INSTRUCTION PROGRAM REVIEW: SPRING 2013 SUBMISSION CYCLE

Program Name: Engineering
Academic Year: 2012-2013
Faculty Contact: Laura Demsetz
Program Review Submission Date: April 12, 2013

I. Description of Program

Provide a brief description of the program and how it supports the college's College Mission and Diversity Statements, Institutional Priorities, 2008-2013, 5 in 5 College Strategies, Spring 2011, and other institutional planning documents as appropriate.

The engineering program provides the lower division engineering classes necessary for transfer to baccalaureate programs in various engineering fields. Though occupational demand in specific fields fluctuates over time, engineers and the problem-solving skills developed through an engineering education are considered critical to the region's economic development.

The engineering program supports the college's mission of providing a comprehensive curriculum, as not all community colleges offer engineering. The program supports Institutional Priority 3: Promote Relevant, High-quality Program and Services, by preparing students for high-demand careers and by offering classes in both on-campus and hybrid modes. The program's full-time faculty member also serves as a faculty advisor, a role that enhances communication between instructional programs and student services, and has been actively involved in participatory governance, supporting Institutional Priority 5: Enhance Institutional Dialog.

Engineering students typically take Math (251, 252, 253, 270, 275), Chemistry (210, often 220 also), and Physics (250, 260, 270). Depending on transfer school and major, students also take 0-6 engineering classes and 0-3 CIS classes along with general education requirements. Due to the continued diversification of lower division transfer requirements and the increased popularity of majors such as bio/biomedical engineering and environmental engineering, some students who transfer in engineering do not take many engineering courses. However, the presence of an engineering program may be part of what initially draws these students to CSM.

Although the program offers an A.S. degree in engineering, the B.S. degree is considered necessary for work in the field and most students do not take classes beyond the many required for transfer. The program also offers an A.S. degree in engineering technology, which allows students to focus on a particular technical area.

II. Summary of Student and Program Data

A. *Student Learning Outcomes Assessment*

Summarize recent SLO assessments, identify trends, and discuss areas in need of improvement.

The 80% threshold for success is met for most SLOs. Improvement is needed in two areas.
ENGR 100: The addition of a Arduino-based programming and design component to ENGR 100 in summer and fall 2012 reduced the time available for in-class coverage of "soft-skills" topics;

assessment of associated SLOs (awareness of field, communication) shows fewer students than expected at the "strong" (rather than "acceptable") level. Changes to the sequence and time of various course components are being considered as a result.
ENGR 260: In the spring 2012 offering of ENGR 260, digital design received very little coverage; only 10% of students satisfied the related SLO. Coverage of digital design will be increased for now. Modifications to the course outline may occur in the near future, as the current C-ID draft descriptors for this course do not include digital design. For two additional SLOs (device circuit analysis, software simulation), student success was just below the 80% criterion.

B. Student Success Indicators

1. Review Student Success and Core Program Indicators and discuss any differences in student success indicators across demographic variables. Also refer to the College Index and other relevant sections of the Educational Master Plan: Update, 2012, e.g., Student Outcomes and Student Outcomes: Transfer. Basic Skills programs should also refer to ARCC data.

Student success rates in engineering courses have historically been around 75% (higher than the math/science division average of 67%), with retention rates a bit above 80% (close to the division average). Both measures decreased in 2010-11 (success: 65%; retention 76%). While fall rates showed some improvement between 2010-11 and 2011-12 (success: 58% → 66%; retention 72% →78%), rates in spring continued to decline (success: 73% → 59%; retention 80% →67%).

Engineering enrollments remain heavily male; the percentage of women students (14%) remains slightly lower than the national average for undergraduate engineering programs (18% in 2009, http://www.nsf.gov/statistics/wmpd/2013/pdf/tab2-10.pdf). However, the national average includes bioengineering and environmental engineering, which have larger fractions of women but typically do not require many lower division engineering courses for transfer. Over the three-year period ending in 2011-12, the success rate of female students increased significantly (61% → 82%; n = 17), while the success rate of male students decreased significantly (80% →61%; n = 97).

Like other community college programs, the engineering program at CSM serves as a gateway for traditionally underrepresented students. At CSM, 75% of engineering enrollment is from students who identify as other than white, compared with 33% nationally (2009, http://www.nsf.gov/statistics/wmpd/2013/pdf/tab2-9.pdf). Success rates across ethnicity vary in roughly the same pattern as in the college as a whole, with engineering showing a slightly smaller gap between highest performing and lowest performing groups.

The number of engineering students who are 30 or older is small. Students in the 25-29 age category show 100% success during 2010-11 and 2011-12, compared with 60% for 20-24 year olds and 65% for students 19 and below. This is a much larger difference with respect to younger students than is the case for the college as a whole. (Note: there appears to be an error in the

Student Success and Core Program Indicator sheet, as the percent success values shown by age for 10-11 and 11-12 are identical while the total percent success values differ.)

2. Discuss any differences in student success indicators across modes of delivery (on-campus versus distance education). Refer to Delivery Mode Course Comparison.

Success and retention rates in the hybrid cross-listed offering of ENGR 215, while still below the rates for the on-campus offering, improved significantly between fall 2010 and fall 2011 (success: 33% → 57%; retention: 58% → 71%). A hybrid offering of ENGR 230 was added in fall 2011, but attracted only 5 students; retention and success were poor (2 of 5 completed the course; 1 of 5 succeeded). For fall 2012, enrollment in the hybrid section increased to 7; retention increased to 57% and success increased to 43%. These rates are still lower than those for the on-campus section. If the hybrid sections are retained, additional measures will be needed to improve success and retention.

C. Program Efficiency Indicators. Do we deliver programs efficiently given our resources?

Summarize trends in program efficiency as indicated in the Student Success and Core Program Indicators (LOAD, Full-time and Part-Time FTEF, etc.).

Low enrollment in advanced engineering courses means that LOAD will continue to be an issue for the program. The reported LOAD for 2011-12 is 476, well below the college average. Due to the small number of engineering courses offered, LOAD values change when faculty carry load in the Math Resource Center (as was the case in spring 2011) or the Integrated Science Center (as was the case in spring 2012) in addition to the load associated with lecture and lab. The program FTEF directly associated with lecture and lab has remained constant at 1.72 for close to a decade (recently added hybrid offerings are cross-listed and do not increase FTEF). Using this value as the divisor in the LOAD calculation gives adjusted LOAD values of 458 for 2010-11 and 505 for 2011-12. The adjusted value for 2011-12, while below the college average, is not unreasonable for a program in which many courses have advanced math and physics courses as prerequisites.

D. Course Outline Updates

Review the course outline update record**.** List the courses that will be updated in the next academic year. For each course that will be updated, provide a faculty contact and the planned submission month. See the Committee on Instruction website for course submission instructions. Contact your division's COI representatives if you have questions about submission deadlines. Career and Technical Education courses must be updated every two years.

Courses to be updated	Faculty contact	Submission month
ENGR 240	Laura Demsetz	November (earlier if engineering TMC and C-IDs are finalized)

E. Website Review

Review the program's website(s) annually and update as needed.

Faculty contact(s)	Date of next review/update
Laura Demsetz	News section is updated weekly; full site will be reviewed and updated in July.

F. Additional Career Technical Education Data – CTE programs only. (This information is required by California Ed. Code 78016.)

1. Review the program's Gainful Employment Disclosure Data, External Community, and other institutional research or labor market data as applicable. Explain how the program meets a documented labor market demand without unnecessary duplication of other training programs in the area. Summarize student outcomes in terms of degrees, certificates, and employment. Identify areas of accomplishment and areas of concern.

   N/A (transfer program)

2. Review and update the program's Advisory Committee information. Provide the date of most recent advisory committee meeting

   N/A (transfer program)

III. Student Learning Outcomes Scheduling and Alignment

A. *Course SLO Assessment*

Explain any recent or projected modifications to the course SLO assessment process or schedule.

The department's original SLO assessment plan called for phased assessment of course SLOs, with selected SLOs from each course assessed every third year. This approach proved cumbersome to implement, especially when additional adjunct faculty were added to the program, and has not provided timely information on overall student learning. Over the past two years, the department has moved to an assessment of each SLO with each course offering; this rollover will be complete in the 2012-2013 (current) academic year.

B. Program SLO Assessment

Explain any recent or projected modifications to the program SLO assessment process or schedule.

Program SLOs are in place and are currently assessed through an exit survey associated with the AS degree application.

C. SLO Alignment

Discuss how Course SLOs support Program SLOs. Discuss how Course and/or Program SLOs support Institutional/GE SLOs. Refer to TracDat related Program and Institutional SLO reports.

Each course supports one or more program SLOs. Taken together, the engineering courses support the following Institutional SLOs: Quantitative Skills, Ethical Responsibility. As part of the spring 2013 assessment process, the department will consider whether linking courses to the Critical Thinking and Effective Communication Institutional SLOs is appropriate.

IV. Additional Factors

Discuss additional factors as applicable that impact the program, including changes in student populations, state-wide initiatives, transfer requirements, advisory committee recommendations, legal mandates, workforce development and employment opportunities, community needs. See Institutional Research as needed.

Demand: The Bureau of Labor Statistics projections for 2010-2020 show employment increase in the 5-10% range for most of the traditional engineering disciplines, below the 14% projected average for all occupations. The projected increases for civil engineering, 19%, and environmental engineering, 22%, are above the projected average. The projected increase for biomedical engineering, 62%, is significantly higher than the projected average, but – due to the small base – the projected increase in the number of jobs in the field, 15,700, is lower than that for mechanical engineering, 21,300 [Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2012-13 Edition*; links to specific disciplines at http://www.bls.gov/ooh/architecture-and-engineering/home.htm]. There has been an increase in the number of transfer schools offering programs in bioengineering and biomedical engineering and an increase in the number of our students seeking to transfer in these majors.

Students who transfer and complete a B.S. degree in engineering continue to find high-paying jobs that make visible contributions to society. Given the regional emphasis on STEM fields and the increased inclusion of engineering in the Next General Science Standards [http://www.nextgenscience.org], it is likely that interest in engineering will remain strong. However, for the large fraction of students who arrive at CSM in need of remedial math, it may be difficult to preserve through a course of study that requires completion of precalculus and then 2 ½ to 3 years of additional study prior to transfer.

Transfer requirements: The move away from a common lower division engineering core curriculum has continued. The divergence across majors can be seen in the work of the engineering FDRG, which has developed drafts of two transfer curricula – one for civil/mechanical/aerospace engineering majors and

one for electrical/computer majors; due to the extensive lower division requirements, the final versions may not meet the 60-unit requirement of SB1440. The divergence across transfer schools has increased as well; most significant for CSM's program are the recent changes at U.C. Berkeley. The lack of coherence in lower division programs at transfer schools means that each engineering course is required by fewer programs than in the past.

Facilities: The program currently uses one of the Electronics program's labs for ENGR 260 and makes use of software funded primarily through the Drafting program for ENGR 210. Changes to these arrangements would impact engineering course offerings.

Support: The strong preparation provided by CSM's math and physics programs continues to produce students who are well prepared for engineering courses. However, our sister colleges to the north and south both have active MESA programs. Incoming students interested in math, science, and engineering may be drawn to Skyline and especially to Cañada for the added support provided by MESA and the high visibility of STEM majors.

V. Institutional Planning

A. Results of Plans and Actions

Describe results, including measurable outcomes, from plans and actions in recent program reviews.

Lottery funds have supported license renewal for the MATLAB software used in ENGR 215 and have helped support the license renewal for the Solidworks and AutoCAD software used in ENGR 210 (this software is primarily funded through the technology division). A Measure G Innovation Grant facilitated the incorporation for programing and design in ENGR 100 through the purchase of a classroom set of Arduino microprosseors, sensors, and actuators. Significant equipment funds granted in spring 2013 will support the purchase of modern equipment for the ENGR 270 materials lab, providing safer working conditions and supporting the extension of laboratory investigations.

The following progress has been made on the goals and actions included in the Spring 2012 Comprehensive Program review. These goals and actions were defined for a three-year period, with most of the work planned for the second two years due to the full-time faculty member's involvement in the accreditation self evaluation.

To increase enrollment, especially in more advanced courses (Goal 1)

- Faculty will update and enhance the engineering transfer guidance document to show the majors and transfer school for which advanced courses are required and recommended.
  Not yet started
- Faculty will implement an enhanced approach to hybrid courses with richer use of interactive and multimedia content.
  Underway; further enhancements will be included in F13 offerings.
- Aging laboratory equipment will be replaced or updated
  Funding requests were granted in spring 2013; equipment should be in place for spring 2014 courses.

To increase awareness of and access to the engineering program for students at or below Math 130

- Faculty will continue involvement with Counseling Services.
  The full time faculty member continues to support online counseling needs and in 2013-14 will once again carry load for in-person advising appointments.
- Engineering club activities will be more broadly advertised.
  Club activities were broadly advertised through flyers, signs, and the club website in fall, though publicity has tapered off in spring.
- The program will support CSM's MESA proposal and, if a MESA grant is received, take an active role in MESA activities.
  A MESA proposal was completed and submitted, but did not receive funding.
- ENGR 100 may be modified or divided into two parts to allow students to take an engineering class before completing Math 130. The most recent curriculum discussions at the Engineering Liaison Council do not include Math 130 as a perquisite for the Introduction to Engineering C-ID descriptor.
  On hold pending vetting and approval of C-ID descriptor.

To increase opportunities for student involvement outside the classroom (Goal 3)

- Faculty will place a higher priority on the Engineering Club and its activities.
  The club is active and has faculty support; support will increase once the full-time faculty member's accreditation responsibilities are complete.
- Faculty will allocate the time needed to coordinate activities such as the engineering transfer panel and engineering alumni panel.
  This will be possible once the full-time faculty member's accreditation responsibilities are complete.
- Peer tutoring for engineering classes, either in the Learning Center or in 19-040, will be investigated.
  One engineering student served as a Learning Center tutor in 2012-13 (listed as math, physics).
- The program will support CSM's MESA proposal and, if a MESA grant is received, take an active role in MESA activities.
  A MESA proposal was completed and submitted, but did not receive funding.

To improve articulation of engineering courses (Goal 4)

- Faculty will continue to attend semi-annual statewide Engineering Liaison Council meetings.
  The full-time faculty member attended the fall 2012 ELC meeting but not the spring 2013 meeting (due to screening committee interviews).
- Faculty will continue to participate in the TMC/C-ID review process for engineering and in the California Alliance for Long-term Strengthening of Transfer Engineering Programs through Cañada College.
  Completed and continuing in 2013-14.
- Faculty will work with CSM's articulation officer to extend articulation of engineering courses.
  Some additional articulation for ENGR 215 has been requested, but a full review of articulation has not yet been completed.

B. Program Vision

What is the program's vision for sustaining and improving student learning and success during the *next six years*? Make connections to the College Mission and Diversity Statements, Institutional Priorities, 2008-2013, and other institutional planning documents as appropriate. Address trends in the SLO assessment results and student success indicators and data noted in Section II. Summary of Student and Program Data.

[*Note*: CTE programs must address changes in the context of completion and employment rates, anticipated labor demand, and any overlap with similar programs in the area as noted in Sections II.F.1 and II.F.2.]

[*Note*: Specific plans to be implemented in the *next year* should be entered in Section V.C.]

The engineering program's vision is to continue to provide to students the engineering coursework and support needed to successfully transfer to the variety of engineering majors available at CSU, UC, and private universities. The vision supports the college's mission of providing a comprehensive curriculum and Institutional Priority 3: Promote Relevant, High-quality Program and Services.

The introduction of an Arduino-based design component to ENGR 100, the engineering club's purchase of a 3-D printer, and the anticipated acquisition of new materials testing equipment have helped modernize and generate enthusiasm for the program. To improve success and retention, the program will consider the increased use of project-based learning based around cutting-edge technologies and the implementation of support strategies such as individual tutoring, small group tutoring, and supplemental instruction. With the completion of accreditation responsibilities, the full-time faculty member anticipates being able to devote more time to activities that support the program outside the classroom, including the engineering club, industry interaction, articulation with transfer programs, and outreach to local high schools.

Given the extensive math and physics prerequisite chain for advanced engineering courses and the fact that a large percentage of CSM students place into remedial math courses, enrollment in advanced courses is likely to remain low. The program anticipates the need to expand its current use of alternate delivery modes to carry out its vision. This includes the coordination of online and hybrid courses with other community colleges in the region and an investigation into the use of MOOC and other online content combined with locally proctored exams to allow students to complete specialized requirements.

The engineering FDRG has proposed and received comments on two transfer curricula, and the program does not anticipate making major curricular changes until engineering C-IDs and one or more engineering TMCs have been finalized.

Students benefit from taking classes with several engineering instructors. To provide continuity and retain strong adjunct faculty, the full-time faculty member will likely need to pick up load in mathematics (preferably at the Math 120 or lower level) or elsewhere.

1. To guide future faculty and staff development initiatives, describe the professional enrichment activities that would be most effective in carrying out the program's vision to improve student learning and success.

   Professional enrichment activities that are most needed are 1) activities that address the use of peer support in small programs, 2) activities that address project-based learning in courses where student have a variety of classroom and life experience, and 3) activities that support effective use of hybrid, online, and other non-traditional delivery models

2. To guide future collaboration across student services, learning support centers, and instructional programs, describe the interactions that would help the program to improve student success.

   The continued interaction provided through the full-time instructor's role as faculty advisor is critical to promoting student success. In addition, it would be helpful to work with learning center staff on approaches to peer support for advanced classes – students typically transfer the year that the complete these courses, so there are few "peers" available on campus to serve as tutors.

3. To guide the Institutional Planning Committee (IPC) in long-range planning, discuss any major changes in resource needs anticipated in the *next six years*. Examples: faculty retirements, equipment obsolescence, space allocation. Leave sections blank if no major changes are anticipated. Specific resource requests for the next academic year should be itemized in Section VI.A below.

   Faculty: To retain strong adjunct faculty, the full-time faculty member will likely need to pick up load in mathematics (preferably at the Math 120 or lower level) or elsewhere.

   Equipment and Technology: The funding allocated to engineering in spring 2013 to replace aged materials testing equipment addresses the program's major long term equipment need. More modest expenditures to support project-based learning in specific classes may be needed on an annual basis.

   Instructional Materials: The introduction of an Arduino-based design component in ENGR 100 and the use of 3-D printing for group projects in ENGR 210 have caused a modest increase in the cost of the instructional materials needed to support the program.

   Classified Staff: 5T

Facilities: The program currently uses 19-100 for project work for ENGR 100 and ENGR 210. If the Electronics program's schedule changes so that the room is not available, alternate space will be needed.

C. Plans and Actions to Improve Student Success

Prioritize the plans to be carried out next year to sustain and improve student success. Briefly describe each plan and how it supports the Institutional Priorities, 2008-2013. For each plan, list actions and measurable outcomes.

Plan 1

Title:

Investigating peer support for engineering courses

Description

To improve success and retention, the program will investigate the implementation of support strategies such as individual tutoring, small group tutoring, and supplemental instruction.

Action(s)	Completion Date	Measurable Outcome(s)
Engineering faculty will meet with learning center staff and will programs using supplemental instruction to determine whether peer support is likely to be feasible for engineering courses.	Spring 2014	A "peer support plan" will be developed outlining appropriate strategies and the resources required for implementation.
Measure G or other proposals will be developed to request any supplemental funding needed to implement peer support plan.	Spring 2014	Proposal for supplemental funding will be submitted.

Plan 2

Title:

Facilitating engineering transfer success through creative course delivery

Description

With the increased impaction of engineering majors at transfer schools, to promote transfer success the engineering program must find a way to help students satisfy as many of the engineering transfer requirements as possible. Adding to this challenge is the diversification of the lower division engineering requirements across majors and transfer schools. For example, the mechanical engineering programs at UC Berkeley and UCLA now require thermodynamics in the lower division and look more favorably upon students who have completed this requirement prior to transfer. However, only a few students at CSM would

be interested in the course in a given year. To allow students to complete specialized requirements without greatly reducing productivity, the engineering program will consider the coordination of online and hybrid courses with other community colleges in the region and investigate the use of MOOC and other online content combined with local support and locally proctored exams.

Action(s)	Completion Date	Measurable Outcome(s)
Identify specialized courses in high-demand transfer programs.	August 2013	A table of specialized courses in high-demand transfer programs is developed.
Identify course delivery approaches for specialized courses, including coordination with other community colleges, online courses available for credit through other institutions, and the use of freely available online content supplemented with locally provided support and exams.	Fall 2013	Possible delivery strategies are added to the table of specialized courses.
If appropriate, develop a proposal for an umbrella course that combines freely available online material with local student support and proctored exams.	Spring 2014	Experimental course outline is submitted to COI.
Incorporate information in specialized courses into engineering transfer guidance documents.	Spring 2014	Guidance documents are updated; information is presented to counselors.

For additional plans, cut/paste from above and insert here. Or add an additional page. Number your additional plans accordingly.

[Note: Itemize in Section VI.A. Any additional resources required to implement plans.]

VI. Resource Requests

A. Itemized Resource Requests

List the resources needed for ongoing program operation and to implement the plans listed above.

Faculty

Full-time faculty requests (identify specialty if applicable)	Number of positions

	Tab to add rows

Complete Full-Time Faculty Position Request Form for each position.

Description of reassigned or hourly time for prioritized plans	Plan #(s)	Cost
Two FLCs of reassigned time (cost based on adjunct replacement at step 5; does not include office hours or benefits)	2	$2200

Equipment and Technology

Description (for ongoing program operation)	Cost
New tablet PC computer (HP 2760p or equivalent) for full-time faculty member (allows hybrid course offerings; faculty member currently uses a personally-owned tablet PC that is several years old)	$2500

Description (for prioritized plans)	Plan #(s)	Cost
none		

Instructional Materials

Description (for ongoing program operation)	Cost
Replacement for worn/torn Arduino components in ENGR 100	$200
MATLAB license renewal for ENGR 215	$300
MATLAB Simulink module (initial subscription) for ENGR 215	$500
Contribution to renewal of licenses for Solidworks and AutoCAD for ENGR 210	$500
Replacement for worn/torn electrical components in ENGR 260	$100
Tension and impact specimens for ENGR 270	$200
Polishing and mounting supplies for heat treated specimens in ENGR 270	$250

Description (for prioritized plans)	Plan #(s)	Cost
none		

Classified Staff

Description (for ongoing program operation)	Cost
none	

Description (for prioritized plans)	Plan #(s)	Cost
none		

Facilities

For immediate or routine facilities requests, submit a CSM Facility Project Request Form.

Description (for prioritized plans)	Plan #(s)	Cost
none		

B. Cost for Prioritized Plans

Use the resources costs from Section VI.A. above to provide the total cost for each plan.

Plan #	Plan Title	Total Cost
1	Investigating peer support for engineering courses.	$0
2	Facilitating engineering transfer success through creative course delivery	$2200