CSU San Marcos Degree Program Proposal

1. Program Type (Please specify any from the list below that apply—delete the others)

State Support[1]

2. Program Identification

a. Campus: California State University San Marcos

b. Full and exact degree designation and title:
Bachelor of Science in Electrical Engineering.

c. Date the Board of Trustees approved adding this program projection to the campus Academic Plan
Spring 2016

d. Term and academic year of intended implementation (e.g. Fall 2016):
Fall 2018 or later when feasible.

e. Total number of units required for graduation. This will include all requirements (and campus-specific graduation requirements), not just major requirements.
120 units

f. Name of the department(s), division, or other unit of the campus that would offer the proposed degree major program. Please identify the unit that will have primary responsibility.

Department of Physics, College of Science and Mathematics

g. Name, title, and rank of the individual(s) primarily responsible for drafting the proposed degree major program.
Michael J. Burin, Associate Professor of Physics

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[1] The $6M HSI-STEM grant, philanthropy, and funding associated with FTES generated by the proposed program will be the source of funds related to the Electrical Engineering program (e.g., equipment and supplies, Electrical Engineering tenure-track faculty and staff salaries and benefits, renovation costs of FCB, …) over the first 5 years of the EE program, and then state support thereafter.

h. Statement from the appropriate campus administrative authority that the addition of this program supports the campus mission and will not impede the successful operation and growth of existing academic programs.

As a public university, CSUSM grounds its mission in the public trust, alignment with regional needs, and sustained enrichment of the intellectual and economic life of our region and the state. Based on a Feasibility Study (attached and referenced throughout this P-form), the current LAMP recommendation, and consultation with regional stakeholders, the addition of electrical engineering supports our campus' mission. This program is strongly aligned with regional needs and educational demands, and its graduates will help our regional and state economies. Thus, there is significant interest from the public and private sector in partnering with us to establish this engineering program at CSUSM. Resources from the recently awarded $6M HSI STEM grant from the Department of Education, as well as committed external donations from industry, will be used to fund the start-up costs of this program. The campus's resource allocation model in dollars and FTES, designed to meet student demand, ensures that adequate funds are available to offer all courses that meet student demand. This P-form includes a memo from Dr. Katherine Kantardjieff, the dean of the College of Science and Mathematics, see Appendix B.

i. Any other campus approval documents that may apply (e.g. curriculum committee approvals).[2] The campus may submit a copy of the WASC Sub-Change proposal in lieu of this CSU proposal format. If campuses choose to submit the WASC Substantive Change Proposal, they will also be required to submit a program assessment plan using the format found in the CSU program proposal template.

See the attached signature page of the P-form.

j. Please specify whether this proposed program is subject to WASC Substantive Change review.[3]
No

k. **Optional: Proposed Classification of Instructional Programs (CIP) Code and CSU Degree Program Code** [4]

CSU degree program code: 09091; CIP Code: 14.1001

Campuses are invited to suggest one CSU degree program code and one corresponding CIP code. If an appropriate CSU code does not appear on the systemwide list at: http://www.calstate.edu/app/documents/HEGIS-CIP2000_102406.xls , you can search CIP 2000 at http://nces.ed.gov/pubs2002/cip2000/ to identify the code that best matches the proposed degree program. The Classification of Instructional Programs (CIP) is a National Center for Education Statistics (NCES) publication that provides a numerical classification and standard terminology for secondary and postsecondary instructional programs. The CSU degree program code (based on old HEGIS codes) and CIP code will be assigned when the program is approved by the Chancellor.

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[2] Proposers do not need to supply this item. As the proposal goes through the approval process, memos from curriculum committees are obtained. These will be collected and added to the proposal by Academic Programs as a response for this item.
[3] Generally, this refers to a degree offered at a new level (e.g., a doctorate). To be certain that a WASC Substantive Change review is not necessary, contact the Associate Vice President Academic Programs.
[4] Contact Academic Programs for assistance in proposing CIP and Program (formerly HEGIS) codes.

3. Program Overview and Rationale

a. Provide a rationale, including a brief description of the program, its purpose and strengths, fit with institutional mission, and a justification for offering the program at this time. A comprehensive rationale also explains the relationship between the program philosophy, design, target population, and any distinctive pedagogical methods.

Brief Description. Engineering is broadly described as the creative application of scientific and mathematical principles used to design, develop, improve, and analyze structures, machines, devices, components, systems, and industrial processes useful to society. Electrical engineering is the field of engineering that deals with the application and study of electricity, electronics, and electromagnetism to process information and energy.

Rationale. The region needs a well-qualified STEM workforce, and all CSUSM students should have the opportunity to join this workforce. Among the STEM baccalaureates degree programs now offered are Applied Physics, Biological Sciences, Biotechnology, Biochemistry, Chemistry, Computer Science, and Mathematics. CSUSM has seen very strong growth in these majors during the past three years. The total number of freshman and transfers declaring STEM degrees has grown from 358 in Fall 2011 to 579 in Fall 2016. This growth is insufficient, however, to meet service area or student needs. A degree in Electrical Engineering is a STEM program that will provide all students the opportunity to choose majors with high economic value. Engineering tops the list, even among all STEM degree programs, as the degree that leads to the highest paid jobs, even at the entry level (see Anthony Carnevale. *The Economic Value of College Majors*. 2015 report by Georgetown University Center on Education and the Workforce). Furthermore, there is growing engineering job opportunity in the CSUSM service area. A clear need for engineering was identified for several types of engineering programs in a comprehensive service-area Feasibility Study completed in Spring 2016 (see Appendix A). This market viability Study was prepared by a consulting group (EAB Research) and funded by MiraCosta Community College. The Study established a clear regional need for an Electrical Engineering program at CSUSM, as shown in Table 1.

Table 1. The number of local job postings in Electrical Engineering (EE) nearly equals the number of statewide degrees awarded in EE. ("local" means San Diego, Orange, Irvine, Temecula, and Riverside areas)

Number of **local** EE job postings	Number of **statewide** degrees in EE completed	Projected job growth for EE from 2012 to 2022 (BLS)
1,649	1,717	6.9%

Note: according to the American Society for Engineering Education,
EE students compose 16.5% of all undergraduate-level engineering enrollments.

Fit with institutional mission. CSUSM's Mission states, "CSUSM provides a range of services that respond to the needs of a student body with diverse backgrounds, expanding student access to an excellent and affordable education. As a public university, CSUSM grounds its mission in the public trust, alignment with regional needs, and sustained enrichment of the intellectual, civic, economic, and cultural life of our region and state." Table 1 shows that there are sufficient job postings in EE locally for every relevant degree completion in the State. CSUSM's Vision states, "students will select from a growing array of specialized programs responsive to state and regional needs." The Feasibility Study reported that local employer demand for electrical engineering-related positions increased 34% from July 2013 to June 2015. (Demand from 2015-2017 has not yet been reviewed). The proposed degree in EE will directly address the CSUSM Vision statement by meeting growing regional needs.

Justification for offering the program at this time. The Feasibility Study says that research confirms local suitability for electrical engineering. Local high school students were surveyed, and they expressed interest in engineering and exhibited sufficient standardized test performance. Community college students can complete support courses before they transfer. A degree in Electrical Engineering is an immediate opportunity for CSUSM because it draws upon a large number of existing courses and requires a moderate amount of faculty course development. In addition, a degree in EE is designed to meet employer demand and respond to unmet local employment need. The proposed degree in EE is also designed to address the ABET Student Learning Outcomes for the 21st century engineer. The upper division topics of electrical engineering that overlap with the Physics degree are digital electronics, signals and systems, solid state physics, embedded microsystems, and electromagnetism. The new upper division courses of electrical engineering would cover the topics of digital design, electronic circuits, sensors and controls, solid state devices, electromagnetism, and digital signal processing. The curriculum in EE also includes two semesters of a senior project course. Employers value experiential learning across engineering disciplines, such as incorporating capstone projects within program curricula, so EE students ideally should conduct at least one large-scale project during their education. In the first few years of the program this capstone course should be limited to about 12-16 students per class. Varied and relevant industry contacts will be vital to the new EE majors in general, and to this seminar in particular. This enrollment cap will help ensure that the EE instructor(s) of record will be able to pursue all promising leads and develop all suitable contacts.

Distinct program characteristics. The engineering curriculum will be built around principles of active and project-based learning in an inter-disciplinary framework. As detailed in Appendix J, the HSI-STEM grant will fund support staff with pertinent experience and expertise.

CSUSM will provide engineering students who start at CSUSM all the advantages of established support services, centers and programs to help them succeed in the critical first two years. CSUSM has many other learning and academic support centers including the STEM Center, Math Lab, and Writing Center. Supplemental Instruction (SI) and learning assistants are offered to support students, particularly in STEM gateway courses. Faculty in gateway courses will have funding and opportunities to participate in collaborative activities to increase their use of high impact practices in these classes. Engineering students will benefit from the improvements in pedagogy, assessment and curriculum at both CSUSM and the partnering community colleges.

b. Provide the proposed catalog description, including program description, degree requirements, and admission requirements. For master's degrees, please also include catalog copy describing the culminating experience requirement(s).

ELECTRICAL ENGINEERING
Office: Science 2 Hall, Second Floor, **Telephone:** (760) 750-4273

Faculty:

Physics
Michael J. Burin, Ph.D.
Gerardo Dominquez, Ph.D.
Charles De Leone, Ph.D.
Justin Perron, Ph.D.
Edward Price, Ph.D.
Stephen Tsui, Ph.D.

Computer Science
Ali Ahmadinia, Ph.D.

Programs Offered: Bachelor of Science in Electrical Engineering

Engineering is broadly described as the creative application of scientific and mathematical principles used to design, develop, improve, and analyze structures, machines, devices, components, systems, and industrial processes useful to society. Electrical engineering is the field of engineering that deals with the application and study of electricity, electronics, and electromagnetism. It originated as a branch of physics and has dramatically changed society. Inventions associated with electrical engineering include the telephone, light bulb, radio, television, electric motor, power plant, as well as modern computers, phones, cameras, and robots.

The coursework electrical engineering begins with the necessary preparatory courses in mathematics, physics, and computer science. Core courses and electives cover a wide range of topics including digital and analog electronic circuits and systems, solid-state devices, instrumentation, control systems, electromagnetics, and signal processing. Students will take courses that include laboratory activities. Students are also required to do a senior research project, which involves planning, design, implementation, documentation, and presentation.

Student Learning Outcomes

Graduates of the program will be able to identify, analyze, and apply skills and professional standards in several areas:

1) **Technical knowledge**.
    a. Apply knowledge of mathematics, science, physics, and engineering
    b. Identify, formulate, and solve engineering problems

2) **Laboratory and Design**.
    a. Conduct experiments, as well as analyze and interpret data
    b. Design a system, component, or process to meet desired needs within realistic constraints (economic, environmental, social)

3) **Communication and Collaboration**.
    a. Function on multi-disciplinary teams
    b. Communicate effectively in both written and oral form

4) **Further study**.
    a. Recognize the need for, and able to engage in, life-long learning
    b. Recognize the broad education necessary to understand the impact of engineering solutions in a broad societal context

5) **Professionalism**.
    a. Demonstrate professional and ethical responsibility
    b. Maintain currency in pertinent contemporary issues
    c. Use the techniques, skills, and modern tools necessary for engineering practice

Career Opportunities

Due to the enormous demand, degree holders have multiple paths to reach their career goals. Electrical engineers find jobs in many businesses and industries. Their job skills are used in electrical design, simulation, electrical systems, schematic diagrams, validation, power distribution, test equipment, circuit design, systems engineering, computer aided drafting, and logic controller programming. Electrical engineers in the industry have a wide range of job titles which includes: Design Engineer, Product Engineer, Applications Engineer, Systems Engineer, Test Engineer, Hardware Engineer, Communications Engineer, Network Engineer, Sales Engineer, Field Engineer, Process Engineer, Electronics Engineer, Manufacturing Engineer, and Device Engineer. The degree in electrical engineering also prepares students for graduate study in electrical engineering and related fields.

Preparation

High school students are encouraged to take four (4) years of English, four (4) years of mathematics including trigonometry and pre-calculus, one year of biological science, and one year of physical science. Courses in calculus, physics, and computer programming are recommended. Experience in clear, concise, and careful writing is valuable for success in all courses.

Transfer Credits

A maximum of thirty-six (36) lower-division units including courses in computer science, mathematics, and physics may be applied toward the preparation for the major requirements. Of the thirty-six (36) units, eleven (11) units must appropriately match the description for EE 280, CS 111, and CS 231 (depending on the articulation agreement between Cal State San Marcos and other institutions; transfer students are also advised to consult with their articulation officer to determine if they need to take EE 280, CS 111, and CS 231); twelve (12) units must appropriately match the description for MATH 160*, 162, and 260; and eight (8) units must appropriately match the description for PHYS 201* and 202 (or 12 units if PHYS 203 is also included).

*Six (6) units of the above-transferred courses, MATH 160 and PHYS 201, will count toward the lower-division General Education requirements in Area B. Students are encouraged to consult their faculty advisor to learn about courses that fulfill the General Education requirements.

Special Conditions for the Bachelor of Science in Electrical Engineering

All courses counted toward the major, including Preparation for the Major courses, must be completed with a grade of C (2.0) or better.
A minimum of fifteen (15) upper-division units counted toward the major must be completed at Cal State San Marcos.

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Units General Education*	51
Preparation for the Major*	36
Major Requirements	48

Students must take a sufficient number of elective units to bring the total number of units to a minimum of 120

Preparation for the Major

Lower-Division (11 units)	Units
EE 280	3
CS 111	4
CS 231	4

Supporting Courses (25 units)	
MATH 160	5
MATH 162	4
MATH 260	4
PHYS 201	4
PHYS 202	4
PHYS 203	4

Six (6) lower-division General Education units in Area B (Math and Science) are automatically satisfied by courses taken in Preparation for the Major.

Major Requirements

Upper-Division (48 units)	Units
MATH 342	3
MATH 346	3
PHYS 321	3
PHIL 348	3
EE 301	4
EE 303	3
EE 322	3
EE 330	4
EE 402	4
EE 415	4
EE 430	4
EE 491A	1
EE 491B	3
Electrical Engineering electives	6 or more units

(Choose electives from EE 404, EE 406, EE 435, PHYS 421, PHYS 422, or PHYS 442)

PHIL 348 satisfies the upper-division General Education units in Area CC (Arts and Humanities).
MATH 346 satisfies the upper-division General Education units in Area BB (Science and/or Mathematics)

4. Curriculum

(These requirements conform to the revised 2013 WASC Handbook of Accreditation)

a. <u>These program proposal elements are required</u>:

- University or Institutional learning outcomes (ILOs)
- Major or Program learning outcomes (PLOs)
- Course or Student learning outcomes (SLOs)

UNDERGRADUATE LEARNING OUTCOMES (ULOs). The institution developed ULOs to guide program review and campus-wide learning. Each program's learning outcomes (PSLOs) are aligned to the ULOs.

Students graduating with a Bachelor's degree from CSU San Marcos will be creative, empathetic, and engaged life-long learners who are:

1. Knowledgeable in their field of study. Students will be able to:
   a. Articulate, integrate, and apply theories and methods of a field of study to create professional, scholarly, and/or artistic work

2. Comprehensive and critical thinkers. Students will be able to:
   a. Identify key concepts and develop a foundation for future inquiry
   b. Analyze complex problems and develop solutions by applying quantitative and qualitative reasoning, integrating knowledge and skills from a variety of disciplines
   c. Construct well-reasoned arguments based on evidence

3. Globally and culturally intelligent. Students will be able to:
   a. Apply multiple perspectives to address local, regional, global, and cultural issues.
   b. Demonstrate an intermediate proficiency in a language other than English

4. Skilled communicators. Students will be able to:
   a. Communicate clearly and effectively in both written and oral forms
   b. Tailor communication to audience and context

PROGRAM GOALS. The degree in Electrical Engineering will use "Program Goals" instead of Program Learning Outcomes. The Program Goals will be used to guide the Student Learning Outcomes (PSLOs), which will be measured. (Note: this form refers to SLOs, but the campus currently refers to PSLOs). The Program Goals are overarching statements, aligned with the mission of CSU San Marcos, while reflecting the needs of constituents. These Program Goals focus on the following areas:

- Technical knowledge
- Laboratory and Design skills
- Communication and Collaboration skills
- Preparation for further study and for the profession

PROGRAM STUDENT LEARNING OUTCOMES (PSLOs). Using the Program Goals as guides, as well as the criteria for accreditation with the Accreditation Board for Engineering and Technology (ABET), the degree's Program Student Learning Outcomes (PSLOs) are measureable statements that further develop the focus areas of the program. The PSLOs are as follows:

Graduates from this program will be prepared in the following areas:

1) **Technical knowledge**. Students will be able to:
   a. Apply knowledge of mathematics, science, physics, and engineering
   b. Identify, formulate, and solve engineering problems

2) **Laboratory and Design**. Students will be able to:
   a. Conduct experiments, as well as analyze and interpret data
   b. Design a system, component, or process to meet desired needs within realistic constraints (economic, environmental, social)

3) **Communication and Collaboration**. Students will be able to:
   a. Function on multi-disciplinary teams
   b. Communicate effectively in both written and oral form

4) **Further study**. Students will be able to:
   a. Recognize the need for, and able to engage in, life-long learning
   b. Recognize the broad education necessary to understand the impact of engineering solutions in a broad societal context

5) **Professionalism**. Students will be able to:
   a. Demonstrate professional and ethical responsibility
   b. Maintain currency in pertinent contemporary issues
   c. Use the techniques, skills, and modern tools necessary for engineering practice

b. <u>These program proposal elements are required</u>:

- Comprehensive assessment plan addressing all assessment elements;
- Matrix showing where student learning outcomes are introduced (I), reinforced (R), and applied at an advanced level (A)

See Appendix C1: Comprehensive Assessment Plan
See Appendix C2: Curriculum Matrix

c. Indicate total number of units required for graduation.
120 units

d. Include a justification for any baccalaureate program that requires more than 120 semester units or 180 quarter units. Programs proposed at more than 120 semester units will have to provide either a Title 5 justification for the higher units or a campus-approved request for an exception to the Title 5 unit limit for this kind of baccalaureate program.
N/A

e. If any formal options, concentrations, or special emphases are planned under the proposed major, identify and explain fully and list the required courses.
N/A

f. List all requirements for graduation, including electives, for the proposed degree program, specifying course catalog numbers, course titles, total units required for completion of the degree, major requirements, electives, and prerequisites or co-requisites (ensuring there are no "hidden prerequisites that would drive the total units required to graduate beyond the total reported in 4c above). Include proposed catalog descriptions of all new courses. (WASC 2013 CFR: 2.1, 2.2)

g. Table 2 lists the required courses for Electrical Engineering for graduation.

TABLE 2. ***Required Courses for Graduation***						
Catalog #	*Title*	*Units*	*Major Reqmt.?*	*Pre Req. or Co Req.? (Y/N)*	*Elective (Y/N)*	*New Course (Y/N)*
EE 280	Introduction to Electronics	3	Y	PHYS 202	N	N *(cross-listed w/ PHYS 280)*
MATH 160	Calculus with Applications, I (B4)	5	Y	Strong HS mathematics	N	N
MATH 162	Calculus with Applications, II	4	Y	MATH 160	N	N
MATH 260	Calculus with Applications, III	4	Y	MATH 162	N	N
PHYS 201	Physics of Mechanics and Sound (B1&B3)	4	Y	MATH 160	N	N
PHYS 202	Physics of Electromagnetism and Optics	4	Y	PHYS 201, MATH 162	N	N
PHYS 203	Thermodynamics and Modern Physics	4	Y	PHYS 202	N	N
PHYS 321	Classical Electromagnetism	3	Y	PHYS 203, MATH 260	N	N
CS 111	Computer Science I	4	Y	MATH 160	N	N
CS 231	Assembly Language and Digital Circuits	4	Y	CS 111	N	N
PHIL 348	Ethics in Engineering (CC)	3	Y	N	N	**Y**
MATH 342	Probability and Statistics for Engineers and Scientists	3	Y	MATH 162	N	**Y**
MATH 346	Methods for Physicists and Engineers (BB)	3	Y	MATH 162	N	N
EE 301	Digital Electronics	4	Y	CS 231, PHYS 202	N	N *(cross-listed w/ PHYS 301)*
EE 303	Signals and Systems	3	Y	PHYS 203	N	N *(cross-listed w/ PHYS 303)*
EE 330	Electronic Circuits I	4	Y	EE/PHYS 280	N	**Y**
EE 322	Solid State Devices	3	Y	PHYS 203, EE/PHYS 280	N	**Y**
EE 402	Computer Interfacing and Control	4	Y	PHYS 301 or EE 301	N	N *(cross-listed w/ PHYS 402)*
EE 415	Instrumentation: Sensors and Controls	4	Y	EE/PHYS 280, EE 303, EE 330; Co-requisite: EE 430	N	**Y**
EE 430	Electronic Circuits II	4	Y	EE 330	N	**Y**
EE 491A	Senior Project Planning	1	Y	N	N	**Y**
EE 491B	Senior Lab Project	3	Y	EE 491A	N	**Y**
EE 404	Digital Signal Processing	3	Elective	EE/PHYS 303	Y	**Y**
EE 406	Digital Embedded Systems Design with HDL	3	Elective	CS 331 or EE/PHYS 301	Y	**N** *(cross-listed with CS445)*
EE 421	Applied Electromagnetic Waves	3	Elective	PHYS 321 and MATH 346	Y	**N** *(cross-listed with PHYS 421)*
EE 435	Communication Systems	3	Elective	EE/PHYS 303	Y	**Y**
PHYS 422	Solid State Physics	3	Elective	PHYS 203	Y	N
PHYS 442	Physical and Geometric Optics	3	Elective	PHYS 203	Y	N

Catalog Description of All New Courses:

PHIL 348 Ethics in Engineering. Survey of ethical issues commonly encountered by engineers. Explores professional ethics of engineering, roles and responsibilities of engineers, and social impact of engineering. Basic concepts of ethical theory and ethical issues in engineering are explored through the study of films, case studies, and historical events.

MATH 342 Probability and Statistics for Engineers and Scientists. Introduction to probability and statistical methods applicable to engineering and science. Includes basic probability theory, special random variables and their uses, sampling distributions and the Central Limit Theorem, estimating parameters and finding confidence intervals, hypothesis testing, simple linear regression, and quality control. Also offered as EE 342. May not be taken for credit by students who received credit for EE 342, MATH 440 or MATH 442. Credit may not be counted toward the mathematics major. *Prerequisite: MATH 260 with a grade of C (2.0) or better*

EE 322 Solid State Devices. Introduction to semiconductor materials and devices, with an emphasis on silicon devices. Electrical properties of semiconductors, energy band theory, equilibrium and non-equilibrium conditions. Semiconductor junction theory and the diode. Bipolar junction transistors. Field effect transistors. Optical devices including light-emitting diodes, solar cells, photodiodes, and semiconductor lasers. *Three hours lecture. Prerequisite(s): PHYS 203, PHYS 280 or EE 280.*

EE 330 Electronic Circuits I. Design and analysis of passive and active analog electronic circuits. Time domain and frequency domain methods including differential equations, phasors, and transforms. Operational amplifier circuits. Direct current, small-signal, and high-frequency models and analysis of diode and transistor circuits including single-stage amplifiers. Current sources, active loads, and feedback. Laboratory activities provide hands-on experience with lecture topics. *Three hours of lecture and three hours of laboratory. Prerequisites: EE 280 or PHYS 280.*

EE 415 Instrumentation: Sensing and Controls. Electronic circuits and algorithms for sensing and control systems. Sampling methods, noise, stochastic models, basic circuit architectures for various sensing systems. Methods for control of motors, pumps, valves, heaters, lasers, and other common actuators or effectors. Linear and non-linear control systems such as PID loops, predictive models, fuzzy logic, and inverse kinematics. *Three hours of lecture and three hours of activity. Prerequisite(s): EE/PHYS 280, EE 303, EE 330, Co-requisite: EE 430*

EE 430 Electronic Circuits II. Design and analysis of single-stage, multi-stage, and differential integrated circuit amplifiers, feedback circuits, operational amplifiers, filters, oscillators, output stages and power amplifiers. Digital circuit design at the transistor level. *Three hours lecture and two hours activity. Prerequisite: EE 330.*

EE 404 Digital Signal Processing. Theory and practice of digital signal processing (DSP). Design and implementation of digital filters as well as simple algorithms for audio and image processing, using standard DSP hardware. *Two hours lecture and three hours of laboratory. Prerequisite: EE 303 or PHYS 303.*

EE 435 Communication Systems. Analysis and design of analog and digital communication systems. Modulation and demodulation techniques including AM, FM, PM. Time and frequency domain concepts including Fourier transforms. Selected topics may include noise, bandwidth, fiber optics, RF and wireless communications systems. *Prerequisite: EE 303.*

EE 491A Senior Project Planning. Design and planning stage of a senior electrical engineering design and laboratory project. Projects will typically be solution-oriented (technology created to solve a problem) and should be of sufficient detail and complexity to present a realistic solution to a given problem. Student(s) must consult with an electrical engineering faculty member to decide on project topic (problem to be solved) and general approach. Student(s) will work under the guidance of a faculty member to design and plan project activities for implementation in EE 491B.

EE 491B Senior Lab Project. Implementation, construction, and documentation of a senior electrical engineering design and laboratory project. Continuation of EE 491A in which student picked project topic and did planning and initial design work. Student must consult with and work under the guidance of an electrical engineering faculty member. Final written report, presentation, and demonstration of project is required. *Prerequisite: EE 491A.*

h. List of any new courses that are: (1) needed to initiate the program and (2) needed during the first two years after implementation. Only include proposed catalog descriptions for new courses. For graduate program proposals, identify whether each course is a graduate-level or undergraduate-level offering.

According to the Road Map for Electrical Engineering, no new courses are needed within the first two years of implementation because the EE majors would be taking 100- and 200-level courses that are either cross-referenced with existing courses (such as EE 280, which would be cross-listed with PHYS 280) or currently offered (such as MATH 160 and 162, and PHYS 201 and 202).

i. Attach a proposed course-offering plan for the first three years of program implementation, indicating, where possible, likely faculty teaching assignments. (WASC 2013 CFR: 2.1, 2.2)

Year	Term	Courses	Faculty
1 (AY 2018 - 19)	Fall		
1 (AY 2018 - 19)	Spring	PHYS 201	Existing faculty
2 (AY 2019 - 20)	Fall	PHYS 202	Existing faculty
2 (AY 2019 - 20)	Spring	PHYS 203	Existing faculty
2 (AY 2019 - 20)	Spring	EE 280	**New TTF1**
3 (AY 2020 - 21)	Fall or Spring	EE 301	**New TTF2**
3 (AY 2020 - 21)	Fall	EE 303	**New TTF1**
3 (AY 2020 - 21)	Spring	EE 330	**New TTF2**
3 (AY 2020 - 21)	Spring	Math 342	Existing faculty
3 (AY 2020 - 21)	Fall	PHYS 321	Existing faculty
3 (AY 2020 - 21)	Spring	PHIL 348	Existing faculty

i. For master's degree proposals, include evidence that program requirements conform to the minimum requirements for the culminating experience, as specified in Section 40510 of Title 5 of the California Code of Regulations.[5] N/A

j. For graduate degree proposals, cite the corresponding bachelor's program and specify whether it is (a) subject to accreditation and (b) currently accredited. (WASC 2013 CFR: 2.2b) N/A

[5] Contact Graduate Studies for assistance in making certain that the program conforms to CSU requirements for a master's program.

k. For graduate degree programs, specify admission criteria, including any prerequisite coursework.[6] (WASC 2013 CFR: 2.2b) N/A

l. For graduate degree programs, specify criteria for student continuation in the program[7] N/A

m. For undergraduate programs, specify planned provisions for articulation of the proposed major with community college programs.

The HSI-STEM grant proposes how CSM will work with local feeder community colleges (Mira Costa College, Miramar College, Mount San Jacinto College, and Palomar College).

The California Community College (CCC) Research and Policy (RP) Group has studied engineering transfer issues extensively, and there are evidence-based recommendations to guide CSUSM in developing the CC/CSU transfer pathway in engineering that is responsive to the needs of Hispanic and at-risk students.

Local feeder community colleges mentioned above have made development of engineering transfer programs a high priority and recognize fully the need to work with CSUSM to meet service area and student need. The program will offer the lower division courses in the first two years, which gives time to build the needed facilities and for the community colleges to approve, articulate, and implement curriculum. The following are community college and industry partners that we plan to work with:

- Mike Fino, Science Dean, Mira Costa College
- Linda Kurokawa, Director Engineering Tech, Mira Costa College
- Mary Benard, VP Instruction, Mira Costa College
- Kathryn Kailikole, Science Dean, Palomar College
- Dan Sourbeer, VP Instruction, Palomar College
- Tom Oxford, Mt. San Jacinto College
- Simon Kuo, ViaSat
- Michael Perry, General Atomics
- Tom McCloud, Northrop Grumman

[6] This item generally applies to graduate programs and self-support programs. For assistance, contact Graduate Studies for the first situation and Extended Learning for the second. For an undergraduate, state-support program for which admission criteria are desired, contact Academic Programs to discuss this matter.
[7] This item generally only applies to programs with admission criteria (item 4k). For undergraduate programs, the criteria should be that the student remain on good academic standing (i.e., not be subject to Academic Disqualification). For assistance with this item, contact Graduate Studies, Extended Learning or Academic Programs as in item 4k.

The Pathways Advisor will help streamline the curriculum at local CCs and CSUSM. Pathway curriculum will be aligned, guided by learning outcomes determined by faculty so that community college students do not have to repeat courses upon transfer to CSUSM. Faculty at CSUSM and community colleges will collaborate to integrate effective pedagogy and support services into all engineering pathway courses and evaluate impact on student success.

Feeder CC faculty will be included in CSUSM professional development activities to integrate and contextualize the first year experience for engineering students and help them strengthen their preparedness to succeed in the major.

The lower division requirements of the proposed Electrical Engineering program are very similar to the Physics program. Therefore, it is straightforward to adapt the existing articulation of the Physics majors with community college programs.

n. Describe advising "roadmaps" that have been developed for the major. [8]

Appendix D contains the supplemental worksheet for EE, and Appendix E contains the advising roadmap for EE.

o. Describe how accreditation requirements will be met, if applicable, and anticipated date of accreditation request (including the WASC Substantive Change process). (WASC 2013 CFR: 1.8)

The Program Student Learning Outcomes of the degree are aligned with the ABET criterion for student learning outcomes. http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/ . The accreditation requirements have been met in the curriculum. As soon as there are sufficient faculty members and equipment as well as the supporting personnel, and as soon as there are significant number of students going through the program and graduate with the degree, our institution will naturally seek the ABET accreditation for the program, which is the widely-acknowledged standard for accreditation in engineering.

[8] Contact the Office of First Year Programs for assistance in developing detailed graduation road maps for the first two years of study.

5. Public Need for the Proposed Degree Major Program

a. List of other California State University campuses currently offering or projecting the proposed degree major program; list of neighboring institutions, public and private, currently offering the proposed degree major program.

   California State Polytechnic University San Luis Obispo; California State Polytechnic University Pomona; California State University Los Angeles; California State University Long Beach; California State University Sacramento; California State University Northridge; California State University Fullerton; California State University Fresno; California State University Chico; San Francisco State University; San Diego State University; Sonoma State University; University of San Diego; Loyola Marymount University; Naval Postgraduate School; Northwestern Polytechnic University; Santa Clara University; Stanford University; UC Berkeley; UC Davis; UC Irvine; UC Los Angeles; UC Riverside; UC San Diego; UC Santa Barbara; University of Southern California; University of the Pacific

b. Describe Differences between the proposed program and programs listed in Section 5a above.

   Most of the campuses listed in 5a have moderate to difficult admissions requirements due to demand. We will recruit transfer students from partner community colleges in our local service area, which maintain high numbers of students with the necessary prerequisites to transfer to a four-year institution. The proposed EE curriculum embraces the campus core GE values without multiple waivers that are common to other EE degrees on other CSU campuses. It will be a modern curriculum designed around research-based instructional practices.

c. List of other curricula currently offered by the campus that are closely related to the proposed program.
   Applied Physics

d. Describe community participation, if any, in the planning process. This may include prospective employers of graduates.

   The research firm EAB Research conducted the Feasibility Study for engineering at CSUSM. They corresponded or interviewed industry representatives at various companies, such as Cubic Global Defense, D&K Engineering, General Atomics, Hunter Industries, Northrop-Grumman, Qualcomm, and Thermo Fisher Scientific. EAB also contacted recruiting staff at various companies, such as Amazon, Broadcom, Illumina, MDR Engineering, Panasonic Avionics Corporation, Parker Aerospace, Siemens, and Verizon Communications. They also corresponded with and/or interviewed administrators at local school districts.

e. Provide applicable workforce demand projections and other relevant data.

   Locally, defense contractors, telecommunications companies, and semiconductor manufacturers indicate high demand for electrical engineers.

   - The Feasibility Study established a clear regional need for an Electrical Engineering program (see Table 1) and reported that local employer demand for electrical engineering-related positions increased 34% from July 2013 to June 2015.

- Figure 1 (from the Feasibility Study) displays a sample of local employers that hire students with a BS in Electrical Engineering.
- Figure 2 (from the Feasibility Study) displays a sample of statewide employers that hire students with a BS in Electrical Engineering.

Figure 1. Sample of local employers

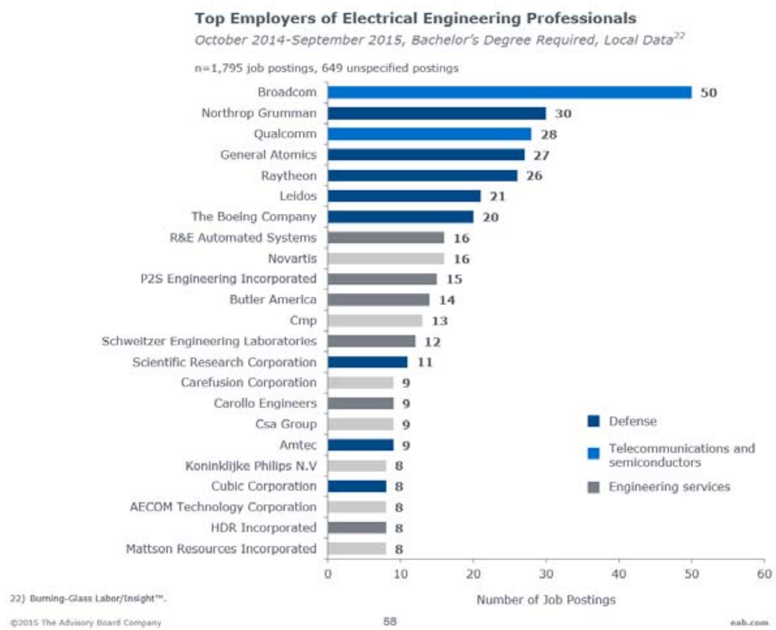
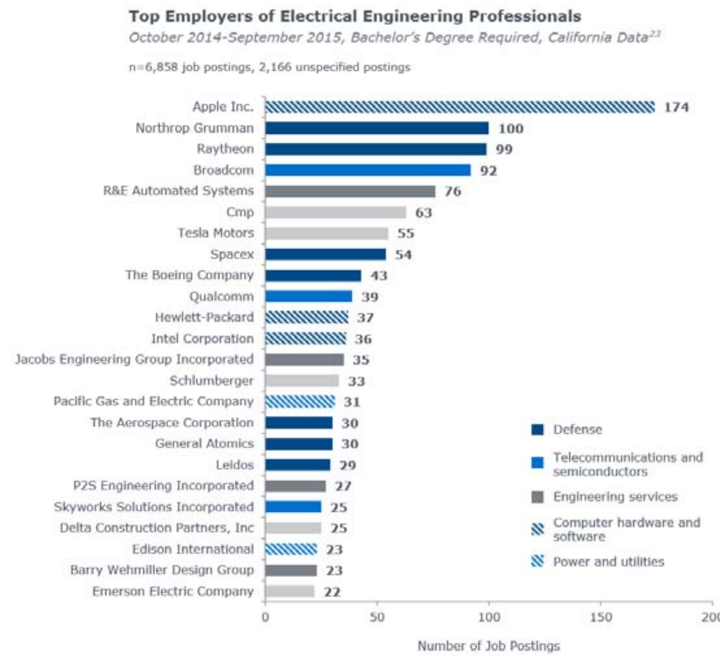


Figure 2. Sample of startewide employers



6. Student Demand

a. Provide compelling evidence of student interest in enrolling in the proposed program. Types of evidence vary and may include national, statewide, and professional employment forecasts and surveys; petitions; lists of related associate degree programs at feeder community colleges; reports from community college transfer centers; and enrollments from feeder baccalaureate programs, for example.

A clear regional need for engineering was identified for several types of engineering programs in a comprehensive service-area Feasibility Study completed in Spring 2016. This Study was prepared by a consulting group and funded by MiraCosta Community College (Appendix A). According to this study, there is strong potential to attract high school students to a new CSUSM engineering program. California high school students select engineering as their intended major, 22% more than the national average. Local high school students were surveyed, and they expressed interest in engineering and exhibited sufficient standardized test performance. Community college students can complete support courses before they transfer.

b. Identify how issues of diversity and access to the university were considered when planning this program. Describe what steps the program will take to insure ALL prospective candidates have equitable access to the program. This description may include recruitment strategies and any other techniques to insure a diverse and qualified candidate pool.

CSUSM has been awarded a nearly $6 million grant under the Hispanic-Serving Institutions (HSI) STEM Program from the Department of Education that will provide foundational funding for establishing an engineering program at CSUSM. The goal of the grant (titled "*Si Se Puede!*" to Close the Equity Gap in Engineering Degree Completion) is to develop and sponsor activities to improve and expand our campus' capacity to serve Hispanic and low-income students during the formation of the program. The Graduation Initiative on campus is part of this CSU system-wide effort to increase the number of degrees awarded, increase 4 and 6-year graduation rates, close the 6-year achievement gap for at-risk students, increase retention rates, improve student access, and ensure their success in attaining educational goals.

c. For master's degree proposals, cite the number of declared undergraduate majors and the degree production over the preceding three years for the corresponding baccalaureate program, if there is one.[9]

N/A

d. Describe professional uses of the proposed degree program.

Locally, defense contractors, telecommunications companies, and semiconductor manufacturers indicate high demand for electrical engineers. See Figure 1 (above) for a partial list of local companies that hire electrical engineers.

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[9] Contact Enrollment Management Services for these data.

e. Specify the expected number of majors in the year of initiation and three years and five years thereafter. Specify the expected number of graduates in the year of initiation, and three years and five years thereafter.[10]

The following data is influenced by the CSM Engineering Resources Taskforce report (see Appendix F, authored by CSUSM faculty, administrators, staff, and an industry representative), the CSM Curriculum Committee, and data from the Institutional Effectiveness and Analytics website at SJSU (http://www.iea.sjsu.edu/Reports/EP).

Estimated Numbers	Year 1	Year 2	Year 3	Year 4	Year 5
FT freshmen	15	30	45	60	75
FT transfer students	0	0	20	35	55

The following data is based on the EE BLP revenue-cost Excel file.

AY	Year 1	Year 2	Year 3	Year 4	Year 5
FRESHMN	15	30	45	60	75
SOPH	0	14	27	41	54
JUNIOR	0	0	33	61	93
SENIOR	0	0	0	33	61
TOTAL	**15**	**44**	**105**	**194**	**283**

The number of graduates each year is expected to vary, about 50% to 100% of the seniors in the AY.
The table above from the BLP revenue-cost worksheet assumes 100% of all seniors graduate, so the number of seniors (and therefore the revenue associated the number of majors) may be an underestimate.

Planning Assumptions:
1. 10% attrition from FR to SOPH and 5% attrition from SOPH to JUNIOR.
2. Transfers will be accepted in AY 19/20.

[10] Contact Academic Programs for assistance in estimating the number of majors and graduates.

7. Existing Support Resources for the Proposed Degree Major Program

Note: Sections 7 and 8 should be prepared in consultation with the campus administrators responsible for faculty staffing and instructional facilities allocation and planning. A statement from the responsible administrator(s) should be attached to the proposal assuring that such consultation has taken place.

a. List faculty who would teach in the program, indicating rank, appointment status, highest degree earned, date and field of highest degree, professional experience, and affiliations with other campus programs. For master's degrees, include faculty publications or curriculum vitae.

Ali Ahmadinia, Assistant Professor, tenure-track, Ph.D. in Computer Engineering, Univ. Erlangen-Nuremberg, Germany
Michael J. Burin, Associate Professor, tenured, Ph.D. in Engineering Physics, UC San Diego
Charles De Leone, Professor, tenured, Ph.D. in Physics, UC Davis
Gerardo Dominquez, Associate Professor, tenured, Ph.D. in Physics, UC Berkeley
Suzanne Montgomery, Adjunct Faculty, Ph.D. in Electrophysics, USC
Justin Perron, Assistant Professor, tenure-track, Ph.D. in Physics, The State University of New York, Buffalo
Gerald Pinter, Adjunct Faculty, MS in Electrical Engineering, UC San Diego
Edward Price, Professor, tenured, Ph.D. in Physics, UC San Diego
David Schaafsma, Adjunct Faculty, Ph.D. in Engineering Physics, University of Colorado, Boulder
Stephen Tsui, Associate Professor, tenured, Ph.D. in Physics, University of Houston

b. Describe facilities that would be used in support of the proposed program.

Initially, the lecture and/or laboratory space needs may be met by the existing space and labs of the Department of Physics. This degree would need additional labs and appropriate computers, equipment and supplies by Fall 2019. It is expected that these labs will be in the FCB building when Extended Learning vacates the space and moves into their new building in Fall 2019. The HSI-STEM grant has a budget for equipment and supplies, as well as renovation. The BLP budget spreadsheet shows the revenues and costs for these needs.

c. Provide evidence that the institution provides adequate access to both electronic and physical library and learning resources [11]
See the attached memo in Appendix G from Dean Jennifer Fabbi.

d. Describe existing academic technology, equipment, and other specialized materials[12]

The Department of Physics laboratories have technology, equipment, and software to teach the existing physics courses and cross-listed courses. These labs are used to high capacity and so some duplication of these existing materials will probably be necessary.

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[11] Please contact the Library for this report.
[12] Contact Instructional and Information Technology Services (IITS) for a report addressing information technology and academic computing resources available to support the program. Programs currently possessing additional equipment and specialized material not addressed in the IITS report should include these here.

8. Additional Support Resources Required

Note: If additional support resources will be needed to implement and maintain the program, a statement by the responsible administrator(s) should be attached to the proposal assuring that such resources will be provided. In all such considerations, we refer to the memo from the Provost concerning program growth and resources, found in Appendix H.

a. Describe additional faculty or staff support positions needed to implement the proposed program.[13]

The Department of Physics is expected to launch a search for an Associate Professor in AY 18/19 so that this person will begin with sufficient time to lay the groundwork of implementing the upper division curriculum, designing the laboratories, and ordering required equipment. The Department should launch a search for a second tenure-track faculty member in AY 2019-20 so that they will begin teaching in Fall 2020. With the bulk of supporting courses in Physics, the Department of Physics may absorb the teaching load within the first two years of the program. Eventually, as outlined in the Task Force Report, more PHYS faculty members will have to be hired for the larger enrollment in supporting Physics courses. A supporting tenure-track faculty math hire is also expected. Any reassigned time for the Department Chair of PHYS will comes from source(s) other than the HSI STEM grant, according to the college guidelines for reassigned time and in consultation with the dean of the college. Appendix J discusses the funding for staff, such as an instructional support technician (IST) and Pathways Advisor.

b. Describe the amount of additional lecture and/or laboratory space required to initiate and to sustain the program over the next five years. Indicate any additional special facilities that will be required. If the space is under construction, what is the projected occupancy date? If the space is planned, indicate campus-wide priority of the facility, capital outlay program priority, and projected date of occupancy. Major capital outlay construction projects are those projects whose total cost is $610,000 or more (as adjusted pursuant to Cal. Pub. Cont. Code §§ 10705(a); 10105 and 10108).[14]

The new spaces that will be constructed and funded partially by the HSI-STEM grant will provide the campus additional capacity and needed technology, equipment, and software to support the EE curriculum, at least for the first couple of years. As mentioned above it is expected that this space will be in the FCB building when Extended Learning vacates the space and moves into their new building in Fall 2019. The HSI-STEM grant has a budget for equipment and supplies, as well as renovation. The BLP budget spreadsheet shows the revenues and costs for these needs, see Appendix M.

[13] Include additional faculty lines needed to support the course offerings indicated in 4.h and 4.m. Indicate whether any external funds are expected to support faculty lines.

[14] Contact Planning, Design and Construction for assistance in answering questions about space that is under construction or being planned. Indicate whether any external funds are expected to support construction of facilities.

c. Include a report written in consultation with the campus librarian, which indicates any necessary library resources not available through the CSU library system. Indicate the commitment of the campus to purchase these additional resources.[15]

See the attached memo in Appendix G from Dean Jennifer Fabbi.

d. Indicate additional academic technology, equipment, or specialized materials that will be (1) needed to implement the program and (2) needed during the first two years after initiation. Indicate the source of funds and priority to secure these resource needs.[16]

Please see the attached memo in Appendix K from Dean Kevin Morningstar on IITS resources for Electrical Engineering. In addition, Appendix L contains preliminary estimates (low and high) for EE equipment and supplies.

9. Self-Support Programs

a. Confirm that the proposed program will not be offered at places or times likely to supplant or limit existing state-support programs.[17]
N/A

b. Explain how state-support funding is either unavailable or inappropriate.
N/A

c. Explain how the program is different, in one or more of the following ways, from state-supported campus offerings operating on campus:
N/A

d. For self-support programs, please provide information on the per-unit cost to students and the total cost to complete the program (in addition to the required cost recovery budget elements listed in the CSU degree proposal faculty check list found earlier in this document).
N/A

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[15] This should follow directly from the Library report in 7.c.

[16] Information technology and academic computing needs should follow directly from the IITS report in 7.d. Additional specialized equipment and materials that will be needed should be addressed here.

[17] Pursuant to Executive order 1099, "Self-supporting special sessions shall not supplant regular course offerings available on a non self-supporting basis during the regular academic year (Education Coder section 89708)."