



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

I. Mission

The mission of the Department of Electrical and Computer Engineering is to provide a comprehensive undergraduate education in Electrical Engineering and Computer Engineering and graduate education leading to an Electrical and Computer Engineering MS degree to a diverse student body across several subdisciplines of the field. The programs are continuously enhanced in order to prepare graduates for industry positions and/or further advanced education both regionally and globally. The undergraduate curriculum emphasizes the theoretical foundations in basic science, mathematics, and engineering science, hands on experience developed by the use of modern tools in the laboratory, the development of professional skills, and an awareness of ethical responsibilities, thereby enabling graduates to become life-long learning successful engineers.

II. Program Objectives

The Electrical and Computer Engineering Department seeks to develop an educational program for students in Electrical Engineering **such that following completion of the degree and once well established in their careers,**

- i) graduates will be employed in the engineering industry, government agencies, or academia and will be engaged in addressing and helping solve complex and technically challenging problems that impact society
- ii) graduates will continuously enhance their careers through life-long learning, active involvement in the development of their skills, and will dedicate themselves to positively contribute to their communities by practicing their profession ethically
- iii) graduates will be skillful communicators, expressing their technical and non-technical ideas through various media to a wide range of audiences, while promoting the power of engineering to collaboratively help solve some of the more vexing challenges faced by civilization with a goal of achieving a more equitable and diverse society

III. Student Learning Outcomes (SLOs)

Graduates of the Computer Engineering program are expected to achieve the following student learning outcomes.

SLO 1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

SLO 2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

SLO 3: An ability to communicate effectively with a range of audiences

SLO 4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

SLO 5: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

SLO 6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

SLO 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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 - graduates will be employed in the engineering industry, government agencies, or academia and will be engaged in addressing and helping solve complex and technically challenging problems that impact society .

This objective is supported by SLOs 1, 2, 3, 6, and 7.

Program Educational Objective 2 – graduates will continuously enhance their careers through life-long learning, active involvement in the development of their skills, and will dedicate themselves to positively contribute to their communities by practicing their profession ethically .

This objective is supported by SLOs 4 and 7.

Program Educational Objective 3 - graduates will be skillful communicators, expressing their technical and non-technical ideas through various media to a wide range of audiences, while promoting the power of engineering to collaboratively help solve some of the more vexing challenges faced by civilization with a goal of achieving a more equitable and diverse society .

This objective is supported by SLOs 3 and 5.

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	
1	X			
2	X			
3	X		X	
4		X		
5			X	
6	X			
7	X	X		

Table 2 Computer Engineering Curriculum Map

SLO	ECE 1	ECE 71	ECE 72	ECE 85	ECE 85L	ECE 90	ECE 90L	ECE 103	ECE 106	ECE 107	ECE 115	ECE 118	ECE1 118L	ECE 124	ECE 125	ECE 128	ECE 128L
1	1	2	2	3		3	1	1	2	2	2	2	2	3	3	3	2
2				3	2	3	2		3	1	2	2	2	3	2	3	2
3	2				1		2	3				1	2				2
4	2			1				3	2	2	3	3	2	1	1		
5	2				3		3	2					3				3
6	2				3		3			1	1		3				3
7	1	3						3									

3=Strong, 2=Moderate, 1=Possible

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Table 2 Computer Engineering Curriculum Map (continued)												
<i>SLO</i>	<i>ECE 141</i>	<i>ECE 141L</i>	<i>ECE 144</i>	<i>ECE 146</i>	<i>ECE 174</i>	<i>ECE 176</i>	<i>ECE 178</i>	<i>ECE 186</i>	<i>ECE electives</i>	<i>ECE lab electives</i>	<i>CSCI courses</i>	<i>GE courses</i>
1	3				2	3	2	3	1	3		
2		3		2	2	3	2	3		3	2	
3								3		2		
4				1	3	3	3	3	3	3		3
5								3				3
6		3		1	1	3	2	3	3	1	3	
7								2				
3=Strong, 2=Moderate, 1=Possible												

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.

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.*)

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.

4. *Alumni Survey* helps assess program objectives and student learning outcomes.

5. *Industry Advisory Council* provides the industry perspective on several related issues including program objectives.

Table 3 Assessment Tools

SLO	Culminating Experience	Embedded Questions	Lab Reports	Poster Presentations	Course Assessment	Student/Faculty Forum	Exit Survey	Alumni Survey
1	•	•	•		•	•	•	•
2	•	•	•		•	•	•	•
3	•	•	•	•	•	•	•	•
4	•				•	•	•	•
5	•	•	•		•	•	•	•
6	•		•		•	•	•	•
7						•	•	•

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Table 4 Computer Engineering Direct Assessment

SLO	ECE 1	ECE 71	ECE 85	ECE 85L	ECE 90	ECE 90L	ECE 103	ECE 118	ECE 118L	ECE 124	ECE 125	ECE 128	ECE 128L	ECE 178	ECE 186A	ECE 186B
1					•					•		•				
2			•						•							•
3	•						•	•							•	•
4	•						•	•								
5				•			•									•
6						•			•				•			•
7		•									•			•		

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
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VIII. Assessment Process

The department established the following comprehensive process to assess students' learning according to the aforementioned 11 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
- (b) Embedded questions

2. Annually

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

3. Every third year (2009, 2012, 2015, 2018, 2021, 2024)

- (a) Alumni survey
- (b) Lab report (ECE85L and ECE118L)

6. Every sixth years (2006, 2012, 2018, 2024)

- (a) Review of a mission statement and program objectives
- (b) Assembly of course binders and assessment of the overall success.

Math Science Engineering Rubric

An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

SLO 1

Course: ECE _____

Date: _____

Evaluate on a scale of 1-4 (4 is for excellent); check the proper box

	1	2	3	4	N/ A
Awareness and identification of the key elements of the problem	Inability to properly understand the essence of the problem	Minimal understanding of the key elements of the problem	General but not complete understanding of the essence of the problem	Clear and unambiguous understanding of the problem presented	
Recognition of one or more methods that can lead to a problem solution using appropriate principles of engineering, science and mathematics	Unable to identify an appropriate solution using principles of engineering, science and mathematics	Partial or incomplete recognition of a method that leads to a solution of the problem	Able to identify one solution method based on established principles but offering no alternatives	Able to identify an appropriate solution including alternatives based on established principles	
Application of engineering, science, and mathematics principles toward analyzing and solving a problem	Utilization of an incorrect methodology in the analysis and solution of a problem	Application of engineering, science, and mathematics principles that are largely incorrect	A mostly correct application of appropriate methods except for some errors	Correct utilization of appropriate methods to analyze and fully solve a problem	
Presentation of a solution that is justifiable and based on a logical and methodical application of engineering, science, and mathematics principles	No solution presented that can be justified by engineering, science, and mathematics principles	Presentation of a solution that is mostly incorrect and cannot be logically justified	Presentation of a solution that is generally correct except for some errors in logic and/or mathematics	Presentation of a complete solution that is correct and logical from an engineering science and mathematics perspective	

Overall average score _____

Evaluator _____

Date _____

Engineering Design Rubric

with consideration of public health, safety, welfare, global, cultural, social, environmental, and economic factors

SLO 2

Course#: ECE _____

Date: _____

Evaluate on a scale of 1 – 4 (4 is for excellent); check the proper box

	1	2	3	4	pts
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 two of the following: public health, safety, welfare as well as global, cultural, social, environmental, and economic factors.	
Design Process including alternative solutions considering factors including public health, safety, and welfare, as well as global, cultural, social, environmental, and economics	No evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design considering the factors	Little evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design considering the factors	Some evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design considering the factors	Clear evidence of ability to understand the design requirements, limitations, analyze different alternatives, and provide a feasible design considering the factors	
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	
Delivery of the 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	

Evaluator: _____

Overall average score: _____

Date: _____

Oral Communication Rubric

An ability to communicate effectively with a range of audiences

SLO 3

Course #: ECE _____

Date: _____

Evaluate on a scale of 1-4 (4 is for excellent); check the proper box

	1	2	3	4	pts
<p><i>Written communication</i></p> <p>a) Organization</p> <p>b) Logic</p> <p>c) Supporting data and inform</p> <p>d) Proper use of the English language, spelling, grammar</p> <p>e) Clarity</p> <p>f) Formality</p> <p>g) Depth</p>	<p>Lacks organization and supporting information.</p> <p>Does not follow principles of logic and makes improper use of English</p>	<p>Limited ability to organize basic ideas in a logical manner and to properly use the English language</p>	<p>Satisfactory ability to present ideas logically with supporting data however there is evidence of improper use of the English language due to grammar and spelling errors</p>	<p>Shows clear evidence and understanding of appropriate writing techniques that include a logical development of ideas, organization, and proper use of the English language including grammar, spelling, and punctuation</p>	
<p><i>Oral communication</i></p> <p>Confidence</p> <p>Voice</p> <p>Gestures</p> <p>Connection with audience</p> <p>Engagement</p> <p>Comprehension</p> <p>Content appropriate to audience</p> <p>Conclusions</p>	<p>Voice lacks projection and a display of confidence, speaker appears nervous, maintains no eye contact and uses inappropriate gestures. Appears disengaged</p>	<p>Limited ability to present technical ideas with confidence, free of inappropriate gestures, while showing connection with the audience and maintaining eye contact</p>	<p>Satisfactory ability to present technical ideas but lacks the ability to speak with enough confidence to engage with the audience and avoid inappropriate gestures</p>	<p>Shows clear evidence of being able to deliver a technical presentation with confidence, with appropriate eye contact, voice projection, free of inappropriate gestures or display of nervousness</p>	

Overall average score _____

Evaluator _____

Date _____

Ethical and Professional Responsibilities

To make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

SLO 4

Course #: ECE _____

Date: _____

Evaluate on a scale of 1-4 (4 is for excellent); check the proper box

	1	2	3	4	Points
<i>Able to analyze a situation for potential ethical problems</i>	<i>Students show no awareness of potential ethical problems in their response to the case studies</i>	<i>Students appear to be aware of some ethical problems in the case studies but are not using appropriate tools to analyze the problem(s).</i>	<i>Students demonstrate understanding of the major ethical problems in the case studies and are applying the tools they have learned to analyze the situation.</i>	<i>Students are able to analyze a complex ethical situation and demonstrate an understanding of major and subtle ethical problems in the case studies.</i>	
<i>Analysis of ethical and professional responsibility in a case study</i>	<i>No evidence that the students are aware of the IEEE Code of Ethics.</i>	<i>Students appear to be aware of the IEEE Code of Ethics, but are not making use of it as they approach ethical problems.</i>	<i>Students are aware of the IEEE Code of Ethics, and use it to when faced with a potentially unethical situation.</i>	<i>Students are aware of the IEEE Code of Ethics, and use it to routinely to work in a professional and ethical manner.</i>	
<i>Make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts</i>	<i>No evidence that the students consider ethics or professionalism as they consider the case studies.</i>	<i>The responses to the case studies indicate that the students do not fully understand what it means to work in an ethical and professional manner.</i>	<i>The responses to the case studies indicate that the students are aware that engineers have a responsibility to work in an ethical and in a professional manner.</i>	<i>The students demonstrate ethical and professional engineering work in their responses to the case studies.</i>	

Overall average score _____

Evaluator _____

Date _____

Teamwork Rubric

An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

SLO 5

Course: ECE _____

Date: _____

Evaluate on a scale of 1-4 (4 is for excellent); check the proper box

	1	2	3	4	Points
<i>Synergy and Attendance:</i> <i>Establish a collaborative and inclusive environment</i>	Unaware of responsibilities and does not help other teammates or demonstrate leadership.	Sometimes provide encouragement and listen to other teammates and share knowledge.	Frequently provides encouragement or listen to other teammates and share knowledge.	Always engaging and bringing new ideas to the table. Always listen and help other teammates and demonstrate leadership	
<i>Responsibility and Helpfulness:</i> <i>Fulfill individual accountability and contribute to the team's success.</i>	Does not complete individual tasks timely. Does not interact with other members or contribute to the team efforts.	Contribute little to the team efforts and interact little with other team members	Complete and deliver tasks timely. Engage and contribute regularly with other team members.	Always on top of what is going on and delivers on time. Always contribute and interact with other team members.	
<i>Establish goals, initiative and Quality of Work:</i> <i>plan tasks, organize and facilitate effective and productive team meetings</i>	Does not define any goals or deadlines. Does not plan shared tasks nor facilitate any part of any team meeting.	Define at least one goal with a deadline. Plans at least one shared and one individual task. Organizes and facilitates at least one part of one team meeting.	Participates in setting necessary goals and plans a few necessary shared and individual tasks. Organizes and facilitates a few parts of a few team meetings	Actively set goals and make shared task plans. Organizes and facilitates several parts of several team meetings.	

Overall average score _____

Evaluator _____

Date _____

Hands-on Experiment Rubric

An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

SLO 6

Course: ECE _____

Date: _____

Evaluate on a scale of 1- 4 (4 is for excellent); check the proper box

	1	2	3	4	pts
Designing Experiments: Develop a methodology to test concepts and produce data to evaluate a specific process	Unable to develop a methodology to test concepts and produce useful data	Incomplete or inappropriate methodology to test concepts	Partial development and design of a methodology to test concepts	Appropriate development of a methodology or technique to evaluate a specific process	
Conducting Experiments: Operate appropriate laboratory equipment or hardware/software tools to collect data	Unable to operate equipment or software tools to collect data	Limited ability to operate equipment and use software tools	Moderate ability to operate equipment and use software tools	Appropriate use of equipment and software tools	
Analysis and interpretation of Data	Unable to analyze and interpret data	Improper or incomplete data analysis and interpretation	Moderate ability to analyze and interpret data	Appropriate data analysis and interpretation	
Engineering judgment to draw conclusions	Unable to draw conclusions on observations or experimental results	Incorrect or incomplete conclusions on the experimental results	Moderate ability to judge the experimental results and draw conclusions	Appropriate judgment of the experimental result and able to draw appropriate conclusions	

Overall average score _____

Evaluator _____

Date _____

Acquire and apply new knowledge as needed

An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

SLO 7

Course#: ECE _____

Date: _____

Evaluate on a scale of 1-4 (4 is for excellent); check the proper box

	1	2	3	4	N/ A
Ability to use an existing knowledge base of techniques and tools for the purpose of acquiring new knowledge and strategies that can be applied to analyzing a problem that has not been previously encountered	Inability to use existing knowledge base for acquisition of new knowledge	Minimal ability to use knowledge base for the acquisition of new knowledge	Significant but not full capability to use knowledge base toward the acquisition of new knowledge	Demonstrated capability to use acquired knowledge and tools for developing strategies to be applied to new problems	
Identify appropriate techniques and tools to apply to analyze a new problem or situation	Inability to identify known techniques and tools to be applied to the analysis of a new problem	Partial or limited ability to identify tools and techniques toward the analysis of a new problem	Generally able to identify at least one technique to analyze a new problem	Fully able to and cognizant of techniques and tools that can be applied to the analysis of a new problem	
Ability to use and explain appropriate techniques and learning strategies applied in the solution of a new problem	Inability to use appropriate techniques and learning strategies toward the solution of a new problem	Limited ability to demonstrate an understanding of appropriate strategies applied in the solution of a new problem	Able to use and explain at least one technique that can be applied to the solution of a new problem	Clearly demonstrates an ability to use appropriate techniques and learning strategies to the solution of a new problem	
Application of acquired knowledge to the solution of a new problem or situation	Inability to analyze and solve a new problem due a lack of new knowledge	Limited ability to analyze a new situation due to minimal acquired new knowledge	Mostly able to analyze a new problem using acquired knowledge	Able to apply new knowledge toward the analysis and solution of a problem or new situation	

Evaluator _____

Overall average score _____

Date _____