Annual Assessment Report

Electrical and Computer Engineering Department

2007-2008

Introduction

The Assessment Committee is responsible for gathering information regarding the undergraduate curriculum and teaching in the Electrical and Computer Engineering (ECE) Department. Formal sources of assessment information include:

- The Industrial Advisory Committee (IAC)
- Alumni surveys (graduates from four years ago)
- Senior exit interviews
- Faculty course assessments
- Special forms for assessing outcomes (a)-(k)

This document, the Annual Assessment Report, is prepared by the Assessment Committee and is meant to summarize the assessment data collected during the academic year. It also documents decisions and action taken to implement course corrections in response to the data collected. Many of the issues identified in the data collection process can be addressed quickly, and where possible this is documented herein. The solution to some problems requiring deeper structural changes or reallocation of resources needs more time to be studied before an appropriate course of action is taken. Therefore, this document also serves as a record of long-term evolutionary changes. Some matters reported herein have been carried forward from previous years.

This report is divided into sections. A section is devoted to each of the sources of assessment information listed above. A great deal of data has been sifted through to arrive at the summary information reported here. Original source data in the form of meeting minutes, survey forms, class assessment forms, and other forms have been archived and are available. This document concludes with two sections: one on curricular changes during the year and another one summarizing ideas for refining the assessment process.

IAC Input

The ECE Department's Industrial Advisory Committee is composed mainly of USU alumni. Currently all members of the committee are graduates of our program and are currently working in industry. The committee is assembled twice each academic year. The committee identified the following issues.

1. Many members of the IAC serve as jurors and evaluators of the senior projects. The timing of the IAC spring meeting is set to coincide with the senior project presentations. This also

happens to coincide with final exam week for the students. It was suggested that the senior project presentations should be advanced by one week. This would solve the problem of students needing to leave or miss their presentation to take final exams.

2. It was also suggested that the number of senior project evaluators should be increased to reduce the work load on the IAC. There were too many projects to evaluate for each juror.

3. Students have expressed a desire for more ideas for senior projects and members of the IAC had many ideas for projects. To help communicate the ideas from the industry representatives to the students, a senior project blog site should be set up. (The department took immediate action on this and the blog site has already been set up. See http://ece.bigblue.usu.edu/senior_design/blog.php)

4. The recruitment and retention of women faculty members was discussed. Flexible schedules and leave of absence should be available. The IAC offered to help with the recruiting effort. The department will also establish an IAC-like committee consisting of women alumni.

5. It was suggested that students need to learn debugging skills in both hardware and software.

6. The IAC was supportive of the curricular change from a single four credit math course on linear algebra and differential equations to two separate three credit courses. (The department has since taken action on this matter and implemented the change. The new math courses are Math 2270 - Linear Algebra and Math 2280 - Differential Equations.)

7. It was suggested that there should be a course taught on written communications. (The department has taken action on this. Students are now required to take the class English 3080 - Introduction to Technical Communication.)

8. The IAC supported the addition of a new semiconductor device physics course taught in the ECE department. (This course has since been added to the university catalogue and was taught for the first time in the Fall 2008 as ECE 5420 - Semiconductor Physics.)

Results from Alumni Survey

The Alumni Survey for 2007-2008 appears in Appendix A. Surveys were mailed to 67 graduates from the 2003-2004 school year. Thirty-one surveys were returned. We have mapped the questions on the survey to the objectives, which are to provide graduates with:

1. Education in the fundamental sciences and mathematics that underlie engineering with a general breadth and depth in engineering analysis and design;

2. Awareness of current technology and the fundamental background to be able to stay informed and adept at new technologies;

3. The ability to put ideas into practice through effective analysis, problem solving, requirements development, design, and implementation;

4. A broad awareness of the world around them through general education so they are prepared to achieve their potential and make contributions in their professional and personal lives;

5. The foundation of communications and teamwork skills and professional attitudes and ethics.

The mapping from the questions to the objectives is as follows:

Objective 1: Questions 6, 18, 19

Objective 2: Questions 7, 8

Objective 3: Questions 9a, 9b, 9c, 9d

Objective 4: Questions 10, 11, 12, 13, 20

Objective 5: Questions 14, 15, 16, 17

Number of surveys requested: 67

Number of surveys returned: 31

A summary of the results are given below. A rubric (1 = no/never/not at all, 5=yes/always) was used in many of the questions. For these questions the scores given are averages.

Number of respondents who graduated in electrical engineering: 25

Number of respondents who graduated in computer engineering: 7

Number of respondents currently employed in engineering: 26

Question	Overview	Score (5=Max)
6	Preparation in fundamentals	4.13
7	Ready to use skills	3.81
8	Adapt to new technology	4.13
9a	Problem solving	4.16
9b	Requirements development	3.77
9c	Design	3.48
9d	Implementation	3.22
10	General education and the world	3.39
11	Choice of general education	2.37
12	More or less general education	1.73
13	Achieve potential	4.58
14	Interact with people	4.03
15	Written and verbal communication	3.79
17	Ethical issues	3.80
19	Compare technical education	3.48
20	Contributions to profession and society	4.11

Written responses to question appear below.

Question 6: Preparation in the fundamentals

- More science would be good.

Question 7: Ready to use skills
- I worked at SDL and those skills were used initially but not from school.

Question 8: Adapt to new technology

- Software – variety of exposure / but USU needs to get more updated.

Question 9: Problem solving, requirements development, design, implementation.

- Junior engineering and senior design were the best for this also the system engineering class.

Question 10: General education and the world

- (No comments.)

Question 11: Choice of general education

- I would like to have had some business classes, they would help.

Question 12: More or less general education

- More flexibility in selection.

Question 13: Achieve potential

- This degree gave me confidence to do hard things and to try.

Question 14: Interact with people

- The class size and teach student relationship helped me to be mentored as well.
- Internship should be required.

Question 15: Written and verbal communication

- (No comments.)

Question 16: How could the program be modified to strengthen your skills?

- More presentation opportunities.
- More hands-on experience, less theory.
- The program is fine, I feel I was prepared by other experiences as well.
- I would suggest doing more design reviews to develop verbal communication skills.
- More team project classes.
- Engineers at USU rarely get graded on their writing and presentation skills. This is not consistent with the real world and what it takes to succeed outside of school.
- Most of these skills I learned taking gen ed courses.

- I underline "at USU" because I did many things outside of EE at USU. The EE department could use more and higher quality one-on-one mentoring relationships between faculty and student. I worked with good faculty, but I felt I had to search them out. They were very helpful when I did (Xxx Yyy and Zzz Aaa).
- Require internships as early as possible.
- Start a technical writing required course.
- More opportunities to formally present technical information.
- Projects and presentations…less book work and more of the soft skills that are needed.
- Assigning small (say one-page) writing assignments to describe something technical.
- How to write proposals, project write-ups, etc. More writing skills.
- There was plenty of communication skills use and emphasis.
- Practicing communication skills with mentors.
- Providing more internship positions in the community (SDL, Campbell SCI, Inovar, Micron).
- More technical reading and presentation focus.
- More design reviews, more group design projects.
- Classes should be geared more toward specific industries.

Question 17: Ethical issues

- The teachers and staff have high morals and demand that from us.

Question 18: What would you have liked to take more of?

Subject	Number of responses
Physics	3
Math	5
Electronics	13
Business	10
Biology	2
Digital	6
English	3
Programming	5
Electromagnetics	5

- I think in general this depends on the job/direction on takes.
- More hands-on stuff. At school everything is so bogged down in the math that sometimes you don't have any idea what the math is really used for.
- Power classes.
- Theory is great, but putting it into practice like the electronics technicians would have been nice.
- Acoustics. These were all available I just didn't take them.
- Matlab tutorial courses would be helpful.
- More project engineering oriented classes.
- Optics. System Integration and test. Not more electronics but applying the circuits (design, build, test for an application).
- More problem solving.
- P.S. I am in Systems Engineering making decisions and making schedules and budgets.

- Especially object oriented programming.
- EM – needs to be better in the midst of change with Dr. Furse. Electronics – practical. More counseling on class content with tech electives.
- Introduce the concept of preliminary and critical design earlier. Practice that on more than one project.
- Learn to design for manufacturing.
- More hands-on development, applying theory that learned filter implementation, etc.
- Either cut the gen ed requirements or allow it to be filled with any elective classes.
- More professor interaction/involvement in projects.
- Embedded systems.

Question 19: Compare technical education

- (No comments.)

Question 20: Contributions to profession and society

- I ended up in Electro-optics though rather than electrical.

Question 21: What did you like best about the ECE program?

- Expertise and help from professors.
- The professors (Dr. W, Dr. X, Dr. Y, Dr. Z).
- I felt there were a couple of excellent teachers that really cared that their students learned the material.
- Helpful, caring professors.
- Cost and accessibility.
- Well laid out program.
- Group projects – working as a team.
- Solid Mathematics curriculum and basic programming are very useful.
- I enjoyed working on the senior project. It combined team work, written and verbal skills, and technical skills and prepared me for a career in engineering more than anything else.
- I really enjoyed the project classes and some of the signal processing classes (Dr. X, Dr. Y, etc.)
- Labs.
- I like the extracurricular programs like SWE and IEEE. The activities helped me prepare and gain skills for my career.
- We had generally good professors and a very personal feel to the program.
- A few of the professors. I like the theoretical background.
- I liked the projects I was involved in both in class and at SDL.
- DSP and signals courses.
- Concurrent BS-MS.
- The robotics courses.
- The sound related classes.
- All of it.
- The teachers and SDL gave me insight to the workplace that is hard to teach and apply in the curriculum.

- Signals classes. Communications class labs. Microprocessor lab. They were all difficult but it forced me to dig in and learn.
- Working with professors and colleagues, controls lab.
- The professors – who actually taught well – supportive as well. Peer support – IEEE, SWE, etc.
- Flexibility, I had a strong interest in CS as well and was able to take several classes as part of the curriculum.
- Classes from Www Xxx and Yyy Zzz.
- Project oriented classes.
- Embedded systems.
- More communication between professors and students.
- Small department, good selections at undergrad classes.

Question 22: If you could change one thing in the program, what would it be?

- More interaction with industrial and enterprise.
- Better instruction in electronics courses.
- Provide more real world experience.
- Use the latest technology. For example in a digital class we programmed GAL22v10's. We shouldn't even know what that is. We should be kept up to date on the latest stuff.
- Strengthen applications and embedded.
- More time allowed. More time toward "real world" engineering.
- Overall, I'm very satisfied. However, I think that professors should focus less on getting through material, and more on ensuring students understand the material.
- Opportunity to focus on specific emphasis earlier in the program.
- Take fewer classes each semester. Too much cramming, not enough time to focus on each course.
- More structured senior design project. Possibly based on faculty research. Also, teach students how to read technical articles.
- Less turnover in professors. When I was there and from what I can see is still the case, most professors hired stays at the university are shorter than most undergraduates at Utah State.
- When doing the labs I never really felt like I knew what I was supposed to learn. Better written labs would have been good.
- More EM classes and some experience in what it takes to design and build electronic assemblies in the real world, start to finish.
- More time for hands-on development and feedback, ie. My current job sets us on task that take years to perfect and modify. It would be good to have a project we could figure out how to work all the kinks in programming and design.
- More hands-on problem solving. Real-life situations, etc. Also – a more stable faculty in an emphasis other than signal processing. (High faculty turn-over.)
- I would suggest doing more design reviews in classes to gain experience in planning a design and defending your design decisions.
- I would have really liked more options when taking a direction. It seemed I quickly took all of the signal processing and image processing classes.
- More of a focus on how what we are learning in the classroom applies to something in the real world. I feel like most of my time in the engineering program was spent learning math theory and grinding through proofs. I'm sure for some professions this would be useful, but for me I wish I could have become more educated on the application side of things.

- Add some kind of professional engineering class. I am an EE consultant and having a class dealing with professional business interaction with people would have been helpful and very applicable to my job now.
- More help in choosing an area of emphasis.
- More application, real-life situations.
- More classes on solving technical problems.
- Students should be involved in at least one major project per year similar to a senior project.
- More project engineering classes and more inter-discipline (i.e. mechanical engineering) classes.
- I feel like I received a little understanding of a broad range of topics, I would have liked a better understanding (through practical applications) of fewer topics. Then let me pick up more later on in my career as I narrow my area. Remembering and understanding common principles/circuits/… is better than remembering that you once studied something about it.
- I would required a business class that incorporated gives presentations on design ideas then wrap that design into a schedule and budget and write a proposal. I enjoyed my experience at USU mostly because the teachers still cared because I was a transfer student and went to other schools but liked the engineering department at USU the best. Thanks!
- My least favorite classes were Design I and II classes. They were just too "fluffy."
- Some classes I took as undergraduate were not helpful to me such as rhapsody, networking. The electrical engineering courses helped me more in my profession.

Discussion of Alumni Survey

Summarizing these scores as associated with the department objectives, we see the following (scores from last year are shown in parenthesis):

- Fundamentals: 3.81 (3.75)
- Current and future: 3.97 (3.75)
- Design aspects: 3.66 (3.4)
- General education and world awareness: 3.24 (3.5)
- Communications and teamwork: 3.87 (3.35)

The score in all of the objectives are better than average, a score of 3. This suggests that we are achieving our objectives. In addition, the scores are slightly better than last year in all cases except for a drop in the outcome involving general education and world awareness.

The following issues stand out in the surveys as areas for improvement.

- The issue of communication was a theme that emerged in many comments to Question 16. One alumnus noted, " Engineers at USU rarely get graded on their writing and presentation skills. This is not consistent with the real world and what it takes to succeed outside of school." Many alumni mentioned that written skills, presentation skills, and proposal preparation skills are extremely valuable on the job. In their view, the department could do more to develop those skills in students.
- In responses to Questions 16, 18 and 22, alumni expressed the desire for more hands-on and real-life projects and less theory.

- Several alumni noted the need for retention of faculty. One observed that " most professors stay at the university shorter than most undergraduates at Utah State." The revolving door is sensed by alumni who are watching our department. When we lose a faculty member, we lose the connection with alumni. Students want mature and stable faculty and alumni see the value in it. Reading through the responses to Question 21 of the alumni survey and the feedback in the senior exit interviews, one gets the sense of how important the faculty are to students and alumni.

Action on Issues Raised in Alumni Survey Last Year. (Closing the Loop.)

- Last year written and verbal communication was flagged as an issue, and it was raised in the alumni survey again this year. To address this issue, the ECE and English departments discussed ways to strengthen technical communication skills for our students. It was determined that starting Fall 2008, ECE undergraduates would take English 3080 "Introduction to Technical Communication".
- Last year, implementation was an area that was flagged as needing improvement. This year comments also came in to this affect. Alumni referred to wanting school to offer more "real-world experiences," use the "latest technology," "hands-on development," "hands-on problem solving," and "projects." This is consistent with responses on Question 20 about what alumni liked best about the ECE program. Many of the responses included mention of labs and lab courses. Apparently, after they get a few years of experience, our graduates see the value of the hands-on laboratory related experiences. The senior exit interviews also indicate that graduating seniors also see the value in laboratory classes. The faculty are striving to offer educational hands-on lab experiences using the latest tools and technologies.
- Last year, math was viewed as inadequate, without sufficient depth or applicability. To remedy this situation, we have replaced Math 2250 (4 cr. hr., linear algebra and differential equations) with Math 2270 (3 cr. hr., linear algebra) and Math 2280 (3 cr. hr., differential equations). The additional credit hours in math will certainly provide greater depth and better preparation for the application of the theory in courses in our department.
- Last year there was the sense that more physics and programming was needed. The redesign of ECE 3720 by Dr. Eames is strengthening the programming on the computer engineering side.
- With the introduction of ECE 5420 - Semiconductor Physics, the Modern Physics course from the Physics Department is no longer required.
- Last year and this year, faculty resource issues rose to the level of significance. Last year the alumni identified research as a distraction to teaching. This year, alumni emphasized more the issues relating to retention of faculty. Faculty issues are very important to alumni and current students alike.
- The department head has had discussions with the Computer Science department to ensure that the topics taught in the introductory computer science sequence are what our students need.

We should note that the changes we have made this year will take several years to work their way into the feedback on the alumni survey since the pool of alumni to whom the surveys were sent graduated four years ago. Even with the additional English writing component, it is likely that students will be shocked about how much writing and communication takes place in real engineering work. School necessarily prepares students with the fundamentals of math and science. Communication is something that is perhaps best learned on the job.

Issues Observed from Senior Exit Interviews

There were many comments made from students. The Senior Exit Survey form appears in Appendix C. Here are some that seem pertinent at the departmental level.

- Almost every course in the undergraduate curriculum from the 2000 level through the 5000 level were listed as students' favorite classes. There was a theme that students liked the hands- and project-based courses.
- At the same time, quite a few favorites were listed as worst classes too. Usually poor ratings were due to "too much math", "too much time", "instructor expected too much", poor textbook, or unprepared teacher.
- In Senior Design, students enjoyed the freedom to work on projects they select and to see the project from beginning design through to completion.
- Hands-on work in the laboratory was viewed as challenging and educational. With the experience behind them, the graduating seniors looked positively upon the lab experience.
- About the required science courses, most students observed that the physics was interesting from the point of view of understanding the broader world around them. Physics helped prepare them for ECE courses in electromagnetics, antennas, and semiconductor device physics.
- About computer science classes, students generally learned C and C++ and recognized the utility of having good programming skills.
- From the perspective of graduating seniors, students recognized the value of math prerequisites. Linear algebra and probability were listed as least favorite classes most often. About the probability class, one clairvoyantly student wrote, "I'm good at Yhatzee now but I think it was not the best way to show how statistics can be visualized in engineering."
- Interestingly, Family Finance was most often listed as the favorite general elective course.
- The pre-professional program at USU and at "feeder schools" prepared students well for the professional program. Only one negative comment from either a transfer student.
- Our undergraduate students feel shorted when it comes to financial aid. They perceive that we are giving it all away to foreign graduate students. "Recruit from local schools and give funding to these students as a first priority!"
- Make senior projects part of other courses.
- Students clearly sensed the conflict between teaching and research that is faced by faculty. "They are so pressed for research they often don't have time to be effective teachers."

- Assign teachers to courses early and don't make last minute changes.
- Students would like representation on a committee considering changes to the curriculum or other programmatic changes. Perhaps this is already accomplished by having an IEEE representative at the department faculty meetings.
- The imbalance in course offerings between Fall and Spring semesters was noted. There are more Fall classes than Spring. A few adjustments (swap Com1 and Com2, move 6030 to spring, what else) has alleviated this somewhat.
- Remark was made about the over use of PowerPoint slides.
- Several students remarked that the programming courses appear too early in the curriculum. By the time they need to use programming in engineering classes, they have forgotten all about it.
- Undergraduate students would appreciate learning more about what their professors are doing for research and how it relates to the subjects they are teaching. Perhaps undergraduates could be invited to the colloquia when faculty are teaching.

Students gave their assessment of the a-k education outcomes and on the five program objectives. Average scores appear in the tables below.

Educational Outcome	Average Score (5=Max, Fall/Spring)
a	4.7/4.4
b	4.75/4.23
c	4.3/4.25
d	4.0/4.13
e	4.7/4.17
f	4.5/4.42
g	3.8/4.25
h	4.3/3.88
i	4.7/4.54
j	3.7/3.46
k	4.0/4.21

Program Objective	Average Score (5=Max, Fall/Spring)
1	4.5/4.15
2	3.8/3.92
3	4.3/4.29
4	4.2/3.92
5	3.7/4.5

On objective 2, despite the relatively high average score, student written comments were mainly negative on feeling unaware of "current technology".

On objective 4, despite the relatively high average score, student written comments reflect frustration in not being able to get as broad an education as they would have liked in the 126 credit hours. There is

not enough flexibility. The department didn't really meet this objective as much as the general university requirements.

Outcome (j) is tied to objectives 2 and 4 in the outcomes to objectives map. Therefore, it is no surprise that the low score for outcome (j) follows the low score for objectives 2 and 4.

Address issues from last year's senior exit interviews. (Closing the loop.)

The following are some of the issues from last year's senior exit interviews. Not every point made last year is addressed here. Those that were merely observations about some aspect of the program were not carried forward. The issues from last year are in italic font and the response is in regular font.

• *There is a strong feeling that the faculty are understaffed. Recent turnovers and need for re-staffing is definitely felt, as is the fact that so many faculty are relatively inexperienced.*

This issue did not appear in the exit interviews this year. However, the turnover rate remains a problem. Several new computer engineering faculty have been hired since last year.

• *PowerPoint was denigrated again.*

The department head has addressed this issue in department faculty meetings and spoken with teachers identified as abusers of the use of PowerPoint slides. A few students mentioned the problems again this year. The assessment committee believes that the situation with overuse of PowerPoint slides is improving.

• *Jump between pre-professional and professional courses was mentioned as being too high.*

This year both USU undergrads and those who transferred from other schools reported that their preparation was either adequate or excellent. There was only one transfer student with a contrary viewpoint and they attended "many" different schools before coming to USU.

• *Probability should be taught in engineering.*

The department head and the assessment committee chair met with the chair of the Mathematics and Statistics Department to discuss this issue. The text and syllabus for the probability class (Math 5710) were reviewed. The course topics and text were deemed appropriate for the preparation of the students and, in turn, provided adequate preparation for the engineering courses.

• *There is a strong sense that the English is not doing the job. The Intermediate composition 2010 is not helping the students with writing, and there is no technical writing course to compensate. More emphasis on verbal communication.*

This year the ECE Department discussed ways to improve the writing experience for ECE students. Working in concert with the English Department, the course English 3080 "Introduction to Technical Communication" was identified. As of Fall 2008, ECE undergraduates are now required to take English 3080. Eventually English 2010 may be phased out in the future. To compensate for the additional three

credit hour technical communication class, the technical writing component of Senior Design (ECE 4850) was dropped and the credit hour allocation was reduced by one credit.

Issues Observed from Faculty Course Assessments

In the following, brief summary information gathered from the course assessments is presented. In particular, if the information seems to be of a nature that the committee should be aware of this and/or act upon it, or if a commitment of resources could help improve things, then it is noted here. But if an instructor makes a comment relevant to in-class issues, it is not noted here. The intent is to provide a document that will help us close the loop in improving the process.

Spring Semester 2008

ECE 3410 (Cripps) A significant number of students were inadequately prepared in basic circuit analysis. Perhaps students should not be exposed to SPICE until after this course. A common lab report template needs to be created.

ECE 3640 (Cripps) Students were not well prepared in two areas taught in ECE 3620, a prerequisite course. These are : 7. Demonstrate understanding of transfer functions, including frequency response and effect of pole/zero placement. Demonstrate ability to use Bode plots for frequency response. 8. Understanding filtering from a spectral point of view. It is the opinion of the instructor that a first course in control systems is a better introduction to a "systems" view than a signals based approach.

ECE 3720 (Eames) The course could use a lab section and a lab TA to answer questions.

ECE 4840 and 4850 (Chen) Here are some good ideas that would require department support and resources.
- A good proposal would be awarded money from an ECE Senior Design Fund.
- Students have a difficult time selecting a project. We need to advertise the Senior Design Blog and get faculty (in this and other departments), community, alumni, and industry participation.
- A Senior Design Hall of Fame could be set up to showcase the best senior projects.
- A common area for senior design would be helpful.
- Establish named Senior Design awards.
- Couple ECE faculty research with Senior Design projects.

ECE 5360 (Chen) Need to enforce the ECE 3620/3640 prerequisite structure. Need funding to get more real-time hardware for prototyping. Could put Mechatronics Lab on show for Engineering State.

ECE 5750 (Brown) Need to work out the continuity between ECE 3710 and this course. The question revolves around the topics of pipelines and caches.

Fall Semester 2007

ECE 1000 (Cripps) Need a bigger classroom.

ECE 2250 (Cripps) Circuit simulation should not be taught. Students use it too much as a crutch and miss learning opportunities.

ECE 3260 (Wheeler) Will not offer this class again on campus, but will offer it on-line instead.

ECE 3710 (Brown) Students at this level should be proficient with C, but they were deficient. It is strongly recommended that we either acquire in-circuit emulators for this course or we use a processor that has software debugging capability built in via JTAG or BDM.

ECE 4250 (Wheeler) The class should be pass/fail rather than letter grade.

ECE 5530 (Dasu) Students were not well prepared for the course. Less than a third remembered material from 2700. Students also need basic understanding of CMOS transistors from 3410. The instructor decided to review prerequisite material before starting into the new material.

ECE 5780 (Eames) There is a hole in the current computer engineering curriculum, where students do not understand the fundamentals of computer systems prior to engaging in senior-level undergraduate courses. The new ECE 3720 is slated to fill the holes.

Follow-up on issues from last year. (Closing the loop.)

ECE 1000 (Baker) Course should be taught twice yearly. Safety/ethics exam needs to be looked at again.

ECE 3410 (Winstead) Students prepared overly long lab reports, leading to time wasted and delays in grading lab reports. There should be department level discussion on lab reports, and training them to be efficient. Need to have a linux-based circuit design lab.

ECE 3710 (Ovaska) Students had less knowledge of pnp and npn transistors than expected.

ECE 5630 (Gunther) This course was taught via the distance program to HAFB. Local students were well prepared, while the distance students had forgotten much of the fundamental material. Students appreciated having a roadmap for the course. (Dr. Gunther has demonstrated this kind of roadmap in our Fall 07 retreat. It was very effective.)

ECE 5750 (Eames) Students were not prepared with background material, due to the nature of the undergraduate preparatory courses (e.g., 3720). This class would benefit from a lab component.

The issue was brought up that students were not really prepared for the course. What this meant was that students had not had sufficient exposure to basic computer architecture concepts. To date, our junior-level computer engineering sequence had a component-level hardware and assembly language software emphasis. Modern computer architecture focuses on the internal design of the components such as the microprocessor. There is no short term fix for this lack of prerequisite knowledge for computer architecture, but we have made some progress towards adjusting our curriculum. The major change is a re-vamped ECE 3720 course. Dr. Eames taught this course in Spring 2008, and used a completely new approach and textbook. The course now has a major focus on modern assembly language development, an introduction to computer architecture, and an examination of how computer software works from a high level language perspective. The concepts we go over in 3720 will prepare students very well for ECE 5750. The next step would be to have ECE 5750 have ECE 3720 as a pre-

requisite; however, this change requires more discussion due to the impact it would have on EE majors as opposed to CompE majors. A dialog between several faculty members has been opened and the discussion is ongoing.

ECE 5780 (Eames) International students seemed less prepared for rigorous programming exercises. Possibly require them to take an introductory programming course.

The issue of preparation with our international graduate students is a difficult one. Many of our international students are not as prepared, due to the fact that many have not had practical programming experience, and lack knowledge about how to construct, and more importantly, debug, computer software. One potential correction for this situation is to make the acceptance criteria for graduate school more strict. However, would not really fix the problem, due to the difficulty candidates would have in demonstrating programming proficiency. The approach Dr. Eames has taken in this class is to create an introductory lab assignment that is given out the first week of class, which requires students to write a "simple" program (simple for those who know how to do software development). Those students who really struggle with this introductory lab assignment are encouraged to drop the class and obtain some programming experience before attempting the course during the following year.

Perhaps the proper corrective action for this course centers on the new ECE 3720 course Dr. Eames offered in Spring 2008 (as discussed above). ECE 3720 offers an introduction to software development, and gives students experience both at the assembly level and with a high level language. Dr. Eames strongly believes that students who successfully complete ECE 3720 will have the capability to successfully complete ECE 5780. ECE 3720 is an undergraduate course. We expect that our graduate students have equivalent experience in their undergraduate education when they begin the graduate program. The major challenge is that many of our international graduate students do not have an equivalent course, but cannot take ECE 3720 for credit due to the fact that it is not in our graduate program. This is yet another situation which requires discussion on the curriculum committee and discussion with faculty members within the computer engineering program here at USU.

ECE 5930 (Winstead) Students need better preparation at the 3410 level. A linux-based circuit design lab is essential. Students need instruction on Unix OS operations and etiquette.

ECE 6620 (Budge) A couple students had not had the prerequisite material.

The instructor indicated that this was a temporary situation caused by low enrolments that semester. Students who had not had the prerequisites were allowed to take the class so that the enrollment would be high enough for the class to carry. Of the two students who had not had the prerequisite material, one got caught up with the rest of the class. The other struggled throughout the semester.

ECE 6670 (Gunther) Not all students had had the prerequisites, or had studied at other universities. Bringing everyone up to speed slowed the presentation and made covering some topics impossible. Will enforce prerequisites in the future. A real-time radio project would significantly add to this course.

Funds from the Anderson Wireless Teaching and Research Center were used to acquire a pair of GnuRadio boards for prototyping software radio functionality.

ABET a-k Outcomes From Classes

Last year (2006-2007) we initiated a program to obtain more direct measurements of the a-k outcomes. As explained in the document "Assessment Processes in the Electrical and Computer Engineering Department, Spring 2006," specific assignments in several classes have been identified to provide measurement data on these outcomes. The assessment forms appear in Appendix B. These do not provide the only means of measurement since the classes have been mapped to the outcomes and we have assessments for the classes as well. But these measurements are more direct and hence, it is hoped, more valuable for assessment purposes. Scores on these measurements are measured using a 0, 1, 2 scale: 0 meaning "does not meet expectation," 1 meaning "meets expectation," and 2 meaning "exceeds expectation."

Class	Outcome	Number of Evaluations	0	1	2	Average
3620 F	a	90	14	16	60	1.43
3640 S	b	97	5	76	16	1.10
3710 F/S	b	79	6	44	29	1.28
3820 S	c	50	0	10	40	1.8
4850 F/S	c	56	0	24	32	1.46
3820 S	d	50	3	11	36	1.66
4850 F/S	e	58	0	25	33	1.49
	f[1]					
3820 S	g	50	0	17	33	1.66
4850 F/S	g	56	0	7	49	1.58
3820 S	h	50	3	0	47	1.88
4850 F/S	h	56	0	9	47	1.60
3820 S	i	50	0	0	50	2.00
3820 S	j	50	4	15	31	1.54
3410 S	k	71	0	53	18	1.24
3710 S	k	15	0	0	15	1.93
5530 S	k	7	0	2	5	1.61

Curricular and Assessment Work This Year

- In the past our undergraduate students were required to take a four credit hour math course covering the subjects of linear algebra and differential equations. ECE faculty members who

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[1] To obtain a direct measure of students' understanding of ethics, there is a web-based ethics module and quiz which is taken in the ECE 3820 course. All students are required to pass this exam to pass the class.

teach classes that draw upon students knowledge of these subjects have noticed insufficient depth in students' understanding. Additionally, last year in the alumni survey, math was viewed as inadequate, without sufficient depth or applicability. Therefore, this year the ECE department investigated changing the math requirement. It was discussed in committee and in faculty meetings. The requirements have now changed to require students to take one three credit hour math class on linear algebra and another three credit hour math class on differential equations. This change is going into effect starting in the Fall of 2008.

- Over the past several years, the faculty course assessment in the ECE 5660 course (Communications Systems I) has indicated that students lack adequate preparation in the subject of probability despite having taken the prerequisite course on probability offered by the Mathematics and Statistics Department. To investigate this, the department head of ECE and the assessment committee chair met with the department head of Math & Stats to discuss the issues. The ECE representatives examined the textbook and syllabus for the course. Both were deemed to be well targeted to the subjects needed in a class on probability for engineers. Two options were being considered: (1) have ECE faculty teach probability to ECE students, or (2) leave the probability class with the Math & Stats department. The decision was made to go with the latter alternative.

- Feedback on alumni surveys and in last year's senior exit interviews recommends strengthening written and verbal communication aspects of our program. In the past, undergraduates have been required to take English 2010 "Intermediate Writing: Research Writing in a Persuasive Mode".   Feedback from students and the opinions of faculty is that this course is not providing adequate training for our students. Through discussions among faculty in the ECE and the English Departments it was concluded that English 3080 "Introduction to Technical Communication" would provide the writing experience our students need. Starting in the Fall semester of 2008, ECE undergraduate students are required to take English 3080, which is a three credit hour class. To compensate, the writing requirements in ECE 4850 "Senior Design III" were reduced and the credit hour allocation was also reduced from three to two credits.

- An issue that was raised in the senior exit interviews this year and one that has been on the minds of faculty had to do with the balance of classes between the Fall and Spring semesters. There are many more elective courses available in the Fall than in the Spring.   We have been at work on this issue for some time. Several years ago, for example, ECE 5660 (Com I), which had been taught in the Fall, was moved to the Spring and ECE 6670 (Com II) was moved from Spring to Fall. This year the faculty representing the different emphasis areas in the department (e.g., controls, electromagnetics, computer engineering, signals, etc.) were asked to meet and review the course load balance between the two semesters. A change arising from this discussion was to move ECE 6030 to the Spring semester. This change allowed first year graduate students to take the signals core classes (ECE 5630-DSP, ECE 6010-Stocastic Processes, and ECE 6030-Mathematical Methods and Algorithms for Signal Processing) in their first year. The other signals and systems classes were determined to be well sequenced and spread evenly between the two semesters. Discussions are ongoing among faculty in other areas.

Refining Our Assessment Process

This year the alumni survey was re-examined and some changes were made. The major change had to do with refining the assessment of objective 3 relating to analysis, problem solving, requirements development, design and implementation. The alumni survey is a work in progress. One way that it could be improved would be to bring up significant issues identified in previous year's alumni surveys in order to see if we are making progress on the issues. Because of the four year delay in the feedback gained from the alumni survey, this is a long-term process. The survey form used this year appears in Appendix A.

At the senior exit interview, seniors should be asked specifically about the points that were flagged from the previous year. There seems to be a lot of variance in the feedback between years. It may be that the one conducting the interview biased the students by their questions. Or, the summary of the exit interviews is biased by a few outspoken students. We need to understand what the real issues are, and by closing the loop on issues from one year to the next, progress can be tracked on issues raised.

The following is raised here as to create a point of discussion for the Assessment Committee and possibly the Executive Committee as well. The memory of issues raised from year to year boils down to this Annual Assessment Report. In particular, the assessment committee chair who writes the initial draft of this report, and the assessment committee who review and revise the initial report, are responsible to carry forward issues that were raised in the previous year and which may or may not have been resolved. If this group of people does neglects to bring an issue forward, it could disappear from the assessment cycle. Therefore, the committee is tasked with discussing remedies to this potential hole in the assessment process. One possible solution would be to use a web-based case system in which assessment issues are entered via a web form. (Potentially any of the constituents could create and author such a case.) The cases could be tracked in a database which could be queried for all open cases. Open cases would be reviewed by the Assessment Committee. When issues have been addressed, cases could be closed and the documentation would be a natural part of closing the case. Progress on open cases could also be documented. The web-based system would therefore provide the memory needed to prevent issues from being accidentally dropped. The system could assist in the collection of assessment data. For example, the web form could ease the process for faculty of filling out their course assessments. In addition, the course assessments would be uniform and contain useful information.

The faculty course assessment template could be improved. Currently the assessment committee reads through each course assessment and must discover issues that merit being elevated to the level of departmental discussions. An improved form would specifically ask instructors to address in separate statements in-class issues and issues that deserved to be looked at the department level. In class issues relate to why a certain outcome received a low score, how the teacher would modify the lectures, homework, textbook, etc., what went well, what needs to change, and so on. Department level issues relate to the facilities, laboratory resources, requests for lab space, lab hardware and software,

scheduling, course sequencing and prerequisites, curricular issues, and so on. This division would aid the assessment committee with its work.

Appendix A

Utah State University
Electrical and Computer Engineering Department
Alumni Survey 2007

Whether you buy a toaster or a video camera, it seems that everyone wants to know how you like the product and the service that came with it. Ideally, this information is used to improve the product in the future.

Well, you paid a lot of time and money for an education from Utah State University, and we want to know how it went for you. We are not merely casually interested. We are charged by our accreditation board (ABET) to produce students who meet certain objectives — objectives which are defined *years after* graduation! We need to hear from you to see how well what we provided to you while you were a student here has served you in achieving our objectives that we hoped for you. Here are the objectives—the long-term goals—that are established for the Electrical Engineering and Computer Engineering Majors.

The educational objectives of the Electrical and Computer Engineering programs at Utah State University are as follows: To provide graduates with:

1. **Education in the fundamental sciences and mathematics that underlie engineering with a general breadth and depth in engineering analysis and design;**

2. **Awareness of current technology and the fundamental background to be able to stay informed and adept at new technologies;**

3. **The ability to put ideas into practice through effective analysis, problem solving, requirements development, design, and implementation;**

4. **A broad awareness of the world around them through general education so they are prepared to achieve their potential and make contributions in their professional and personal lives;**

5. **The foundation of communications and teamwork skills and professional attitudes and ethics.**

Please provide a thoughtful response to the following 22 questions and return it to us in the envelope provided. Please circle responses as appropriate. Also, please feel free to add additional written feedback on the lines provided.

1. What size T-shirt would you like?   (**M, L, XL, XXL, None**)
(To say thanks for helping us out with this survey, we will send a T-shirt back to you if you send in this survey. We'll try to send the size you indicate.)

2. If you want a T-shirt, we will need your address to send it back to. (This means that your comments won't be anonymous.) Your address:

_____

_____

_____

3. Were you an Electrical Engineering Major or a Computer Engineering Major? (Circle one)

Electrical Engineer	Computer Engineer

4. Are you employed as an engineer or in an engineering-related position?

Yes	No

5. If the answer to the previous question is "no," have you found that your engineering education at USU has helped you arrive at your current position?

Yes	No

6. Did the technical courses at USU equip you with *fundamentals* in math and science appropriate for a professional engineering position?

1=not at all	2	3	4	5=very much

7. A technical education can be viewed as consisting of two parts: An education in the foundational principles of math and science; and an immediately useful set of tools, which allows you to be effective and useful "right out of the box," that is, immediately upon employment.
To what extent do you feel like you had useful skills that your employers were able to use "right out of the box?"

1=not at all	2	3	4	5=very much

8. If you have had to develop new skills or adapt to new technology, to what extent did your education prepare you for that?

1=not at all	2	3	4	5=very much

9. Please indicate the degree to which your education at USU prepared you with the following engineering skills.

(a) Problem solving skills: an ability to formulate a problem, determine a direction of attack, and proceed toward a solution.

1=not at all	2	3	4	5=very much

(b) Requirements development: figuring out what you will need in order to approach and solve a problem.

1=not at all	2	3	4	5=very much

(c) Design: Considering tradeoffs; employing creative ideas; making informed decisions.

1=not at all	2	3	4	5=very much

(d) Implementation: Understanding how to actually build or manufacture your solution.

1=not at all	2	3	4	5=very much

10. In addition to the technical classes, your education also had general education courses. To what extent have the general education courses that you took, and the habits of self education you may have acquired, helped you maintain an awareness of the world situation?

1=not at all	2	3	4	5=very much

11. Now that you are finished with your undergraduate degree and looking back, to what extent would you change the choices of the general education courses that you chose to take?

1=not at all	2	3	4	5=very much

12. Would you have wanted more general education courses, less general education courses, or about the same?

1=not at all	2	3	4	5=very much

13. To what extent has your education generally contributed to your ability to "achieve your potential." That is, to what degree do you feel like your college education has helped you accomplish things in your professional and/or personal life that you would not have been able to accomplish without it?

1=not at all	2	3	4	5=very much

14. To what extent has your education at USU prepared you for interaction with other people in your professional life?

1=poorly	2	3	4	5=strong

15. To what extent has your education at USU provided you with appropriate written and verbal communication skills?

1=poorly	2	3	4	5=strong

16. How could the program be modified to further strengthen these skills?

_____

_____

17. To what extent has your education at USU provided you with an understanding of ethical issues?

1=poorly	2	3	4	5=strong

18. Are there ways in which your education at USU could have been modified which would have improved your abilities to make professional and societal contributions? Circle all that apply
OK as is
more physics
more math
more electronics
more English
more digital
more programming
more EM
more business
 more biology
Other (please specify):

_____

_____

19. Compared to your professional peers with similar education levels from other institutions, how do you feel the technical aspects of your engineering education compare to theirs?

1=very poorly	2=weakly	3=about equal	4=stronger in some areas	5=generally stronger

20. What is the extent to which your engineering education at Utah State University has helped you make contributions to your profession and to society.

1=not much	2=a little	3=some	4=quite a bit	5=a great deal

21. What did you like best about our ECE program?

_____

_____

22. If you could change one thing in the program, what would it be?

_____

_____

Thanks for your input!

Appendix B

ABET Outcome A
Assessment Form
ECE 3620
Numerical Solution of Differential Equations

Name: _____

Students must demonstrate "an ability to apply knowledge of mathematics, science, and engineering."

The assignment required application of computer science (programming) and math (differential equations) to solve a problem of engineering interest: the response of a linear time-invariant system in general, particularly the zero-input response of a circuit.

Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

- Student correctly moves from physical system (circuit) to mathematical descriptions as a differential equation and differential equations in state variable form.

    _____

- Student correctly translates mathematical problem into appropriate computer language.

    _____

- Student compares theoretical results with simulated results and accounts for any discrepancy.

    _____

- Provided evidence of understanding and application in discussion.

    _____

- **Average:**   _____

ABET Outcome B
Assessment Form
ECE 3710
Output Characteristics on a Digital IC

Name: _____

      Students must demonstrate "an ability to design and conduct experiments, as well as to analyze and interpret data."

      Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

      Students must obtain at least a **1** in each item to pass the class.

- Student develops an effective procedure for experimentally determining the effect of exceeding voltage/current limits on a digital IC.

  _____

- Student effectively presents the data from the experiments and interprets the results.

  _____

- Student interprets and applies results in terms of design limitations.

  _____

- **Average:** _____

Assessment Form
ECE 3640
Determining maximum μ for an adaptive filter.

Name: _____

       Students must demonstrate "an ability to design and conduct experiments, as well as to analyze and interpret data."

       Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

       Students must obtain at least a **1** in each item to pass the class.

- Student develops an effective procedure for experimentally determining the largest value of μ that you can use.

    _____

- Student effectively presents the data from the experiments and interprets the results.

    _____

- Student makes effective comparisons between experimental results and theoretical predictions and accounts for discrepancies.

    _____

- **Average:**   _____

ABET Outcome D
Assessment Form
ECE 3820
Multidisciplinary Team Evaluation Form

This form is to be filled out by each member of each team.

Students must demonstrate "an ability to function on multidisciplinary teams."

Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

Student Being Evaluated: _____

Student Doing Evaluation: _____

Please score on the basis of 1 to 2:

0   Missing or significantly deficient
1   Present and adequately executed. However, there is room for improvement.
2   Present and fully executed.
_____

1. Student was present at most or all team meetings: _____

2. Student carried out designated responsibilities: _____

3. Student shared *constructive* criticism: _____

4. Student avoided negative attitudes: _____

5. Student carried fair share of load: _____

6. Student was committed to good of team, and not just self-interest: _____

Average Score: _____

ABET Outcome K
Assessment Form
ECE 5530
Digital State Machine Design

Name: _____

      Students must demonstrate "an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."

      Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

      Students must obtain at least a **1** in each item to pass the class.

- An ability to use the following techniques:
    - Design parallel to serial converters using shift registers.   _____

    - Design an adder using a Moore-based finite state machine.   _____

    - Design a pattern detection circuit using a FSM.   _____

- An ability to use the following skills:
    - Design an adder FSM using a minimal number of states.   _____

    - Design a pattern detection FSM using a minimal number of states.   _____

- An ability to use modern engineering tools necessary for engineering practice:
    - Have the students used the Xilinx ISE 8.li synthesis tool correctly?   _____

    - Have the students used Modelsim SE correctly so as to obtain timing diagrams to verify the design?

       _____

- **Average:**   _____

ABET Outcome K
Assessment Form
ECE 3410
Analysis, Simulation and Measurements of MOSFET Amplifiers

Name: _____

        Students must demonstrate "an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."

        Scores are based on the scale of 0 – 2: 0 meaning "not adequate skill," 1 meaning "adequate," and 2 meaning "strong skill."

- Apply fundamental circuit analysis skills to predict the gain and output resistance of MOSFET amplifiers.

                                                  _____

- Translate schematic diagrams into SPICE-language circuit descriptions.

                                                  _____

- Utilize laboratory power supplies, function generators, multi-meters and oscilloscopes for experimental evaluation of the designed circuit.

                                                _____

- Compare and contrast results from analysis, simulation and experiment. The student should be able to note significant differences and offer plausible explanations.

                                                _____

- **Average:**   _____

Senior Project Jury Evaluation Form

Student Name(s): _____   _____   _____

Project Number: _____

Student Project Name: _____

Students are to be evaluated *as a team*.
For ABET requirements, students must demonstrate:
- (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."
- (e) – "An ability to identify, formulate, and solve engineering problems."
- (g) – "An ability to communicate effectively."
- (h) – The broad understanding necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context."

Please score on the basis of 0 to 2:

0   Missing or significantly deficient
1   "Meets expectations," present and adequately executed. However, there is room for improvement.
2   "Exceeds expectations," present and fully executed.

The "project" in the items below includes either the physical item, or the documentation associated with it. Answers may also be obtained to questions asked by the jury.

1. The design states and meets desired needs (ABET C, E).   _____

2. The design solution exhibits consideration of constraints, and meets the needs within reasonable constraints, such as economic, environmental, social, political, ethical, health, and safety, manufacturability, and sustainability (ABET C, E).   _____

3. The student/team is able to demonstrate that design steps were followed, such as:
    — Clearly defining the problem
    — Gathering information
    — Considering alternative designs and trading off aspects of the design
    — Clearly documenting progress
    (ABET C, E)   _____

4. The implementation follows proper procedures appropriate for the design (ABET C, E).   _____

5. Student/team has appropriately identified engineering problems and solved them (ABET E). _____

6. Student/team orally describes impact of project on economic, environmental, or societal systems
    (ABET H).   _____

7. Student/team communicates orally in a clear and effective manner (ABET G).   _____

Evaluator Name: _____   Date: _____

Appendix C

Senior Exit Luncheon

Spring 2008

1. List the most valuable ECE courses you have had. What makes them valuable?

2. List the favorite ECE courses you have had. Why are these your favorites?

3. List your least favorite ECE courses you have had. Why are these your least favorite?

4. What aspects of the senior project have been most beneficial. Explain.

5. What has been helpful about the science courses your took (e.g. Physics)?

6. What has been helpful about the computer science courses you took?

7. List your most valuable math courses. Why were these valuable?

8. List your favorite math courses. Why are these your favorites?

9. List you least favorite math courses. Why are these your least favorite?

10. List your most valuable general education courses. Why are these valuable?

11. List your least favorite general education course. Why are these your least favorite?

12. Are you a transfer student? (yes / no)
    a.   If no: How well did our pre-professional program prepare you for the professional program? What changes would improve   the pre-professional program?

    b.   If yes: Where did you transfer from? How well did the pre-professional program prepare you for our professional   program?

13. Identify aspects that you have found positive about your experience in the ECE department at USU. What did we do well?

14. What would you suggest the faculty or department do to improve the ECE department?
The department has the following stated education program objectives:
1) Education in the fundamental sciences and mathematics that underlie engineering with a general breadth and depth in engineering analysis and design;
2) Awareness of current technology and the fundamental background to be able to stay informed and adept at new technologies;

3) The ability to put ideas into practice through effective analysis, problem solving, requirements development, design, and implementation;

4) A broad awareness of the world around them through general education so they are prepared to achieve their potential and made contributions in their professional and personal lives; and

5) The foundations of communications and teamwork skills and professional attitudes and ethics.

Please score your assessment on how well you have met these objectives on the basis of 1 to 5 (with 5 being the highest). Comment on the extent to which each of these objective has been achieved.

1) Score 1-5 ____   Comments:

2) Score 1-5 ____   Comments:

3) Score 1-5 ____   Comments:

4) Score 1-5 ____   Comments:

5) Score 1-5 ____   Comments:

We also have some particular educational outcomes we must meet. Please give your ECE education at USU a grade (on scale of 1 to 5, with 5 being the best) for providing you with:

…an ability to apply knowledge of mathematics, science and engineering. ____

…an ability to design and conduct experiments, as well as to analyze and interpret data. ____

…an ability to design a system, component, or process to meet desired needs. ____

…an ability to function on multidisciplinary teams. ____

…an ability to identify, formulate, and solve engineering problems. ____

…an understanding of professional and ethical responsibility. ____

…an ability to communicate effectively. ____

…the broad education necessary to understand the impact of engineering solutions in a global and societal context. ____

…a recognition of the need for, and an ability to engage in life-long learning. ____

…a knowledge of contemporary issues. ____

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

What are you plans after graduation?

Any additional comments?