California State University, Chico

Department of Electrical & Computer Engineering

Program Improvement Process: Electrical/Electronic Engineering

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INTRODUCTION

To have engineering programs that meet the needs of their constituents, it is necessary to continuously evaluate and improve the programs. To that end, the EECE Department has developed a Program Improvement Process that is repeatable, manageable, and sustainable.

The process aims at achieving the department program objectives that are based on the mission statements for the University, College, and Department. Several distinct constituents were involved in setting those objectives. The constituents included undergraduate faculty, graduate faculty, employers and students. Each group contributed in some aspect to this process. To define the department's mission the faculty first reviewed the University's and the College's mission statements to determine how the programs offered by the department could best help the University and College achieve their missions.

The mission and objectives of the electrical/electronic Engineering and computer engineering program are reviewed at least once every six years by all the constituents. Three years after the ABET accreditation visit the department chair solicits inputs from the abovementioned groups. The faculty, as a whole, evaluates the inputs to decide if any changes in the objectives are warranted. If changes are made, the assessment plans are revised to evaluate the effectiveness of the changes.

The department is responsible for verifying that its graduates satisfy the education objectives of its programs. ABET has stated that achievement of education objectives should be measured three to five years after graduation, and to for that purpose, the EECE department has developed an assessment process as outlined in a companion document entitled "Program Improvement Plan". The process is executed once each year, but there is a different set of inputs each year.

1. PROGRAM EDUCATIONAL OBJECTIVES

The following sections describe the University, College, Department mission statements, the Electrical and Computer Engineering (EENG) program educational objectives, and the consistency between the mission statements and the program educational objectives, respectively. Several terms are used throughout this section are defined in Table 1-1 below for clarity and convenience.

Table 1.1 Definition of Terms

Term	Definition
Program Educational Objectives (PEO)	Statements that describe the career and professional accomplishments that the program is preparing graduates to achieve three to five years after graduation.
Program Outcomes (PO)	Statements that describe what students are expected to know and be able to perform after successfully completing the program.
Course Learning Outcomes (CLO)	Statements that describe what students are expected to learn in a course and be able to perform after successfully completing the course.
Assessment Process	Processes that identify, collect, and prepare data to evaluate the program educational objectives and outcomes and their achievement.
Evaluation Process	Processes for interpreting data and evidence accumulated through assessment practices. Evaluation determines the extent to which program educational objectives and outcomes are being achieved, and results in decisions and actions to improve the program.
Industry Advisory Board (IAB)	A committee comprised of several industry representatives that frequently hire our students, review and advise our program.
Student Advisory Board (SAB)	A committee comprised of representatives from the engineering student organizations including ASME, SME, IEEE, SAE, SWE, and SHPE that review and advise our program.

A. Mission Statement

Several distinct constituents were involved in setting the Program Educational Objectives (PEO) for the EENG program. The constituents included undergraduate faculty, graduate faculty, employers and students. Each group contributed in some aspect to this process. Prior to setting the objective for the Electrical Engineering Program it was necessary to define the mission of the department. To define the department's mission the faculty first reviewed the University's and the College's mission statements to determine how the programs offered by the department could best help the University and College achieve their missions.

The CSU, Chico Mission, Vision and Strategic Priority Statements:

Mission: California State University, Chico is a comprehensive university principally serving Northern California, our state and nation through excellence in instruction, research, creative activity, and public service. The University is committed to assist students in their search for

knowledge and understanding and to prepare them with the attitudes, skills, and habits of lifelong learning in order to assume responsibility in a democratic community and to be useful members of a global society.

The division of Academic Affairs advances the mission of the University to serve Northern California, the state, the nation and the global community through excellence in learning, scholarship and creativity, and public engagement.

Vision: California State University, Chico sees its distinctive residential context as an opportunity to create an active, diverse, healthy, caring, innovative, and green learning and working environment. We aim to create a vital and collaborative living and learning experience for students who will appreciate and embrace the local, regional, and global communities of which we are all a part. We have a well-respected and dedicated faculty, a superior staff, and committed leadership together with cutting-edge learning and information resources. All of these assets are placed within a beautiful and engaging physical environment. We are a place devoted to the academy's most fundamental tenets: reason, respect, civility, and community. We are a place where the passion of our commitments and clarity of our values find expression every day in the community of learning and serving we have fashioned.

As surely as we are a special place of people and ideas, as boldly as we are the "University of the North State," we aspire to be the "university of choice" for all those who wish to share our vision and values.

University Strategic Priorities (USP):

1. Believing in the primacy of learning, we will continue to develop high-quality learning environments both inside and outside the classroom.
2. Believing in the importance of faculty and staff, and their role in student success, we will continue to invest in faculty and staff development.
3. Believing in the wise use of new technologies in learning and teaching, we will continue to provide the technology, the related training, and the support needed to create high quality learning environments both inside and outside of the classroom.
4. Believing in the value of service to others, we will continue to serve the educational, cultural, and economic needs of Northern California.
5. Believing that we are accountable to the people of the State of California, we will continue to diversify our sources of revenue and strategically manage the resources entrusted to us.
6. Believing that each generation owes something to those which follow, we will create environmentally literate citizens, who embrace sustainability as a way of living. We will be wise stewards of scarce resources and, in seeking to develop the whole person, be aware that our individual and collective actions have economic, social, and environmental consequences locally, regionally, and globally.
7. Believing in the importance of civic engagement for both individual fulfillment and the institutional commitment to serving the public good, we will educate generations of civically engaged, informed, and active students. We will engage students, faculty, staff, and community members through curricular and co-curricular experiences that actively involve them with the communities and the issues of the North State and beyond.

8. Believing in the importance of diversity as central to the values of the University and the education of its students, we will continue to develop and enhance programs, policies and activities to create and sustain a welcoming and inclusive learning and working environment for all.

The College of Engineering, Computer Science, and Construction Management Mission Statement

We prepare students for successful professional careers in applied science, engineering, and technology. We educate them to be successful leaders and innovators capable of meeting complex challenges. We shape the college mission through our values:

1. We teach, mentor, motivate, and challenge students
2. We foster rich learning environments
3. We advance scholarship and creativity
4. We encourage industry engagement and collaboration
5. We promote teamwork through projects and co-curricular activities
6. We value graduate education and life-long learning
7. We create a new generation of problem solvers for a sustainable future

The EECE Department Mission Statement

The Electrical and Computer Engineering Department will educate each student to be a responsible and productive engineer who can effectively manage future challenges.

Electrical/Electronic Engineering graduates from Chico are qualified for professional practice or graduate work in several areas of specialization. In addition to fundamentals of science and mathematics, the program provides a solid background in circuits, analog and digital electronics, microprocessors, and electromagnetics. The senior-level classes offered for electrical/electronic engineers include control systems, communication systems, power systems, digital signal processing, electro-optics, radio frequency circuits, and digital system design.

The Computer Engineering program at CSU, Chico bridges the curriculum gap between electrical/electronic engineering and computer science. The program is designed to provide a broad background in both the theory and practice of computer hardware and software design, and the integration of both into useable digital systems. The curriculum includes courses in logic design, microprocessor system design, computer interfacing, programming and data structures, computer architecture and assembly language programming, embedded system design, and system requirements and design.

B. Program Educational Objectives

The objective of the **Electrical/Electronic Engineering** Program is to produce graduates able to:

1. apply knowledge of mathematics, science, and engineering to identify, formulate, and solve electrical/electronic engineering problems,
2. use industry standard tools to analyze, design, develop and test electrical/electronic-based systems,
3. achieve success in graduate programs in electrical engineering or a related field,

4. continue to develop their knowledge and skills after graduation in order to succeed personally and professionally,
5. work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate,
6. Communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work,
7. appreciate the importance of ethics in the profession and the need to act in society's best interest, and
8. become active participants in professional societies and a contributor to the community.

C. Consistency of the PEO with the Mission of the Institution

The set of seven objectives above have been developed to formulate the career and professional accomplishments that the program is preparing graduates to achieve in some three to five years after graduation. Such accomplishments provide a reliable manifestation of the department mission of graduating responsible and productive electrical/electronic engineers who can effectively manage future challenges. That mission and those accomplishments are consistent with the institutional mission as well as strategic goals and priorities as described in Table 1.2:

Table 1.2 - EENG Program Objectives Support of the Institutional Mission

Program Educational Objectives	University Strategic Priorities
1. Apply knowledge of mathematics, science, and engineering to identify, formulate, and solve electrical/electronic engineering problems.	USP 4, USP 3, USP 1
2. Use industry standard tools to analyze, design, develop and test computer-based systems containing both hardware and software components.	USP 4, USP 3, USP 2
3. Achieve success in graduate programs in electrical engineering or a related field.	USP 4, USP 2
4. Continue to develop their knowledge and skills after graduation in order to succeed personally and contribute to employer success.	USP 4, USP 3
5. Work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate.	USP 4, USP 3
6. Communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work.	USP 4
7. Appreciate the importance of ethics in the profession and the need to act in society's best interest	USP 4
8. become active participants in professional societies and a contribute to the community	USP 4, USP 3

D. Program Constituencies

The EENG program educational objectives are systematically determined and reviewed based on a system of assessment processes that include the EENG program's various constituents groups. EENG program constituencies include two group types: primary constituencies and other entities influencing program planning. The primary constituencies are the groups that we communicate with on a regular basis. There are other parties whose decisions we must incorporate into our continuous improvement processes for our programs (second group type). However, we do not have regular and continuous interaction with these parties, although some pose constraints on our curriculum. The communication process used by the EENG program to communicate with program constituencies is described in Section E. A list of EENG program constituencies is shown in Table 1.3.

Table 1.3 - Program Primary Constituencies and Other Entities Affecting Planning

Primary Constituencies
Students of the EENG Program • Current students • Students' benefactors • Graduates (Alumni)
EENG Faculty
College Faculty
Employers of EENG Students, Members of the IAB
College Administration
Other CSU, Chico Faculty
CSU, Chico Administration
Entities Affecting EENG Program Planning
CSU System Regents
California Board for Higher Education
The California Legislature
Professional Engineering Associations and Societies
Citizens of the State of California

E. Process for Establishing PEO

The Program Educational Objectives were developed by the faculty as informed by Industry Advisory Board (IAB) and guided by other program constituencies. The interests of all constituencies were considered by the faculty in developing the Educational Objectives, while not all constituencies were directly involved in the initial development process. Therefore, the initial process produced a set of program objectives that addresses the needs of the Students, their Employers, the College, the University, and the State. The department has

made a concerted effort to make sure that the Program Educational Objectives that have been established are communicated to all students who are planning to enter the program and to all students in the program. The PEO are published in the University catalog, on the department web page, and on handouts given to students during orientation. As the main constituent of our department educational/learning mission, and through the SAB, students have a formal forum to maintain active involvement in their department. The SAB consists of a cross section of ECE students at different program ranks, as well as from the professional and honor society leaderships. The SAB meets with the EECE Chair typically once a year and provides input for consideration by the department regarding curriculum, facilities, and other aspects of their educational experience in the department. In its meetings, the SAB systematically reviews and provides feedback to support keeping an effective set of program objectives.

Table 1.4 illustrates that the needs of each constituency are addressed at least once by the Program Educational Objectives.

Table 1.4 - Mapping of constituent need to Educational Objectives

Constituent	Needs	PEO's
Students	Employment	
	Active membership in the society	7
	Intellectual development	1-7
	Ability to continue learning	4
Employers	Sound fundamentals	1-3
	Productive and Responsible	1-6
	Performance in teams	5
	Professional ethics	7
	Communication	5,6
College	Student success	1-7
	Reputable graduates	1-7
	Contribution to university mission	1-7
University	Active membership in the community	3-7
	Enhancement of the region's intellectual, economic, and social	1-7
	Reputable membership in the CSU System	1-7
State	Specially skilled workforce	1,2,4
	Economic development of the state	1-7

The needs for the State, University, and College were largely obtained by studying their respective mission statements and selecting the items we could appropriately address. The needs of the employers have been based on the interaction with our IAB, our faculty industrial experience and consulting, and keeping contacts with our student employers including those at regularly scheduled campus job fairs. The needs of the Students are based on our faculty experience with current students and informed by follow up contacts with our graduates. While the input for modifying and setting the EENG program educational objectives come from the primary constituents and the evaluation process, the EENG faculty play the major role in directly setting the program educational objectives. They are the focal point in harvesting, fusing, and analyzing data. Adjustments and improvements to the EENG program educational objectives are made through qualitative and quantitative assessment by the EENG Faculty. For example, EENG faculty take into consideration results from the evaluation process and feedback from the IAB. Alumni and employer surveys as well as performance of our graduates in graduate school also provide information and insight into the effectiveness of the EENG program in achieving the PEO. The EENG faculty meets to specifically analyze this information. Based on input from program constituencies and the assessment process the program faculty adopts actions for program improvement.

Role of the IAB:

The IAB consists of representatives from industry and government selected by the Department Chair in consultation with the faculty and the college dean. The members are all employers or prospective employers of our graduates. They represent local and national companies, as well as several of our constituencies.

The IAB has been systematically involved in the development and review of the EENG program activities. The board provides counseling and recommendations to the program faculty.

Role of Students and the Student Advisory Board (SAB):

The EENG faculty communicate with current students about the EENG program, including program educational objective, in several ways:

- At the beginning of each semester, members of the faculty and the department chair meet with incoming students in a "Getting Connected" orientation meeting. Our programs are discussed and input from students via oral and/or comments are received
- Graduating EENG seniors fill out an exit questionnaire.
- Through formal and informal meetings with the students and the Student Advisory Board members.

As the main constituent of our department educational/learning mission, and through the SAB, students have a formal forum to maintain active involvement in their department. The board consists of a cross section of EECE students at different program ranks, as well as from the professional and honor society leaderships. The EECE Chair meets with members of the SAB or the board as whole, typically once a year, to solicit input for consideration by the department regarding curriculum, facilities, and other aspects of their educational experience in the department.

Role of the University Administration:

Most of our communication from the administration is directed to the Dean and Associate Dean of the College. The EECE department chair invites them to key faculty meetings to provide input on important topics and answer questions from the faculty.

Role of the Alumni:

The communication with this group is by surveys, meetings, email, mail, and telephone conversations. In addition, a traditional interaction is held once a year on Alumni Day. The yearly Department Banquet is also provides an opportune time for connections with the Alumni.

F. Achievement of PEO

Periodic Review Process:

Electrical and Computer Engineering are two of the most rapidly changing areas of technology in today's society. Therefore, constantly evaluating and updating our programs is critical to their survival and growth. For several years the department has been applying the concepts of continuous program improvement to our programs. Our efforts in this area have been spurred on by the ABET 2000 accreditation framework, which outlines a "2-loop" approach to program Assessment and Improvement as shown in Figure 1.1.

The left loop shows the steps involved in establishing and assessing program objectives; the right loop shows how outcomes that support the program's objectives are developed and assessed. The interaction between the loops assures that the outcome assessment is used to verify that the program's objectives are met.

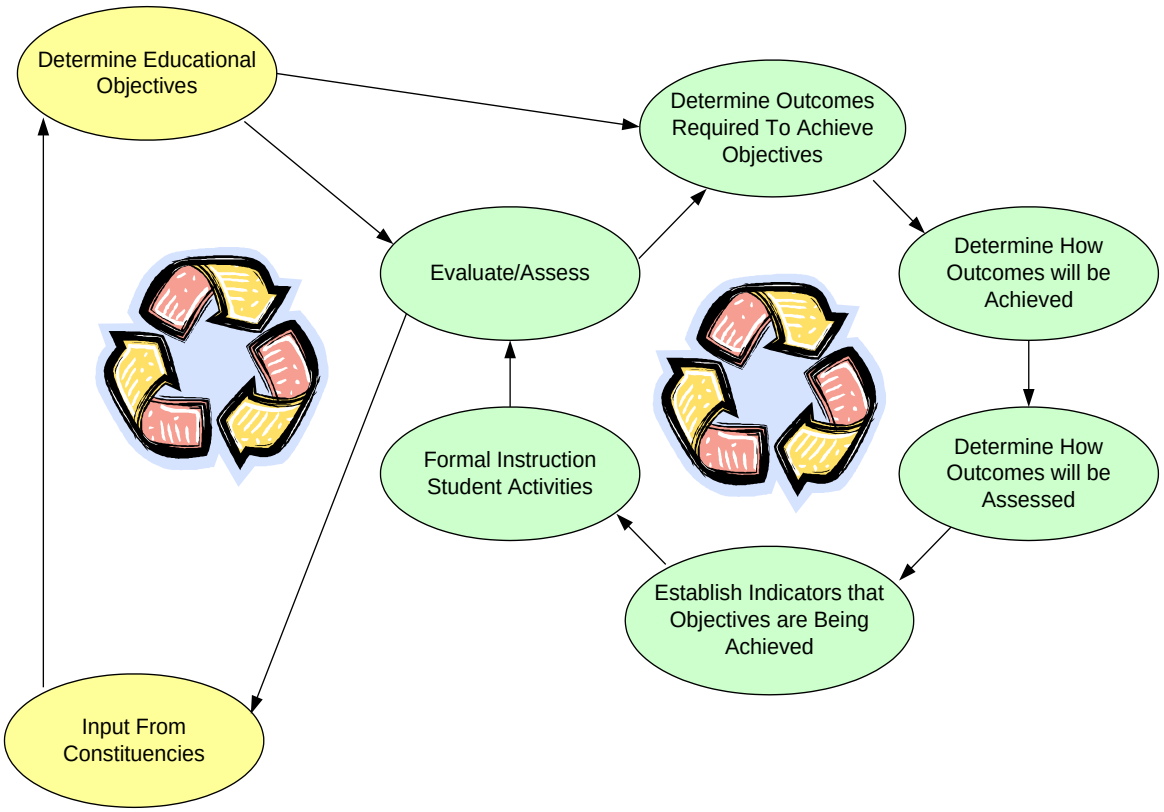

Figure 1.1 - Two Loops Approach for Program Assessment and Improvement

The first step in establishing a process by which we can continuously improve our programs is to define the objectives for the graduates from our EENG program. Because objectives are defined at a relatively high level, the objectives of the EENG program are also mapped to the program outcomes, as outlined below, in order to facilitate their assessment in terms of measurable set outcomes for the program. After defining the objectives for the EENG degree, it was necessary to create a curriculum that supports these objectives. We evaluated each of the courses in our undergraduate program to see how the expected outcomes for the courses support the program objectives. The relationship between course outcomes and program objectives is shown in following section. Defining objectives, outcomes, and assessment methods is a good start toward a continuous improvement program, but processes must be in place to ensure that objectives and outcomes are reviewed, that assessment data is collected and analyzed, and that changes are made to the program when necessary. To that end, the EECE Department has developed a Program Improvement Process that is repeatable, manageable, and sustainable. The plan is based on the mission statements for the University, College, and Department as previously outlined.

The objectives of the EENG program are reviewed at least once every year by different constituents, but there is a different set of inputs each year. The faculty, as a whole, evaluates the inputs to decide if any changes in the objectives are warranted. If changes are made, the assessment plans are revised to evaluate the effectiveness of the changes. The EECE department is responsible for verifying that its graduates satisfy the education objectives of its programs. The overall Program Improvement Process is depicted in the Figure 1.2 shown below. The process begins each fall semester of the academic year with a review of the assessment tool(s) that will be used to gather that year's data. Based on past results, the faculty may choose to update or replace a given assessment tool. When the assessment tool has been chosen, data is gathered from one or more of the sources (employers, IAB, alumni, students, and faculty). The data is collected and tabulated by a subset of the faculty. The data is then reviewed by the faculty to determine what, if any, changes should be considered. If needed, a Change Improvement Plan is developed. Based on the plan, changes are implemented. Figure 1.3 shows the timeline for the assessment of program outcomes.

Timeline of Periodic Review Process:

The timeline for the program improvement activities is shown in Figure 1.3. As can be seen in the figure, each January and February change plans are developed; if needed; changes are implemented during the following year. Alumni data collection via the web page survey actually happens continuously throughout the year. Other data collection activities, such as employer surveys, senior exit surveys, and program retrospectives, take place at specific times.

G. PEO Assessment

Assessment Implementation:

Determining that each student has met all of the elements of the Program Educational Objectives cannot be fully determined until after graduation. However, the structure and content of the curriculum must be designed so that every student has the ability to satisfy the objective.

Achievement of PEO (that graduates with 3 to 7 years of experience meet the program objective) is assessed by the assessment of alumni input through faculty-alumni interactions and surveys, as well as department interactions with the IAB and industry employers. In addition, the following systematic instruments are also systematically used as outlined below: **(a)** the assessment of the EENG program outcomes that support EENG Program Educational Objectives, **(b)** 3-7 year alumni self assessment, and **(c)** employer surveys.

a) Assessment of EENG program outcomes that support the PEO:

Demonstrating that the Electrical/Electronic Engineering curriculum supports the objectives is a two-step process. First, and as shown in Table 1.6, the EENG program outcomes are shown to support the objective. As can be seen in the table, every objective is supported by at least two outcomes. This increases the probability that graduates with 3 to 7 years' experience will meet the objective. Secondly, it is shown how the individual course outcomes support the program outcomes as detailed in the following Section 2.

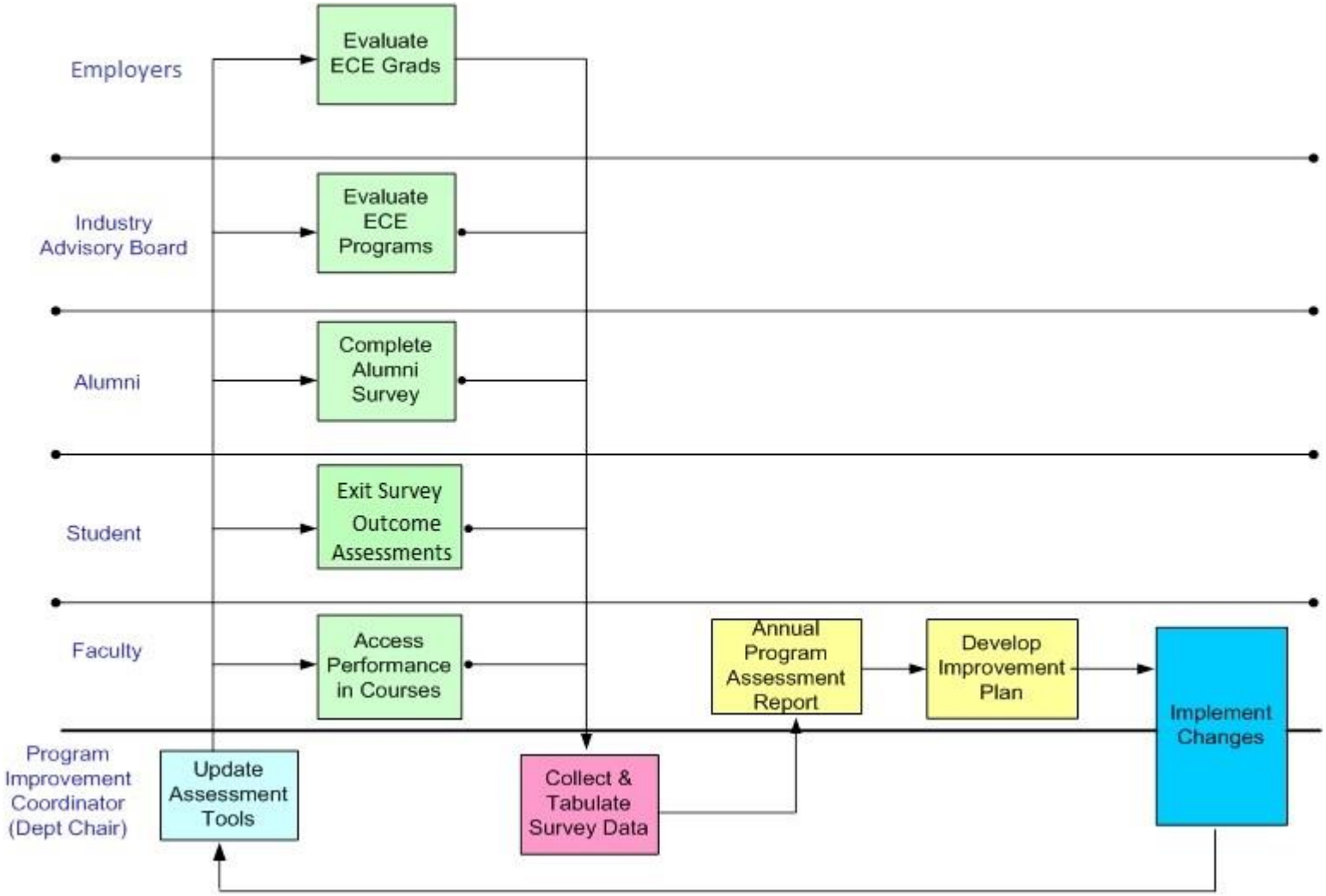

Figure 1.2 - EECE Department Program Improvement Process

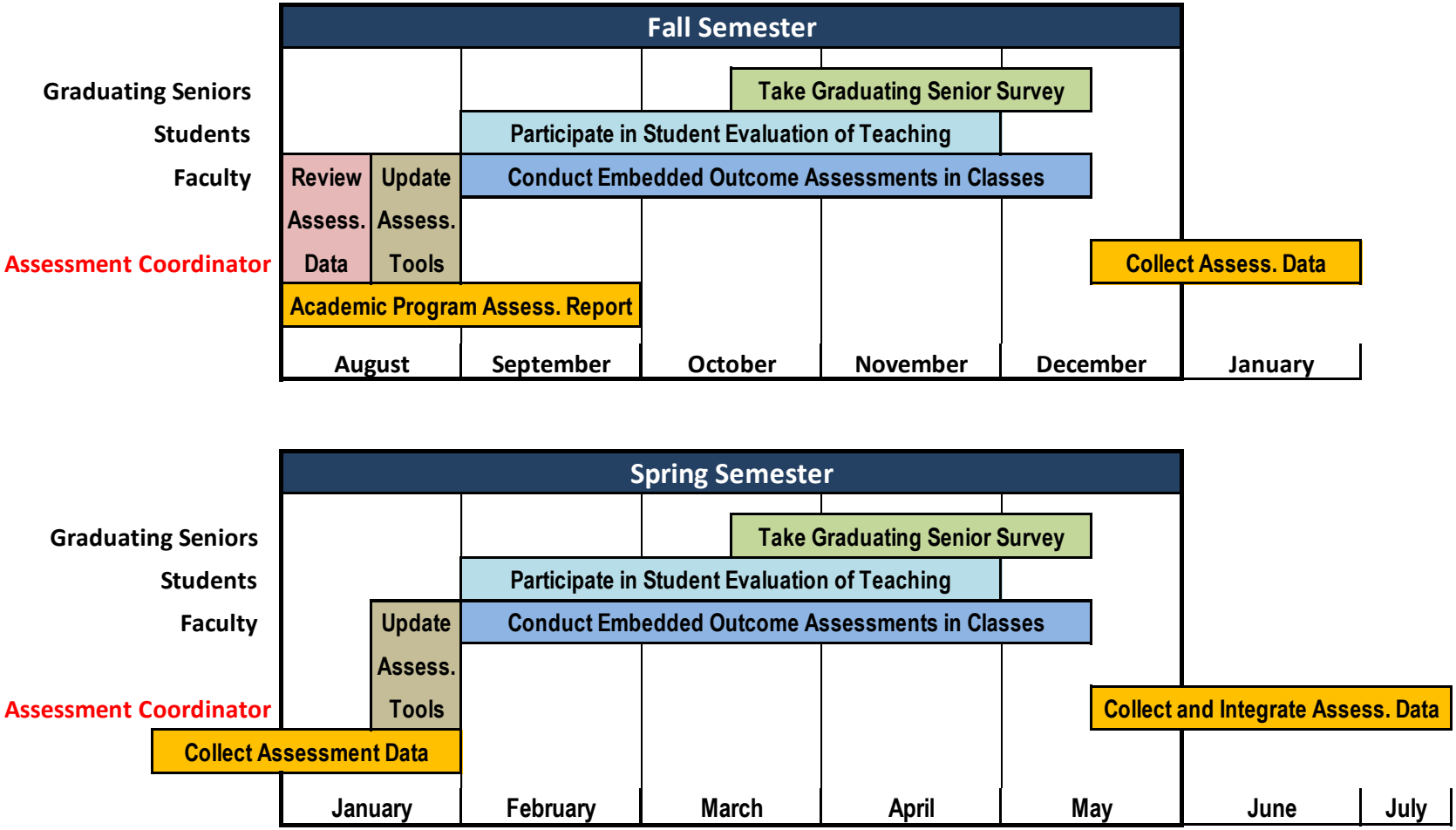

Figure 1.3 - Timeline for Program Outcome Assessment process activities

b) Alumni Self Assessment of the EENG Program:

The department has created a web page for alumni surveys. The page contains links to three separate surveys: 1-2 year alumni, 3-7 year alumni and 8+ year alumni. Those who fill out the 3-7 year alumni survey are asked to supply their supervisor's contact information. Supervisors are contacted by phone and asked to evaluate how well the Chico alumni have met all of the elements of the program objective.

Table 1.6 shows the survey questions that are relevant to the Program Educational Objectives (PEO). The survey questions reflect the degree to which the alumni, having been in industry for three to seven years, considered that the objective of the program had been met. Those questions seeking responses in the form of 'agree' or 'disagree' had five qualitative responses and a 'does not apply' response. Those questions asking for answers in the form of 'well prepared' or 'ill prepared' also had five qualitative responses, namely, 'well prepared' (5), 'somewhat well prepared' (4), 'neutral' (3), 'not well prepared' (2), and 'ill prepared' (1).
Before the survey was put online, the faculty had several discussions about what they would consider acceptable responses. A few faculty thought that the minimum acceptable response should be 4.0. The argument was that this would be the equivalent of a "B" grade average. Others thought that the minimum should be a 3.0, which would be the equivalent of a "C" average. Since the faculty had little actual data upon which to make a choice, they decided to compromise and selected 3.5 as the minimum acceptable. This level of acceptability continues to be the faculty consensus.

c) Employer Survey:

The program outcome evaluation is one of the most important components of our PEO evaluation. A relationship mapping of the Program Educational Outcomes to the Program Educational Objective is given in the following section, where it will also be shown that every objective is supported by at least two outcomes. This increases the probability that graduates with 3 to 7 years' experience will meet the objective.

The IAB meets with the Department Chair and faculty every year for program assessment activities. The PEO are discussed and supported at least once every year by the IAB. The department uses two systematic methods of assessment to verify that graduates with 3 to 7 years of experience meet the program objective: the 3-7 year alumni self assessment and employer surveys. Those who fill out the 3-7 year alumni survey are asked to supply their supervisor's contact information. Supervisors are contacted by phone and asked to evaluate how well the Chico alumni have met all of the elements of the program objective. Moreover, employers of our graduate as known by faculty are requested to respond to the same survey. The eight questions in the employer survey attempted to determine how well Chico State engineering graduates have achieved the objective of the Electrical Engineering program. Table 1.8 shows the survey questions and their relevance to the Program Educational Objectives (PEO).

Table 1.6 - Program Educational Outcomes and PEO

The objective of the Electrical/Electronic Engineering Program is to produce graduates able to:

1. apply knowledge of mathematics, science, and engineering to identify, formulate, and solve electrical/electronic engineering problems,
2. use industry standard tools to analyze, design, develop and test electrical/electronic-based systems containing both hardware and software components,
3. achieve success in graduate programs in computer engineering, electrical engineering, or computer science,
4. continue to develop their knowledge and skills after graduation in order to succeed personally and professionally,
5. work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate,
6. communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work,
7. appreciate the importance of ethics in the profession and the need to act in society's best interest, and
8. become active participants in professional societies and a contributor to the community.

		Program Educational Objectives							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Program Educational Outcome	**a)**	√		√	√				
	b)	√		√	√				
	c)		√	√	√				
	d)					√	√		
	e)	√		√	√				
	f)							√	√
	g)					√	√		
	h)							√	√
	i)			√	√				
	j)							√	
	k)	√	√						

All Electrical/Electronic engineering graduates shall demonstrate:

a) an ability to apply knowledge of math, 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 responsibilities,
g) an ability to communicate effectively in both oral and written forms,
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in, life-long learning
j) a knowledge of contemporary issues, and
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Table 1.7 - The 3-7 Year Alumni Survey Indicator of PEO

Relevant Survey Question: How well prepared are you to:	**Supported PEO**
4a Apply math, science, eng. and tech. to solve problems (a)	**PEO 1, 3, 4**
4b Design and conduct experiments (b)	**PEO 1, 3, 4**
4c Analyze and interpret experimental data (b)	**PEO 1, 3, 4**
4d Design a component or system to meet requirements (c)	**PEO 2, 3, 4**
4e Function on a multi-disciplinary team (d)	**PEO 5, 6**
4f Identify, formulate and solve technical problems (e)	**PEO 1, 3, 4**
4g Communicate technical matters in writing (g)	**PEO 6, 5**
4h Communicate technical matters orally (g)	**PEO 6, 5**
4i Understand professional and ethical responsibilities (f)	**PEO 7**
4j Understand contemporary issues facing society (j, h)	**PEO 7**
4k Use modern tools and technology (k)	**PEO 1, 2**
4m Continue expanding your technical knowledge (i)	**PEO 4, 3**

Table 1.8 - Employer Survey Indicator of PEO

Survey Question and Number		**Supported PEO**
Q1	How do you rate the graduates' problem solving skills.	**PEO 1**
Q2	Have they continually upgraded their technical skills by engaging in professional development activities?	**PEO 4**
Q3	How do you rate their performance as team members?	**PEO 5**
Q4	Have they demonstrated the ability to take on different roles as team member including leadership roles?	**PEO 5**
Q5	Do they show adequate concern for how their work impacts your organization, society, and the environment?	**PEO 7**
Q6	Where their assignments have involved design, has their work shown creativity and imagination?	**PEO 2**
Q7	If they enrolled in any graduate degree programs, have they made satisfactory progress toward the degree?	**PEO 3**
Q8	How would you rate their oral and written skills?	**PEO 6**

2. PROGRAM OUTCOME ASSESSMENT

A. Process for Establishing and Revising Program Outcomes

The Electrical/Electronic Engineering program is designed to provide a broad background in both the theory and practice of electrical/electronic engineering. In addition to fundamentals of science and mathematics, the program provides a solid background in circuits, analog and digital electronics, and electromagnetics. The senior-level classes offered for electrical/electronic engineers include control systems, communication systems, digital signal processing, optics, and digital system design. A strong commitment to hands-on approach in the program's laboratory component plays a major role in reinforcing the achievement of the outcomes set forth for the program.

The faculty had several assessment meetings devoted to identifying the program's educational outcomes. At first the faculty thought that it would be necessary to identify a set of outcomes independent of the ABET (a)-(k) outcomes. However, each set of outcomes so considered turned out to be little more than a restatement of the ABET outcomes. Therefore, the faculty chose to adopt the ABET (a)-(k) outcomes directly. This is also consistent with supporting the set of eight objectives described in the previous section, which have been developed to formulate the career and professional accomplishments that the program is preparing graduates to achieve in some three to five years after graduation. Such accomplishments provide a reliable manifestation of the department mission of graduating responsible and productive electrical/electronic engineers who can effectively manage future challenges. That mission and those accomplishments are consistent with the institutional mission as well as strategic goals.

B. Program Outcomes

The EENG outcomes are listed below with the elements of the program objective supported by the outcome shown in parentheses:

All electrical/electronic engineering graduates shall demonstrate:

a) An ability to apply knowledge of math, science and engineering
(Objective elements 1, 3, 4)
b) An ability to design and conduct experiments as well as to analyze and interpret data
(Objective elements 1, 3, 4)
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability
(Objective elements 2, 3, 4)
d) An ability to function on multi-disciplinary teams
(Objective element 5, 6)
e) An ability to identify, formulate and solve engineering problems
(Objective element 1, 3, 4)
f) An understanding of professional and ethical responsibilities
(Objective element 7, 8)

g) An ability to communicate effectively
(Objective elements 5, 6)

h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(Objective elements 7, 8)

i) A recognition of the need for, and an ability to engage in, life-long learning
(Objective elements 3, 4, 8)

j) A knowledge of contemporary issues
(Objective elements 7)

k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(Objective elements 1, 2)

The program outcomes and measurement of outcome achievement are well documented in section E of this Program Improvement Plan. The program outcomes are also documented in the Computer Engineering program website.

C. Relationship of Program Outcomes to PEO

Table 2.1 below shows the extent of achievement of the EENG Program Educational Objectives by the program outcomes. As can be seen in the table, every objective is supported by at least two outcomes. This increases the probability that graduates with 3 to 7 years' experience will meet the objective.

Table 2.1 – Support of Program Educational Objectives by Program Outcomes

Electrical/Electronic Engineering Program Outcomes

Electrical/Electronic Engineering Educational Objectives

Table 2.1

Support of Program Educational Objectives by Program Outcomes

Strong Support

Modest Support

All Electrical/Electronic Engineering graduates will be able to:	**All Electrical/Electronic Engineering graduates should demonstrate:**	a) An ability to apply knowledge of math, 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, manufacturing, 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 responsibilities	g) An ability to communicate effectively	h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	i) A recognition of the need for, and an ability to engage in, 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
1. apply knowledge of mathematics, science, and engineering to identify, formulate, and solve computer engineering problems,												
2. use industry standard tools to analyze, design, develop and test computer-based systems containing both hardware and software components,												
3. achieve success in graduate programs in computer engineering, electrical engineering, or computer science,												
4. continue to develop their knowledge and skills after graduation in order to succeed personally and professionally,												
5. work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate,												
6. communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work,												
7. appreciate the importance of ethics in the profession and the need to act in society's best interest, and												
8. become active participants in professional societies and a contributor to the community.												

D. Relationship of Courses to the Program Outcomes

Table 2.2 below illustrates several important facts about the Program Outcomes and the courses required in the major. First, every required course in the program, including those taken outside the engineering disciplines, supports at least one of the Program Outcomes. A course may support an outcome by introducing material related to the outcome (Introduced), giving students the opportunity to practice applying methods and techniques necessary to develop proficiency in the outcome (Practiced), or by measuring how well the student has mastered the outcome (Assessed). Second, the table shows that every Program Outcome the material is Introduced, Practiced, and Assessed in multiple courses. This ensures that students have multiple chances to learn how to master each Program Outcome. Third, each Program Outcome is assessed at least once during a student's course of studies. By requiring each student to pass at least one assignment that directly assessed the mastery of an outcome, it is guaranteed that no student will graduate from the program without having demonstrated mastery of every one of the outcomes.

E. Achievement of Program Outcomes

Aassessment of the Electrical/Electronic Engineering program's educational outcomes is achieved by direct measurements (embedded in course) and indirect measurement (student surveys).

The program's educational outcomes are assessed directly by assessing individual course outcome in designated course and then mapping the courses' outcomes to the program's outcomes. Course grades of D or higher are required to pass all EECE classes. Students who do not meet the minimum competency of course outcomes do not necessarily fail the classes. This assessment, combined with other surveys, determines how well the program's educational objectives have been met.

Table 2.3 below summarizes the outcome assessment and evaluation activities, which include both direct and indirect measures. The following is a description of the criteria used to determine how each of the program outcomes is met and the data to verify that the outcomes were met successfully.

Outcome (a) An ability to apply knowledge of math, science and engineering

Performance Criteria: Each graduating student shall demonstrate his or her ability to

a) Formulate and solve problems in electrical/electronic engineering
b) Successfully complete the courses that utilize substantial amounts of mathematics and science for analyzing engineering problems.

Outcome (b) An ability to design and conduct experiments as well as to analyze and interpret data.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to

a) Conduct experiments using a variety of laboratory equipment and following accepted safety standards and procedures
b) Analyze and interpret the resultant data

Outcome (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to

a) Design electrical/electronic-based system to meet stated requirements
b) Design experiments to evaluate the performance of such systems with respect to specifications
c) Consider realistic constraints in design

Outcome (d) An ability to function on multi-disciplinary teams.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to function effectively in teams.

Outcome (e) An ability to identify, formulate and solve engineering problems.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to integrate both hardware and software components into systems.

Outcome (f) An understanding of professional and ethical responsibilities.

Performance Criteria: Each graduating student should be able to demonstrate an understanding of his or her professional and ethical responsibilities.

Outcome (g) An ability to communicate effectively in both written and oral forms.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to communicate technical matters in a variety of appropriate forms. This includes written reports, oral reports, and graphical presentations of their work.

Outcome (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Performance Criteria: Each graduating student should be able to demonstrate an appreciation of contemporary issues concerning the interaction between technology and society.

Outcome (i) A recognition of the need for, and an ability to engage in, life-long learning.

Performance Criteria: Each graduating student should be able to demonstrate his or her ability to

a) Locate resources for additional education
or
b) to pursue graduate studies in work-related fields.

Outcome (j) A knowledge of contemporary issues.

Performance Criteria: Each graduating student should be able to demonstrate a knowledge of occurring issues and their impact of occurring issues on his or her engineering work.

Outcome (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Performance Criteria: Each graduating student should be able to demonstrate competence with

a) Hardware design and simulation tools (such as LogicWorks, PSpice, ORCAD, and PLD development software)
b) Software design and simulation tools (such as assemblers/compilers and debuggers, software simulators)
c) General purpose systems design and analysis tools (such as MATLAB)

Table 2.2 - Course Support of the EENG Program Educational Outcomes

		Program Educational Outcomes										
		a	b	c	d	e	f	g	h	i	j	k
Required Courses In Electrical / Electronic Engineering	MATH 120-260											
	CHEM 111											
	PHYS 204 A-C											
	CSCI 111											
	EECE 144											
	EECE 211											
	EECE 211L											
	EECE 311											
	EECE 365											
	EECE 315											
	EECE 316											
	EECE 344											
	EECE 343											
	EECE 375											
	EECE 453											
	EECE 465											
	EECE 481											
	EECE 482											
	ECE 490A											
	ECE 490B											
	General Ed.											

Introduced **Practiced** **Assessed**

Table 2.3 – Courses designated for assessment of Program Outcomes

Electrical/Electronic Engineering Program Outcomes												
Designated Courses	***Table 2.3*** ***Mechanisms for Assessing Program Outcomes***	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 with realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	d. An ability to function effectively as members of multidisciplinary teams	e. An ability to identify, formulate, and solve engineering problems	f. An understanding of professional and ethical responsibilities	g. An ability to communicate effectively	h. The board education necessary to understand the impact of engineering solution in a global, economic, environmental, and social 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
	EECE 311 – Linear Circuits II	■										
	EECE 343 – Advanced Logic Design					■						
	EECE 344 – Digital System Design				■							
	EECE 365 – Signals, Systems, and Transforms											■
	EECE 481 – Electromechanical Conversions									■		
	EECE 490A – Engineering Profession and Design		■	■				■	■			
	EECE 490B – Engineering Economics and Project Implementation			■			■				■	

Direct (Course Embedded) Assessment:

With reference to the previous Table 2.2 above, identified elements of selected courses are used to measure, on average, student proficiency at attaining learning outcomes. Although the assessment is embedded in those selected courses, it is not solely the responsibility of such courses to provide the corresponding outcomes. Rather, it is a collective responsibility of the program, including all prior courses for which each outcome is a component. The measure of outcome assessment varies as appropriate to the course and to the outcome. The program faculty reviews assessment summaries on a yearly basis. Programmatic changes are considered as applicable, and the effectiveness of the assessment is also evaluated and modified as warranted. The assessment components include:

Metric: *The measure of student proficiency (e.g., a quantitative or qualitative measure of achievement on an assignment or test question which emphasizes the target outcome)*

Rubric: *Evaluative conclusions versus corresponding descriptions of achievement level (e.g., highest* ***score*** *represents mastery)*

Standard: *Evaluative result that represents minimally acceptable achievement of proficiency*

The same assessment Metric used for programmatic assessment is also used to assess achievement by individual students. Course instructors use the normal course evaluation process for this phase of the assessment process. This entails the grading of assignments and examinations to determine the degree to which the outcomes of the course have been met by each student. A passing grade, usually a grade of 'D', in a course signifies that the particular program outcomes for that course, as indicated in Table 2.3 above, have been met by the student.

A sample assessment data record sheet can be found in Appendix A. The record sheet contains major components including Outcome Assessment Summary, Rubric for Program Outcome, and Student Record. Assessment rubrics specific to outcome assessments are documented below.

Assessment Rubrics for Program Outcomes

a: An ability to apply knowledge of mathematics, science, and engineering

Assessment will be based on an evaluation of selected assignments for each student in EECE 311. A student will demonstrate successful completion of this outcome by achieving a score of 4 of 8 (based on the assessment rubric shown in the following table) on at least three class assignments or examination problems. A minimum of four assignments or exam problems will be evaluated throughout the semester.

Student:

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Problem Solution-style	Results poorly presented; hard to follow reasoning; final answer not clearly indicated; missing units.	Correct solution given but difficult to follow; missing steps in solution, or results not in logical order.	Problem solution steps in logical order and neatly written; final answers clearly marked with appropriate units and labels.	2
Knowledge of Circuit Analysis - fundamental relationships and laws of physics.	Relationships between currents and voltage for R,L,C, or transformer incorrect; energy or power calculations incorrect.	Relations between currents and voltages correct, but there are sign errors or they are used incorrectly.	Equations relating current and voltage for R,L,C clear with correct directions and polarities; relationships involving energy and power state correctly.	2
Knowledge of Circuit Analysis - starting the solution.	KVL or KCL circuit equations incorrect; energy or power relationships needed to solve problem set up incorrectly.	KVL or KCL set up, but with sign errors or missing terms.	Circuit variables such as currents and voltages identified with their directions or polarities on a circuit diagram; KCL, KVL, or energy equations applied correctly.	2
Knowledge of Circuit Analysis - solving the problem.	Incorrect solution for current, voltage or power variables; incorrect application of appropriate mathematics, such as, linear algebra, calculus, complex variables, or differential equations	Most variables, such as currents, voltages or power, found by applying appropriate mathematical methods but several errors in the details.	All desired variables such as currents, voltages or power, found by applying appropriate mathematical methods correctly; problem solution checked using PSpice if appropriate.	2
			Total	**8**

b: an ability to design and conduct experiments, as well as to analyze and interpret data

Assessment will be based on an evaluation of documents produced in EECE 490A and EECE 490B, which focus on a capstone project.

Student:					
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**		**Evaluation Course**
Scale	**0**	**1**	**2**	**Score**	
Test Plan					
Plan	Plan does not include all critical system requirements.	Plan does not include some non-critical system requirements or some requirements partially evaluated.	All system requirements included in test plan and thoroughly evaluated.	2	490A
Procedure	Test procedures missing or unusable.	Some test procedures missing steps or lack sufficient details.	Accurate and detailed test proceduces provided for all tests.	2	490A
Evaluation Criteria	Evaluation criteria missing or invalid.	Some evaluation criteria not suitable for project (e.g., unmeasureable, unclear, unlikely to achieve).	Reasonable and clear evaluation criteria provided for each test.	2	490A
Resources	Test resources unidentified or major resources missing.	Some resources required for testing inadequately defined or minor resources missing.	All hardware and software required for testing is listed.	2	490A
Test Results					
Data Collection and Presentation	Data from critical system requirement tests missing.	Data relevant to testing incomplete or not clearly presented.	All data relevant to testing clearly identified.	2	490B
Results Summary	Summary missing from critical system requirement tests.	Some tests missing a summary or summary is incomplete.	Each test includes an appropriate summary of test results.	2	490B
Exception Analysis	Deviations from expected results lack explanation.	Some deviations from expected results lack a clear or reasonable explanation.	All deviations from expected results are reasonably explained.	2	490B
				Total	**14**

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

Assessment will be based on a project documents developed for a capstone project.

Student:

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Executive Summary	Project purpose missing or incomprehendable or target market unidentified.	Project purpose or target market not clearly defined.	Clear description of project purpose and target market.	2
Product Users	Little or no description of product users.	Major product users identified, but some important users missing. Many uninterested users listed.	All valid users clearly identified.	2
External Impacts	Little or no description of external impacts arising from product.	Some external impacts missing, incomplete, or inaccurately portrayed.	All appropriate external impacts appropriately defined.	2
Assumptions, Dependencies, and Constraints	Major project assumptions, dependencies, or constraints missing.	Major product assumptions, dependencies, and constraints defined, but some minor items are missing or unclear.	All appropriate project assumptions, dependencies, and constraints clearly defined.	2
User Accessible Features	Major user accessible not described.	Major user accessible features defined, but some minor features missing or poorly defined.	Clear and thorough description of all user accessible features.	2
Estimated Project Cost	Most or all major project costs or estimates missing.	Few major project costs or estimates missing or more expensive alternatives used without justification.	All major project costs identified, valid estimates provided, and alternatives evaluated.	2
			Total	**12**

d: an ability to function on multidisciplinary teams

Assessment will be based on a group design project over the semester with multiple milestones.

Student:				
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Discipline Knowledge	Unable to decompose a problem into tasks and assign them to an appropriate group member based on discipline.	Decomposes a problem into to few or too many tasks, assigns many tasks to inappropriate group members, or divides the work unevenly.	Decomposes a problem into appropriate tasks and assigns them to members in responsible disciplines so that work is divided equally.	2
Participation				
Meeting Attendance	Missed a significant number of group meetings or regularly late to meetings.	Missed a small number of meetings – limited impact to group progress – and arrived on time to most meetings.	Attended all team meetings and regularly arrives on time.	2
Met Deadlines	Missed multiple deadlines resulting in a negative impact on group progress.	Met all but a few deadlines with minimal impact on group progress.	Met all deadlines.	2
Meeting Preparation	Unprepared for team meetings.	Partially prepared for team meetings with incomplete materials or unhelpful resources.	Fully prepared for team meetings with relevant resources and materials.	2
Contribution				
Meeting Contributions	Contributed little or contributed in negative ways.	Contributed somewhat to meetings, but discouraged member input or provided superficial feedback.	Contributed significantly to team meetings. Displayed honest consideration of member input and provided valuable feedback.	2
Quality of Work	Unacceptable work – discarded or required rework by teammates.	Marginal work – acceptable quality that is unpolished or not thorough.	High quality work that achieves all objectives presented in a professional manner.	2
Overall Contribution of Work Products	Contributed limited or no work products.	Contributed acceptable work products, but not equal in share compared to other team members.	Contributed an equal share of team work products.	2
			Total	**14**

e: an ability to identify, formulate, and solve engineering problems

Assessment will be based on design projects over the semester.

Student:				
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Problem Description	Problem description is unclear and major objectives missing or inappropriate.	Marginal description of engineering problem. Some objectives poorly defined.	Clear description of engineering problem with major objectives indentified.	2
Interfaces	Critical system or subsystem interfaces undefined.	Some interfaces only partially defined.	All system interfaces clearly indicated along in adequate detail.	2
Evaluation Criteria	Evaluation criteria missing or unclear.	Some evaluation criteria defined imprecisely or open to misinterpretation.	Evaluation criteria for each requirement clearly stated.	2
Design	High-level design missing or trivial and no useful functional descriptions provided.	Inappropriate level of detail provided or funtional descriptions incomplete or with some errors.	Relationship between subsystems clearly defined and functional descriptions complete.	2
Implementation	Result satisfies few evaluation criteria and implementation includes unprofessional work.	Result satisfies most evaluation criteria or implementation includes minor unprofessional attributes.	Result satifies all evaluation criteria with a professional implementation.	2
			Total	**10**

f: An understanding of professional and ethical responsibility

Assessment will be based on a set of writing assignments exploring professional and ethical responsibility within the engineering profession.

Student:				
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Knowledge of Professional Codes of Ethics	Student cannot identify an appropriate professional code of ethics or demonstrates a lack of understanding.	Student can identify appropriate professional codes of ethics, but demonstrates a marginal understanding.	Student can identify and demonstrate knowledge of the professional codes of ethics appropriate for his/her major or specialization.	2
Application of Professional Codes of Ethics	Student cannot identify which aspects of professional codes of ethics applies to given situations.	Student can identify only some aspects of professional codes of ethics as they relate to a given situation or cannot not relate how the code guides ethical and professional behaviour.	Student can identify which aspects of professional codes of ethics apply to given situations and explain how the code guides ethical and professional behaviour.	2
Recognition of Engineering Design Choices on Health and Safety	Student is unable to explain how engineering design choices increase health or safety.	Student can identify how responsible engineering choices increase health and safety in only some cases or can only do so at a superficial level for all cases.	Student can explain how responsible engineering choices increase health and safety within society and the consequences of unprofessional or unethical decisions.	2
Identification of Resources for Reporting Professional or Ethical Violations	Student is unable to identify agencies that handle reports of ethical or professional violations.	Student can identify some agencies or bodies which handle professional or ethical violations, but selects an inappropriate entity for a given violation.	Student can select the appropriate agency or body to handle a given professional or ethical violation.	2
			Total	**8**

g: An ability to communicate effectively

Assessment will be based on an evaluation of oral status report assignments for each student in EECE 490A. A student will demonstrate successful completion of this outcome by achieving a score of 35 of 50 (based on the assessment rubric shown in the following table).

Student:				**ORAL**
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Visual Aids				
Readability	too much text; confusing fonts	a few slides are too crowded;	all slides clear and readable; appropriate amount of info on each slide	2
Style Format and Spelling	inconsistent style or format; use of color inappropriate; one or more spelling errors	a few format or style errors	consistent style and format; spelling correct	2
Presentation Content				
Introduction and Purpose	author's name or purpose not given; objective of presentation not clear	distinction between introduction and body not obvious; incomplete introduction	problem clearly stated, constraints and assumptions listed	2
Body; facts, analysis, comparison, as needed	significant information missing or misplaced; too long or too short	material not organized well, skips from topic to topic;	clear, complete, and well organized, all facts are supported	2
Conclusions or Recommendations: significance explained, no new ideas	not stated; includes ideas not already discussed in body	some conclusions or recommendations not supported in body	clear, concise and meaningful; follows from body	2
Presentation Mechanics				
Voice	can't hear; many fillers "ah", "um", "uh"	monotone presentation; some fillers; uneven pace	good voice control. few or no fillers	2
Audience interaction	often speaks to screen or projector, not to audience;	sometimes loses contact with audience	keeps audience engaged	2

Total 14

g: An ability to communicate effectively

Assessment will be based on an evaluation of project concept and engineering requirements documents for the senior project EECE490A. A student will demonstrate successful completion of this outcome by achieving a score of at least 13 of 18 (based on the assessment rubric shown in the first table below) on the concept document and a score of at least 13 or 18 (based on the assessment rubric shown in the second table below) on the requirements document.

Student:				**PCD**
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Mechanics				
Organization (Introduction-Body-Conclusions)	inappropriate content in several sections of report	some content placed incorrectly in report	content appropriate to all section of report	2
Format	style inconsistent among sections	a few format or style errors	consistent and correct format and style	2
Spelling, Grammar and Punctuation	several spelling errors; pages or paragraphs with multiple grammar and punctuation errors	few spelling errors; a few significant grammar and punctuation errors	one or two spelling errors; minor, if any grammar and punctuation errors	2
Content				
Executive Summary	unclear what project will be	missing one or two important elements	problem clearly stated, limitations listed	2
Users	unclear who users will be	too generic; user background missing	clear description of users and their characteristics (background)	2
Inpact	missing or irrelevant	little or no justification for impact listed	thoughtful discussion of both environmental and social impact of project	2
Assumptions, Dependencies, Constraints	missing or irrelevant	one or two important elements missing	complete description of all important elements	2
Features	incomplete; not stated from users' perspective; not verifiable	one or two important features missing or untestable	all features describes in enough detail to allow technical requirement to be developed	2
Budget	missing	little or no indication of the basis of the estimation	justification given for budget estimation	2
			Total	18

Student: **ERD**

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Mechanics				
Organization (Introduction-Body-Conclusions)	inappropriate content in several sections of report	some content placed incorrectly in report	content appropriate to all section of report	2
Format	style inconsistent among sections	a few format or style errors	consistent and correct format and style	2
Spelling, Grammar and Punctuation	several spelling errors; pages or paragraphs with multiple grammar and punctuation errors	few spelling errors; a few significant grammar and punctuation errors	one or two spelling errors; minor, if any grammar and punctuation errors	2
Content				
Introduction: scope, overview, constraints and dependencies	unclear what scope is or what project will be; constraints and dependencies not considered	overview too short or too long; constraints or dependencies not explained	project clearly stated including the scope; important dependencies and constraints explained	2
Features and Functions	requirements not verifiable; design is often substituted for requirements	some pass/fail criteria not clear; some design is included	clear description of most requirements including pass/fail criteria	2
Interfaces: user and external	missing or unclear	one or two interfaces not completely defined	all interfaces clearly defined	2
Installation, Packaging and Test requirements	missing or irrelevant	one or two important elements missing	complete description of all important elements	2
Power and Operating environment	incomplete; not veirifable	one or two items missing or untestable	power requirements clearly stated: operating environment constrains clear and testable	2
References, Glossary and Appendicies	missing	one or two new terms not explained	all needed support material included	2
			Total	18

h: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Assessment will be based on a set of writing and oral response assignments covering topics from the course.

Student:

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Technical Aspects - life long learning, education, career life cycle, technical and professional societies, intellectual property	Responses missing or fail to demonstrate an understanding of several technical aspects of an engineering career.	Responses demonstrate an understanding of most technical aspects of an engineering career, but include confused or marginal presentation.	Responses show a strong understanding of most technical aspects of an engineering career.	2
Sociological Aspects - public safety and trust, corruption and whistle blowing, licensure and liability, codes of ethics, engineers' image in popular culture, femails and minorities in engineering.	Responses missing or fail to demonstrate an understanding of several sociological aspects of the engineering profession.	Responses demonstrate an understanding of most sociological aspects of the engineering profession, but include confused or marginal presentation.	Responses show a strong understanding of most sociological aspects of the engineering profession.	2
Physiological Aspects - managing working conditions, workplace safety organization, healthy lifestyle choices	Responses missing or fail to demonstrate an understanding of several physiological aspects of an engineering career.	Responses demonstrate an understanding of most physiological aspects of an engineering career, but include confused or marginal presentation.	Responses show a strong understanding of most physiological aspects of an engineering career.	2
Psychological Aspects - healthy work-life balance, stress management, dealing with difficult people, cultivating technical interest, leadership roles and	Responses missing or fail to demonstrate an understanding of several psychological aspects of an engineering career.	Responses demonstrate an understanding of most psychological aspects of an engineering career, but include confused or marginal presentation.	Responses show a strong understanding of most psychological aspects of an engineering career.	2
Global and Economic Aspects - impact of engineering decisions globally and on the economy, international trade, offshoring	Responses missing or fail to demonstrate an understanding of several global or economic aspects of the engineering profession.	Responses demonstrate an understanding of most global and economic aspects of the engineering profession, but include confused or marginal presentation.	Responses show a strong understanding of most global and economic aspects of the engineering profession.	2
			Total	**10**

i: a recognition of the need for, and an ability to engage in life-long learning

Assessment will be based on assignments and exams throughout the semester.

Student:				
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Locating Resources	Unable to determine or locate resources to help solve a problem.	Able to identify some appropriate resources, but difficulty locating the resource, or selects inappropriate resources.	Able to identify and locate appropriate resources to help solve a problem, such as product datasheets, technology summaries, and problem domain overviews.	2
Remaining Current	No interest in remaining current in the field.	Shows marginal interest in remaining current in the field. Participates very little in extracurricular activities and has not evaluated the benefits and costs of graduate school.	Shows an interest in remaining current in the field by attending extracurricular activities or planning to attend graduate school.	2
Independent Learning	Incapable of independent research without significant guidance. Unable to apply course topics beyond examples provided in lecture and the textbook.	Capable of independent research into related course topics with some guidance and direction. Some difficulty applying course topics to new scenarios.	Capable of independent research into related course topics and application of course topics to new scenarios.	2
Assessment of Self and Others	Incorrectly evaluates the strengths and weaknesses of individual team members and the effectiveness of those members in a team.	Some errors in evaluating the strength and weaknesses of team members or their effectiveness of those members in a team.	Accurately assesses the strengths and weaknesses of individual team members (including himself or herself) and the team as a whole.	2
			Total	**8**

Rubric for Program Outcome

j: A knowledge of contemporary issues

Assessment will be based on a set of writing assignments exploring contemporary issues within the engineering profession.

Student:				
Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Current Events in Engineering	Student cannot identify significant current events related to the engineering profession.	Student can identify current events related to the engineering profession, but selects events of marginal significance or cannot explain the relevance of the events.	Student can identify and explain the relevance of current events related to the engineering profession.	2
Intersection of Engineering with Politics and the Law	Student demonstrates very little understanding of the relationship between the engineering profession and politics and the law.	Student can identify some issues relating the engineering profession to politics and the law, but cannot evaluate political and legal alternatives.	Student can identify contemporary issues between the engineering profession and politics and the law and can evaluate the effect of legal and political decisions on the engineering profession.	2
Contemporary Engineering Economics	Student demonstrates a lack of understanding of engineering economics in contemporary and past periods.	Student demonstrates a marginal understanding of engineering economics or lacks current knowledge.	Student can identify current economic problems and trends related to the engineering profession.	2
Current Engineering Research Topics	Student cannot identify or explain a current academic or industrial research topic.	Student can identify, but not explain, a current academic or industrial research topic or explains an outdated research topic.	Student can explain a current academic or industrial research topic related to his/her specialization or major.	2
			Total	**8**

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

A student will demonstrate successful completion of this outcome by achieving a total score of 8 out of 12 points on MATLAB programming assignments shown in the attached rubric.

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Ability to plot signals including an ability to write function programs that can be called from a main program.	Incorrect work	Figure plotted without labels to axis. Does not use function programs.	Plot of figure correct with labels and use of function program.	2
Ability to plot a waveform as a weighted sum of several waveforms using Fourier series expansions.	Incorrect work	Insufficient number of expansion terms from Fourier series chosen.	Sufficient number of expansion terms chosen to indicate good convergence.	2
Ability to find Laplace transform and inverse Laplace transform using symbolic mathematical functions.	Incorrect work	Use of symbolic feature implemented incompletely or partially incorrect.	Use of symbolic features to obtain the solution in a pretty way.	2
Ability to find system response of a system to a input i.e. simulating a system in time domain.	Incorrect work	System response in time domain shown for inadequate amount of time.	System response shown clearly while simulating the system.	2
Ability to find the frequency response of a system (obtaining bode plot).	Incorrect work	System simulation is partially correct.	Bode plot drawn clearly.	2
Ability to define a system and simulate it.	Unable to define a problem	Problem defined but incorrect solution OR Problem insufficiently defined and hence solution	Problem clearly defined and correct solutions obtained.	2
			TOTAL	12

Indirect Assessment:

The Graduating Senior Survey conducted in the college gives an indirect measure of how well graduating students feel they have met the program outcomes. Questions are scored on a scale of "very unprepared (or disagreed)" = 1 to "very well prepared (or very agreed)" = 5, with a score of 3 indicating a satisfactory prepared category. While mean responses of 4.0 or greater are desirable, responses over 3.0 are considered positive. The faculty has chosen a score of 3.5 or above out of 5 as being positively acceptable level.

Survey questions paraphrasing Program Outcomes include the following.

Q31: Apply knowledge to solve problems (Outcome a)
Q32: Design and conduct experiments (Outcome b)
Q33: Analyze and interpret experimental data (Outcome b)
Q34: Design component or system to meet needs (Outcome c)
Q35: Function on multidisciplinary team (Outcome d)
Q36: Identify, formulate, solve technical problems (Outcome e)
Q37: Communicate technical matters in writing (Outcome g)
Q38: Communicate technical matters orally (Outcome g)
Q39: Understand professional, ethical principles (Outcome f)
Q40: Understand contemporary issues facing society (Outcome j)
Q41: Use modern tools and technology (Outcome k)
Q42: Appreciate impact of your solutions on society and environment (Outcome h)
Q43: Continue learning (Outcome i)

3. PROGRAM CONTINUOUS IMPROVEMENT

A. Information Used for Program Improvement

The program improvement process begins each academic year with a review of the assessment results from the previous year and the assessment tool(s) that are to be used to gather the year's data. In a series of faculty meetings at the beginning of the fall semester, and prior to publishing the Annual Assessment report in the fall semester, the faculty adopts measures for program improvements. The primary information used for program improvement is an annual process based on the EENG Program Annual Assessment report, which includes: (a) annual review of EENG Program Educational Objectives (PEO), (b) EENG Program Outcome (PO) assessments and results, (c) input from program constituencies, and (d) faculty meetings, decisions and implementation. The report is prepared by the Department Assessment Coordinator, and is made available for faculty in the fall semester of each year.

As shown in Figures 1.2 and 1.3, the objectives of the EENG program are reviewed at least once every year by different constituents, but there is a different set of inputs each year. The faculty, as a whole, evaluates the inputs to decide if any changes in the objectives are warranted. If changes are made, the assessment plans are revised to evaluate the effectiveness of the changes. The EECE department is responsible for verifying that its graduates satisfy the education objectives of its programs. As depicted in the Figure 1.3, the process begins each year with a review of the assessment tool(s) that will be used to gather that year's data. Based on past results, the faculty may choose to update or replace a given assessment tool. When the assessment tool has been chosen, data is gathered from one or more of the sources (employers, IAB, alumni, students, and faculty).

Program Annual Assessment Reports: The data is collected, tabulated and collated in the *Program Annual Assessment Report*. The report is prepared by the *Department Assessment Coordinator*, and is made available for faculty in the early fall of each year. The data is then reviewed by the faculty to determine what, if any, improvement changes should be considered.

Industry Advising Board meeting Records: The data is also reviewed with the IAB for its possible feedback and recommendations for improvement actions.

Program Retrospectives: In addition to other forms of assessment, the EECE department has been conducting *Program Retrospectives* for graduating seniors. The goal of the process is to identify areas of potential improvement and ultimately to give students a chance to acknowledge the courses and educational approaches that they feel have worked well and to give their opinions on what needs to be improved. The process is conducted in a 30 minute interview/meeting between the department Chair and graduating seniors after the Graduating Senior Survey. The meeting is guided by the following questions:

1. EECE faculty and instructors in my classes were good, qualified teachers.
2. EECE faculty and instructors were available and helpful when I need assistance.
3. The equipment available in the labs was adequate and up-to-date.
4. The software available in the labs was adequate.
5. The laboratories were accessible when I needed to work.
6. My adviser helped me plan my schedule.

7. Required courses were available when I needed to take them.
8. Elective courses were available when I needed to take them.
9. My graduation check revealed no problems.
10. The department staff was available and helpful when I needed assistance.
11. Student organizations were helpful and fun.
12. My classmates were supportive and helpful.
13. The best feature of the EENG program was
14. The best way to improve the EENG program would be to:
15. The elective(s) I would most like to have taken are:

While the first group of questions (1-12) provides very useful information about the program characteristics, it is the remaining questions focus directly on needed improvements. Those questions ask students to identify specific features of the program that they felt were good and also areas that they felt needed improvement. In addition to identifying problems, students are asked for their input on suggested solutions, which is a feature that is missing from other assessment tools. The Department Chair takes notes to share with faculty for preparing the program improvement plan/activities.

In a series of faculty meetings at the beginning of the fall semester, and prior to publishing the annual assessment report, the faculty adopts measures for program improvements. If needed, a Change Improvement Plan is developed. Based on such plan, changes are implemented. As shown in Figure 1.3, each August and September change plans are developed; if needed, changes are implemented during the academic year. Alumni data collection via the web page survey actually happens continuously throughout the year. Other data collection activities, such as employer surveys, senior exit surveys, and program retrospectives, take place at their appropriate times.

B. Actions to Improve the Program

The EECE Department has developed a Program Improvement Process that is repeatable, manageable, and sustainable. The plan is based on the program educational objectives and is executed once each year. The process begins each year with a review of the assessment results from the previous year and assessment tool(s) that are to be used to gather the year's data. The department has made a concerted effort to make sure that the Program Educational Objectives that have been established are communicated to all students who are planning to enter the program and to all students in the program. Objectives are published in the University catalog, on the department web page, and on handouts given to new students during orientation.

The annual Graduating Senior Survey and the Student Evaluation of Teaching each semester are used to solicit input for consideration by the department regarding curriculum, facilities, and other aspects of their educational experience in the department.

In addition, ABET Feedback from previous visits are used for program improvement by appropriate actions.

Appendix A

Outcome Assessment Summary

Program Outcome:	a: An ability to apply knowledge of mathematics, science, and engineering	Instructor:	
Course:	EECE 311 Linear Circuits II	Semester:	

Description:	Circuit analysis techniques for networks with both independent and dependent sources. Network topology. Natural and forced response for RLC circuits. Complex frequency, poles and zeros. Magnetically coupled circuits and two-port networks.
Metric:	Assessment will be based on an evaluation of selected assignments for each student in EECE 311. A minimum of six assignments or exam problems will be evaluated throughout the semester.
Rubric:	A student will demonstrate successful completion of this outcome by achieving a score of 4 of 8 (based on the assessment rubric shown in the attached table) on three class assignments and one examination problem.

Standard: 4

Students must meet the standard on at least two of the four assignments evaluated throughout the semester.

Instructor Evaluation Summary

Number of students achieving standard:	0	#DIV/0!
Number of students failing standard:	0	#DIV/0!

Comments related to student achievement of this outcome measurement.

Comments related to the suitability of this outcome measurement.

Suggestions for possible changes to this outcome measurement.

Instructions: Enter information in blue fields. Yellow fields will be updated automatically.

Rubric for Program Outcome

a: An ability to apply knowledge of mathematics, science, and engineering

Assessment will be based on an evaluation of selected assignments for each student in EECE 311. A student will demonstrate successful completion of this outcome by achieving a score of 4 of 8 (based on the assessment rubric shown in the following table) on at least three class assignments or examination problems. A minimum of four assignments or exam problems will be evaluated throughout the semester.

Student:

Evaluation Measures	**Inadequate**	**Marginal**	**Adequate**	
Scale	**0**	**1**	**2**	**Score**
Problem Solution-style	Results poorly presented; hard to follow reasoning; final answer not clearly indicated; missing units.	Correct solution given but difficult to follow; missing steps in solution, or results not in logical order.	Problem solution steps in logical order and neatly written; final answers clearly marked with appropriate units and labels.	2
Knowledge of Circuit Analysis - fundamental relationships and laws of physics.	Relationships between currents and voltage for R,L,C, or transformer incorrect; energy or power calculations incorrect.	Relations between currents and voltages correct, but there are sign errors or they are used incorrectly.	Equations relating current and voltage for R,L,C clear with correct directions and polarities; relationships involving energy and power state correctly.	2
Knowledge of Circuit Analysis - starting the solution.	KVL or KCL circuit equations incorrect; energy or power relationships needed to solve problem set up incorrectly.	KVL or KCL set up, but with sign errors or missing terms.	Circuit variables such as currents and voltages identified with their directions or polarities on a circuit diagram; KCL, KVL, or energy equations applied correctly.	2
Knowledge of Circuit Analysis - solving the problem.	Incorrect solution for current, voltage or power variables; incorrect application of appropriate mathematics, such as, linear algebra, calculus, complex variables, or differential equations	Most variables, such as currents, voltages or power, found by applying appropriate mathematical methods but several errors in the details.	All desired variables such as currents, voltages or power, found by applying appropriate mathematical methods correctly; problem solution checked using PSpice if appropriate.	2
			Total	**8**

a: An ability to apply knowledge of mathematics, science, and engineering		0
Number of students achieving standard:	0	######
Number of students failing standard:	0	######

EENG Majors

Student Name	Score 1	Score 2	Score 3	Score 4	Standard Met