06-07 Assessment Report

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1. What goals or learning objectives/outcomes were assessed in AY 2006-2007?

1. A knowledge of mathematics through discrete mathematics, statistics, differential and integral calculus, differential equations, physics and chemistry. (Program Criteria)
2. A knowledge of basic engineering sciences including statics and dynamics. (Program Criteria)
3. The ability to apply knowledge of mathematics, science and engineering to solve problems in the fields of computer engineering. (Engineering Criteria)
4. A knowledge of core computer engineering topics in algorithms, data structures, circuits, electronics, computer networks, microprocessors, peripheral devices, and embedded systems. (Program Criteria)
5. Depth in areas of computer engineering: computer networks, embedded programming, and microprocessor-embedded control systems. (Program Criteria)
6. Knowledge of discrete mathematics, probability, statistics, and their applications to fields in computer engineering. (Program Criteria)
7. The ability to use contemporary engineering techniques and tools in conducting analysis and design in the fields of computer engineering. (Engineering Criteria)
8. The ability to work with modern instrumentation, software and hardware design tools, to perform tests, design, implementation, and analysis. (Engineering and Program Criteria)
9. The ability to integrate knowledge gained from the core curriculum to solve a complex design problem. This includes the identification, specification, design and implementation of products/components and/or systems that meet required specifications and performance. (Engineering and Program Criteria)
10. The ability to function on multi-disciplinary teams and exercise leadership to accomplish project goals. (Engineering Criterion 3d)
11. The ability to communicate effectively through written technical papers and/or project reports. (Engineering Criterion 3g)
12. The ability to make effective oral presentations and convey technical material to an audience. (Engineering Criterion 3g).
13. An understanding of professional and ethical responsibility and a broad education to appreciate the impact of engineering solutions in the societal context. (Engineering Criteria 3f, 3h, and 3j)
14. Recognition of the need for and an ability to engage in "life-long" learning. (Engineering Criterion 3i)
15. Knowledge and appreciation of cultural diversity and demonstration of proficiency in foreign languages.
2. How did you assess these learning outcomes?

a. Describe the measures you used and the information gathered. (Description, date administered, results)

1. **Students’ Work.** Each faculty member has collected and continues to collect sample students’ work (exams, tests, and assignments) of various grades (A, B, and C) as part of the course portfolios presented to the ABET assessment teams.

2. **Industrial Visits.** We have visited HP, PMC-Sierra, and Intel during this May for the outcome assessment. Reports and detail material for these visits have been summarized and processed in the office of the college career development (Cici Matuzzi).

3. **Written and verbal questionnaires** have been developed specifically for the industrial visits and filled out by our alumni and their supervisors during the visits.

4. **Portfolios** of each course are available in the office of computer engineering program.

5. **Faculty** have been given a set of forms designed to identify various knowledge areas of computer engineering topics during the meetings in Spring 2007. Part of the results have been collected.

6. **Faculty** are requested to update their course description during the meetings of Spring 2007. Part of the courses have been completed with updated descriptions.

b. As a result of these assessments what did you learn about the program’s success in helping its students achieve these learning outcomes?

Retention. During faculty meetings the issue of retention has been the focus. The discussion and action on the causes of low retention rate have been studied. One significant aspect may lie within the structure of the curriculum.

Outreach and Enrollment. A committee to address issues and solutions to student enrollment and outreach has been formed during Spring 2006, and monthly meetings have been conducted since. Several suggestions to the department have been presented, and several actions have been taken.

3. As a result of faculty reflection on these results, are there any program changes anticipated?

1. **A freshmen course: introductory to CPE.** Faculty agreed that a major structural studies and changes may be needed before the scheduled next ABET visit. Certainly more advising and tutoring activities are needed to boost the confidence of new students. A first course as an introductory to the program itself is understood to be one of the most helpful approach and is proposed. See meeting minutes during Fall 2006 and Spring 2007.

2. **Curriculum structure.** The feedbacks from alumni, especially during the industrial visits, have reflected many needed information points of which most of them address the need for the studies and improvements of the overall curricular structures. Almost all the feedbacks approve the pragmatic natures of the program and disapprove the
overemphasis and redundant theoretical components in courses structured along the program.

4. Did your department engage in any other assessment activities such as the development of rubrics or course alignment?

Based on ABET Criterion #3 we are in development of a set of rubrics to align the following list of **program outcomes** to a list of **course objectives** from our program curriculum. Below is the list of program outcomes.

a. an ability to apply knowledge of mathematics, science, and engineering  
b. an ability to design and conduct experiments, as well as to analyze and interpret data  
c. an ability to design a system, a component, or process to meet desired needs  
d. an ability to function on multi-disciplinary teams  
e. an ability to identify, formulate, and solve engineering problems  
f. an understanding of professional and ethical responsibility  
g. an ability to communicate effectively  
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context  
i. a recognition of the need for, and an ability to engage in lifelong learning  
j. a knowledge of contemporary issues  
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Program Outcomes ‘a’ through ‘k’ are identical to ABET program outcomes ‘a’ through ‘k’. Each of these outcomes states clearly what is expected. The five Program Educational Objectives are correlated with outcomes as follows:

- **Enter professional employment and/or graduate study in computer engineering areas, such as, logic design, computer architecture, processor hardware, and computer systems.**
  - an ability to apply knowledge of mathematics, science, and engineering (a)
  - an ability to design a system, a component, or process to meet desired needs (c)
  - an ability to identify, formulate, and solve engineering problems (e)
  - an ability to communicate effectively (g)
  - a recognition of the need for, and an ability to engage in lifelong learning (i)
  - an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (k)

- **Identify, analyze, and solve practical computer engineering problems using both hardware and software design tools and techniques.**
  - an ability to apply knowledge of mathematics, science, and engineering (a)
  - an ability to design and conduct experiments, as well as to analyze and interpret data (b)
  - an ability to design a system, a component, or process to meet desired needs (c)
  - an ability to identify, formulate, and solve engineering problems (e)
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (k)

- Work cooperatively and communicate effectively through speaking, writing, and graphics, with peers, with multi-disciplinary teams, with the general public.
  - an ability to function on multi-disciplinary teams (d)
  - an ability to communicate effectively (g)
  - an ability to identify, formulate, and solve engineering problems (e)

- Practice computer engineering in a professionally responsible and ethical manner.
  - an ability to function on multi-disciplinary teams (d)
  - an understanding of professional and ethical responsibility (f)

- Anticipate changes in one’s own career with respect to changing technology and shifting societal needs for the application of computer engineering.
  - an ability to design and conduct experiments, as well as to analyze and interpret data (b)
  - an ability to identify, formulate, and solve engineering problems (e)
  - the broad education necessary to understand the impact of engineering solutions in a global and societal context (h)
  - a recognition of the need for, and an ability to engage in life long learning (i)
  - a knowledge of contemporary issues (j)

For each course, a set of course objectives (CO) can first be identified and then mapped to program outcomes.

Collection of Course Outcomes (example, CPE 159)

CO1 Students will follow a design guideline and write code to build a microkernel with utilities.

CO2 Students will learn to develop large-scale software in a team environment and apply software engineering skills to manage source code development, conduct testing, and schedule regression.

CO3 Students will be able to relate security and vulnerability issues into designs and implement solutions.

CO4 Students will learn tools for embedded-system development.

CO5 Students will coordinate between team members and write technical team reports.

- an ability to apply knowledge of mathematics, science, and engineering – CO1 and CO2. The project utilizes comprehensive knowledge of computer architecture, interfaces, operating systems, programming techniques, system-level programming, and software engineering.
- an ability to design and conduct experiments, as well as to analyze and interpret data – CO2. First exercises are software experiments in processing of timer interrupts and in observing a RPC/cross-platform debugging process.
c. an ability to design a system, a component, or process to meet desired needs – CO1, CO2, and CO4. The semester project is the design of an operating system complete with its operating system service (especially kernel service).

d. an ability to function on multi-disciplinary teams – CO5. The course requires team work and is cross-listed with computer science; the project teams are composed of two different disciplines: students strong in software engineering and software design and students strong in computer architecture and interfacing.

e. an ability to identify, formulate, and solve engineering problems – CO5. The engineering problem for this course is the design of an operating system with its kernel service.

f. an understanding of professional and ethical responsibility – CO5. Requirement that each project include quality online documentation, source-code control, and a signed team report stating the work and effort of each team member addresses professionalism, ethics and teamwork.

g. an ability to communicate effectively – CO5. Project team members must communicate with each other and submit a joint written report.

h. the broad education necessary to understand the impact of engineering solutions in a global and societal context – CO3. Security, identification, and user-interface issues are part of the project assignment.

i. a recognition of the need for, and an ability to engage in life long learning – CO1. The course provides a thorough understanding of computer systems with the consideration of scalability from uni-processor to multiprocessor platforms and compatibility between platforms of different architecture.

j. a knowledge of contemporary issues – CO3. Security, identification, and user-interface issues are part of the project assignment.

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice – CO4. The usage of software packages and of cross-platform, embedded-system source-code compilation and development are features of this course.

Summary of course objectives (of all courses) that map to a program outcome (example: Program Outcome #a: an ability to apply knowledge of mathematics, science, and engineering)

Outcome Delineation: to evaluate evidence of knowledge and applications of Boolean algebra, probability, chemistry, physics, electrical engineering, electronics, and programming science. Most importantly, applying the vast field of computer engineering is included.

Measurables:
- CpE 64 CO1, CO2, and CO3. Boolean algebra, minimization, emphasis on logic design are applied in laboratory and included on exams.
- CpE 138 CO1, CO2, CO4, and CO5. The bulk of the material in this course is mathematical (transfer rates, probability of collision avoidance, noise, etc) and is related to engineering limitations (maximum rate of data flow, noise generation).
- CpE 142 CO1 and CO2. Projects and homework assignments reinforce computer architecture design and analysis principles.
- CpE 144 CO1, CO2, and CO5. Sampling theory, frequency response, DFT and z-transforms are based in mathematics.
- CpE 151 CO1, CO2, CO3, and CO7. Students first learn the physics of creating a channel between the source and drain. They then learn the mathematics for calculating the threshold voltage necessary to create the channel. Finally, they use that threshold voltage to find the operating current and/or resistance. Students are drilled in the relationship between various parameters (e.g. if the channel length decreases, what happens to the resistance).
- CpE 159 CO1 and CO2. Class projects utilize comprehensive knowledge of computer architecture, interfaces, operating systems, programming techniques, system-level programming, and software engineering.
- CpE 166 CO2 and CO4. Knowledge in electronics is required in the laboratory projects; students apply their knowledge of statistics when calculating mean time between failure, students use probability in one of their projects.
- CpE 185 CO1, CO2, and CO4. Skills in mathematics are required in understanding timing and bus cycle details; knowledge of computer architecture/science/engineering is needed to understand interfacing details.
- CpE 186 CO2 and CO4. Engineering knowledge of electronics is required in the laboratory projects. Students apply their knowledge of Mathematics when calculating DRAM refresh time and other timing specifications analysis.
- CpE 187 CO1 and CO2. A comprehensive project is typical of what computer engineers must be able to do with embedded microcomputers (timing, electrical considerations, software).
- CpE 190 CO1. Engineering knowledge of electronics is required to design senior projects; students apply their knowledge of hardware and software to design their senior projects.
- CpE 191 CO1. Engineering knowledge of electronics is required to design senior projects; students apply their knowledge of hardware and software to design their senior projects.

**Metric:** All students receiving a "C" or better grade in related courses must clearly exhibit this Program Outcome in their projects, homework, or exams. The alumni survey should confirm that approximately 80% of the responses indicate "satisfied" or "very satisfied."

5. What assessment activities are planned for the upcoming academic year?

1. **Alumni Surveys.** To administer an alumni survey explicitly to measure the five CPE Program Educational Objectives:

   - Enter professional employment and/or graduate study in computer engineering areas, such as, logic design, computer architecture, processor hardware, and computer systems.
   - Identify, analyze, and solve practical computer engineering problems using both hardware and software design tools and techniques.
• Work cooperatively and communicate effectively through speaking, writing, and graphics, with peers, with multi-disciplinary teams, with the general public.
• Practice computer engineering in a professionally responsible and ethical manner.
• Anticipate changes in one’s own career with respect to changing technology and shifting societal needs for the application of computer engineering.

2. Exit Surveys. To continue using exit surveys. Exit surveys have proven to be helpful for the assessment process. These exit surveys, conducted during the graduation ceremony, are not at the level of exit interviews between individual faculty and students. The intent was to capture real time data from students as they transition to the status of "graduates." Survey results will be used by the program coordinator and made available to the ABET visiting team.

3. Focus Visits. The continuation of Focus Visits is very crucial. Except for off-the record discussions about a company’s product or technology, discussions often reach a common summary: hands-on experiences, communication skills, and teamwork are key educational objectives. Coordination of meeting time takes great efforts. The format of the meeting does not encourage opinions that are contrary to company policies. It may however generate a much greater volume of information and quantitative data, covering a broad spectrum of industrial work practices; and take much less time to collect them. Focus visits have great visibility and value in their intentions. Having such meetings brings good will and friendliness not only to the alumni but also to local industry. The visits are usually enjoyable for faculty and graduates to renew acquaintances, and faculty members usually benefit a lot more from the visits for the reason of getting in touch with the current trends in specialized fields.

4. Joint Assessment Meetings (JAM). In the past, the joint assessment meeting is conducted semi-annually among faculty, industrial liaisons, alumni, and student representatives. Curriculum and assessment material are all presented and discussed. JAM serves as a forum for ABET assessment preparation. The combined groups; full time faculty, part time faculty, CPE Liaison Council, and students, meet twice a year for half a day, or longer. Minutes of these meetings are available for review. These meetings have been so productive that they are planned ahead for each semester.