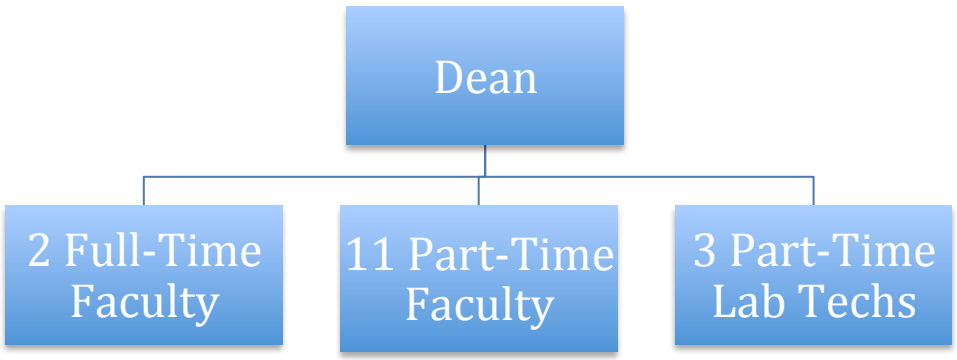
GAVILAN COLLEGE
INSTRUCTIONAL PROGRAM SELF STUDY
(Version with Instructions)

Physical Sciences and Engineering
Physical Sciences and Engineering: Engineering Option

PROGRAM REVIEW

A. Provide a organizational chart of your program (below is a sample)



B. Program Data

Provide appropriate analysis for the following sections based on data acquired from the Office of Institutional research.

1. Basic description of program

Under the Program Description "Physical Sciences and Engineering" there are two main foci for course offerings: 1) preparation for transfer in the sciences, and 2) courses that meet the general education requirements for non-majors.

Within the transfer focus, there are three paths: one towards transfer to a four-year college program in engineering, one towards transfer to a four-year college program in the sciences (physics, chemistry, astronomy, etc.), and the third is in support of transfer to a four-year college program in the life sciences. The degree to which individual disciplines within Physical Sciences and Engineering support an individual student depends upon the particular degree and the destination transfer institution.

Within the general education focus, Physical Sciences and Engineering offers courses in the sciences, both with and without a laboratory, to meet the general education requirements.

a. Enrollment and FTES

- Enrollment by top code and course over time (4 years)

Academic Year	08/09	09/10	10/11	11/12
Astronomy	178	159	148	153
Chemistry	459	333	411	394
Engineering	0	0	12	74
Geology	106	118	139	182
Physics	123	138	114	178
Physical Sciences	104	140	149	130
Total	970	888	973	1394
College Overall	**48,983**	**52,113**	**52,140**	**44,198**

Enrollments in the Engineering courses have increased because we are now offering Engineering courses.

Enrollments in Physics courses have increased because more courses have been being offered recently, and enrollment in Physics 2A has increased by about 50%. Physics 4ABC are transfer requirements for students planning to transfer to a four-year school and pursue a degree in engineering. Now that we are offering engineering classes, we are offering Physics 4ABC in addition to the Physics 1 and Physics 2AB courses that we have always offered so now there are greater enrollments in the discipline. (This "trickle down" effect of the engineering program increasing enrollments in other disciplines is also true for Math 2 and Math 2C.)

Chemistry appears stable.

Geology grew because a second section is now offered to accommodate GECA students.

Physical Science is stable.

• FTES by top code over time (4 years)

Academic Year	08/09	09/10	10/11	11/12
Astronomy	23.4	20.4	18.0	17.3
Chemistry	75.1	76.3	95.5	90.8
Engineering	0	0	1.3	9.4
Geology	22.9	25.6	30.1	39.5
Physics	26.0	29.4	24.2	38.0
Physical Sciences	10.7	14.4	15.4	13.4
Total	158.1	166.1	184.5	208.4
College Overall	**5,748.23**	**6,069.32**	**5,595.30**	**5,099.0**

Astronomy, Geology, and Physical Science are designed to meet the needs of non-major students' general education requirements. They all appear to be meeting that need steadily.

Engineering and Physics have experienced large growth in the past year because we are now offering engineering classes and an additional three Physics classes are being offered to meet the prerequisite needs of the engineering classes and to meet the transfer requirements of engineering students. Enrollment in Physics 2A has increased from about 40 to about 60 in the past two years.

• Current enrollment by term last available census

Academic Year	First Census
Astronomy	73
Chemistry	202
Engineering	25
Geology	32
Physics	97
Physical Sciences	62
Total	491
College Overall	**16,555**

These numbers are roughly half of the enrollment by top code and course shown above, except for engineering which up because we are in the second year of offerings now.

b. Student Outcomes

• Success rate by top code and course and year (4 years).

Academic Year	08/09	09/10	10/11	11/12
Astronomy	66.06%	70.90%	81.55%	75.93%
Chemistry	56.64%	87.09%	88.08%	84.49%
Engineering	N/A	N/A	75.00%	67.57%
Geology	75.47%	81.36%	84.89%	94.2%
Physics	62.60%	55.80%	48.25%	60.11%
Physical Sciences	41.35%	55.00%	61.07%	49.23%
College Overall	**62.26%**	**65.62%**	**67.52%**	**68.01%**

* *Success is defined as the proportion of students who either received a grade of C or above or credit.*

Success rate in Physical Science is alarmingly low. Location where PSci 1 is offered, time of offering, and number of days the class meets per week should be reconsidered. In 2011/2012, the success rate of PSci 1 (only offered face-to-face) was 50% and the success rate of PSci 2 (only offered online) was 48%. Evaluation of current instructor about a year ago resulted in a request for administrative follow up.

Success rate in Geology is unusually high (especially in 11/12). GECA students are high achievers and may have increased the success rate in 11/12. Overall, the success rate of Geology students is well above what is typical in other math and science classes at Gavilan.

• Retention rate by top code and course and year (4 years).

Academic Year	08/09	09/10	10/11	11/12
Astronomy	80.5%	92.1%	88.1%	94.4%
Chemistry	87.8%	90.7%	92.2%	88.8%
Engineering	N/A	N/A	83.3%	81.1%
Geology	89.6%	89.8%	92.8%	95.6%
Physics	77.2%	74.6%	73.7%	76.4%
Physical Sciences	67.3%	75.7%	77.2%	71.5%
College Overall	**81.6%**	**76.64%**	**82.2%**	**82.9%**

* *Retention is defined as the proportion of students who received a grade of some kind.*

There are generally high retention rates in all disciplines.

• Number of majors by year (4 years).

Academic Year	08/09	09/10	10/11	11/12
Engineering	28	48	39	46
Physical Science and Engineering	1	23	55	72
Physics	38	15	8	7
Total	**67**	**86**	**102**	**125**

* *Majors are declared by students typically at initial application, but in some cases are revised through a consultation with a counselor.*

Evident here is that even when we are not offering engineering classes, and the Engineering program is dormant, a large number of students at Gavilan College still identify themselves as Engineering majors. This has always been the case for at least the past 22 years. Students want to take Engineering and if we aren't offering the classes then students living in our district will bypass Gavilan and attend other community colleges to complete the lower-division transfer requirements.

Surprisingly large number of Physics majors, especially in 08/09, even though we weren't offering the first year classes required for the major.

The large number of Physical Science and Engineering majors includes all those majoring in science who are NOT Biology, Physics or Engineering majors (i.e., Chemistry, Biochemistry, etc.). A Chemistry major is being developed during instructor release time supported by STEM.

- Number of degrees and certificates by top code and year (4 years).

Academic Year	08/09	09/10	10/11	11/12
AS Physical Science and Engineering	0	0	0	0
AS Physical Science and Engineering: General Engineering	0	0	0	0
Total	**0**	**0**	**0**	**0**

It's really not surprising that there are no AS degrees in Physical Science and Engineering because transfer to, and graduation from, a four-year school with a Bachelor's degree is the goal for students in the Physical Sciences. These disciplines are focused on Bachelor's degrees for employment and the lower-division courses are just preparation for transfer and upper-division coursework in specific scientific or engineering disciplines. In addition, because these are all "high-unit" majors with lots of prerequisites and discipline specific courses in the lower division that are required for transfer, when students also take the general education requirements for Gavilan's AS degree they end up well over the allowable unit limit for transfer; in fact, general education transfer requirements are minimal at some four-year schools.

No degrees in the General Engineering option because we haven't offered one complete cycle of the Engineering courses yet that are required for a degree and for transfer.

The AS-T degree in Physics has been approved at the state level. This degree has not been adopted at Gavilan because although it meets the administrative need set by SB-1440, it does not provide the all of the lower-division major preparation required for transfer by many CSU and virtually all UC campuses.

The AS-T degree in Engineering does not yet exist at the state level and may never exist because of the many lower-division courses that are required as preparation for upper-division course work in all of the Engineering fields. The Engineering AS-T TMC currently being submitted for review contains the math courses that are required for the Math AS-T, plus the physics courses that are required for the Physics AS-T, plus the engineering courses required for the Engineering AS-T. So, completing the AS-T degree requirements in Engineering means the students will have also completed the degree requirements for two other AS-T degrees enroute to completing their Engineering AS-T. The point is that the Engineering transfer program consists of lots of courses, most of the courses follow a prerequisite path where one course depends upon successful completion of a prerequisite course, and success in a particular course requires an adequate mastery of skills in the prerequisite course.

c. Staffing Data

- Faculty Headcount (by contract and hourly) (past 4 years)

Academic Year		08/09	09/10	10/11	11/12
Astronomy	Contract	0	1	0	0
	Hourly	1	2	1	1

Chemistry	Contract	1	0	1	1
	Hourly	1	1	3	3
Engineering	Contract	0	0	1	1
	Hourly	0	0	0	4
Geology	Contract	0	0	0	0
	Hourly	1	1	1	2
Physics	Contract	1	1	1	1
	Hourly	0	0	0	1
Physical Sciences	Contract	0	0	0	0
	Hourly	2	3	2	1
Total	Contract	2	2	2	3
	Hourly	5	5	7	12

* These counts are comprised of any instructor who taught a course in this discipline, even if this instructor comes from a different discipline.

- Faculty productivity (Weekly Student Contact Hours [WSCH] divided by Full Time Equivalent Faculty [FTEF]) (past 4 years)

Academic Year		**08/09**	**09/10**	**10/11**	**11/12**
Astronomy	WSCH	702	612.3	538.56	519.36
	FTEF	1.2	1	0.8	0.8
	Productivity	585	612.3	673.2	649.2
Chemistry	WSCH	2261.5	2289.75	2895.25	2714.22
	FTEF	5	4.3	3.7	5.1
	Productivity	452.3	532.5	782.5	532.2
Engineering	WSCH			42.74	273.52
	FTEF			0.2	1.3
	Productivity	N/A	N/A	213.7	210.4
Geology	WSCH	672.8	754	886	1133.73
	FTEF	1	1	1	1.3
	Productivity	672.8	754	886	872.1
Physics	WSCH	788.48	893.04	718.76	1143.52
	FTEF	2.2	2.4	1.7	2.8
	Productivity	358.4	372.1	422.8	408.4
Physical Sciences	WSCH	320	431.84	462.24	403.2
	FTEF	0.8	0.8	0.8	0.8
	Productivity	400	539.8	577.8	504
Total	WSCH	4744.78	4980.93	5543.55	6187.55
	FTEF	10.2	9.5	8.2	12.1
	Productivity	465.17	524.31	676.04	511.37
College Overall	**WSCH**	**174858.3**	**173269.5**	**167277**	**167277**
	FTEF	**572**	**498.63**	**638.4**	**638.4**
	Productivity	**305.7**	**347.49**	**262.03**	**262.03**

Errors in the calculation of productivity have been addressed so the data appearing here is not accurate. Regarding the erroneous data provided, every discipline except Engineering is above the overall college productivity. The productivity in Engineering will increase as the class sizes increase with time. I don't expect that productivity will ever be high in Engineering as the classes will never be very large. This is because: the prerequisite classes for the "first" Engineering class are two semesters of Calculus (Math 1AB) and one semester of calculus-based Physics (Phys 4A, which has Phys 2A as a prerequisite). The prerequisite classes for the "second" Engineering class are Math 1A, Phys 4A, and Chem 1A. The prerequisite classes for

the "third" Engineering class are Math 1ABC, Math 2C, and Physics 4B. Since we have a hard time getting most Gavilan students through Intermediate Algebra, it would be unrealistic to expect huge numbers in classes with such an arduous prerequisite path. That being said, however, there are students on campus right now who are making their way through this gauntlet and they deserve our support of their efforts; they are well on their way!

- Current ethnic and gender distribution of faculty

Academic Year	11/12
Male	2
Female	0
Non-reported	0
White/European-Am.	0
Hispanic/Latino-Am.	0
Black/African-Am.	0
Asian-Am.	0
Pacific-Islander-Am.	0
Native Am. Alaskan Native	0
Mixed Race/Other	0
Unknown	2
Total	**2**

- Contract overload by year (past 4 years)

Academic Year	07/08	08/09	09/10	10/11
	8	15	15	6

Data provided by the Dean.

There are many semesters when faculty members have chosen to work an overload. It is understood that full-time overloads and part-time costs have equal impact on the general fund of the college.

- Program Release Time (past 4 years)

Academic Year	07/08	08/09	09/10	10/11
	0	0	40	10

Data provided by the Dean.

Both full-time faculty members in the program have been assigned release time to complete STEM activities. Release time of 40% has been encouraged (and awarded) by the administration even when faculty members have applied for lower levels of release time.

- Classified Staff who contribute to the instructional program, e.g., Instructional Assistant, lab supervisor (past 4 years)

Academic Year	07/08	08/09	09/10	10/11
Physics				0.3

By retitling the Studio Classroom Technician position outlined in STEM II, we have had a Physics Lab Tech working 20 hours per week for the weeks school is in session for about the past year (0.3 FTE). This position has been incredibly valuable to students because now the laboratory component of the physics classes is better supported and the new equipment we have is organized, cataloged, accessible for lab classes and lecture demonstrations, and being used by students to provide hands-on experience with abstract concepts. Hopefully, the Physics Lab Tech position will be institutionalized so it will continue upon the completion of STEM II. This position is essential for the smooth running of the physics labs. Also, the Physics Lab Tech is a valuable resource for students.

Chemistry Lab Assistants are supported by the General Fund.

- Student Assistants (tutors, Calworks, Work Study, etc.) (past 4 years)

Academic Year	07/08	08/09	09/10	10/11
	2	2	2	2

These data are for Chemistry, there are no students assistants for Physics or Engineering. Data provided by the Dean.

1. Provide comments on any salient data above.

Hopefully, the Physics Lab Tech position will be institutionalized so it will continue upon the completion of STEM II. This position is essential for the smooth running of the physics labs. Also, the Physics Lab Tech is a valuable resource for students.

2. Budgetary allocations over the past 3 years (4-5-6's and 1-2-3's if applicable) see sample below.

Costs	07/08	08/09	09/10
Instructional supplies	$4,450	$4,450	$4,450
Equipment			
Travel			
Printing			

Data provided by the Dean. These amounts must be sum for all of the individual program codes in the area.

The allocated amount for instructional equipment for Physics is about $1,300 per year, which is barely adequate to replenish consumable items for an academic year. To our knowledge, there is currently no money for instructional equipment (or budget of any kind) for Engineering. Budget figures for any of the other categories or for any of the individual disciplines are unknown and were not provided by the Dean.

3. Provide an overview of how budget allocations have changed over the past three to five years?

According to the Dean, the "budget has been the same year after year." For Physics and Engineering, all expenses for instructional supplies, equipment, and travel have been provided by STEM for about the last three years. Instructional equipment funds from the general fund for Physics is about $1300 per year and has been stable for the past few years. It has not been spent during that time period, however, as a contribution to the general fund, since STEM has been meeting the financial needs of the area.

4. What were the results of any significant additional budget or resource allocations/reductions over the past three to five years?

A significant amount of new laboratory equipment has been purchased with STEM money for Physics and Chemistry to replace antique equipment. Multiple set-ups of an experiment now allow an entire lab section to conduct an experiment at the same time while working in small groups. The efforts of the lab tech have resulted in a lab manual that contains about ten, copy machine ready, lab exercises that can be used by instructors and students.

C. Program Progress (What have you done since your last review)

1. What specific goals, curricula, program, and/or pedagogical modifications were made within the program to support college-level strategic initiatives and student success during the past three years (For example, scheduling changes, distance learning, ladder concepts, work-based learning strategies, internships, service learning, learning communities, technological enhancements, and other student centered learning pedagogies)?

Chemistry and Physics have incorporated new equipment into the laboratory component of their classes resulting in greater student involvement in hands-on activities that support learning. All new experimental equipment with computer data-acquisition systems have allowed students to conduct experiments, collect data, distinguish random vs. systematic variations, all using the scientific method.

Chemistry is offering the full complement of lower-division courses required for transfer.

Physics is offering the full complement of lower-division courses required for transfer to any engineering, physics, math, or science four-year school degree program.

Engineering courses are being offered so Gavilan students are now able to transfer directly to four-year schools without having to transfer to another community college to meet the transfer requirements of their four-year school of choice.

All Engineering and Physics courses have been reviewed, updated, and approved by Gavilan's Curriculum Committee in the past year (2012) to ensure that they are transferrable and will articulate with lower division courses at their destination four-year schools.

Descriptions of the program, prerequisites, and pathways through the prerequisite maze have been created and presented to students and counselors to assist counselors with preparing ed-plans and empowering students about what they should be taking, when they should be taking it, how to evaluate the value of the information they are provided, and how important it is to stay on track through the many sequential prerequisite classes.

An Engineering Club was developed to provide an opportunity for students not yet far enough along in the prerequisite stream to take engineering classes, but consider themselves Engineering majors, to feel like they are part of the program.

Field trips are being taken to SJSU and Cal Poly SLO to tour the Colleges of Engineering at these campuses.

2. What results have you seen because of these modifications (include data if available)?

Enrollments in second-year college (sophomore) classes are no longer zero!

Now that laboratory activities are being conducted as a group during the assigned laboratory time, students are actively involved with each other and with the instructor in conducting experiments, collecting data, and experiencing physics concepts. Because we are running classes for the first time with the new equipment, quantitative measurements of the effectiveness of adding the new equipment have not been conducted for comparison with the previously measured effectiveness.

There is a large cohort of "Engineering Students" taking classes. They identify with the major, work together, and are developing a community with a common, high-standards goal. There are many women and under-represented students in this cohort.

3. What methods does the program use to maintain the integrity of academic standards and achieve consistency within the discipline, particularly in regard to multiple section introductory classes?

Primarily, we make sure that the lower-division courses in our transfer programs meet statewide articulation standards. Because every one of these courses is transferrable, and must articulate with corresponding lower-division courses at the four-year school, integrity of the course outline of record is determined as a result of the articulation effort.

Physics and Engineering faculty members attend bi-annual meetings with colleagues at two- and four-year schools to insure consistency of offerings with local, regional, and statewide peers.

Physics and Engineering faculty members participated in the AS-T and C-ID efforts for these disciplines.

We don't offer multiple sections of many classes. In some cases, large first-class-in-a-multi-semester-sequence classes may have two laboratory sections but a single, common lecture. This makes consistency simple because a single instructor is responsible for all of the sections.

4. What are the program's methods for evaluating and modifying the contents of course offerings, please provide examples of the result of this process.

Unfortunately, in comparison to some other programs on campus, the feasibility of tailoring the course content of the majority of this program's classes is limited. All the classes must articulate with lower division classes at four-year schools so students who take them at Gavilan can use them to satisfy transfer and degree requirements at those schools.

That being said, Physics and Engineering faculty members attend bi-annual meetings with colleagues at two- and four-year schools to insure consistency of offerings with local, regional, and statewide peers. And Physics and Engineering faculty members participated in the AS-T and C-ID efforts for these disciplines.

All Physics and Engineering courses were updated and approved by the Gavilan College Curriculum Committee during academic year 2011/2012.

5. What staff development efforts has your program undertaken?

Physics and Engineering faculty members attend bi-annual meetings with colleagues at two- and four-year schools to ensure consistency of offerings with local, regional, and statewide peers. And Physics and Engineering faculty members participated in the AS-T and C-ID efforts for these disciplines.

6. How is the program articulated with regional four-year colleges and universities and district high schools?

All courses in the Program articulate with all regional and statewide colleges and universities. Our courses are all college-level, lower-division courses and there are no courses in our program that will articulate with high school courses.

7. If applicable, how does the program meet all local, state, and federal requirements, including professional, or trades and industry organizations?

Not applicable.

8. How has your program collected information and responded to the needs of the community/field (e.g. advisory council, needs assessment)?

The most important "need" of our community is for us to provide instructional programs that will prepare them for success after transferring to a four-year school. Also, even though we are close to Silicon Valley,

many of our students are not aware of the culture that exists there and we must help them become aware of that culture by taking them to companies and events in Silicon Valley to increase this awareness.

Unfortunately, in comparison to some other programs on campus, the feasibility of tailoring the course content of the majority of this program's classes to meet the needs of the community is limited. All the classes must articulate with lower division classes at four-year schools so students who take them at Gavilan can use them to satisfy transfer and degree requirements at those schools.

Articulation requirements are the motivation for, and require our "response to needs of the community/field." In other words, we are responding to the needs of the community by keeping our classes up-to-date in the eyes of the four-year schools and thus offering classes that will articulate and transfer to four-year schools so students will be able to meet their career goals.

Programmatically, all of our courses are transferrable to CSU and UC so "needs" of community is to insure the Program's courses meet the articulation requirements.

All of the courses in our program have been kept up-to-date, and faculty have remained involved and aware of regional and statewide trends, in anticipation of the institutional support required to offer our programs again and provide our community with access to the education leading to high-demand, professional jobs.

Engineering continues to be a high-need area for employers nationwide. Large employers (Lockheed, Cisco Systems) have come to Gavilan to promote students on track to become engineers. Because employers are relying upon graduates from abroad to fill their needs at great expense, these employers have recognized the importance in supporting the academic progress of students attending U.S. colleges and universities, especially historically under-represented students in the engineering disciplines.

Recruitment of incoming Gavilan students so they are immediately visible as members of the Engineering program is difficult because 85-90% of incoming Gavilan students assess into non-transferrable math classes (Math 233 and below) and Math 1A is the prerequisite course for all of the engineering courses. Students can't take an Engineering class (and be counted in an engineering class) until they are enrolled in first semester calculus class and the pathway to calculus class proves insurmountable for many of the students entering Gavilan. Therefore, unlike other programs on campus, a typical incoming student at Gavilan can't be immediately recruited and immediately counted as a member of the Engineering program because of the prerequisite standards for the engineering courses. The prerequisite pathway for the core engineering coursework is long and prescriptive, and actual mastery of many skills and concepts in math and physics are required to be successful in the engineering courses. There are no shortcuts.

To help students stay motivated until they reach Math 1A so they can begin the engineering coursework, a multi-year bridge program is currently being explored to help students entering Gavilan with at least one year of math remediation before being eligible for the Engineering courses. This includes students taking Precalculus, Algebra, and Pre-algebra upon entry (one, two, and three years of remediation, respectively). The specifics of this multi-year bridge will hopefully engage students at all levels, allow many more students to call themselves "engineering" students, and motivate them through possibly years of math remediation before they are eligible for enrollment in the Engineering program courses.

D. Issues and Trends Facing your Program

1. Briefly describe your program's strengths and weaknesses (utilize data to support your contentions).

Our strengths are long-time, committed, full-time faculty members prepared to provide excellent experiences for students so they are successful at their destination four-year institutions. We have a stable, articulated transfer curriculum that is consistent with regional and statewide standards. We have new lab equipment with modern interfaces to capture students' interest with hands-on experiences. And over time we have maintained stable success and retention numbers.

A primary difficulty is maintaining a cadre of "Physical Science and Engineering" students as they work through the long pipeline of prerequisite courses that is required for the majority of our incoming students to reach the first transferrable course. For many students, it may take two or three years of prerequisite classes to be able to take the first Engineering class. Maintaining the interest of these students as "Engineering" students will require activities with our newly formed "Engineering Club" and a multi-year bridge effort that will all "Engineering" students no matter where they are in the prerequisite stream.

Internship opportunities for Engineering students are vitally important and a phenomenal potential resource exists with the opportunities obviously apparent in Silicon Valley. Exploiting these opportunities for our students is essential and is part of the STEM grant objectives. So far, efforts to secure internship opportunities in Engineering have not provideded valuable internships for our students. Recruitment at locations in Silicon Valley other than San Jose State is essential and students should be mentored to apply for the plethora of internships beyond the local area.

Retention and success of students in the engineering pipeline has always been impressively high! And, their success transferring to good schools, completing their degree, and securing good jobs is equally high! All of our previous engineering students graduated and are employed in jobs of their liking. Completion of the Engineering program once students are in the pipeline of engineering courses is not a problem. A strength of the program is that once students reach the Engineering courses, the cohort is well known to the instructors and there are lots of opportunities to interact with the students, know that they are (or are not) making progress, intervene with those struggling, and generally keep the program going strong. Also, students who have navigated the prerequisite pathway and reached this level of course work have learned many of the important tools necessary to be successful students so they are successful in the Engineering and Physics courses; i.e., retention in engineering courses tends to be high.

2. Provide a brief review of the past three program plans (formerly Unit Plans) and any emerging themes identified in them.

Because the program was not active until STEM II was received, Program Plans were not completed during the above stated time period. Also, with only two full-time faculty members whose primary responsibility is to be teachers, the administrative tasks add up.

3. If not mentioned above, what are some of the needs or challenges facing your program (include support and documentation for your contentions)?

As enrollments grow, the need for additional faculty, classroom space, and equipment storage space will also grow. Additional classroom space within the "science cluster" buildings is possible for science classes. More efficient use of existing storage space is also possible.

Physical Science and Engineering courses have the greatest number of out-of-discipline prerequisites of any program on campus. Additionally, mastery of the prerequisite math courses is important for engineering and physics students so they can use what they have mastered in the class that requires those skills. There is not time in an engineering or physics class to learn the math skills that should have been mastered previously. It is obvious that there are cycles where students have obtained greater and lesser proficiency in prerequisite math courses and that some students have been passed without obtaining the basic skills in algebra, precalculus and calculus. This will adversely affect the success and retention of students in engineering courses; it's a shame if students aren't successful in engineering or physics because they can't do the math that is included in the courses established as prerequisites for the engineering and physics courses.

E. Program/Student Learning Outcomes

1. Complete the program/student learning outcome matrix for your program(s). Complete separate matrices for each Chancellor's approved Degree or Certificate. If assessments have not been completed, provide an update of your program's work to assess your program-level student learning outcomes.

Institutional Outcome	Program/Student Learning Outcomes	Assessment / Measurement	Result	Use of Results
Transfer of Knowledge and Skills to a New Context: Students will apply their knowledge and skills to new and varied situations.	Identify, compare and contrast engineering problems and demonstrate integration of math and science to solve them.	Laboratory design project.	88% of the 24 students correctly identified the problem to be solved. Of the 88% who correctly identified the problem to be solved, 56% of the students did an excellent job integrating math and science to solve the problem, 33% did a good job, and 11% did a poor job of integrating math and science to solve the problem.	Increased use of sophisticated laboratory equipment will help students correctly identify problems and allow faster assessment of the validity of their answers.

Quantitative Reasoning: Students will use college-level mathematical concepts and methods to understand, analyze, and explain issues in quantitative terms.	Identify, compare and contrast engineering problems and demonstrate integration of math and science to solve them.	Laboratory design project.	88% of the 24 students correctly identified the problem to be solved. Of the 88% who correctly identified the problem to be solved, 56% of the students did an excellent job integrating math and science to solve the problem, 33% did a good job, and 11% did a poor job of integrating math and science to solve the problem.	Increased use of sophisticated laboratory equipment will help students correctly identify problems and allow faster assessment of the validity of their answers.
Students will communicate effectively in many different situations, involving diverse people and viewpoints.	Demonstrate an ability to communicate clearly using written, oral, electronic and graphical means.	Laboratory design project and Capstone laboratory project.	22% of the 24 students did an excellent job communicating clearly using written, oral, electronic and graphical means, 45% did a good job, and 33% did a poor job communicating clearly using written, oral, electronic, and graphical means.	Personality was a factor in the ability to communicate orally and greater practice by having more opportunities to present will assist these students. Motivation seemed to be the greatest factor determining the apparent ability of students in this Outcome. Smaller, more frequent projects, and specific due dates for increments of the design process may increase student success in this area.

2. What percentage of course-level student outcomes has your program assessed?

59% of course-level student outcomes have been assessed. Some of our classes have not been offered in the recent past and all courses will be assessed as they are offered. With 22 courses in the program, and only two full-time faculty members, and some part-time instructors unaware of the process, and course outline update requirements, and teaching responsibilities, and making sure students are aware of the "new" program that is evolving quickly, not all tasks will be completed according to the same schedule permitted when there is a larger faculty/responsibility ratio.

F. Program Plan/Budget Requests

1. List goals and objectives for the next three to five years that will address the needs and trends identified above.

1. Ensure the courses taught for general education students are meeting the criteria of quality instruction, at a college level, with appropriate standards of performance.

2. Ensure classrooms and laboratory spaces are meeting the needs of the institution and of the student.

3. Procure sufficient space to offer the increased number of course offerings by re-evaluation of room allocations in the science cluster.

4. Make the campus community aware of the unique position of programs containing only college-level, lower-division, transfer courses that are laden with multiple-discipline, skill-based prerequisites.

5. Increase program's visibility to Gavilan students not yet at the academic level of engineering courses via the Engineering Club so they feel connected and also to infuse a greater campus awareness of the program.

6. Make sure instructors of prerequisite courses realize the definition of success has changed slightly to include sufficient mastery in the prerequisite course that the skills translate across discipline boundaries; i.e., students that pass a math class should be able to do the problems.

7. The most important goal is to ensure top quality instruction is provided by instructors in the disciplines.

2. Provide your current Program Plan (required) which should include these goals and objectives.

An initial (draft) version of the Program Plan is available online. A more comprehensive Program Plan will result from the efforts of the Engineering Program advisory committee that meets once or twice a semester. With 22 courses in the program, and only two full-time faculty members, and some adjunct unaware of the process, and course outline update requirements, and teaching responsibilities, and making sure students are aware of the "new" program that is evolving quickly, not all tasks will be completed on schedule.

PROGRAM SUMMARY

Use data provided above and previous program plans to complete the following summary. Please provide a summary which should include an overall description of the program, a summary of the program's progress, a summary of issues and trends facing the program, and the program's plans for the future (2 page limit).

Gavilan College's Engineering Program has always been great for students! Every student who has completed our program in the last 22 years has transferred to a four-year school, graduated from that school, and is working in the field of their choice. Many women have completed the program. Our first student from the current cycle of offering engineering courses has been accepted to Cal Poly SLO to study Biomedical Engineering and will continue this tradition. There are over 20 students in the engineering pipeline at Gavilan College right now (Spring 2013) who are headed for transfer to study engineering. Based upon the size of our service area, the number of students in any one Engineering class will never be huge. However, the pyramid of students attracted to the college because of the engineering program is huge. The young people of southern Santa Clara and San Benito counties deserve high-quality education that will prepare them for transfer and success at a high-quality school so they can get a good job as an engineer in Silicon Valley and create good lives for themselves and their families.

There are two degree programs within the broader heading of Physical Sciences at Gavilan College:

1. Physical Sciences and Engineering. This degree is for students interested in Astronomy, Chemistry, Physics, etc. – any of the areas within the Physical Sciences that require calculus-based physics.

2. Physical Sciences and Engineering – General Engineering option. This degree is for students interested in any of the engineering disciplines (aerospace, chemical, civil, electrical, materials, mechanical).

In addition to these two majors, we offer a number of single courses with and without labs (Astronomy, Geology, Physical Science) to meet general education requirements for non-science majors.

Lastly, courses from this program are used by students to meet the requirements for A.S. degrees and for transfer in the Biological Sciences, pre-med, and nursing disciplines.

Unique elements of this program are 1) we don't offer any non-transferrable courses, 2) we only offer transferrable courses that are articulated at CSU and UC four-year schools, and 3) the majority of the courses we offer have lots of prerequisites that must be taken in order and require mastery of the prerequisite material before success is possible, i.e., many math courses are prerequisites for physics courses, physics courses are prerequisites for engineering courses. This last element has proven difficult for virtually all groups on campus to understand. Students don't understand the ramifications of falling "out of step" within the hierarchical prerequisite structure. Counselors sometimes prepare education plans for students that don't reflect the sequential order of classes based upon the prerequisite pathway, or don't acknowledge that these are "college level" transferrable classes and 18-unit semesters aren't practical. Lastly, faculty sometimes pass students without demanding mastery of basic ideas and skills that are needed in the subsequent class.

An additional unique element is that before students take an engineering class they have needed to pass at least two semesters of calculus and two semesters of physics. When one looks at the size and/or composition of an engineering class, they must realize that the number of students they see in that class depends upon the ability of instructors of prerequisite courses in other disciplines (math and physics) to prepare students for enrollment in the observed class. Engineering classes, because of the prerequisite structure, are only taken by students who have made it through a gauntlet of prerequisites and proven their abilities as successful learners – in contrast to many of the courses offered at Gavilan College where any incoming student is qualified.

The heavy prerequisite load for engineering also makes outreach difficult. Most students eligible to take calculus as college freshman are also CSU and/or UC eligible and have proven to be successful learners in high school and therefore go directly to a four-year school. Engineering students at Gavilan typically enroll initially unprepared for college level math courses and may have several years of prerequisite course work before taking an engineering course and being in the Engineering Program.

A final unique element is that many students in these "high-unit majors" do not graduate from Gavilan with an A.S.; their only goal is to receive a Bachelor's degree from a four-year school.

In the past two years there have been many accomplishments in bringing the engineering program back. Equipment for laboratory classes has been purchased and is being brought online in the classroom with the assistance of a 0.3 FTE lab tech. The lab tech works only during the semester and is being paid with grant funds. All of the curriculum documents for all of the courses associated with the engineering program (physics and engineering) have been updated in accordance with statewide standards for the discipline. Courses are being offered and we are looking at a cohort of about 28 students in Physics 4A (F 2013) many of whom are planning to become engineering majors at four-year schools. An Engineering Club has been founded at Gavilan and is fairly active. Appropriate advising documents have been provided to counselors, students, and staff describing the Engineering Program, its courses, and suggested pathways to transfer.

Chemistry offerings have grown to meet the needs of more students and new equipment has been integrated into the laboratory experience.

Supporting student achievement is the goal. Because it is a transfer program, it is essential that our students both transfer and be successful at their destination institution. To this end, classes are articulated, faculty are in contact with discipline faculty at typical destination institutions, adjunct faculty are hired based upon their familiarity with, and knowledge of, the demands and rigors of upper-division coursework and what is required from the lower-division to ensure success upon transfer, site-visits are made with students to show them what native lower-division students are doing and what their lower-division coursework at Gavilan is preparing them for.

Also supporting student achievement is the implementation and integration of new laboratory equipment that has brought modern equipment and greater student/instructor interactions into the classroom.

STEM funds have supported all of the equipment acquisition, travel, and 0.3 FTE Physics lab technician.

Concerns for the Engineering Program are that the campus will fail to understand the second-order reasons for small classes that are unrelated to the Engineering Program itself and due to the rigorous preparation required before engineering courses are taken.

Trends for the program are hugely optimistic! The need for engineers remains great. Both large and small employers see the need to support the education of non-foreign engineers for both social and economic reasons. Our community base is a target population for many employers for their efforts to support education of their future work forces. With so many community college engineering programs in the Bay Area, Gavilan's program in South Santa Clara county and San Benito is perfectly located to prepare the under-represented students that are attractive to so many four-year schools and employers.

A goal for the broader program is to ensure the courses taught for general education students are meeting the criteria of quality instruction, at a college level, with appropriate standards of performance.

A second goal is ensuring classrooms and laboratory spaces are meeting the needs of the institution and of the student.

A third goal is to procure sufficient space to offer the increased number of course offerings by re-evaluation of room allocations in the science cluster.

A fourth goal is to make the campus community aware of the unique position of programs containing only transferable, lower-division university courses that are laden with multiple skill-based prerequisites.

A fifth goal for the program is to increase the Engineering Program's visibility to the community and to Gavilan students not yet at the academic level of engineering courses via the Engineering Club and a multi-year bridge program so they feel connected and also to infuse a greater campus awareness of the program.

A sixth goal is to make sure instructors of prerequisite courses realize the definition of success has changed slightly to include sufficient mastery in the prerequisite course that the skills translate across discipline boundaries.

Lastly, the most important goal is to ensure that we provide top quality instruction.

CERTIFICATION OF THE INSTITUTIONAL EFFECTIVENESS COMMITTEE REPORT

Program/Department

This program review report reflects the completion of the required elements of the IEC form, including dialogue in the department about the results of the program review, and depicts a clear and consistent link to the strategic plan and the department's program planning goals.

We certify to the Institutional Effectiveness Committee that this report is a compilation of broad departmental input and has been reviewed by all department/program staff and faculty.

Dean Date

Department Chair Date

Faculty/Staff