Improving our programs

Outline

1 Changing the curriculum

Curriculum change results from evaluating the degree to which Program Outcomes and Educational Objectives are achieved. By examining the assessment results, the faculty and Industrial Advisory Board members can suggest changes in improve the curriculum.

2 Continuing process used by the programs

There is a "two-loop" process used to improve the programs. The first loop contains Program Outcomes that are assessed every year, and it focuses on what students should know by the time they graduate. Every year, metrics are established, data is collected, and a subset of all outcomes is assessed and evaluated. This subset of outcomes is related to Educational Objectives that evaluated in the second loop. The Educational Objectives are examined, data collected, and achievement assessed every three years to determine students' performance 3 - 5 years after graduation.

3 Educational Objectives

The Educational Objectives of the Electrical and Computer Programs are broad statements that describe the career and professional accomplishments students should achieve in three to five years after graduation.

Objective 1: To create in our students the passion for engineering that will allow them to understand and correct the increasingly diverse problems facing modern society.
Objective 2: To graduate quality engineers who are forward thinking and equipped with the leadership skills needed to make tomorrow's world a better place through their desire for lifelong learning.

Objective 3: To provide our students with the broad-based interdisciplinary education that will allow them to excel in the global marketplace.
Objective 4: To give our undergraduates opportunities for hands-on research that not only advances the state of the art in their field, but also allows them in-depth study of specialization areas that lead the growing knowledge base in the profession.
Objective 5: To ingrain in our students the desire to better serve society's needs, to search for better ways to solve the world's problems, and to give them the tools to raise the standards of engineering worldwide.

3.1 Program Constituencies

We consider the constituencies—the students, faculty, alumni, and Industrial Advisory Board—to be active partners with common reasons for working together. In incorporating constituency feedback in our Program, the faculty can be more effective than if each acted alone. We hope that involving students in the process will help them to be stakeholders in the process and develop a better relationship with faculty. The process of identifying and working with constituencies also helps sustainability because a stronger base of support exists. Having constituents involved in the planning, execution, and evaluation of the Program helps build ownership for the Program, and having everyone involved in the valuation of results educates all participants.

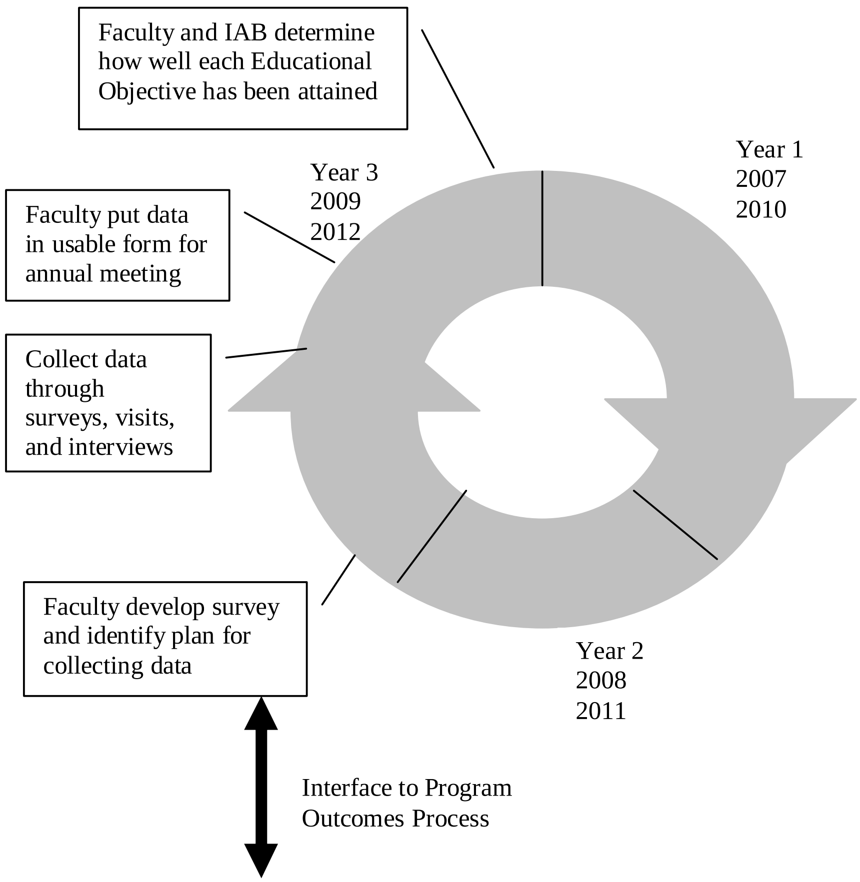
- ***Faculty members*** are represented as course instructors, through individual departmental activities, and through a Curriculum Committee. Faculty members also represent the connection between the Educational Objectives and Program Outcomes.

- ***Engineering Alumni*** are represented by graduates of the program who are now enrolled in graduate ECE classes, work in local industry, and provide feedback through alumni surveys.
- ***Industrial Advisory Board (IAB)* members** are electrical and computer engineers from a diverse cross-section of companies and agencies within the central Florida area that meets annually. The Department has historically worked closely with the Board to foster meaningful exchange and interaction regarding program issues.

- ***Undergraduate Engineering Students*** are represented by all incoming students and those enrolled in ECE classes through surveys and focus groups. They are also represented indirectly through local industry, the IAB, and faculty in courses, orientation, and informal events.

3.2 Achievement of Educational Objectives

The block diagram of the assessment process for the Educational Objectives is shown below. At the beginning of a cycle, faculty members refine the assessment and performance criteria related to the Educational Objectives. The next step is data collection through surveys and visits to local industry to perform interviews with project managers and alumni. When all data is collected, the IAB and faculty evaluate the data and make a decision about the Educational Objectives.



Block diagram of assessment process for Educational Objectives

The assessment of the Educational Objectives occurs at the annual meeting of the IAB. There, both program faculty and IAB members discuss the degree to which the Educational Objectives have been met.

3.3 Collecting Data

Data is collected primarily through an online survey. The campus alumni association provides email information, and the department asks graduates to complete the survey. Surveys are also sent to local companies.

4 Program Outcomes

The program assessment process is based on measuring and evaluating the outcomes that each graduate is expected to have. The outcomes are listed below:

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 multidisciplinary teams

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

f an understanding of professional and ethical responsibility

g an ability to communicate effectively

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

i a recognition of the need for and an ability to engage in 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

4.1 Relationship of Program Outcomes to Program Educational Objectives

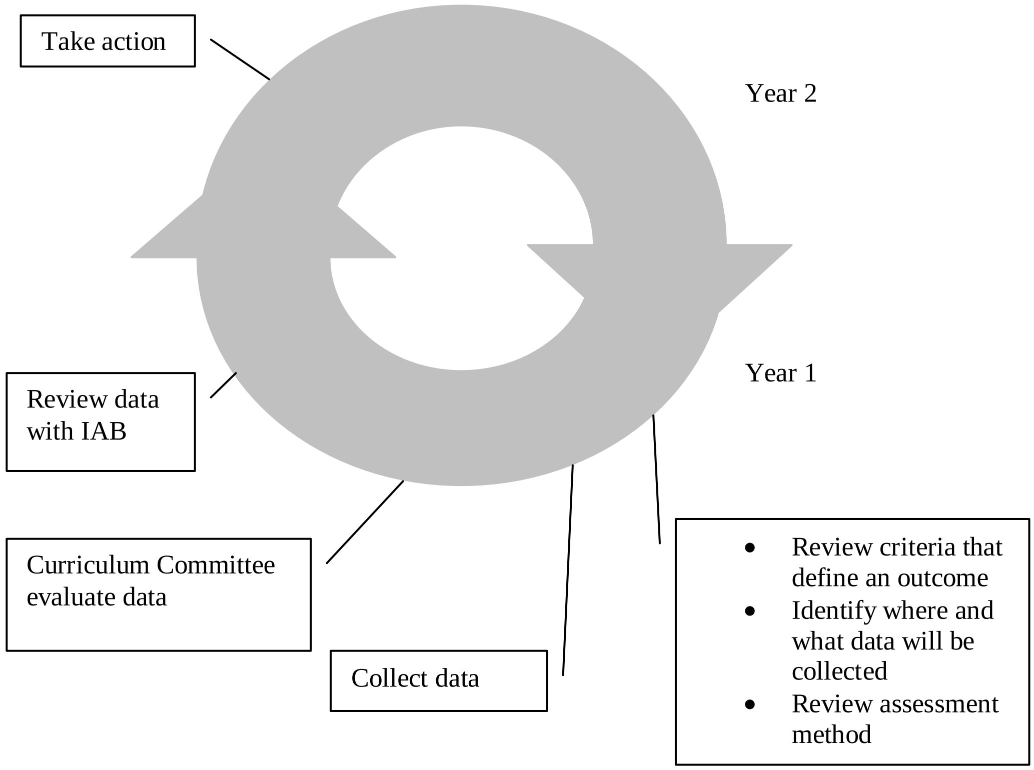
The faculty is critical in verifying that the Educational Objectives are supported by the Program Outcomes. Each Educational Objective maps to a least two program outcomes. The table below indicates which Program Outcomes should be addressed if the Educational Objectives are not being achieved.

Relationship between Educational Objectives and Program Outcomes

Educational Objectives	Program Outcomes
To create in our students the passion for engineering that will allow them to understand and correct the increasingly diverse problems facing modern society.	(a) an ability to apply knowledge of mathematics, science, and engineering
	(d) an ability to function on multidisciplinary teams
	(e) an ability to identify, formulate, and solve engineering problems
	(g) an ability to communicate effectively
To graduate quality engineers who are forward thinking and equipped with the leadership skills needed to make tomorrow's world a better place through their desire for lifelong learning.	(i) a recognition of the need for, and an ability to engage in life-long learning
	(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
To provide our students with the broad-based interdisciplinary education that will allow them to excel in the global marketplace.	(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
	(j) a knowledge of contemporary issues
To give our undergraduates opportunities for hands-on research that not only advances the state-of-the-art in their field, but also allows them in-depth study of specialization areas that lead the growing knowledge base in the profession.	(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
To ingrain in our students the desire to better serve society's needs, to search for better ways to solve the world's problems, and to give them the tools to raise the standards of engineering worldwide.	(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 constraints
	(e) an ability to identify, formulate, and solve engineering problems
	(f) an understanding of professional and ethical responsibility

4.2 Achievement of Program Outcomes

Our current assessment process is streamlined, efficient, and manageable. It centers around the data collection and assessment activities for program outcomes shown below. Four to five different outcomes are assessed every year. Therefore, all outcomes are assessed over a three-year period. In concert with our Educational Objectives assessment process, all outcomes and objectives are assessed every three years, which provides us with a manageable timeline for improving our program.



Block Diagram of Assessment Process for a Program Outcome

The Curriculum Committee consists of all faculty members in the Program. The Committee typically meets every month to discuss any topic related to the Program. The Committee also reviews issues with the assessment process, develops criteria for outcomes, evaluates collected data, and presents the results to the Department's Industrial Advisory Board (IAB). Generally, the IAB presents feedback on the Committee's assessment, and evaluates senior and junior design projects to ensure that program outcomes are being achieved. The results of the meetings indicate recommended changes to the curriculum.

We evaluate all our Program Outcomes over a three-year period. In the first year, Outcomes *a, b, c,* and *e* are assessed; in the second year, Outcomes *f, g, h,* and *i* are assessed; and in the third year, Outcomes *d, j,* and *k* are assessed. We consider evaluating each set of Program Outcomes to be a two-year process, with action taken only during the second year. This timeline was developed to maximize the efficiency of the assessment process.

Early in the academic year, the Curriculum Committee reviews the assessment process. The Committee ensures that outcomes for which data collection has been scheduled are mapped to curricular activities.

When student work is being assessed, we typically use rubrics developed by the program faculty to assess student projects and exams to determine how well each outcome is being achieved. When rubrics are used, one copy of a rubric is used to score each example of student work. Each rubric is organized in a matrix where rows indicate the evidence a student must show to demonstrate the level at which a particular outcome is being achieved.

We have also used external reviewers such as members of our IAB and local members of industry at student Capstone Design Showcases to aid in evaluating Program Outcomes. At these showcases, senior-level students give detailed verbal presentations of their senior design projects with the aid of posters and breadboards. Junior-level students give presentations with the aid of posters on what they plan to do for their senior design projects.

We also collect data through student surveys where students are encouraged to provide written feedback. All students in a particular course are asked to fill out the survey, which results in about 10–35 surveys per course.

4.3 Curriculum maps for Electrical Engineering and Computer Engineering Programs

The curriculum map shows the courses from which data is collected for each outcome. For each outcome (column), a circle indicates that the outcome is practiced at a medium level for a particular course, and a filled-in circle indicates that the outcome is practiced at a high level. A square around a circle indicates that the outcome is assessed in that course. A minimum of four courses is used to collect data to assess a particular outcome. For example, Outcome *h* is practiced and assessed in ECE 3240 but not in ECE 3111. Outcomes may also be assessed in a noncourse setting, such as with focus groups, or by external reviewers as part of a course.

Course-Outcome Curriculum Map for Electrical Engineering

Courses	Program Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
ECE 1551 ***Digital Logic***	○	○	●	○	●	●			○		●
ECE 1552 ***Computer Design***	○	○	●	◘	●	●			○		●
ECE 2111 ***Circuit Theory 1***	●	●			○		○				●
ECE 2112 ***Circuit Theory 2***	◙	◘	◘		●						●
ECE 2551 ***Software/hardware design***	○	○	●		●				○	●	◙
ECE 3111 ***Electronics***	●	●	○		○						◘
ECE 3222 ***Signals and Systems***	●				●						●
ECE 3240 ***Junior design***	○	◘	○	○	○	○	◙	◘	◙	●	○
ECE 3331 ***Electron Devices***	●				○						
ECE 3441 ***Electromagnetic Fields***	●				●						○
ECE 3442 ***Electromagnetic Waves***	●		○		●						
ECE 3551 ***Microcomputer Systems 1***	●	◙	◙	○	◙		◘			●	●
ECE 4221 ***Communication Systems***	◙	○			◙						
ECE 4231 ***Control Systems***	●	●	●	○	●				○	○	●
ECE 4241 ***Systems Design 1***	●	●	●	◘	●	○	○			◘	●
ECE 4242 ***Systems Design 2***	◙	●	◙	○	●	◘	○	◘	◘	○	●
ECE 4311 ***Microelectronics Fab Lab***	●	◘	◘		○		○				
ECE 4332 *Electro-optical Devices*	◘	○	●		●						●
ECE 4342 *Virtual Instrumentation*		●	●				●			○	●
External review	♦	♦	♦		♦						
Focus Group								♦	♦	♦	♦

Legend:
○ Course where outcome is practiced at a medium level, ◘ and assessed
● Course where outcome is practiced at a high level, ◙ and assessed
♦ Outcome is assessed in a non-course setting

Course-Outcome Curriculum Map for Computer Engineering

Courses	Program Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
ECE 1551 ***Digital Logic***	○	○	●	○	●	●			○		●
ECE 1552 ***Computer Design***	◘	○	●	◘	●	●			○		●
ECE 2111 ***Circuit Theory 1***	●	●			○		○				●
ECE 2112 ***Circuit Theory 2***	●	○	○		●						●
ECE 2551 ***Software/hardware Design***	○	○	●		●				○	●	◙
ECE 2552 ***Software/hardware Integration***	●	●	○	○	○		○	○	○	○	●
ECE 3111 ***Electronics***	●	●	○		○						◘
ECE 3240 ***Junior Design***	○	◘	○	○	◘	○	◙	◘	◙	●	○
ECE 3541 ***Digital State Machines***	●	○			●					●	●
ECE 3551 ***Microcomputer Systems 1***	●	◙	◙	○	◙					●	●
ECE 3552 ***Microcomputer Systems 2***	●	●	◙		●		◘		○	●	●
ECE 3553 ***Multifarious Systems 1***	●	◙	●		◙					●	●
ECE 4112 ***Digital Electronics***	◘	◘	●		◙				○	●	●
ECE 4241 ***Systems Design 1***	●	●	●	◘	●	○	○			◘	●
ECE 4242 ***Systems Design 2***	◙	●	◙	○	●	◘	○	◘	◘	○	●
ECE 4342 *Virtual Instrumentation*		●	●				●			○	●
ECE 4551 ***Computer Architecture***	○		○		○						
ECE 4561 ***Computer Communications***	○				●		○	○	○	○	○
External review	♦	♦	♦		♦						
Focus Group								♦	♦	♦	♦

Legend:
○ Course where outcome is practiced at a medium level, ◘ and assessed
● Course where outcome is practiced at a high level, ◙ and assessed
♦ Outcome is assessed in a non-course setting