PROGRAM REVIEW: ENGINEERING

FALL 2023

SOLANO
COMMUNITY COLLEGE

Program Review - Engineering (2023)

SECTION 1: Program Overview

1.1 - Introduction - List the names of full-time and adjunct faculty in the program, along with any staff members and their titles/roles. Note major changes in personnel since the last program review.

Note: This program review covers the seven-year period between 2015-2022.

The following instructors currently teach courses within the SCC Engineering Program:

Full-time faculty
Melanie Lutz (Ph.D., UC Berkeley), full-time since 2000 f

Adjunct faculty
Scott Berta (M.S., UC Berkeley), adjunct since 2017
Sana Vaziri (Ph.D., UC Davis), adjunct since 2022

The following instructors taught courses within the Engineering Program within the reporting period, but are no longer associated with the program:

Tom MacMullen (Ph.D., University of Arizona), adjunct 1995-2016

Other associated staff included:
Richard Crapuchettes (B.S., San Jose State), laboratory technician for all of the Physical Sciences, 1987-2020; note that there was no lab technician associated with this program between Spring 2020 and Spring 2023, inclusive.

1.1a - Briefly summarize any large, substantive changes made to the degrees/certificates since the last program review, and what prompted those changes. Note also any organizational changes (for example, if the program is now in a different School/Division than before). If changes have already led to noticeable improvement, please describe.

The Engineering Department at Solano Community College traces itself back to the very start of the college in 1945. In accordance with the statewide master plan for higher education, the Engineering program has always been focused on preparing students to transfer to an engineering major at a four-year university. In recent years, we have transferred about fifteen students per year, mostly to UC Davis, Sacramento State, and UC Berkeley. Some go on to pursue graduate degrees after receiving their B.S. degree, and most eventually find highly paid and productive jobs in Solano and nearby counties.

A new Associate in Science Degree in Engineering was created in 2018, and has been offered since 2019. Successful completion of this degree will provide an adequate background for employment in many technological and scientific areas, and provide a firm foundation for students planning to pursue a baccalaureate degree in engineering.

The Associate in Science Degree in Engineering consists of sixty units of courses, which include seven required courses in science, mathematics, and engineering (31 units), six elective engineering, science, and technical courses, at least three of which must be taken (10-13 units). The remainder of the sixty units must be filled by general education courses, such as are required for the specific university and major to which the student intends to transfer. The general education courses listed in the table below are examples of courses that might be taken.

Category	**Course No.**	**Course Name**	**Units**	**CSU-GE**	**IGETC**
These seven courses are required	MATH 020	Analytic Geometry and Calculus I	4	B4	2A
	MATH 021	Analytic Geometry and Calculus II	4	B4	2A
	MATH 022	Analytic Geometry and Calculus III	4	B4	2A
	MATH 023	Differential Equations	4	B4	2A
	PHYS 006	Physics for Science & Engineering I	5	B1, B3	5A, 5C
	PHYS 007	Physics for Science & Engineering II	5	B1, B3	5A, 5C
	CHEM 001	General Chemistry	5	B1, B3	5A, 5C
At least three courses from these seven courses. Note: DRFT 045 **or** DRFT 058, but not both.	ENGR 017	Introduction to Electrical Engineering	5		
	ENGR 026 /MATH 026	Math and Engineering Problem Solving with Matlab	4		
	ENGR 030	Engineering Mechanics: Statics	4	B1, B4	
	ENGR 045	Properties of Materials	4		
	DRFT 045	Introduction to Computer-Aided Drafting (CAD)	3		
	DRFT 058	Solid Modeling with Solidworks	3		
	CIS 022	Introduction to Programming	3		
General Education courses	ENGL 001	College Composition	4	A2, A3	1A, 8A
	ENGL 002	Critical Thinking and Writing About Literature	4	A2, A3	1B, 8B
	COMM 001	Introduction to Public Speaking	3	A1	1C, 8A
	SPAN 001	First Semester Spanish	5	C2	6A

Required Technical Courses	31 units
Elective Technical Courses	10-13 units (at least)
Completion of CSU-GE Breadth or IGETC pattern	16-19 units (i.e., enough to reach 60 units)
TOTAL UNITS	60 (at least) units

The largest growth area in engineering, and in the sciences and professional world more broadly, is the field known as Data Science. According to a report published in the Annual Review of Statistics and its Application (2017, 4:15-30), "Data Science is experiencing rapid and unplanned growth, spurred by the proliferation of complex and

rich data in science, industry, and government." Demand for data scientists is high, and starting salaries are very competitive. Data Scientist has been called "the most promising career" by LinkedIn, and the "best job in America" by Glassdoor.

In response to this new opportunity, an A.S. degree in Data Science was created and approved in 2022, along with a Certificate of Achievement in Data Science. The first specific course in our Data Science program is being offered in Fall 2023. This new A.S. degree will train students in the fundamentals of Data Science, and prepare them to transfer to four-year universities at which they can earn a B.S. that will allow them to enter the burgeoning data science job market. The Certificate of Achievement is aimed at people with diverse backgrounds who want to retrain in the field of Data Science.

The Associate in Science Degree in Data Science consists of sixty units of courses, which include eight required courses in science, math, and engineering (31 units), and three elective data science courses, at least one of which must be taken (4 units). The remainder of the sixty units must be filled by general education courses, such as are required for the specific university and major to which the student intends to transfer.

The course structure for the A.S. Degree in Data Science is shown in the following table. The general education courses listed in the table are examples of GE courses that might be taken.

Category	Course No.	Course Name	Units	CSU-GE	IGETC
These eight courses are required (31 units)	MATH 011	Elementary Statistics	4	B4	2
	MATH 020	Analytic Geometry and Calculus I	4	B4	2
	MATH 021	Analytic Geometry and Calculus II	4	B4	2
	MATH 022	Analytic Geometry and Calculus III	4	B4	2
	MATH 040	Introduction to Linear Algebra	3	B4	2
	ENGR 007 **(C-ID ENGR 120)**	Python Programming for Scientists and Engineers	4		
	ENGR 008	Data Science with Python for Scientists and Engineers	4		
	ENGR 012 **(C-ID MATH 160)**	Discrete Mathematics for Scientists and Engineers	4		
One of these three elective courses (4 units)	ENGR 010	Machine Learning with Python for Scientists and Engineers	4		
	ENGR 011	Deep Learning with Python for Scientists and Engineers	4		
	ENGR 014	Introduction to Statistical Programming in R for Scientists and Engineers	4		
General Education courses (25 units)	COMM 001	Introduction to Public Speaking	3	A1	1C
	ENGL 001	College Composition	4	A2	1A
	LR 010	Information Skills for College and Beyond	1		

	ENGL 002	Critical Thinking and Writing About Literature	4	A3	1B
	ASTR 010	General Astronomy	3	B1	5A
	ASTR 020	Astronomy Laboratory	1	B3	5C
	SOC 001	Introduction to Sociology	3	D	4
	SPAN 001	First Semester Spanish	5	C2	6
	KINE 002A	Swimming - Beginning	1	E	

Required Technical Courses 31 units
Elective Technical Courses 4 units
Completion of CSU-GE Breadth or IGETC pattern 25 units
TOTAL UNITS 60 units

The focus of the SCC Certificate in Data Science is to introduce students to the tools, methods, and conceptual approaches used to support modern data analysis and decision-making in professional and applied research settings. The pre-requisite skills that are required to enter this program are limited to high-school level algebra and trigonometry; there are no other specific requirements.

To earn the SCC Certificate in Data Science, students must:

(1) Complete the following five required courses: MATH 011, ENGR 007, ENGR 008, ENGR 012, and ENGR 014.
(2) Complete one of the following two elective courses: ENGR 010, ENGR 011.
(3) Complete the above-mentioned courses with a minimum grade point average of 2.0.

The course structure for the Certificate of Achievement in Data Science is shown in the following table:

Category	**Course No.**	**Course Title**	**Units**	**Sequence**
These five required courses (20 units)	MATH 011	Elementary Statistics	4	Term 1
	ENGR 007 **(C-ID ENGR 120)**	Python Programming for Scientists and Engineers	4	Term 1
	ENGR 008	Data Science with Python for Scientists and Engineers	4	Term 2
	ENGR 012 **(C-ID MATH 160)**	Discrete Mathematics for Scientists and Engineers	4	Term 1
	ENGR 014	Introduction to Statistical Programming in R for Scientists and Engineers	4	Term 2
One of these two elective courses (4 units)	ENGR 010	Machine Learning with Python for Scientists and Engineers	4	Term 2
	ENGR 011	Deep Learning with Python for Scientists and Engineers	4	

1.1b - CTE Programs: Describe the membership of the program's advisory board. Describe how the program requirements are influenced by the advisory board, accrediting institutions, and other external organizations. Note how the membership might be expanded to get more helpful, diverse voices in the field.

The first external member who has agreed to serve on our Advisory Board for the Certificate of Achievement in Data Science is Doug Sherman, Director of Engineering at the Sacramento-based company Stratovan, a leading developer of interactive visual analysis software for 3D imaging for the medical, life science, and threat detection markets. We are currently in discussion with other local technology companies to join our Advisory Board.

1.1c - CTE Programs: Provide advisory board minutes from the past two years [upload to the blue folder in the upper right corner of Section 1]. If minutes are unavailable, please describe what meetings have taken place, noting dates if possible, along with attendees' names and professional positions.

The Advisory Board for the Certificate of Achievement in Data Science met on Thursday, December 8, 2022. This meeting was attended by Melanie Lutz and Joe Ryan of SCC. The Advisory Board also met on Thursday, June 8, 2023, and discussed the SCC Data Science website, and the lack of available faculty to teach some of the new Data Science courses.

1.2 – Future Outlook: describe conditions (inside the college, or beyond) that may affect the future of the program in the coming years. For example, note what factors may put a strain on the program or give it a boost in the next five years.

The 2022 Physics Program Review stated that "There is only one course that shows a data-driven need to add an additional section: this would be to add an extra section of PHYS 002 in the Spring semester." Unfortunately, this clear directive has been ignored, and a new section of PHYS 007 has been added in the Spring in Vacaville, taught by an instructor with no Engineering background. Students who take PHYS 007 with an instructor who lacks a connection to Engineering do not receive encouragement and motivation to consider Engineering as a career path. The immediate consequence of this new course addition has been that enrollment in our key transferable Engineering courses, such as ENGR 017, ENGR 030, and ENGR 045, has plummeted, and consequently, once-per-year offerings of ENGR 030 and ENGR 045 were cancelled in Fall 2023. This left many of our students unable to satisfy their TAG agreement obligations to the UC system. Essentially, we are losing half of our traditional stream of potential Engineering majors. The only way to resolve this is to eliminate the Spring PHYS 007 section. The motivation of having added this new section, which was presumably to allow students to take all of their courses at Vacaville, is having the effect of destroying our Engineering program. Please note that there will never be enough Engineering students to justify having sections of our Engineering courses at Vacaville and/or Vallejo.

Furthermore, students who start their Physics sequence with PHYS 006 in the Fall, and then take PHYS 007 in the Spring, must wait another year before taking courses such as ENGR 017, ENGR 030, and ENGR 045. Counselors must advise Engineering majors to start with PHYS 006 in the Spring and PHYS 007 in the Fall, as is currently specified in the Guided Pathway for Engineering.

According the U.S. Bureau of Labor Statistics Employment Projections, growth in nationwide engineering employment will be roughly 8%, over the next ten-year period (https://data.bls.gov/search/query/results?cx=013738036195919377644%3A6ih0hfrgl50&q=engineers), which is higher than the average for all job categories. Moreover, the BLS points out that the median wage for engineers is "more than *twice* the median wage for all workers".

The outlook for the engineering profession in California is even stronger than that for the U.S. as a whole. According to Tassel (https://welcome.solano.edu/tassel-engineering/), engineering jobs in California will increase by 12.6% over the next decade. The median annual salary for engineers in California, $117,000, is 77% higher than the median annual salary for all California employees.

Having said this, it is nevertheless the case that enrollment in "traditional" engineering programs has been declining throughout the country, in both community colleges and four-year universities, for the past few years. Specifically, total undergraduate enrollment in U.S. engineering programs declined by 6.5% between 2019 and 2022 (https://www.thespacereport.org/).

Within the broader sphere of engineering, growth is expected to be focused in those areas of engineering that rely heavily on data science and machine learning. For this reason, we have developed a new A.S. Degree in Data Science, along with a Certificate of Achievement in Data Science.

Employment prospects for Data Scientists are even more encouraging than those for engineers in general. According to the Bureau of Labor Statistics, "employment of data scientists is projected to grow 35 percent from 2022 to 2032, much faster than the average for all occupations" (https://www.bls.gov/ooh/math/data-scientists.htm). Moreover, average annual salaries for Data Scientists, currently $120,000, are 82% higher than the mean salary of all occupations (https://welcome.solano.edu/data-science/).

According to Tassel, job growth for Data Scientists in California will be 45% over the coming decade, higher yet than the overall U.S. Data Science growth rate of 36% (https://solano.tasselup.com/occupation/15-2051.00).

Unfortunately, the new requirement that all online instructors undertake an additional six hours each year of LMS and online pedagogy training places an unreasonable burden on adjuncts, and is already making it difficult to find adjuncts willing to teach our Data Science

courses. All online instructors have already completed 80 hours of training in online instruction. New LMS/Canvas changes could be accommodated via optional training courses, as needed.

The inquiry-based learning offered to our students in the laboratory components of our Engineering courses is heavily dependent on having a skilled, dedicated lab technician. The previous lab technician, Richard Crapuchettes, who worked with the Physics, Engineering, Geology, Geography, Astronomy, and Physical Science Departments, retired in Spring 2020. A replacement, Joshua Ang, was hired in July 2023, and is currently being trained. It is imperative for the continued health of the Engineering Program that this position continues to be supported and funded. It is also imperative for Tom MacMullen to continue to be employed through December 2026, which will extend through the period of disruption of the Engineering program due to the remodeling of Building 300.

1.2a - CTE programs: Review the provided labor market data, including employment and wage projections for employees in fields related to the program [upload any additional data to the blue folder in the upper right-hand corner of Section 1]. Comment on any areas that appear especially relevant to the program and its graduates.

According to the Labor Market Information Report on Data Science Occupations, that was prepared for SCC in December 2022 by the San Francisco Bay Center of Excellence for Labor Market Research, "Based on all available data, there appears to be an "undersupply" of Data Science workers compared to the demand for this cluster of occupations in the Bay region and in the North Bay sub-region (Marin, Napa, Solano, Sonoma counties)." **[Please see file uploaded to blue Document Library folder in Section 6]**

1.3 Population - Address how the population of students majoring in the program and/or taking classes in the program differ from the college as a whole; note what demographics (age, race, gender, etc.), are more or less represented, if any.

The following table shows the racial/ethnic breakdown of SCC students taking Engineering courses, contrasted with the corresponding breakdown for SCC as a whole:

	Asian	Black	Hispanic	Other	2 or more	White
SCC	15%	15%	13%	3%	29%	26%
Engineering	20%	7%	11%	2%	33%	28%

For most categories (Hispanic, White, Two or more, Other), the percentage of that group in the Engineering cohort closely mirror the percentages for SCC as a whole. The two discrepancies are that Black students are under-represented in Engineering, and Asian students are over-represented. Although Black students are under-represented in the SCC Engineering program, this is similar to nationwide statistics. In fact, the 7% Black

component of our program is larger than the nationwide figure of 5% of undergraduate Engineering degrees being awarded to Black students (https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf). The percentage of Black students in Engineering in SCC has increased from the value of 5.5% that was reported in the previous Engineering Program Review of 2015, to 7% in the current reporting period.

The following table shows the gender breakdown of SCC students taking Engineering courses, contrasted with the corresponding breakdown for SCC as a whole:

	Male	Female	Other or Not-reporting
SCC	44%	53%	3%
Engineering	80%	18%	2%

The gender breakdown for the SCC Engineering student population is quite different from that for SSC as a whole. Women are under-represented, relative to their proportion of the student-age population as a whole, in Engineering programs throughout the country. However, we can report that the percentage of female Engineering students at SCC has increased to 18%, from the value of 14% that was reported in the 2015 Engineering Program Review. This percentage (18%) is close to the figure of 22% of undergraduate Engineering degrees that are being awarded to female students (https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf).

The age distribution of Engineering students at SCC is nearly the same as the distribution for SCC as a whole. Both distributions peak at about age 19, and more than half of the students are in the age range of 17-21.

1.3a – In the student survey, students were asked to identify why they were taking Program courses. Please summarize and briefly discuss the results.

In the most recent student survey, 75% of the respondents said that they were "taking this course as a requirement for the major", 12.5% reported that they were "taking this course as an elective", and 12.5% reported that they were "taking this course as a requirement for my job".

Program Overview – Goals

Note new or ongoing program-related goals (goals to delete, add, or significantly modify degrees/certificates); for each, note actions to be taken, person(s) responsible, priority, and time frame.

For priority, note that "urgent" means that a program cannot properly function without changes made. For time frame, note that "short term" means within an academic year, and "long term" means within five years.

Program Goals	Actions to be Taken	Persons Responsible	Priority (Important or Urgent)	Time Frame (Long term or Short term)
No changes foreseen at this time	NA	NA	NA	NA

END OF SECTION 1: PROGRAM OVERVIEW GOALS

SECTION 2: COURSES IN DEPARTMENT (TABLE)

2.1 Course Offerings - Specify which courses in the department and/or degree/certificate have been deleted or added since the last program review, and what prompted those changes. If these changes have already led to improvement, please describe.

As of the time of the previous program review in 2015, the Engineering Department offered four courses: ENGR 001 (Introduction to Engineering), ENGR 017 (Introduction to Electrical Engineering), ENGR 030 (Engineering Mechanics: Statics), and ENGR 045 (Properties of Materials).

Eight new courses have been introduced since the previous Program Review: ENGR 003 (Introduction to Ethics in Engineering, 3.0 Units), ENGR 007 (Python Programming for Scientists and Engineers, 4 units), ENGR 008 (Data Science with Python for Scientists and Engineers, 4 units), ENGR 010 (Machine Learning with Python for Scientists and Engineers, 4 units), ENGR 011 (Deep Learning with Python for Scientists and Engineers, 4 units), ENGR 012 (Discrete Mathematics for Scientists and Engineers, 4 units), ENGR 014 (Introduction to Statistical Programming in R for Scientists and Engineers, 4.0 Units), and ENGR 026 (Mathematics and Engineering Problem Solving Using Matlab, 4 units). These new courses are discussed in more detail below.

ENGR 003 (Introduction to Ethics in Engineering) was introduced in 2021, and has been taught once each year since then. ENGR 003 has received IGETC and CSU GE approval. It has consequently proven to be very successful, and attracts about 25 students each year, including many non-engineering students who take it as a GE course. This is the first course devoted to Ethics in Engineering to be approved at any California community college.

ENGR 007 (Python Programming for Scientists and Engineers) was approved in December 2022. It has been offered for the first time in Fall 2023, and has an enrollment of 19, with a class maximum of 30. Python is the main computer programming language used in the field of Data

Science, and is not taught in any other transferable courses within SCC. This new course is therefore a key component of our new Data Science A.S. degree, and our new Data Science Certificate of Achievement. This course has been submitted for articulation to the four-year colleges, and for C-ID approval (C-ID ENGR 120).

ENGR 008 (Data Science with Python for Scientists and Engineers) was approved in December 2022. This course provides the main introduction to the field of data science, and will therefore be a key component of our new Data Science A.S. degree, and our new Data Science Certificate of Achievement. This course has been submitted for articulation to the four-year colleges.

ENGR 010 (Machine Learning with Python for Scientists and Engineers) was approved in December 2022. Machine Learning is one of the most powerful tools in the new field of data science, and will therefore be a key component of our new Data Science A.S. degree, and our new Data Science Certificate of Achievement.

ENGR 011 (Deep Learning with Python for Scientists and Engineers) was approved in December 2022. Deep Learning is a branch of Artificial Intelligence, and will be a useful elective course within our new Data Science program.

ENGR 012 (Discrete Mathematics for Scientists and Engineers) was approved in December 2022. Discrete Mathematics underpins many of the concepts and tools used in the field of data science, and much of this material is not covered in other SCC Math courses. This course has been submitted for articulation to the four-year colleges, and for C-ID approval (C-ID MATH 160).

ENGR 014 (Introduction to Statistical Programming in R for Scientists & Engineers) was developed and approved in 2021, and was offered once in Spring 2022, but was cancelled due to low enrollment. R is a statistical programming language that is widely used in the biological sciences, and in data science more generally. This course is an elective course in the Data Science A.S. Degree, and a required course in the Data Science Certificate of Achievement. Once these degrees/certificates are fully up and running, we expect enrollment in ENGR 014 to be healthy.

ENGR 026 (Mathematics and Engineering Problem Solving Using Matlab), was created in 2016, and has been taught twice since 2017. This course is co-listed with the Math Department as MATH/ENGR 026. Matlab is a computing language that is widely used in the engineering field, and is not taught in the CIS Department. Its addition has strengthened and broadened our Engineering program. However, this course has been cancelled several times due to low enrollment, which was probably due to the fact that the course did not articulate to UC Davis. After several years of bureaucratic delay, we finally received confirmation by UC Davis on Nov. 17, 2023, that ENGR 026 now articulates to ENG 006 at UC Davis, effective Fall 2023. Once the course is included in the TAG agreements with UC Davis for various engineering majors, we expect enrollments to increase.

Several other important changes were made to our Engineering courses during the period of time covered by this program review. Specifically, we obtained C-ID approval for several existing courses:

ENGR 017 (Introduction to Electrical Engineering) received approval for C-ID ENGR 260 and ENGR 260L.

ENGR 026 (Mathematics and Engineering Problem Solving Using Matlab) received approval for C-ID ENGR 220.

ENGR 030 (Engineering Mechanics: Statics) received approval for C-ID ENGR 130.

ENGR 045 (Properties of Materials) received approval for C-ID ENGR 140B.

Additionally, ENGR 001 was changed from 1 unit to 2 units, by expanding the course from one hour per week to two hours per week. This change, which allowed more time to be devoted to each topic in the curriculum, enabled us to obtain C-ID approval for this course. This approval (C-ID ENGR 110) was obtained in Fall 2019.

We are currently in the process of obtaining C-ID approval for ENGR 007 (C-ID ENGR 120) and ENGR 012 (C-ID MATH 160).

The full list of currently-offered Engineering courses is as follows, as taken from the 2023-24 SCC Catalog:

ENGR 001: Introduction to Engineering (2.0 Units)
Course Advisory: ENGL 001
C-ID: ENGR 110
Transferable to both UC and CSU
A first, non-technical course for engineering students and students considering majoring in engineering. Introduction to different engineering fields, the campus life of engineering students, schedule guidelines, opportunities in engineering, engineers' roles in society, ethics in engineering, and strategies and approaches required to survive math, science, and engineering courses. Develops communication skills pertinent to the engineering profession. Possible field trips.

ENGR 003: Introduction to Ethics in Engineering (3.0 Units)
General Education: IGETC: Area 3B; CSU: Area C2
Transferable to both UC and CSU
Development of techniques of moral analysis and their application to ethical problems encountered by engineers, such as professional employee rights and whistle blowing; environmental issues; ethical aspects of safety, risk and liability; conflicts of interest. Emphasis on developing the capacity for independent ethical analysis of real and hypothetical cases.

ENGR 007: Python Programming for Scientists and Engineers (4.0 Units)
C-ID: ENGR 120 (approval in progress)
Transferable to both UC and CSU
Introduction to programming for scientists and engineers, utilizing the Python language and environment. Topics covered include object-oriented programming, elementary data structures, modules, algorithms, recursion, data abstraction, code style, documentation, debugging techniques, and testing. Also covers the interface between software and the physical world (i.e., sensors).

ENGR 008: Data Science with Python for Scientists and Engineers (4.0 Units)
General Education: CSU: Area B4
Transferable to both UC and CSU
This course covers the three main aspects of data science: inferential thinking, computational thinking, and real-world relevance. Topics include critical concepts and skills in computer programming and statistical inference, and the analysis of real-world datasets, as well as social issues surrounding data analysis such as privacy and design. This course will be taught in Python.

ENGR 010: Machine Learning with Python for Scientists and Engineers (4.0 units)
Transferable to both UC and CSU
Machine Learning encompasses the study of algorithms that learn from data. It has been a key component in a number of problem domains including computer vision, natural language processing, computational biology, and robotics. This class will introduce the fundamental concepts and algorithms in machine learning (supervised as well as unsupervised learning), as well as best practices in applying machine learning to practical problems.

ENGR 011: Deep Learning with Python for Scientists and Engineers (4.0 Units)
Transferable to both UC and CSU
Deep Learning is a branch of Artificial Intelligence (AI) that is based on the architecture of Neural Networks. When the number of hidden layers in a neural network is extended, it becomes a 'Deep Learning' Neural Network. This course will cover the basic concepts and tools of Neural Networks and Deep Learning, including the TensorFlow and Keras interfaces.

ENGR 012: Discrete Mathematics for Scientists and Engineers (4.0 Units)
C-ID: MATH 160 (approval in progress)
Transferable to both UC and CSU
General Education: CSU: Area B4.
Discrete mathematics: set theory, logic, Boolean algebra, methods of proof, mathematical induction, number theory, discrete probability, combinatorics, functions, relations, recursion, algorithm efficiencies, graphs, trees.

ENGR 014: Introduction to Statistical Programming in R for Scientists and Engineers (4.0 Units)
Transferable to both UC and CSU

Advances in computing power have enabled scientists to amass huge amounts of data on everything from genetics to climate science, but there is a need for someone to make sense of this data. In this class we will learn how to perform basic statistical analysis such as writing data frames, creating functions, using variables, statements, and loops and employing statistical concepts such as exploratory data analysis, probabilities, hypothesis tests, regression modeling and data visualization, using the statistical software R.

ENGR 017: Introduction to Electrical Engineering (5.0 Units)
C-ID: ENGR 260 and ENGR 260L
Transferable to both UC and CSU
A study of basic DC circuit analysis techniques including Kirchhoff's laws, mesh-currents, node-voltages, Thevenin and Norton equivalent circuits, transient and steady-state response of AC passive circuits, power calculations, active circuit elements including operational amplifiers and semiconductor devices. Construction and measurement of electrical circuits using multimeters, oscilloscopes, power supplies, and function generators. Introduction to circuit simulation software.

ENGR 026: Mathematics and Engineering Problem Solving Using Matlab (4.0 Units)
C-ID: ENGR 220
Transferable to both UC and CSU
Covers methodologies for solving mathematics and engineering problems. Students will learn to perform mathematics and engineering computation and visualization using the MATLAB language. Students will write a variety of programs in the MATLAB language. Same as MATH 026.

ENGR 030: Engineering Mechanics: Statics (4.0 Units)
C-ID: ENGR 130
General Education: SCC: Area A; IGETC: Area 5A
Transferable to both UC and CSU
A study of the principles of statics of particles and rigid bodies as applied to equilibrium problems of two and three-dimensional structures, and the principles of friction, virtual work, and stability of equilibrium.

ENGR 045: Properties of Materials (4.0 Units)
C-ID: ENGR 140 B
General Education: IGETC: Area 5A, 5C; CSU: Area B1, B3
Transferable to both UC and CSU
Covers the application of basic principles of physics and chemistry to the structure and properties of engineering materials. Special emphasis is devoted to the relationship between microstructure and the mechanical properties of metals, polymers and ceramics, and the electrical, magnetic, and optical properties of materials.

2.1a - Describe what new course or courses are planned and provide reasons for these new offerings, including how these courses might address issues of equity and student success. CTE programs: Note how advisory board input has led to planned course changes. Please add any new course plans to the Course Goals table at the end of Section 2.

There are currently no plans to add any additional new courses to our Engineering / Data Science degrees or department.

2.2 Scheduling, Sequencing, and Fill - Describe the student survey feedback related to course scheduling. What barriers to enrollment do students report? In terms of timing, location, and instructional format of course offerings, what changes are suggested by the survey responses?
(Be sure to add any goals which address these survey responses to the Course Goals table at the end of Section 2.)

The Student Survey was sent out in Spring 2022. In that survey, 75% of the students who responded reported that "I have not experienced any barriers enrolling in courses in this program/department", whereas 25% reported that "the course(s) I needed were not offered this semester".

2.2a - For courses with low enrollment numbers, note possible causes (such as the type of class, scheduling, etc.).

ENGR 001 and ENGR 003 easily surpass the 60% enrollment target. These two courses are generally taken as GE courses, and are not required for the Engineering major. The main Engineering courses that are required for the Engineering A.S. degree, ENGR 017, 030, and 045, have had average enrollments (during this current reporting period) of 15, 14, and 13, respectively. Although the class maxima in each of these cases is 30, these maxima have never been realistic, and have never come close to being achieved in the twenty-five years of our current institutional memory.

Unfortunately, in contradiction to the clearly-stated directive contained in the 2022 Physics Program Review, a new section of PHYS 007 has been added in the Spring in Vacaville, taught by an instructor with no Engineering background. Students who take PHYS 007 with an instructor who lacks a connection to Engineering do not receive encouragement and motivation to consider Engineering as a career path. The immediate consequence of this new course addition has been that enrollment in our key transferable Engineering courses, such as ENGR 017, ENGR 030, and ENGR 045, has plummeted. Essentially, we are losing half of our traditional stream of potential Engineering majors. The best way to resolve this is to strongly encourage Engineering

majors to take PHYS 006 in the Spring and PHYS 007 in the Fall, as is already prescribed in the Guided Pathway for Engineering.

2.2b - Note if there is a preferred sequence of classes that students should take in the department/degree/certificate, or if there is no preferred sequence, and how students are informed of your preferred sequence (if any). Describe any work done to support PACE/Guided Pathways and inform counselors.

Sample Course Sequence for the Engineering A.S. degree:

Course No.	Course Name	Units	Sequence
MATH 020	Analytic Geometry and Calculus I	4	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4	Year 1, Spring
MATH 022	Analytic Geometry and Calculus III	4	Year 2, Fall
MATH 023	Differential Equations	4	Year 2, Spring
PHYS 006	Physics for Science & Engineering I	5	Year 1, Spring
PHYS 007	Physics for Science & Engineering II	5	Year 2, Fall
CHEM 001	General Chemistry	5	Year 1, Fall
ENGR 017	Introduction to Electrical Engineering	5	Year 2, Spring
ENGR 030	Engineering Mechanics: Statics	4	Year 2, Fall
CIS 022	Introduction to Programming	3	Year 2, Spring
ENGL 001	College Composition	3	Year 1, Fall
ENGL 002	Critical Thinking and Writing About Literature	4	Year 1, Spring
COMM 001	Introduction to Public Speaking	3	Year 2, Fall
SPAN 001	First Semester Spanish	5	Year 2, Spring

Year 1, fall term	Year 1, spring	Year 2, fall term	Year 2, spring term
MATH 020 (5)	MATH 021 (5)	MATH 022 (4)	MATH 023 (4)
ENGL 001 (3)	PHYS 006 (5)	PHYS 007 (5)	ENGR 017 (5)
CHEM 001 (5)	ENGL 002 (4)	ENGR 030 (4)	CIS 022 (3)
		COMM 001 (3)	SPAN 001 (5)
13 units	14 units	16 units	17 units

TOTAL UNITS: 60 units

Sample Course Sequence for the Data Science A.S. degree:

Course No.	Course Name	Units	Sequence
MATH 011	Elementary Statistics	4	Year 1, Spring
MATH 020	Analytic Geometry and Calculus I	4	Year 1, Fall
MATH 021	Analytic Geometry and Calculus II	4	Year 1, Spring
MATH 022	Analytic Geometry and Calculus III	4	Year 2, Fall
MATH 040	Introduction to Linear Algebra	3	Year 2, Spring
ENGR 007	Python Programming for Scientists and Engineers	4	Year 1, Spring
ENGR 008	Data Science with Python for Scientists and	4	Year 2, Fall

ENGR 010	Machine Learning with Python for Scientists and	4	Year 2, Spring
ENGR 012	Discrete Mathematics for Scientists and Engineers	4	Year 1, Fall
ENGL 001	College Composition	4	Year 1, Fall
LR 010	Information Skills for College and Beyond	1	Year 1, Fall
ENGL 002	Critical Thinking and Writing About Literature	4	Year 1, Spring
SOC 001	Introduction to Sociology	3	Year 1, Fall
COMM 001	Introduction to Public Speaking	3	Year 2, Spring
ASTR 010	General Astronomy	3	Year 2, Fall
ASTR 020	Astronomy Laboratory	1	Year 2, Fall
SPAN 001	First Semester Spanish	5	Year 2, Spring
KINE 002A	Swimming – Beginning	1	Year 2, Fall

Year 1, fall term	**Year 1, spring term**	**Year 2, fall term**	**Year 2, spring term**
MATH 020 (4)	MATH 011 (4)	MATH 022 (4)	MATH 040 (3)
ENGR 012 (4)	MATH 021 (4)	ENGR 008 (4)	ENGR 010 (4)
ENGL 001 (4)	ENGR 007 (4)	ASTR 010 (3)	SPAN 001 (5)
LR 010 (1)	ENGL 002 (4)	ASTR 020 (1)	COMM 001 (3)
SOC 001 (3)		KINE 002A (1)	
16 units	16 units	13 units	15 units

TOTAL UNITS: 60 units

Sample Course Sequence for the Data Science Certificate of Achievement:

Course No.	**Course Title**	**Units**	**Sequence**
MATH 011	Elementary Statistics	4	Term 1
ENGR 007	Python Programming for Scientists and Engineers	4	Term 1
ENGR 008	Data Science with Python for Scientists and Engineers	4	Term 2
ENGR 010	Machine Learning with Python for Scientists and	4	Term 2
ENGR 012	Discrete Mathematics for Scientists and Engineers	4	Term 1
ENGR 014	Introduction to Statistical Programming in R for Scientists and Engineers	4	Term 2

Term 1	**Term 2**
MATH 011 (4)	ENGR 008 (4)
ENGR 007 (4)	ENGR 010 (4) or ENGR 011 (4)
ENGR 012 (4)	ENGR 014 (4)
12 units	12 units

Our Engineering Program has traditionally received excellent support from SCC counselors, particularly Amy Dauffenbach, who is extremely knowledgeable about our Engineering program. In addition, Adjunct Counselor and SCC articulation officer Ashlie Lawson provided crucial assistance in creating the new Data Science A.S. degree. Ashlie Lawson's work as Articulation Officer provides a pillar for the College, without which it could not function as

well as it does. Articulation of courses is crucial to the health of the Engineering (and other) programs, and so it is imperative that the position of Articulation Officer be made a full-time position.

The pipeline of Engineering students at SCC is very leaky, and only a small fraction of declared Engineering majors eventually take our key ENGR courses. As mentioned above, it is imperative that counselors strongly encourage Engineering majors to take PHYS 006 in the Spring, and PHYS 007 in the Fall, as is already prescribed in the Guided Pathway for Engineering. This will allow these students to move directly to our core Engineering courses (ENGR 017, ENGR 030, ENGR 045), without having to wait one or two semesters, as is the case if they start with PHYS 006 in the Fall. These points have recently been brought to the attention of Interim Dean of Counseling, Ashlie Lawson, in November 2023. Lastly, it would be very beneficial if the Research and Planning Department would track each Engineering major, to find out why we are losing so many students from the Engineering pipeline.

2.3 Prerequisites, Course Advisories, and Placement. Review and summarize student survey feedback regarding prerequisites. Note how advisories and pre- and co-requisites might be changed to get students better prepared for classes in the program. Be sure to add any goals that address these survey responses to the Course Goals table at the end of Section 2.

The Student Survey was sent out in Spring 2022. In that survey, 72% of students who responded said that they "strongly agreed" (57%) or "agreed" (14%) with the statement that "This course builds on the material presented in the prerequisite (or previous) class."

Course Goals:

Course Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)
Faculty are discussing adding "hybrid" as a possible permanent mode of delivery for all of our lab-based courses.	Create curriculum proposals.	Melanie Lutz	Important	Short Term

END OF SECTION 2: COURSE GOALS

SECTION 3: ASSESSMENT OF PLOS & SLOS (TABLES)

Assessment of PLOs (Note that the A.S. degree in Data Science was not offered during the period 2015-2022 that is covered by this Program Review)

PLOs for ENGR A.S. degree	Expected Performance	Performance
PLO 1: Demonstrate analytical problem solving skills in Math, Physics, Chemistry, and Engineering. (SLO2 ENGR 030)	70%	92.3%
PLO 2: Conduct experiments and critically assess the data. (SLO1 ENGR 017)	70%	100%
PLO 3: Write professional laboratory reports and/or give oral presentations. (SLO3 ENGR 045)	70%	100%

3.1 Program Learning Outcomes (PLOs) - Summarize the student survey feedback related to PLOs. To what extent do majors understand the PLOs, find the classes effective in preparing them to succeed in the PLOs, and feel they are able to achieve the PLOs?

According to the Student Survey that was sent out in Spring 2022, 87.5% of the respondents said that they understood the PLOs. However, only 62.5% of the respondents found the classes to be effective in preparing them to succeed in the PLOs. The negative responses pertained mainly to the PLOs that related to laboratory experiments, and correspond to the period when our lab experiments were "online". We expect that these responses will improve as the labs return to face-to-face mode.

Assessment of SLOs

SLOs for ENGR 001	Expected Performance	Performance
SLO 1: Develop a general knowledge of the tasks and responsibilities of engineers in various fields.	70%	86%
SLO 2: Understand the role of engineers in today's world and the importance of ethical issues in decision-making processes.	70%	82%
SLO 3: Demonstrate the ability to effectively communicate engineering ideas and information through an oral presentation.	70%	75%

SLOs for ENGR 003		
SLO 1: Demonstrate the capacity to think analytically, critically, and creatively about ethical issues in engineering.	70%	88%
SLO 2: Know some of the classic cases in engineering ethics and some of the typical ethical and professional issues that arise in engineering.	70%	78%
SLO 3: Demonstrate skills in effective communication, both oral and written.	70%	72%
SLOs for ENGR 017		
SLO 1: Apply Kirchhoff's Laws and Thevenin's and Norton's Theorems to analyze electrical circuits.	70%	92.3%
SLO 2: Analyze electrical circuits with active circuit elements such as op-amps.	70%	96.2%
SLO 3: Utilize phasor techniques to analyze AC circuits.	70%	96.2%
SLOs for ENGR 030		
SLO 1: Students will be able to use the principles of statics to analyze the equilibrium of rigid bodies in two and three dimensions.	70%	96.3%
SLO 2: Students will be able to use the principles of statics to analyze beams and determine their shear and moment diagrams.	70%	96.3%
SLO 3: Students will be able to use energy methods such as virtual work and potential energy to determine the equilibrium and stability of rigid bodies.	70%	96.3%
SLOs for ENGR 045		
SLO 1: Students will be able to explain the microscopic mechanisms that underlie the macroscopic behavior of engineering materials.	70%	100%
SLO 2: Students will be able to explain the relationship between microstructure and material properties and the impact of	70%	100%

processing on microstructure and material properties.		
SLO 3: Students will be able to perform lab experiments and write up professional lab reports.	70%	100%

3.2 Student Learning Outcomes (SLOs) - Review the current status of SLOs in your program. Note if all course SLOs are written and up-to-date (at least two per course).
Identify which courses have not been assessed in over two years, and note which of these courses have not been offered in over two years.

All course SLOs are complete and up to date, and can be found in the Course Outline of Record (COR) within eLumen. Five of the six courses in the Engineering Department that were active during the reporting period of 2015-2022 were offered at least once each year, and were each assessed within the past two years. The sole exception is ENGR 026, which has been cancelled in the past two years due to low enrollment, and consequently its SLOs have not recently been assessed. The SLOs for this course will be assessed in Spring 2024, provided that the Dean and the Academic VP allow the course to run.

> **3.2a - Describe collaborative efforts among faculty to assess SLOs. For example, note if SLO assessments in online and face-to-face courses have been compared, and what these comparisons indicate. Note if rubrics have been used in different sections of the same course, or across courses, to aid SLO assessment.**
>
> None of our Engineering courses have been taught by more than one instructor, and none of these courses have more than one section per year. Hence, it was not necessary to correlate assessments between different sections. In those cases for which we can compare the success rates for sections taught face-to-face, against sections taught online (albeit in different years), the success rates were roughly similar, to within +/– 6%.

SECTION 4: STUDENT SUCCESS (by RACE/ETHNICITY and GENDER – TABLES)

4.1 Student Success and Support - Describe the student survey feedback related to success. What barriers did students identify, and what did they find helpful? How did students address the question of equity and emotional safety?

The only barriers to success that were identified in the student survey pertained to the lack of face-to-face labs during the Covid era. For example, one such comment was "The lack of labs in engineering and physics courses significantly impacts the learning experience of students. Science and engineering courses are provided with a lab element to provide hands on, practical experience with the concepts delivered in the lecture portion. Online lab exercises, whether via

simulation or demonstration by another are NOT equal substitutes." This issue will disappear as we return to face-to-face labs.

With regards to aspects that helped them to succeed, several students mentioned "Prof. Lutz". One student mentioned that Prof. Lutz "pushes students to their potential. Other classes offer a standard approach. Having experienced both, one method provided a quality education, and motivates students to succeed. The other method sets low expectations, and prepares students to fail when challenged."

75% of the responding students responded affirmatively to the question "The courses (online or face-to-face) in this program/department provide an emotionally safe, supportive learning environment, where I can explore ideas and express myself". No specific comments were provided in response to this question.

4.2 Success by Population - Review the student success rates in the program/department, if available. If possible/applicable, review student success in general education classes (across specific populations) with student success in degree-specific courses. Note if certain groups are significantly more or less successful than their peers, and if there have been any clear trends upward or downward since the last program review. Provide possible reasons for higher or lower success rates.

The success rate for all courses taught in the Engineering Department, over the entire reporting period of 2015-2022, was 82%. This success rate was substantially higher than the success rate for SCC as a whole, which was 75%.

The Engineering Department's success rate of 82% shows an improvement from the 79% success rate that was reported in the previous 2015 Program Review.

The overall success rate in those Engineering courses that are required for the major was 91%, whereas the success rate for the two GE courses, ENGR 001 and ENGR 003, was 74%. The success rate for the two GE courses was essentially the same as the success rate for SCC as a whole (74% vs. 75%).

The following table shows the racial/ethnic breakdown of the success rates of SCC students taking Engineering courses, contrasted with the corresponding breakdown for SCC as a whole:

	Asian	Black	Hispanic	Other/Unknown	2 or more	White
ENGR	79%	NA	83%	NA	79%	87%
SCC	79%	65%	73%	73%	73%	78%

The success rate for each racial/ethnic group in Engineering was in all cases at least as high, and in most cases higher, than the success rate for that group in SCC as a whole. Note that there seems to be an error in the http://solano.edu/research_planning/worksheet1test.php database,

since the Student Success page shows no data for Engineering in the "Black" or "Other" categories, whereas, for example, the Demographic page indicates 24 Black Engineering students.

The next table shows the gender breakdown of the success rates of SCC students taking Engineering courses, contrasted with the corresponding breakdown for SCC as a whole:

	Male	Female
ENGR	83%	80%
SCC	74%	75%

The success rate in Engineering for female students (80%) was only slightly lower than the success rate for male students (83%). The success rates for both male and female students in Engineering were each substantially higher than the corresponding success rates in SCC as a whole.

4.3 Degrees/Certificates Awarded (if applicable). Review the number of degrees and certificates awarded over the past five years, if available, and address any clear upward or downward trends. If students are leaving the program before earning the degree/certificate, note whether certain courses are a stumbling block, or if students don't need all the courses in the program to achieve their goals. If possible, note if certain populations of students are having greater difficulty completing the program.

The Engineering Department has been offering an A.S. degree since 2015. The number of degrees awarded each year is shown in the following table:

Academic Year	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Average
No. of degrees	7	5	6	9	7	8	7

The number of Engineering degrees awarded has been relatively stable during the period covered by the Program Review, at about seven per year. The percentage of Engineering A.S. degrees awarded to women was 19% (8 out of 42), which is very close to the national figure of 22% of undergraduate Engineering degrees that are awarded to female students (https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf). Also worth noting is the fact that 17% (7 out of 42) of our Engineering degrees were awarded to Veterans.

4.4 Preparation for the Future - Describe how students are informed about future options, such as the kinds of schools they might transfer to, the kinds of employment available in

their field, and what further degrees might be useful to get into a particular profession. CTE programs: Note also if any agreement or MOU exists with employers to place graduates.

The Transfer Center at SCC provides prospective transfer students with direction and assistance in navigating the transfer process. The services that they offer include connecting students with university representatives, holding transfer-related workshops and transfer fairs, helping students access information on transfer websites, and assisting students with researching colleges, and arranging campus tours. SCC counselors and individual Engineering instructors also give advice to students regarding career pathways, transfer opportunities, and degree options, that will help them to achieve their goals.

4.4a CTE programs: Note if there are any statewide, local or national tests that students should take, after leaving your program, in order to get employed or be more competitive in the job market. Note also if students need additional study or coursework (not provided by the college) before they are ready to take those tests. Explain how students are informed about these requirements.

NA

SECTION 5: OUTREACH

5.1 Outreach for Equity - Describe outreach efforts since the last program review to attract and retain under-represented populations (such as diversified curriculum or guest lecturers).

- SCC Engineering student Erin Nebel attended the Conference for Undergraduate Women in Physics (CUWiP), at UCLA, January 13-17, 2017.
- Engineering instructor Melanie Lutz met with Mark Asta, Chairman of the Materials Science and Engineering Department at UC Berkeley, about creating pathways for students at SCC to transfer into MSE at UC Berkeley, on July 27, 2017.
- SCC Engineering was listed in "Top 100 for Asians and Minorities in Engineering": http://diverseeducation.com/top100/pages/AssociatesDegreeProducers2018.php.
- Scott Berta presented information about the new SCC AS Degree in Engineering, at the SCC High School Counselors Conference, on March 8, 2018.
- Three SCC Engineering students, Leena Hussein, Kathleen Matsumoto-Elliott, and Kelsey Balella, attended the American Physical Society Conference for Undergraduate Women in Physics at UC Davis on January 18-20, 2019. http://www.solano.edu/president/insidesolano/2019/Inside012819.pdf. `
- Faculty member Katie Berryhill, and former SCC Engineering student Nicole Peacock, participated in the SCC Women in STEM Panel, on March 21, 2019. https://www.dailyrepublic.com/all-dr-news/solano-news/fairfield/solano-college-to-host-stem-panel-discussion/.

- Scott Berta gave a presentation at the SCC High School Counselors Conference, about the Physics and Engineering programs, on March 3, 2022.

5.2 Outreach on Campus - Describe how the program has connected with the campus community. Include any cross-discipline collaborations, student clubs, or other activities that connect students in the program to the college as a whole. Note whether there is currently need for more coordination with Counseling.

- A group of nineteen students from the SCC Welding Department were invited to our Engineering lab, to participate in a tensile test experiment, on April 25, 2016.
- Engineering student Geff Freire distributed flyers about the SCC Engineering Program at STEM CLUB DAY, on Oct. 27, 2016.
- Engineering student Geff Freire distributed Engineering flyers at Club Promo Day on Feb. 1, 2017.
- Scott Berta presented information about the new SCC AS Degree in Engineering, at the SCC High School Counselors Conference, on March 8, 2018.
- Engineering adjunct instructor Scott Berta set up a table to promote our Engineering Program at the SCC Majors Fair on March 20, 2018 on the Fairfield campus.
- Engineering adjunct instructor Scott Berta set up a table to promote our Engineering Program at the SCC Majors Fair on March 20, 2019 on the Fairfield campus.
- Engineering instructor Melanie Lutz invited DRFT 058 instructor Cynthia Jourgensen to visit ENGR 030 in Fall 2021 to inform our students about Solid Works.
- Engineering adjunct instructor Scott Berta gave a presentation about the Physics and Engineering Programs at the SCC High School Counselors Conference on March 3, 2022.
- Engineering adjunct instructor Scott Berta spoke at a UC Berkeley alumni event that took place on Dec. 3, 2022.

5.3 Outreach to the Community - Describe how the program has connected with the larger community. Provide examples of activities, field trips, and community/classroom partnerships since the last program review. Note who has been brought into the classroom, and where students have been brought, beyond the classroom.

- Engineering instructor Melanie Lutz spoke to high school teachers and counselors about pre-engineering opportunities at SCC, as part of an Engineering Pathway Partner Workshop, Friday, on March 4, 2016.
- Engineering instructor Melanie Lutz hosted 40 students from Engineering Academy High School in Vallejo to tell them about the pre-Engineering program at SCC, on March 23, 2016.
- A group of ten students from Buckingham Charter Magnet High School in Vacaville, along with their teacher, former SCC Engineering student Ben Pochop, were invited SCC to participate in a tensile test experiment, in Spring 2016.
- SCC Engineering student Geff Freire attended a robotics outreach event for high school students at St. Mary's Church in Vacaville on Sept. 25, 2016, and distributed the SCC Engineering Brochure.

- Engineering instructor Melanie Lutz and Engineering student Geff Freire gave presentations about the SCC Engineering Program to two groups of 6th, 7th, and 8th graders from the Matt Garcia Career and College Academy on Oct. 26, 2016.
- US Air Force representative Sgt. Rolando Lora was invited to speak to our PHYS 007 students about opportunities for Engineering majors in the Air Force, on Nov. 18, 2016.
- Engineering Student Geff Freire spoke to 30 DSP high school students from Fairfield about studying CIS, Computer Science, and Engineering at SCC, on March 16, 2017.
- Engineering instructor Melanie Lutz spoke to 25 students from Vallejo High School, about the SCC Engineering Program, on May 5, 2017.
- Engineering instructor Melanie Lutz invited two US Navy Representatives to a session of PHYS 006 (one of the key courses in our Engineering A.S. degree) on February 21, 2018, to inform students about job opportunities in Nuclear Engineering in the US Navy.
- SCC Engineering students Heath Muskat and Jered Bell served as mentors to students from Winters High School for their senior project involving rocket building, 2018-19.

Outreach Goals

Outreach Goals	Actions to be taken	Person(s) Responsible	Priority (Important or Urgent)	Time Frame (Short term or Long term)	Funding (N/A, One-time, Ongoing)	Cost
Faculty will continue to participate in SCC outreach activities to promote the Engineering / Data Science programs	Participate in SCC outreach activities	Faculty / lab technician	Important	Long term	N/A	$0

END OF SECTION 5: OUTREACH GOALS

SECTION 6: RESOURCES

6.1 Human Resources - Describe the current staffing levels in the program, and whether they are currently adequate to meet students' needs. If the program has been functioning for a

while without needed faculty/staff, note how long has this position been needed, and how this gap has affected the program's health.

Full-time Engineering instructor Melanie Lutz, and adjunct Engineering instructor Scott Berta, teach our "traditional" engineering courses, ENGR 001, ENGR 003, ENGR 017, ENGR 030, and ENGR 045. We have now been rolling out our new Data Science courses (ENGR 007, ENGR 008, ENGR 010, ENGR 011, ENGR 012, and ENGR 014), and Dr. Sana Vaziri was hired in Fall 2022 to help teach these courses. However, we do not currently have a sufficient number of adjuncts to teach the full suite of our new Data Science courses. We eventually need to hire a full-time instructor to teach our new Data Science courses; until then, we need two additional adjuncts.

For the three years following the retirement of our laboratory technician Richard Crapuchettes in Spring 2020, our Engineering program was functioning without a lab tech. A replacement, Joshua Ang, was hired in July 2023, and is currently being trained by former SCC Engineering instructor Tom MacMullen. It is imperative for the continued health of the Engineering Program that this full-time lab technician position continues to be supported and funded. It is also imperative for Tom MacMullen to continue to be employed through December 2026, which will extend through the period of disruption of the Engineering program due to the remodeling of Building 300.

6.1a - Note what gaps will need filling within the next year, and within the next five years, and why new or replacement faculty/staff will be needed.

In the short term, we need to hire two adjuncts who are qualified to teach some of our new Data Science courses. In the longer term (*i.e.*, within the next five years), we will need to hire a full-time instructor to teach some of our new Data Science courses, and to help direct the growth of the Data Science program.

6.2 Technology - If the program has been functioning for a while without needed technology (IT, software, hardware), note how long the technology/equipment has been needed, and how this gap has affected the program's health.

Although most of our laboratory equipment is old, it is still functional, and suitable for its purpose. This equipment, along with the desktop and laptop computers used in the labs, needs to be, and is, maintained and upgraded as needed. Maintaining our aging equipment will require the continued employment of a lab technician, as has been discussed elsewhere in this Program Review.

6.2a - Note what new or special technology will be needed in the next year, and the next five years, and why it will be needed.

No new technology will be needed at Fairfield for our "traditional" engineering program, aside from normal maintenance and upkeep of our existing laboratory equipment and lab software. Based on input from Doug Sherman of Stratovan, who is the chairman of the external Advisory Board of our new Data Science program, we need a main server that runs the Jupyter Hub that students log into (https://www.thinkmate.com /system/gigabyte-g292-2g0/623931), and an additional server to store data for students (https://www.thinkmate.com/system/stx-nl-xe12-12s3-10g /623932). The estimated cost of this hardware is $36k. We are in discussion with Stratovan regarding the possibility that they provide and manage (for a fee) some of the computer technology that will be needed for our Data Science program.

6.2b - Describe survey feedback describing students' experiences with technology in the classroom.

In the Student Survey that was sent out in Spring 2022, the vast majority of respondents (72%) commented that the statement: "The classroom facilities, equipment, and physical space support student learning in this class" was not applicable to them, as they were taking the course online. During the past three calendar years, 2020-23, all of our Engineering courses have been delivered online, and no issues have been reported by students with the Zoom or Canvas technology that has been used.

6.3 Facilities & Equipment - Note what classrooms, buildings, and other facilities the program currently uses/occupies. Describe how the existing facilities/equipment serve the program's needs, and in what ways the existing facilities are inadequate to meet students' needs. If the program has been functioning for a while with inadequate facilities/equipment, note how this has affected the program's health.

Currently, all Engineering courses are taught either online, or at the Fairfield campus in Room 302. This room, and its associated prep room, are perfectly suited to the needs of this program, for the near future.

In the near term, there are plans to remodel Building 300, which will force our ENGR courses to relocate for at least three semesters (Fall 2024 through Fall 2025). Unfortunately, despite numerous e-mails to Dean Ryan and Vice President of Facilities Lucky Lofton, the Engineering (and Physics and Astronomy) faculty are not being allowed to have any input into this process, and so it is not clear if the remodeled space will be fit for purpose.

As has been mentioned in the Physics, Physical Science, and Astronomy Program Reviews, the long-term ambition is to build a new STEM Center, with a domed planetarium, on the Fairfield campus, that will house Mathematics, Physics, Engineering, Astronomy, Physical Science, along with our new Data Science Program. This new STEM Center, which will contain a state-of-the-art computer lab, was mentioned in Section 4.4 of the 2016 Astronomy Program Review: "For

the longer term, the Astronomy Department faculty, along with the Physics and Engineering Departments, have been advocating the construction of a new dedicated Physical Sciences building, which would include a domed planetarium."

6.3a - Note what new facilities/equipment will be needed in the coming years.

As mentioned above, our long-term plans are to move the Engineering program at Fairfield into a new STEM Center, which will house the Physics, Astronomy, Engineering, Physical Science, and Mathematics Departments. Until this time, the facilities in Building 300 are perfectly suitable for our Engineering Program.

6.3b - Describe survey feedback describing students' experiences with the Program's facilities/equipment.

In the Student Survey that was sent out in Spring 2022, the vast majority of respondents (72%) commented that the statement: "The classroom facilities, equipment, and physical space support student learning in this class" was not applicable to them, as they were taking the course online.

6.4 Library and Student Support Resources - Note how the program uses tutors and other specific support for student learning. Include any plan to change or expand student support in the goals list below.

Many students from our Engineering program have served as tutors in the MAC lab, and at the Academic Success and Tutoring Center (ASTC).

6.4a - Review the college's discipline-specific library resources with a librarian. Summarize the current status of the library resources and plans to supplement the collection. Upload the librarian's collection evaluation form to the blue folder in the upper right-hand corner of Section 6.

Copies of all textbooks used in the Engineering program are kept on file in the SCC Library.

6.5 Other Resources - Note the program's routine or special costs not addressed above, such as regularly contracted services. Note whether any of the funds for these goods/services come from a special source; if so, note if the funding will run out or will continue for the foreseeable future, and potential impact on the program.

Our program needs continued support from the Administration to make our Engineering and Data Science programs successful. In this regard, we thank James Thomas Media for helping is to create our websites, and Irving Chin of Tassel for helping with the content of our websites, and for his sage advice.

6.6 Resources Leading to Improvement - Using specific examples, describe how changes to staffing, faculty, technology, equipment, facilities, library collection, student support, and/or funding have led to an improved experience for students and greater student equity. CTE programs: Address specifically any improvements funded by Perkin's money or other sources.

Since the previous Engineering Program Review, we have hired two adjunct instructors, Sana Vaziri and Scott Berta, who are now teaching courses within our Engineering Program. Specifically, Sana Vaziri is teaching ENGR 007, and Scott Berta has been teaching ENGR 001 and ENGR 003. Both of these instructors are SCC Engineering graduates, and bring with them diverse educational and personal backgrounds, which are already helping to inspire and motivate our students.

Resources: Hiring Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)	Funding (N/A, One-time, Ongoing)	Cost
1. Hire additional adjuncts to teach some of our Data Science courses.	Post job advert	HR/Dean	Urgent	Short term	Ongoing	TBD
2. Hire a full-time instructor to teach our Data Science courses.	Post job advert	HR/Dean	Urgent	Long term	Ongoing	TBD
3. Extend the current contract of Tom	Approval by Academic VP and Governing	Dean, Academic VP	Urgent	Short term	One-time	TBD

MacMullen through 31 Dec 2026.	Board.					

Resources: Technology Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)	Funding (N/A, One-time, Ongoing	Cost
1. Purchase or lease servers for our Data Science Program	Consult with Advisory Board	Melanie Lutz	Important	Short term	One-time	TBD
2. Upgrade Logger-Pro Software in Fairfield	Order new software	IT/Lab Tech	Important	Long term	Ongoing	TBD
3. Upgrade desk-top and laptop computers in Building 300	Place request to IT	IT/Lab Tech	Important	Long term	Ongoing	TBD

Resources: Facilities and Equipment Goals

Resource Goals	Actions to be Taken	Person(s) Responsible	Priority (Important or Urgent)	Time frame (short term or long term)	Funding (N/A, One-time, Ongoing)	Cost
1. ENGR, PHYS, and ASTR faculty must have	Meeting needs to be set up with architects	Lucky Lofton	Urgent	Short term	N/A	$0

input to plans for remodeling Bldg 300						
2. Add on/off light switch in room 302	Place work order to Facilities	Melanie Lutz	Urgent	Short term	One-time	TBD

Resources: Student Support Goals

Resource Goals	**Actions to be Taken**	**Person(s) Responsible**	**Priority (Important or Urgent)**	**Time frame (short term or long term)**	**Funding (N/A, One-time, Ongoing)**	**Cost**
1. Our new Data Science A.S. degree and Certificate of Achievement to be approved for inclusion in the CA Virtual Campus	Submit all six courses to the DE committee	ENGR faculty	Important	Long term	N/A	$0
2. Supply desk copies of all textbooks for 2-hr reserve to library	Contact publishers for desk copies	ENGR faculty	Important	Long term	N/A	$0
3. Counselors must require ENGR students to follow the course sequence in the Guided Pathway	As in Column 1	Counseling Department	Urgent	Short term	N/A	$0
4. ENGR majors must be tracked to understand	Counseling Dept. and Research &	Counseling Dept. and Research &	Urgent	Short term and Long	N/A	$0

why we are losing so many students between PHYS 006 and our ENGR courses	Planning Dept. must implement a plan as described in Column 1.	Planning Dept.		term		

Resources: Other Resource Goals

Resource Goals	**Actions to be Taken**	**Person(s) Responsible**	**Priority (Important or Urgent)**	**Time frame (short term or long term)**	**Funding (N/A, One-time, Ongoing)**	**Cost**
1. The CIS courses that are aimed at STEM transfer students must be brought into the Math/Science Division as a newly formed CS Department	Decisive action by SCC leadership	Superintendent-President, VP of Academic Affairs, Deans	Urgent	Short Term	N/A	$0

END OF SECTION 6: HR GOALS, TECHNOLOGY GOALS, FACILITIES GOALS, STUDENT SUPPORT RESOURCES GOALS, OTHER RESOURCES GOALS

SECTION 7: CONCLUSION

7.1 Need for Improvement and Support - Summarize the program's top two or three areas most in need of improvement and support.

1. It is imperative that our core Engineering courses, which are taught only once each year and are part of our TAG agreements, not be cancelled, as several were in Fall 2023. These cancelations drive our students to other community colleges, and lead to an almost irreversible weakening of our program.

2. Another major issue that is driving students away from our Engineering program is that the CIS department does *not provide proper training to our transfer students*. This problem was brought to the attention of the administration starting in 2019, in a series of e-mails, presentations, and other documents, which included testimonials from eighteen current and former SCC students. This problem is widely acknowledged throughout higher education. According to an ACM Education Policy Committee report published in 2018, "the majority of Computer Science programs at community colleges fall into the "technician" category — designed for certification, not vertical transfer to four-year colleges, the way other science and engineering STEM programs are designed." To solve this problem, those CIS courses that are aimed at transfer students must be brought into the Math/Science Division, and appropriately upgraded; the courses aimed at students obtaining terminal associate degrees should remain in the Applied Technology and Business (ATB) Division. The SCC administration needs to provide decisive leadership, and act promptly to facilitate the upgrading of our computer science courses for Engineering and other STEM transfer students. **[Please see file uploaded to blue Document Library folder in Section 6]**

3. As explained above in sections 1.2 and 2.2a, it is imperative that PHYS 007 be offered only once per year, in the Fall semester in Fairfield, to stem the loss of students entering into our Engineering Program.

4. Additional adjuncts (two, at minimum), and eventually a new full-time instructor, are needed to teach our new Data Science courses, and drive our Data Science program forward.

5. It is imperative that we retain our classroom 302 on the Fairfield campus, and its associated prep rooms, 330 and 331. If any changes are to be made to these rooms, full-time Engineering and Physics instructors at the Fairfield campus **must** be included in the planning meetings. Our longer-term plan is to move face-to-face Engineering teaching at the Fairfield campus into the planned new STEM Center with domed planetarium.

6. It is critically important that the Data Science program be explicitly listed and easily found on the web-based and pdf versions of the SCC catalog. This is currently not the case in the 2023-24 catalog.

7.2 Improvement, Success, and Strength - Summarize the program's top two or three areas of improvement, success, and strength.

Among the improvements made in the SCC Engineering program over the period 2015-22 are the following:

- A new Associate in Science degree in Engineering was developed, and has been offered since 2019.
- A new suite of Data Science courses have been created and approved within the Engineering Department, along with a new A.S. degree and a Certificate of Achievement in Data Science.

Among the many notable success stories of our Engineering Program have been the following:

Faculty:

- Engineering instructor Melanie Lutz received the SCC Presidential Recognition Award in 2015.
- Melanie Lutz published two papers in refereed scientific journals:
  1. "Effect of the interphase zone on the conductivity or diffusivity of a particulate composite using Maxwell's homogenization method", M. P. Lutz and R. W. Zimmerman, *Int. J. Eng. Sci.*, vol. 98, pp. 51-59, 2016. https://www.sciencedirect.com/science/article/pii/S0020722515001056
  2. "The effect of pore shape on the Poisson ratio of porous materials", M. P. Lutz and R. W. Zimmerman, *Math. Mech. Solids*, vol. 26(8), pp. 1191-1203, 2021. https://journals.sagepub.com/doi/full/10.1177/10812865211023535

Students:

- Nicole Peacock participated in the NASA Community College Aerospace Scholars Program, 2016
- Arthur Ingraffia did a Field Engineering Internship at Flatiron West, Inc., 2016
- Mark Delarosa did a Summer REU Internship at Louisiana State University, 2016
- Michael Lostica did a Summer REU Internship at Brandeis University, 2017
- Erin Nebel did a Summer REU Internship at UT Austin, 2017
- Sean Casey did an Engineering Internship with the City of Napa, 2017
- Morgan Renner did an Engineering Internship with the City of Napa, 2018
- Heath Muscat participated in the NASA Community College Aerospace Scholars Program, 2018
- Jered Bell participated in the NASA Community College Aerospace Scholars Program, 2018
- Jered Bell and Heath Muscat did NASA Goddard Space Center Internships, 2018
- Kathleen Matsumoto-Elliott did a Summer REU Internship at Arizona State University, 2020
- Duncan Koelzer participated in the NASA Community College Aerospace Scholars Program, 2020
- Joseph Penrose did an Engineering Internship with Genetech, 2020
- Andrea Solis-Olguin did an Engineering Internship at the Fairfield Suisun Sewer Treatment Plant, 2022
  [Please see file uploaded to blue Document Library folder in Section 6]

Graduates:

- SCC Engineering graduate Dan Wiese received a Ph.D. in Mechanical Engineering from MIT in 2016, and founded his own biomedical device start-up company in Boston.
  [Please see file uploaded to blue Document Library folder in Section 6]

7.3 Signature Page - The following faculty in the program (or in a related program) have read this self-study report and have had the opportunity to provide feedback:

Melanie Lutz, full-time
Scott Berta, adjunct
Sana Vaziri, adjunct