

ANNUAL ASSESSMENT REPORT

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

2011-2012

INTRODUCTION

This annual assessment report details the activities, events, decisions and actions in relation to the process of continuous improvement in the Department of Electrical and Computer Engineering. The following sections discuss curricular changes and updates as well as proposed modifications to the data collection process for assessment within the department. Included are descriptions relating to how we closed the loop on issues raised in previous years. We note that these changes are in response to feedback from various constituencies including faculty, students, graduating seniors and the industrial advisory committee. These changes are evidence of an active assessment process within the Department of Electrical and Computer Engineering.

UPDATES ON CURRICULAR CHANGES

Various constituencies provide inputs to the cycle of continuous improvement in the department. One of the areas where input is sought is in the area of the curriculum. Over the past several years, inputs from students, graduates, alumni, industrial advisors, and teachers have been collected. As data have been collected, the department executive committee, curriculum committee, and assessment committee have discussed with faculty ways to respond to data from the constituents. This year, several changes have been made to the curriculum-- some changes are major, others are minor. This section documents these curricular adjustments. Since some of the changes apply to undergraduate courses that are taken by both electrical engineering and computer engineering majors, it should be recognized that these issues apply to both programs.

NEW ISSUES

1. It has long been felt by students and computer engineering faculty alike that there is too much overlap between ECE 2700 and ECE 5530. ECE 2700 is usually taught in the freshman year and then 5530 is taken as a senior. Last year a committee was appointed to review this course sequence for topical content, topic overlap, choose texts, and so on. The committee members were Paul Wheeler (chair), Sanghamitra Roy, Rose Hu, and Chris Winstead. When Dr. Wheeler retired, Dr. Roy was appointed the acting chair. A recommendation was made to and accepted by the faculty at the fall retreat. This included a teaching schedule, textbooks to be used, software tools to be used, lab updates, and rewritten course descriptions. We will seek feedback on these updates from faculty and from students at senior exit interviews in future semesters.
2. A trend of low enrolments in microelectronics courses was traced to the requirement that all students in both electrical and computer engineering programs are required to take ECE 5530. To create more flexibility and to get more students into the microelectronics path, the faculty voted at the fall retreat to change the

requirements. Now students are required to take either ECE 5530 (Digital System Design) or ECE 5420 (Microelectronics II).

3. The College of Engineering made the decision to no longer require a 1000 level engineering class. This freed up two credit hours. These hours were incorporated into curricular changes made in the new circuits course sequence. The change in the 1000-level requirement was based on student feedback that the time spent in the 1000-level class learning a little bit about a wide array of subjects could be better used in the core curriculum. Therefore, this was an exchange of breadth for depth. In the electrical and computer engineering programs, the two credit hours freed up by dropping the 1000-level course were incorporated into a newly expanded circuits course sequence.
4. A curricular change was made that addressed two problem areas in the curriculum. There were two main driving factors that converged in a solution that was accepted. First, several faculty and many students have commented that there is too much overlap of topics between ECE 3640 (Signals and Systems) and ECE 5630 (Introduction to Digital Signal Processing). Secondly, faculty involved in teaching circuits voiced the concern that a single semester course in circuits is insufficient for students to develop appropriate knowledge and skills. The latter problem has been dealt with in the past by adding a few of the uncovered circuits topics in the first signals and systems course (ECE 3620). The first few weeks of ECE 3620 were used to finish the circuits topics. This was problematic because it took time away from the signals and systems material.

A committee of faculty was created to find a solution to these problems. Committee members were Drs. Budge, Swenson, Moon, Gunther. The circuits and signals and systems curriculum was rebuilt from the ground up. The two hours freed up by eliminating the 1000-level course were included in a new two-course (3+3 credit hours) circuits sequence (ECE 2250 & 2290) to be taken the fall and spring semesters in the junior year. The signals and systems courses were redesigned with the first course (ECE 3620) being devoted to continuous-time signal processing concepts and the second course (ECE 3640) being devoted to discrete-time signal processing concepts, with advanced signal and image processing concepts being left for courses ECE 5630 (deterministic signal processing) and ECE 7630 (stochastic/statistical signal processing). These changes were presented to and accepted by the faculty. This change solved the circuits problems and eliminated the overlap in the signal processing classes. We will seek feedback on these changes in future semesters as these changes are implemented.

CLOSING THE LOOP ON OLD ISSUES

1. ECE 3710, Microcomputer Hardware and Software – Two years ago students indicated that the content in this course was outdated. The course was re-organized and modernized around the 8051 microcontroller and modern software tools were introduced. This course was taught by Dr. Fon Brown and then by Dr. Paul Wheeler. When Dr. Ryan Gerdes arrived, he began teaching this course. Since making this change, we have received very positive feedback from students at senior exit interviews. There is currently discussion underway to move to an ARM-based microcontroller. After changing to the 8051, the department head presented the change to the industrial advisory committee (IAC). This group of engineers, who is in touch with current trends in the industry, asked why we didn't move all the way to a more modern processor such as an ARM microcontroller. These are becoming ubiquitous in industry. Therefore, the computer engineering faculty have begun discussing the change to ARM.
2. ECE 5720, Computer Systems Programming and Architecture – Two years ago, using inputs from students and faculty, ECE 3720 was removed and the material moved to and combined with ECE 5720. This change was made to help prepare students for the graduate program in computer engineering. Dr. Brandon Eames initiated this change, and Dr. Koushik Chakraborty has continued teaching by the same model. Feedback from

students in senior exit interviews has been very positive. One student commented that this course convinced him/her to pursue computer engineering in graduate school.

3. English 3080 – There seems to be a lot of variability in the way that this class is taught. The first year this course was required of our students, they had a very good experience. This year a different teacher taught the class and the students said they didn't learn anything. More oversight from the ECE department may help to stabilize the quality for students.
4. CS I and CS II (C/C++ programming) – Students feel that they are learning syntax but not good software architecture or software engineering principles. Students emerge from these classes confused about the difference between C and C++. Often they don't feel like they really learn the language until they have to use it in ECE classes. One student observed that the programming projects are like 1980s business applications. Students would like to learn to interface to libraries such as OpenGL. The department head of ECE has had extensive discussions with the CS department head on this subject. Discussions relating to improvement are underway. We will look to student feedback over the next few years to gage the success of these discussions.

MODIFICATIONS TO ASSESSMENT DATA COLLECTION PROCESS

During the past three years the assessment committee has discussed and experimented with new ways to collect assessment data pertaining to courses and student achievement of the A-K program outcomes. This section describes the updated process for collecting this data. We note that the updated process is not a wholesale replacement of the previously used process. We kept the best of what was in place and made modifications as appropriate.

In considering modifications to the existing process, the assessment committee was guided by three principles: (1) every student should be evaluated on each of the A-K outcomes; (2) the assessment process should not be overly burdensome on faculty; and (3) to the extent possible, data collection for direct measures should be a natural part of course administration. The model described below was presented to the faculty for a vote at the department fall retreat (August 2011), and it was unanimously approved.

MOTIVATING FACTORS

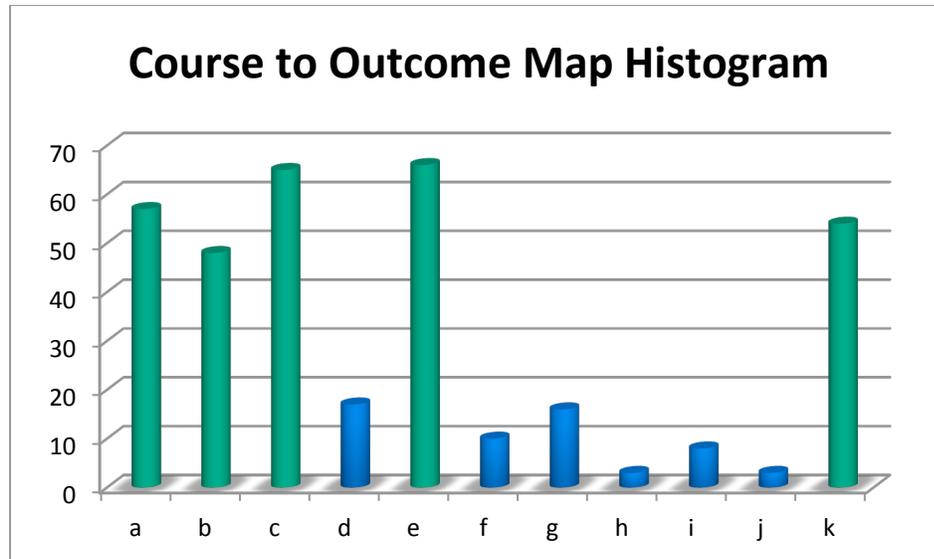
To prepare graduates to attain the program educational objectives, the Electrical Engineering and Computer Engineering Programs within the ECE Department have adopted a set of eleven student outcomes. These coincide with the ABET Criterion 3 Student Outcomes A-K. As it is important to use multiple methods for assessment, both direct and indirect measures are performed as described below.

Associated with each course in the department are course outcomes. These outcomes are posted to the department web site. Based on these outcomes, a course may support one or more of the A-K student outcomes. As shown below, the course-to-outcome map is organized into a table showing which courses support which of the A through K outcomes. Entries in the table are "2" if the course strongly supports the outcome, "1" if the outcome is weakly supported, and "0" or empty if the outcome is not addressed in the course.

Course to A-K Outcome Map												
Number	Title	a	b	c	d	e	f	g	h	i	j	k
1010	Intro. to ECE	1	1			1	1			1		
2410	Elec. circuits	2	1	1		1						1
2530	Digital circuits	1		2		2		1				2

3410	Microelectronics I	2	2	2	2						2
3620	Circuits and Signals	2	1	1	1						1
3640	Signals and Systems	2	1	1	1						1
3710	Micro.Comp.Hard.&Soft.	1	1	2	2	2					2
3720	Micro.Comp.System Prog.	1		2	2	1	1				2
3820	Design I	1	2	2	2	1	2	2	1	1	1
4650	Optics I	1	1	1	1						1
4680	Optics II	1	1		1						1
4740	Comp. and Data Commun.	1	1	2	2						2
4840	Design II	1	1	2	2	2	2	2	1	1	1
4850	Design III	1	1	2	2	2	2	2	1	1	1
5230	Spacecraft Syst. Engr.	2	1	2	1	1	1	1		1	2
5240	Spacecraft Syst. Design	2	1	2	2	1	1	1		1	1
5310	Control Systems	2	2	2	1	2					2
5320	Mechatronics	2	2	2	1	2					2
5340	Mobile Robots	1	1	2	1	2					1
5420	Microelectronics II	2	2	2	2						1
5430	Applied CMOS Electr.	2	2	2	2						2
5460	Digital VLSI Syst. Design I	2	2	2	2						2
5470	Digital VLSI Syst. Design II	2	2	2	2						2
5480	Electromagnetic Compatibility	2	2	2	2	1	1				2
5530	Digital Systems Design	1		2	2	2	1				2
5630	Intro. to Dig. Sig. Proc	2	1	2	2						2
5640	Real-time processors	2	1	2	1	2	1				2
5660	Communication Syst. I	2	1	2	2	1	1				1
5740	Concurrent programming	1	1	2	2						2
5750	High Performance Mic. Arch	1	1	2	2						2
5770	Microcomp. Interfacing	1	2	2	2						2
5780	Real-time systems	1	2	2	2						2
5800	Electromagnetics II	2		1	1						1
5810	Microwaves I	2	1	1	2						1
5820	Electromagnetics Lab.	1	2	2	2						2
5850	Antennas I	2	1	2	2						1
5870	Wireless Comm. Lab	1	2	2	1	2					1
5820	Electromagnetics Lab.	1	2	1	1	2					1

A histogram of the numerical values beneath each of the A-K outcomes reveals that about half of the outcomes (outcomes A, B, C, E, K) are well supported in the curriculum while about half of the A-K outcomes (outcomes D, F, G, H, I, J) are assessed at a few key points in the curriculum. We refer to outcomes A, B, C, E, K as “hard” outcomes and outcomes D, F, G, H, I, J as “soft” outcomes.



DIRECT ASSESSMENT OF SOFT OUTCOMES

Because the soft outcomes (D, F, G, H, I, J) are supported at only a few points in the curriculum, we naturally evaluate these outcomes at these points. The points below explain how and where direct measures are made for the soft outcomes.

Outcome D – an ability to function on multidisciplinary teams

- Engineering Professionalism, ECE 3810 - EE and CE majors in same class and teams are always mixed. Design package produced as a team and graded by instructor (team grade). Informed observer assigns 0-2 (direct measure).
- Senior exit interviews and questionnaire.

Outcome F - an understanding of professional and ethical responsibility

- Engineering Professionalism, ECE 3810 - Formal presentations on and teaching about ethics and professional responsibility, unit and case studies.
- English 3080 – Unit on ethics.
- Senior exit interviews and questionnaire.

Outcome G - an ability to communicate effectively

- English 3080 – Extensive writing and evaluation
- Engineering Communication, ECE 4850 – Extensive writing and evaluation
- Engineering Professionalism, ECE 3810
- Senior design documents
- The review of senior projects by a panel of faculty and other reviewers from industry serves as one of the main assessment points for this outcome. Formal presentations, posters, report, written and verbal communication as well as the innovativeness of the project are evaluated. This information is collected on the Senior Project Jury Form.

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

- ECE 4840/4850 – A requirement of the senior design document asks students to specifically address how their project fits within a global, economic, environmental, and societal context. Students’ responses appear in their project reports. This is a direct measure.
- Engineering Professionalism, ECE 3810 – Formal presentation.
- Senior exit interviews and questionnaire.

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

- Engineering Professionalism, ECE 3810 - Students learn about and convey what they learn by reading a five page paper, they give formal presentation, 0-2 assigned. (direct measure)
- Senior exit interviews and questionnaire.

We accept the definition of life-long learning as (1) reviewing fundamentals of electrical and computer engineering; (2) extending knowledge into other fields such as mechanical engineering, physics, chemistry, mathematics, etc.; and (3) having the ability to effectively find information on the Internet.

Outcome J - a knowledge of contemporary issues

- Engineering Professionalism, ECE 3810 - Formal presentation, students write two page paper, 0-2 assigned. (direct measure)

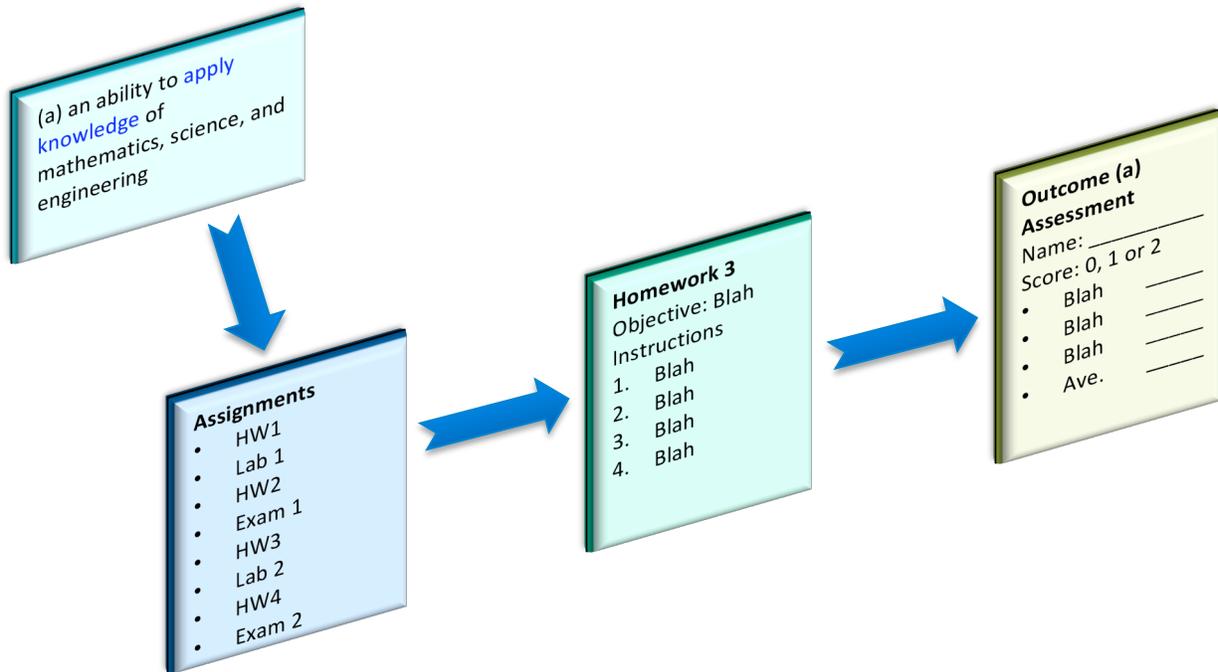
We accept the definition of contemporary issues as (1) events and factors that impact jobs, e.g. outsourcing and the economy; (2) diversity, sexual harassment and workplace issues; (3) issues impacting electrical and computer engineering today. Simply following the latest news headlines is not considered staying abreast of contemporary issues.

DIRECT ASSESSMENT OF HARD OUTCOMES

Our attitude toward assessing the hard outcomes (A, B, C, E, K) is somewhat different than the soft outcomes because it is evident from the course to outcome map that the hard outcomes are thoroughly assessed across the curriculum. Outcome A, for example, is assessed to some extent in each of our undergraduate courses. However, we do not collect assessment information in each of those courses as we feel that this would create an unnecessary burden for faculty. Instead we make sample assessments of the hard outcomes at only a few places in the curriculum. These so called special assessments are made in the core classes that all EE and all CE students are required to take. The table below shows which outcomes are attached to which core classes.

Class	Outcome	Semester
ECE 3410 – Microelectronics I	(k)	Spring
ECE 3620 – Circuits and Signals	(a)	Fall
ECE 3640 – Signals and Systems	(b)	Spring
ECE 3710 – Microcomputer HW/SW	(e)	Spring
ECE 4840 – Design II	(c)	Spring
ECE 4850 – Design III	(c)	Fall/Spring

Instructors have some flexibility in how the special assessments are made. The figure below illustrates the process. First an outcome is assigned to a course. The instructor looks at the list of assignments for the course and chooses one that assesses the assigned outcome. Then the instructor prepares a special assessment form for the chosen assignment. This form lists the performance indicators on which students are evaluated. One form is filled out for each student either by the instructor or by the teaching assistant. The assignments are a natural part of the course. The added burden for the instructor is to prepare the special assessment form and to fill out the form based on the students' work or to make sure that the teaching assistant performs this function. These special assessments are saved in a permanent record.



INDIRECT ASSESSMENT

At the end of each semester, a course assessment is completed for each course by the course instructor. To be clear, the course assessment evaluates the students as a whole against the subset of A-K pertaining to the particular course. It is quantized to the level of a course and summarizes student attainment of the course outcomes on average. In the course assessment instructors also record information about the preparation of students upon entering the course, issues raised in the student course evaluations, and other matters pertaining to the course (what went well/not well, what could be changed to improve the course, etc.). The course assessment provides an indirect measure of student attainment of the course outcomes and the associated student outcomes.

DISCUSSION

The updated assessment of student achievement of the A-K outcomes described above provides for direct assessment of each student on each outcome. It makes point measurements of all the outcomes. The soft outcomes are naturally assessed at the few points in the curriculum where they appear. The hard outcomes are

already directly assessed in nearly every course in the curriculum through exams, quizzes, homework, lab reports, project reports, and so on. Special assessments are samples these measurement devices at a few places in the core curriculum. These special assessments explicitly list performance indicators relating to the outcome that is being assessed. By this plan we believe that student attainment of the course and program outcomes can be evaluated, and this can be accomplished without placing an undue burden on faculty.