California State University
SAN MARCOS

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MEMORANDUM

DATE: January 23, 2018

TO: Regina Eisenbach, Dean of Academic Programs

CC: Michael Burin, Chair, Department of Physics
Jackie Trischman, Chair, CSM Curriculum Committee
Rick Fierro, Associate Dean, CSM
Laurie Schmelzer, Student Services Professional, CSM
Criselda Yee, Curriculum Specialist, Academic Programs

FROM: Katherine Kantardjieff, Dean
College of Science and Mathematics

SUBJECT: P-Form Approval for the Bachelor of Science in Electrical Engineering

I have reviewed the P-form from the Department of Physics for the proposed Bachelor of Science in Electrical Engineering. In addition, I have discussed the implementation and budgetary aspects with Associate Dean Rick Fierro and the HIS-STEM Grant implementation team. Please find my comments regarding this program attached. The CSM Dean's Office approves of the P-form and enthusiastically recommends that the proposal move forward in the Senate review process. If there are any questions or concerns, please do not hesitate to contact me.

Enclosures (1)

CSM Dean's Response to the Bachelor of Science in Electrical Engineering P-form

Justification

An engineering feasibility study conducted on behalf of Cal State San Marcos in 2015 confirmed what the university has believed for some time – engineering represents an area for much-needed programs in our region. The study reaffirmed what we know from Bureau of Labor Statistics and regional workforce forecasts. Electrical engineering nationally is expected to see a 7% growth through 2024, In the San Diego-Carlsbad area, however, electrical engineering has seen tremendous job growth in the last five years (77.4%), and is expected to continue to provide jobs for nearly 9% of California's nearly 16M workers.

The main reason for the rapid growth is a large increase in the demand for individuals who can design, test, install, and maintain large-scale electronic equipment or machinery for use in manufacturing or power generation or transmission. Growing industry sectors in our region who will need of electrical engineers in the near future include unmanned autonomous systems and biomedical devices/personalized health. The technology cluster along the San Diego region's 78 Corridor spans 70 different industries and 200 unique occupations. This tech cluster is 1.4 times more concentrated than the nation, and is expected to grow by 5% over the next five years, with biomedical devices expected to grow by 9%. The typical entry-level education required in electrical engineering is a bachelor's degree, with a median starting salary of $70,000 – $90,000.

The feasibility study highlighted also how Cal State San Marcos is in a prime position to draw from our existing curricula and faculty expertise while appealing to the hiring needs and goals of local industry. As Greg McKee, President and Chief Executive Office of CONNECT, has observed, ""Engineering proliferates nearly every aspect of modern life, and San Diego embodies how engineering is intertwined with daily life," said Greg McKee, president and chief executive officer of CONNECT. "With so many brilliant minds gathered in one place, it's essential to provide the means to nurture and excel each one, regardless of gender, ethnicity or income. Cal State University San Marcos is primed to support equitable student success through its engineering program and we at CONNECT are excited to see what the future holds as a more diverse round of innovators contribute to our local economy."

The proposed Bachelor of Science in Electrical Engineering is built from the ground up around principles of active and project-based learning in an authentically interdisciplinary framework. In addition, the proposed degree is designed to address the Accreditation Board for Engineering and Technology (ABET) Student Learning Outcomes for the 21st century engineer. CSUSM is well-positioned to build on existing curricula and faculty expertise, as we already offer a highly regarded Applied Physics degree. Upper division topics in the proposed curriculum that borrow from the current physics curriculum include digital electronics, signals and systems, solid state physics, embedded microsystems, and electromagnetism. New upper division topics in the proposed electrical engineering curriculum include digital circuit design, electronic circuits, sensors and controls, solid state devices, electromagnetism, and digital signal processing.

We also know that employers value experiential learning across engineering disciplines, such as incorporating capstone projects within program curricula to ensure students conduct at least one large-scale engineering project during their education. For this reason, the curriculum in electrical engineering includes two semesters of a senior project design course.

As a CSU campus, we value General Education. The skills taught in general education required courses – critical thinking, written and oral communication, problem solving, global awareness – help to prepare students to advance steadily in their field. In designing the Bachelor of Science in Electrical Engineering, we have not compromised General Education. As is customary in the CSU, our proposed EE curriculum assures that three units in the GE A3 area will be met by completion of the EE degree itself. Our students will not only possess the career-focused knowledge, but also the intangible skills necessary to do the job well as 21st century engineers. The proposed Bachelor of Science in Electrical Engineering will enable our students to contribute to addressing some of the most pressing grand challenges in engineering for the 21st century, as outlines by the National Academy of Engineering. These challenges include sustainable energy; personalized health and advanced health informatics; restoring and improving urban infrastructure; defense; and engineering the tools of scientific discovery.

Characteristics and Strengths

CSM is currently developing a 10-year strategic plan. Part of this process involves conducting "key informant interviews". What we have learned about CSM strengths from our external stakeholders, many who employ our graduates, is that our degree programs enable students to "*be in the research environment in a practical way*" and "*be productive more quickly in the workplace*". The proposed Bachelor of Science in Electrical Engineering degree builds on these strengths in CSM.

The proposed Bachelor of Science in Electrical Engineering degree distinguishes itself from other programs in the region in several ways. First, it draws upon a large number of existing courses and requires the least amount of faculty course development. Second, the degree is designed to meet employer demand and respond to unmet local employment need. Third, the degree structure meets the criteria set forth by the Accreditation Board for Engineering and Technology (ABET), and it meets topic standards set forth by the 2014 Institute of Electrical and electronics Engineers (IEEE). This high quality degree program is achieved without exceeding 120 units. Currently the ABET-accredited electrical engineering programs at surrounding CSUs (SDSU, CSUF, CSULB, CPP) are impacted. We will be the only four-year university with a Bachelor of Science in Electrical Engineering serving North County San Diego, Southwest Riverside County, and South Orange County, offering students, many of whom are place bound (veterans, first-generation), the opportunity for upward mobility. Finally, employers value experiential learning across engineering disciplines, such as incorporating capstone projects within program curricula to ensure students conduct at least one large-scale engineering project during their education. Building on our highly regarded hands-on curriculum, students will be required to complete a yearlong capstone senior project design course.

Planning Assumptions, Capacity and Sustainability

The start of the Bachelor of Science in Electrical Engineering without any diversion of resources from existing programs is made possible by the awarding of a significant $6M HSI-STEM grant from the Department of Education in September 2016. This will be enhanced by philanthropic support coming from the relevant industry sector. The BLP budget worksheet attached to the P-form reflects the HSI-STEM grant and philanthropic support.

The Bachelor of Science in Electrical Engineering is anticipated to begin with approximately 15 first-time freshman students. The program expects the number of first-time freshman to grow by approximately 15 students per year. In Year 3, we will begin admitting approximately 15 transfer students per year. Courses required during the first two years of the program already exist at CSUSM, and the majority of these currently articulate with our community college partners, Mira Costa College and Palomar College. Our partner institutions will develop the necessary additional courses and market articulation to CSUSM during Years 1 and 2. The relevant deans at MCC, PC and CSUSM have received financial support from NCHEA to bring faculties together in AY 17/18 to identify the next steps/action items for successful articulation. Renovations to the FCB building will provide the necessary facility capacity to accommodate the students. The program revenue will exceed the program costs in Year 5, as shown in the revenues-cost worksheet.

Initially, the Department of Physics at CSUSM will offer the Bachelor of Science in Electrical Engineering. It is important to note here that we assume the number of units in the "EE program" to be SUM of all the units for PHYS and EE courses required for the EE degree. There are 54 units in the "EE program". The number of units inside CSM but outside the EE program in the MATH and CS courses sum to 27. Program costs take into account the hiring of three tenure track faculty directly affiliated with the program.

Additional faculty hires in supporting disciplines will be requested based on and supported by the FTES revenue generated by the program. Current practices in the allocation of FTES and matching resources are based on student demand. All majors and minors are considered in the determination of course demand, including service courses, which includes processes (such as the use of Enrollment Requirement Group numbers) to ensure that students can enroll in courses required for their major. Continuous adjustments to the course schedule are made to capture fluctuations in student demand measures. It is the policy of this Administration to assure that resources to meet student demand are made available. The College of Science and Mathematics has established data driven guidelines for adjusting department chair compensation based on department growth and, as the program increases in size, CSM will adjust chair reassigned time accordingly.

Bachelor of Science in Electrical Engineering
Comprehensive Assessment Plan

ULOs	*PSLOs*	*Courses (Where SLOs are assessed)*	*Assessment activities (to measure each SLO)*	*Suggested assessment tools*	*Assessment schedule – how often SLOs will be assessed*	*How will data/ Findings be reported?*	*Designated personnel to collect, analyze, and interpret student learning outcome data*	*Program data/ findings dissemination schedule*	*Anticipated closing the loop strategies*
1, 2, 4	1) Technical knowledge	EE 303 (YES)	Exam to measure students' knowledge of mathematical, science, and engineering concepts	Final exam	Biennial – every odd fall semester	Exam scores will be aggregated, reviewed program faculty; annual reports to Academic Programs	Course instructor, program faculty	Semester following assessment activity	Program faculty will analyze data and determine if change is needed the following year; implement change in next year; re-measure the following year
1, 2, 4	2) Laboratory and Design	EE 406 (YES)	Project requiring students to design a system and conduct analysis	Project rubric	Biennial – every even fall semester	Rubric scores will be aggregated, reviewed program faculty; annual reports to Academic Programs	Course instructor, program faculty	Semester following assessment activity	Program faculty will analyze data and determine if change is needed the following year; implement change in next year; re-measure the following year
1, 2, 4	3) Communication and Collaboration	EE 499b (YES)	Culminating project demonstrating students' abilities to use appropriate skills to analyze and articulate a problem and apply appropriate skills to the solution	Project rubric	Biennial – every even spring semester	Rubric scores will be aggregated, reviewed program faculty; annual reports to Academic Programs	Course instructor, program faculty	Semester following assessment activity	Program faculty will analyze data and determine if change is needed the following year; implement change in next year; re-measure the following year
1, 2, 3, 4	4) Further study								
1, 2, 3, 4	5) Professionalism								

BSEE Curriculum Matrix of PSLOS for required courses	PHYS 201	PHYS 202	PHYS 203	EE 280	EE 301	EE 303	PHYS 321	EE 322	EE 330	EE 402	EE 415	EE 430	PHYS 421	EE 491A	EE 491B
1) Technical Knowledge															
a. apply knowledge of mathematics, science, and engineering	I	IR	R	R	I	A	R	R	R		A	A	A		A
b. identify, formulate, and solve engineering problems.	I	IR	R	R	IR	RA		R	R	RA		A			A
2) Laboratory and Design															
a. conduct experiments, as well as analyze and interpret data.	I	IR	R	R	R	A			R			A			A
b. design a system	I	IR	R	R	IRA	A			R	IRA	A	A			A
3) Communication and Collaboration															
a. function on multi-disciplinary teams.	I	R		R	R	A									
b. communicate effectively.	I	R	R	R	R	A			RA					A	A
4) Further study															
a. recognize the need for, and able to engage in, life-long learning.		I	IR	IR		R		R	R		A	A	I	A	
b. recognize the broad education necessary				I	I	R		R			A		R	A	
5) Professionalism															
a. demonstrate professional and ethical responsibility.					I	R								A	A
b. maintain currency in contemporary issues.			I		I	I			R	R	A	A	R	A	
c. use the techniques, skills, and modern engineering tools				I	I	R	I	R	R	R	A	A	R	A	A

I = Introduced; R = Reinforced; A = Advanced level application

CATALOG TERM: TBD **TOTAL UNITS REQUIRED = 120**

ELECTRICAL ENGINEERING

- This worksheet is intended for supplemental use only. The University will use your Academic Requirements Report (ARR) to track your graduation requirements, including those for your major. Please continue to check your Student Center and ARR for accuracy.
- If your ARR requires a correction, please submit an ARR Correction Form at www.csusm.edu/academicadvising.
- All courses used for the major and preparation for the major must be completed with a grade of C (2.0) or higher.
- All non-articulated courses MUST be reviewed and approved by a faculty advisor in the corresponding department.

PREPARATION FOR THE MAJOR

Lower Division (6 units):

✓	Course	Units
	GEL 101: The Student, The University, The Community	3
	EE 280: Introduction to Electronics	3

Supporting Courses (45 units):

✓	Course	Units
	CS 111: Computer Science I (^MATH 160)	4
	CS 231: Assembly Language and Digital Circuits (*CS 111)	4
	MATH 160: Calculus with Applications I (*MATH 125 or strong HS MATH skills, including Trig)	5
	MATH 162: Calculus with Applications II (*MATH 160)	4
	MATH 260: Calculus III (*MATH 162)	4
	MATH 342: Probability and Statistics for Engineers and Scientists	3
	MATH 346: Methods for Physicists and Engineers I (*MATH 162)	3
	PHYS 201: Physics of Mechanics and Sound (*MATH 160)	4
	PHYS 202: Physics of Electromagnetism and Optics (*PHYS 201, MATH 162)	4
	PHYS 203: Thermodynamics and Modern Physics (*PHYS 202)	4
	PHYS 321: Classical Electromagnetism (*PHYS 202, MATH 260)	3
	PHIL 348: Ethics in Engineering and Science	3

UPPER-DIVISION COURSEWORK

Electrical Engineering Core Coursework (30 units):

✓	Course	Units
	EE 301: Digital Electronics (*EE 280)	4
	EE 303: Signals and Systems (^MATH 346)	3
	EE 322: Solid State Devices (*PHYS 203)	3
	EE 330: Electronic Circuits I (*EE 280, MATH 346)	4
	EE 402: Computer Interfacing and Control (*EE 301)	4
	EE 430: Electronic Circuits II (*EE 330)	4
	EE 415: Instrumentation: Sensing and Controls	4
	EE 499A: Senior Project Planning	1
	EE 499B: Senior Lab Project	3

*^co/prerequisite, *prerequisite*

ELECTRICAL ENGINEERING

Elective Courses (6 units):
Choose 2 courses from the following:

EE 404: Digital Signal Processing (*EE 303)
EE 406: Digital Embedded Systems Design w/ HDL (*EE 301)
EE 435: Communication Systems (*EE 303)
PHYS 421: Applied Electromagnetic Waves (*PHYS 321)
PHYS 422: Applied Solid State Physics (*PHYS 203, MATH 346)
PHYS 442: Physical & Geometric Optics (*PHYS 203, MATH 346)

✓	Course	Units
☐		3
☐		3

California State University San Marcos

Major: ELECTRICAL ENGINEERING BS

Catalog Year(s): 2018
Degree Units: 120

Semester 1	
MATH 160 (GE Area B4)	5
CS 111	4
GEL 101 (GE Area E)	3
Language Course 201 (GE Area C3)	3
Total Units	**15**

Semester 2	
MATH 162	4
PHYS 201 (GE Area B1/B3)	4
GEW 101 (GE Written: Area A2)	3
GES 102 (GE Oral: Area A1)	3
Total Units	**14**

Semester 3	
PHYS 202	4
MATH 260	4
CS 231	4
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
Total Units	**15**

Semester 4	
PHYS 203	4
EE 280	3
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
Total Units	**16**

Semester 5	
PHYS 321	3
EE 301	4
EE 303	3
MATH 346 (GE Area BB)	3
Total Units	**13**

Semester 6	
EE 322	3
EE 330	4
PHIL 348	3
MATH 342	3
EE UD Elective	3
Total Units	**16**

Semester 7	
EE 402	4
EE 415	4
EE 430	4
EE 491A	1
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
Total Units	**16**

Semester 8	
EE 491B	3
EE UD Elective	3
GE Upper Division	3
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
LDGE: B2, C1, C2, D, Dc/Dg, Dh, D7	3
Total Units	**15**

Comments
UDGE must be taken after 60 units have been completed. EE majors may double count MATH 346 as a BB and PHIL 348 as a CC. EE UD electives include EE 404, EE 406, EE 435, PHYS 21, PHYS 422, and PHYS 442.

Prerequisites for CORE Courses
PHYS 201: MATH 160;
PHYS 202: PHYS 201;
PHYS 203: PHYS 202;
EE 280: PHYS 202;
EE 301: EE 280, CS 231
EE 303: MATH 346 (co-req);
EE 330: EE 280, MATH 346;
EE 402: EE 301;
EE 430: EE 330

Faculty Approval

Semester of Offerings
Fall Only:
Spring Only:

Engineering resources task force report

Edward Price (Chair), Associate Professor and Department Chair, Physics
Kamel Haddad (Assistant Chair), Vice Provost
Ali Ahmadinia, Assistant Professor, Computer Science
Michael Burin, Associate Professor, Physics
Matthew J. Ceppi, Associate Vice President, Institutional Planning & Analysis & Chief of Staff
Katherine Kantardjieff, Dean, College of Science and Mathematics
Simon Kuo, Vice President, Corporate Quality, ViaSat
Youwen Ouyang, Professor and Department Chair, Computer Science
Janine Smock, Instructional Support Technician III, Physics

Charge

In March 2016, Provost Oberem formed this Task Force to give consideration to the following aspects of what it will take to implement two or three engineering degree programs in CSM:

- Personnel (faculty, admin support, tech support, etc.)
- Space (building, lab space, office space, equipment storage, etc.)
- Equipment needs
- Short- and long-term financial model (to include support departments)
- An enrollment model (FTES growth planning)
- Impact on allied departments (MATH, PHYS, etc.)
- Scalability

The work of the Task Force was intended to inform university planning and the preparation of an HSI-STEM proposal to the Department of Education.

The task force met regularly during spring 2016.

Background

In fall 2014, Academic Affairs administrators expressed interest in exploring engineering programs, and encouraged faculty in computer science and physics to develop program abstract forms (A forms). In winter 2014, computer science submitted A forms for computer engineering and software engineering, and physics submitted an A form for electrical engineering. The CSU Board of Trustees approved these in spring 2015. The 2014-15 LAMP Task Force identified and prioritized areas of employment or academic study based on regional relevance, demand from students and community partners, consistency with CSUSM's mission and values, and need for foundational programs. Several engineering programs were given high priority.

In summer 2015, the Education Advisory Board Company was commissioned, using funds from an external grant, to conduct a feasibility study, which was completed in fall 2015. The study surveyed the competitive landscape for engineering programs, suggested concentrations for priority launch, and described audiences and recruitment strategies. The study compared local employer demand for engineers to the number of relevant degree completions at California universities, considered relevant community college programs (sources of students with relevant preparation), and evaluated the "gap" between existing curriculum at CSUSM and that needed for engineering. Candidate programs for priority launch were those that draw upon a large number of existing courses and require the least amount of course development, have ample employer demand (i.e., large numbers of job postings and above average job growth), and face low competition relative to employer demand. Based on these criteria, the study prioritized Software Engineering (SE), Electrical Engineering (EE), and Mechanical Engineering (ME).

Methodology

The Task Force began by making guiding assumptions and identifying example programs. An enrollment model was generated based in part on the Feasibility Study. The example programs and enrollment model were used to estimate the number of required sections, and thereby lab classroom and faculty needed. An inventory of required resources was based on experience in physics and computer science and examination of comparable programs. Combined with a roll out timeline, this gave start-up and steady-state costs.

Guiding assumptions

The Task Force focused on SE and EE and was guided by several assumptions:
These programs would be housed in computer science (SE) and physics (EE).
The programs would be designed to achieve ABET accreditation.
New programs should not negatively impact current programs, e.g., hires, funds, and space needed for existing programs should not be diverted to new programs.
Impacts of service courses (computer science, mathematics, and physics) should be accounted for.
New tenure track faculty should have appropriate salaries, research space, and start up packages.
External funds are available during the start-up phase, such as a Department of Education HSI-STEM grant, which could be up to $6M over 5 years.

Required resource categories

The Task Force identified the following categories of resources required for engineering programs:

a) Personnel, including salary and benefits
   i) Faculty (TT and LF)

   ii) Staff (admin support, instructional tech support)
b) Instructional lab supplies and equipment
c) Library acquisitions and subscriptions
d) Computer support
e) Space
   i) General purpose instructional (for engineering and service courses)
   ii) Instructional lab (for engineering and service courses),
   iii) Equipment storage, lab prep
   iv) Student project space
   v) Office space (TT and LF faculty, staff)
   vi) Faculty research
   vii) Meeting rooms (conference)
f) General program expenses
   i) Operating expenses
   ii) Reassigned time for additional department chair workload
   iii) Student assistants

Enrollment models and revenue

The Task Force used the following enrollment model for **each** program:

AY	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
FRESHMN		10	23	28	35	45	58	58
SOPH		0	9	21	25	32	41	52
JUNIOR		0	0	29	50	54	60	68
SENIOR		0	0	0	29	50	54	60
TOTAL		10	32	77	138	180	212	239
FTES		8.67	27.73	66.95	119.96	156.09	184.05	206.79

Planning Assumptions
0. 16-17 is first year of external funding, no students
1. 10% attrition from FY to SOPH
2. 5% attrition from SOPH to JUNIOR
3. By Yr 5, program at steady state
4. FTES assumes average unit load of 13 units undergrad.
5. No transfers until 19-20. No current students allowed to change majors into program until 19-20. [This is to allow time to establish instructional lab space needed for upper division students.]

The enrollment model was used to estimate revenues assuming $4,500/FTES. This is more than the $4,000/FTES given in the BLP worksheet for new programs. However, given the recent increase in system rate from approximately $9k/FTES to $10k/FTES, the $4,500/FTES figure is considered realistic.

The financial- and space-needs analyses presented below are sensitive to enrollment, and this model is subject to considerable uncertainty. However, given local employer demand, impaction of engineering programs at UCSD and SDSU, and enrollment in relevant community college programs (all documented in the Feasibility Study), **over-enrollment** is judged a greater risk than under enrollment. Effective enrollment control measures are therefore important.

Example curricula

For planning purposes, the Task Force surveyed several EE and SE programs in the CSU. This gave an estimate of the number and subject area of required courses, and the number of lab-based courses. Several programs were evaluated to determine commonalities and trends. Given the structured nature of the subject and the constraints of ABET accreditation, the core features of most programs are similar. The SE estimates most closely followed the San Jose State SE curriculum, while the EE estimates follow the Sonoma State EE curriculum. It is important to note that these were used for planning purposes only, and are not being recommended as models or templates for CSUSM programs.

Number of sections and teaching load

The example curricula were used to estimate the number of courses that would need to be offered each semester. An enrollment estimate and assumptions about course format and teaching load were then used to calculate the WTU required to offer the curriculum.

These calculations were based on an enrollment of 60 students at each level (freshman to senior) in each program. This is a simple assumption that is consistent with the later years of the enrollment model; in the early years it is an over-estimate. Each lecture was counted as 3 WTU and each lab as 2 WTU. Lab section cap was assumed to be 24, thus each lab course requires 3 lab sections. Calculus courses and intro CS courses require 9 WTU (3 for lecture and 2 each for 3 breakout sections). Other math and CS courses are assumed to be lectures requiring 3 WTU.

EE course requirements^

	fall			spring		
	# required courses	# lab sections	# WTU	# required courses	# lab sections	# WTU
EE lecture	6		18	7		21
EE lab	3	9	18	5	15	30
math	2		18	2		18
phys lecture	1		3	1		3
phys lab	1	3	6	1	3	6
CS	1		9			
total	14	12	72	16	18	78

^based on CSU Sonoma EE curriculum. Fall/spring includes courses offered that semester for students in all four program years. Senior design project is not included.

SE course requirements^

	fall			spring		
	# required courses	# lab sections	# WTU	# required courses	# lab sections	# WTU
SE lecture	7		21	5		15
SE lab	0	0	0	0	0	0
math	3		21	3		15
phys lecture	0		0	2		6
phys lab	0	0	0	2	6	12
CS lecture	4		12	3		9
CS lab	1	3	6	1	3	6
total	15	3	60	16	9	63

^based on SJSU SE curriculum. Fall/spring includes courses offered that semester for students in all four program years. Senior design project is not included. 1 CS course with lab each fall and spring; 3 of the 6 math courses are only 3 units.

Faculty needed

Assuming 64.3% of the WTU are TTF[1] leads to the following requirements:

Electrical engineering:

	TTF required		LF FTE required
dept	calculation	recommended	calculation
EE	1.8-3.1	2-3	1.8-1
math	0.8-1.3	1	0.8-0.4
phys	0.4-0.6	0.5	0.4-0.2

Software engineering:

	TTF required		LF FTE required
dept	calculation	recommended	calculation
SE	0.8-1.3	1-2	0.8-0.4
math	0.8-1.3	1	0.8-0.4
phys	0.4-0.6	0.5	0.4-0.2
CS	0.7-1.2	1	0.7-0.4

The recommended number of TTF is based on rounding up the calculated number required. Combining the physics TTF needed for both programs gives 1 TTF. Given the expected service load associated with starting the program, having TTF teach a max of 6 WTU may be more realistic. Furthermore, more TTF will help ensure ABET accreditation. Thus, the higher number of TTF is recommended, as follows:

Total TTF needed:	**3 EE**	**2 SE**	**1 CS**	**1 phys**	**2 math**

The curriculum analysis did not include senior design projects, which will be essential to ensure accreditation. Supervising projects is faculty-intensive; for instance, CoBA's Senior Experience uses a dedicated director. This element of the curriculum will add to the workload beyond what is projected here.

Space required

The number of required lab sections each semester can be used to determine the amount of lab classroom space needed. For example, the EE curriculum at Sonoma State includes 4 lab courses in fall and 6 in spring. With 3 sections per course, this would require enough space to offer a max of 18 sections. Balancing the lab courses between fall and spring would reduce this requirement to 15 lab sections. With

[1] Based on 75% of FTEF being TTF, assuming TTF FTE = 9 WTU, LF FTE = 15 WTU.

current scheduling patterns, a lab classroom can accommodate a max of 14, 3-hr sections/week.

Accommodating required lab courses, and allowing some space for senior design projects (essentially an ABET requirement), growth, and flexibility suggests that two lab classrooms are needed for each program. Recommended size is 1200 sq. ft. These spaces will need appropriate infrastructure (e.g. raised floor, power, temperature control, etc.).

Additional space needs include lab stockroom and prep space, faculty research space, faculty office space, and general-purpose instructional space (a SCALE-UP classroom is recommended to support research-based instruction).

Space needed*

area	#	sq ft each	sq ft total
instructional lab	4	1200	4800
SCALE-UP classroom	1	2800	2800
stockroom	2	300	600
faculty research	7	400	2800
office	7	110	770
conference	1	300	300
total			12070

**Does not include hallways, restrooms, etc.*
Assumes tech staff offices in stockroom; AC offices in current department space.

We note that the current physics instructional lab space is near capacity, and CS currently has **no** dedicated instructional lab space.

This analysis does not include the cost to build the needed space.

Expenses

Program expenses were based on costs for personnel (salary, benefits, start-up), equipment and supplies, library acquisitions, and department operating expenses.

Personnel cost assumptions:
1. Salary and startup as listed below
2. Starting engineering faculty for each program is at associate level
3. Average lecturer salary = $1,777/wtu
4. Benefits at 48.5%

Anticipated TTF salary and start-up costs

engin salary, associate	$120,000
engin salary, assistant	$90,000
CS salary	$80,000

physics/math salary	$75,000
EE/physics startup	$80,000
CS/SE start up	$40,000
math start up	$15,000

Most TTF were assumed to start in the programs' third year, as program size increases and students begin the upper division, moving from mostly prerequisite courses in physics, math, and CS to specialized engineering courses.

Supply, equipment, and computing needs were based on an analysis of lab courses included in typical SE and EE programs, as well as experience with similar courses in the physics and computer science departments. IT expenses are included with computer equipment. Total estimated supply and equipment costs approach $1M for each program (this includes workbenches, workstations and storage for outfitting instructional labs). Costs for consumable supplies, and a prorated 10-year lifetime for equipment with long-term durability suggest $80k/yr for EE and $75k/yr for SE is needed for instructional equipment.

Financial model – externally funded and ongoing

Total expenses during the externally funded period total $3.86M for EE and $3.5M for SE. Expected revenue from FTES and external funds (anticipated $6M award from Department of Education) total $7.97M. The table below summarizes.

5-year externally funded period	
REVENUE	
SE Tuition Revenue	$1,004,894
EE Tuition Revenue	$965,894
Grants* and donations	$6,000,000
TOTAL REVENUE	$7,970,787
COSTS	
SE costs	-$3,504,468
EE costs	-$3,861,794
TOTAL COSTS	-$7,366,262
NET	$604,525

The costs during this period depend greatly on the timing of personnel hiring, which in this analysis was synced with enrollment. It was assumed that all needed personnel would be hired, and needed instructional equipment purchased, before the end of the external funding period.

Beyond the external funding period, estimated annual expenses and revenues are:

Annual CSM costs	
REVENUE	
SE Tuition Revenue	$930,540
EE Tuition Revenue	$930,540
Course fees	$35,873
TOTAL REVENUE	$1,896,953
COSTS	
SE costs	-$888,927
EE costs	-$1,000,152
TOTAL COSTS	-$1,889,079
NET	$7,873.38
NET/FTES	$19.04

Scalability and Limitations

If the enrollment model is exceeded, this will increase both costs and revenues. Enrollment control is important during the start up phase so that the timing of course need matches available faculty, space, and other resources. Scalability is constrained by the availability of instructional lab space and tenure track faculty.

The validity of this analysis depends on assumptions about curricula, enrollment, and resources. Any program is complex, and many details will not be determined until the curriculum is designed and the programs implemented. In particular, faculty supervision of senior design projects was not accounted for here. A more lab-intensive curriculum will impact space, personnel, and equipment resources. It is important to emphasize that the distribution of lab, lecture, and prerequisite courses is **not** intended to be a template for program development; it was simply used as a best estimate of program structure for resource planning. CSUSM program development should strive for quality programs, coordinate with and leverage existing programs, and plan for ABET accreditation.

The balanced financial models presented here depend on external funding and revenue to the programs of $4,500/FTES. Space (~12k sq ft) is required as well.

The financial model for the startup period depends on the relative timing between personnel hiring and student enrollment. It was assumed that these would happen together. The process and timing for program development remains uncertain, and the analysis of the start up phase should be viewed accordingly.

A. ANTICIPATED COST PROJECTIONS FOR NEW STATESIDE PROGRAM: Software Engineering

P form process 1st year students x^er students; building

	16-17		17-18		18-19		19-20		20-21		annual CSM costs		
Personnel	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	
TT Faculty salary, engin	0	$0	0	$0	2	$210,000	2	$210,000	2	$210,000	2	$210,000	
TT faculty benefits (48.5%)		$0		$0		$101,850		$101,850		$101,850		$101,850	
TT Faculty start-up funds, SE		$0				$80,000							
TT Faculty salary, CS	0	$0	0	$0	0	$0	1	$80,000	1	$80,000	1	$80,000	
TT faculty benefits (48.5%)		$0		$0		$0		$38,800		$38,800		$38,800	
TT Faculty start-up funds, CS		$0		$0		$0		$40,000					
TT Faculty salary, math	0	$0	0	$0	1	$75,000	1	$75,000	1	$75,000	1	$75,000	
TT faculty benefits (48.5%)		$0		$0		$36,375		$36,375		$36,375		$36,375	
TT Faculty start-up funds, math		$0		$0		$15,000							
Lecturers	0	$0	0.6	$31,986	1.3	$69,303	1.6	$85,296	1.6	$85,296	1.6	$85,296	
Lecturer benefits (48.5%)		$0		$15,513		$33,612		$41,369		$41,369		$41,369	
Technician	0	$0	1	$45,000	1	$45,000	1	$45,000	1	$45,000	1	$45,000	
Staff benefits (48.5%)		$0		$21,825		$21,825		$21,825		$21,825		$21,825	
Library Resources													
Acquisition				$15,000		$1,500		$1,500		$1,500			
Subscription				$6,000		$6,000		$7,000		$7,000			
Equipment/Materials													
Computer Network & Software				$60,000		$60,000		$60,000				$75,000	$180,000
Lab benches & equipment				$150,000		$250,000		$50,000		$50,000		$10,000	$500,000
Expendables				$100,000		$100,000		$50,000		$10,000		$10,000	$260,000
													$940,000
Dept expenses													
OE				$3,000		$5,000		$7,000		$7,000		$7,000	
DC resassigned time			1CR	$5,500	1CR	$5,500	2CR	$11,000	2CR	$11,000	2CR	$11,000	
AC			0.5	$22,500	0.5	$22,500	0.5	$22,500	0.5	$22,500	0.5	$22,500	
AC benefits (48.5%)				$10,913		$10,913		$10,913		$10,913		$10,913	
student assistants				$2,000		$3,000		$5,000		$7,000		$7,000	**Projected 5-year cost**
Program Cost (SUM)		**$0**		**$489,237**		**$1,152,377**		**$1,000,427**		**$862,427**		**$888,927**	**$ 3,504,468**

Planning Assumptions:

0. Salary and startup as listed below
1. Starting Faculty is at associate level
2. Average Lecturer Costs = $1,777/wtu + 41% benefits if time base at .4
3. Staff Costs = salary + 41% benefits
4. 1 TTF in physics included in EE, 0 in SE
5. 1 TTF each in math included in EE, SE
6. Math TTF start 1 each in 18-19, 19-20; Phys and CS TTF start in 19-20

engin salary, associate	$ 120,000
engin salary, assistant	$ 90,000
CS salary	$ 80,000
math salary	$ 75,000
CS/SE start up	$ 40,000
math start up	$ 15,000

B. ANTICIPATED REVENUES FOR NEW STATESIDE PROGRAMS: Software Engineering

	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
FRESHMN		10	23	28	35	45	58	58
SOPH		0	9	21	25	32	41	52
JUNIOR		0	0	29	50	54	60	68
SENIOR		0	0	0	29	50	54	60
TOTAL		10	32	77	138	180	212	239
FTES		8.67	27.73	66.95	119.96	156.09	184.05	206.79
Revenue to AA		$39,000	$124,800	$301,275	$539,819	$702,410	$828,224	$930,540
COURSE FEES		$600	$2,190	$6,113	$10,551	$13,370	$15,755	$17,936
Total Revenue		$39,600	$126,990	$307,388	$550,369	$715,779	$843,978	$948,476

5-year external funding period (Yrs 16-17 to 20-21):	
Tuition Revenue	$1,004,894
Grants* and donations	$0
Course fees	$19,453
TOTAL	$1,004,894

included in EE worksheet

Planning Assumptions

0. 16-17 is first year of grant
1. 10% attrition from FY to SOPH
2. 5% attrition from SOPH to JUNIOR
3. By Yr 5, program at steady state
4. FTES assumes average unit load of 13 units undergrad.
5. Academic Affairs will receive approx. $4,500 per FTES
6. *Expected as federal grant funding (likely Dept of Ed, eg, Title IV funds)
7. Course fees of $30/student-lab course, ~10 labs offered each year
8. No transfers until 19-20. No current students allowed to change majors into program until 19-20

A. ANTICIPATED COST PROJECTIONS FOR NEW STATESIDE PROGRAMS: Electrical Engineering

	P form process		1st year students				xfer students; building					
	16-17		17-18		18-19		19-20		20-21		ongoing CSM costs		
Personnel	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	**Number**	**Cost**	
TT Faculty salary, engin	0	$0	0	$0	2	$210,000	3	$300,000	3	$300,000	3	$300,000	
TT faculty benefits (48.5%)		$0		$0		$101,850		$145,500		$145,500		$145,500	
TT Faculty start-up funds, engin		$0		$0		$180,000		$90,000		$0		$0	
TT Faculty salary, phys	0	$0	0	$0	0	$0	1	$75,000	1	$75,000	1	$75,000	
TT faculty benefits (48.5%)		$0		$0		$0		$36,375		$36,375		$36,375	
TT Faculty start-up funds, phys				$0		$0		$90,000					
TT Faculty salary, math	0	$0	0	$0	0	$0	1	$75,000	1	$75,000	1	$75,000	
TT faculty benefits (48.5%)		$0		$0		$0		$36,375		$36,375		$36,375	
TT Faculty start-up funds, math		$0		$0				$15,000					
Lecturers	0	$0	0.6	$31,986	1.3	$69,303	1.3	$69,303	1.6	$85,296	1.6	$85,296	
Lecturer benefits (48.5%)		$0		$15,513		$33,612		$33,612		$41,369		$41,369	
Technician	0	$0	1	$45,000	1	$45,000	1	$45,000	1	$45,000	1	$45,000	
Staff benefits (48.5%)		$0		$21,825		$21,825		$21,825		$21,825		$21,825	
Library Resources													
Acquisition				$15,000		$1,500		$1,500		$1,500			
Subscription				$6,000		$6,000		$7,000		$7,000			
Equipment/Materials													
Computer Network & Software				$40,000				$40,000				$10,000	$80,000
Lab benches & equipment				$250,000		$250,000		$100,000		$50,000		$60,000	$650,000
Expendables				$75,000		$75,000		$50,000		$10,000		$10,000	$210,000
													$940,000
Dept expenses													
OE				$3,000		$5,000		$7,000		$7,000		$7,000	
DC reassigned time			1CR	$5,500	1CR	$5,500	2CR	$11,000	2CR	$11,000	2CR	$11,000	
AC			0.5	$22,500	0.5	$22,500	0.5	$22,500	0.5	$22,500	0.5	$22,500	
AC benefits (48.5%)				$10,913		$10,913		$10,913		$10,913		$10,913	
student assistants				$2,000		$3,000		$5,000		$7,000		$7,000	**Projected 5-year cost**
Program Cost (SUM)		**$0**		**$544,237**		**$1,041,002**		**$1,287,902**		**$988,652**		**$1,000,152**	**$ 3,861,794**

Planning Assumptions:

0. Salary and startup as listed below
1. Starting Faculty is at associate level
2. Average Lecturer Costs = $1,777/wtu + 41% benefits if time base at .4
3. Staff Costs = salary + 41% benefits
4. 1 TTF in physics included in EE, 0 in SE
5. 1 TTF each in math included in EE, SE
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physics/math salary	$75,000
engin/physics startup	$80,000
math start up	$15,000

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SOPH		0	9	21	25	32	41	52
JUNIOR		0	0	29	50	54	60	68
SENIOR		0	0	0	29	50	54	60
TOTAL		0	32	77	138	180	212	239
FTES		0.00	27.73	66.95	119.96	156.09	184.05	206.79
Revenue to AA		$0	$124,800	$301,275	$539,819	$702,410	$828,224	$930,540
COURSE FEES		$600	$2,190	$6,113	$10,551	$13,370	$15,755	$17,936

5-year external funding period (Yrs 16-17 to 20-21):	
EE Tuition Revenue	$965,894
Grants* and donations	$6,000,000
Course fees	$19,453
TOTAL	$6,965,894

Planning Assumptions

0. 16-17 is first year of grant
1. 10% attrition from FY to SOPH
2. 5% attrition from SOPH to JUNIOR
3. By Yr 5, program at steady state
4. FTES assumes average unit load of 13 units undergrad.
5. Academic Affairs will receive approx. $4,500 per FTES
6. *Expected as federal grant funding (likely Dept of Ed, eg, Title IV funds)
7. Course fees of $30/student-lab course, ~10 labs offered each year
8. No transfers until 19-20. No current students allowed to change majors into program until 19-20

5-year externally funded period	
REVENUE	
SE Tuition Revenue	$1,004,894
EE Tuition Revenue	$965,894
Grants* and donations	$6,000,000
TOTAL REVENUE	$7,970,787
COSTS	
SE costs	-$3,504,468
EE costs	-$3,861,794
TOTAL COSTS	-$7,366,262
NET	$604,525

Annual CSM costs	
REVENUE	
SE Tuition Revenue	$930,540
EE Tuition Revenue	$930,540
Course fees	$35,873
TOTAL REVENUE	$1,896,953
COSTS	
SE costs	-$888,927
EE costs	-$1,000,152
TOTAL COSTS	-$1,889,079
NET	$7,873.38
NET/FTES	$19.04

California State University
SAN MARCOS
Library

University Library California State University San Marcos 333 S. Twin Oaks Valley Road San Marcos, CA 92096-0001
Tel: 760.750-4330 **Fax:** 760.750.3318 jfabbi@csusm.edu biblio.csusm.edu

Date: March 17, 2017

To: Dr. Michael Burin

From: Dr. Jennifer Fabbi
Dean, University Library

Subject: Library Review of the Proposal for Bachelor of Science in Electrical Engineering

Thank you for the opportunity to respond to the proposal for a Bachelor of Science in Electrical Engineering. The following information reviews the current capacity and describes probable needs of the CSUSM Library to support this program. Talitha Matlin, STEM Librarian, has reviewed the program proposal in its current form.

Resource Implications
Collections relevant to the proposed program would be housed with the CSUSM Kellogg Library, or more likely, virtually accessible through the Library website, The California State University at San Marcos (CSUSM) Library (http://biblio.csusm.edu). CSUSM has no branch or satellite libraries on or off campus.

Existing Collections
Collections relevant to the proposed program would be housed with the CSUSM Library. CSUSM has no satellite libraries on campus. The CSUSM Library currently has monographs and journals to support undergraduate/graduate programs in Computer Science, Mathematics, Physics, and Chemistry, which also appear to be relevant to significant aspects of the B.S. in Electrical Engineering program. Relevant current holdings include:

- Safari eBooks collection (over 9,500 programming ebooks, with 270+ titles related to Electrical Engineering)
- Science Direct books and journals related to Electrical Engineering, General Computer Science, General Engineering, Physics, and Mathematics
- Wiley journal collections in the following areas: Physical Sciences & Engineering and General & Introductory Computer Science
- Association for Computing Machinery Digital Library, which includes journals, conference proceedings, technical newsletters, and video/audio files related to a wide range of computing topics (subscription cost is currently paid by Extended Learning in support of the PSM in Cybersecurity)

Additional Needed Collections

To keep up with the continued growth and advancement of Computer Science/Engineering-related programs at CSUSM, we strongly recommend the following resources be added in order to provide an enriching educational experience and to maintain excellence in the research activities of faculty and students:

Core Resources	Notes	Cost
Monographs	Titles related to electrical engineering	$1,000 annually
IEEE Xplore Digital Library Journals and Proceedings Collection	One of the premier resources for scientific and technical content.	$4,839 (annually, + 6% inflation per year)
Engineering Village	Previously known as Compendex; 12 engineering literature and patent databases providing comprehensive coverage from a range of trusted, reliable and relevant sources: scholarly journals, conference proceedings, trade publications, patents, and government reports.	$11,465 (annually, + 6% inflation per year)
Compendex Engineering Index Backfile	Significantly enhances usability of Engineering Village subscription.	$20,049 one-time fee, plus $1000 annual hosting fee
Association for Computing Machinery Digital Library	Although the University Library currently provides access to this subscription with funding from Extended Learning in support of the PSM in Cybersecurity, the proposed Engineering programs (in Engineering, Computer Engineering, and Electrical Engineering) will shift the core users of this resource from EL students to stateside-funded students. Correspondingly, we recommend that the subscription for ACM be paid for out of stateside funds.	$6,738 (annually, + 6% inflation per year)
Total for Year One		$25,042 ongoing $20,049 one-time

Highly Recommended Resources	Notes	Cost
JoVE Engineering	The Journal of Visualized Experiments is a new resource that publishes high quality, engaging scientific video demonstrations. This unique online collection of peer-reviewed videos can supplement a program for which there are not extensive laboratory facilities. A subscription to this journal may depend on the extent of available laboratory facilities that are constructed to support the new B.S. in Electrical Engineering.	$2000 annually
ENGnetBASE	eBook collection of over 2,300 Engineering-related reference texts.	$23,000 annually
SpringerLink Engineering eBooks	PDF eBooks covering a range of engineering topics.	$30,000 annually
Thomson Reuters InCites	Measures research influence and impact at the journal and category levels, and shows the relationship between citing and cited journals	$25,000 annually*
Total for Year One		$80,000

*placeholder, waiting for vendor response

Faculty may, at any time, contact the librarian assigned to the B.S. in Electrical Engineering regarding suggestions for acquisitions to the collection. Further, reports, assessment, and other analysis of library collections in all subjects are done in response to program review, by the library liaison.

Additional Needed Personnel

A B.S. in Electrical Engineering program bears some topical overlap to Computer Science, Mathematics, Physics, and Chemistry. Currently, Talitha Matlin (STEM Librarian) is the subject specialist for the College of Science and Mathematics. However, the addition of an Electrical Engineering program (in combination with the other planned Engineering programs such as Software and Computer Engineering) will necessitate an additional faculty line in the library in order to provide relevant expertise and capacity. At the moment, Ms. Matlin is responsible for instruction, reference, and collection development for the entire CSM. The potential subject portfolios of two science librarians could be:

- (NEW) STEM Librarian: Engineering, Physics, Mathematics, & Computer Science

- Chemistry and Life Sciences Librarian: Biology, Chemistry, Biotechnology, Environmental Sciences, and other relevant subjects in Extended Learning and CSM

The P-form states that three tenure-track faculty will be needed to be hired to support upper-division EE courses, with additional faculty members needing to be hiring in the Mathematics, Physics, and EE departments in order to support larger enrollment in the future; an additional faculty line in the library would also be necessary to support the new program and larger enrollment. ***The average cost of a library faculty member with a science background is $72,000/year.***

Reference and instruction by subject specialist librarians
The proposed new faculty librarian would serve as the liaison to the B.S. in Electrical Engineering program. The current STEM Librarian has provided online and in-class instruction to students in the Physics, Chemistry, Mathematics, and Computer Science. Most relevant to the B.S. in Electrical Engineering is online instruction through course guides and online tutorials, although some in-person instruction with the STEM Librarian might be necessary for more advanced Engineering research such as patent searching, using technical reports, and finding standards. Faculty who will be teaching the year-long senior capstone projects should also encourage their students to meet with the STEM Librarian as they begin their research.

Beyond instructional impact, it is worth noting that each new program increases demand on all Library services from interlibrary loan to extended hours.

Basic information about the Library's collections and services follows in the table below.

Library holdings	http://biblio.csusm.edu/external/about-the-library/collection-overview
Circulation	http://biblio.csusm.edu/external/policies/books-and-media-borrowing-policies
Inter-library loan services	http://biblio.csusm.edu/interlibrary-loan-borrowing-policies
Reference/Research help	https://biblio.csusm.edu/research-assistance
Information Literacy Program	http://biblio.csusm.edu/about/departments/337/info
E-thesis, project, and dissertation submission	http://biblio.csusm.edu/guides/subject-guide/193-CSUSM-ETD-Submission-Guide/

The Library looks forward to continued collaboration with those working on the proposed program and is happy to provide further information. It is essential that the program proposers continue discussions with the Library as the program is approved to ensure that students and faculty have sufficient information resources at the inception of the program.

cc: Hua Yi
Talitha Matlin

California State University
SAN MARCOS

Academic Affairs

Office of the Provost and Vice President for Academic Affairs CSU San Marcos 333 S. Twin Oaks Valley Road San Marcos, CA 92096-0001
Tel: 760.750.4050 **Fax:** 760.750.3150 www.csusm.edu/aa

MEMORANDUM

DATE: October 17, 2014

TO: Edward Price
Associate Professor and Department Chair, Physics

FROM: Graham Oberem
Provost and Vice President for Academic Affairs

SUBJECT: Development of engineering curricula

Thank you for your thoughtful memorandum regarding the development of engineering programs at CSUSM and the potential impact that engineering could have on your department and College. I agree that it would not be wise to grow existing and/or new programs without ensuring that the elements you mention are adequately provided for as we move forward. We have to ensure that the quality of existing and future programs is protected.

As you are aware, we are moving to a formulaic model for resource allocation in Academic Affairs. This model is designed to quantify the resources necessary to deliver our instructional programs, recognizing that each academic department is different both in their needs and in what it takes to deliver their curriculum. The model quantifies the amount of FTES that a given department will be asked to deliver (their target), based not only on the number of majors in that department, but also on the number of students in other majors who need courses in that department. This will capture the impact, on any given department, of new academic programs and/or tracks, across the university.

Once the FTES is known for any department, the cost of delivering that instruction can be calculated, using the known cost per FTES. This will ensure that adequate resources in terms of TT faculty, lab equipment, supplies, staff, space, etc., will be allocated to that department. If resources are limited, the number of students in the proposed program would be limited, or the program would not be able to start. It is important to understand that the resources referenced here are not just for the department in which a program is based, but would be the resources needed for all participating or impacted departments.

Accordingly, I want to assure you that if engineering programs were to be implemented at CSUSM, resources from external sources and general funds to support growth will be used to ensure that existing programs are adequately funded to participate directly or indirectly in these new programs. We are committed to helping CSM make progress relative to the benchmarks set out in the CSM Strategic Plan, some of which you include in your memorandum. Apart from providing budgetary resources for TT faculty, supplies, etc., the University is committed to addressing the instructional and research space problems that you mention. Growth in the Sciences will not be sustainable without addressing those needs.

GO/mab

cc: Katherine Kantardjieff, Dean, College of Science and Mathematics
Kamel Haddad, Vice Provost, Office of Planning and Academic Resources

California State University
SAN MARCOS

College of Science
& Mathematics

Department of Physics California State University San Marcos 333 S. Twin Oaks Valley Road San Marcos, CA 92096-0001
Tel: 760.750.4273 physics@csusm.edu www.csusm.edu/physics

MEMORANDUM

DATE: October 11, 2014

TO: Katherine Kantardjieff, Dean, College of Science and Mathematics

FROM: Edward Price, Associate Professor and Department Chair, Physics

RE: **Development of engineering curricula**

In recent discussions of possible engineering curricula, both the Physics Department and the Dean's Office have acknowledged potential positive outcomes including better serving our region; adding space, laboratory facilities, and equipment; and engaging external donors. Yet current programs in the College are already overextended and underfunded (as documented in the CSM Strategic Plan), and growth without adequate resources includes risk of reduced program quality, extended times to graduation, safety concerns, reputational harm, and faculty/staff burnout.

The purpose of this memo is to seek agreement on how we bring on engineering programs and respond to the impacts on the College. Consideration of engineering programs is only feasible due to the College's success and reputation; furthermore, current College programs will be the foundation upon which engineering programs are built. Successful growth that maintains our current quality will require reinvesting in this foundation. The successful launch of engineering programs will require funds and resources for the new programs, as well as the following for current programs:

Tenure track faculty As described in the CSM Strategic Plan, the ratio of CSM majors to instructional tenure track faculty should be no more than 30:1.

Laboratory budgets Again according to the CSM Strategic Plan, "Laboratory budgets should scale with student laboratory enrollment to ensure quality instruction and safety." A commitment to a sustainable approach to funding laboratory courses is needed. This should include current offerings, new lab-based courses for engineering students, service contracts, and capital depreciation.

Faculty research space Even with the renovation of space on the 3rd floor of SCI2, the College will run out of faculty research space in two years. Additional research space, perhaps off-site but nearby, is needed to support faculty hiring and student research experiences until a new building can be constructed.

Administrative & technical support staff The CSM Strategic Plan calls for a 100:1 ratio of students served per IST, and for additional administrative support staff.

Regarding timing, these elements were identified in the CSM Strategic Plan as critical to the College's current programs, suggesting they should be remedied immediately and regardless of engineering programs. However, we understand that this may take time and can proceed in parallel with securing resources and developing curriculum for engineering programs. In any case, these four foundational elements must be addressed before launching engineering programs.

We request that you consult with Provost Oberem and obtain his assurance that no engineering programs will be offered unless these four needs of current programs are addressed, whether by internal or external means.

Appendix: Additional Personnel from HSI STEM grant

Four additional staff positions are planned. These positions are to be cost-shared with the proposed SE program and funded solely through the HSI STEM grant.

First, the HSI-STEM grant will fund the position of an Engineering Laboratory Developer (**ELD**). This project includes new laboratory facilities and resources to support the active, project-based approach to learning at the core of the classroom experience. Project leadership will select a qualified Engineering Laboratory Developer to assist with the planning and design of the new engineering laboratories at CSUSM and assist faculty with purchase, set up, and maintenance of all new science equipment and supplies. To ensure that lab materials and tools are meeting student needs, the Engineering Lab Developer will also assist students in class and oversee all aspects of technology integration in the curriculum. The selected person will also be responsible for cataloging and keeping records of all laboratory equipment and supplies according to Federal, State, and local guidelines, as well as maintain the servers in the computer labs.

Second, the HSI-STEM grant will fund the position of an Engineering Pathways Advisor (**EPA**) to play a central role in the design of pathway services. Advising is crucial to this suite of services, and the advising methods incorporated in the proposed project will be modeled after the best available research, including decentralized, intrusive, and dedicated caseload methodology. Dedicated engineering advising will be added to existing support services for pathway students. The EPA will furthermore develop, implement and assess strategies to provide dedicated academic advising, including community college as well as CSUSM engineering majors; will work with/liaison with all relevant CSUSM advising programs and centers; will assist in recruiting, training and evaluating peer coaches and ambassadors; will assist in developing strategies to institutionalize engineering advising. This position is developmental during the grant period. The EPA will develop engineering transfer guides and handbooks, will develop an operational plan for pathway cohort services including requirements and incentives, will train counselors and university advising staff to understand engineering course requirements and transfer/completion timelines, and will assist assessment of advising services. The continued need for this staff position will be evaluated in the final year of the grant.

Third, the HSI-STEM grant will fund the position of a Research Designer/Specialist (**RDS**). This consultative position is designed to support both formative and summative assessment of progress toward specific measurable objectives and testing of specific innovative features. CSUSM has a strong institutional research office, and capable research faculty, but this project is thought to require additional research capacity with specific interest in the contextual factors that promote and reinforce social disparities in STEM.

Fourth, the HSI-STEM grant will fund an Interdisciplinary Curriculum Specialist (**ICS**), who will have a central role in ensuring that the engineering program is interdisciplinary, that faculty development fosters breakdown of disciplinary silos, and that students experience interdisciplinary projects. This person will have a role in developing interdisciplinary capstone projects, working with STEM faculty and will also be a liaison with the Academic Support and STEM Centers for engineering pathway courses. The role for the ICS will expire at the end of the final year of the grant.

California State University
SAN MARCOS

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MEMORANDUM

DATE: March 28, 2017

TO: Michael Burin, Ph.D., Associate Professor
Department of Physics

FROM: Kevin D. Morningstar, Dean & Chief Information Officer
Instructional & Information Technology Services (IITS)

SUBJECT: IITS Comments Related to Program Proposal for
Bachelor of Science in Electrical Engineering

After carefully reviewing the aforementioned program proposal to establish a Bachelor of Science in Electrical Engineering, the following factors were considered relative to the established technology resources and support services provided by Instructional and Information Technology Services.

1. The proposal noted that the curriculum "will be built from the ground up" (p.4) and further indicated that ten (10) new courses will be developed as noted in the Required Courses for Graduation Item 4F (p. 14 -15). The proposal also noted that "no new courses are needed within the first two years of implementation" (p.15) due to students taking existing 100 & 200 level courses.

2. The College intends to initiate the program in Fall 2017 and move to state-side support in AY 22/23 (p. 1). One new tenured/tenure track faculty was indicated in the program proposal (item 4h) in AY 19/20 and four additional program/research related positions were also noted (p22-23). They included: STEM Interdisciplinary Curriculum Specialist, Engineering Pathways Advisor, Engineering Laboratory Developer, and Research Designer/Specialist.

3. Program projects a rapidly increasing student enrollment growing from ten (10) students in the first year to one hundred eighty (180) students in the fifth year (p. 24).

4. Under Item 8d, the proposal does not address additional Academic Technology, but the program proposes to use of two existing computer labs in Sci2 202 and Sci2 251. The document also notes that these spaces are nearing capacity. (p.25) Additionally the program proposed up to four (4) additional instructional labs with 24 workstations per classroom. (p.25) Additionally, 15 laptops are noted under "Microprocessor System Design" (p.28)

FINDINGS

IITS fully supports the proposal for the Bachelor of Science in Electrical Engineering and looks forward to partnering with the College of Science and Math to assist with technology support that helps the program's growth and development. Given the information available in this proposal, IITS projects that the unit will initially have adequate existing staff resources for the first two years, but as the program proposes four new instructional labs and additional hardware and software, the program will likely grow to a level of resource demand that is impactful and the source of funding for the classroom hardware purchase and support was not defined. Additional resources for IITS will likely be needed in future years to successfully support this Program.

While the proposal notes that many of the courses are existing, the addition of four new instructional lab spaces, ten new courses, one new tenure track faculty, four related staff positions, and continuing student growth will certainly increase the level of desktop, computer lab, and Academic Technology support. Related to the Instructional Developer staff, all members are already fully engaged with existing academic programs. The proposal did not address the equipment requirements, technology costs, implementation effort, and ongoing support activities for the proposed instructional labs.

Without a clear funding designation, IITS is unable to commit to either providing the equipment or related support services. The department's experience is that IITS staff are often highly engaged in assisting and supporting faculty and students in programs that rely heavily on the use of technology as compared to other majors. The extent to which this program may create unforeseen demand on IITS is notable, based on the experience and utilization of staff from existing programs. Given the information available at this time, including a similar proposal for the Bachelor of Science in Software Engineering, IITS anticipates that existing staff resources will not be adequate to fully support the Bachelor of Science in Electrical Engineering and other developing programs to the level anticipated. Additional resources recommended to successfully support this program at maturity include:

- Lab Computer Technician – Currently the College of Science and Math provides partial funding of one Information Technology Consultant – Foundation position. Related to this proposal and the proposal for Software Engineering, IITS requests that funding be increased to full-time reimbursement to cover the additional computer lab and faculty desktop support activities. Anticipated salary range of $50,000 - $60,000; the CSIS department currently funds $23,800.

- Equipment Refresh – Equipment and technical support costs for the four proposed labs were not estimated in the proposal; permanent funding for the proposed computers labs and other IT equipment will need to be established on a four year refresh schedule consistent with the campus standards. IITS did not receive a request for cost estimates for the proposed labs.

- Software Tools & Licensing – As the proposal is not specific as to the software tools required by the program, the requirements and licensing costs are unknown. Anticipated support costs are undefined.

- Academic Technology – No specific staffing recommendation is made at this time

Intro to Electronics: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Oscilloscope	$6,600	12	$79,200
Spectrum Analyzer	$5,900	12	$70,800
Signal Generator	$6,000	12	$72,000
Curve tracer	$9,000	5	$45,000
USB oscilloscopes	$1,000	12	$12,000
power supplies	$700	24	$16,800
Cables and tools	$1,000	12	$12,000
Multi-meter	$330	12	$3,960
LCR meter	$180	12	$2,160
Tax/Ship			$31,392
Total			**$345,312**

Intro to Electronics: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Oscilloscope	$6,600	24	$158,400
Spectrum Analyzer	$5,900	24	$141,600
Signal Generator	$6,000	24	$144,000
Curve tracer	$9,000	5	$45,000
USB oscilloscopes	$1,000	24	$24,000
power supplies	$700	24	$16,800
Cables and tools	$1,000	24	$24,000
Multi-meter	$330	24	$7,920
LCR meter	$180	24	$4,320
Tax/Ship			$56,604
Total			**$622,644**

Micropressor System Design: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Logic Analyzer	$17,600	5	$88,000
PLC (FPGA) Boards	$500	12	$6,000
Laptops	$1,500	12	$18,000
Cables and tools	$1,000	12	$12,000
Tax/Ship			$12,400
Total			**$136,400**

Micropressor System Design: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Logic Analyzer	$17,600	5	$88,000
PLC (FPGA) Boards	$500	24	$12,000
Laptops	$1,500	24	$36,000
Cables and tools	$1,000	24	$24,000
Tax/Ship			$16,000
Total			**$176,000**

Signals Theory: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Mixed-signal Oscilloscope	$21,500	12	$258,000
Protocol Analyzer	$47,500	2	$95,000
DSP Dev Board	$600	12	$7,200
Software	$1,500	12	$18,000
Cables and Tools	$1,000	12	$12,000
Tax/Ship			$39,020
Total			**$429,220**

Signals Theory: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Mixed-signal Oscilloscope	$21,500	24	$516,000
Protocol Analyzer	$47,500	2	$95,000
DSP Dev Board	$600	24	$14,400
Software	$1,500	24	$36,000
Cables and Tools	$1,000	24	$24,000
Tax/Ship			$68,540
Total			**$753,940**

Embedded Systems: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Software	$1,500	12	$18,000
Student Project Supplies	$500	12	$6,000
Cables and Tools	$1,000	12	$12,000
Tax/Ship			$3,600
Total			**$39,600**

Embedded Systems: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Software	$1,500	24	$36,000
Student Project Supplies	$500	24	$12,000
Cables and Tools	$1,000	24	$24,000
Tax/Ship			$7,200
Total			**$79,200**

Control Systems: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Sensors/Motors	$1,100	12	$12,000
Cables and Tools	$1,000	12	$12,000
Tax/Ship			$2,400
Total			**$26,400**

Control Systems: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Sensors/Motors	$1,100	24	$26,400
Cables and Tools	$1,000	24	$24,000
Tax/Ship			$5,040
Total			**$55,440**

Modeling and Data Analysis: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Cables and Tools	$1,000	12	$12,000
Tax/Ship			$1,200
Total			**$13,200**

Modeling and Data Analysis: Equipment and Supplies			
ITEM	COST	QUANTITY	TOTAL
Cables and Tools	$1,000	24	$24,000
Tax/Ship			$2,400
Total			**$26,400**

	A	B	C	D	E	F
1						
2	**A. ANTICIPATED REVENUES FOR THE PROPOSED NEW UNDERGRADUATE PROGRAM**					
3						
4	**Data about the proposed program.**					
5	**The grey fields in this section should be filled out by the proposer.**					
6	College(s) where the program is housed	CSM				
7	Department(s) which proposes the program	PHYS				
8	Name of the proposed program	Electrical Engineering				
9	Number of units of the proposed program	120				
10	Number of units taken inside the program's department(s)	54				
11	Number of units taken inside the department(s)' college(s) but outside the program's department(s)	27				
12						
13		Year 1	Year 2	Year 3	Year 4	Year 5
14	Estimated number of incoming freshmen	15	30	45	60	75
15	Estimated number of incoming transfer students	0	0	20	35	55
16						
17	External funding	$175,000	$650,000	$725,000	$725,000	$725,000
18	Estimated additional internal funding	$0	$0	$0	$0	$0
19	Estimated FTES generated by Service and GE demand	0	0	0	0	0
20						
21						
22	**Projected enrollment and revenue**					
23						
24		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
25	Freshmen	15	30	45	60	75
26	Sophomore	0	14	27	41	54
27	Junior	0	0	33	61	93
28	Senior	0	0	0	33	61
29	TOTAL	15	44	105	194	283
30						
31	**Revenue for the program (based on the enrollment in the major)**	**$27,495**	**$80,652**	**$192,465**	**$355,602**	**$518,739**
32	Revenue for the college (without the revenue for the proposed program)	$13,748	$40,326	$96,233	$177,801	$259,370
33	Revenue for outside colleges	$19,858	$58,249	$139,003	$256,824	$374,645
34	Revenue for AA	$61,100	$179,227	$427,700	$790,227	$1,152,753
35						
36						
37						
38	**Planning assumptions (to be updated by the Office of the Vice-Provost)**					
39	1. 10% attrition from freshman to sophomore:	10%				
40	2. 5% attrition from sophomore to junior:	5%				
41	3. FTES assumes average unit load of 13 units per undergraduate:	13				
42	4. Amount Academic Affairs will receive per FTES:	$4,700				

	A	C	D	E	F	G	H	I	J	K	L
1											
2	**B. ANTICIPATED COST AND REVENUE PROJECTIONS FOR THE PROPOSED NEW UNDERGRADUATE PROGRAM**										
3											
4	**Data about the proposed program**										
5	**The grey fields in this section should be filled out by the proposer.**										
6	**Average cost of TT faculty (without benefit) :**			$95,000							
7											
8		**Year 1**		**Year 2**		**Year 3**		**Year 4**		**Year 5**	
9	**Personnel**										
10	TT Faculty	0	$0	2	$283,100	3	$424,650	3	$424,650	3	$424,650
11	Lecturers	0	$0	0	$0	1	$79,432	1.5	$119,148	1.75	$139,006
12	Staff	0.6	$31,290	2.4	$125,160	2.4	$125,160	2.4	$125,160	2.4	$125,160
13											
14	**Startup if program is self-supported**		$0		$0		$0		$0		$0
15											
16	**Space**										
17	Construction		$0		$0		$0		$0		$0
18	Renovation		$150,000		$150,000		$150,000		$0		$0
19	Rental/Lease		$0		$0		$0		$0		$0
20											
21	**Library Resources**										
22	Acquisition		$0		$1,000		$1,000		$1,000		$1,000
23	Subscription		$0		$7,000		$7,000		$7,000		$7,000
24											
25	**IITS Resources**										
26	Acquisition		$0		$60,000		$60,000		$0		$0
27	Other		$0		$0		$0		$0		$0
28											
29	**Equipment/Materials**										
30	Durable		$0		$300,000		$325,000		$325,000		$0
31	Expendable		$0		$5,000		$5,000		$10,000		$30,000
32											
33	**Miscellanea**		$0		$80,000		$40,000		$0		$0
34											
35											
36	**Projected cost and revenue**										
37											
38	**Program Cost**		**$181,290**		**$1,011,260**		**$1,217,242**		**$1,011,958**		**$726,816**
39	**Program Revenue**		**$27,495**		**$80,652**		**$192,465**		**$355,602**		**$518,739**
40	**External funding**		**$175,000**		**$650,000**		**$725,000**		**$725,000**		**$725,000**
41	**Additional internal funding**		**$0**		**$0**		**$0**		**$0**		**$0**
42	**Revenue from GE offerings**		**$0**		**$0**		**$0**		**$0**		**$0**
43	**Program net return**		**$21,205**		**($280,608)**		**($299,777)**		**$68,644**		**$516,923**
44											
45											
46	**Planning assumptions (to be updated by the Office of the Vice-Provost)**										
47	1. Average Lecturer Cost (without benefit):						$53,310				
48	2. Average Staff Cost (without benefit):						$35,000				
49	3. Average Benefit:						49%				

EE COST and REVENUE	Year 1	Year 2	Year 3	Year 4	Year 5
TT faculty salary (95k) plus benefits (49%)	0	283,100	424,650	424,650	424,650
Lecturer salary plus benefits	0	0	89,400	134,100	156,450
Staff salary plus benefits (split with SE)	31,290	125,160	125,160	125,160	125,160
Renovation	150,000	150,000	150,000	0	0
Library	0	8,000	8,000	8,000	8,000
IITS	0	60,000	60,000	0	0
Equipment and Supplies	0	305,000	330,000	335,000	30,000
Start-up costs	0	80,000	40,000	0	0
EE SubTotal Cost	181,290	1,011,260	1,227,210	1,026,910	744,260
EE Program Revenue	27,495	79,735	192,098	355,602	518,922
EE NET COST	153,795	931,525	1,035,112	671,308	225,338

Launch SE & EE	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
SE & EE COST	362,580	1,967,520	2,474,420	1,878,820	1,458,520	8,141,860
SE & EE FTES REVENUE	56,008	162,424	391,312	724,374	1,057,064	2,391,182
Grant Revenue-Equip Supplies	0	448,070	332,060	328,132	328,460	1,436,722
Grant Revenue-Renovation	150,000	300,000	150,000	300,000	0	900,000
Grant Revenue-Faculty salaries and benefits	0	200,000	300,000	300,000	300,000	1,100,000
Grant Revenue-Staff salaries and benefits	67,000	250,320	250,000	250,000	250,000	1,067,320
Grant REVENUE TOTAL	217,000	1,198,390	1,032,060	1,178,132	878,460	4,504,042
PHILANTHROPIC NEED (INDICATED BY POSITIVE NUMBERS)	89,572	606,706	1,051,048	-23,686	-477,004	
{ sum the positive numbers (Philanthropic Sum) }	Total Philanthropic Need for SE and EE: $1,747,326					