El Camino Community College

PROGRAM REVIEW 2017

MATHEMATICAL SCIENCES
ENGINEERING

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SECTION 1
Overview of the Program

A) Provide a brief narrative description of the current program, including the program's mission statement and the students it serves.

The mission of the Engineering Program is to introduce students to the engineering profession and help them transfer to universities as engineering majors. The Engineering Program at El Camino College consists of those courses required for engineering students by many, if not most, of our transfer institutions. These courses include MATH 190, 191, 220 (the calculus sequence), 270, 210, PHYS 1a, 1b, 1c, 1d, CHEM 1a, 1b, CSCI 1, 2, 3, as well as ENGR 1 and ENGR 9. It is, of necessity, multidisciplinary. In order for our engineering students to benefit fully from their time at ECC, it is essential that the courses they are required to take work in concert. The courses must be scheduled at times which don't conflict, else students will be forced to choose which of the conflicting courses is more essential. Courses must be offered often enough (and with a sufficient number of sections) that they can fit into the crowded schedules of engineering students. (Engineering is a high unit major. Students do not have much flexibility in their schedules.) Ideally this program review would be a multidisciplinary product in which we could work to coordinate our efforts on behalf of our students. Realistically, this has not happened. Access to information about those students who identify as engineering majors but who do not take either of the engineering courses is limited. Thus, instead of addressing the entire program of courses taken by our engineering majors, this program review concentrates on the two engineering courses at El Camino College, which are taken by a small minority of our engineering students (currently approximately 200 students per year). These two courses are Introduction to Engineering (ENGR 1), a 2 unit course and Engineering Mechanics - Statics (ENGR 9), a 3 unit course. Thus, the Engineering courses that comprise the narrow Engineering Program consist of a grand total of just 5 units.

Both of the courses in the Engineering Department may be used to satisfy the General Education Mathematics requirement for transfer to a university. However, the two courses are very different. Engineering 1, Introduction to Engineering, is an orientation to the preparation, training, practice, obligations, and ethics of the engineering profession, as well as an introduction to the various engineering disciplines such as: civil, mechanical, electrical, chemical, etc.. Speakers from various fields describe opportunities and challenges in the engineering profession. Academic success strategies related to the study of engineering are emphasized. Engineering 1 has no prerequisites and is open to all students. In this course, students do very little computational work. Most of the exams are in the form of essay, short answer, or multiple-choice questions. Since the previous Engineering Program Review, the demand for Engineering 1 has increased. In the Fall 2016 semester, there were two sections of Engineering 1 offered and both filled, while in the Spring 2017 semester, three sections were offered. Engineering 1 was designed to stimulate student interest in pursuing a career in engineering. On the other hand, Engineering 9, Engineering Mechanics – Statics, is an advanced (sophomore level) community college course. In Engineering 9, students explore forces on rigid bodies and analyze structures. Engineering 9 has both a Physics course prerequisite and a prerequisite of a Calculus II course. Students enrolled in Engineering 9 are already well into completing their lower division

requirements for transfer to a university as engineering majors. At the time of the previous Engineering Program Review, only one section of Engineering 9 was offered per year and it was offered in the Spring semester. Now two sections of Engineering 9 are offered, one in the Spring and one in the Fall.

B) Describe the degrees and/or certificates offered by the program.

There are no degrees or certificates offered in the Engineering Program.

C) Explain how the program fulfills the college's mission and aligns with the strategic initiatives.

The mission of El Camino College is to make a positive difference in people's lives by providing a comprehensive educational program and services that promote student learning and success in collaboration with our diverse communities.

Engineering (as well as other STEM fields) is a popular major at this time and there are many opportunities for employment after graduation (with a Bachelor's Degree). Any college which claims to offer a comprehensive educational program must include preparation for a major in the various fields of engineering. Many of the students who are majoring in engineering are first generation college students and their success will be a positive influence on the lives of their extended family.

STRATEGIC INITIATIVES

1. **Student Learning:**
   Support student learning using a variety of effective instructional methods, educational technologies, and college resources.
   In addition to a traditional lecture, Engineering 9 students solve statics problems at their desks, during class time. A project involving manipulatives, is a portion of the course grade. For that group project, students are required to select one of the toy blocks provided and calculate the centroid and the center of mass. The group is then required to write a report describing their and analyzing their work, for which students will earn the same grade as their group. For other work, students are encouraged to form study groups outside of class, as well. Most exams contain a take home portion to ensure that students have sufficient time to work on the solutions to more complicated problems. To stay abreast of the latest developments in teaching, the Engineering 9 instructor attends an engineering conference at Caltech every year.

2. **Student Success and Support:**
   Strengthen quality educational and support services to promote and empower student learning, success, and self-advocacy.
   The Engineering instructors have worked with the MESA Program. Based on the promotion of the MESA Center in class and in the course syllabus, a number of Engineering 9 students meet

and study there regularly at every semester. Not all interested students qualify to join MESA and so the resources of that program are not available to them, but the ASEM program, with similar resources, has been instituted for these students. In collaboration with the instructor, Engineering students with learning disabilities have availed themselves of the services of the Special Resource Center. On occasion, students have taken exams at the SRC.

3. Collaboration:

Advance an effective process of collaboration and collegial consultation conducted with integrity and respect.

Up until very recently, only one instructor has taught Engineering 1, so very little collaboration has occurred. Now that the Engineering Program has expanded, to include three sections of Engineering 1 in Spring 2017, there are three instructors teaching the course. Since one of the instructors is full time and has taught the course previously, to promote collaboration, he plans to mentor the two new part time instructors and discuss ideas in teaching the course. For Engineering 9, there has been only one instructor teaching the course, since the course was reactivated. Thus, very little intra-departmental or –college collaboration has occurred. In June of 2017 the instructor attended the Summer Engineering Teaching Institute held at Pierce College where engineering (and math) faculty from several schools shared their experiences.

4. Community Responsiveness:

Develop and enhance partnerships with schools, colleges, universities, businesses, and community-based organizations to respond to the educational, workforce training, and economic development needs of the community.

Both of the Engineering courses articulate with the universities that offer such courses. Along with Calculus, Computer Science, Physics, and Chemistry courses, the two Engineering courses help students transfer as Engineering Majors to universities. After they complete their university degrees, they enter the American workforce in responding to the increased demand for STEM professionals. Students in the program do not typically go straight into the workforce, so no partnerships with businesses, in the areas of workforce training or economic development are currently in place. It may be desirable to forge some partnerships with local engineering firms to help mentor and encourage our engineering students, though what that might entail remains undetermined.

5. Institutional Effectiveness:

Strengthen processes, programs, and services through the effective and efficient use of assessment, program review, planning, and resource allocation.

Since the inception of Student Learning Outcomes, all Engineering SLO and PLO reports have been completed in a timely manner. Course and Program Reviews have been performed, both regularly and conscientiously, with the best interests of students in mind. The small Engineering Department is faithfully represented on the Division Curriculum Committee, the Division Learning Outcomes Committee, and the Division Council.

6. **Modernization:**

Modernize infrastructure and technological resources to facilitate a positive learning and working environment.

The Engineering Committee recommends an increase in funding to allocate more resources for computer labs and computer software to accommodate the new Electric Circuits course, that will have a laboratory component (either optional or required).

D) Discuss the status of recommendations from your previous program review.

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1. **Reactivate and offer the Electric Circuits course.**

   Status: ON HOLD The Electric Circuits course revision is in progress, but has been put on hold, during this Program Review calendar year.

2. **Add Engineering as an FSA for the interested and qualified instructor.**

   Status: ON HOLD This recommendation is also on hold, during the time of Program Review. The instructor to whom this refers may no longer be interested in the Electric Circuits course.

3. **Investigate the demand for a section of Engineering 9 in the Fall semester, and offer it if warranted.**

   Status: COMPLETED Since the Fall 2015 semester, this course has been offered each semester and has generally filled.

4. **Hire a Mathematics instructor, who is also qualified to teach engineering.**

   Status: IN PROGRESS Although the ability to teach engineering courses remains a desirable qualification when hiring instructors in the Mathematics Department, it has not been a high priority and no such candidates have been hired. Once there are enough sections of engineering courses being offered such that an instructor could teach 50% math and 50% engineering courses, a case will be made for creating a hybrid position. This could occur as soon as the Electric Circuits course is active and/or if/when the statics course has its units/load increased.

SECTION 2
Analysis of Research Data

A) Head count of students in the program.

The number of students enrolled in engineering classes has been steadily increasing. (The Fall 2016 low enrollment in ENGR 9 is an, as yet unexplained, anomaly.) We are now offering ENGR 9 each semester and beginning with the Fall 2016 semester we have increased the number sections of Engr 1 offered. There is no reason to expect that these trends will reverse themselves.

Number of Students Enrolled in Engineering Classes

	F 2012	Sp 2013	F 2013	Sp 2014	F 2014	Sp 2015	F 2015	Sp 2016	F 2016	Sp 2017
ENGR 1	37	32	46	39	33	38	36	33	61	100
ENGR 9	---	35	---	40	---	40	28	25	13	34
Total	37	57	46	79	33	78	64	58	74	134

B) Course grade distribution:

The grades in ENGR 1 appear to be increasing. Almost all of the students earn an A or a B. The goal for ENGR 9 is to have all of the students earn a grade of A, B, or C. This happened twice in the seven semesters ENGR 9 was offered during the 5 years of this program review cycle. During one other semester almost everyone passed with the exception of one student who had stopped participating in the class but did not withdraw.

Grade Distribution for ENGR 1

	F 2012	Sp 2013	F 2013	Sp 2014	F 2014	Sp 2015	F 2015	Sp 2016	F 2016	Sp 2017
A	4	6	7	9	27	25	14	15	17	30
B	10	3	8	14	1	3	13	8	23	34
C	8	5	9	3	0	1	4	4	5	11
D	2	2	2	3	0	0	0	0	2	2
F	1	0	0	0	0	0	2	1	3	7
W	7	8	10	5	5	9	3	5	11	16

Grade Distribution for ENGR 9

	Sp 2013	Sp 2014	Sp 2015	F 2015	Sp 2016	F 2016	Sp 2017
A	6	9	6	8	12	1	9
B	12	12	17	11	9	6	8
C	7	8	9	6	3	2	7
D	0	2	1	2	0	0	4
F	0	1	1	0	0	1	1
W	5	4	6	1	1	3	5

C) Success rates (Discuss your program's rates, demographic success characteristics and set a success standard for your program.)

The student success rates have been increasing with time. The 2015-2016 school year had the highest success rates. It is not certain why the rates fell in the following year, but they fell in both ENGR 1 and ENGR 9, so the cause may not be related to the courses themselves, but possibly some outside event which affected both courses. Also, with so few courses offered each semester, the data are naturally subject to a great deal of variability not related to anything occurring in the classroom but to the small sample size. Due to this small sample size, the data for all sections of ENGR 1 were combined. (There was no more than one section of ENGR 9 offered in any semester.)

Success Rates in Engineering Courses

	F 2012	Sp 2013	F 2013	Sp 2014	F 2014	Sp 2015	F 2015	Sp 2016	F 2016	Sp 2017
ENGR 1	68.8%	58.3%	66.7%	76.5%	85%	76%	86%	82%	74%	75%
ENGR 9	---	83.3%	---	80.6%	---	80%	89%	96%	69%	71%
Total	68.8%	72.2%	66.7%	78.6%	85%	78%	88%	88%	73%	74%

D) Retention rates (if applicable, include retention based on placement method)

Due to the small sample size, the data for all sections of Engr 1 were combined. (There was no more than one section of Engr 9 offered in any semester.)

Retention Rates in Engineering Courses

	F 2012	Sp 2013	F 2013	Sp 2014	F 2014	Sp 2015	F 2015	Sp 2016	F 2016	Sp 2017
ENGR 1	78.1%	66.7%	72.2%	85.3 %	85 %	76%	92%	85%	82%	84%
ENGR 9	---	83.3%	---	88.9%	---	85%	96%	96%	77%	85%
Total	78.1%	75.9%	72.2%	87.1%	85%	81%	94%	90%	81%	84%

E) A comparison of success and retention rates in face-to-face classes with distance education classes

There are no distance education classes in the Engineering Department.

F) Enrollment statistics with section and seat counts and fill rates

The fill rates for ENGR 1 are fairly steady. For 8 of the relevant 10 semesters, the fill rate was above 90%, and the average fill rate for the past five years was 93.8%. In the Spring 2016 semester there were three sections of ENGR 1 offered and the fill rate was 95.2%. The demand for ENGR 1 appears to be strong.

For ENGR 9 the fill rate is much more variable, ranging from a high of 114% to a low of 37.1% and an average of 84.0%. Some effort was made to determine why the enrollment in the Fall 2016 semester was anomalously low, but no reason could be established. Fortunately, the enrollment picked back up the next semester and has remained above 80%. There are many more potential ENGR 9 students at El Camino. It might be wise to increase the visibility of the course to encourage higher enrollment. In the early days of the course, a lot of effort went into recruiting students to enroll. This could be tried again. Emphasis should be made that this is a course that will need to be taken after transfer, if it is not taken before.

ENGR 1 Enrollment Statistics

Semester	Number of Sections	Seats Available	Seats Taken	Fill Rate (%)
Fall 2012	1	35	32	91.4
Spring 2013	1	35	24	68.6
Fall 2013	1	35	36	102.9
Spring 2014	1	35	34	97.1
Fall 2014	1	35	33	94.3
Spring 2015	1	35	38	108.6
Fall 2015	1	35	36	102.9
Spring 2016	1	35	33	94.3
Fall 2016	2	70	61	87.1
Spring 2017	3	105	100	95.2
Total	13	455	427	93.8

ENGR 9 Enrollment Statistics

Semester	Number of Sections	Seats Available	Seats Taken	Fill Rate (%)
Spring 2013	1	35	30	85.7
Spring 2014	1	35	36	102.9
Spring 2015	1	35	40	114.0
Fall 2015	1	35	28	80.0
Spring 2016	1	35	25	71.4
Fall 2016	1	35	13	37.1
Spring 2017	1	35	34	97.1
Total	7	245	206	84.0

G) Scheduling of courses (day vs. night, days offered, and sequence)

Engineering 9 was originally scheduled to avoid conflicts with the physics courses and labs likely to be taken by the students, thus it has always been offered on Monday/Wednesday evenings. Informal surveys among the ENGR 9 students has indicated that this scheduling is convenient, although students for whom it is not convenient would not likely be enrolled in the course. Students did however indicate that few of their peers, including those not enrolled in the course, were negatively affected by the timing of the class.

Engineering 1 has generally been offered in the evenings as well, though a morning section was offered in Spring 2017. Since it is staffed primarily by part-time instructors as well as by a full-time instructor who has a full load of non-engineering classes, the scheduling tends to be for the convenience of the instructors as well as during times when classrooms are available. Regardless of when the classes are offered, they generally fill.

H) Improvement Rates (Course success by placement method, if applicable)

The success rate for ENR 1 had been steadily improving. In the previous program review, the success rate varied from a low of 43.8% to a high of 60.4%. For the past five years, that range has been 64% to 84%. There were two semesters (2014-2015 school year) during which almost every ENGR 1 student earned a grade of A. This anomaly was probably related to a particular professor, though this is not certain. At any rate, although the students continue to do well, the average grade is not an A.

The success rate for ENGR 9 has also been improving, generally in the 80% to 90+% range. (During the time of the previous program review, the averages were generally in the 70% - 80% range.) There was one semester (Fall 2016) when the size of the class was very small and the success rate was low. In a section with a small class size, just one or two students performing badly can affect the success rate substantially.

I) Additional data compiled by faculty.

None.

J) List any related recommendations.

1. Keep an eye on the enrollment in ENGR 1 and if it continues to increase, add as many sections as will fill. There may be some difficulty in finding qualified instructors interested in teaching the extra sections.
2. Try to increase enrollment in ENGR 9 through informing potential students of its existence and that it is a requirement of many engineering programs.

SECTION 3
Curriculum

Review and discuss the curriculum work done in the program during the past four years, including the following:

A) Provide the curriculum course review timeline to ensure all courses are reviewed at least once every 6 years.

There are two courses in the Pre-Engineering Program and both have been reviewed within the past five years. The Curriculum Course Review Timeline is shown below.

Six-Year Course Review Cycle Worksheet

Division: Mathematical Sciences
Department: Engineering
Faculty: Jill Evensizer, Satish Singhal
Date: 5/30/2017
Semester/year of next Program Review: Fall/2021
Total # of Courses: 2
Courses Requiring CCC Blanket Approval: none

Course	Last Course Review	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6	
		FA 16	SP 17	FA 17	SP 18	FA 18	SP 19	FA 19	SP 20	FA 20	SP 21	FA 21	SP 22
Program			P	P							P	P	
ENGR-1	2008-2009									X			
ENGR-9	2008-2009					X							

B) Explain any course additions to current course offerings.

The Engineering Committee is looking into the possibility of reactivating some courses, developing a new course, offering more sections of our current courses, and modifying courses to include a laboratory component. As indicated in the data in the previous section, there is a need for more Engineering courses, based on the increasing enrollment in the courses currently offered. Additionally, it is imperative that El Camino offer a full program of engineering courses if we wish to remain competitive. As discussed in the previous program review, an analysis of data from the California Community Colleges Chancellor's Office shows that the most frequently offered engineering courses in the California community colleges are (in order of most frequently offered to less): Statics, Electric Circuits (with or without a lab component), Science of Engineering Materials, Graphics, Dynamics, and Strength of Materials (sometimes combined with Statics). At that time, over twenty California community colleges with fewer than 10,000 FTES (credit courses) offered a more comprehensive engineering program than El Camino College. If these smaller colleges can offer these courses, it is likely that if El Camino were to increase its offerings, the courses would fill.

Students in ENGR 9 would benefit greatly from having more time in class to practice their problem solving skills, but there is not sufficient time in a course that meets only 3 hours a week and which covers as much material as this course does. We are looking into ways to increase the students' contact hours for this course. Possibilities include offering it as a 3 unit, 4 hour course (similar to how Math 12 is offered) or adding a lab component which would actually be a problem solving session. Professors Kjeseth and Evensizer have begun working on this.

Based on student demand and in turn, a recommendation from the previous Engineering Program Review, three sections of Engineering 1 are now offered, as well as one section of Engineering 9 in both the Fall and Spring semesters. As mentioned above, the second most commonly offered engineering content course, after Statics, is Electric Circuits. Based on a recommendation from the previous review, an Electric Circuits course in in the process of reactivation. The course outline needs more modification. In the past, this course was taught at El Camino without a laboratory component. It would better serve our students if the course included a lab. This would involve modifying the course outline accordingly and securing the equipment and facilities necessary for the laboratory. This feature will be considered once the course (without a lab) is being offered regularly. A goal of offering this course in the Fall of 2018 does not seem unreasonable. After a course in Electric Circuits is up and running, we can look into the possibility of adding a Materials course and possibly also a Dynamics course. Additionally a faculty member is interested in developing a course on solar energy. Although it would not satisfy any engineering transfer requirements, a few other colleges do offer such "non-standard" courses (according to data from the Chancellor's Office) and so offering such a course would not be unheard of. It is certainly worth investigating.

C) Explain any course deletions and inactivations from current course offerings.

Neither of the engineering courses is being considered for deletion at this time.

D) Describe the courses and number of sections offered in distance education. (Distance education includes hybrid classes.)

There are no hybrid or online versions of either of the Engineering courses, that are offered.

E) Discuss how well the courses, degrees, or certificates meet students' transfer or career training needs.

1. Have all courses that are required for your program's degrees and certificates been offered during the last two years? If not, has the program established a course offering cycle?

Both the Engineering 1 and Engineering 9 courses are offered each year.

2. Are there any concerns regarding program courses and their articulation to courses at other educational institutions?

Both the Statics and Introduction to Engineering courses articulate to universities that offer those particular courses. There are no concerns regarding articulation with either of the courses in the Engineering Program at this time.

3. **How many students earn degrees and/or certificates in your program? Set an attainable, measurable goal related to student completion of the program's degrees/certificates.**

   There are no degrees or certificates for the Engineering Program.

4. **Are any licensure/certification exams required for program completion or career entry? If so, what is the pass rate among graduates? Set an attainable, measurable goal for pass rates and identify any applicable performance benchmarks set by regulatory agencies.**

   There are no licensure/certification exams for the Engineering program.

F) List any related recommendations.

1. Reactivate the Electric Circuits course, with the goal of offering it in the Fall of 2018.
2. Modify ENGR 9 (Statics) to increase the number of hours students spend in class, with the aim of improving their problem solving skills. The problems in this course are lengthy and complicated and can take as much as (or possibly more than) 30 minutes to solve, an impossibility in a course that meets for only 170 minutes a week.
3. Investigate which course should be the next to be added to the curriculum once the Electric Circuits course is up and running.

SECTION 4
Assessment of Student and Program Learning Outcomes (SLOs & PLOs)

A) Provide a copy of your alignment grid, which shows how course, program, and institutional learning outcomes are aligned. (This will be Appendix A.)

Since the two courses, ENGR 1 and ENGR 9 are so drastically different, a single Program Level SLO was created to correspond to each course. The two Course Level SLOs for ENGR 1 align directly with Program Level SLO #1, while the Course Level SLOs for ENGR 9 align with the broadly stated general Program Level SLO #2. Both the Program and Course SLOs align primarily with the following ILOs: I Content Knowledge and II Critical, Creative, and Analytical Thinking, though there is strong alignment with III Communication and Comprehension. This situation of Course and Program SLOs aligning with ILOs I and II is fairly common in Math and Science based programs and courses. The Engineering SLO Alignment Grid is provided on the following page.

Program: Engineering	**Number of Courses:** **2**	**Date Updated** **1.26.13**	**Submitted by** : Jill Evensizer Ext. 5210

Institutional SLOs	I. Content Knowledge	II. Critical, Creative, and Analytical Thinking	III. Communication and Comprehension	IV. Professional and Personal Growth	V. Community and Collaboration	
Program Rating	3	4	3	2	2	

Program Level SLOS
1. Students will analyze the preparation, assess the cognitive skills, and apply academic success strategies required in engineering.
2. Students will apply principles from mathematics, physics, and chemistry to solve applied problems in engineering.

Course Level SLOs
ENGR 1 Introduction to Engineering SLO #1: Analyze the preparation, training, practice, obligations, and ethics required in the engineering profession.
ENGR 1 Introduction to Engineering SLO #2: Assess the cognitive skills and apply academic success strategies related to the study of engineering.
ENGR 9 Engineering Mechanics – Statistics: SLO #1: Solve equilibrium problems in two and three dimensions using algebraic or trigonometric methods.
ENGR 9 Engineering Mechanics – Statistics: SLO #2: Draw diagrams and determine distributed forces, shear forces, and moments in beams .

B) Provide a timeline for your course and program level SLO assessments. (This will be Appendix B.)

Students in the Engineering Program are assessed for SLOs only in the Spring semester of each year.

Timeline for Course and Program Level SLO Assessments for the Engineering Program

SLO Timeline for Engineering

3 Years before Program Review for Engineering	
Spring Semester 2014	Program Level (SLO #1) Engineering 1 (SLO #1) Engineering 9 (SLO #1)
Fall Semester 2014	**** **** ****
Winter Session 2015	**** **** ****

2 Years before Program Review	
Spring Semester 2015	Program Level (SLO #2) Engineering 1 (SLO #2) Engineering 9 (SLO #2)
Fall Semester 2015	**** **** ****
Winter Session 2016	**** **** ****
1 Year before Program Review	
Spring Semester 2016	Program Level (SLO #1) Engineering 1 (SLO #1) Engineering 9 (SLO #1)
Fall Semester 2016	**** **** ****
Winter Session 2017	**** **** ****
Program Review Year	
Spring Semester 2017	Program Level (SLO #2) Engineering 1 (SLO #2) Engineering 9 (SLO #2)
Fall Semester 2017	**** **** ****

3 Years before Program Review for Engineering	
Spring Semester 2018	Program Level (SLO #1) Engineering 1 (SLO #1) Engineering 9 (SLO #1)
Fall Semester 2018	
2 Years before Program Review	
Spring Semester 2019	Program Level (SLO #2) Engineering 1 (SLO #2) Engineering 9 (SLO #2)
Fall Semester 2019	
1 Year before Program Review	
Spring Semester 2020	Program Level (SLO #1) Engineering 1 (SLO #1) Engineering 9 (SLO #1)
Fall Semester 2020	
Program Review Year	
Spring Semester 2021	Program Level (SLO #2) Engineering 1 (SLO #2) Engineering 9 (SLO #2)
Fall Semester 2021	

C) State the percent of course and program SLO statements that have been assessed.

Students have been assessed in 100% of the SLOs and PLOs for the Engineering Program.

D) Summarize the SLO and PLO assessment results over the past four years and describe how those results led to improved student learning. Analyze and describe those changes. Provide specific examples.

The grading rubric for all of the Course and Program Level SLOs is based on a 4 point scale (with possible scores of 0, 1, 2, and 3) with 4 levels of understanding. A score of 0 corresponds to no understanding and a score of 1 corresponds to some understanding. Those two scores are associated with students being unsuccessful in acquiring that skill. A score of 2 corresponds to most understanding, while a score of 3 corresponds to complete understanding. The scores of 2 and 3 correspond to students being successful at that SLO.

Since Engineering 1 and Engineering 9 are such vastly different courses, two separate Program Level SLOs were constructed, one for each course. The table below summarizes the SLO data for each of the courses. In the year 2014, TracDat was adopted by El Camino College, as a system for inputting SLO and PLO reports. At that time the SLO/PLO timeline for the Engineering Program was revised and that is the reason that students were assessed for SLO #1 in consecutive semesters.

SLO Assessment Summary - Engineering 1 – Introduction to Engineering

(SLO #1: Analyze the preparation, training, practice, obligations, and ethics required in the engineering profession.)

(SLO #2: Assess the cognitive skills and apply academic success strategies related to the study of engineering.)

Spring	SLO Number	Score 0	Score 1	Score 2	Score 3	Success Rate (scoring 2 or 3)
2013	1	0% (0)	0% (0)	36% (4)	64% (7)	100%
2014	1	0% (0)	0% (0)	27% (7)	73% (19)	100%
2015	2	0% (0)	3% (1)	18% (5)	79% (23)	97%
2016	1	7% (2)	14% (4)	57% (16)	22% (6)	79%
2017	2					

The reason for the extremely high student success rate for both SLOs for Engineering 1 is the nature of the course. Engineering 1 introduces students to the engineering profession and there is no prerequisite

for the course. Students with a wide variety of preparation levels enroll in this course. Some students in Engineering 1 have not even completed an Elementary Algebra course, while others may be concurrently enrolled in Differential Equations. For this reason, students in Engineering 1 are required to solve very, very few actual mathematics and engineering type problems. Most of the required work consists of multiple choice exams, short answers, and some essay questions.

For SLO #1: Analyze the preparation, training, practice, obligations, and ethics required in the engineering profession, students were asked to write a one page essay, discussing each of the concepts listed in the SLO. If a student correctly analyzed just one of the concepts listed, the student would earn 1 point, if the student correctly analyzed three of the ideas listed, the student would earn 2 points, and if they analyzed all five correctly, they would earn 3 points, which is the maximum. This essay constituted the assessment for SLO #1 up to and including Spring 2014. In Spring 2016, a different instructor expanded the assessment for this SLO. That semester, students were asked, based on a semester long project, to write a report that would cover the following aspects of the engineering discipline which the student was planning to study:

1. What academic preparation is required for an engineering professional planning to graduate in the area in which you are planning your engineering study? (If you have not chosen an engineering or computer science major, then you can write about academic preparation for a general engineering degree). Discuss in terms of areas of concentration during the study program and key courses related to those areas of concentration. Discuss as to what would be the best quality academic preparation. (2 points)

2. What post academic training would be needed for a successful engineering career by an engineering professional planning to practice the branch of engineering of your interest? (2 points)

3. Analyze and describe the typical practice day, week, and month of a practicing engineer in the area of your interest. What kinds of practice problems would such an engineer solve on a daily, weekly, and monthly basis? (2 points)

4. What ethical responsibilities would an engineer in your area of interest would have and how would he/she meet them? How would such an engineer resolve an ethical dilemma? (2 points)

5. What kinds of professional, civic, and social obligations would an engineer in your area of interest have? How would he/she meet those obligations? (2 points)

Since this semester long report was considerably more involved than a one page essay, the student success rate was somewhat lower. However, through this assessment, students gained a deeper knowledge of the Engineering profession and what it takes to be an engineer.

The following are some instructor suggestions to improve student learning and success for SLO #1:

- Students need to be encouraged to comprehend and address the question completely and provide answers for all elements in the question. Also, the instructor plans to emphasize and repeat important issues.

- To improve student engagement in engineering, it is planned that invitations be extended to representatives from the following organizations: El Camino Chapter of Society of Women Engineers (SWE), Society of Hispanic Professional Engineers (SHPE), El Camino ACM (American Computing Machinery) Chapter, and El Camino Robotics Club to speak to the Engineering 1 class and describe avenues for professional engagement at El Camino College.

- Also, an invitation is planned to be extended to representatives from the writing center staff to give a talk to Engineering 1 students, describing the writing lab facilities that are available at El Camino College.

For SLO #2: Assess the cognitive skills and apply academic success strategies related to the study of engineering, students were directed to write a one page assessment of their cognitive skills, which they would utilize in their chosen engineering discipline, which could include: remembering, understanding, applying, analyzing, evaluating, and creating. Also, they would write about applying their academic success strategies related to the study of engineering, which include: structuring their life to minimize distractions, setting goals, working collaboratively with other students, making a commitment to their study, and communicating to family and friends about their academic priorities. If a student wrote what was irrelevant to the question, the student earned a score of 0. If the student did not write about any intellectual skills, but wrote about at least one of the academic success skills, the student earned a score of 1. If the student wrote about two levels of intellectual skills and one academic success strategy, the student earned a score of 2. If a student wrote about more than two levels of intellectual skills and more than one academic success strategy, the student earned the maximum score of 3.

Again the student success rate for this SLO was very high, based on the assessment instrument of a one page essay.

The following are some instructor suggestions to improve student learning and success for SLO #2:

- The next time that SLO #2 is assessed, the instructor will direct students to discuss cognitive skills and apply academic success strategies related to the study of Engineering, in pairs during class time.
- Students would be asked to complete a number of group discussion projects related to academic success and cognitive skills during class time and discussed the outcomes with the rest of the class.

SLO Assessment Summary - Engineering 9 – Engineering Mechanics – Statics

SLO #1: Solve equilibrium problems in two and three dimensions using algebraic or trigonometric methods.

SLO #2: Draw diagrams and determine distributed forces, shear forces, and moments in beams.

Spring	SLO Number	Score 0	Score 1	Score 2	Score 3	Success Rate (scoring 2 or 3)
2013	2	0% (0)	4% (1)	16% (4)	80% (20)	96%
2014	1	22.5% (7)	10% (3)	45% (14)	22.5% (7)	68%
2015	2	6% (2)	14% (5)	46% (16)	34% (12)	80%
2016	1	4% (1)	33% (8)	21% (5)	42% (10)	63%
2017	2					

Up to and including 2014, Engineering 9 was offered only in the Spring semester, with just one section. Based on increased student demand, and in turn, a recommendation from the previous Engineering Program Review, starting in the 2015 academic year, an additional section of Engineering 9 was offered in the Fall semester also.

For SLO #1: Solve equilibrium problems in two and three dimensions using algebraic or trigonometric methods, students were asked, based on a provided diagram, to determine the reactions at the beam supports for a given loading of 300 pounds.

The same 4 point scale, described earlier, was used for all SLO assessments for Engineering 9. The lowest score being 0, corresponding to No Understanding, 1 corresponding to Some Understanding, 2 corresponding to Most Understanding, and 3 corresponding to Complete Understanding. Students earning a 2 or 3 are deemed successful at mastering the SLO, while those scoring 0 or 1 were Unsuccessful.

If a student sketched a completely incorrect Free Body Diagram, their score was 0. If the FBD was mostly correct, the student earned 1 point. If the FBD was completely correct, but there was a major algebraic error in the solution, the student earned a score of 2, while if only a minor error occurred, the student earned a score of 3, which is the maximum.

The success rates for SLO #1 were 68% and 63%, considerably lower than for SLO #2. A reason for this is the more complex nature of the problem of determining the reactions in a beam, over sketching diagrams to determine distributed forces, shear forces, and moments. Though the problem was not any more difficult than in previous exams from earlier years, all of the exam scores were lower in Spring 2014, than in past years.

Students who had difficulty, did not appear to fully understand two different aspects of the problem. The beam had a distributed load applied to it and some students did not handle that correctly. Additionally, there was an applied couple moment at one end of the beam and several students attempted to include a force there, as well, when that is not correct.

The instructor will continue to stress the correct ways to handle these situations. The publisher has workbooks that accompany the text and the instructor will investigate these books, to determine if they would be beneficial to students in future classes. Students suffer from lack of tutoring for this course and since there is insufficient time for their homework to be graded, they get very little feedback on their work, prior to exams. The instructor will try to collect and look over a problem or two from the

homework, before an exam. Also, the instructor is considering doubling the number of exams, thus giving one exam per chapter, rather than one exam for two chapters.

In Spring 2016, students were assessed for SLO #1 again, but with a somewhat more complicated problem, resulting is a 63% success rate. However, it was on the take home portion of an exam, so the students had all the time they needed and it was also open book. Many students don't seem to be able to be bothered to look things up or to check to see that what they think is correct, actually is. They seem to spend their time trying to find a similar example problem in the book and then copying that approach.

Next time, the instructor plans to make the in-class portions of the exam closed book, but perhaps let students have a page or two of notes, rather than having it open book. Thus, students won't be looking for similar problems to copy from the text for that portion. It won't stop them from doing this on the take-home portions, but at least they will not have this as their only strategy. The need for take home exams is based on the complexity and amount of time required to solve even a basic statics problem. One hour and 25 minutes, the amount of time allocated for each class meeting, is not sufficient for students to display their skills in solving statics problems. At most four statics problems may be included on a 1 hour 25 minute exam.

Although this SLO problem had less than optimal results, overall the students did well in the course. Every one of the 24 students enrolled in Engineering 9 in Spring 2016, passed the course with an A, B, or C. This was one of the first times that no student earned a D or F course grade. Part of the reason for this was that homework was periodically assigned, collected, and graded during the semester and homework counted as a portion of the course grade. The feedback was helpful to them.

For SLO #2: Draw diagrams and determine distributed forces, shear forces, and moments in beams, students were directed to draw the shear and bending moment diagrams for a beam shown in a figure provided. Then they are to determine the shear and moment at the middle of the beam. Students who drew incorrect shear and moment diagrams, or wrote nothing, earned a score of 0, corresponding to "no understanding", while students who drew the shear diagram correctly, but not the moment diagram, earned a score of 1, which corresponded to "some understanding". Scores of 0 or 1 corresponded to students being unsuccessful.

Students in the "most understanding" category completed the problem correctly, but did not label axes and constructed incorrect scales, earned a score of 2. Those students in the "complete understanding" category completed the problem with no errors and earned the maximum score of 3. Scores of 2 and 3 correspond to students being successful at this SLO.

Engineering 9 is a relatively advanced course for Community College students, which is taken by Engineering majors. These students needed to successfully complete a number of Calculus and Physics courses, to qualify to enroll in Engineering 9. This explains the high success rates (96% in 2013 and 80% in 2015) for students in mastering SLO #2. The following is a discussion of the results by the instructor, Jill Evensizer:

The students did quite well, particularly considering that this came fairly late in the semester and not as much time was spent as much time, as should have been in presenting this topic. Most students did far more work than necessary in solving this problem. They went back to first principles, rather than use the methods developed from those principles. This was likely due to the fact that it was an exam and they may have been concerned that they would not earn full credit if they didn't demonstrate that they understood those principles. To improve student success, some of the basic features of sketching

diagrams could be emphasized, along with reminding students to be as careful as possible in their calculations. Also, it should be carefully and clearly explained as to how the different parts of the answers influence each other. The next time that Engineering 9 is taught, the instructor intends on emphasizing short cuts, which will help students in not getting bogged down with doing far more work than is necessary. In addition, the instructor will stress the importance of drawing neat, properly labeled diagrams, with correct scales.

Program Learning Outcomes for Engineering:

Since the Program Learning Outcome that was assessed each Spring semester corresponds to either Engineering 1 or Engineering 9, the student success rates for those PLOs are identical to the corresponding Course Level SLOs for Engineering 1 and Engineering 9. PLOs are only assessed during the Spring semester.

E) Describe how you have improved your SLO/PLO assessment process and engaged in dialogue about assessment results.

In 2016, a different instructor started teaching Engineering 1 and he expanded the assessment to include a semester long project. Though the success rate was somewhat lower than in previous semesters, the level of learning experienced by the students was considerably higher. This was based on the amount of research conducted by the students in exploring the Engineering profession. Starting this Spring 2017, three instructors are teaching Engineering 1, so there will be some dialogue regarding the SLO results, once they have been tabulated at the end of this semester. For Engineering 9, SLO #1, the only proposed change is to assess the students sooner after they have learned the skill for that SLO. Based on the high student success rate for SLO #2, there are no changes that are proposed to the assessment instrument, rubric, or teaching methodology for that SLO. However, if the success rate remains high in future assessments, changing this SLO (#2) and testing a different skill, will come under consideration. Since Engineering 9 was reactivated some years ago, Jill Evensizer has been the only instructor teaching the course, resulting in very little dialogue with colleagues regarding teaching methods.

F) Discuss any findings from SLO/PLO assessments that help to justify recommendations

Not applicable

G) List any related recommendations.

There are no recommendations related to SLOs/PLOs at this time.

SECTION 5

Analysis of Student Feedback

Provide a copy of any feedback reports generated by Institutional Research and Planning or your program. Review and discuss student feedback collected during the past four years including any surveys, focus groups, and/or interviews.

No surveys were administered or student feedback formally solicited. It is felt that the two courses offered in the Engineering Department are so dissimilar that no survey would be relevant to both courses. Additionally, many of the students who are engineering majors do not take any engineering courses before they transfer. It would be of interest to discover the reasons for this, but surveying the students who do take engineering courses would not be helpful. All instructors have, of course, informally requested student feedback on a variety of issues and some of that will be described a bit later, but not in this section.

List any related recommendations.

None

SECTION 6
Facilities and Equipment

A) Describe and assess the existing program facilities and equipment.

The program has no existing facilities or equipment, other than those provided to the Division of Mathematical Sciences as a whole (e.g. classrooms).

B) Explain the immediate (1-2 years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

There is no current need for new facilities and equipment. As the program expands, there may be need for laboratory space and equipment, but that is not expected to happen in the immediate future.

C) Explain the long-range (2-4+ years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

Although equipment may be needed as old courses are reactivated and new courses are introduced, those needs will not be determined until work on the courses is completed.

D) List any related recommendations.

1. Purchase the equipment necessary to support instruction in ENGR 17 (Electric Circuits), based on the faculty decision regarding course design (e.g. lab component).
2. Consult with the Division of Industry and Technology to assess the viability of sharing any equipment to support courses planned for future activation or development.

SECTION 7
Technology and Software

A) Describe and assess the adequacy and currency of the technology and software used by the program.

No technology or software is currently being used.

B) Explain the immediate (1-2 years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

If the circuits course is reactivated with a lab component similar to that at SMC and UCLA, then software and hardware that can be used with a laptop computer will be used. UCLA is using a platform produced by National Instruments called the MyDAQ as well as a breadboard attachment and a small set of consumable electronics. The current estimate is that the cost of this would be $200 per student. This could be required of each student or provided by the school or a combination (most likely). Students would also need access to laptop computers. Some students may prefer to use their personal laptops, but the school would need to provide laptops for other students. It is expected that the laptops currently owned by the division will be adequate. Alternatively, the labs could possibly be run in a classroom equipped with computers.

Most circuit analysis courses, at 4 year schools as well as community colleges, have a lab component, optional or required. A course with a lab component will assist our students wishing to transfer to those schools which require one.

C) Explain the long-range (2-4+ years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

This can not be determined until work on introducing new courses is well underway.

D) List any related recommendations.

1. Purchase the technology and/or software necessary to support instruction in ENGR 17 (Electric Circuits), based on the faculty decision regarding course design.
2. Estimate cost and develop a cycle for purchasing and updating technology/software associated with courses planned for future reactivation or development.

SECTION 8
Staffing

A) Describe the program's current staffing, including faculty, administration, and classified staff.

This Spring 2017 semester, there are four instructors teaching Engineering courses. Two are full time and two are part time. Engineering 1 is taught by one full time instructor and two part-timers. Since its activation in 2008, Engineering 9 has been taught only by Jill Evensizer, a full time instructor.

B) Explain and justify the program's staffing needs in the immediate (1-2 years) and long-term (2-4+ years). Provide cost estimates and explain how the position/s will help the program better meet its goals.

The size of the engineering faculty is adequate for the current needs of the department. However, both of the full time professors who teach engineering courses are over 60 and likely to retire soon. They will need to be replaced by another full time professor (even if not teaching engineering courses exclusively), not an assortment of part time instructors. The continuity and expansion of the program requires an invested, full time professor (or two or three) to oversee it.

The students in the program, especially those in Engineering 9, would benefit greatly from the opportunity for help in problem-solving. This could come from extra hours spent in class (as discussed in Section 3) as well as free, on-campus tutoring. It is virtually impossible to find peer tutors capable of tutoring this course as students generally transfer soon after completing it. The most immediate source of tutors may be the faculty. Several of the part-time math faculty have backgrounds in engineering and might be interested in tutoring, perhaps in much the same way as some of the part-time faculty work in the Math Study Center. It may also be possible to hire students from local colleges to tutor, but historically, it has been difficult to find students interested in tutoring anywhere other than their own campus.

Program/department's future needs: As the number of courses and sections offered by the Engineering Dept. increases, so will the need for faculty to teach them. The most immediate need, for an instructor to teach the soon to be activated Electrical Circuits course, may be met. A full-time math instructor is potentially interested in teaching this course. He does not currently have Engineering as an FSA, but appears to have all of the qualifications, so it is only a matter of filling out the appropriate paperwork, before he is officially qualified. In addition to now offering Engineering 9 both in the Fall and Spring semesters, the number of sections of Engineering 1 that are offered has increased from one to three. In view of this expansion of the Engineering program, coupled with the activation of the Electric Circuits course, will result in a transfer of faculty teaching assignments from Math to Engineering. This will require the hiring of either full-time or part-time math instructors. In order that this program may continue to grow, it is recommended that a hybrid full time instructor be hired, who would be qualified to teach both Engineering and Mathematics. As the program grows, providing tutoring services to the students will be increasingly important. The possibility of including engineering tutors in the Math Study Center, possibly by hiring part-time instructors capable of tutoring engineering, is recommended. The funding could come from the same source as the math tutoring. Indeed, it is possible that the tutors could tutor both math and engineering.

C) List any related recommendations.

1. Hire an instructor capable of, and interested in, teaching both mathematics and engineering (or computer science and engineering).
2. Offer tutoring for engineering students in the Math Study Center, using part time instructors as tutors.

SECTION 9
Direction and Vision

A) Describe relevant changes within the academic field/industry. How will these changes impact the program in the next four years?

No relevant changes are foreseen.

B) Explain the direction and vision of the program and how you plan to achieve it.

El Camino College will be known for the excellence of its engineering program, for both its academics and support services. All of the courses necessary or desirable to be taken prior to transfer will be offered. Information on transfer requirements will be easily available to all students. Free tutoring will be available for all engineering courses. There will be a dedicated space on campus where students in the various STEM fields can meet to work together and assist each other, both academically and personally. (Students often have similar difficulties to overcome, under-preparation, difficult work/school/family responsibilities, etc., and can offer others advice and strategies that have worked for them.) Such a facility should have access to computers and printers.

The first of these is perhaps the easiest to achieve. Over time the college will increase its engineering course offerings, concentrating on those courses which will help the most students prepare for transfer to the schools most popular among our students. A reasonable goal might be to add a new course offering every two or three years. This is easier if there are dedicated full-time engineering faculty members. Asking part-time instructors to work on developing new courses is not optimal. Also, it is better when more than one faculty member is working on such a project. Right now we really do not have the personnel to do this kind of work without sacrificing attention to the courses that are being taught as well as other duties. Fortunately, as the course offerings increase, it will be necessary to add engineering faculty and thus there will be more faculty to participate in adding even more courses.

Members of the Counseling faculty possess the information that engineering students need for transfer, but not all of the students avail themselves of this resource. Perhaps the faculties of Counseling and Engineering can work together to help get the information to the students. This would likely result in engineering students taking more engineering courses prior to transfer, thus increasing their likelihood of success. We are not certain of the best way to achieve this goal, but it is something to investigate.

It may be possible to introduce tutoring in engineering to El Camino in a manner similar to the mathematics tutoring offered in the Math Study Center, particularly since the two departments are part of the same division.

Finding a dedicated place for STEM students to meet and study is probably the most difficult of these goals. This will likely require some amount of money. There may be resistance to the perception that this implies that one group of students deserves such a facility while others do not. Some may argue that the MESA center already provides such a facility, but it is not accessible to all

STEM students. The benefits of synergy and collaboration that such a facility would provide students can not be overemphasized. It is unfortunate that the math faculty is physically removed from the science faculty, as it would be helpful if such a space as that being proposed were easily accessible to all STEM instructors, but even if such a facility were located away from both divisions, it would still be of great benefit to the students. If the facility is to include technology, then there would have to be some sort of staff to ensure that it was not misused (or stolen) and to make sure that it remains functional. Perhaps it would be easiest to first obtain a space that is set up for study and collaboration, introducing technology at a later time.

C) List any related recommendations.

1. Increase the course offerings in the Engineering Department in a consistent and steady way, beginning with Engr 17, Electric Circuits, and making an ordered list of the other courses that we would like to add.
2. Work with the Counseling faculty to disseminate information about engineering careers and preparation for transfer.
3. Find a way to offer free tutoring in engineering courses at El Camino.
4. Investigate the possibility of obtaining a dedicated space for all STEM majors to study and work together.

SECTION 10
Prioritized Recommendations

A) Provide a single, prioritized list of recommendations and needs for your program/ department (drawn from your recommendations in sections 2-8). Include cost estimates and list the college strategic initiative that supports each recommendation. Use the following chart format to organize your recommendations.

	Recommendations	Cost Estimate	Strategic Initiatives
1.	Hire an instructor capable of, and interested in, teaching both mathematics and engineering (or computer science and engineering).		1, 2, 5
2.	Modify ENGR 9 (Statics) to increase the number of hours students spend in class, with the aim of improving their problem solving skills.		1, 2
3.	Reactivate the Electric Circuits course (ENGR 17), with the goal of offering it in the Fall of 2018. As the course outline is developed, decide on the structure of the course and the type of lab desired.		1, 2,4
4.	Find a way to offer free tutoring in engineering courses at El Camino, perhaps using the tutoring in the Math Dept. as a model, perhaps even offering the tutoring in or through the Math Study Center.		1, 2, 4
5.	Investigate the possibility of obtaining a dedicated space for all STEM majors to study and work together.		2, 3, 6
6.	Increase the course offerings in the Engineering Department in a consistent and steady way, beginning with ENGR 17, Electric Circuits, and making an ordered list of the other courses that we would like to add. As courses are added to the curriculum, their equipment needs must be addressed and the possibility of sharing equipment can be investigated.		1, 2, 3, 4, 5
7.	Increase the number of sections of ENGR 1 if the demand increases.		1, 2, 5
8.	Increase the enrollment in ENGR 9 through outreach to students who may be interested, but are not planning to enroll.		1, 5
9.	Work with the Counseling faculty to disseminate information about engineering careers and preparation for transfer.		2, 3

B) Explain why the list is prioritized in this way.

It was difficult to prioritize the list. The items that appear near the top of the list (particularly #1 - #5) are those which will most immediately help our students to succeed both at El Camino and in their

transfer institutions (by being well-prepared). We have placed hiring a hybrid instructor as the top priority because it is necessary for the continuation of the program. A quality program can not be run (and expanded) without a full time instructor at the helm. The current full time instructors in the program are not young and are likely to retire in the fairly near future. The program is expanding and would benefit from an additional instructor capable of (and interested in) teaching Engineering courses. Items #2 and #3 are ones on which the Engineering Department is already working to implement. The items lower in the list, while also important and contributing to the success of our students, are of less immediate concern. Several of them (#7 - #9) address the issue of encouraging more of our El Camino students to take advantage of the courses we already offer.