CALIFORNIA STATE UNIVERSITY, FRESNO

LYLES COLLEGE OF ENGINEERING

B.S. in COMPUTER ENGINEERING
Student Outcomes Assessment Program (SOAP)

I. Mission

The mission of the Department of Electrical and Computer Engineering is to fulfill the needs of the region and state by providing an undergraduate technical education in Electrical Engineering and Computer Engineering to a diverse group of students. The department strives to continually update its strong program of study in order to qualify its graduates for positions in industry located in the region and beyond, while providing sufficient breadth and depth in its program to assure its graduates a successful practice in the profession. At the same time, students are grounded in the rigorous scientific and theoretical foundations of the discipline in order to enable graduates to enter and be successful in any advanced level educational program of their choosing, and to allow them to build upon this strong foundation and extend it to new depths.

II. Program Objectives

The Computer Engineering Program through the academic structure of California State University, Fresno awards degrees to students who within three to five years of graduation, through work experience and/or graduate education in the engineering field will be expected to

1. have grown technically and be productive in their respective workplaces.
2. be capable of addressing technical problems of increasing complexity.
3. communicate and function effectively in an interdisciplinary team environment at a level commensurate with their career development.
4. demonstrate an ability for independent learning and continued professional as well as ethical development.

III. Student Learning Outcomes (SLOs)

Graduates of the Computer Engineering program are expected to achieve the following student learning 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 multi-disciplinary teams"
e. "an ability to identify, formulate, and solve engineering problems"
f. "an understanding of professional and ethical responsibility"
g. "an ability to communicate effectively"
h. "the broad education necessary to understand the impact of engineering solutions in a global, 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"

IV. Relevance of Outcomes to Program Objectives

The student learning outcomes prepare graduates to attain the program educational objectives in the following ways:

Program Educational Objective 1 - ***Have grown technically and be productive in their respective workplaces.***
Knowledge of mathematics, science, and engineering (SLOs a, e, and k), conducting analysis, design, analysis, and evaluation using mathematical and engineering tools (SLOs b, c, e, and h), communication skills (SLO g) are essential attributes to be productive in the workplace. Additionally, the motivation for continuous development of engineering knowledge and skills (SLOs i and j) is also emphasized.

Program Educational Objective 2 – ***Be capable of addressing technical problems of increasing complexity.***
This objective is supported by several Student Learning Outcomes. Knowledge of mathematics, science, and engineering (SLOs a, e, and k) and conducting analysis, design, evaluation, using tools (SLOs b, c, and e) are fundamental of addressing technical problems of increasing complexity.

Program Educational Objective 3 - ***Communicate and function effectively in an interdisciplinary team environment at a level commensurate with their career development.***
This objective is supported by SLOs d and g.

Program Educational Objective 4 - ***Demonstrate ability for independent learning and continued professional as well as ethical development.***
SLOs i and j contribute directly to developing students the ability for independent learning and continued professional growth. Additionally, SLO f and h provides the foundation for ethical development as engineers.

Table 1 summarizes the above statements that describe the link between student learning outcomes and the program educational objectives. The table shows the relational mapping between student learning outcomes and program educational objectives. The ‘x’ markings on

the table identify those student learning outcomes that most directly support a given program educational objective.

Table 1 SLO/PEO Map

SLO	Program Educational Objectives (PEO)			
	1	**2**	**3**	**4**
a	x	x		
b		x		
c		x		
d			x	
e	x	x		
f				x
g			x	
h				x
i	x			x
j	x			x
k	x	x		

Table 2 Computer Engineering Curriculum Map

SLO	*ECE 1*	*ECE 72*	*ECE 85*	*ECE 85L*	*ECE 90*	*ECE 90L*	*ECE 103*	*ECE 106*	*ECE 107*	*ECE 115*	*ECE 118*	*ECE1 20L*	*ECE 124*	*ECE 125*	*ECE 128*	*ECE 128L*	*ECE 174*
a		2	3		3	1		2	2		2	1	2	3	3	2	
b	2			3		3			1	1		3				3	1
c			3	2	3	2		3	1	2	2	2	3	2	3	2	2
d	2			3		3	2					3				3	
e	1		1	1	3		1	2	2	2	1	2	3	2	2	2	2
f	2						2										
g	2			1		2	3				1	2				2	
h			1					2	2	3	3	2	1	1			3
i	1						3										
j	1						3				1		1				
k	1	3	1	2	1	2		1	2	1	1	3	3		2	1	2

3=Strong, 2=Moderate, 1=Possible

SLO a – apply math, science, engineering
SLO b – conduct experiments, analyze, interpret
SLO c – design a system, component, or process
SLO d – function on multi-disciplinary teams
SLO e – identify, formulate, solve engineering problems
SLO f – professional and ethical responsibility
SLO g – communicate effectively
SLO h – broad education
SLO i – life-long learning
SLO j – contemporary issues
SLO k – use the techniques, skills, and tools for engineering practice

Table 2 Computer Engineering Curriculum Map (continued)

SLO	*ECE 176*	*ECE 178*	*ECE 186*		*ECE electives*	*ECE lab electives*	*CSCI courses*	*GE courses*
a	1	2	2		1	3		
b	3	2	3		3	1	3	
c	3	2	3			3	2	
d			3					3
e	3	2	3					
f								3
g			3			2		
h	3	3	3		3	3		
i			1					
j			2					
k	3	3	3			3	2	

3=Strong, 2=Moderate, 1=Possible

SLO a - Apply math, science, engineering
SLO b – Conduct experiments, analyze, interpret
SLO c – Design a system, component, or process
SLO d – function on multi-disciplinary teams
SLO e – identify, formulate, solve engineering problems
SLO f – professional and ethical responsibility
SLO g – communicate effectively
SLO h – broad education
SLO i – life-long learning
SLO j – contemporary issues
SLO k – use the techniques, skills, and tools for engineering practice

V. Constituencies

Faculty, students, alumni, and industrial employers are the program's primary constituencies who provide both informal and formal input to the educational process. Students' parents and individuals from the community and state provide informal input to the process on matters affecting the program.

VI. Assessment Tools

The department ensures that graduates achieve learning outcomes in two ways: first, by offering a coherent program of study that provides an opportunity for learning (Table 2), and second, by developing and applying ***direct*** and ***indirect*** assessment techniques to determine the success of students in fulfilling learning outcomes. Table 3 summarizes the assessment tools.

Direct Student Assessment Tools:

1. *Culminating Experience* (ECE 186) is assessed through *Capstone Design Reports*. *Capstone Design Reports* provide a strong indicator for many of the outcomes indicated in Table 4. Applying engineering science, open-ended problem solving, use of modern engineering tools, computation competence, problem solving, written communication, and team skills for group projects are elements that can be assessed through oral progress reports and written final reports. Sample reports will be made available during the site visit. (*Scoring rubrics applied*.)

2. *Embedded Questions* provide a moderate indicator for breadth and depth in computer engineering subjects. Table 4 ties the learning outcomes to the current curriculum. The learning outcomes are ***introduced*** in lower division courses and continue to be ***reinforced*** throughout the sequence of courses toward the culminating experience. (*Scoring rubrics applied*.)

3. *Lab Reports* are strong monitoring instruments for hands-on experiences, use of modern engineering tools, following technical instructions, written communication, and teamwork skills. *(Scoring rubrics applied.)*

4. *Poster Sessions/Oral Presentations* strongly demonstrate the student's written and oral communication skills. These sessions also show examples of hands-on experiences, engineering design, use of modern engineering tools, and teamwork skills (for group projects). Sample posters will be available to the visiting team during the site visit. (*Scoring rubric applied*.)

5. *Employer Survey* helps assess program objectives and learning outcomes for practicing engineers and VIP students.

Indirect Student Assessment Tools:

1. *Course Assessment* demonstrates the accomplishment of course objectives as related to learning outcomes in individual courses. The level of student satisfaction is an indicator of

relevant knowledge gained. Survey forms are administered in individual courses in which students appraise the contribution of the course to each educational outcome.

2. *Student/Faculty Forum* is administered in an open forum where students from all levels are present. Most of the outcomes can be monitored by such student input. In these meetings students typically tend to discuss issues like laboratory facilities, curriculum, internships and job opportunities, hands-on experience, available modern tools, lab upgrades, communication skills, ethics, and teamwork.

3. *Exit Interviews/Surveys* address most of the outcomes and document students' level of satisfaction with the learning attributes at the time of graduation. Graduating seniors typically spend between 2-4 years in the department. Therefore, their experiences, usually in the form of oral comments expressed during exit interviews are much more telling and useful than numeric scores on survey sheets. Electrical and Computer Engineering faculty members spend time discussing these comments while placing them in context of other assessment data before considering any changes or adjustments.

6. *Alumni Survey* helps assess program objectives and learning outcomes.

Table 3 Assessment Tools

SLO	Culminating Experience*	Embedded Questions*	Lab Reports*	Poster Presentations*	Course Assessment	Student/ Faculty Forum	Exit Survey	Alumni Survey‡	Employer Survey*‡
a		●	●		●		●	●	●
b	●		●		●	●	●	●	●
c	●	●	●	●	●	●	●	●	●
d	●	●	●	●	●	●	●	●	●
e	●	●		●	●	●	●	●	●
f				●		●	●	●	●
g	●	●	●	●	●	●	●	●	●
h	●			●	●	●	●	●	●
i	●		●	●		●	●	●	●
j	●			●		●	●	●	●
k	●	●	●	●		●	●	●	●

* ***Direct assessment tools***
** ***Scoring rubrics applied***
‡ ***Provides feedback relative to program objectives***

Table 4 Computer Engineering Direct Assessment

SLO	ECE 1	ECE 2	ECE 85	ECE 85L	ECE 90	ECE 90L	ECE 103	ECE 106	ECE 107	ECE 115	ECE 118	ECE 120L	ECE 124	ECE 125	ECE 128	ECE 128L	ECE 174	ECE 176	ECE 178	ECE 186
a		•			•								•	•	•					
b						•						•				•				
c			•					•										•		•
d					•											•				•
e					•					•					•					
f	•						•													
g	•					•	•					•								•
h									•		•		•	•						•
i	•						•					•								•
j	•						•													•
k		•											•						•	•

SLO a - Apply math, science, engineering
SLO b – Conduct experiments, analyze, interpret
SLO c – Design a system, component, or process
SLO d – function on multi-disciplinary teams
SLO e – identify, formulate, solve engineering problems
SLO f – professional and ethical responsibility
SLO g – communicate effectively
SLO h – broad education
SLO i – life-long learning
SLO j – contemporary issues
SLO k – use the techniques, skills, and tools for engineering practice

VIII. Assessment Process

The department established the following comprehensive process to assess students' learning according to the aforementioned 13 program outcomes. The current assessment process has been in place since the year 2000.

1. Reevaluation of the mission statement, program objectives, and learning outcomes. (This is done with the input from the advisory council, faculty, and survey response from the alumni and the employers.)

2. Reevaluation of surveys and scoring rubrics will be done by faculty during the scheduled faculty retreat sessions.

3. Data is collected using the assessment tools and according to the established time schedule.

4. Data is analyzed according to the established time schedule. (This is done by faculty and advisory council members.)

5. The action items are determined to close the loop of the assessment.

6. Progress is monitored based on the action items.

Standard: On a scale of 1 (poor) to 5 (excellent), the faculty members consider a rating of 3.75 or higher to be satisfactory. An overall rating below 2.75 for any of the outcomes requires immediate attention, and a rating between 2.75 and 3.75 requires further observation as a "carry over item" in the next evaluation cycle.

Rubrics for assessing student learning outcomes have been developed and utilized. (Attached)

IX. Assessment Activities Timeline

The department collects and analyzes data according to the following schedule:

1. Every semester

    (a) Exit Surveys (Spring and Fall Graduates)
    (b) Embedded questions

2. Annually

    (a) Culminating Experience
    (b) Poster Sessions/Oral Presentations
    (c) Student/Faculty Forums
    (d) Course Evaluations
    (e) Faculty focus group
    (f) Alumni/Advisory Meeting

3. Every third year (starting from 2009)

    (a) Alumni Survey/Alumni Focus Group Meeting
    (b) Employer Survey (Currently using Co-op Employer Surveys)
    (c) Review of a mission statement, program objectives, and learning outcomes.

4. Every sixth years (starting from 2012)
    Assembly of course binders and assessment of the overall success.

Math Science Engineering Rubric

SLO a

Course: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Identification of Applicable Physics and Mathematics Principles	Lack of Knowledge				Complete Knowledge	
Utilization of Physics and Mathematics Principles toward Modeling of an engineering system	Improper utilization or application				Proper and correct utilization	
Application of the Mathematics Methodology toward analyzing an engineering system	Incorrect Application				Correct and Complete Application	
Use of mathematical steps toward solving an engineering problem	Incorrect or invalid mathematical steps				Except for minor errors, completion of appropriate mathematical steps	
Interpretation and appropriate presentation of results	Lack of Valid results				Complete results that include proper units	

Overall average score _____

Evaluator _____ Date _____

Math Science Engineering Rubric

SLO a

Course#: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Uses the Appropriate Engineering Model						
Uses the Appropriate Engineering Principles Associated with the Model						
Correct Solution Methodology						
Presented Correct Results						
Understands Implications of Results						

Overall average score _____

Evaluator _____ Date _____

Hands-on Experiment Rubric
SLO b

Course: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Designing Experiments: Develop a methodology to test concepts and produce data to evaluate a specific process	Improper design or technique				Appropriate design or technique to evaluate a specific process	
Conducting Experiments: Operate appropriate laboratory equipment or hardware/software tools to collect data	Unable to operate equipment				Appropriate use of equipment	
Interpreting Data: Data manipulation and judgment	Improper data				Reasonable results	

Overall average score _____

Evaluator _____ Date _____

Design Rubric
SLO c

Course#: ECE _____ Date: _____

Evaluate on a scale of 1 – 5 (5 is for excellent); check the proper box

	1	2	3	4	5
Design Statement (Problem explanation and identification of its constraints and specifications)	No clear objectives or identified needs	Unclear objective statement or not appropriate for the level of the activity	Clear objectives but no identified needs or constraints		Clear objectives and needs within realistic constraints including at least three of the following: economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
Design Process including alternative solutions	No evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design	Little evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design	Some evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design		Clear evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design
Application of appropriate mathematical models and engineering concepts in the design process	No evidence of ability to identify and use engineering principles in design	Identified appropriate concepts and demonstrated some effort to apply them	Some evidence of ability to use engineering principles in design		Clear evidence of ability to use mathematical models and/or engineering principles to design components, devices or systems
Final Product	Final design is lacking and the final product doesn't meet expectations in format		Acceptable final product but needs better presentation format		Optimal / creative design in proper format

Overall average score: _____

Evaluator: _____ Date: _____

Teamwork Rubric
SLO d

Course: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	0	1	2	3	4	5
Initiative	Doesn't seem aware of responsibilities			Aware of responsibilities but does the absolute minimum		Engaging and brings new ideas to the table.
Responsiveness	Behind most of the time			Delivers on time but doesn't seem to be engaging		Always on top of what is going on and delivers on time
Attitude	Rarely supports the efforts of others			Respects the views of others but not assertive in his views		Tries to make people work together and assertive in his actions

Overall average score _____

Evaluator _____ Date _____

Formulate & Solve Engineering Problems Rubric
SLO e

Course#: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Recognize class of problems	no recognition				Correct recognition	
Formulate the problem using equations	No formulas or equations				Right formulas or equations	
Solving equations and finding an answer	unsolved				Well solved	
Analysis of the results	No analysis				Right analysis	

Overall average score _____

Evaluator _____ Date _____

Written Communication Rubric

SLO g

Course#: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Spelling and grammar	many errors				minor or no errors	
Focus and Organization	not organized and lacks clarity				well organized and clear	
Sentence structure	poor structure				well structured	
Use of references	not cited				cited properly	
Transition between paragraphs	Ideas are not flowing smoothly				Document flows smoothly	

Overall average score _____

Evaluator _____ Date _____

Oral Communication Rubric
SLO g

Course #: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	0	1	2	3	4	
Spoken communication ***a) Clarity*** ***b) Formality***	unclear pronunciation and lacking vocabulary			clear pronunciation but lacking vocabulary		clear pronunciation and appropriate vocabulary
Presentation ***a) Clarity of Voice*** ***b) Eye Contact***	Unclear voice and no eye contact			clear voice but no eye contact		proper level of voice and good eye contact
Ability to express ideas and answer questions	not able to express ideas or answer questions			Ideas expressed reasonably well but answers to questions is lacking		ideas expressed clearly and all questions are answered properly
Technical content ***a) Depth*** ***b) Soundness***	no depth and unclear approach			sufficient depth but unclear approach		appropriate depth and sound approaches

Overall average score _____

Evaluator _____ Date _____

Breadth Rubric
SLO h

Course#: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Breadth Indicators: • Referencing relevant information • Awareness of alternative solutions • Identification and application of pertinent engineering principles • Generalization of results and conclusions • Ability to verify validity of results • Understanding the impact of conclusions in a broader context	Inability to satisfactorily demonstrating at least one indicator		Satisfactory demonstration of at least three indicators		Strong demonstration of at least three indicators	
Overall score for breadth						
Depth Indicators: • Ability to carry out detailed math and science analysis • Use of appropriate concepts and methods • Development of proper solution methodology • Ability to build on knowledge base of fundamental engineering principles • Integration of multiple knowledge areas to the solution of problems	Lacks in satisfactorily demonstrating at least one indicator		Satisfactory demonstration of at least three indicators		Strong demonstration of at least three indicators	
Overall score for depth						

Overall average score _____

Evaluator _____ Date _____

Modern Engineering Tools Rubric

SLO k

Course: ECE _____ Date: _____

Evaluate on a scale of 1-5 (5 is for excellent); check the proper box

	1	2	3	4	5	N/A
Translation (Translating statement to design)	Do not understand design statement				Finish design correctly	
Choice of Right Tool (Choosing tool for purpose)	Cannot choose tool for purpose				Choose the best available tool	
Entry (Using tool correctly to enter design)	Cannot use tool to enter design				Enter design correctly	
Design Simulation (Being able to run simulation)	Do not know how to run simulation				Generate correct simulation result	
Verification (Verifying the correctness of design)	Cannot interpret the simulation result to verify the correctness of design				Analyze the simulation result to verify	

Overall average score _____

Evaluator _____ Date _____