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Computer Science, Computer Engineering, and Electrical Engineering
ABET Planning Document: Fall 2012

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1. ABET Criterion 3: Program/Student Outcomes

Program/Student Outcomes are skills and abilities which students should meet on or before graduation. The Program/Student Outcomes should be compatible with and support the long-term Criterion 2. Program Educational Objectives.

For the purpose of verifiable assessment, faculty members were assigned to required core courses which they were familiar with. This was done in such a way that each required core ended up with a team of at least assigned two faculty members.

Marc Thomas: ECE 304, CMPS 312, CMPS 321, ECE 332, CMPS 360, CMPS 376
Huaqing Wang: CMPS 222, CMPS 223, CMPS 335, CMPS 342, CMPS 350
Arif Wani: CMPS 222, CMPS 223, CMPS 335, CMPS 356, CMPS 371

Wei Li: CMPS 224, ECE 320, CMPS 321, ECE 322, ECE 330, ECE 420
Melissa Danforth: CMPS 222, CMPS 223, CMPS 321, CMPS 356, CMPS 376
Shahrzad Mazlouman: ECE 307, ECE 320, ECE 322, ECE 420
Hani Mehrpouyan: ECE 330, ECE 332, ECE 423, ECE 337
Saeed Zadeh ECE 304, ECE 307, ECE 337, ECE 423
Donna Meyers: CMPS 224, CMPS 295, CMPS 312, CMPS 350, CMPS 360

Programs are strongly urged to use the ABET "Criterion 3" Program/Student Outcomes, possibly with modifications (but this was viewed as a bit dangerous at the ABET workshop).

ABET Program/Student Outcomes for **Computer Science**

- 3a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- 3b. An ability to analyze a problem, and identify and define the computing requirements and specifications appropriate to its solution.
- 3c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
- 3d. An ability to function effectively on teams to accomplish a common goal.
- 3e. An understanding of professional, ethical, legal, security, and social issues and responsibilities.
- 3f. An ability to communicate effectively with a range of audiences.
- 3g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- 3h. Recognition of the need for and an ability to engage in continuing professional development.
- 3i. An ability to use current techniques, skills, and tools necessary for computing practice.
- 3j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- 3k. An ability to apply design and development principles in the construction of software systems of varying complexity.

There are some differences between the Program/Student Outcomes for Computer Science and those for Computer/Electrical Engineering:

ABET Program/Student Outcomes for **Computer and Electrical Engineering**

- 3a. An ability to apply knowledge of mathematics, science, and engineering.
- 3b. An ability to design and conduct experiments, as well as to analyze and interpret data.
- 3c. 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.
- 3d. An ability to function on multidisciplinary teams.
- 3e. An ability to identify, formulate, and solve engineering problems.
- 3f. An understanding of professional and ethical responsibility.
- 3g. An ability to communicate effectively.
- 3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context.
- 3i. A recognition of the need for, and an ability to engage in, life-long learning.
- 3j. A knowledge of contemporary issues.
- 3k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET recommends both *direct* and *indirect* assessment methods [5, page 38]; direct methods will be the primary source of information but indirect methods can supplement this in a productive way. These are listed below.

I. Direct Assessment Methods

- **project**: performance tasks, including both individual and team projects
- **present**: student presentations
- **exam**: locally developed exams with embedded questions
- **normed**: national normed exams (e.g. the Major Field Test)
- **portfolio**: student portfolios

II. Indirect Assessment Methods

- **survey**: surveys and questionnaires
- **focus**: focus groups
- **advisory**: advisory board meetings
- **inteview**: exit interviews

In this document we restrict our attention to the direct methods.

2. Course Matrices

For ABET assessment, a Course Matrix links each Program/Student Outcome to a weighting factor for each required core course. We used weighting factors 0–5 for all Computer Science, Computer Engineering, and Electrical Engineering Course Matrices. Note that a level of 0 means that the given outcome is not being formally assessed in that particular course; **it does not mean that the outcome has no connection with the course**. For example, Outcome 3a. is a factor in **most** of our courses. However, we formally assess it only in those courses which require extensive use of mathematics and the physical sciences.

Here are the Course Matrices which we worked up for Computer Science, Computer Engineering, and Electrical Engineering. The Computer Science Course Matrix also incorporates the three major areas of the Major Field Exam in Computer Science (which we give to our graduating seniors):

Table I - Computer Science Course Matrix (CAC/ABET)

Out-come	CMPS	224	295	312	320	321	335	342	350	356	360	376	490
3a.	math, physical sciences	2	5	3	0	5	0	0	0	0	0	5	0
3b.	problem analysis	3	3	5	5	0	0	3	2	5	3	0	3
3c.	design to desired needs	0	0	0	0	3	5	3	0	3	0	0	3
3d.	effective teamwork	0	0	0	0	0	3	0	0	0	0	0	3
3e.*	prof., ethical, security	0	0	0	0	0	0	0	0	0	0	5	0
3f.*	effective communication	0	0	0	3	0	3	3	0	3	0	0	0
3g.	computing in global con.	0	0	0	0	0	0	0	0	0	0	0	3
3h.*	professional development	0	0	0	0	0	0	0	0	0	0	0	3
3i.	current techniques, tools	0	0	0	4	3	0	0	2	0	0	3	0
3j.	design tradeoffs	0	0	4	0	5	0	0	3	0	3	0	0
3k.	software system/life cycle	0	0	0	0	0	5	0	0	0	0	0	0
	Core Areas on Major Field Exam												
	Prog. Fundamentals	0	0	3	0	0	0	0	5	0	0	0	0
	Disc. Struct & Algorithms	0	5	5	0	0	0	2	0	0	0	0	0
	Sys: Arch/OS/Net/Dbase	0	0	0	3	5	0	5	0	0	5	5	0

*PHIL 316 (Professional Ethics) will support these outcomes as well.

Table II - Computer Engineering Course Matrix (EAC/ABET)

Out-come	CMPS/ECE	160	207	224	295	304	307	320	321	322	360	420	490
3a.	math, physical sciences	0	0	2	5	5	0	0	5	0	0	0	0
3b.	design/conduct experiment	0	3	0	0	0	5	5	0	5	0	5	0
3c.	design within constraints	0	0	0	0	0	0	0	3	0	5	0	0
3d.	multidisciplinary teamwork	0	5	0	0	0	0	0	0	0	0	0	5
3e.	solve engineering problems	0	0	3	0	5	4	0	0	4	0	0	0
3f.*	professional responsiblity	5	0	0	0	0	0	0	0	0	0	0	5
3g.*	effective communication	3	0	0	0	0	0	3	0	0	0	3	5
3h.	engineering in global con.	5	0	0	0	0	0	0	0	0	0	0	0
3i.*	life-long learning	0	0	0	0	0	0	0	0	2	0	4	5
3j.	contemporary issues	0	0	0	0	0	5	0	3	0	0	0	5
3k.	modern engineering tools	0	0	0	0	3	4	4	3	5	0	5	0

Add New Course: ECE 160 Introduction to Engineering (3)
*PHIL 316 (Professional Ethics) will support these outcomes as well.

Table III - Electrical Engineering Course Matrix (EAC/ABET)

Out-come	ECE	160	207	224	304	307	320	330	332	337	423	490
3a.	math, physical sciences	0	0	2	5	0	0	5	5	0	0	0
3b.	design/conduct experiment	0	3	0	0	5	5	0	3	0	5	0
3c.	design under constraint	0	0	0	0	0	0	0	0	5	5	0
3d.	multidisciplinary teamwork	0	5	0	0	0	0	0	0	0	0	5
3e.	solve engineering problems	0	0	3	5	4	0	5	5	0	0	0
3f.*	professional responsiblity	5	0	0	0	0	0	0	0	0	0	5
3g.*	effective communication	3	0	0	0	0	3	0	0	5	0	5
3h.	engineering in global con.	5	0	0	0	0	0	0	0	0	0	0
3i.*	life-long learning	0	0	0	0	0	0	0	0	0	0	5
3j.	contemporary issues	0	0	0	0	5	0	0	0	4	0	5
3k.	modern engineering tools	0	0	0	3	4	4	2	0	0	5	0

Add New Course: ECE 160 Introduction to Engineering (3)
Add New Course: ECE 337 Fundamentals of Power Systems (5)
*PHIL 316 (Professional Ethics) will support these outcomes as well.

3. ACM/IEEE Core Topics (Body of Knowledge) Linkage

In the case of Computer Science and Computer Engineering, ACM and IEEE collaborate on producing a set of " Core Topics" (also called the "Body of Knowledge"). Each of these topics requires a minimum number of hours of lecture instruction in the program core [2] and [3].

ACM/IEEE **Computer Science** Core Topics (CC2001/CA2008)

DS. Discrete Structures
PF. Programming Fundamentals
AL. Algorithms and Complexity
AR. Computer Architecture

OS. Operating Systems
NC. Computer Networks
PL. Programming Languages
HC. Human-Computer Interface
GV. Graphics and Visual Computing
IS. AI and Intelligent Systems
IM. Database and Information Management
SP. Societal and Professional Issues
SE. Software Engineering
CN. Computational Science (program optional)

Here is the Core Topics Linkage for Computer Science at CSUB. Note that a small number of elementary topics are covered in the first-year sequence CMPS 221, 222, and 223.

Table IV - Computer Science Topics Linkage (280 lecture hours)

Topic	CMPS	295	312	320	321	335	342	350	356	360	376	490
DS.	Disc. Structures (43)	1-6										
PF.	Prog. Fundamentals (38)											
PF1-2:	CMPS 221											
PF3-5:	CMPS 223											
AL.	Algor. and Complex. (31)		2-4					5				
AL1:	CMPS 223											
AR.	Comp. Architecture (36)			1-2	4-7							
AR3:	CMPS 224											
OS.	Operating Systems (18)									1-5		
NC.	Computer Networks (15)										1-4	
PL.	Program. Languages (21)							1-5				
PL1:	CMPS 221											
PL4-6:	CMPS 222											
HC.	Human-Comp. Inter. (8)						1-2					
GV.	Graphics and Visual (3)					1-2						
IS.	AI and Intel. Systems (10)								1-3			
IM.	DB and Inform. Man. (10)						1-3					
SP.	Soc. and Prof. Issues (16)											
SP1:	CMPS 223											
SP2-7:	PHIL 316											
SE.	Software Engineer. (31)					3-8						
SE1-2:	CMPS 222											

ACM/IEEE **Computer Engineering** Core Topics (CE2004)

CE-ALG. Algorithms (cf. Computer Science AL.)
CE-CSE. Computer Systems Engineering
CE-DBS. Database Systems (cf. Computer Science IM.)
CE-DSP. Digital Signal Processing
CE-ESY. Embedded Systems
CE-CAO. Computer Architecture and Organization
CE-CSG. Circuits and Signals
CE-DIG. Digital Logic
CE-ELE. Electronics

CE-HCI. Human-Computer Interaction (cf. Computer Science HC.)
CE-NWK. Computer Networks
CE-PRF. Programming Fundamentals (cf. Computer Science PF.)
CE-SWE. Software Engineering (cf. Computer Science SE.)
CE-OPS. Operating Systems (cf. Computer Science OS.)
CE-SPR. Social and Professional Issues (cf. Computer Science SP.)
CE-VLS. VLSI Design and Fabrication
CE-DSC. Discrete Structures (cf. Computer Science DS.)
CE-PRS. Probability and Statistics

Here is the (very preliminary) Core Topics Linkage for Computer Engineering at CSUB which we submitted to the Chancellor's Office. Note that a small number of elementary topics are covered in the first-year sequence CMPS 221, 222, and 223.

Table V - Computer Engineering Topics Linkage (486 lecture hours)

Topic	ECE	207	224	295	304	307	320	321	322	360	420	490
ALG.	Algorithms (30)											
AL0-5:	CMPS 223											
CSE.	Comp. Sys. Engineering (18)											
DBS.	Database Systems (5)											
DSP.	Digital Signal Proc. (17)				3,5							
ESY.	Embedded Systems (20)										0-6	
CAO.	Comp. Arch. & Org. (63)		0-3					4-9				
CSG.	Circuits & Signals (43)	0-6										
DIG.	Digital Logic (57)						0-9					
ELE.	Electronics (40)					0-9						
HCI.	Human-Comp. Interact. (8)											
NWK.	Computer Networks (21)											
PRF.	Prog. Fundamentals (39)											
PF0-2:	CMPS 221											
PF3-5:	CMPS 223											
SWE.	Software Engineering (13)											
OPS.	Operating Systems (20)									0-5		
SPR.	Soc. & Prof. Issues (16)											
SP0:	CMPS 223											
SP2-8:	PHIL 316											
VLS.	VLSI Design & Fab. (10)								0-5			
DSC.	Discrete Structures (33)			0-6								
PRS.	Probability & Stat. (33)				0-7							

4. ABET Criterion 2: Program Educational Objectives

Program Educational Objectives are (very) broad, long-term, and likely to be attained 2-5 years *after* graduation. They are based upon the needs of the program's constituencies and stakeholders. Our program educational objectives are very similar for each of the three degree programs:

CSUB **Computer Science** Program Educational Objectives

2a. To produce graduates who are scholastically competitive in science, mathematics, and computer science, and who will engage in the productive practice of computer science to identify and solve significant problems across a broad range of application areas.

2b. To produce graduates who ethically apply their computer science knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.

2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship.

2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computers and computer science principles.

2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning.

CSUB **Computer Engineering** Program Educational Objectives

2a. To produce graduates who are scholastically competitive in science, mathematics, and general engineering, and who will engage in the productive practice of computer engineering to identify and solve significant problems across a broad range of application areas.

2b. To produce graduates who ethically apply their computer engineering knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.

2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship.

2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computers and computer engineering principles.

2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning.

CSUB **Electrical Engineering** Program Educational Objectives

2a. To produce graduates who are scholastically competitive in science, mathematics, and general engineering, and who will engage in the productive practice of electrical engineering to identify and solve significant problems across a broad range of application areas.

2b. To produce graduates who ethically apply their electrical engineering knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.

2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship.

2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computer and electrical engineering principles.

2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning.

Program Educational Objectives support the Program/Student Outcomes. The tables on the next few pages show this mapping.

Table VI - Computer Science PEO Mapping

Program Educational Objectives	Supporting Program/Student Outcomes
2a. To produce graduates who are scholastically competitive in science, mathematics, and computer science, and who will engage in the productive practice of computer science to identify and solve significant problems across a broad range of application areas	3a. An ability to apply knowledge of computing and mathematics appropriate to the discipline 3b. An ability to analyze a problem, and identify and define the computing requirements and specifications appropriate to its solution 3c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs 3g. An ability to analyze the local and global impact of computing on individuals, organizations, and society
2b. To produce graduates who ethically apply their computer science knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.	3k. An ability to apply design and development principles in the construction of software systems of varying complexity 3e. An understanding of professional, ethical, legal, security, and social issues and responsibilities 3f. An ability to communicate effectively with a range of audiences
2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship	3g. An ability to analyze the local and global impact of computing on inidividuals, organizations, and society. 3i. An ability to use current techniques, skills, and tools necessary for computing practice
2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computers and computer science principles	3j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices 3d. An ability to function effectively on teams to accomplish a common goal 3c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs 3f. An ability to communicate effectively with a range of audiences
2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning	3h. Recognition of the need for and an ability to engage in continuing professional development

Table VII - Computer Engineering PEO Mapping

Program Educational Objectives	Supporting Program/Student Outcomes
2a. To produce graduates who are scholastically competitive in science, mathematics, and general engineering, and who will engage in the productive practice of computer engineering to identify and solve significant problems across a broad range of application areas	3a. An ability to apply knowledge of mathematics, science, and engineering 3b. An ability to design and conduct experiments, as well as to analyze and interpret data 3e. An ability to identify, formulate, and solve engineering problems 3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context
2b. To produce graduates who ethically apply their computer engineering knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.	3c. 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 3f. An understanding of professional and ethical responsibility 3g. An ability to communicate effectively 3j. A knowledge of contemporary issues
2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship	3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context 3k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computer and electrical engineering principles	3c. 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 3d. An ability to function on multidisciplinary teams 3e. An ability to identify, formulate, and solve engineering problems. 3g. An ability to communicate effectively
2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning	3i. A recognition of the need for, and an ability to engage in, life-long learning

Table VIII - Electrical Engineering PEO Mapping

Program Educational Objectives	Supporting Program/Student Outcomes
2a. To produce graduates who are scholastically competitive in science, mathematics, and general engineering, and who will engage in the productive practice of electrical engineering to identify and solve significant problems across a broad range of application areas	3a. An ability to apply knowledge of mathematics, science, and engineering 3b. An ability to design and conduct experiments, as well as to analyze and interpret data 3e. An ability to identify, formulate, and solve engineering problems 3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context
2b. To produce graduates who ethically apply their electrical engineering knowledge and skills with an understanding of realistic constraints for the overall benefit of a diverse society.	3c. 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 3f. An understanding of professional and ethical responsibility 3g. An ability to communicate effectively 3j. A knowledge of contemporary issues
2c. To produce graduates who will enhance the economic well-being of both Kern County and the State of California through a combination of technical expertise, social responsibility, leadership, and entrepreneurship	3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context 3k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
2d. To produce graduates who can work and communicate effectively, either independently or in a team, to solve problems using computer and electrical engineering principles	3c. 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 3d. An ability to function on multidisciplinary teams 3e. An ability to identify, formulate, and solve engineering problems. 3g. An ability to communicate effectively
2e. To produce graduates who will reflect the diversity of our service area and who will enhance their intellectual development and technical skills through life-long learning	3i. A recognition of the need for, and an ability to engage in, life-long learning

All of our Program Educational Objectives are clearly aligned with the CSUB Mission Statement:

> CSUB Mission Statement: "California State University, Bakersfield, is a comprehensive public university committed to offering excellent undergraduate and graduate programs that advance the intellectual and personal development of its students.
> An emphasis on student learning is enhanced by a commitment to scholarship, diversity, service, global awareness, and life-long learning. The University collaborates with partners in the community to increase the region's overall educational level, enhance its quality of life, and support its economic development."

5. Assessment Diagram

Every program provides an "Assessment Diagram" (which may appear to be meaningless [6]) but it does seem necessary. We can summarize the above sections with the following Assessment Diagram for the Department of Computer and Electrical Engineering and Computer Science at CSUB:

long-term		**by graduation**		**course-level**
program educational educational objectives (4)	⟶	determine student outcomes (1)	⟶	determine how outcomes will be achieved
↑	↖	↑	↻	↓
input from constituencies		faculty assess and evaluate	⟵	course matrix (2) how will outcomes be assessed? establish indicators
				↑
				also satisfy core content (3) if body of knowledge

6. Performance Indicators

ABET uses a Student Outcome (3a.–3k.) coupled with one or more "Performance Indicators" to establish a *measurable* entity. ABET Performance Indicators have three critical components [5, pages 29–32]:

i. **Content Referent (noun):** subject content that is the focus of instruction.
ii. **Action Verb:** specific performance that is indicated.
iii. **Value Free:** free of terms which themselves express value (e.g. "effectively," "completely").

We have separate Performance Indicators for Computer Science and Computer and Electrical Engineering.

Listing IX - Computer Science Performance Indicators

3a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- a1. Use probability and statistics to model situations in computer science.
- a2. Use single and multi-variable calculus techniques.
- a3. (*no reliance on mathematical transforms in computer science required core*)
- a4. Use principles of newtonian and maxwellian physics to solve problems in computer science.
- a5. Use discrete mathematics techniques and algorithms.

3b. An ability to analyze a problem, and identify and define the computing requirements and specifications appropriate to its solution.
- b1. Identify key components and algorithms necessary for a solution.
- b2. Produce a solution within specifications.
- b3. Analyse at least two possible solutions to a given problem and select the best solution for the given problem.

3c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs (*similar to ECE 3e*).
- c1. Identify constraints on the design problem and establish criteria for acceptability of solutions.
- c2. Carry solution through to the most economic/desirable solution and justify the approach.

- c3. Design the selcted solution for a given probelm.
- c4. Implement the designed solution for a given problem.
- c5. Evaluate the implemented solution.

3d. An ability to function effectively on teams to accomplish a common goal (*similar to ECE 3d*).
- d1. Fulfill team duties and share in the work of the team.
- d2. Listen and communicate with other team members.
- d3. Research and gather information.
- d4. Meet deadlines and achieve project goals.
- d5. Cooperate on reports with a reasonable share of duties.

3e. An understanding of professional, ethical, legal, security, and social issues and responsibilities (*similar to ECE 3f*).
- e1. Recognize ethical issues involved in a professional setting.
- e2. Recognize and describe current issues in security.
- e3. Respect and honor ethics in writing assignments.

3f. An ability to communicate effectively with a range of audiences.
- f1. Write technical reports.
- f2. Prepare and deliver oral presentations.

3g. An ability to analyze the local and global impact of computing on individuals, organizations, and society (*similar to ECE 3h*).
- g1. Understand impact of computing solutions on society and the environment in a global economic context.
- g2. Understand and explain non-technical issues such as sustainability and entrepreneurship.
- g3. Consider a variety of available options in computing design and make a proper choice based on their impact.

3h. Recognition of the need for and an ability to engage in continuing professional development (*similar to ECE 3i*).
- h1. Read and report on papers in the technical literature.
- h2. Involve oneself in professional activities (e.g. meeting, presentations, workshops).
- h3. Handle problems for which the required knowledge is not complete.

3i. An ability to use current techniques, skills, and tools necessary for computing practice (*similar to ECE 3k*).
- i1. Program in a suitable computer language.
- i2. Use appropriate simulation software and/or hardware design tools application.
- i3. Utilize problem solving skills and techniques to complete the task.

3j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- j1. Understand performance and cost as these relate to software/firmware-based and hardware-based implementations.
- j2. Understand market volume and research and design costs as these determine computer-based offerings.

3k. An ability to apply design and development principles in the construction of software systems of varying complexity.
- k1. Understand the software/system life-cycle.
- k2. Write documentation for each phase of the development cycle.

Listing X - Computer and Electrical Engineering Performance Indicators

3a. An ability to apply knowledge of mathematics, science, and engineering.
- a1. Use probability and statistics to model situations in computer and electrical engineering.
- a2. Use single and multi-variable calculus techniques.
- a3. Use mathematical transforms and complex variables to solve problems in computer and electrical engineering.

- a4. Use principles of Newtonian and Maxwellian physics to solve problems in computer and electrical engineering.
- a5. Use discrete mathematics techniques and algorithms.
- a6. Use complex calculations in analysis of AC circuits.

3b. An ability to design and conduct experiments, as well as to analyze and interpret data.

- b1. Design and set up experiments.
- b2. Conduct experiments and perform measurements.
- b3. Analyze data and interpret results.
- b4. Detect the experimental faults and troubleshoot them.

3c. 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.

- c1. Follow systematic and logical design procedures and define specifications to meet project requirements.
- c2. Adhere to non-technical constaints such as environmental, social, political, ethical, health and safety, and sustainability.
- c3. Consider alternative designs and choose the optimal solution.

3d. An ability to function on multidisciplinary teams.

- d1. Fulfill team duties and share in the work of the team.
- d2. Listen and communicate with other team members.
- d3. Research and gather information.
- d4. Meet deadlines and achieve project goals.
- d5. Cooperate on reports with a reasonable share of duties.

3e. An ability to identify, formulate, and solve engineering problems.

- e1. Develop a clear and quantifiable statement of performance requirements.
- e2. Develop technical specifications for the performance requirements.
- e3. Select and implement the desirable solution and evaluate the results.

3f. An understanding of professional and ethical responsibility.

- f1. Recognize ethical issues involved in a professional setting.
- f2. Respect and honor ethics in writing assignments.
- f3. Recognize and cope with professional and ethical issues related to safety and sustainability in engineering problems.

3g. An ability to communicate effectively.

- g1. Write technical reports.
- g2. Prepare and deliver oral presentations.

3h. The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context.

- h1. Understand the impact of engineering solutions on society and the environment in a global economic context.
- h2. Understand and explain non-technical issues such as sustainability and entrepreneurship.
- h3. Consider a variety of available options in engineering design and make a proper choice based on their impact.

3i. A recognition of the need for, and an ability to engage in, life-long learning.

- i1. Carry out research on engineering topics by reading and reporting on papers in the technical literature.
- i2. Involve oneself in professional activities (e.g. meeting, presentations, workshops).
- i3. Analyze and evaluate engineering information and handle problems for which the required knowledge is not complete.

3j. A knowledge of contemporary issues.

- j1. Identify and discuss emerging technologies related to computer and electrical engineering.
- j2. Identify recent trends in computer and electrical engineering.

   j3. Understand the relation of classical topics in engineering with their implementation in modern technologies.
3k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
   k1. Use appropriate tools, simulation software, or hardware design tools to solve engineering problems.
   k2. Utilize appropriate software and hardware measurement and test equipment.
   k3. Determine the appropriate choice of tools when several are available.

7. Assessment Plan Timetables

The Department of Computer and Electrical Engineering and Computer Science has set up an initial two-year Assessment Plan (2013–14 and 2014–15) Timetable (for Computer Science and Computer and Electrical Engineering) as follows.

Table XI - Assessment Plan Timetables (Computer Science)

Student Outcomes	Performance Indicators	Quarter(s)	Assessment Method	Method of Grading Outcome
CMPS 224				
3a.	a5.	Winter 2014	embedded exam question	actual score
3b.	b1.	Fall 2014	individual project	4-pt rubric
3b.	b2.	Spring 2015	individual project	4-pt rubric
CMPS 295				
3a.	a5.	Fall 2013	embedded exam question	actual score
3a.	a5.	Spring 2014	embedded exam question	actual score
3b.	b3.	Winter 2015	embedded exam question	actual score
CMPS 312				
3a.	a5.	Fall 2013	embedded exam question	actual score
3b.	b1.	Fall 2013	embedded exam question	actual score
3j.	j1.	Fall 2014	embedded exam question	actual score
CMPS 320				
3b.	b2.	Fall 2013	laboratory assignment	4-pt rubric
3f.	f1.	Winter 2015	written report	4-pt rubric
3i.	i2.	Spring 2014	laboratory assignment	4-pt rubric
CMPS 321				
3a.	a5.	Winter 2014	embedded exam question	actual score
3c.	c1.	Winter 2013	individual project	4-pt rubric
3c.	c5.	Winter 2014	individual project	4-pt rubric
3i.	i2.	Winter 2013	laboratory assignment	4-pt rubric
3i.	i3.	Winter 2014	individual project	4-pt rubric
3j.	j1.	Winter 2013	embedded exam question	actual score

Student Outcomes	Performance Indicators	Quarter(s)	Assessment Method	Method of Grading Outcome
CMPS 335				
3c.	c2.	Spring 2014	group project	4-pt rubric
3d.	d4.	Spring 2014	group project	4-pt rubric
3f.	f2.	Spring 2015	group project	4-pt rubric
3k.	k1.	Spring 2015	embedded exam question	actual score
CMPS 342				
3b.	b2.	Fall 2013	team/individual project	actual score
3c.	c2.	Fall 2013	team/individual project	actual score
3c.	c4.	Fall 2013	team/individual project	actual score
3f.	f1.	Fall 2014	written report	4-pt rubric
3f.	f2.	Fall 2014	two oral presentations	class w/rubric
CMPS 350				
3b.	b2.	Winter 2014	individual project	actual score
3b.	b3.	Winter 2014	embedded exam question	actual score
3i.	i1.	Winter 2015	individual project	actual score
3i.	i3.	Winter 2015	individual project	actual score
3j.	j1.	Winter 2014	embedded exam question	actual score
CMPS 356				
3b.	b1.	Winter 2013	individual project	4-pt rubric
3b.	b2.	Winter 2014	individual project	4-pt rubric
3b.	b3.	Winter 2014	individual project	4-pt rubric
3c.	c3.	Winter 2014	individual project	4-pt rubric
3c.	c4.	Winter 2013	individual project	4-pt rubric
3c.	c5.	Winter 2014	laboratory assignment	4-pt rubric
3f.	f1.	Winter 2013	individual project	4-pt rubric
3f.	f2.	Winter 2013	individual project	4-pt rubric
CMPS 360				
3b.	b2.	Winter 2014	individual project	4-pt rubric
3b.	b1.	Fall 2014	individual project	4-pt rubric
3j.	j1.	Spring 2015	embedded exam question	actual score
CMPS 376				
3a.	a1.	Spring 2013	embedded exam question	actual score
3a.	a4.	Winter 2014	embedded exam question	actual score
3e.	e2.	Winter 2014	laboratory assignment	4-pt rubric
3i.	i1.	Spring 2013	laboratory assignment	4-pt rubric
3i.	i3.	Winter 2014	embedded exam question	4-pt rubric
CMPS 490				
3b.	b1.	Spring 2014	team project	actual score
3b.	b2.	Spring 2014	team project	actual score
3b.	b3.	Spring 2014	team project	actual score
3d.	d1.	Spring 2015	embedded question	actual score
3d.	d2.	Spring 2015	embedded question	actual score
3d.	d3.	Spring 2015	embedded question	actual score
3d.	d4.	Spring 2015	embedded question	actual score
3d.	d5.	Spring 2015	embedded question	actual score
3f.	f1.	Spring 2015	written report	4-pt rubric
3f.	f2.	Spring 2015	written report	4-pt rubric
3g.	g1.	Spring 2014	embedded questions	actual score

Table XI - Assessment Plan Timetables (Computer and Electrical Engineering)

Student Outcomes	Performance Indicators	Quarter(s)	Assessment Method	Method of Grading Outcome
ECE 160				
3f.				
3g.				
3h.				
ENGR 207				
3b.				
3d.				
CMPS 224				
3a.	a5.	Winter 2014	embedded exam question	actual score
3e.	e1.	Fall 2014	individual project	4-pt rubric
3e.	e2.	Spring 2015	individual project	4-pt rubric
CMPS 295				
3a.	a5.	Fall 2013	embedded exam question	actual score
ECE 304				
3a.	a2.	Fall 2013	laboratory assignment	4-pt rubric
3a.	a3.	Fall 2014	embedded exam question	actual score
3e.	e3.	Fall 2013	embedded exam question	actual score
3e.	e1.	Fall 2014	laboratory assignment	4-pt rubric
3k.	k1.	Fall 2013	laboratory assignment	4-pt rubric
3k.	k3.	Fall 2014	laboratory assignment	4-pt rubric
ECE 307				
3b.	b1.	Winter 2013	laboratory assignment	4-pt rubric
3b.	b2.	Winter 2013	laboratory assignment	4-pt rubric
3b.	b3.	Winter 2013	laboratory assignment	4-pt rubric
3e.	e2.	Winter 2013	laboratory assignment	4-pt rubric
3e.	e3.	Winter 2013	laboratory assignment	4-pt rubric
3j.	j1.	Winter 2014	laboratory assignment	4-pt rubric
3j.	j3.	Winter 2014	laboratory assignment	4-pt rubric
3k.	k1.	Winter 2014	laboratory assignment	4-pt rubric
3k.	k2.	Winter 2014	laboratory assignment	4-pt rubric
3k.	k3.	Winter 2014	laboratory assignment	4-pt rubric
ECE 320				
3b.	b1.	Fall 2013	laboratory assignment	4-pt rubric
3b.	b2.	Fall 2013	laboratory assignment	4-pt rubric
3b.	b3.	Fall 2013	laboratory assignment	4-pt rubric
3g.	g1.	Winter 2015	written report	4-pt rubric
3g.	g2.	Winter 2015	written report	4-pt rubric
3k.	k1.	Spring 2014	laboratory assignment	4-pt rubric
3k.	k2.	Spring 2014	laboratory assignment	4-pt rubric
3k.	k3.	Spring 2014	laboratory assignment	4-pt rubric

Student Outcomes	Performance Indicators	Quarter(s)	Assessment Method	Method of Grading Outcome
CMPS 321				
3a.	a5.	Winter 2014	embedded exam question	actual score
3c.	c1.	Winter 2013	individual project	4-pt rubric
3c.	c5.	Winter 2014	individual project	4-pt rubric
3k.	i2.	Winter 2013	laboratory assignment	4-pt rubric
3k.	i3.	Winter 2014	individual project	4-pt rubric
3j.				
ECE 322				
3b.	b2.	Spring 2013	laboratory assignment	4-pt rubric
3b.	b3.	Spring 2013	laboratory assignment	4-pt rubric
3e.	e2.	Spring 2013	laboratory assignment	4-pt rubric
3e.	e3.	Spring 2013	laboratory assignment	4-pt rubric
3i.	i1.	Spring 2014	embedded exam question	4-pt rubric
3i.	i3.	Spring 2014	embedded exam question	4-pt rubric
3k.	k1.	Spring 2014	laboratory assignment	4-pt rubric
3k.	k2.	Spring 2014	laboratory assignment	4-pt rubric
3k.	k3.	Spring 2014	laboratory assignment	4-pt rubric
ECE 330				
3a.	a3.	Winter 2013	embedded exam question	actual score
3a.	a5.	Winter 2013	embedded exam question	actual score
3a.	a6.	Winter 2013	laboratory experiment	4-pt rubric
3e.	e3.	Winter 2013	laboratory experiment	4-pt rubric
3k.	k1.	Winter 2013	laboratory experiment	4-pt rubric
3k.	k2.	Winter 2013	laboratory experiment	4-pt rubric
ECE 332				
3a.	a2.	Fall 2013	embedded exam question	actual score
3a.	a3.	Fall 2013	embedded exam question	actual score
3a.	a4.	Fall 2013	embedded exam question	actual score
3a.	a6.	Fall 2013	laboratory experiment	4-pt rubric
3b.	b2.	Fall 2013	laboratory experiment	4-pt rubric
3b.	b3.	Fall 2013	laboratory experiment	4-pt rubric
3e.	e3.	Fall 2013	laboratory experiment	4-pt rubric
ECE 337				
3c.	c1.	Winter 2013	laboratory assignment	4-pt rubric
3c.	c3.	Winter 2014	individual project	actual score
3g.	g1.	Winter 2013	written project report	actual score
3g.	g2.	Winter 2014	project presentation	actual score
3j.	j1.	Winter 2013	project summary report	4-pt rubric
3j.	j1.	Winter 2014	project summary report	4-pt rubric
CMPS 360				
3c.	b2.	Winter 2014	individual project	4-pt rubric
3c.	b1.	Fall 2014	individual project	4-pt rubric

Student Outcomes	Performance Indicators	Quarter(s)	Assessment Method	Method of Grading Outcome
ECE 420				
3b.	b1.	Fall 2013	laboratory assignment	4-pt rubric
3b.	b2.	Fall 2013	laboratory assignment	4-pt rubric
3b.	b3.	Fall 2013	laboratory assignment	4-pt rubric
3g.	g1.	Fall 2013	written report	4-pt rubric
3g.	g2.	Fall 2013	written report	4-pt rubric
3i.	i1.	Fall 2014	embedded exam question	actual score
3i.	i3.	Fall 2014	embedded exam question	actual score
3k.	k1.	Fall 2014	laboratory assignment	4-pt rubric
3k.	k2.	Fall 2014	laboratory assignment	4-pt rubric
3k.	k3.	Fall 2014	laboratory assignment	4-pt rubric
ECE 423				
3b.	b1.	Winter 2014	individual project	4pt-rubric
3b.	b2.	Winter 2013	laboratory experiment	actual score
3b.	b3.	Winter 2013	laboratory experiment	actual score
3c.	c1.	Winter 2013	embedded exam question	actual score
3c.	c3.	Winter 2014	individual project	4-pt rubric
3k.	k1.	Winter 2013	laboratory experiment	actual score
3k.	k2.	Winter 2013	laboratory experiment	actual score
3k.	k3.	Winter 2013	laboratory experiment	actual score
ECE 490				
3d.				
3f.				
3g.				
3i.				
3j.				

8. ABET Science and Mathematics Area A. & B. Requirements

ABET has science and mathematics requirements as well. Both general requirements (for all areas) as well as specific requirements (for the particular program) are given. They are grouped into two areas: A. & B. as follows:

Computer Science

A. A general requirement of one year (45 quarter units) of college level mathematics and basic science. This must *specifically include*
   i. knowledge of additional mathematics which could include probability and statistics, linear algebra, numerical methods, number theory, geometry, or symbolic logic.
   ii. knowledge of mathematics through the differential and integral calculus
   iii. knowledge of discrete mathematics
   iv. a science component which must include laboratory work (usually physics or chemistry).

B. One and one-third years (60 quarter units) of computer science which must *specifically include*
   i. coverage of the fundamentals of algorithms, data structures, software design, concepts of programming languages, and computer organization and architecture.
   ii. an exposure to a variety of programming languages and systems.
   iii. proficiency in at least one higher-level language.
   iv. advanced work which builds on the fundamental course work and which provices depth.

Computer Engineering

A. A general engineering requirement of one year (45 quarter units) of college level mathematics and basic science. For computer engineering, this must *specifically include*
   i. knowledge of probability and statistics including appropriate applications
   ii. knowledge of mathematics through the differential and integral calculus
   iii. knowledge of discrete mathematics
   iv. knowledge of basic sciences
B. One and one-half years (67 quarter units) of engineering topics. For computer engineering, this must *specifically include*
   i. knowledge of appropriate computer science (through data structures).
   ii. knowledge of the analysis and design of circuits and electrical devices, understanding of hardware and software components.
   iii. other appropriate computer engineering.

Electrical Engineering

A. A general engineering requirement of one year (45 quarter units) of college level mathematics and basic science For electrical engineering, this must *specifically include*
   i. knowledge of mathematics through the differential and integral calculus
   ii. knowledge of basic sciences (including science laboratory work)
B. One and one-half years (67 quarter units) of engineering topics. For electrical engineering, this must *specifically include*
   i. knowledge of basic computer science, and computer science appropriate to electrical engineering, including hardware-software systems.
   ii. knowledge of probability and statistics, and knowledge of advanced mathematics selected from discrete mathematics, linear algebra, complex variables, and differential equations
   iii. knowledge of the analysis and design of digital and analog circuits and complex electrical devices.
   iv. other appropriate engineering pertinent to electrical engineering.

Our CSUB proposed curriculum covers these ABET requirements for each degree program as the following tables show (quarter units are given).

Table XII - ABET Science and Mathematics Requirement Tables

Item	**Computer Science** Short Description	ABET Requirement	CSUB	Course work
A.i.	Prob., Stats. & Addl.	—	15	MATH 330,340, and CMPS 312
A.ii.	Calculus	—	15	MATH 201,202,203
A.iii.	Discrete Mathematics	—	5	CMPS 295
A.iv.	Basic Science (Physics)	—	12	PHYS 221,222
A.	Total	45	47	
B.i.	Fundamental Comp. Sci.	—	25	CMPS 223,224,320,321,335
B.ii.	Langs. & Systems	—	10	CMPS 350,360
B.iii.	Proficiency One Lang.	—	5	CMPS 222
B.iv.	Advanced Work	—	25	CMPS 342,356,376,and 2 electives
B.	Total	60	65	

Item	**Computer Engineering** Short Description	ABET Requirement	CSUB	Course work
A.i.	Probability & Stats.	—	5	MATH 340
A.ii.	Calculus	—	20	MATH 201,202,203,204
A.iii.	Discrete Mathematics	—	5	CMPS 295
A.iv.	Basic Science (Physics)	—	23	PHYS 207,221,222,223
A.	Total	45	53	
B.i.	Basic Computer Sci./Eng.	—	18	ECE 160, and CMPS 221,223,224
B.ii.	Ciruits, Devices, etc.	—	25	CMPS 321,360 and ECE 304,320,307
B.iii.	Other Comp. Engineering	—	25	ECE 322,420,and 3 electives
B.	Total	67	68	

Item	**Electrical Engineering** Short Description	ABET Requirement	CSUB	Course work
A.i.	Calculus	—	20	MATH 201,202,203,204
A.ii.	Basic Science (Physics)	—	23	PHYS 207,221,222,223
	Basic Science (Chem.)	—	5	CHEM 211
A.	Total	45	48	
B.i.	Basic Computer Sci./Eng.	—	13	ECE 160, and CMPS 221,224
B.ii.	Prob., Stat, & Adv. Math.	—	15	MATH 230/330, 340, and ECE 304
B.iii.	Circuits, Systems, etc.	—	15	ECE 320,330,307
B.iv.	Other Elect. Engineering	—	25	ECE 332, 337, and 3 electives
B.	Total	67	68	

References

[1] ABET, **Criteria For Accrediting Computing Programs**, 2010–11, online see `http://www.abet.org/forms.shtml#For_Computing_Programs_Only -> 2010-2011 Criteria (pdf) -> Proposed Changes to the Accreditation Criteria (pdf)`

[2] ACM, **Computer Science Body of Knowledge**, 2001, 2008, online see `http://www.acm.org/education/education/education/curric_vols/cc2001.pdf` and the "Interim Revision" at `http://www.acm.org//education/curricula/ComputerScience2008.pdf`

[3] ACM, **Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering**, online see `http://www.acm.org/education/education/curric_vols/CE-Final-Report.pdf`

[4] Estes, Allen and Ressler, Stephen, **Surviving ABET Accreditation: Satisfying the Demands of Criterion 3**, online see `http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1000&context=aen_fac`

[5] **Program Assessment Workshop Handbook**, ABET Annual Conference, Baltimore, MD, October 26, 2011.

[6] Maurice Bleibermacher, Ed.D., **Freud, Quantum Mechanics, and the Collective Unconscious: Where?**.

9. Appendix I: Original Assessment Plan: Spring 2010 Through Winter 2012

Assignments and results are tabulated below. Completed assessment assignments were graded on the following scale:

E – Exceeds CAC/ABET expectations
M – Meets CAC/ABET expecectations
C – Conditionally meets expectations
F – Fails to meet CAC/ABET expectations

If the grade was a "C" then the instructor explained how he/she planned to remedy this. If the grade was an "F" the department met to discuss the issue. Note that this plan was **only** in operation through Winter 2012 because after we added the Computer Engineering degree program in 2011-12 and the Electrical Engineering degree program in 2012-13 we were **not satisfied** with the matrices and indicators as we had first set them up.

Table A1 - Original Assessment Plan Results

Outcome	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k	3l	3m
Spring 2010													
CMPS 295 - Donna Meyers	C	M											
CMPS 335 - Arif Wani		M	M	E		M					E		
CMPS 360 - Marc Thomas	M									E		C	M
Fall 2010													
CMPS 312 - Donna Meyers	M	M								M			
CMPS 320 - Wei Li	M								E	C		M	
CMPS 342 - Huaqing Wang		E	E			M				M			
Winter 2011													
CMPS 321 - Wei Li	M	M							M	M		M	M
CMPS 350 - Donna Meyers	M				M				E				M
CMPS 356 - Arif Wani	M	-	-					M	E	M			
Spring 2011													
CMPS 295 - Donna Meyers	M	M											
CMPS 335 - Arif Wani		M	M	M		M					M		
CMPS 360 - Donna Meyers	3									3		5	5
CMPS 376 - Melissa Danforth	C				M								
CMPS 490 - Huaqing Wang		M	M	E		E		M			M		

Table A1 - Original Assessment Plan Results (Continued)

Outcome	3a	3b	3c	3d	3e	3f	3g	3h	3i	3j	3k	3l	3m
Fall 2011													
CMPS 295 - Donna Meyers	5	3											
CMPS 312 - Donna Meyers	5	5								4			
CMPS 320 - Wei Li	5								3	3		3	
CMPS 342 - Huaqing Wang		E	E			E				M			
Winter 2012													
CMPS 321 - Marc Thomas	M								M	M		M	M
CMPS 350 - Huaqing Wang	M				M				E				M
CMPS 356 - Arif Wani	5	3	2					2	3	5			
CMPS 360 - Donna Meyers	3									3		5	5
CMPS 376 - Melissa Danforth	M				M								M
Spring 2012													
CMPS 295 - Donna Meyers	5	3											
CMPS 320 - Linwei Niu	5								3	3		3	
CMPS 335 - Arif Wani		5	5	5		5					5		
CMPS 490 - Huaqing Wang		M	E	E		-		-			-		