Institutional Effectiveness Report
2019-20

Program: Computer Engineering BS

College and Department: College of Engineering – Electrical & Computer Engineering

Contact: Allen MacKenzie

Mission: "Provide quality undergraduate and graduate education and perform research in the areas of electrical and computer engineering to enhance the competitiveness of our graduates and contribute to economic, scientific, and social development."

Note that the electrical engineering and computer engineering programs are based in the same department (electrical and computer engineering), share a common faculty, and have identical program goals and student outcomes. As such, the programs also share an assessment methodology; however, assessment data is disaggregated between the two programs where possible.

Program Goals:

Within a few years following graduation, our graduates will have:

- progressed in their careers as indicated by promotions, positions of leadership, awards, recognitions, entrepreneurial activities, products or processes developed, patents, and/or publications;
- advanced their knowledge and expertise as indicated by continuing education, advanced degrees, and/or professional registration;
- contributed to the profession and society as indicated by research, national and international collaboration, professional service, community service, and/or public service.

Student Learning Outcomes:

Students will demonstrate:

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.

A departmentally developed curriculum map can be found in Appendix 1 that shows the connections between courses and student learning outcomes.

Relationship of Student Outcomes to Program Educational Objectives

Student Outcome		**Program Educational Objective**		
		i	**ii**	**iii**
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	X	X	
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	X		X
3	an ability to communicate effectively with a range of audiences	X		X
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	X		X
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	X		X
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	X	X	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	X	X	

Assessment Methods:

1. *The Capstone Assessment.* Written and oral final presentations of each senior capstone project are evaluated every semester. This evaluation focuses primarily on a final oral presentation presented to the ECE Advisory Board. The advisory board is given a survey in which they were asked to rate several items, many of which related directly to student outcomes SO1-SO5 and to provide commentary to each team.

2. *The Final Exam Assessment (FEA).* Specific exam questions for specific ECE courses are used to directly assess Student Outcome 1 each semester. The FEA is conducted in ECE 3020: Discrete-Time Signal and Systems, ECE 3130: Microcomputer Systems, ECE 3300: Electronics I, and ECE 3510: Electromagnetic Fields. (ECE 3510 is not required of BSCmpE students; the other three courses are.) This assessment is performed by the faculty member who administered the exam plus an expert in the field. Data is disaggregated for BSCmpE students. The final exam assessment, which has typically been collected directly from relevant faculty by the assessment chair, was not adequately conducted during the 2018-2019 academic year, after the assessment chair (who was also the interim department head at the time) left the department suddenly in the Fall.

3. *The Senior Exit Survey.* Each semester, both a written survey and a group oral interview of graduating seniors are performed. Students are asked a variety of questions about their experiences in the program, including being asked to rate their attainment of each student outcome; this data is disaggregated for BSCmpE students. In addition to numerical feedback, comments are obtained regarding the overall ECE program experience, specific courses, and specific faculty and staff.

4. *The Faculty Course Assessment (FCA).* For each course each semester, the instructor provides an assessment of the achievement of the course instructional outcomes. The results of this assessment are used to ensure that the course instructional outcomes listed on the course syllabus are accurate and that they are actually achieved. All course outcomes which are rated at levels 2 (poor) or 1 (unable to perform / not covered) are flagged for investigation to determine the cause and what action needs to be taken to remedy the problem. While this assessment of the course instructional outcomes is used primarily for the purpose of maintaining individual course quality, for certain courses, the course instructional outcomes are related to certain student outcomes. In these cases, the results of this assessment are also used to assess student outcomes.

5. *The Student Course Assessment (SCA).* For each course each semester, students are asked to self-assess their attainment of the course instructional outcomes. The results of this assessment are used to ensure that the course instructional outcomes listed on the course syllabus are accurate and that they are actually achieved. Course outcomes which receive low ratings are flagged for investigation to determine the cause and what action is needed to remedy the problem.

Attainment of Student Outcomes

The raw data from most tools is obtained on a 1-5 scale with 5 being the best score. For the final exam assessment, scores on selected exam questions are reported out of 100%. For comparability, we translate this into a 5 point scale with the formula X/20, this translates into an average grade of 60 on the selected exam problems receiving a 3.0, the threshold for acceptability on our 5 point scale.

Our target for each student outcome and each assessment tool is to achieve greater than 3.5 out of 5. We categorize the attainment of each outcome using each assessment tool as:

- Highly Satisfactory (HS) if the rating is 3.75 or
- Satisfactory (S) if the rating is 3.0 or
- Unsatisfactory (U) if the rating is less than 0.

Results:

Student Outcome 1: Identify, Formulate, and Solve Complex Engineering Problems

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

Historical Attainment of Student Outcome 1

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New Rubric)	-	-	-	-	4.50
Final Exam Assessment	3.69	3.58	4.12	-	3.98
Senior Exit Survey	4.52	4.07	4.17	4.06	4.50
Faculty Course Assessment	4.36	4.25	4.17	4.29	4.02
Student Course Assessment	4.04	4.08	4.12	4.14	4.18

In Spring 2020, the format of the Capstone Assessment final presentations changed due to the ongoing pandemic. Instead of a longer oral presentation, a "virtual poster session" was held, in which the advisory board was given the opportunity to review a poster from each team (over a few days) and then each team made a short presentation (in a videoconference setting) describing their project and answering questions from the advisory board and from other students and faculty. Even with the change in venue, the Capstone Assessment had a highly satisfactory level of attainment (HS, >3.75). The Final Exam Assessment resumed for 2019-2020 and continued to meet a highly satisfactory level of attainment (HS, >3.75). Although all indicators suggest strong attainment of this student outcome, we continue to monitor to ensure that the outcome is attained as directly measured by the FEA and Capstone Assessment.

Student Outcome 2: Apply Engineering Design

Student outcome 2 is "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."

Historical Attainment of Student Outcome 2

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New Rubric)	-	-	-	-	4.33
Senior Exit Survey	4.22	4.06	4.04	3.78	4.29
Faculty Course Assessment	4.45	4.30	3.89	4.21	3.69
Student Course Assessment	4.06	4.01	4.09	4.07	4.16

Students showed a highly satisfactory level of attainment (HS, >3.75) on the new Capstone Assessment even given the change to an online format due to COVID. The Senior Exit Exam and Student Course Assessment also showed highly satisfactory levels of attainment (HS, >3.75). The Faculty Courses Assessment went down slightly into the satisfactory level of attainment which is above the target (3.5), but a bit below the "highly satisfactory" threshold, but met the highly satisfactory level of attainment for the two previous years. The satisfactory level of attainment does not warrant actions currently, so we will continue to monitor progress.

Student Outcome 3: Communicate Effectively

Student outcome 3 is “an ability to communicate effectively with a range of audiences.”

Historical Attainment of Student Outcome 3

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New Rubric)	-	-	-	-	4.35
Senior Exit Survey	4.22	4.03	4.31	3.94	4.21
Faculty Course Assessment	4.40	4.27	4.04	4.26	4.07
Student Course Assessment	4.20	4.28	4.22	4.05	4.19

All metrics met the highly satisfactory level of attainment (HS, >3.75) for 2019-2020. Students demonstrated strong communication ability on the new Capstone Assessment even with the shift to an online environment. In general, student continue to perform very well on this student outcome.

Student Outcome 4: Recognize Ethical and Professional Responsibilities and Make Informed Judgments

Student outcome 4 is “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.”

Historical Attainment of Student Outcome 4

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New Rubric)	-	-	-	-	3.70
Senior Exit Survey	4.17	4.17	3.84	3.83	4.36
Faculty Course Assessment	4.86	4.38	4.58	4.75	4.33
Student Course Assessment	4.44	4.50	4.42	4.43	4.40

The new Capstone Assessment measures as 3.70, which is above the target for satisfactory (S, > 3.0) but just below the threshold for highly satisfactory (HS, >3.75). All other metrics for this student outcome are highly satisfactory (HS, >3.75) for 2019-2020. Given the satisfactory level of attainment and new nature of the Capstone Assessment rubric, this student outcome merits further monitoring and might possibly be better integrated throughout the curriculum.

Student Outcome 5: Function Effectively on a Team

Student outcome 5 is “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.”

Historical Attainment of Student Outcome 5

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New)	-	-	-	-	4.17
Senior Exit Survey	4.39	4.28	4.19	3.89	4.64
Faculty Course Assessment	4.29	4.06	4.18	4.38	3.95
Student Course Assessment	4.28	4.36	4.20	4.22	4.46

Students continue to excel in metrics related to functioning effectively as a team. All assessments are highly satisfactory (HS, >3.75) for 2019-2020.

Student Outcome 6: Develop and Conduct Appropriate Experimentation, Analyze and Interpret Data, and Use Engineering Judgment

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

Historical Attainment of Student Outcome 6

	15-16	16-17	17-18	18-19	19-20
Laboratory Assessment (New)	-	-	-	-	3.84
Senior Exit Survey	4.61	4.33	4.19	4.11	4.43
Faculty Course Assessment	4.50	4.31	3.92	4.10	3.90
Student Course Assessment	4.14	4.14	3.96	4.20	4.16

Starting this year, the new Laboratory Assessment separately assessed the ability of students to "develop and conduct appropriate experimentation" and to "analyze and interpret data." The sub score for developing and conducting appropriate experimentation was 4.00; the BSCmpE sub score for analyzing and interpreting data was 3.67. However, there were only 3 BSCmpE students enrolled in ECE 3060; hence the BSCmpE results have low confidence. While the new Laboratory Assessment met the highly satisfactory attainment level, we will continue to monitor this assessment going forward. All other metrics were above the highly satisfactory level of attainment.

Student Outcome 7: Acquire and Apply New Knowledge

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

Historical Attainment of Student Outcome 7

	15-16	16-17	17-18	18-19	19-20
Capstone Assessment (New Capstone)	-	-	-	-	4.18
Senior Exit Survey	4.72	3.83	4.31	4.33	4.36
Faculty Course Assessment	3.71	4.11	4.49	3.70	4.02
Student Course Assessment	4.33	4.47	4.25	3.99	4.38

The Capstone Assessment provides a new direct measure of student performance on the ability to acquire and apply new knowledge. All metrics for this outcome are at the highly satisfactory (HS, >3.75) level of attainment for 2019-2020. The Faculty Course Assessment has improved back into the highly satisfactory level from the satisfactory level last year (2018-2019).

Modifications for Continuing Improvement

Capstone Assessment

In Spring 2020, the format of the Capstone Assessment final presentations changed due to the ongoing pandemic. Instead of a longer oral presentation, a "virtual poster session" was held, in which the

advisory board was given the opportunity to review a poster from each team (over a few days) and then each team made a short presentation (in a videoconference setting) describing their project and answering questions from the advisory board and from other students and faculty. This format will continue until final presentations can be help in person.

Appendices

1. Curriculum Map

Appendix 1: Curriculum Map

Course	Title	SO1	SO2	SO3	SO4	SO5	SO6	SO7
ECE 2001	Computer Aided Engineering in ECE	*					*	
ECE 2010	Electric Circuits I	*	*					
ECE 2011	Electrical Engineering Lab. I			*	*		*	
ECE 2020	Electric Circuits II	*	*					
ECE 2110	Intro. to Digital Systems	*	*	*		*		
ECE 3010	Signals & Systems	*	*					
ECE 3020	Discrete-Time Signals & Systems	*	*					
ECE 3060	Electrical Engineering Lab. II	*	*	*	*		*	
ECE 3130	Microcomputer Systems	*	*	*		*	*	*
ECE 3160	Digital Systems Lab.	*	*	*		*	*	
ECE 3300	Electronics I	*	*					*
ECE 3920	Professional Issues in ECE			*	*	*		*
ECE 4110	Digital System Design	*	*	*			*	
ECE 4120	Fundamentals of Computer Design	*	*	*		*	*	
ECE 4140	Embedded System Design	*	*	*		*	*	*
ECE 4961	Capstone Design I	*	*	*	*	*		*
ECE 4971	Capstone Design II		*	*		*	*	*
CSC 1300	Intro. to Problem Solving and Computer Programming	*	*					
CSC 1310	Data Structures and Algorithms	*	*					
CSC 2400	Design of Algorithms	*	*					
CSC 2500	UNIX Lab.	*						
CSC 4100	Operating Systems	*	*					
CSC 4200	Computer Networks	*						