2011 Assessment Report
Submitted by
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Chair and Professor
# Table of Contents

1. EEE / CpE Program Goals and Objectives........................................................................ 3
2. EEE / CpE Program Learning Outcomes........................................................................ 10
3. Continuous Improvement............................................................................................. 19
4. Implementation Plan.................................................................................................... 26
1 EEE, CpE Goals and Objectives

The undergraduate program in Electrical & Electronic Engineering (EEE) and Computer Engineering (CpE) are fundamental to the mission of the College of Engineering and Computer Science at CSUS.

Five years from graduation, graduates from our program will:

A. Obtain a broad education in electrical engineering built upon a solid understanding of mathematics, science, and basic engineering.
B. Be able to apply fundamental electrical engineering concepts to complex situations and solve problems, using contemporary engineering tools and techniques.
C. Be able to communicate effectively.
D. For EEE Program: Obtain breadth and depth through required core courses in circuits, electronics, communications, control systems, microprocessors, electromagnetics and electric machines. Depth is obtained from elective courses consistent with the range of technical specialties.
   For CpE Program: Educational breadth and depth through required core courses in Computer Architecture and Microprocessors, Logic Design, Circuits and Electronics, Software Development and Operating Systems, and Computer Networks. Depth is obtained from elective courses consistent with the range of technical specialties.
E. Be able to work with contemporary laboratory instrumentation, design and perform experiments, and analyze and interpret the results.
F. Be able to work in teams to solve complex design problems.
G. Obtain a balanced education with a solid understanding of ethical and professional responsibility, which enables them to function well in the profession of engineering. The program prepares them to be “life-long” learners who are prepared to meet the demands of a rapidly changing technologically advancing society.
H. Obtain knowledge of the important human factors such as safety, environmental impact, and impact on society. They will be able to apply their skills in new contexts and learn to appreciate and manage intelligently the consequences of their technical decisions.

The EEE and CpE programs objectives are published online at http://www.ecs.csus.edu/eee/portfolio/index.htm & http://www.ecs.csus.edu/cpe/portfolio/objectives-1.htm may and be accessed from the Assessment link on the EEE Department Web site. Each student receives a copy of the program objectives and student learning outcomes as part of their student folder during the new student orientation program.

Our program objectives are also published in the CSUS Catalog under the description of the EEE Department and CpE program and on the online catalog Web site at: http://aaWeb.csus.edu/catalog/current/PROGRAM/EEE.asp and http://aaweb.csus.edu/catalog/current/PROGRAM/CPE.asp.
Consistency of the Program Educational Objectives with the Mission of the Institution

The Electrical and Electronic Engineering (EEE) and Computer Engineering (CPE) Program at CSUS aims to provide high quality education that will transform students into professional engineers who are prepared to meet the needs of society and adapt to rapidly changing technology. Thus, the Program Educational Objectives (PEOs) of the CPE Program are aligned with the Baccalaureate Learning Goals of California State University, Sacramento. The CPE Program’s PEOs include emphasis on the achievement of critical problem-solving and communication skills alongside accomplished ability in the EEE and CpE disciplines. Also emphasized is the need for professionalism, ethics and flexibility within society.

Table 1   EEE and CpEE Program Objectives as Related to California State University, Sacramento’s Baccalaureate Learning Goals

<table>
<thead>
<tr>
<th>Educational (Program) Objective</th>
<th>Competencies in the Disciplines</th>
<th>Analysis and Problem solving</th>
<th>Communication</th>
<th>Information Competence</th>
<th>Cultural Legacies</th>
<th>Values &amp; Pluralism</th>
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<tbody>
<tr>
<td>P0 (A)</td>
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<tr>
<td>P0 (B)</td>
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<tr>
<td>P0 (C)</td>
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<tr>
<td>P0 (D)</td>
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<td>P0 (G)</td>
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<td>P0 (H)</td>
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</table>

A. A broad education in electrical engineering built upon a solid understanding of mathematics, science, and basic engineering.
B. An ability to apply fundamental computer engineering concepts to complex situations and solve problems, using contemporary engineering tools and techniques.
C. An ability to communicate effectively.
D. EEE educational breadth and depth through required core courses in circuits, electronics, communications, control systems, microprocessors, electromagnetics and electric machines. Depth is obtained from elective courses consistent with the range of technical specialties CpE educational breadth and depth through required core courses in Computer Architecture and Microprocessors, Logic Design, Circuits and Electronics, Software Development and Operating Systems, and Computer Networks. Depth is obtained from elective courses consistent with the range of technical specialties.
E. An ability to work with contemporary laboratory instrumentation, design and perform experiments, and analyze and interpret the results.
F. An ability to work in teams to solve complex design problems.
G. A balanced education with a solid understanding of ethical and professional responsibility, which enables them to function well in the profession of engineering. The program prepares them to be “life-long” learners who are prepared to meet the demands of a rapidly changing technologically advancing society.
H. Knowledge of the important human factors such as safety, environmental impact, and impact on society. They will be able to apply their skills in new contexts and learn to appreciate and manage intelligently the consequences of their technical decisions.

Table 2  EEE and CpE Program Outcomes as Related to California State University, Sacramento’s Baccalaureate Learning Goals

<table>
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<tr>
<th>ECS Matrix</th>
<th>BACCALAUREATE LEARNING GOALS</th>
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<tr>
<td></td>
<td>Competencies in the Disciplines</td>
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<tr>
<td>Program Outcomes</td>
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<tr>
<td>P0 (a)</td>
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<td>P0 (b)</td>
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<td>P0 (c)</td>
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<td>P0 (d)</td>
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<td>P0 (j)</td>
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<tr>
<td>P0 (k)</td>
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</tbody>
</table>

Students are taught to develop:

a. an ability to apply knowledge of mathematics, science, and engineering or computing as appropriate to discipline
b. an ability to design and conduct experiments, as well as to analyze and interpret data, or an ability to analyze a problem and identify and define the computing requirements appropriate to solution
c. an ability to design a system, component, program or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. an understanding of the impact of engineering or computing solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning and continuing professional development
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering and computing tools necessary for engineering or computing practice.
Program Constituencies

The constituencies of the program include:

1. The students and alumni of the EEE and CpE Programs at CSU, Sacramento, who will be well prepared for productive and rewarding careers;
2. The Electrical and Computer related industries that will hire graduates of this program (such industries being a major part of the economic base of the state of California);
3. The faculty of EEE and CpE who will enjoy an exciting professional, teaching career and keeping abreast of changing technology.
4. CSU, Sacramento, which will gain stature among other universities in California, a state which has many competitive, highly ranked engineering programs; and
5. The State of California, that will benefit from having well educated citizens in general, and from having a base of resident computer engineering expertise in specific areas.

Students and Alumni

As stated previously, the mission of the EEE and CpE Programs at CSUS is to provide high quality education that will transform students into professional engineers who are prepared to meet the needs of society and adapt to rapidly changing technology. CSUS has a diverse student body from a wide range of cultures and socioeconomic backgrounds and our students are the primary constituents of our program.

Our Program Educational Objectives represent the abilities of our graduates upon graduation from the EEE and CPE Program. Our alumni serve as the “eyes and ears” of our program and enjoy a dynamic relationship with the Program through opportunities such as career counseling, program feedback surveys and industry visits.

Industry Employers

Computer related industries are the primary employers of graduates from the EEE and CPE Programs. Our graduates enter a competitive market wherein such employers seek candidates with strong technical and communication skills as well as an ability to thrive within current industry standards and to address the challenges of the future. The PEOs of the CPE Program aid in the maintenance of a highly competent, experienced and skilled computer engineering job applicant pool.

Our employers are in a unique position to reflect on the talents, abilities and skills that are necessary for our graduates to succeed in the workplace.

Faculty

Faculty members in the Program represent one of the important constituents of the program and they are directly responsible for the education of our students and ensuring that they are prepared to meet the educational objectives of our program. Besides the direct involvement of some faculty in the accreditation process due to their membership in various committees such as the ABET committee, Assessment Committee, and Curriculum Committee, all faculty are involved by providing course outlines, creating course goals and objectives, assessing course outcomes, responding to surveys and closing the loop. Individual faculty members make minor changes within individual courses, while the entire faculty acts upon major curriculum changes resulting from evaluation of the outcomes assessment and the input from the other major constituents.
California State University Sacramento

As the fostering institution for the EEE and CpE Programs, California State University, Sacramento enjoys a mutually beneficial relationship with the CPE Program. The success of the EEE and CPE Programs in meeting its PEOs reflects upon the University as a whole and offers stature to the institution in the competitive arena of engineering education providers. Conversely, the standing of the University attracts a competitive pool of undergraduate students, about the top one-third of the High school graduates in California.

The State of California

With a present and growing need for skilled professional engineers, especially in the field of electrical and computer technologies, the State of California benefits from a base of resident electrical and computer engineers that are California State University graduates. The EEE and CPE Programs produces graduates who possess the ability to adapt to constantly changing technology and shifting societal needs for the application of computer engineering. The Programs emphasis on currency and lifelong learning lends to a state population of electrical and computer engineers who are at the forefront of technological advancement.

Program Educational Objectives

The Program Educational Objectives (PEOs) were developed and approved by the faculty. The PEOs are developed to be consistent with the mission of the Institution, the College of Engineering and Computer Science. Our program objectives reflect the faculty’s philosophy on the value of a broad education that prepares graduates to be life-long learners, capable of adapting to the rapid technological challenges that they will encounter in their lives and careers.

The flow chart in Figure 3 depicts the EEE and CPE Programs process for formulating, reviewing and revising PEOs. It captures the Program’s efforts to formalize and document our activities and use the information collected to make continuous improvements to our program. These objectives are evaluated periodically using a variety of instruments including surveys, site visits to industry and industry advisory boards at the college and department levels.
Evaluation by Program Constituencies

The EEE and CpE Programs involves all identified constituencies in our assessment of the effectiveness of our program. Input from faculty, students, graduates, employers and the Industry Advisory Committee was used to establish our program objectives. We continue to solicit input from these constituencies to monitor and refine these objectives.

EEE and CPE Meetings are held regularly to assess the current needs, the program’s success at addressing these needs and/or action items that may lead to course improvements, curriculum implementation or resource adjustments. Additionally, alumni surveys, Industry Focus Team visits, graduation exit surveys and course surveys serve as valuable resources, proving information to the program on whether or not the primary program constituencies (students and alumni) found the PEOs to meet their needs.
While students progressing through the EEE and CPE Programs are expected to demonstrate successful achievement of the learning outcomes Student Learning Objectives (SLOs), alumni of the program represent a much broader spectrum of individuals with a wide range of experience in their lives and careers. It is very important to include their feedback in evaluating the program’s success in meeting its desired educational objectives (PEOs).

For example, Alumni input is sought through standard surveys, as well as focused site visits to industry by a team of faculty from the Program. Groups of faculty from the CPE Program have visited a major employer of our graduates every semester to obtain a cross-section of our alumni’s impressions of the EEE and CPE program’s objectives and future directions. Over the past two and a half years we have visited six companies, placed the entire audio transcripts of the interviews on the Web, collected and analyzed the data as a faculty, formulated recommendations, and acted upon them.

Additionally, the Program has an active relationship with industry representatives, which provides independent feedback to the faculty and helps tremendously in our efforts to close the “outer loop” that is used to measure a program’s success in meeting defined objectives and serving its constituents.

Industry representatives have independently reviewed site visit transcripts, conducted independent interviews of their own, and provided the Program with its report on Observations, Analysis and Recommendations for Action. Employer surveys administered through the Career Development and Placement office in our College are also used to assess our program’s success in successfully meeting the Program Educational Objectives.
EEE, CpE Program Learning Outcomes

Once the Program Educational Objectives (PEOs) were defined, our next step was to design Student Learning Outcomes (SLOs) corresponding to each PEO. Our goal in designing the outcomes corresponding to each objective is to ensure that if every student achieves the skills and abilities specified in each of the outcomes corresponding to an objective, then the program through appropriate measurement of that outcome can satisfy the corresponding objective. For example all students of the EEE and CPE programs at CSUS are expected to have: A knowledge of mathematics through differential and integral calculus, differential equations, physics and chemistry.”

We monitor our student learning outcomes compare the results with our desired outcomes, and make changes for improvement as needed. Typically, this is the domain of the faculty and the students presently in our program. This part of the process focuses on the instructional objectives of our program and thus the individual course objectives and the corresponding course outcomes that demonstrate students’ achievement of the course objectives. The course outcomes in turn contribute to the SLOs, and achievement of the SLOs by the students indicates that they are now prepared to achieve the EEE and CPE Programs Educational Objectives. Hence, by assessing and evaluating SLOs through course embedded assessment with appropriate indicators, we can measure the extent to which our PEOs can be successfully achieved.

Achievement of Program Educational Objectives

Evaluation of the degree to which the program educational objectives are attained is carried out by using a variety of assessment tools:

1. Evaluation of Program Outcomes.
2. Student and alumni surveys reflecting on program outcomes.
3. Site visits to industry.
5. Feedback from College’s Industry Advisory Board.

Feedback for assessment and validation of the EEE and CPE Programs PEOs is obtained in a variety of ways from the constituencies identified previously in this section. Since faculty is primarily responsible for assessment, we use faculty surveys to set indicators as appropriate for our program outcomes. In some instances it is more appropriate to use qualitative indicators to assess success of a particular outcome (typically feedback and action items resulting from independent assessment by the Program’s Industry Liaison Council).

Timelines for feedback vary longitudinally to allow the EEE and CPE faculty to monitor progress and provide opportunities for continuous improvement. The table below summarizes the timelines for formal feedback obtained from the different constituencies that have a stake in the EEE and CPE programs and the analysis and recommendations based on the most recent reports.

Table 3. Timelines for Program Constituency Feedback

<table>
<thead>
<tr>
<th>Constituency</th>
<th>Specific Group</th>
<th>Timelines</th>
<th>Type of Feedback</th>
</tr>
</thead>
</table>

10
The EEE and CpE Programs at California State University, Sacramento developed Program Educational Objectives. From this set of objectives we developed a set of program outcomes. Our goal in designing the outcomes corresponding to each objective is to ensure that if every student achieves the skills and abilities specified in each of the outcomes corresponding to an objective, then the program through appropriate measurement of that outcome can satisfy the corresponding objective. The following is an outline of the process for establishing and revising EEE and CPE program outcomes:

i. Define goals, objectives, and learning outcomes

ii. Identify performance criteria and measurement metric for each learning outcome and identify the courses that support the outcome.

iii. Identify assessment tools and provide data relevant to each learning outcome

iv. Develop plan to assess achievement of program goals and learning outcomes

v. Identify problem areas and develop strategies for improving delivery of learning outcomes

vi. Implement strategies targeted at improving specific learning outcomes and assess the effectiveness of the changes

vii. Reassess objectives and learning outcomes and continue the process.

The following table 4 shows the CPE Program’s strategies for monitoring student learning outcomes and achievement of program educational objectives:

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<tbody>
<tr>
<td>Students</td>
<td>All students</td>
<td>Every three years</td>
<td>Student Survey</td>
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<tr>
<td>Alumni</td>
<td>Graduating classes 5</td>
<td>Every six years</td>
<td>Alumni Survey</td>
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<td></td>
<td>years</td>
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<tr>
<td>Faculty</td>
<td>Full time and part</td>
<td>Every three years</td>
<td>Faculty Survey</td>
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<td>time</td>
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<td>Employers</td>
<td>Industry Liaison</td>
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<td>Biannual meeting</td>
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<td>Council</td>
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<td>report</td>
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<td></td>
<td>ECS College Industry</td>
<td>Every year</td>
<td>Biannual Report</td>
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<td>Advisory Board</td>
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<td>Industry Focus Team</td>
<td>Managers and Alumni</td>
<td>Every Spring</td>
<td>Report</td>
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<td>Visits</td>
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## Table 4 Processes for Monitoring Student Learning Outcomes

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<td>2. Graduation Petition</td>
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<td>3. Student Surveys / Exit Interview of Graduating Seniors</td>
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<td>4. Alumni Survey</td>
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<td>5. Employer Survey</td>
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<td>8. College Advisory Board</td>
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<td>9. Faculty survey</td>
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<td>10. Community College Articulation Conference</td>
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<td>12. Faculty meetings</td>
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The EEE and CPE Programs have several mechanisms for revising program outcomes. Specific assessment tools include the following surveys and committees:

### Alumni Survey

Alumni surveys are conducted as a part of ongoing program assessment. The online survey text is outlined in Appendix F, section A.

### Focus Industry Team Visits

The EEE and CPE programs visits industry employers of EEE and CPE graduates every year. Alumni are surveyed about the importance of student learning outcomes and educational objectives. They rate Student Learning Outcomes (SLOs) and Education Outcomes (EOs) on the scale from 1-6, where 1 is critical and 6 is no relevance. Verbatim: “Please evaluate the following list of educational objectives from 1- Critical, 2- Important, 3- Desirable, 4- Marginal, 5- Not Importance, 6- Not applicable with respect to what is expected from any students five years after graduation.

### Faculty Survey
Program faculty is surveyed periodically on the importance of each student learning outcome and educational objective. They rate the SLOs and PEOs on a scale from 1-6, where 1 is critical and 6 is no relevance.

**Student Survey**

Students of the EEE and CPE program are surveyed every three years about the importance of student learning outcomes and educational objectives. Students are asked about the achievement of SLOs and all “Not Applicable” responses are counted. Subsequently, using the EO/SLO matrix, program educational objectives are evaluated.

**Engineering Accreditation Criteria from ABET**

As often as appropriate, the EEE and CPE ABET Assessment Committee monitors the abet.org website and compares ABET suggested educational objectives to the CPE Program’s own education objectives.

**College Assessment Committee Input**

Once a year, the College of Engineering and Computer Science (ECS) Assessment Committee meets with the agenda of reviewing the educational objectives and student learning outcomes of different departments within the College.

**University Assessment Committee Input**

California State University, Sacramento has established baccalaureate learning goals, as outlined in Section 2 of this Self-Study Report. Student learning outcomes at the departmental level are evaluated at the college level. College level learning outcomes are then evaluated on the basis of the University Baccalaureate learning goals.

**Program Meetings**

As applicable, data from the about assessment mechanisms are reviewed during bi-monthly program meetings, and revision of student learning outcomes are proposed.

**Program Outcomes**

Faculty in the EEE and CPE Programs at CSUS are committed to developing and implementing a comprehensive Outcomes Assessment Plan that is tied to the Department’s missions and can be used to guide decision making, maintain accountability, and foster understanding. With its priority focused on students, the Program provides an environment in which teaching, scholarship, research, and professional activity are valued and supported. We aim to continuously improve programs and processes through introspective assessment and evaluation. This is important in evaluating our efforts in meeting program education objectives.

The EEE and CPE Program at CSUS student learning outcomes correspond to the curricular requirements and graduate attributes specified in ABET and program criteria in Electrical and Computer Engineering.

**ABET Engineering**
ABET Engineering Criterion 3 says that Engineering programs must demonstrate that their students attain the following outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

IEEE Program Criteria for Electrical, Computer and Similarly Named Engineering Programs

PROGRAM CRITERIA FOR ELECTRICAL, COMPUTER, AND SIMILARLY NAMED ENGINEERING PROGRAMS
Lead Society: Institute of Electrical and Electronics Engineers
Cooperating Society for Computer Engineering Programs: CSAB

These program criteria apply to engineering programs that include electrical, electronic, computer, or similar modifiers in their titles.

1. Curriculum

The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program name and objectives; and knowledge of mathematics through differential and integral calculus, basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.

Programs containing the modifier “electrical” in the title must also demonstrate that graduates have knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

Programs containing the modifier “computer” in the title must also demonstrate that graduates have knowledge of discrete mathematics.

Computer Engineering Program at CSUS Student Learning Outcomes

The EEE and CPE faculty has adopted a set of 14 “Student Learning Outcomes” or SLOs, which define what students, are expected to know and be able to do by the time they graduate. These SLOs parallel the
requirements of ABET Engineering Criterion 3, items (a) through (k) and applicable Program Criteria, and this relationship is detailed parenthetically below.

All students of the EEE program at CSUS are expected to have at the time of graduation:

1. A knowledge of mathematics through differential and integral calculus, differential equations, physics and chemistry
2. A knowledge of basic engineering sciences including statics and dynamics
3. The ability to apply knowledge of mathematics, science and engineering to solve problems in EEE
4. A knowledge of core E&EE topics in circuits, electronics, communications, control systems, microprocessors, electromagnetics, and electric machines
5. Depth in at least one area of E&EE out of Analog/Digital Electronics, Control Systems, Communications and Power.
6. Knowledge of probability, statistics and applications to E&EE.
7. The ability to use contemporary engineering techniques and tools for analysis and design.
8. The ability to work with modern instrumentation, software and hardware, design and perform experiments, and analyze and interpret the results.
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 desired safety, economic and performance criteria.
10. The ability to function on multi-disciplinary teams and exercise leadership to accomplish project goals.
11. The ability to communicate effectively through written technical papers and/or project reports.
12. The ability to make effective oral presentations and convey technical material to an audience.
13. An understanding of professional and ethical responsibility and a broad education to appreciate the impact of engineering solutions in the societal context
14. Recognition of the need for and an ability to engage in “life-long” learning.
15. An appreciation for and knowledge of diverse cultures and demonstrated proficiency in a foreign language.

All students of the CPE program at CSUS are expected to have at the time of graduation:

1. A knowledge of mathematics through differential and integral calculus, differential equations, physics and chemistry
2. A knowledge of basic engineering sciences
3. The ability to apply knowledge of mathematics, science and engineering to solve problems in CPE
5. Knowledge of probability, statistics and discrete structures.
6. The ability to use contemporary engineering techniques and tools for analysis and design.
7. The ability to work with modern instrumentation, software and hardware, design and perform experiments, and analyze and interpret the results.
8. 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 desired safety, economic and performance
9. The ability to function on multi-disciplinary teams and exercise leadership to accomplish project
goals.
10. The ability to communicate effectively through written technical papers and/or project reports.
11. The ability to make effective oral presentations and convey technical material to an audience.
12. An understanding of professional and ethical responsibility and a broad education to appreciate
the impact of engineering solutions in the societal context.
13. Recognition of the need for and an ability to engage in “life-long” learning.
14. An appreciation for and knowledge of diverse cultures and demonstrated proficiency in a foreign
language.

Relationship of Program Outcomes to Program Educational Objectives

As described in section, we found it best to draft our Program Educational Objectives in such a way that
they provided a high-level description of the main goals of the program. This was a comprehensive process
involving all our major constituents. The faculty then drafted the Student Learning Outcomes to provide details
of specific skills and abilities that we expected our students to acquire in the program.

To assess our success in meeting our PEOs, it is necessary to internally monitor our student learning
outcomes, compare the results with our desired outcomes, and make changes for improvement as needed. This
part of the process focuses on the instructional objectives of our program and thus the individual course
objectives and the corresponding course outcomes that demonstrate students’ achievement of the course
objectives. The course outcomes in turn contribute to the SLOs, and achievement of the SLOs by the students
indicates that they are now prepared to achieve the CPE Program’s Educational Objectives. Hence, by
assessing and evaluating SLOs through course embedded assessment with appropriate indicators, we can
measure the extent to which our PEOs can be successfully achieved.

Achievement of Program Outcomes

In this section we describe the processes used to assess the achievement of Student Learning Outcomes
(SLOs) in the EEE and CPE Programs. Our ultimate goal is to utilize these assessment instruments to make
ongoing improvements to our program. The EEE and CPE programs perform outcomes assessment at two
levels: Course and Program.

Course Level Assessment (Direct Measurement)

Course Embedded Assessment represents the “bricks and mortar” of our assessment program. Our
experience shows that assignments and exams in individual courses provide immediate and valuable feedback
to both the student and the faculty. Assignments and examinations including mid-terms and final are required
in all courses. In addition, projects, Computer Aided Design and term papers are required in several classes as
appropriate. They allow the faculty to identify any potential problems in related courses, i.e. if the performance
of several students in a given exam or assignment indicates that they do not understand a concept they should
have acquired in a prerequisite course, that probably indicates a problem with the related course.

We have established a Course Embedded Assessment (CEA) process that focuses on a set of core
classes required of all students in our major. Each course has detailed objectives, specific course outcomes, and
indicators that are monitored to ensure successful achievement of those outcomes. The Course Coordinators for
courses covered by CEA present a report to the Department faculty reflecting on student achievement on the
specific course outcomes and course topics, whether prerequisites are appropriate, student reaction to the
course, and suggested changes if any.
This process is useful because it enables faculty who are not directly involved in specific courses from the CEA group to get a full understanding of the courses in the CEA group and make any adjustments to their own courses. It allows new faculty and part-time faculty to acquire a thorough understanding of the curriculum and become familiar with the challenges by perusing the annual CEA reports. Also, the process ensures that faculty in related courses interact with each other on a regular basis when preparing the CEA report for a particular course. Equally important, the CEA reports provide the documentation to illustrate how the faculty uses assessment results for ongoing program improvement.

For courses that are not part of the CEA group, individual faculty members who teach the course are responsible for course-level assessment. Each course has clearly defined objectives, a set of measurable outcomes, and contributes to one or more of the program’s Student Learning Outcomes. The faculty member teaching the course is responsible for reporting any major issues that are revealed from outcomes assessment and initiating appropriate changes to ensure that the course objectives are met successfully.

**Program Level Assessment (Indirect Measurement)**

Outcomes assessment at the program level is carried out by using a variety of assessment tools:

1. Student and alumni surveys reflecting on program outcomes.
2. Site visits to industry.
3. Independent assessment by Department-level Industry Representatives.
4. Feedback from College’s Industry Advisory Board.
5. Exit Interviews with graduating seniors

Since faculty is primarily responsible for assessment, we use faculty surveys to set indicators as appropriate for our program outcomes. In some instances it is more appropriate to use qualitative indicators to assess success of a particular outcome (typically feedback and action items resulting from independent assessment by the Department’s Industry Representatives).

**Assessment Instruments**

The following assessment instruments are used in our program:

*Surveys of Graduating Seniors:* Graduating seniors are surveyed at the time of graduation for their perceptions about the program’s educational objectives and student learning outcomes, our relative success in achieving those outcomes, and suggestions for improvement.

*Alumni Surveys:* Alumni from our program are surveyed five years out (1997-2001 alumni for the 2002 academic year) to rank the importance of each of our Program Educational Objectives and Student Learning Outcomes in the context of their current professional position and their level of preparation with respect to that objective or outcome.

*Industry Focus Teams Visits:* Faculty teams visit a company or industry that employs several graduates from our program to meet with a group of our alumni. Typically the alumni include recent graduates (1-5 years out), as well as experienced engineers and managers (6-10 years out, 11 years and over). A set of open-ended questions is distributed to the site prior to the visit to provide a foundation for the participants. The interviews are audio taped and placed on the Web for faculty review following the visit. A written transcript is also
produced and shared with all faculty members. The reports are analyzed and action items with appropriate timelines are developed for implementation.

*Industry Liaison Council:* The EEE and CPE program enjoys a relationship with engineers from industry representing all major areas of emphasis in the CPE program. The program meets with industry representatives biannually and the industry representatives provide the program and the faculty with independent feedback on its efforts to achieve the Program Educational Objectives. We will merge the EEE and CPE ILC into one with representations from the electrical and computer industries.

*Industry Advisory Board:* At the College level, the IAB receives reports from each program on a biannual basis and evaluates each program’s success in implementing the strategic plan of the college. The IAB meets in executive session following the presentations and reports back to the Program Coordinators, Department Chairs and Deans with specific recommendations for follow up and action.

*Employer Surveys:* The College’s Career and Placement Office periodically surveys employers and provides salary information and relevant information on upcoming trends and opportunities to the programs.

*Exit Surveys:* Graduating students were surveyed.
3 Continuous Improvement

The EEE and CpE Programs at CSUS strives to produce graduates that possess a broad education in the areas of Electrical and Computer Engineering (software and hardware design), and who are prepared to be life-long learners, capable of adapting to the rapid technological challenges that they will encounter in their lives and careers. The EEE and CPE Programs employs a variety of evaluation tools that are in constant revision in order to assess the level of success of the program in meeting its program objectives, and thus make the appropriate modifications.

The flow chart in Figure below depicts the EEE and CPE Program’s process for formulating, reviewing and revising its program educational objectives. It captures the Program’s efforts to formalize and document its activities and use the information collected to make continuous improvements to our program. Review and discussion of the data collected from surveys, industry visits, faculty and departmental meetings along with data from individual course level assessment allows for ongoing examination of the EEE and CPE Programs’ success at meeting its educational objectives and any course or program level improvements that may be necessary.

Figure 4 Flowchart of EEE and CPE Program’s Process for Monitoring Program Educational Objectives
Information Used for Program Improvement

In this section, data is presented from several of the assessment tools used by the EEE and CPE program as outlined previously. Course level assessment, industry site visits and student exit.

Direct Measures – Course Level Assessment

As a direct level of assessment and one of the processes most commonly used for curriculum improvement, core courses in the EEE and CPE curriculum are evaluated separately with respect to expected outcomes. Formal direct measures such as all raw data collected at the course level (exams, projects, reports, etc.) provide invaluable data for assessment of individual course outcome achievement. The number of students who are exceeding expectations (grades of either A or B), meeting expectations (grade of C) or below expectations (grade below C) for each course outcome is presented. Because individual course outcomes were developed with the overall program student learning outcomes (SLOs) in mind, achievement of individual course outcomes relates directly to achievement student learning outcomes, and revision and improvement to program curriculum is largely based on the data collected from selected course level assessments for example:

EEE/CPE 64 – Introduction to Logic Design

Course Description:
Covers the following topics: logic gates, binary number system, conversion between number systems, Boolean Algebra, Karnaugh maps, combinational logic, digital logic design, flip-flops, programmable logic devices (PLDs), counters, registers, memories, state machines, designing combinational logic and state machines into PLDs, and basic computer architecture. Lab emphasizes the use of software equation entry design tools, the use of a schematic entry, and the use of a logic simulation design tool. Lab assignments are design-oriented. Cross listed as EEE 064; only one may be counted for credit. Lecture three hours; laboratory three hours. Prerequisites: CSc 15 or CSc 25. Units: 4.0.

Course Outcomes:

CPE 64 CO_1 Problem solving: Boolean algebra, minimization, emphasis on logic design are applied in laboratory and included on exams.
CPE 64 CO_2 Integration of knowledge to solve design problems: Two thirds of lab experiences are designs focused on logic, sequential, state machine, and CPU.
CPE 64 CO_3 Use of contemporary tools for analysis and design: Two thirds of the laboratory is dependent upon the use of Verilog and Xilinx’s Foundation tool (to design, choose pins for PLD, simulate, and download design).

CPE 138 – Computer Networks and Internets Assessment Results

Course Description:
An overview of the fundamentals of computer networks and connections between networks, from the physical layer up through peer-to-peer communications at the application level. Lower layer characteristics including serial vs. parallel, capacity issues, high-speed connections, LAN framing and error handling. LAN vs. WAN characteristics, network architecture and the ISO network model. Internetworking components including LANs repeaters, routers, bridges, and gateways. Internet addresses, TCP/IP, and the Domain Name System. Common Internet client/server application protocols including SMTP and FTP. Client/Server programming involving sockets. World Wide Web characteristics including CGI and HTTP protocol, Web pages, Web browsers, Web servers, and Applets. Introduction to advanced Web issues such as Web security, search engine operations, and Web database operations. Prerequisite: CSc 35, 60, 130, 3 units.

Course Outcomes:
CPE 138 CO_1 Students will understand terminology common to ‘networks and internet’
CPE 138 CO_2 Students will design software to exercise data transfers on various networks; socket protocols
CPE 138 CO_3 Students will acquire hands-on laboratory skills in observing data transfers
CPE 138 CO_4 Students will understand the design of hardware network equipment
CPE 138 CO_5 Students will write a technical, grammatically term paper

CPE 151 – CMOS and VLSI

Course Description:
Begins with an introduction to CMOS gates and design of CMOS combinational and sequential functions at the gate level, including CMOS memory. The theory of MOS transistors is covered including: DC equations, threshold voltage, body effect, subthreshold region, channel length modulation, tunneling, punch through, basic CMOS inverter, and the CMOS transmission gate. A basic exposure to VLSI includes the following topics: CMOS processing technology, CMOS layout, CMOS circuit design and CMOS logic design. Simulations on SPICE and basic VLSI layouts using LEDIT will be included. Prerequisite: CPE 64, EEE 102 or EEE 108. Units: 3.0.

Course Outcomes:
CPE 151 CO_1 Students will understand basic device physics that dictate the functionality of CMOS circuits
CPE 151 CO_2 Students will analyze circuits that contain MOSFETs
CPE 151 CO_3 Students will learn how variations in physical and environmental parameters effect MOSFET circuits
CPE 151 CO_4 Students will implement low level logic gates and other logic building blocks using CMOS circuits
CPE 151 CO_5 Students will generate and interpret a physical design (layout) of CMOS circuits
CPE 151 CO_6 Students will acquire practical experience using an industrial type of physical design tool
CPE 151 CO_7 Students will understand the tradeoffs between performance, power, and area as they apply to the design of digital circuits
CPE 159 – Operating System Pragmatics

Course Description:
The application of operating system principles to the design and implementation of a multitasking operating system. Students will write an operating system for a computer platform. Topics include: scheduling of processes, control and allocation of computer resources, and user interfacing. Prerequisite: CSc 139. Units: 3.0.

Course Outcomes:
CPE159 CO_1 Students will follow a design guideline and write code to build a microkernel with required utilities
CPE 159 CO_2 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
CPE 159 CO_3 Students will be able to relate security and vulnerability issues into designs and implement solutions
CPE 159 CO_4 Students will learn tools for embedded-system development
CPE 159 CO_5 Students will coordinate between team members and write technical team reports

CPE 186 – Computer Hardware System Design (Required Course)

Course Description:
Study of Intel and Motorola architectures, bus structures, interrupts, memory interface and controllers, bus arbitration, MA controllers, I/O interface, bridges and microcontroller. Electromagnetic compatibility and regulations, cabling and shielding, grounding, digital circuit noise and layout. Prerequisite: CPE 185 or EEE 174. Units: 3.0.

Course Outcomes:
CPE186 CO_1 Students will design systems based on logic that includes PC system bus, architecture components.
CPE 186 CO_2 Students will understand PC architecture/components technologies when using schematic design tools.
CPE 186 CO_3 Students will acquire extensive hands-on laboratory skills (understanding technical specifications, designing to industry specifications/protocols, generating schematic diagrams).
CPE 186 CO_4 Students will design implementations of ISA based data steering, ISA bus cycles, DRAM technologies, contemporary industry bus protocols, PCI bus, PCI slave-Master protocols, and Cache architectures.
CPE 186 CO_5 Students will practice writing a technical, grammatically correct report and technical papers. Students will also learn professional presentation skills.
CPE 187 – Embedded Processor System Design

Course Description:
Students will design, construct and test an embedded processor system project. All address decoding, control functions, input and output ports, handshaking signals and interrupt control will be implemented in an FPGA. The system will interface to a microcontroller system. Students will use an assembler, a C compiler and either VHDL or Verilog to fully test their project. Laboratory techniques include oscilloscopes, logic analyzers, protocol analyzers and programmers for EPROMs, FLASH and microcontrollers. One lecture per week and one three-hour laboratory per week.
Prerequisite: CpE 185, 166, passing score on the WPE. Units: 2.0.

Course Outcomes:
CPE187 CO_1 Students will design, build, and test hardware and software for a microcontroller system
CPE 187 CO_2 Students will prepare written lab reports and the final project report
CPE 187 CO_3 Students will prepare a professional powerpoint of their project, including two oral presentations

CPE 190 – Senior Design Project I (Required Course)

Course Description:
Centers on developing hardware and software project planning and engineering design skills. Emphasis is placed on design philosophies, problem definition, project planning and budgeting, written and oral communication skills, working with others in a team arrangement, development of specifications, and effective utilization of available resources.
Prerequisite: CPE 142, CPE 166, CPE 186, CPE 187, EEE 102, and passing score on WPE. Units: 2.0.

Course Outcomes:
CPE190 CO_1 Students will design projects that are comprised of hardware and software in wireless, internet, networking, robot controller technologies
CPE 190 CO_2 Students will learn how to design circuit boards, assemblies, and systems
CPE 190 CO_3 Students will acquire extensive hands-on laboratory skills (construction, testing, use of logic analyzers, universal programmers, download techniques) to design and debug their projects.
CPE 190 CO_4 Students will learn to work together as a team (of 3 or 4), and generate tasks, schedules, and milestones for their project
CPE 190 CO_5 Students will practice writing a technical and grammatically correct project report, and perform oral presentations of their projects
CPE 190 CO_6 Students will learn how to do research and design a project they are not inherently familiar with
Further Focus on Written and Oral Presentations

We pay high attention to the level of written and oral presentations our students give. The College Assessment Committee reviewed oral presentation skills and written reports.

The evaluation criteria were Below Expectation (1), Progressing to Criteria (2), Meets Criteria (3), Exceeds Criteria (4).

For the oral presentation, 16 questions/statements had to be responded to. The questions were:

1. Organizes content logically and sequentially.
2. Main points are clearly identified and concisely presented.
3. Transitions are logical and smooth.
4. Introduction, body and conclusion are clearly delineated. Provides a clear summary of project.
5. Attracts and holds interest of audience.
7. Presents material effectively with confidence and enthusiasm.
8. Maintains eye contact throughout presentation.
9. Answers all questions clearly and to the point.
10. Uses appropriate visual aides (e.g., audio, video, multi-media) that are clear, readable, and aid in better understanding of project.
14. Presents ideas and arguments persuasively, logically, clearly. Solution is supported.
15. Identifies related and existing applications. Techniques used are clearly stated and presented in the context of existing applications and solutions.
16. Demonstrates a thorough knowledge of problem area.

Indirect Measures

EEE and CPE programs use a variety of processes to gather assessment data including various surveys (alumni surveys, surveys conducted in courses, graduation exit surveys) and data received from students, alumni, faculty, and industry advisors to evaluate and assess program outcome achievement. In this informal way, the CPE Program continuously reviews its program, involving discussions among faculty and review of curriculum recommendations by professional organizations and industry advisors. These indirect measures of program outcome achievement provide useful data for program level assessment.
Industry Focus Team Visits:

As part of ongoing program assessment, the EEE and CPE outcomes assessment committee, which is comprised of faculty members and the program coordinator, conducts annual visits to local companies employing CSUS graduates. Industry Focus Team visits provide invaluable feedback regarding whether the program outcomes each graduate achieved at CSUS are indeed applicable to their careers. Information gathered from the graduate employees included their view of the CPE program’s strengths and weaknesses, what knowledge they use most and least in their current positions, their opinion regarding emerging and expanding fields in computer engineering and what knowledge they feel that computer engineers will need in the future. Associated employers and managers were also asked to provide information on the strengths and weaknesses of the CPE graduates they employ and where the program may need improvement.

Exit Interview

Another process commonly used for continuous improvement to the EEE and CPE program is feedback collected from graduating students and alumni. Upon graduation from the EEE and CPE program, each student is asked to complete an online exit survey for the purpose of ongoing program assessment. In order to more efficiently assemble such feedback from graduating students, the College of Engineering and Computer Science at CSUS now employs a Web Enabled Survey System (WESS) through Educational Benchmark, Inc. (EBI).
4 Implementation Plans

Through the years, positive response from alumni surveys and exit interviews has reinforced that implemented changes to the EEE and CPE curriculum as a result of course level assessment have been beneficial. Alternatively, improved student performance in the core curriculum has reinforced changes made as a result of program constituent feedback through surveys and interviews. In this self-perpetuating manner, direct and indirect methods of assessment works as a system of checks and balances for the achievement of student learning outcomes and program objectives.

The demonstrated confidence of industry employers in EEE and CPE graduates and the confidence of alumni in their ability illustrates that the EEE and CPE programs successfully prepares students to apply their knowledge in an efficient and relevant manner within their respective careers of graduate school programs. Local industry employers often prefer to hire Sac State EEE and CpE graduates, favoring applicants with practical, hands-on experience over graduates from other programs with more theoretical emphasis.

Most of the curriculum revisions are assessment related such as:

1. Reviewed the results of previous cycle of assessment in Fall2010
2. Faculty met on average an hour a week in area groups (in Fall 2010 and Spring 2011) to discuss challenges and draft alpha version of the curriculum.
3. Faculty developed lists of concepts that students need to know in different depth areas, and the core classes.
4. Faculty identified pre-requisite knowledge concepts for core classes.
5. Faculty developed draft of Area Learning Outcomes.
6. Faculty identified some concerns and issues in our current curriculum, and gave draft solutions.
7. EEE Faculty attended PACA meetings in the Spring 2011,
8. EEE faculty attended College Assessment Committee meetings in Spring 2011,
9. EEE will review the rubrics for oral and written assessment, and review current practices for oral and written assessment, I believe this Friday during our last department meeting of the semester.

The majority of the modifications made to EEE and CpE Programs at CSUS are revisions made to the core curriculum as a results of the assessment (Actions taken address items such as general technological advances, the amount of lecture or lab time spent to ensure achievement of specific course outcomes, and course prerequisites, delivery or format.

The system of checks and balances provided by direct and indirect assessment methods allows for a kind of fluidity to program improvement. Through evaluating student performance, surveying program constituents and comparing its curriculum to a model, the CPE program monitors its success in educating graduates that possess:

A. A broad education in computer engineering built upon a solid understanding of mathematics, science, and basic engineering.
B. An ability to apply fundamental computer engineering concepts to complex situations and solve problems, using contemporary engineering tools and techniques.
C. An ability to communicate effectively.
D. For EEE program to obtain breadth and depth through required core courses in circuits, electronics, communications, control systems, microprocessors, electromagnetics and electric...
machines. Depth is obtained from elective courses consistent with the range of technical specialties.

For CpE program to obtain breadth and depth through required core courses in Computer Architecture and Microprocessors, Logic Design, Circuits and Electronics, Software Development and Operating Systems, and Computer Networks. Depth is obtained from elective courses consistent with the range of technical specialties.

E. An ability to work with contemporary laboratory instrumentation, design and perform experiments, and analyze and interpret the results.
F. An ability to work in teams to solve complex design problems.
G. A balanced education with a solid understanding of ethical and professional responsibility, which enables them to function well in the profession of engineering. The program prepares them to be “life-long” learners who are prepared to meet the demands of a rapidly changing technologically advancing society.

Knowledge of the important human factors such as safety, environmental impact, and impact on society. They will be able to apply their skills in new contexts and learn to appreciate and manage intelligently the consequences of their technical decisions. As is true of many engineering programs, there is constantly room for improvement in graduates’ confidence in their communication skills and ability to address economic, societal and environmental impact issues. Based on the results of our assessments for last three years and reviews from ABET and other constituencies we started complete curriculum revision for both EEE and CpE programs. We are planning to complete the program review this academic year 2011-12.
### Proposed Computer Engineering Curriculum

#### Freshman First Semester
- Math 30  Calculus I (Pre-Calculus, Math 29)  4
- CSc 15  Prog. Concepts & Methodology I (CSc 10)  3
- Bio 20  A Human Perspective  3
- GE  (English Recommended)  3
- Engr 1A  Intro to Engineering  3
Total units  16

#### Sophomore First Semester
- Math 45  Differential Equations (Math 31)   3
- CSc 60  Intro. to Systems Programming  3
- Econ 1B  Introduction to Microeconomic Analysis  3
- CpE 64  Introduction to Logic Design  4
- CpE XX  Discrete Structures  1
- GE  3
Total units  17

#### Junior First Semester
- CpE 166  Advanced Logic Design  4
- EEE 180  Signals and Systems  3
- EEE 117  Network Analysis (Engr 17)  3
- EEE 117L  Network Analysis Lab  1
- CSc 130  Data Struct. & Algorithm Develop. (CSc 20, CSc 28)  3
- GE  3
Total units  17

#### Senior First Semester
- CpE 151  CMOS & VLSI (CpE 64, EEE 102)  3
- CpE 159N  Operating System Principals & Pragmatics  4
- EEE 193A  Senior Project Design I  2
- CSc  Technical Elective  3
- EEE 166  Physical Electronics  3
- GE  3
Total units  18

#### Freshman Second Semester
- Math 31  Calculus II (Math 30)  4
- Phys 11A  Mechanics (Math 30, Math 31)  4
- CSc 20  Prog. Concepts & Methodology II (CSc 15)  3
- Engr XX  Freshman Seminar  3
- Engl 20  Expository Writing (Engl 1A)  3
Total units  17

#### Sophomore Second Semester
- Engr 17  Introductory Circuit  3
- Stat 50  Introduction to Probability & Statistics  4
- Phys 11C  Electricity & Magnetism (Math 31, Phys 11A)  4
- EEE 74  Intro to Microprocessors  4
- GE  3
Total units  18

#### Junior Second Semester
- CpE 142  Advanced Computer Organization  3
- CpE 186  Computer Hardware Design (CpE 185)  3
- EEE 108  Electronics I  3
- EEE 108L  Electronics I Lab  1
- EEE 181  Intro Digital Signal Processing  3
- or  
- CSc 131  Intro to Software Engineering  3
- GE  3
Total units  16

#### Senior Second Semester
- CpE 138  Computer Networks and Internets,  3
- EEE 193B  Senior Design Project II  2
- CSc  Technical Elective  3
- Math 100/150  Linear Algebra or Numerical Analysis  3
- GE  3
- GE  3
Total units  17
## Curriculum Pattern

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<th>Second Semester Courses:</th>
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| **SOPHMORE**            |                          |
| EEE 064                 | Engl 20                  |
| Intro. to Logic Design  | College Composition II   |
| Math 32                 | Engr 017                 |
| Calculus III            | Intro to Circuit Analysis|
| Phys 11C                | Math 45                  |
| Gen Phys:Electricity & Magnetism | Differential Equations |
| General Education       | Engr 70                  |
|                          | Engineering Mechanics    |
|                          | General Education         |
|                          |                          |
| **SEMESTER UNITS**      |                          |
| 1                       | 8                        |

### 04/15/2011 Proposed Lower Division

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<td>Phys 11A</td>
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<td><strong>SEMESTER UNITS</strong></td>
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| **SOPHMORE**            |                          |
| EEE 064                 | Engl 20                  |
| Intro. to Logic Design  | College Composition II   |
| Math 32                 | Engr 017                 |
| Calculus III            | Intro to Circuit Analysis|
| Phys 11C                | Math 45                  |
| Gen Phys:Electricity & Magnetism | Differential Equations |
| General Education       | EEE 74                   |
|                          | Intro. to Microprocessors|
|                          | General Education         |
|                          |                          |
| **SEMESTER UNITS**      |                          |
| 1                       | 6                        |

Page 29 of 30