, Spec. Cri. = EE Specific Criteria) https://www.sonoma.edu/engineering/internal/

Courses	Student Outcomes General Criteria											Spec. Cri.		
	a	b	c	d	e	f	g	h	i	J	k	l	m	n
GE Area A: Communication & Critical Thinking				Y		Y	Y							
GE Area B: Natural Sciences & Mathematics (Biol 115, CS 115, MATH 161, PHYS 114 & 116)	Y	Y				Y								
GE Area C: The Art & Humanities				Y		Y	Y	Y	Y					
GE Area D: Social Sciences				Y		Y	Y	Y	Y	Y				
GE Area E: The Integrated Person				Y		Y	Y	Y	Y	Y				
MATH 142E: Discrete Mathematics for Engineering	Y													
MATH 211: Differential & Integral Calculus II	Y													
MATH 241: Linear Algebra w/App. in Differential Equations	Y													
MATH 261: Multivariable Calculus	Y													
PHY 214: Introduction to Physics II	Y													
ES110: Introduction to Engineering & Laboratory Exp.	3	3	4	4	3						3			
ES112: Fundamentals of Digital Logic Design	3	4	4		3						3			
ES210: Digital Circuit & Logic Design (+ Lab)	3	4	3		3						4			
ES220: Electric Circuits	4	4	4	3	3	3								
ES221: Electric Circuits Laboratory	3	4	4		4									
ES230: Electronics I	4		3	3	4								3	
ES231: Electronic I Laboratory	4	4	4	2	3						5			
ES310: Microprocessors & System Design	3	3	3	4	3					4	4			
ES314: Advanced Programming, Modeling and Simulation	4	3	3				3				4	4	4	4
ES330: Electronics II	4		4						3	3				
ES345: Probability & Statistics for Engineers	4				3							5		
ES400: Linear System Theory	4	3	3								4			
ES430: Electromagnetic Theory & Applications	4												4	
ES442: Analog & Digital Communications (+ Lab)	4	3	4		4					3	4			
ES445: Photonics	4				4						3			
ES465: Intro to Networking & Network Management (+Lab)	3	4			4						4			
ES485: Selected Topics in ES, RF Design, Betts	4	4			4						4			
ES485: Selected Topics in ES, VLSI Design, Ryan											4			4
ES485: Selected Topics in ES, Wireless Communications	4		4				2				4			
ES492/493: Senior Design Project	4	4	4	4		4	3	3	3					4
ES497: Engineering Science Colloquium							4	4	3	3				

The Student Outcome Champion generally uses a variety of tools and data to assess the student outcome that he/she supervises. This involves both direct and indirect data. The **direct** data for each student outcome assessment is based upon the meetings with the instructor/coordinator of the courses that offer the strongest support for that student outcome and the course maintenance records. *Direct assessment is based on the data from homework assignments, quizzes, exams, and projects in the course.* The major courses that have a high level support (e.g., 4 or 5) for student outcomes are considered here. The course coordinators for these courses provide valuable input and recommendations to the champion of each student outcome based upon the performance of the students in the course (including the exams, assignments, projects, and student discussions). The **indirect** data come primarily from survey questionnaire results; we discuss this below. All these are done during the **assessment phase**. Table E.5 summarizes various assessment tools and methods used for the assessment of the EE program.

Table E.5: Program Assessment Methods and Strategies

Assessment tool	Assessed by	Indicators	Used to
Course Content	Instructor, course coordinator	Course Learning Objectives (**CLO**)	Define levels of support to a student outcome (**SO**, Direct)
Course Performance	Instructor and course coordinator	Exams, homework assignments, projects, etc.	Assess CLOs and SOs (Direct)
Courses vs Student Outcomes	Instructor, course coordinator, student outcome champion	CLOs & levels of supports of Student outcomes	Map courses to SOs (Table E.4, Direct)
Junior Survey	Student responses to Junior Survey	Results from Junior Survey Form	Assess SOs (Indirect)
Senior Survey	Student responses to Senior Survey	Results from Senior Survey Form	Assessment of SOs (Indirect)
Senior Project	Project advisors, course coordinators, senior design committee	Proposals, reports, presentations, demonstrations	Assess CLOs and SOs (Direct)

Course Content Improvement: The course enhancements / improvements are based upon course assessments and student performance. The course coordinator/instructor propose changes and meet with the curriculum representative to discuss and review the proposed CLOs of the course content, depth of the content, pre/co-requisites, and the level of support for each student outcome. The proposal for the course content is then brought to the faculty for final consideration. The changes to the course content are documented in the "Course Changes" file in "Course Maintenance Record" folder for future reference.

Course Performance Assessment: This is a direct assessment method and is mainly performed by the instructor/course coordinator of the course periodically (i.e., every semester the course is taught). It is based upon student performance (i.e., assignments, quizzes, exams and course project). The result is recorded in the Course Assessment Report. Each course assessment report contains the summary of the class performance including the number of students, the maximum, minimum, and average/acceptable grades in the class, e.g., for homework assignments, tests, midterm and final exams for a lecture course. The assessment report can be done for a lab or project course in the same way. The report also specifies which student outcome the course is supporting. **Appendix 5.a** contains the assessment reports for all courses in the program for F2015 and S2016. By looking at the grades in a course assessment report that support certain student outcome, the champion of that student outcome can determine whether the student outcome is supported satisfactorily and level of support. The course instructor / coordinator is responsible for relating the available assessment data to the CLO and the subsequent evaluation and propose revisions of the course structure, contents, and assessment methods to the **department curriculum committee,** if necessary.

Deciding on the Relationships between Courses and Student Outcomes: *It is important that for each course the course coordinator and student outcome champion agree upon the level of support that the course contributes to that student outcome*. Since the levels of support for each student outcome that are prepared by the faculty are subjective, they should be used as a reference rather than a complete assessment tool.

Junior and Senior Surveys: The Junior survey is conducted at the beginning of a student's junior year. This is the entry point to the EE program for most students who transfer from two-year community colleges. Results from this survey provide a baseline data for the later survey results. The senior survey is conducted at the end of a student's senior year. This survey assesses the student opinions about the whole program that is based on the student outcomes. The Junior and Senior survey results are included in **Appendix 6.c**, and **6.d,** "Samples of the Surveys" of this report.

Senior Design Project: The senior design project is completed over two semesters. During the first semester of the Senior Design course (ES492), the students complete a *project proposal* and an *oral design review presentation***,** and an oral defense of the proposed project. During the second semester (ES493), students implement the design project defined in ES492, give an *oral presentation*, and complete a *written project report.* A Senior Design Project Committee (consisting of faculty, project sponsor, and community partners) provides feedback to the students throughout the duration of the project. The committee members also fill up a few assessment forms after the project presentation to ES492/3 instructor. as shown in **Appendix 5.b**, "ES492/493 Assessment forms". The reports provide valuable direct assessment tool.

E.3. The Student Outcome Assessment by Direct Method

We used both the direct and indirect methods of the assessment process for evaluating student outcomes. With the direct method, the course coordinators and the student outcome champions identify several *major* courses and courses that require a *lab or project*. Then each student outcome champion performs the evaluation based on the related course assessment data. The student outcome champions present their recommendations for curriculum enhancement to the faculty during a department curriculum meeting, or retreat, and document the assessment data, evaluation, and enhancement recommendations from the Student Outcome assessment reports. Table E.6 below lists the courses suggested by the Department AEI group to each outcome champion for direct evaluation of student outcomes and the high scores in their level of achievement for the associated student outcomes when available.

Table E.6: Course Selected for Direct Assessment of Student Outcomes (SO)

a	b	c	d	e	f	G	h
ES345 ES465	ES221 ES231	ES221 ES492/3	ES310 ES492/3	ES442 ES492/3	ES492/3 ES492/3	ES492/3 ES497	ES492/3 ES497

i	j	k	l	m	n
ES442 ES497	ES310 ES497	ES465 ES492/3	ES314 ES345	ES314 ES430	ES314 ES485

Table E.7 summarizes the assessment methods of the student outcomes, expected attainment, and the assessment results. These are based on the course assessment reports discussed earlier. or each outcome two examples are provided.

Table E.7: Summary of Assessment Methods of Student Outcomes (SO), Goals, and Assessment Results (deliverables = assignments, quizzes, reports, midterm, final)

SO	Assessment Methods	Goals*	Results
a	ES345 "Probability and Statistics for Engineers": Assessment based on the deliverable outcomes on knowledge of math, science, & engineering.	The averages on all deliverables were over 82%.	Goals met.
a	ES485 "Selected Topics in Engineering Science - Intro to RF Design": Assessment based on the deliverable outcomes.	The averages on all deliverables were over 83% & the performance of the students was acceptable.	Goals met.
b	ES221 "Electric Circuit Lab": Assessment of students is based on deliverables & lab performance, reports & projects.	The average of the lab reports was over 91% & the exams over 85% & the students could conduct the experiments, handle the equipment, measurements, & analyze the data satisfactorily in the lab & project.	Goals met.
b	ES231 "Electronics I Lab": Assessment based on the deliverable outcomes including the lab reports.	The averages of the lab reports were over 81% & the students could conduct the experiments, handle the equipment, measurements, & analyze the data satisfactorily in the lab & project.	Goals met.
c	ES221 "Electric Circuit Lab": Assessment of students is based on deliverables & lab performance, reports & projects.	The average of the lab reports was over 91% & the exams over 85. The students could design system, components, & process to meet desired needs satisfactorily in the lab & project.	Goals met.
c	ES492/493 "Senior Design Planning & Project" See the attached Proposal Eval Form used to assess the overall project designs & process used to meet desired needs within constraints.	A committee of 4-6 faculty and industry mentors evaluated each project proposal. 97% of ES492/3 students performed better than average with respect to addressing realistic constrains. The remaining 3% had to redo their work.	Goals met.
d	ES310 "Microprocessors & System Design": The students are required to work together on the project & deal with various issues. Assessment based on how students deal with multi-disciplinary tasks.	All students were observed to work together in the lab & project as partners and delivered their projects successfully on time.	Goals met.
d	ES492/493 "Senior Design Project": Students are required to find partners & find mentors & client in the senior design project.	100% of ES493 students were able to find interdisciplinary partners, mentors, & client in the required disciplines.	Goals met.
e	ES442 "Analog & Digital Communication Systems": Assessed the deliverables & lab reports	Over 60% of the students were found to solve problem satisfactorily.	Goals met.

	for ability to identify, formulate, & solve problem.		
e	ES492/493 "Senior Design Project": See the attached Final Project Evaluation Form used to assess the ability to formulate engineering problems.	At least 81% of the students are able to define, analyze, represent, & find a solution to an engineering problem. Most students met the criteria.	Goals met.
f	ES492/493 "Senior Design Project": The students presented in a team report on importance of engineering ethics in ES 492. The reports were graded based on a rubric in ethical issues.	100% of ES492/493 students observed & met the ethical expectations as explained in the course syllabus of ES492.	Goals met.
g	ES492/493 "Senior Design Project": Each student in the team was asked to complete the Team Evaluation Form and evaluate other individuals in the team. Students were also required to provide monthly oral feedback regarding their partners in this course.	87% of students believe that their partner was doing a good job & they had good mutual communication. We have added two new lectures describing the common goals & collaborations in partnerships.	Goals met.
g	ES497 "Engineering Science Colloquium": Assessment was on effective communication ability & quality of the reports. Students were required to attend six EE colloquia & write technical reports summarizing what the speaker presented. The instructor read the reports in detail & sent comments on the technical writing skill to the student to address & resubmit. This process was repeated until the report was satisfactory.	All students submitted highly acceptable reports demonstrating they have acceptable technical communication writing skill.	Goals are met.
h	ES492/493 "Students Design Project": Students were evaluated based on the quality of their, their literature review, motivation, social and economical impact in the final project report using the Senior Design Project Report Rubric.	95% of the students can meet the expectations.	Goals are met.
h	ES497 "Engineering Science Colloquium": Students were required to attend six EE technical colloquia & write reports summarizing what the speaker presented. The instructor read the reports in detail & sent comments on their understanding the impact of engineering solutions in a global, economic, environmental, & social responsibility. This process is repeated until the report was acceptable. Assessment is based on the quality of the reports addressing the above issues.	Most students submitted acceptable reports the first time demonstrating they understand the impact of engineering solutions in a global, economic, environmental, & social responsibility. Some students needed to resubmit their report after improvements based on the instructor's comments.	Goals are met.
i	ES442 "Analog & Digital Communications & Lab": Assessment based on how much the students appreciate the importance of life-long learning & focus was mainly on communication issues that students confront on a daily basis.	60% of the students met the expectations. More real-world examples & demos are required.	Goals are met.
i	ES497 "Engineering Science Colloquium": The colloquium speakers coming from different fields of EE industries or academia & share with the audience how important the life-long learning	All students submitted acceptable reports demonstrating they understand the importance of life-long learning in going forward successfully. Some	Goals are met.

	experience was in accomplishing their goal. The assessment is based on how much students understand the importance of life-long learning.	students needed to resubmit their report after improvements based on the instructor's comments.	
j	ES310 "Microprocessors & System Design": The students are required to search for innovative engineering solutions by reading at least 4 articles and expressing their views about the topic orally in class.	95% of the students completed the assignment.	Goals are met.
j	ES497 "Engineering Science Colloquium": The colloquium speakers coming from various fields of EE industries or academia in various research areas bring a depth of knowledge on contemporary issues & the students write about these in their reports or their presentations for assessment.	More than 75% get knowledge of contemporary issues & were able to talk & technically write about it.	Goals are met.
k	ES465 "Intro to Networking & Network Management & Lab": The students are required to use modern software tool necessary to practice. Assessment based on the deliverables & use of software in the lab.	The average of the grades of the labs that involved using Wireshark network analyzer on Ubuntu to display the network protocols were over 82%.	Goals are met.
k	ES492/493 "Senior Project Design": All students in the two courses are required to accompany simulation results to demonstrate the expected outcome & to present a CAD based schematic of the project details. Student projects were evaluated using Final Project Evaluation.	At least 84% of the students can fully utilize simulation tools to demonstrate the expected behavior of their proposed system. At least 95% of the students were able to use CAD-based schematic capture to show their project details.	Goals are met.
l	ES314 "Advanced Programming, Modeling & Simulation": Assessment of having a knowledge of probability and statistics is based on the deliverables on knowledge of probability.	Averages were generally above 82%. Over 70% of the students showed to have a good handle on probability.	Goals are met.
l	ES345 "Probability and Statistics for Engineers": Assessed based on deliverables. The assignments, quizzes, exams, & projects involved an understanding of probability in engineering applications.	Over 82% of the students showed to have a good grasp of probability & statistics.	Goals are met.
m	ES314 "Advanced Programming, Modeling & Simulation": Assessment based on mathematics & Matlab application in electrical engineering. Assessed on assignments, quizzes & projects.	The assignments, quizzes, exams & project required good grasp of mathematics used in Matlab for solving electrical engineering problems. Over 70% of the students did satisfactorily overall.	Goals are met.
m	ES430 "Electromagnetic Theory & Applications": The course requires advanced calculus. Assessment based on deliverables.	Over 60% of the students showed to have a good handle of differentiation & integral calculus.	Goals are met.
n	ES314 "Advanced Programming, Modeling & Simulation": Assessment based deliverables & using software to analyze EE problems. The course requires Matlab programming to solve problems in application in electrical engineering.	Over 70% of the students showed to have a good handle on Matlab programming.	Goals are met.

n	ES485 “Selected Topics in Eng’g Science, VLSI Design required knowing VHDL (Verilog Hardware Description Language). Assessment is based on the deliverables.	All students had a total final grade of Over 77% of the students showed to have a good handle of the required programming.	Goals are met.

***** The **Goals** are based on the *“Assessment Reports of Courses”* as listed in **Appendix 5.** The class averages for each deliverable in Column 5 indicate how the students perform for that deliverable.

E.4. The Student Outcome Assessment by Indirect Method

The indirect methods of the assessment process for evaluating student outcomes are largely based upon the results of survey questions administered to our senior and junior students. The questions are focused upon the student outcomes, specifically about how important they find each student outcome and how satisfied they are with what they have learned so far from the curriculum. Using this approach we were able to get a feel for *how good the program is*. This method provides a powerful and effective tool. In fact, we used this indirect method for the assessment and evaluation of the student outcomes. We assembled a number of survey questions and asked our senior and junior students in the ES Department to respond. We have collected their responses to the survey questions and analyzed them in our evaluation.

As shown in **Appendix 6.c** and **6.d**, sample survey questionnaire for the senior and junior students, there are 25 questions for the senior and 25 questions for the junior students. The questions are not directly a student outcome statement, rather each group of questions addresses the capabilities that each student outcome is looking for in the engineering program. The questions in the junior form are more basic questions for competency in the areas in lower division as the students start the more advanced courses. The questions in the senior form are targeted at competency in the areas of upper division as the students have already taken these more advanced courses.

In both forms there are four columns: Column 1 is the sequence number of the question, Column 2 is the question itself, Column 3 is for the level of **importance** of the associated student outcome, and Column 4 is for the level of **satisfaction** of the student with the ability. Whereas the third column addresses the importance of student outcome, the fourth column addresses how much the students feel to have gained in the knowledge of the student outcome. For the level assignment in columns 3 and 4 there are seven choices, 0 to 6, where 0 indicates Not Applicable (N/A), and the other levels are assigned the corresponding values:

- In column 3, 1 = Not Important, 2 = Very Limited Important, 3 = Limited Important, 4 = Moderately Important, 5 = Important, and 6 = Very Important.
- In column 4, 1 = Not Capable, 2 = Very Limited Capability, 3 = Limited Capability, 4 = Moderately Capability, 5 = Capable, and 6 = Very Capable.

The survey questions were administered to **sixteen seniors** and **twenty juniors** in early Fall 2014 and collected the responses after ten minutes time limit. To assess the data we took the responses and performed some calculations. **Appendixes 6.c and 6.d** provide the questions and responses, respectively. The related calculations for employees and alumni, and senior and junior students are shown in **Appendixes 6.e.1, 6.e.2, and 6.e.3**, respectively.

Appendix 6.e.1 shows the calculations for the Alumni and employer responses in achievements of PEOs. For this table, we used the importance level of each question to gauge the importance level of the related student outcome. To calculate the average importance level value for each question, we added the levels (i.e., 0-6) in the importance column for each question and divide it by the number of questions (i.e., twenty-five).

Next, to obtain the average of the importance level value of each student outcome, we added the averages of all questions supporting that student outcome and divided this sum by the number the questions supporting that student outcome. For example, in the **senior survey**, questions 1, 2, and 3 support Student Outcome (a). In **Appendix 6.e.2,** we took the sum of the level values of all senior responses and divided it by three to obtain the average level value for Student Outcome (a). Next, to get the **percentage importance**, namely **%Importance**, we divide the above average level value by the maximum value of the level, i.e., six and multiplied by 100 for that question. Thus, we obtained an estimate for the average %Importance level for each student outcome from the senior student survey.

The same approach was finally applied to obtain an estimate for the average %Satisfaction level (from Column 4 of the survey) that indicates how satisfied the seniors are with what they have learned from the program so far.

We repeated this approach to the survey responses from the **juniors** (**Appendix 6.e.3)** to obtain the percentage importance (%Importance) and percentage satisfaction (%Satisfaction) for the junior students.

Tables E.8 and E.9 summarize the results of the responses from the seniors and junior students in fall 2014- the percentage levels of Importance and Satisfaction for the student outcomes.

Table E.8: Senior Students %Importance and %Satisfaction Levels of Student Outcomes (App 6.e.2)

Senior Students Fall 2014	Student Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
	%Importance	86.5	94.8	89.1	90.6	89.6	84.4	87.0	82.8	89.6	83.3	93.8
	%Satisfaction	78.5	87.5	79.7	85.4	85.9	78.1	81.8	76.0	80.2	80.2	87.0
	%Difference	8.0	7.3	9.4	5.2	3.6	6.3	5.2	6.8	9.4	3.1	6.8

Table E.9: Junior Students %Importance and %Satisfaction Levels of Student Outcomes (App 6.e.3)

Junior Students Fall 2014	Student Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
	%Importance	95.6	96.1	88.5	89.8	96.1	93.5	88.9	91.2	89.2	88.2	97.5
	%Satisfaction	81.5	84.6	85.2	95.4	81.3	93.3	90.4	81.4	89.2	83.3	88.2
	%Difference	14.2	11.5	3.3	-5.6*	14.8	0.2	-1.5*	9.8	0.0	4.9	9.3

(the negative differences are due to the fact that the student indicated higher levels for Satisfaction than for Importance)*

The goal is to have a high level of %Importance in the student outcomes from both the senior and junior students *to assure that they consider importance of the student outcomes.* Also we got to assure that the students are satisfied with the program and receive what they are looking for, which means we should have a high level of %Satisfaction in the student outcomes from both groups. Considering that the *acceptable percentage* for both the %Importance and %Satisfaction is 75% (See Table C.3), we can conclude the following:

Conclusions for Evaluation of Student Outcomes:

- *The %Importance levels of all student outcomes in both tables being above 75% indicate that both seniors and juniors believe that all student outcomes are **important** in their engineering education.*
- *The %Satisfaction levels with all student outcomes in both tables being above 75% indicate that both seniors and juniors feel that they **are satisfied** with what they have learned so far.*
- *The %Differences between the %Importance and %Satisfaction levels for all student outcomes in both tables being low (<25%) indicate that both seniors and juniors feel their satisfaction level compared to their expectation level (%Importance) are close, meaning that the **student outcomes they are receiving are satisfactory** according to the ABET recommendations.*

The assessment and evaluation of the program specific criteria, i.e., **student outcomes l, m, and n** is presented below. The indirect method used is based on the responses to the survey questionnaire sent to the junior and senior students for *assessing the student outcomes*. The questions used in these surveys were designed specifically to assess the EE program criteria. Similar approach to the assessment of student outcomes in Continuous Improvement" section is used to estimate the %Importance and %Satisfactions of the program specific criteria as done for.

Table E.10 shows the results for the %Importance and %Satisfaction data for the **Program Specific Criteria (Student Outcomes)** from the responses from the seniors. In this table the program specific student outcome (m) is divided into the EE math and EE science required for the EE program. It should be noted that other engineering programs may not require as much depth in math and science fields.

Table E.10: Senior Students %Importance and %Satisfaction Levels of Program Specific Criteria

Program Specific Criteria Fall 2014	Student Outcomes	l	m		n
		EE Probability	EE Math	EE Science	EE Computer Science
	%Importance	78.1	90.6	90.6	84.4
	%Satisfaction	77.1	75.0	88.5	78.1
	%Difference	1.0	15.6	2.1	6.3

Table E.11 shows the results for the %Importance and %Satisfaction Levels for the Program Specific student outcomes from the responses from the juniors. In this table the EE program specific student outcome (n) is not included since the juniors are not assumed to have learned enough of computer science in the lower division of the program.

Table E.11: Junior Students %Importance and %Satisfaction Levels of Program Specific Criteria

Program Specific Criteria Fall 2014	Student Outcomes	l	M	
		EE Probability	EE Math	EE Science
	%Importance	84.3	90.0	87.4
	%Satisfaction	79.9	87.7	79.4
	%Difference	4.4	2.2	8.1

The estimations indicate that both the %Importance and %Satisfaction levels satisfy the acceptance level of 75%. It can be concluded that our students believe that the given program specific criteria are important and they are satisfied with the program outcome.

It should be mentioned that ***the total student outcomes already cover the program specific criteria and this was an extra exercise to confirm our previous findings.*** In summary:

Evaluation Conclusion for Program Specific Criteria from Juniors and Seniors:

- *All %Importance and %Satisfaction are above 75% for the Program Specific Criteria, confirming that the students consider the Program Specific Criteria are important and they are satisfied with what they have learned so far in the program.*

In May 2015 we introduced another **indirect assessment method** for the student outcomes by the graduating senior students from the **Exit Survey** as shown in **Appendix 6.f.1. "Exit Survey for 2015 Senior Students**" in which there were 13 students participated. Questions 2.1 to 2.10 are specifically designed to assess the student outcomes of the EE program such as "*I have developed an understanding of physics and mathematics, and the ability to apply this knowledge to the analysis and solution of engineering problems*" and the students' responses could be "Strongly Disagree", "Disagree", "Neutral", "Agree", and "Strongly Agree". We collected the percentages of the "Agree" and "Strongly Agree" responses to assess the student outcome. The student outcome assessment via the Exit Survey reflects what the senior students think about the whole program and the student outcomes. Table E.11 summarizes the results.

Table E.11: Senior Students Responses on Student Outcomes from Exit Survey in May 2015

Student Outcomes	a	b	c	d	e	f	g	h	i	j	k
%Agree	41.7	38.6	42.1	45.5	38.5	53.8	46.2	38.5	30.8	NA	30.8
%StronglyAgree	41.7	53.8	53.8	54.5	61.5	38.5	53.8	61.5	69.2	NA	61.5
%Agree + %StronglyAgree	83.4	92.4	95.9	100	100	92.3	100	100	100	NA	92.3

Since the 2015 Exit Survey did not cover all student outcomes, we added the missing student outcomes in the 2016 Exit Survey in May 2016 and included the EE Specific criteria (see Questions 2.1 to 2.14 for student outcomes a-n, respectively, in **Appendix 6.f.2 "Exit Survey for 2016 Senior Students**"). 19 students participated in this survey and the results are shown in Table E.12.

Table E.12: Senior Students Responses on Student Outcomes from Exit Survey in May 2016

Student Outcomes	a	b	c	d	e	f	g	h	i	j	k	L	m	n
%Agree	52.6	38.8	50	57.9	63.2	68.4	52.6	52.6	38.8	50	68.4	10.5	47.4	68.4
%Strongly Agree	42.1	57.9	38.9	31.6	36.8	15.8	31.6	26.3	52.6	16.7	10.5	57.9	47.4	31.6
%Agree + %Strongly Agree	94.7	96.7	88.9	89.5	100	84.2	84.2	78.9	91.4	66.7	78.9	68.4	94.8	100

Considering that the total acceptable responses of "Agree" + "Strongly Agree" is 75% and over, it is observed that except for the Students Outcome "knowledge of probability and statistics" all Student Outcomes are acceptable. We will see to this later.

Another set of responses to the questions in the 2016 Exit Survey can support the achievements in student outcomes as summarized in Table E.13.a and E.13.b below.

Table E.13.a Summarizes the Achievements of Some of Student Outcomes (SOs)

Question (SO = Student Outcome)	Great Strength	Above Average	Average	Below Average	Week
Q4.2.1: Learning experience in Labs (**SO b**)	31.6%	42.1%	22.3%	0	5%
Q4.2.2: Did you develop an understanding of graphing and engineering software, such as Excel, MultiSIM, MatLab, Mathematica, LabVIEW or Cadence? (**SO k**)	31.6%	47.4%	15.8%	4.2%	5%
Q4.2.3**:** Did you receive training on writing technical report? (**SO g)**	36.8%	31.6%	15.8%	10.8%	5%
Q4.2.4: Did you receive training in instrumentation? (**SO b**)	10.5%	57.9%	21.1%	4.5%	5%
Q4.2.5: Did you access computers and engineering software in the department? (**SO n**)	52.6	36.8	10.5	0	0

Other questions provide additional measure for student outcomes (e.g., *for life-long student outcome*).

Table E.13.b Summarizes the Achievements of Some Other Student Outcomes (SOs)

Question (SO = Student Outcome)	Yes	No
Q3.19: Have you participated in undergraduate research? (**SO i**)	36.8%	63.2%
Q3.20: Have you contributed to the publication of any conference paper or conference poster session? (**SO i)**	36.8%	63.2%

E.5. Assessment of Program Educational Evaluations (PEOs) from Student Outcomes

It is interesting to observe how the PEO evaluations can be estimated from the survey results obtained from the juniors and seniors on the student outcomes. Table D.1 (repeated below for convenience) shows how the PEOs and student outcomes are related in the program. First, consider PEO 1 which is supported by student outcomes *a, d, c, d, e,* and *h*. Therefore the average of the associated %Importance levels of the student outcomes can be used to estimate the %Importance of PEO 1. In the same way, the estimated %Importance of PEO 2 can be obtained from the average of %Importance of student outcomes *h, i, j,* and *k*. Also, we can estimate the %Importance of PEO 3 from the average of %Importance of student outcomes *d, f,* and *g*.

Table D.1: PEOs versus Student Outcomes

Program Educational Objectives	Student Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
4. Be successful engineers in electrical engineering and related fields, including graduate studies	Y	Y	Y	Y	Y			Y			

5. Maintain and enhance their professional skills continuously through life-long learning								Y	Y	Y	Y
6. Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world				Y		Y	Y				

Table E.14 summarizes the results showing %Importance, %Satisfaction, and %Difference for PEOs 1-3 based on the corresponding percentages obtained for the student outcomes from the survey responses we received from sixteen senior and twenty junior students in Fall 2014.

Table E.14: Evaluation of PEOs Based on Student Outcomes Results from Seniors and Juniors Survey

PEOs	Responses from Senior			Responses from Junior		
	%Importance	**%Satisfaction**	**%Difference**	**%Importance**	**%Satisfaction**	**%Difference**
1	88.89%	82.18%	6.71%	92.9%	84.9%	8.0%
2	87.37%	80.86%	6.51%	91.5%	85.5%	6.0%
3	87.33%	81.77%	5.56%	90.7%	93.0%	-2.3%

Evaluation Conclusion for PEO Based upon student outcomes results from Juniors and Seniors:

- All %Importance and %Satisfaction are above 75% for the PEOs confirming that the students consider the PEOs **important and are satisfied** with what they have learned so far in the program.

E.6. Overall Continuous Improvement

The evaluation and improvement of the courses in the program is a **continuous effort** and includes discussions among the faculty, input from the faculty advisors, student feedbacks and using new/updated textbooks as they become available.

The continuous program improvement can be explained through the *feedback loop* in Figure E.1 (repeated here for convenience). As we discussed before, basically:

- The course learning objectives (CLOs) and the content and delivery of the courses are improved continuously based upon the inputs from faculty, industry, alumni, the existing students, and ABET to achieve the optimal student outcomes Box (3) to Box (2).
- In turn, continuous improvement of the student outcomes results in continuous improvement of the PEOs Box (1) to Box (5) to Box (6) to Box (7) and together with Box (8) to Box (7) to Box (9), to Box (1).

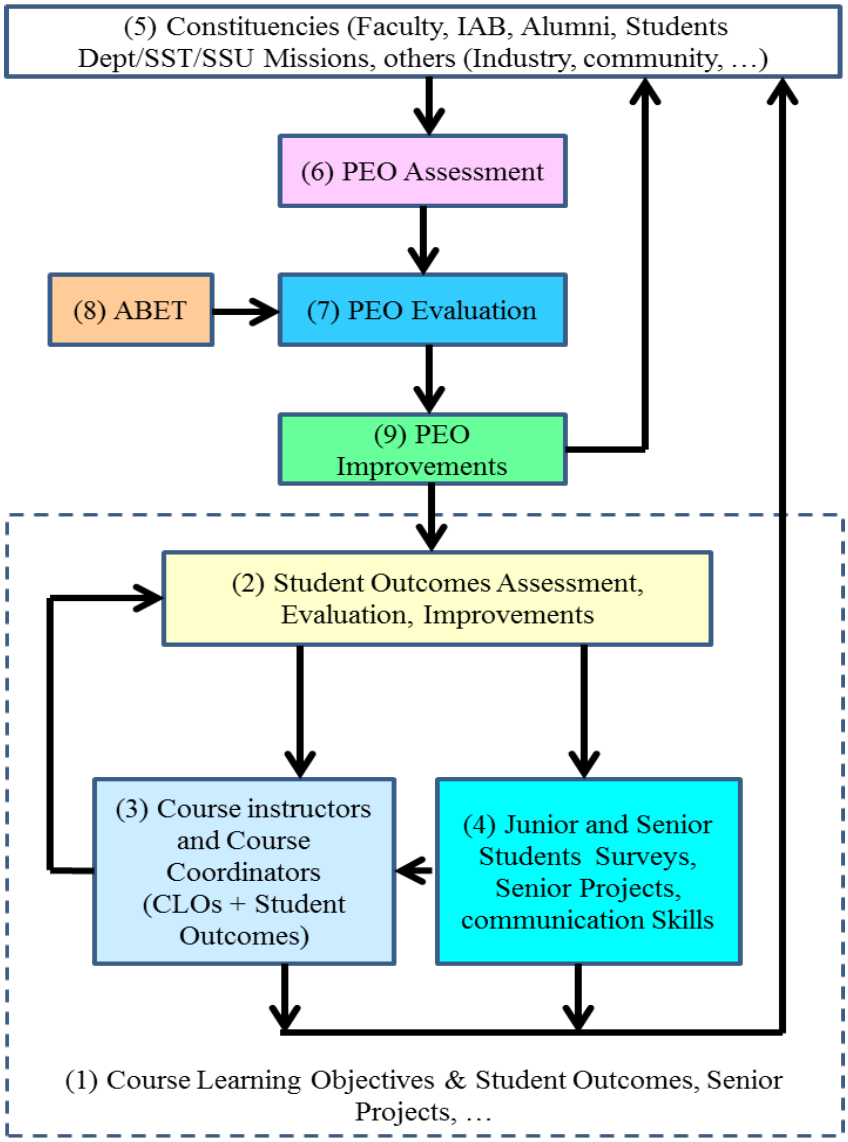

Figure E.1: Overall Process for PEO Assessment together with Student Outcomes

Figure E.2 shows the EE program constituencies, the data assessment collected, the evaluation, and the improvement. The figure also indicates the data flow.

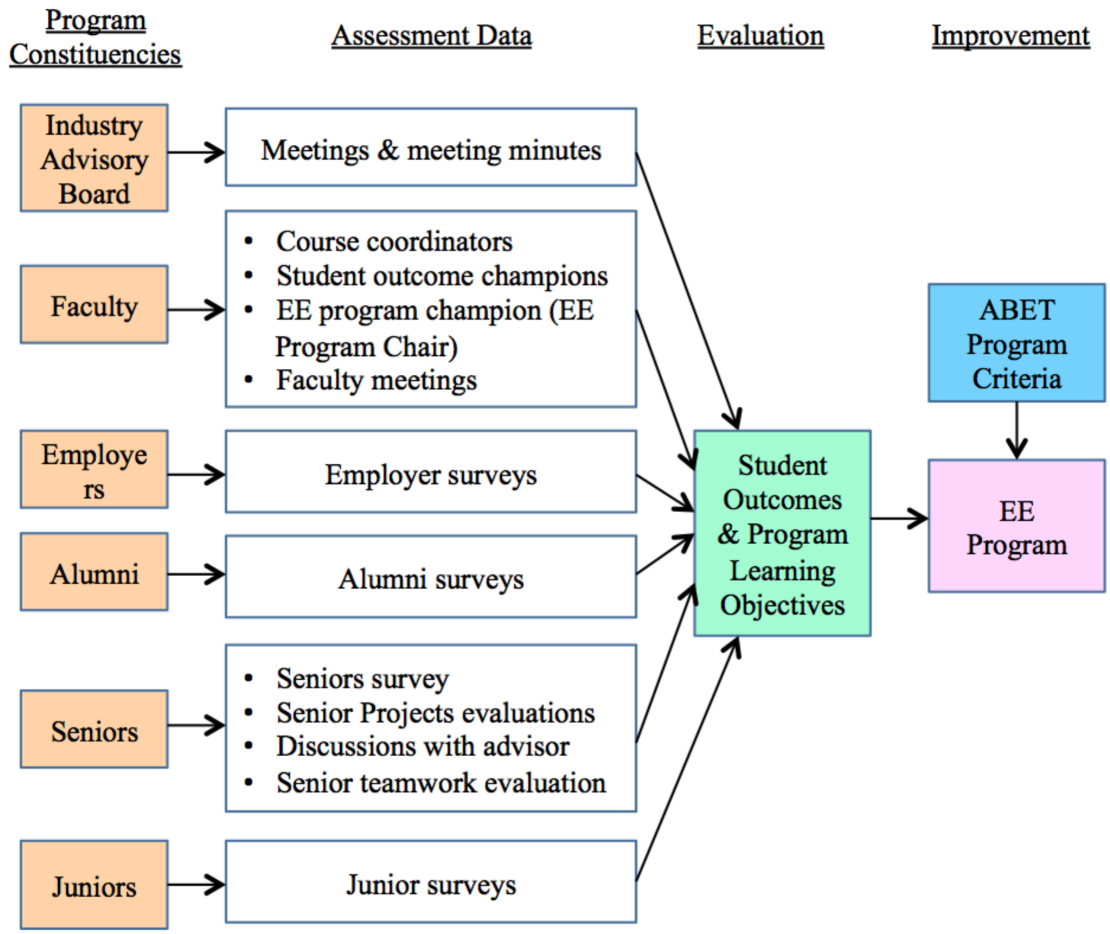

Figure E.2: Data Assessment, Evaluation, and Improvement by the EE Program Constituencies

Some of the IAB members gave us feedback on our PEOs and Student Outcomes. For example, till Spring 2014 the program had four PEOs:

BSEE Program Educational Objectives (PEO) – Our BS EE graduates:

1. Practice Electrical Engineering successfully in areas of circuit design, testing, manufacturing, systems and research.
2. Contribute responsibly and ethically to society in their engineering or related careers.
3. Maintain and enhance their professional skills continuously through life-long learning.
4. Communicate engineering results effectively in their individual or team-working environment.

One knowledgeable executive, an IAB member, had attended ABET-related workshops in Napa, CA, reviewed our PEOs, and recommended that we should streamline and simplify the PEOs. The result was the current PEOs as presented below:

BSEE Program Educational Objectives (PEO) (http://www.sonoma.edu/engineering/bsee/)

1. Be successful engineers in electrical engineering and related fields, including graduate studies.
2. Maintain and enhance their professional skills continuously through life-long learning.
3. Be able to lead in their chosen roles, contributing professionally and ethically to society in a globally competitive world.

However, as the assessment, evaluation, and improvement operation go forward, the faculty may decide to go to the original PEO statements to make the PEOs more specific and the association of the questions and each PEO easier.

In another instance, the same IAB member, suggested to simplify our original twelve student outcomes and remove the last item "*A competence in one or more technical specialties that meet the needs of our local and regional industries"* and adopt the existing student outcomes (a)-(k).

This proved to be a good suggestion as it slightly reduced the preparation of the self-study report. However in future as the local industries grow and try to hire more of our graduates, it makes sense to build the students' competency in their required specialties.

To make the course assessment more conclusive for the student outcomes, the EE department may decide to change the format of the Course Assessment Report as shown in **Appendix 5.c. "A Course Assessment Form".** The form can be used to assess an assignment, a test, report, etc. - one report for each student outcome or rubric that the course is supporting. After the assignment/test is graded for the class, the grades are distributed into levels 1-4 from lowest to highest performance. Table E.15 highlights the main part of Course Assessment Report as a sample for the assessment of a class with 10 students in test.

Level Description	**# of Students**
4. Demonstrates a complete & accurate understanding of the important concepts	**3**
3. Applies appropriate strategy of concepts without significant errors	**4**
Your **ACCEPTABLE** (Passing) Threshold	
2. Displays an incomplete understanding of the important concepts and has some notable misconceptions; makes a number of errors when performing important strategies or skills but can complete a rough approximation of them	**2**
1. Demonstrates severe misconceptions about the important concepts: makes many critical errors	**1**
Total Number of Students:	**10**
Percentage of Students at Levels 3-4	**70%**

Table E.15: Sample assessment table for a Course Assessment Report

In this sample, assume that the instructor decides to use grade 60 for the passing (acceptable threshold) grade, i.e. those students that receive grade 60 and above pass and those who received a grade below 60 fail (not acceptable) in the test. Also assume that there are a total of 7 students who performed acceptably (above the acceptable threshold) in the class, then 70% of the student have performed acceptably. This means that the goal for the related student outcome is achieved. Such course assessment form can be used to construct Table E.7 above. In fact this course assessment report format was used for our self-study report in 2014.

F. ELECTRICAL ENGINEERING PROGRAM CURRICULUM

F.1. Program Curriculum Summarized

The EE program similar to all other programs at SSU operates on semester basis. Table F.1 describes the plan of study for students in the EE program. It includes information on course offerings in the form of a recommended schedule by semester and year along with the maximum section enrollments for all courses in the program based on the last two semesters the course was taught. The table lists the required as well as the elective courses.

Table F.1: Electrical Engineering Program Core Courses

The courses in the program by semester	R = Required E = Elective	*Subject Area (Credit Hours)*				Course Offered in F2015 and / or S2016	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math and Basic Sciences	(Y) = Contains Significant Design	General Education	Other		
ES110: Intro. to Engineering and Lab Experience	R		1(Y)			F15/ S16	19 / 12
ES112: Fundamentals of Digital Logic Design	R		1			F15/ S16	17 / 20
ES210: Digital Circuit and Logic Design (GE: A3)	R		4(Y)			F15/S16	7 / 21
ES220: Electric Circuits	R		3			F15	21
ES221: Electric Circuits Laboratory	R		1(Y)			F15	18
ES230: Electronics I	R		3			S16	20
ES231: Electronics I Lab	R		1(Y)			S16	20
ES310: Microprocessors and System Design	R		4(Y)			F15	11
ES314: Advanced Programming, Modeling and Simulation	R		4(Y)			F15	30
ES330: Electronics II	R		2			F15	28
ES345: Probability and Statistics for Engineers	R		3			F15	0
ES400: Linear Systems Theory	R		3(Y)			F15	25
ES430: Electromagnetic Theory and Applications	R		3			S16	20
ES442: Analog and Digital Communications	R		4(Y)			S16	23
ES443: Intro to Optical Fiber Communication	R		3(Y)			F15	0
ES465: Introduction to Networking and Network Management	R		3(Y)			F15	20
ES492: Senior Design Project Planning	R		1			F15	21
ES493: Senior Design Project	R		3(Y)			S16	
ES497: Engineering Science Colloquium	R		1			F15/S16	17 / 10
CS 115: Programming I	R	4					
PHYS 114: Introduction to Physics I	R	4					
PHYS 116: Introductory Lab Experience	R	1					
PHYS 214: Introduction to Physics II	R	4					

MATH 161: Calculus I	R	4					
MATH 211: Calculus II	R	4					
MATH 241: Calculus III	R	4					
MATH 261: Calculus IV	R	4					
ENGL 101: Expository Writing and Analytical Reading	R			4			
AMCS 260 or any course in Fine Arts, Theatre, Dance, Music and Film	R			4			
PHIL 302: Ethics and Value Theory	R			4			
AMCS 355 or any course in Comparative Perspectives and/or Foreign Languages	R			4			
EDUC 417 or any course in Individual and Society	R			3			
HIST 201 or any course in World History and Civilization	R			3			
HIST 241 or any course in United States History	R			3			
POLS 200: American Political System	R			3			
ANTH 200 or any course in Contemporary International Perspectives	R			3			
BIOL 318 or any course in The Integrated Person	R			3			
ES485: Selected Topics in Engineering Science, Wireless Communications*	E		3(Y)				
ES485: Selected Topics in Engineering Science, Antenna Engineering*	E		3(Y)				
ES485: Selected Topics in Engineering Science, Digital Signal Processing*	E		3(Y)				
ES485: Selected Topics in Engineering Science, RF Design*	E		3(Y)			S16	18
ES485: Selected Topics in Engineering Science, VLSI Design*	E		3(Y)			S16	12
ES480: Artificial Intelligence*	E		3(Y)				
* Students are required to take two technical electives; total of 6 units.							

F.2. CSU Degree 120-Unit Cap

Mandated by CSU Chancellor's Office, effective Fall of 2014, all degree's requirement could not exceed 120 units except for a few specified disciplines. The ES Department used to require 128 units for a BS degree in Electrical Engineering. In response the Department went through a careful examination of the existing curriculum and identified ways to improve the efficiency of the curriculum without hurting the integrity of our engineering program. Led by Dr. Ravikumar, a complex proposal of combining redesigning two Engineering courses (ES110, 112), removing a math pre-requisite (MATH142E) from the requirement and double counting an engineering course (ES210) for GE. After a period of nearly two years, the full proposal was approved. As a result ES210 became a GE course. As of now, the BS EE degree requires 120 credits for graduation.

F.3. Curriculum Alignment with Student Outcomes

The EE curriculum at SSU provides students with a solid foundation in mathematics, physics, engineering, hardware and software design, oral and written communication, and a skill set in core areas of electrical engineering. The curriculum has a significant laboratory component that integrates theory with practical design and enhances students' learning. Overall the student outcomes are mainly supported by the three main categories of courses in the EE curriculum as follows:

- **Student outcome (a)** is supported by the 29 units in mathematics and physics including:
  - 16 units of Calculus, Differential Equations
  - 9 units in Physics
  - 4 units in CS (introductory computer programming)
- **Student outcomes (b) to (n)** are supported by the 54 units in engineering including:
  - 48 units required EE courses
  - 6 units in technical electives (two 3-unit courses)
- **Student outcomes (d), (f), (g), and (i)** are additionally supported by the 37 units in General Education (GE)

For more details please see **Appendix 3.d.,** Engineering Science in SSU Catalog

As presented earlier, the general (**a** to **k**) and EE specific (**l, m, n**) student outcomes of the B.S. degree program in Electrical Engineering are as follows. The students will attain:

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) a 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 life-long learning

j) a knowledge of contemporary issues

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

l) a knowledge of probability and statistics, including applications appropriate to Electrical Engineering program.

m) a knowledge of advanced mathematics through differential and integral calculus, linear algebra, complex variables, and discrete and math as appropriate to Electrical Engineering program

n) a knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components as appropriate to Electrical Engineering program

Table E.4 in the Continuous Improvement Section 4 lists all courses (including core and EE technical electives) that students majoring in the EE program should take and the level each course supports the student outcomes.

F.4. Program Curriculum Components

F.4.1. Computer Science Courses

CS 115, Programming I, 4 units, provides an introduction to logic of problem solving, and the basic features of a high-level programming language (e.g., input/output, functions, conditional statement, loops, classes and objects) using the Python language.

F.4.2. Mathematics Courses

In mathematics, a sequence of four math courses in four semesters of Calculus and Differential Equations. The goal of the mathematics (and basic sciences courses) in the EE program is to provide a theoretical foundation and the computational tools for solving Electrical Engineering problems.

- MATH 161: Calculus I, 4 units, includes limits, continuity, the concept of the derivative, differentiation rules, and applications of the derivative, including curve sketching, extremum problems, L'Hopital's rule, implicit differentiation, related rates, Mean Value Theorem, introduction to integration, fundamental theorem of calculus, and substitution. Satisfies the GE Area B4 requirement for mathematics.
- MATH 211: Calculus II, 4 units, includes the calculus of exponential and logarithmic functions, trigonometric and inverse trigonometric functions, numerical integration, techniques of integration, introduction to applications of integration including volumes and probability distributions, differential equations, Taylor polynomials, L'Hopital's rules, improper integrals, series, and introduction to partial derivatives. Prerequisite: Grade of C or better in MATH 161 or 161X or consent of instructor.
- MATH 241: Calculus III 4 units, is a course in vector and matrix algebra applied to the study of differential equations. Topics include vectors and matrices, linear independence, spanning, bases, linear transformations, first order differential equations and linear systems, phase planes, geometric and numerical methods.
- MATH 261: Calculus IV, 4 units, includes partial derivatives, multiple integrals, alternative coordinate systems, vector functions and their derivatives, line integrals, Green's Theorem, Stokes' Theorem, and Divergence Theorem.

In addition to these courses, the EE curriculum includes advanced level mathematics and physics in many of its upper-division EE courses such as ES345 (Probability & Statistics for Engineers), ES400 (Linear System Theory), and ES430 (Electromagnetic Theory and Applications).

Regarding the Probability and Statistics requirement, the EE program used to cover the engineering applications of probability theory in Math 345 (in a one-unit and later in a two-unit course) before Fall 2014. Starting fall of 2014, the department offered a 3-unit course in engineering probability under ES345 ("Engineering Applications of Probability Theory" before and now "Probability and Statistics for Engineers"). Topics studied in this course include probability, conditional probability, sequential experiments, independence, counting methods, discrete and continuous distributions, functions of random variables, expectations, multiple random variables, central limit theorem, weak law of large numbers, estimation of random variables. The knowledge acquired in the engineering probability course is used in the sequential courses such as ES442 (Analog and Digital Communications) and ES485 (Selected Topics in Engineering Science, Digital Signal Processing).

F.4.3. Physics Courses

Regarding the science coverage, all EE students are required to take a sequence of three physics courses:

- PHY 114, Introduction to Physics I, 4 units, is a required course for physics majors as well covers vectors, mechanics, simple harmonic motion, statistical mechanics and thermodynamics.
- PHY 116, Introduction to Lab Experience, 1 unit, is a unique course that teaches through experimentation the nature of various forces – gravitational, electromagnetic and atomic forces through applications to wide areas such as biology and environmental sciences.
- PHY 214, Introduction to Physics II, 4 units, covers electrostatics, electricity and magnetism, induction, geometric and physical optics. These courses cover all the basic physics requirements for a standard EE curriculum.

F.4.4. General Education Courses

The General Education program is required for all SSU students and is designed to align SSU graduates with the institution's mission and goals. As described at http://www.sonoma.edu/senate/committees/ge/lgos_new.html the GE courses come in five areas A, B, C, D, and E with the following missions:

- **GE Area A:** This area provides the students with basic concepts and experiences necessary for *human communication and critical thinking*.
- **GE Area B:** This area explains the important theories and models of the *natural sciences* to enhance scientific understanding and sense of curiosity of the students about the world.
- **GE Area C:** This area studies significant works of the human imagination to cultivate intellect, imagination, sensibility, sensitivity and interpretive skills.
- **GE Area D:** This area examines the *social science* disciplines and injects an appreciation of the multiple perspectives, diversity, and complexity of human life methodologies from the individual to the global.
- **GE Area E:** This area studies the psychological, social, or physiological processes and the interaction between the individual and society that affect the individual throughout the human life cycle.

Figure F.3 (below) lists the GE Courses that the EE Students should take in the four-year program. For more information you can go to http://www.sonoma.edu/advising/ge/50.pdf?3

Recommended GE Curriculum for the BSEE Majors Effective Fall 2015

Area Subjects	Suggested GE Courses		
	Courses	Actual units	GE Units
A. Communication and Critical Thinking (8)			
A.2. Fund. of Communication	ENGL 101	4	4
A.3. Critical Thinking	ES 210	4	4
B. Natural Sciences and Mathematics (12)			
B.1. Physical Sciences	PHYS 114 and PHYS 116	4+1	5
B.2. Biological Sciences	ANTH 201 or BIOL 115	3	3
B.4. Mathematical Concepts & Quantitative Reasoning	MATH 161	4	4
C. The Arts and Humanities (12)			
C.1. Fine Arts, Theatre, Dance and Music and Film	Select from the GE C.1 list in the SSU Catalog	4	4
C.2. Literature, Philosophies, Values	Select from the GE C.2 list in the SSU Catalog	4	4
C.3 Comparative Perspectives And /Or Foreign	Select from the GE C.3 list in the SSU Catalog	4	4
D. Social Sciences (15)			
D.1. Individual and Society	Select from the GE D.1 list in the SSU Catalog	3	3
D.2. World History and Civilization	Select from the GE D.2 list in the SSU Catalog	3	3
D.3. United States History	Select from the GE D.3 list in the SSU Catalog	3	3
D.4. US Constitution and CA State and Local Govt.	POLS 200	3	3
D.5. Contemporary International Perspectives	Select from the GE D.5 list in the SSU Catalog	3	3
E. The Integrated Person (3)			
E. The Integrated Person	Choose one from: BIOL 318, KIN 217, KIN 316, NURS 480	3	3

3/29/2016, For more informstion, visit **General Education Requirements Overview**.

Figure F.3: GE Courses for the EE Students

It should be noted that ES210 (4), Math 161 (4), Physics 114 (1), and Physics 116 (4), a total of 13 units are part of the required GE courses and should not be double counted.

It should be noted that the ES Department offers actually three GE courses:

- ES210, Digital Circuit & Logic Design (4), GE Area A3
    - For EE and non-EE students, it teaches how to analyze and evaluate scientific, inductive and deductive reasoning through digital logic and its application to logic gates and digital electronic circuits. Lab work includes designing, building and testing of digital circuits and designs. Project assignments require students present their own design and the final product in public, making persuasive presentations with efficient verbal and non-verbal skills, and listening to peer's critiques for improvement.
- ES101A, Communication in Digital Age (3), GE Area B3, and its companion lab course ES101B
- ES101B, Communication in Digital Age Lab (1), GE Area B3

  Both ES101A and B are for non-EE majors and present some high level concepts of electricity, electronics and digital circuits
    - ES101A deals with modern communications in digital age, understanding various routinely used technical terms and commonly known computer and communications components and devices; mobile communication and communication through the Internet; invasion of privacy, unethical usages and protection from them; and enhance scientific understanding.
    - ES101B uses electric and electronic equipment to build, test basic electric and digital electronics logic circuit.

F.4.5. Electrical Engineering Courses

The 54 units of electrical engineering courses cover the core and technical elective area. **Appendix 1** lists the BSEE Degree Requirements, and **Appendix 2** lists the EE Minor Degree Requirements, Electives, and Support Courses. **Appendix 3** shows the description and the syllabus of the EE courses including the course coverage plus the mapping of the CLOs and what student outcome each course supports.

Incidentally, for the last three years, there have been 8 EE minor students in AY 2013-14, 6 EE minor students in AY 2014-15, and 5 EE minor students in AY 2015-16.

Students gain capabilities in circuit analysis and hardware design with ES112 (Fundamentals of Digital Logic Design), ES210 (Digital Circuits and Logic Design), ES310 Microprocessors and System Design).

The core areas of EE Circuit Theory, Electronics, Systems and Signals, Electromagnetics, Computer Hardware and Microprocessor Design, Communication Theory, and Networking are the required topics. The program has a strong software component in requiring eight units of programming that covers Python and MATLAB programming and includes an elective course on Artificial Intelligence. Many of the graduate level courses are cross-listed as senior level courses that can be taken as electives. The senior design project requires the students to work with a client or customer whose requirements of a real product form the basis for design. All these support our PEOs.

The EE program has a major emphasis on engineering design. To prepare students with a basic understanding of design methodology, EE students are required to take ES110 (1), which is the first introduction to the design process and the use of basic engineering design tools and ES112 (1) that provides the basics of digital circuits. Students acquire design experience in various laboratory courses, as well as fulfilling class design projects in the first three years of the BS (EE) program. In their senior year they are required to take a one-year senior design 4-unit course sequence, ES492 (Senior Design I, 1-unit) and ES493 (Senior Design II, 3-unit).

The Engineering Department at SSU offers a bachelor's degree in *Electrical Engineering* with specialization in electronics and communication. The core courses consist of the foundation courses in EE and advanced topics in the faculty's specialty areas. Examples of the advanced courses include: Analog and Digital Communications, Probability and Statistics for Engineers, Linear System Theory, Networking and Network Management, Embedded Systems, RF Design, VLSI Design, and Digital Signal Processing.

F.5. The Curriculum and its Associated Prerequisite Structure to Support the Attainment of the Student Outcomes

Figure F.3 displays the EE program structure and how the courses relate with their associated pre-/co-requisites.

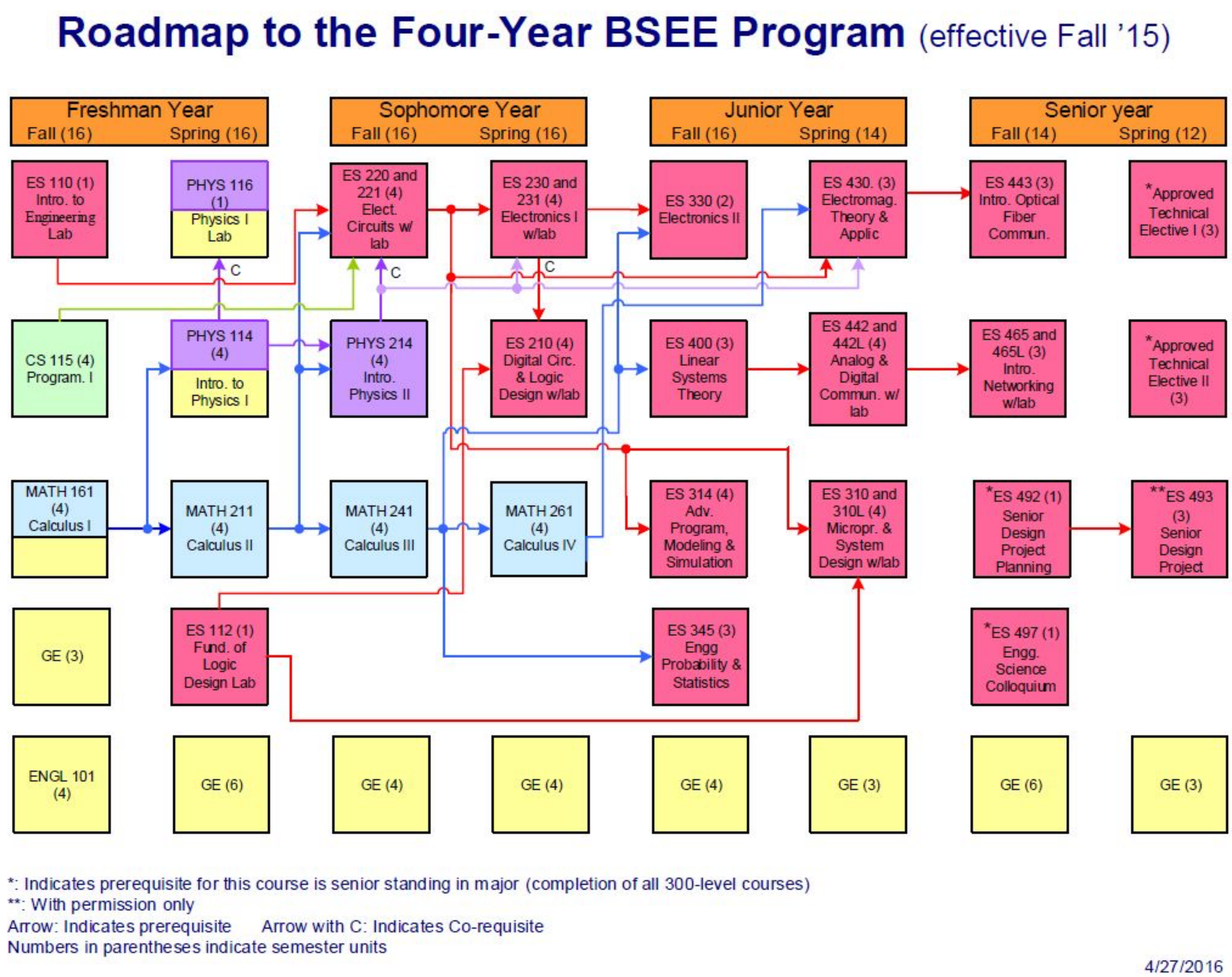

Figure F.3: EE Program structure with mapping of courses with their associated pre-/co-requisites

F.6. Program Design Experience

The major design experience within the EE curriculum is contained in Senior Design Project Planning (ES492 a 1-unit, fall semesters) and Senior Design Project (ES493 a 3 units, spring semesters). Both courses are required for the EE degree and students take these courses during their senior year.

The two-semester senior design project course calls on the professional skills of the discipline; it draws on core disciplines of the students` major field of study, as well as exploring necessary topics such as scheduling, organization, budgeting, prototyping, developing teamwork, customer liaison skills, employ creativity in proposing new solutions, and so forth. Hence, by the end of the capstone process students are expected to have a good understanding about the various design phases, including analysis phase, a design phase, a validation phase, a production phase, testing phase, and documentation phase.

During the first semester, students are introduced to the principles of the engineering design process. Students are asked to complete small group projects, formulate problem statement, analyze requirements, list design constraints, and formulate a solution based upon skills acquired in earlier coursework. Students are encouraged to apply for an undergraduate research grant from the university. Students are required to make a presentation about their progress at the end of the first semester. Students are required to list the courses that have been helpful to them in their presentation slides.

Thus, upon the completion of ES492, each student team is expected to present a *Preliminary Design Review* (PDR). The twofold purpose of the PDR is for the team to present their preliminary design and receive feedback from the Faculty Review Board on that design. At the PDR, each team will deliver a written report presentation to the Faculty Review Board and team advisor. Each team member participates in the preparation of the report as well as the preparation and delivery of a PowerPoint presentation. The report and presentation includes a problem statement, requirement specifications, system-level block diagram and project specifications, as well as the team`s proposed prototype specifications. The advisor and Faculty Review Board can modify the proposed prototype specifications at the PDR. The prototype specifications must be substantial and complete enough to demonstrate that the team has successfully tackled one or more of the core technical design challenges of the overall project. The prototype specifications will be included in the team presentation to the class at an all-course meeting. The project manager's responsibility is to schedule the team`s PDR.

Midway through ES493, each team of student is required to provide a *Mid-course Design Review* (MDR). The MDR takes place before the Faculty Review Board and the team advisor near the end of the Capstone course. The twofold purpose of the MDR is for the team to present a prototype (and its associated design) and to receive feedback from the Faculty Review Board and the team advisor on the design. The hardware and/or software prototype presented should demonstrate that the chosen design path is likely to lead to a completed project in April that meets or exceeds the project specifications. The role of the Faculty Review Board is to provide independent feedback to the advisors and team members. The review board consists of ES faculty members that participate in all MDRs.

Each team turns in a written report and delivers a PowerPoint presentation at the MDR. Each team member must participate in the preparation of the report as well as the preparation and delivery of the PowerPoint presentation. The MDR report and presentation must include a problem statement, requirement specifications, system-level block diagram, project specifications, and an explanation and demonstration of how the MDR specifications were met. The Board suggests a grade to the advisor. The project manager is responsible for scheduling the specific MDR time for their team and maintaining all the required forms.

Upon completion of the project in ES493, students are required to present their *Final Design Review* (FDR). The FDR is essentially a formal oral presentation of the content of the Final Project Report. The FDR will generally be given off-site at the **SoCo Nexus**, a broad-reaching and fast-growing innovation community focused on empowering startups throughout the North Bay located about two miles away from the SSU campus. Students are expected to submit their *Final Project Report* (FPR) at the time of their presentation.

The FPR must completely specify the design solution and also present the final detailed design, including design optimization documentation and appropriate engineering drawings and schematics. Any performance results must also be included, as well as cost information and environmental impact of the design. The FPR should include a complete accounting of the project management issues and an overall assessment of the project. In short, the Final Project Report provides everything the client or customer needs to know about what you was accomplished. All requirements regarding the senior design project are provided in http://www.sonoma.edu/users/f/farahman/sonoma/courses/capstoneproject_1/syllabusweb.htm

F.7. Engineering Lecture Series

The ES Lecture Series, http://www.sonoma.edu/engineering/lecture_series/, sponsored by Keysight (formerly Agilent) Technologies, is organized for the benefit of the academia, industry, businesses and community in the North Bay region, particularly the Sonoma County area, to keep abreast with the advancement of science and technology developments and future trends in various high tech fields including communications, computing, networking, RF, photonics and fiber optics, solar energy, computational biology, and robotics. Attendance in the seminars is open to the students, faculty and staff of SSU and any other academic institutions, engineers and scientists from the industries, members of the business community and members of the community.

The ES lectures are generally held on the 1st & 3rd Thursdays, 4:00 - 5:30 PM, every month in each semester. The 1st half hour is for reception and refreshments, followed by the presentation including the Q&A from 4:30-5:30 PM.

Expert speakers from industry and academia are invited to lecture on the trend of technologies so that the students would have a better understanding in selecting jobs with a better future. Keysight Technologies have been sponsoring the lecture series. The lectures are Audio/Video recorded and saved on the server for those who missed a lecture and watch it later, simply by going to "Go to Past Lectures" (http://www.sonoma.edu/engineering/lecture_series/) and click on the lecture of interest. At end S2016, there were 111 ES lectures including 24 invited speakers from Keysight Technologies (21.2%) and 15 female speakers (13.5%).

The ES Colloquium, ES497/CES597, course is based on the ES lecture series where the students are required to write a technical report on each lecture to improves their technical writing communications skill. The students are required to develop presentation slides on technical and informative topics and present to their classmates. These sessions are to improve the student presentation skills. Topics in Fall 2016 includes "How to write good resume", "Engineering job-hunting", "Interviews for engineering jobs", "Product life cycle", "Electrical engineering identity crisis", "Most in-demand engineering jobs", "Electrical engineering has a great future growth potential", "Evolutions in electrical engineering in the past century", "20 Greatest Engineering Achievements of the 20th Century and identify those that are related to electrical engineering", and "Discuss the impact of the information age on society, economy, world politics, the way we live, etc.". This course supports the **Student outcomes g, i, j, and k**.
http://www.sonoma.edu/engineering/lecture_series/

F.8. Skill Building Workshops

Every semester, the faculty, local professionals, graduate and undergraduate students offer informational and practical skill building training workshops beyond the scope of our regular engineering classes. All EE and MSCES students are highly encouraged to attend these workshops. Eligible students can receive units towards their technical electives or missing credits. All students who complete a workshop will receive an official Certificate of Completion from the department. The students can ask the Department Chair for more information or see http://www.sonoma.edu/engineering/activities/skills/. The interested students can signup for free upcoming **Skill Building Workshop**.

The Skill Building workshops mainly support the **Student Outcomes e, i, j, and k**.

In summary, the engineering portion of the curriculum strongly aligns with PEO 1 and serves as a vehicle for fulfilling PEOs 2 and PEO 3.

G. FACULTY OF EE PROGRAM

G.1. Overview

The ES Department comprises two programs, the EE undergraduate program and the CES graduate program. Due to major changes in the high-tech industry and their needs, these programs have gone through several important changes in recent years. In particular, four years ago, the department launched a five-year plan to rebuild and grow the department both in size and of quality. It is necessary to place the performance of the faculty and staff in light of the development of the department effort to better describe the achievements of the engineering faculty. A brief overview of the department's performance is presented here, followed by each specific criterion item.

First the main responsibilities of the faculty are:

- *Teaching*
  - Teaching - Undergraduate and graduate lectures, labs, and advising the student projects.
  - Advising - class taking, problems with studying, research, career, others.
  - Constant Curriculum Improvement - to fit the needs of the students and industry.
- *Research* - mentorship, grants, presentations and publications.
- *Administration*
  - Serving in various committees - at department, school, and university levels.
  - Take part in the department meetings and retreats, and represent the department in various school and university committees.
- *Additional*
  - Professional development - conferences, workshops, professional organizations.
  - Outreach - colleges, pre-college schools, participating in community events, establishing connections with the high-tech industry.

However, our faculty are additionally involved in the following activities:

- *Teaching and Curriculum Improvement of the program*
  - *Tutoring* - In order to ensure our Freshman students are doing well in their Physics, Programing, and Math courses, our EE faculty often volunteer to tutor then in these courses.
  - *ABET accreditation* – The continuous improvement of the program will continue using the ABET processes and plan to apply for ABET accreditation till we have enough full-time faculty members.
  - *ES485,* "Selected Topics in Engineering Science: Electronic and Optoelectronic Devices" – new 3-unit EE elective course.
  - *Senior Design Projects* – continue to improve
  - According to the project mentors/advisors, the senior design projects have already improved a lot in the past 2-3 years. These improvements are based on the level, mobility application, and customer support of the projects.
  - ES497: Engineering Science Colloquium - The students in the associated course (are required to write a technical summary report on each ES Lecture they attend to improve their technical writing communications skills. Additionally to improve their general communication skilss:

  - The students are required to develop a slide presentation and present to the classmates in the areas of building oral and written communication skills, writing resume and improving the interview skills.

- *Research*
  - *Engineering Summer Academy* – to help the research, hands-on, and team working experience of the students.
    - We had two summers in which the faculty mentors worked with 20+ students (from SSU, UC, SRJC, and local high schools) on various research projects; sponsored by faculty grants, student grants, scholarships and the foundation funds.
- *Administration*
  - *Recruitment* - new pipeline from Santa Rosa Junior College (SRJC), BSEE-MSCES program with the following institutions: Ansal University in India, South Ural State University – Technical Faculty, Electro-technical Department South Ural State University, Russia, and Universidade da Beira Interior, Portugal.
  - *Student Tracking* - As part of student advising the Department tracks the performance of each Freshman student in supporting courses, such as Physics, Programing, and Math to ensure students are performing at a satisfactory level. Student tracking forms are available upon request.
- *Additional*
  - *Industry Advisory Board* - continue our IAB meetings
  - *Advising EE Student Club* – help the club grow and improve team building.
  - *Advising SWE, Society of Women Engineer student chapter* – help with growing the club and increase their activity.
  - *Graduate Program* - help the program grow

G.2. Faculty Qualifications

The SSU Engineering Department consists of faculty in two categories: tenured and tenure-track (TT) and adjunct faculty. As of Fall 2016, there are two full-time faculty members including an Associate Professor who also chairs the department, one Tenure-Track Assistant Professor, two part-time professors from the CS and Physics departments, and over half a dozen of adjunct professors to teach the courses and take care other functions. Table G.1 lists the course teaching and professional involvement of faculty.

Table G.1. Faculty Qualifications

Faculty Name	Highest Degree Earned - Field and Year	Rank	Appointment	FT or PT	Years of Experience		Courses Taught/Teaching
					Academic	Industrial	
Derek Decker	Ph.D. in BioPhysics (in progress)	A	A	FT	3	14	ES110, 112, 220, 221, 230, 231, 442 Lab
Don Estreich	Ph.D. in EE	A	A	PT	7	30	ES101A, 230, 330, 442
Farid Farahmand	Ph.D. in EE, 2005	ASC	T	FT	8	18	ES Dept. Chair, ES310, 442, 465, 492/493

Brendan Hamel-Bissell	Ph.D. in EE, 2016	AST	TT	FT	1	4	ES101B, 314, 443
Sara Kassis	Ph.D. in Physics, 2009	A	A	PT	12	1	ES101A, 112, 345
Ali Kujoory	Ph.D. in EE, 1974	A	NTT	PT	29	22	CES552, ES497, 465, 442, 230, 210Lab, 101A, 101B, & *ES Lecture Series*
Shahram Marivani	M.S. in EE	I	NTT	F	9	5	CS 101, CES 490b, ES101B, 110, 210 Lab, 231, PHYS 231
Saeid Rahimi	Ph.D. in Solid State Physics, 1982	A	A	PT	32	22	ES110, 430, 485
Bala Ravikumar	Ph.D. in CS, 1987	P	T	PT	27	1	ES314, 480
Hongtao Shi	Ph.D.in Physics	P	T	PT	17	1	ES430

(A = Adjunct, ASC = Associate Professor, AST = Assistant Professor, FT = Full Time, I = Instructor, NTT = Non Tenure Track, O = Other, P = Professor, PT = Part Time, T = Tenured, TT = Tenure Track)

The size of adjunct faculty fluctuates from semester to semester, depending mostly on the demands of the course offering and the instructor's specialty. However, Dr. Don Estreich, Dr. Ali Kujoory, Mr. Shahram, and Dr. Saeid Rahimi are the four long-standing adjunct members and have developed and taught many courses. Dr. Rahimi who was the main agent to bring in the CES and later the EE programs, had the Acting Provost position in 2013. After he retired, he joined the ES Department on FERP (Faculty Early Retirement Program) and he is now teaching courses in the EE program as an adjunct professor.

Both Dr. Kujoory and Mr. Marivani have been active in the department as adjunct professor since 2003 and established their "three-year teaching entitlement" twice, following California State University's policy on protecting lecturer's right of teaching. Dr. Kujoory had retired from his long and outstanding career at AT&T Bell Laboratories and Alcatel. Dr. Estreich who had retired after outstanding career at HP/Agilent Technologies joined as adjunct professor in fall 2009. He donates his salary to the Engineering Department as part of his volunteer service for the department.

Other adjunct faculty members that taught in the last two semesters include:

- Dr. Loren Betts, Ph.D. in EE, R&D at Keysight Technologies, taught ES485 RF Design and ES210.
- Dr. Chris Halle, Ph.D. in Mechanical Engineering, taught ES314.
- Dr. Ryan Hirth, Ph.D. in EE, Director at Broadcom, taught ES485 VLSI Design.
- Mr. David Leyba, M.S. in EE, R&D at Keysight Technologies, taught ES400.

The adjunct faculty pool includes a group of highly qualified professionals from local engineering and science communities who have cutting-edge expertise in various engineering disciplines and interests. Furthermore, the newly established Engineering Department Industry Advisory Board (IAB) is expected to enhance the Department's adjunct pool both in quantity and quality. The department has strong support from the telecom industries in Sonoma County, in particular Keysight Technologies, National Instrument, Medtronic, Cyan, Parker, Solmetric, and many other individual local scientists and engineers.

G.3. Faculty Workload: Full-Time Equivalent Faculty (FTEF) & Student/Faculty Ratio

Following the departure of two faculty members in August 2015, the department hired a one-year visiting faculty and involved many adjunct faculty from the pool to carry on the teaching load. At the same time, the department experienced a moderate increase in number of enrolled EE majors and minors. Consequently, larger classes, created even more work for our faculty. However, with the extra ordinary dedication of both the adjunct and full-time faculty, the department graduated 18 EE students in Spring 2016. Currently, 86 percent of this class is employed in the high-tech industry.

Table G.2 shows the Full-Time Equivalent (FTE) teaching in the academic year F2015-S2016.

Table G.2. Full-Time Equivalent Teaching in F2015-S2016

Course	S-UNIT	WTU	Semesters	Enrollment	FTES	FTEF
ES110: Intro. to Eng'g and Lab Experience	1	2	F15 & S16	31	2.07	0.13
ES112: Fundamentals of Digital Logic Design	1	2	F15 & S16	37	2.47	0.13
ES210: Digital Circuit and Logic Design	4	5	F15 & S16	28	7.47	0.33
ES220: Electric Circuits	3	3	F15	21	4.20	0.20
ES221: Electric Circuits Lab	1	2	F15	18	1.20	0.13
ES230: Electronics I	3	3	S16	20	4.00	0.20
ES231: Electronics I Lab	1	2	S16	20	1.33	0.13
ES310: Microprocessors and System Design	4	5	F15	11	2.93	0.33
ES314: Advanced Programming, Modeling and Simulation	4	4	F15	30	8.00	0.27
ES330: Electronics II	2	2	F15	28	3.73	0.13
ES345: Probability and Statistics for Engineers	3	3	F15	20	0.00	0.20
ES400: Linear Systems Theory	3	3	F15	25	5.00	0.20
ES430: Electromagnetic Theory and Applications	3	3	S16	20	4.00	0.20
ES442: Analog and Digital Communications	4	5	S16	23	6.13	0.33
ES465: Introduction to Networking and Network Management	3	4	F15	20	4.00	0.27
ES492: Senior Design Project Planning	1	1	F15	21	1.40	0.07
ES493: Senior Design Project	3	3	S16		0.00	0.20
ES497: Engineering Science Colloquium	1	1	F15/S16	27	1.80	0.07
ES444: Introduction to RF Design	3	3	S16	18	3.60	0.20
ES485: Selected Topics in Engineering Science, VLSI Design	3	3	S16	12	2.40	0.20
TOTALS					**65.73**	**3.93**

From the table above:

- FTES = *Sum (Course # of students x Credit units) /15 = 65.73*
- FTEF = *Sum (Course # of Instructors x Work Teaching units) /15 = 3.93*
- Student-Faculty Ratio = *FTED /FTEF = 65.73/3.93 = 16.71*

G.4. Faculty in the Committees

The number, the activities, and the accomplishments of the committees in the ES Department are truly remarkable, considering the small size of faculty. The key to this success is through the collective and supportive committees and task groups formed by both TT and adjunct faculty. Table G.3 lists varios committees the ES faculty members are involved in.

Table G.3. ES Faculty members in ES Department, SST, and SSU Committees

Committees	Dept	School	University
Industry Advisory Board	Rahimi (2012-16) Kujoory (2012-16) Estreich (2012-16)		
Assessment, Evaluation, Improvement	Rahimi (2015-16) Kujoory (2015-16) Estreich (2015-16)		
Curriculum	Decker (F2015-S16) Hamel-Bissell (F2016-S17)	Hamel-Bissell (F2016-S17)	
Graduate Admission	Rahimi (2012-16) Farahmand (2011-16) Kujoory (2012-16)	Farahmand (2012-15)	Farahmand (2012-16)
RTP (Reappointment, Tenure and Promotion**)**		Rahimi (2012-15) Farahmand (2015-16)	Farahmand (2012-16)
Chair		Su (2012-15) Farahmand (2015-16)	
School Faculty Development		Farahmand (2011-16)	
Senior Design Project Approval	Kujoory (2012-16) Estreich (2012-16) Farahmand (2012-16) Rahimi (2012-16)		
Resource	Farahmand Rahimi Shahram (2012-16)		
Recruitment (Reach out to High Schools)	Estreich (2012-16) Goodlund (2012-16) Marivani (2012-16)		
Student Advisors	Rahimi (2015-16) Farahmand (2015-16) Kassis (2015-16)		
SST Women In Tech Coordinator		Kassis (2016-17)	
Diversity Council, Sonoma State University			Hamel-Bissell (F2016-S17)

Many of EE faculty members, are also involved in community activities. For example, the Department Chair is also serving as a member of MESA Industry Advisory Board in Santa Rosa Junior College.

G.5. Teaching Performance

Based on the received responses from 2016 Exit Surveys, our students have been satisfied with performance of EE faculty. Table G.4. Summarizes the student satisfaction with faculty knowledge, availability, and instruction from the 2016 Exit Survey in **Appendix 6.f.1** and **2**.

Table G.4. The student satisfaction with faculty knowledge, availability, and instruction

Question	Great Strength	Above Average	Average	Below Average	Week
Q 4.1.1: Overall satisfaction with faculty knowledge of subject matter	36.8	57.9	5.3	0	0
Q 4.1.2: Overall satisfaction with faculty availability outside classroom	36.8	42.1	15.8	5.3	0
Q 4.1.3: Overall satisfaction with course instructions	10.5	63.2	26.3	26.3	0

For the evaluation of the teaching effectiveness of the instructors, the SETE (Student Evaluations of Teaching Effectiveness) surveys are used at SSU. Figure G.1 shows the Aggregate of Instructor Evaluation of the courses taught at the ES Department in Spring 2016.

Based on the Spring 2016 Department aggregates, the satisfaction mean in all categories is about above 4 (out of 5), indicating that the students are satisfied in all categories. It should be noted that the Department Chair receives and evaluates the SETEs for all the courses and communicates with the instructors should there be need for further improvements.

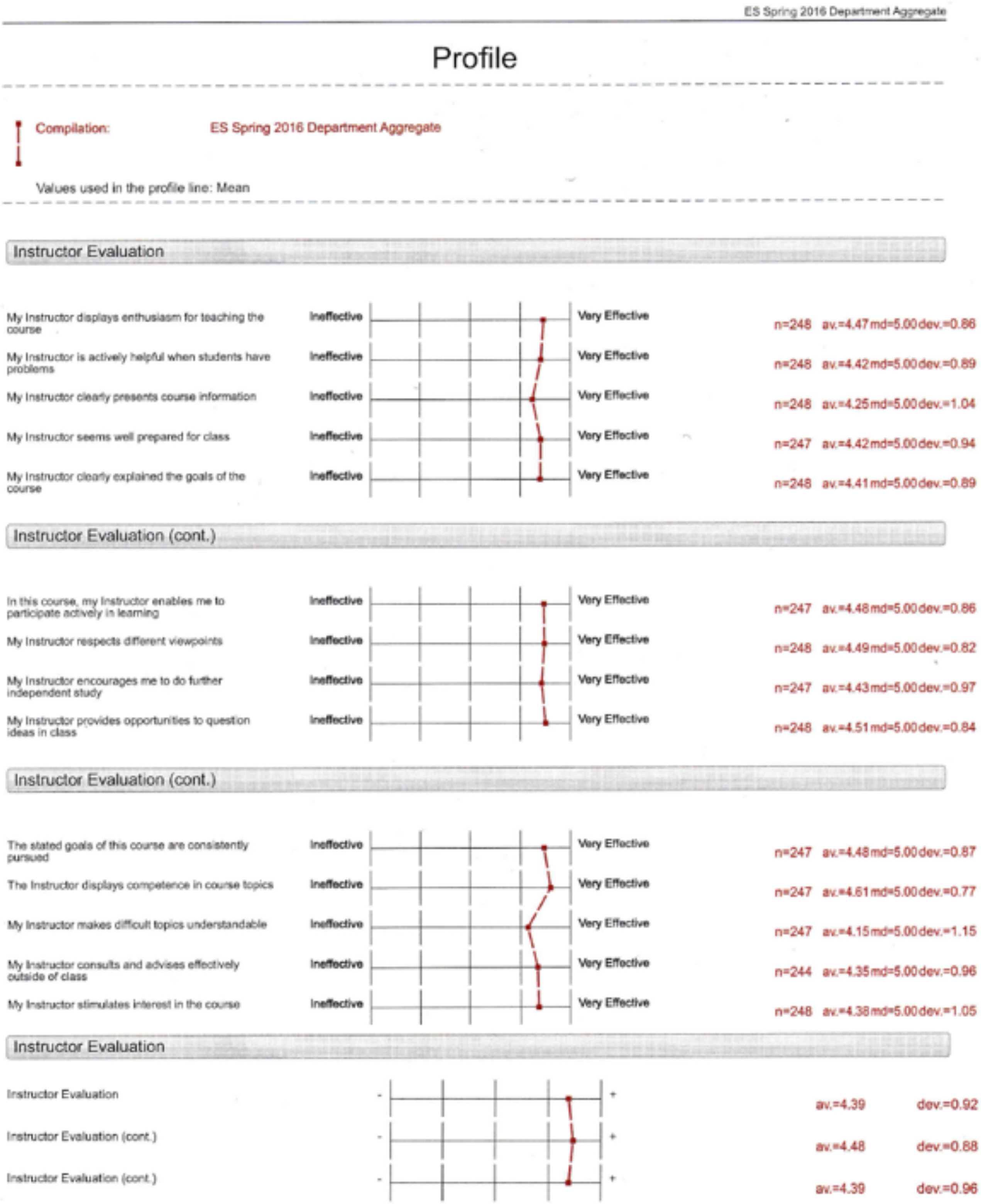

Figure G.1. Spring 2016 Aggregate of Instructor Evaluation

G.6. Student Advising

Prior to 2013 student advising was only conducted by the Department Chair. In order to cope with the enrollment growth, the department has changed this practice and since then all TT faculty members are involved in advising. It must be noted that following departure of two TT faculty in Fall 2015, the department has been involving the adjunct and visiting faculty to assist with some of administrative tasks (e.g., attending committees, and participating in outreach activities) and student advising.

Overall, however, based on students' responses in Exit Surveys, most of our graduates appear to be satisfied with the quality of the advising they received. Table G.4. Summarizes the student satisfaction with advising from 2016 Exit Survey in **Appendix 6.f.2.** However, we believe that through newly implemented shared advising strategy, the overall advising quality can be further improved. Through more effective advising, we believe the department can further improve the interaction between the students and faculty, which in turn can result in improving student retention rate and student's learning effectiveness, in general.

The shared advising strategy has improved the interaction between the students and faculty, which in turn has increased student retention rate (please see Fig. A.1) and student's learning effectiveness in general. Some other benefits brought by the new advising system include greater student involvement in the classroom teaching (primarily as graders, lab assistants, peer tutors, etc.), more engagement in faculty research, greater participation in our Engineering Summer Academy, and increased assistance in career planning and placement for the graduating class. Table G.5. Summarizes the student satisfaction with advising from 2016 Exit Survey in **Appendix 6.f.2.**

Table G.5. Summary: the student satisfaction with advising

Question	Great Strength	Above Average	Average	Below Average	Week
Q 4.1.5: Overall satisfaction with availability of advising	31.6	36.8	21.1	5.3	5.3
Q 4.1.6: Overall satisfaction with usefulness of advising	42.1	26.3	15.8	15.8	0
Q 4.1.7: Overall satisfaction with advising	36.8	21.1	31.6	5.0	5.5

G.7. Research Activity

The research activities in the ES Department can be categories into three categories:

- Industry Collaboration - funded by the industry
- Faculty-Research Funded Projects carried out by faculty and funded through national funding organizations (e.g., NSF)
- Student-centered Projects that are based on student grants and scholarship funded by the university and CSU system.

Industry interactions: The ES Department was founded through generous donations and strong support of local industries. To this date, such strong ties have remained intact. Our EE students continue to receive industry support, ranging from scholarships, internships, and employment opportunities. Over the years, the faculty has played an important role in fostering this alliance with the industry. Furthermore, Industry Advisory Board (IAB) plays a critical role in strengthening such partnership. The IAB was initiated in 2014 under the leadership of Dr. Rahimi. It consists of fifteen Board members who are either founders or executive officers of prominent companies in the North Bay region. Since its conception, the Board members have worked closely partnered with faculty in providing practical work experience and enhancing professional training for EE students.

G.8. Toward ABET accreditation

In 2012 the Department started to gather all the support and know-hows processes to pursue ABET (Accreditation Board for Engineering and Technology) accreditation. This was led mainly by tireless efforts of Dr. Kujoory, who is an adjunct faculty member with over twenty three years of industrial experience at IBM, AT&T Bell Laboratories, and Alcatel), and with over twenty five years of academic experience at several universities teaching both graduate and undergraduate courses. Under Dr. Kujoory's leadership, the Department put together a draft Self Study Report and sent it to one of the ABET teams for their comments before applying for accreditation. Being the first on SSU campus to apply for ABET, it was necessary to go through a Readiness for Review process which was due by November 1, 2014. ***The department did so to establish a standardized process of assessing and evaluating the program and get addicted to continuous improvement of the program.*** We received some minor comments for the draft Self Study Report that we implemented. However, the Department realized that the very low number of faculty can be a big shortcoming and the chance of getting final accreditation would be low. So, the Department decided to delay going for the full ABET review until the department hires and have an acceptable core number of full time faculty.

The department is dedicated to complete the ABET accreditation for the following reasons:

- Improve the program and make it more acceptable by the student and community, hence to increase the student population and program quality.
- Make the program more acceptable for the industry.
- Receive the CSU accreditation automatically since CSU accepts the ABET accreditation.

H. FACILITIES IN ES DEPARTMENT

H.1. Offices, Classrooms and Laboratories

The ES department, called Cerent Engineering Science Complex, is located on the second floor of the Salazar building and comprises 15 small and large rooms/offices. Except the department and faculty offices, all rooms are equipped with computer cabinet with audio-visual projection. For more information, please see http://www.sonoma.edu/engineering/resources/labs/

Table H.1 summarizes the function of these rooms:

Table H.1. Classrooms and offices ES Department
http://www.sonoma.edu/engineering/resources/labs/

Salazar	Name	**Used For Lectures, Labs, Offices, and Research Activities**	**# of Seats**	**# of PCs**	**Others**
2001	Rolf Illsley Photonics Laboratory	• Lab for Optical measurement & experiments, ES 112 • Various Lectures • ES442 Lab	36	9	Lasers, optical wave meters & spectrum analyzers
2002	Agilent Technologies Communications Laboratory	• Mr. Marivani's Office • Grad students' area • RF test & measurements		6	B&W & color printers & servers
2003	Electronics Laboratory	• Lab for electronics measurements • Various Lectures • Labs for ES 101B, ES 110 and ES 221	24	13	Printer
2004	ES Department	• Offices of Dr. Farahmand and Ms. Goodlund	NA		Department printer
2005	AFC Access Technologies Laboratory	• Lab for Digital & electronics measurements • Various Lectures • Labs for ES 210, ES 231, ES 442	24	15	
2006	Networking Laboratory	• Lab for Internet & networking expts. • Various Lectures • ES465	24	25	Switches and routers
2007	Senior Project Laboratory	• Lab for Senior projects, prototypes and demos	12-20	9	Various test equipment
2008		• Classroom	16	17	
2008A		• Dr. Hamel-Bissell's office	NA		
2008B		• Dr. Rahimi's office	NA		
2009	William Keck Microanalysis Lab	• Nanotechnology, confocal imaging and SEM			AFM, SEM, LIBS and Confocal Microscopy
2009A		• Lecture series and Big classes	40		
2010A		• Dr. Sara Kassis's office	NA		
2010B		• Dr. Kujoory's office	NA		
2010C		• Dr. Estreich's office	NA		
2010D		• Mr. Decker's office	NA		

Appendix 8.a. provides a list of the equipment in the labs http://www.sonoma.edu/engineering/resources/ug/

H.2. Hardware Equipment

The electrical engineering requires various power sources and measurement equipment in the areas of electric circuits, analog and digital electronics, radio frequency, optical measurements, etc. These include

- Electronic Trainers
- Electric and electronic components (e.g., resistors, capacitors, inductors, diodes, transistors, sensors)
- Component Testers
- Digital Multimeters
- DC Power Supplies
- Function Generators
- Frequency Sweep Generators
- Laser Sources
- Network Analyzers
- Optical Spectrum Analyzers
- Oscilloscopes
- Pulse Generators
- Spectrum Analyzers
- Vector Signal Generators
- Wavelength Meters
- Computers - *the 94 computers in the labs are all obsolete, going back to 2009, and need to be upgraded.*

The department website "Resources http://www.sonoma.edu/engineering/resources/" has an excellent list of components (and their data sheet), the equipment (and users' guides) that are located in various laboratories for different courses:

Appendix 8.b. provides a list of RF & Microwave Equipment
http://www.sonoma.edu/esee/rf_mw_equipment.html

A list of the datasheet for ICs is provided at http://www.sonoma.edu/engineering/resources/ds/

A list of the Suggested Part List is provided at
http://www.sonoma.edu/engineering/resources/suggested_parts.html

H.3. Computing and Simulation Software

- National Instruments suite of software packages including
  - LabVIEW (Laboratory Virtual Instrument Engineering Workbench) - a system-design platform and development environment for a visual programming language.
  - Multisim - an electronic schematic capture and simulation program for circuit design programs. Circuits can be simulated easily without need for connecting the electronic components and soldering.
- Matlab – by Mathworks, is a high-performance language for technical computing. It can be used to

solve mathematical equations and engineering simulations. It integrates computation, visualization, and programming in an easy-to-use environment.

- Keysight Technologies suite of software packages including ADS - a software package electronic design automation software for RF, microwave, and high-speed digital applications. It is a 3D EM simulator.
- Cadence suite of software packages including
  - Virtuoso – a software tool by Cadence for simulation, circuit design, RF design, PCB layout, FPGA-based prototyping and debug analysis.
  - Verilog - a Hardware Description Language (HDL) that is standardized as IEEE 1364 and is used to model electronic systems. It is most commonly used in the design and verification of digital circuits at the register-transfer level of abstraction.
- SolidWorks – is a solid modeling computer-aided design (CAD) and computer-aided engineering (CAE) that runs on Microsoft Windows. SolidWorks is published by Dassault Systems.

H.4. ES Department Website

The ES Department website http://www.sonoma.edu/engineering/ designed and managed by Mr. Shahram Marivani provides lots of valuable on-line resources and categories of information for the students, faculty, and community.

H.5. Library Services

The University Library is housed in the Jean and Charles Schulz Information Center provides various informative resources, interlibrary loans, and service for the EE and CES students and faculty. List of the services provided by SSU Library are explained in details in **Appendix 9.** “Library Services”.

H.6. Helpful SSU Centers

There are several centers at SSU that the students can use to their advantage. These include

- SSU Writing Center http://www.sonoma.edu/writingcenter/
- Tutorial Center http://www.sonoma.edu/lss/tutorialcenter.html
- Disability Services for Students http://www.sonoma.edu/dss/
- Career Center http://www.sonoma.edu/career/
- Faculty development http://www.sonoma.edu/aa/fa/facdev/
- Support services http://www.sonoma.edu/catalog/04-06/supportservices.html

The EE program continuously provides tutoring for freshman students in need of extra assistance with their fundamental courses such as basic electronics, math, and physics. The department posts the tutoring opportunities on its web page every semester (http://www.sonoma.edu/engineering/activities/tuturing.html). Furthermore, the Math and PHYS departments also offer tutoring to students needing extra help with their love-level physics and math courses.

H.7. Maintenance and Upgrading of Facilities

SSU IT procures the software packages including those we have from Keysight Technologies, National Instruments, and Solidworks. Additionally, Mr. Marivani handles the computer updates, imaging of the software on the computers in each lab, configures the equipment, trouble-shoots lots of hardware and software problems for the faculty and the students.
A complete list of equipment in each laboratory is available on the department web page http://www.sonoma.edu/engineering/resources/ug/ . In order to ensure EE graduates are well prepared for the engineering job market the department has vigorously injected various industry standard software tools into different courses. Table below lists some of these tools and the corresponding course.

Software	Course	Application
Matlab	ES 400, 492/3	Solve math formulas, graph results
Keysight ADS	ES 444	Wireless Communications and Transmission lines
LabVIEW	ES 486	Programming and Interfacing
Wireshark	ES 465	Network protocols
Cadance /Verilog	ES 210	Draw digital circuit waveforms
Multisim	ES 210, 492/3	Draw digital circuit
Genesys	ES 430	Understanding wave propagation
CST	ES 485	Antenna design
3D Printer	ES 492/493	Making the housing and parts of the senior projects
Eagle: Schematic Design	ES 492/493	Making the housing and parts of the senior projects
MPLAB: Microchip	ES 310	Micro-controller design
Autodesk Fusion 360	ES 492/493 and projects	Cloud-based 3D CAD/CAM Tool (3D Printing)

I. INSTITUTIONAL SUPPORT

I.1. Leadership

The mission of the EE Program at Sonoma State is to provide high-quality education to a diverse group of students who will excel in an electrical engineering profession, assume leadership roles in advancing technology, remain engaged in lifelong learning, and be responsible citizens.

Over the past several years the Engineering Science has gone through a shift in curriculum direction and leadership to ensure its commitment to such mission. Under the new university leadership, Department chair, and incoming faculty the program is rejuvenating and moving to the next level. The goal of the program is to ensure that its graduates are ready and capable to seize the existing opportunities in the high-tech industry and become successful professionals.

Consequently, the program is thriving to expand it partnerships and collaborations with the community and the local industry, and local community colleges, while positioning itself as a hub for advanced technologies in areas such as fiber optic communications, RF, and Internet-of-Things in the North Bay area. As the result, over the past two years we have carefully drafted a three-year plan to expand undergraduate research and scholarly activities, and ensure student participation in real-world hands on projects, while attracting more students from high schools and neighboring junior colleges to work with EE students at SSU.

Per our three-year plan, we focus on the following tasks:

- Promote student mentorship and personal attention to all students by maintaining small classes
- Encourage hands-on teaching and learning
- Ensure that all freshmen and transfer students possess basic academic skills
- Update and improve EE program in consultation with the local high-tech industry
- Receive ABET accreditation
- Promote research and lifelong learning
- Educate students with solid technical skills and strong soft skills
- Enhance the MS-CES graduate program
- Enhance external research collaborations
- Strong industry collaboration and sponsorship
- Strengthen partnership with junior colleges and high schools

The full details of department three-year plan can be obtained upon request.

I.2. Program Budget and Financial Support

Operating Expenses: The ES Department receives $9380 per year to cover items such as supplies, repairs and maintenance of equipment and salaries for student assistants to help with grading. Currently, the Department has a $4 million endowment, which was collected through the support of support local community and industry. The endowment pays for half of the chair salary and AC in the Department. Considering the fact that currently there are only two TTF in the department, the ES department receives minimal state support, in terms of salaries. Furthermore, due to receiving adequate funding on a regular basis from the University to maintain our laboratories or facilities, over past several years the department has heavily relied on equipment donations from the local industries.

In Fall 2016, the Department was granted access to additional $50,000/year from the endowment. This additional fund will be used for offsetting faulty teaching small MSCES courses, purchasing new test equipment, and funding students and faculty summer research. In addition, the Department will be using the fund to pay for faulty assisting the Department with student advising and senior design projects.

Student Summer Research Support: Over the past three years we have received $4000 per year to support student summer research. This funding is provided from the endowed account. Through this fund, on average we have supported 3-4 students each summer.

Public Programs: The main public program is Department's bi-weekly engineering colloquium. Over the past two years the department has been receiving an average of $2000 per year from the IRA fund to support the program. The IRA fund is mainly used for paying honoraria for the speakers, pizza for participants, printing posters and advertising the series. More information about the colloquium can be found here: http://www.sonoma.edu/engineering/lecture_series/

Faculty Travel: In recent years, the School of Science and Technology has made $25,000-$35,000 available for travel funding for faculty professional development. The funding is available to faculty on a competitive basis. Generally, through this funding one or two faculty members receive at least partial funding ($1500-$2000) to attend technical conferences or training activities. It is unclear at this time whether or not this resource will be available during the next several years.

Graduate Courses: Currently, due to small enrollment in graduate courses, the Department has to fund MSCES courses with only five students. The funding is provided from the endowed account. This amounts to about $6000/year.

I.3. Equipment Support

The ES Department has been receiving various measurement equipment and devices from the local industry or funds to buy equipment since the start. Over that past 10 years, through such donations, the Department has been able to construct and maintain eight well-equipped laboratories, classrooms. This facility is constructed to accommodate the undergraduate and graduate programs and its hands-on activities. Details of equipment in each of the eight laboratories are posted on the Department web page: (http://www.sonoma.edu/engineering/resources/labs/

I.4. Staffing

Since August 2016, the department has had two full-time faculty including Dr. Farid Farahmand who is the department chair and Dr. Brendan Hamel-Bissell, who joined the Department as a new TT faculty member in August 2016. New TTF only teach 9 units during their first two years at SSU. Consequently, the Department continues to rely very heavily on adjunct faculty teaching undergraduate and graduate courses. Currently, the department has 9 part-time faculty teaching both undergraduate and graduate courses.

The Administrative Coordinator of the Department is Ms. Ronnie Goodlund who does an excellent job taking care of some 117 undergraduate students, graduate students, and about 9 faculty members.

Mr. Shahram Marivani is the Network Analyst of the department and has taught a few courses including ES231, ES210, ES110, and ES101B (since the start) as an adjunct professor. He also does excellent job in managing all the labs in the ES Department, helping students for the labs, senior projects, and answering their design questions.

In addition, through Department's OE fund and endowed account the department has been able to hire 3-5 students per semester as teacher-assistant to assist with laboratories and grading larger classes. Supporting TAs has been particularly critical in courses, which are taught by adjunct part-time faculty.

Over the past several years the department has been receiving assistance from many volunteers who continue assisting graduate and undergraduate students with their senior design project and thesis projects. These individuals represent many local companies, including the following:

- Switch Vehicle, Sebastopol CA
- Pocket Radio, Santa Rosa CA
- AeroTestra, Palo Alto CA
- Broadcom, Petaluma CA
- Dew Mobility, San Jose CA
- Keysight, Santa Rosa CA
- National Instrument, Santa Rosa CA

I.5. Faculty Hiring and Retention

Following Departure of two tenure-track faculty from the department in Fall 2015, the Department has been severely struggling with lack of instructors and assistance with student projects. In 2015 the ES department had only one TTF, who also acted as the Department chair. Consequently, the department hired 12 new part-time faculty and one visiting faculty. It is expected that in 2015-2016 the department would hire two more new faculty members.

Current faculty crunch has adversely impacted the quality of courses, particularly, the project-based courses, where special efforts are required to design hands-on activities for students. Furthermore, due to lack of resources, faculty without PhD degrees are currently teaching several of our EE courses.

The Department expects to have over 150 electrical engineering majors by Fall 2017. It is also expected that the number of students requiring advising and mentorship for their senior design projects will grow to about 24-26 students in 2017 (currently 18). We note that the new TT faculty will be teaching 9 units/semester for the first two years. Furthermore, in order to significantly reduce attrition among Freshman and Sophomore EE students, the department is currently devising plans to identify and engage at risk students. This planned intervention goes beyond EE courses and will cover mathematics and physics courses as well. Extra faculty are required to implement such initiatives. Additionally, hiring part-time faculty from the industry provides the EE students to benefit from cutting edge courses taught by the members of the local industry who are actively working in the fields outside of the expertise of the TT faculty. The department also expects to have over 25 graduate students by Fall 2018. Each graduate student is required to complete a Master's Thesis and one semester of supervised Internship. Consequently, by 2018 the department requires an equivalent to 5 **TT+** 1.25 Part-time Faculty in order to ensure offering quality graduate and undergraduate courses, provide continuous advising, and support student projects and graduate projects.

I.6. Support of Faculty Professional Development

The Department receives very limited funding to support faculty professional development. In recent years, the School of Science and Technology has made $25,000-$35,000 available for travel funding for faculty professional development. The funding is available to faculty on a competitive basis. Generally, through this funding one or two faculty members receive at least partial funding ($1500-$2000) to attend technical conferences or training activities. It is unclear at this time whether or not any of these funds will be available during the next several years.

I.7. Student & Faculty Research

The department of Engineering Science strongly supports student research and scholarly activities. Each individual faculty is responsible to apply for internal or external grants to support equipment, student salary, and parts. Furthermore, many ES faculty are highly motivated to collaborate with other institutions and local industry.

For example, over the past several years the Advanced Internet Technology in the Interest of Society Laboratory (AITIS Lab), Directed by Dr. Farahmand, has been the key entity in providing research opportunities for both undergraduate and graduate students, establishing external collaborations, involving students in publications, and successfully obtaining research money. AITIS Lab is very active is developing low-cost technologies utilized for environmental monitoring and bio-medical devices. For more information about current projects developed by students at AITIS Lab please refer to the web page http://faridfarahmandresearch.blogspot.com/. Below we present a brief snapshot of various research activities carried out by the AITIS Lab in the past three years:

Grants:

- I-CORs-NSF provided by CSUPERB 2014 & 2016 ($7500)
- Environmental Sensor Network for Academic Programs (IRA) Grant (S'14 – S'17) - $35,000
- Enhancing the Osborn Sensor Network, Sonoma County Water Agency Grant (S'14-S'16) - $4000
- CSUPERB Joint Venture for $25,000 (S'13)
- SSU Summer Research Faulty Grant (S'13-S'16) - $9000
- Green Music Center (GMS) 2013 & 2015 - ($23,000)

Student Presentations, Posters, and Peer-Reviewed Publications:

- Feng Weng & Farahmand, Advanced Flood Monitoring, presented at Global City Team Challenge Expo, Austin TX, June 2016, Sponsored by National Institute of Standards and Technology (NIST), and USIgnite
- McGuire & Farahmand &, "Techniques in Data Visualization for Electrical Engineering: From Embedded Systems to the IoT," American Society for Engineering Education, New Orleans, LA, Jun. 2016.
- Luis Reyes & Farahmand, PD Analytics: a low-cost device that can quantify tremors associated with Parkinson's Disease (S'13)- Poster presentation
- Jenifer Nunn & Farahmand, Advances in Movement Monitoring, Lawrence Berkeley National Laboratory, Berkeley, CA, March 2015
- Janene Grippi & Farahmand, A Low-Cost Real-Time Movement Monitoring System To Evaluate Parkinson Disease Treatment, Global Humanitarian Technology Conference, October 2016
- Scott Parmley, Jason Kelly, Farid Farahmand, "Smarden: A Smart Gardening Approach to Conserve Resources," Global Humanitarian Technology Conference (GHTC), San Jose CA, Oct. 2014.
- Harika Kuppuru, Swathi Matsa & Farahmand, "Introducing a Remotely Accessible Optical Laboratory for Undergraduate Students," American Society for Engineering Education (ASEE), San Antonio, TX, Jun. 2013.

Partnerships and Collaborative Projects:

- Switch Vehicle, Sebastopol, CA
- Pocket Radio, Santa Rosa, CA

- AeroTestra, Palo Alto, CA
- Broadcom, Petaluma, CA
- Dew Mobility, Jan Jose, CA
- Keysight Technologies, Santa Rosa, CA
- National Instrument, Santa Rosa, CA
- Lawrence Berkeley National Laboratory – Erath Sciences, CA
- Austin Cancer Center TX
- Oncology Institute of Methodist Hospital, Bourbonnais, IL.

For more information please refer to http://www.sonoma.edu/engineering/activities/scholarly_works.html.

Through the above collaborations and partnerships, many Sonoma State University EE students have received real-world paid internship positions.

In addition to scholarly activates sponsored by AITIS Lab, many other students have submitted their scholarly and research work to SSU library. It is worth mentioning that overall, each year the ES Department sponsors 10-14 paid student research assistants to work on various projects.

Furthermore, in addition to guiding and mentoring students, in spite of being extremely short-handed, the Engineering faculty is highly dedicated to scholarly works in their area of concentration. Below we provide a partial list of peer-reviewed publications by the Engineering faculty over the last three years:

- M. Masud Hasan, Farid Farahmand, and Jason P. Jue, "k-Connected Network Partitioning Under Shared Risk Link Groups," J. Opt. Commun. Netw. 7, 695-706 (2015)
- Zuqing Zhu, Chuanqi Wan, Farid Farahmand, and Jason P. Jue, "Energy-Efficient Translucent Optical Transport Networks with Mixed Regenerator Placement", *Journal of Lightwave Technology*, Nov. 2013
- M. Masud Hasan, Farid Farahmand, Jason P. Jue, and Joel J. P. C. Rodrigues, "A Study of Energy-Aware Traffic Grooming in Optical Networks: Static and Dynamic Cases", *IEEE Systems Journal*, Sep. 2013
- Ou, J., Saephan, C., Maldonado, A., Kikuchi, J., Farahmand, F., and Caggiano, M., "A Low-Cost PCB Fabrication Process," Electrical Components and Technology Conference, Orlando, Fl, May 2014.
- Numerical Analysis of Conformal UC-PBG Structures; Khaleel, Haider; Al-Rizzo, H.M.; Rucker, D.G. (Progress In Electromagnetics Research M, 2011), A Systematic Approach for the Design, Fabrication, and Testing of Microstrip Antennas Using Inkjet Printing Technology , Al-Naiemy, Yahiea; Elwi, Taha A.; Khaleel, Haider; Al-Rizzo, Hussain (ISRN Journal of Communications and Networking, 2012)
- Miniaturized Thin Soft Surface Structure Using Metallic Strips with Ledge Edges for Antenna Applications , Abushamleh, Said A.; Al-Rizzo, Hussain; Kishk, Ahmed A.; Abbosh, Ayman;Khaleel, Haider (Progress in Electromagnetics Research B, 2014)
- A Novel µ-Negative Metamaterial with Enhanced Rejection Bandwidth; Khaleel, Haider; Al-Rizzo, Hussain; Abbosh, Ayman; Abushamleh, Said (American Journal of Engineering and Applied Sciences, 2013)
- High Impedance Surfaces for Flexible and Conformal Wireless Systems, Khaleel, Haider; Al-Rizzo, Hussain M.; Issac, Ayman; Abushamleh, Said (American Journal of Engineering and Applied Sciences, 2014-06)

J. ACTION PLAN STARTING SPRING 2017

First, the ES Department will wait to hear what the **External Reviewer** recommends for improvement after the visit.

Next, based on available feedback and comments from our own EE students and the external reviewer, the ES department is dedicated to work toward improving its program. A detailed description of department goals and objectives over the next three years has been provided in a separate document[8]. Below, we summarize areas that we believe require particular attention and for each area we briefly point out tasks that are in progress or will be implemented in the new future:

- ABET Completion
  - The department is dedicated to Continuous Improvement and it is planning to apply for ABET accreditation. Therefore, it continues to improve per ABET requirements, particularly in terms of documenting student assessment and performance.
  - The department is committed to create strong relationship with employers who hire its graduates. This will assist the department to collect valuable information about the quality of our graduates as they enter the job market.
  - The department is planning to assign Student Outcome Champions for each student outcome to work with the course instructors and address the relationship between the student outcomes and the course learning objectives, improve the course assessment reports (e.g., Appendix 5.c.) and work with the department curriculum committee to review the Program Educational Objectives periodically and continuously improve the program.

- Hiring New TT Faculty
  - Over the past year the department has been operating with ONE TT faculty. This has been absolutely detrimental to the normal operation of the department and the quality of the program. We are glad that University administrators have agreed to hire two new TT faulty for Fall 2017.
  - Ideally the department needs five full-time plus five adjunct faculty members in order to offer high-quality undergraduate and graduate courses, fully conduct all its administrative responsibilities, and engage in cutting-edge research areas.

- Student Research
  - Funding is the key to be able to engage students in scholarly activities. Through sufficient funding, faculty can receive adequate release time to be engaged in meaningful research and engage their students in such activities. Available research continues to point out that students, who are involved in scholarly activities during their undergraduate years, can excel significantly beyond their graduation.

- Student Advising
  - Mandatory Advising: As of 2014, the department has been rigorously emphasizing on the importance of advising. As such, all first-year freshman and transfer EE students must attend **mandatory advising**. The department preferably should expand mandatory advising to the first two years and the senior year.
  - Advising Training: While, hiring new TT faculty can certainly improve the overall advising process, it is important that all new faculty members receive proper training regarding effective advising.

[8] Please refer to (https://docs.google.com/document/d/1sjsAaqpooxqKHMtwypvteWemdSQYWQXVD0aqyjXB-MM/edit?usp=sharing).

- Effective Group Advising: Over the past several years, in addition to individual advising the department has conducted group advising. In these sessions the advisor attend a freshman course and spends 20 minutes talking about the registration process. We intend to make these sessions more effective.
- Peer-Advising: Peer-advising has proved to be very effective. However, the department must take the lead in preparing and engaging more senior students in such efforts.
- Student Tracking: As part of student advising the Department tracks the performance of each freshman student in supporting courses, such as Physics, Programing, and Math to ensure students are performing at a satisfactory level. Student tracking forms are available upon request.
- On-line Advising: In order to reach out to new and transfer students, the department should establish online advising. Currently, the department has created a web page dedicated to answering registration questions for new and transfer students (http://goo.gl/y9NOYs). More can be done in this area, including setting aside online advising sessions over summer.

- Communications with Students
  - Club Advising: The ES department must improve its communications with clubs and have a more active role in guiding them to define their activities.
  - Inviting Club Presidents: The Department has been inviting the presidents of the Engineering and SWE clubs to the Department meetings to receive their feedback. Such efforts much be more consistent.
  - EE Student Outreach: The ES department must attempt to reach out to all EE students to make them aware of the current changes and activities in the department.

- Tutoring Students
  - Provide one-on-one tutoring for students needing extra assistance with EE courses. Such tutoring sessions can be offered by more advanced students. Currently, the department is working with the Learning Center to offer more tutoring hours for advanced and freshman courses.
  - Designate and utilize on-line recourses for courses that historically are challenging for students. The ES department has currently compiled a web page for this purpose (goo.gl/m3osDs). More improvements are required in this area.
  - Freshmen Tutoring: In order to ensure our Freshmen is doing well in their Physics, Programing, and Math courses, our EE faculty often volunteer to tutor then in these courses. The department should compensate one or two faculty for conducting more rigorous tutoring in these areas.

- Support the graduates
  - As part of its responsibility, the department believes that it must fully prepare students for their first entry-level jobs. In some case and for some students requiring extra assistance, such training can go beyond their graduation.

- Improving the Overall Curriculum
  - Change the "ES" in the course number to "EE", in order to represent the true nature of the courses and their focus
  - Changing the content of the 3-units of ES314 "Advanced Programming, Modeling & Simulation" such that it can be offered as a 2- or 1-unit course.
  - Introduce more projects into the courses and the labs to enhance the design skills of the students.
  - Evaluate the courses more rigorously using the collected student assessments and feedback. As such we believe we can identify difficult sections and areas and assign tutors or design more effective assignments.
  - Improve the teaching effectiveness using student feedback and comments.

  - Enforce course pre-requisites in order to ensure student readiness.
  - Engage students in mentorship to build and improve their soft skills.
  - Add engineering ethics in forms of modules throughout various engineering courses.
  - Include more elective courses, in order to enable students to build expertise in particular engineering area they with to be involved.
    - Take advantage of online resources and activities to prepare students for core courses.
    - Take advantage of online resources and activities to prepare transfer students prior to attending SSU.

- Improving Laboratory-based Courses
  - Introduce more laboratory-based courses as technical electives.
  - Ensure laboratory-based courses and laboratory activities include software and hardware tools common in the industry, such as LabVIEW, Matlab, WEKA, R, Cadence, AutoCAD, Fusion, FPGA, etc.
  - Upgrade the computers in the lab. As of now the ES department does not have a fully functional high-power computer lab that we can use as a simulation laboratory. Our more recent computers date back to 2009.

- Strengthen ties with Junior Colleges
  - The ES department is dedicated to establish strong connections and partnership with the local junior colleges. Currently, the Department is putting together a partnership program between SSU, SRJC and Keysight Technologies Inc.

The ES Department is well aware that its curriculum is subject to continuous and never-ending improvement. Therefore, in order to implement the above improvements we are currently discussing each one and creating a priority list.