

ELECTRICAL ENGINEERING

Student Outcomes Assessment Program (SOAP)

Department of Electrical and Computer Engineering

Lyles College of Engineering

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 program 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,

- a) Have grown technically and be productive in their respective workplaces.
- b) Be capable of addressing technical problems of increasing complexity.
- c) Communicate and function effectively in a team environment.
- d) Demonstrate ability for independent learning and continued professional as well as ethical development.

As such, the program has the following specific learning objectives:

1. Offer a broad education in the Electrical Engineering discipline with topical depth, as well as hands-on experience through laboratory courses, and grounded in both the sciences and mathematics;
2. Prepare students to accept responsibilities appropriate to an entry level engineer in a variety of engineering industries or government organizations;
3. Provide its graduates the necessary knowledge base to succeed in subsequent

graduate electrical engineering education or other professional schooling;

4. Give the students an understanding of societal issues by exposing them to the humanities through a required program of general education;
5. Develop students' capability of thinking creatively, of synthesizing concepts, and researching sources of information for the purpose of analyzing and solving engineering problems;
6. Motivate students for a life-long ethical practice in the engineering profession, while recognizing the need for continual updating of skills in order to have a successful, productive, and enjoyable career;
7. Enhance students' ability to communicate and work effectively in a team environment.

III. Student Learning Outcomes

Through their program of education in electrical engineering, students would

Outcome 1 - Have guaranteed exposure to statistics and the ability to apply knowledge of mathematics and physics to solving engineering problems.

Outcome 2 - Have the ability to apply knowledge of engineering sciences and engineering design to solving engineering problems.

Outcome 3 - Are capable of designing and conducting experiments and interpreting data.

Outcome 4 - have the ability to design a system, component, or process, to a set of specifications.

Outcome 5 - Are capable of working independently.

Outcome 6 - Are able to function and be productive in a multi-disciplinary team environment.

Outcome 7 - Are able to formulate and solve engineering problems. (e)

Outcome 8 - Are knowledgeable about the ethical and professional responsibilities of engineers.

Outcome 9 - Are able to present ideas orally, in writing, and can communicate effectively in their daily environment.

Outcome 10 - Have the ability to understand technical instructions, and interpret documents prepared by others.

Outcome 11- Have a broad education and knowledge of contemporary issues necessary to understand the impact of the work of engineers on society.

Outcome 12 - Recognize the need for and have the ability to undertake life-long learning and continual updating of professional skills.

Outcome 13 - Have the ability to use the techniques, skills, and modern engineering tools needed for the engineering practice.

Outcome 14 - Have breadth and depth in engineering subjects.

IV. Relevance of Outcomes to Program Objectives

The learning outcomes contribute to the program objectives as follows:

Objective 1 - Offer a broad education in the Electrical Engineering discipline with topical depth, as well as hands-on experience through laboratory courses, and grounded in the both the sciences and mathematics.

This objective is supported via outcomes 1, 3, and 14, where basic science and mathematics (outcome 1), hands-on experience (outcome 3), and breadth and depth in electrical engineering (outcome 14) are ensured.

Objective 2 - Prepare students to accept responsibilities appropriate to an entry-level engineer in a variety of engineering industries or government organizations.

All outcomes contribute to this objective. Breadth and depth of knowledge (outcomes 1 and 14), hands-on experience (outcomes 3 and 13), and design and open-ended problem solving (outcomes 2, 4, 7, and 10) are essential technical attributes needed for engineering practice. Outcomes 6, 8, and 9 pertain to the soft skills of communication and teamwork, which are important to employers and for successful career. Life-long learning and the ability to work independently (outcomes 5, 11, and 12) are attributes that have a long-term positive impact on one's challenging career. Use of engineering tools (outcome 13) is an important aspect to effective engineering practice.

Objective 3 - Provide graduates the necessary knowledge base to succeed in subsequent graduate electrical engineering education or other professional schooling.

Outcomes 1-4, and 7 provide necessary competencies to succeed in technical graduate programs. The ability to apply mathematics and physics concepts (outcome 1), knowledge of engineering design (outcomes 2 and 4), hands-on experience (outcome 3), and the ability to formulate and solve problems (outcome 7) are all relevant attributes.

Outcome 5, 7, 9, and 12 are also of important to engineering graduate programs, as well as other professional programs like medicine and law. The ability to work independently (outcome 5), communication skills (outcome 9), and life-long learning (outcome 12) are universal attributes of direct value in these programs.

Objective 4 - Give the students an understanding of societal issues by exposing them to the humanities through a required program of general education.

Outcome 8 is directly relevant to this objective. This outcome addresses students' exposure to societal issues, which help them make informed ethical and social decisions. Outcome 11 also

helps strengthen students' understanding of the contributions that engineering has on the quality of living and technological advances in technology that benefit mankind.

Objective 5 - *Develop students' capability of thinking creatively, of synthesizing concepts, and researching sources of information for the purpose of analyzing and solving engineering problems.*

Outcomes 1, 2, 4, and 12-14 address this objective most directly. Having the necessary knowledge (outcomes 1 and 14) and the ability to apply it (outcome 2) gives rise to creative thinking. Design skills (outcome 4) usually require critical thinking and taking creative approaches to complete a competitive product. Life-long learning (outcome 12) is an indication of the ability to seek information and identify its sources. Familiarity with modern engineering tools (outcome 13) facilitates conducting effective research.

Objective 6 - *Motivate students for a life-long ethical practice in the engineering profession, while recognizing the need for continual updating of skills in order to have a successful, productive, and enjoyable career.*

Outcomes 1 and 2 provide the base for further learning. Independent work (outcome 5) is required for continuing one's own learning. Outcome 8 addresses the ethical component of the objective directly. Outcome 12 promotes a desire and interest in life-long learning while ethical conduct is partly addressed in the general education component of the program.

Objective 7 - *Enhance students' ability to communicate and work effectively in a team environment.*

Outcome 6 contributes directly to enhancing teamwork skills. Communication skills (outcome 9) are also a key to success in functioning in a team environment.

Objectives/Outcomes Summary Matrix

Objectives	Outcomes													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Broad education in EE	X		X								X			X
2. Prepare students for practice	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3. Prepare students for advanced education	X	X	X	X	X		X		X			X		
4. Understanding of societal issues								X			X			
5. Critical thinking and solving engr. prob.	X	X		X								X	X	X
6. Life-long learning and ethical conduct	X	X			X			X				X		
7. Communication and team work						X			X					

- Outcome 8 - Ethics
- Outcome 9 - Communication Skills
- Outcome 10 - Understand Technical Instructions
- Outcome 11 - Contemporary Issues
- Outcome 12 - Life-long Learning
- Outcome 13 - Modern Engineering Tools
- Outcome 14 - Breadth and Depth in Engineering

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 has on-going data collection and reflection processes that include the following:

- The department holds a general departmental students/faculty meeting every semester. All ECE students are invited to attend this meeting. The purpose of the meeting is twofold: first, to strengthen the face-to-face, out-of-class communication channel with students and to listen to their views of the program and the department in general; and second, to share with students updates regarding upcoming curriculum changes, department news, and to receive their opinion on the changes that have taken place. Comments from students at these and other meetings have highlighted issues as perceived by them – e.g., the state of laboratories, the need for additional hands on experience in courses, scheduling and timing of course offerings, etc. In most of these cases, the faculty has been able to institute changes in order to accommodate student needs.
- Graduating students are invited individually or in small groups for an exit interview with the chairman of the department. Personal reflections and comments are encouraged, and are usually much more informational and useful than numeric scores on a survey sheet. At the end of the interview, students are handed out a survey form to fill out. These meetings are very telling, and graduating students are very forthcoming with their comments and suggestions.
- Faculty make personal observations during their numerous casual visits with students, prospective students, and their parents.
- The department collects input from alumni.

The department collects input from industry representatives who come to campus to recruit students for co-op and permanent employment, and from members of the advisory board.

VII. How The Program Demonstrates that the Graduates Achieve Outcomes

The department ensures that graduates achieve outcomes in two ways: first, by offering a coherent program of study that provides an opportunity for learning, and second, by developing and applying an assessment program to determine the success of students in fulfilling learning outcomes.

1. *Student Transcripts* demonstrate the breadth and depth of topics attempted by individual students. They also moderately demonstrate student exposure to basic science, mathematics, engineering subjects, contemporary issues, and the sequence in which students take their courses. The faculty believe that transcripts provide a possible indicator to students' success in achieving the remainder of the outcomes. The relevance of courses to outcomes and the grades earned by the student demonstrate, to some extent, achievement of these outcomes. Mandatory advising has provided an opportunity for continuous monitoring of student transcripts and the students' academic progress reports (DARS reports).
2. Since Capstone Design is a culminating experience, *Capstone Design Reports* provide a strong indicator for many of the outcomes indicated in Table B.3.2. 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.
3. *Student Homework and Exams* provide a moderate indicator for breadth and depth in electrical engineering subjects. Knowledge in basic science and the ability to work independently are moderately indicated through student coursework and exams. There is also sufficient evidence of computer skills in student work, and students' open-ended problem solving skills are moderately monitored through their coursework. *Lab Reports* are strong monitoring instruments for hands-on experiences, use of modern engineering tools, following technical instructions, written communication, and teamwork skills. Additional documentation will be provided in course binders for individual courses.
5. *Video Recordings of Student Presentations* strongly demonstrate the student's oral communications skills. These recordings also show examples of hands-on experiences, engineering design, use of modern engineering tools, and teamwork skills (for group projects). Sample videos will be available to the visiting team during the site visit.
6. *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.
7. The *Student Survey* 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, and teamwork.
8. *Graduates' 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. ECE faculty spend time discussing these comments while placing them in context of other assessment data before considering any changes or adjustments.

9. *Employer Input* is obtained in an informal manner via meetings with advisory board members from industry, potential employers of students that come to campus for on-campus interviews, and also from feedback provided by the VIP Co-Op employers.

Assessment Summary Table										
	<i>Trans.</i>	<i>Capstone design reports</i>	<i>Home-work & exams</i>	<i>Lab reports</i>	<i>Video tapes</i>	<i>Course Assessment</i>	<i>Student survey</i>	<i>Graduates survey (exit)</i>	<i>Employer survey</i>	<i>Alumni survey</i>
Out. 1	2		3	2		3		2		2
Out. 2	2	3	3		2	3	2	2	3	2
Out. 3	1	3		3		3	3	3	3	2
Out. 4	1	3	3	2	3	3	2	2	3	2
Out. 5	1	2	2			3	3	3	3	1
Out. 6	1	3		3	3	2	3	3	3	3
Out. 7	1	3	3			2	2	2	3	1
Out. 8	1	1					2	3	3	1
Out. 9	1	3	2	3	3	2	3	3	3	1
Out. 10	1	3	2	3		2	1	1	3	
Out. 11	1	2			2		1	2	1	1
Out. 12	1	2		1	1		1	2	1	1
Out. 13	1	3	2	1	3	3	3	3	3	3
Out. 14	3	3	3		3	3	2	2	3	2

3=Strong, 2=Moderate, 1=Possible

Outcome 1- Apply Math and Physics
 Outcome 2- Apply Engineering Science
 Outcome 3 - Hands-on Experience
 Outcome 4- Design
 Outcome 5 - Independent Work
 Outcome 6 - Teamwork

Outcome 8 – Ethics
 Outcome 9 - Communication Skills
 Outcome 10 - Understand Technical Instructions
 Outcome 11 - Contemporary Issues
 Outcome 12 - Life-long Learning
 Outcome 13 - Modern Engineering Tools

Outcome 7: Formulate and solve engineering Problems
 Outcome 14: Breadth and Depth in Engineering

VIII. Assessment Process

The department established a comprehensive process to assess students' learning according to the aforementioned 14 program outcomes. The current assessment processes have been in place for the last six years. These processes (listed below) have proven to be extremely useful to the faculty and have resulted in several changes to improve the curriculum – in essence; they have helped the faculty to collectively make informed decisions and to “close the loop”. They include the following:

1. Assessment survey instruments were designed and were themselves assessed for continued appropriateness.
2. Data is collected. The faculty work together in department meetings to review available assessment material. Students in their respective courses also fill out course evaluation forms. The quantitative and qualitative data gathered using the evaluation forms provide:
 - a) faculty perspective through transcripts, student course work, lab reports, Capstone Design reports, and video presentation evaluation forms,
 - b) students' perspectives through course objectives assessment forms, and student/faculty forums,
 - c) the graduating class perspective through graduate (exit) interviews and surveys,
 - d) the alumni perspective through the alumni surveys/alumni focus groups,
 - e) the industry perspective through the employer survey.

An important source of input to the assessment process is provided via educational conferences and workshops, industry contacts, advisory board, alumni meetings, and informal visits with students.

3. The compiled data collected in Step 2 was analyzed to assess achievement of outcomes and to establish a point of reference for future evaluations. Action items for program improvements were then determined.

The general philosophy in analyzing the available data is to examine the faculty perspective in light of the students' and graduating class' perspective to determine an opportunity for curriculum improvement. Repeated concerns of students supported by faculty are considered a high priority item for program modification and improvement. The alumni and industry perspective is then considered to support longer-term changes.

IX. Data Analysis and Outcomes Satisfaction

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

1. Annually

- a) Exit Surveys (Spring and Fall Graduates)
- b) Student/Faculty Forums
- c) Alumni/Advisory Meeting
- d) Course Evaluations
- e) Student Records (Transcripts, DARS Report)

2. Every other year

- a) Capstone Design Reports
- b) Video Tapes

3. Every third year

- a) Alumni Survey/Alumni Focus Group Meeting
- b) Employer Survey (Currently using Co-op Employer Surveys)

4. Every sixth year

- a) Student Coursework Assessment (assembly of course binders)

On a scale of 1 (poor) to 5 (excellent), the faculty consider a rating of 3.0 or higher to be satisfactory. An overall rating below 2.0 for any of the outcomes requires immediate attention, and a rating between 2.0 and 3.0 requires further observation as a “carry over item” in the next evaluation cycle.