Natural Sciences, Mathematics & Engineering Department Summary: Curriculum Transformation

*Save file as (Degree Name) Summary and send the file as an email attachment to* [*nsmesummaries@share.calstate.edu*](mailto:nsmesummaries@share.calstate.edu)

Please submit **one document per degree program**.

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| **Degree Program** | Computer Engineering |

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| **Introduction and Rationale**  *Provide a concise introduction to the curricular transformation. What is the rationale for the changes and what transformation elements are utilized (e.g., High Impact Practices, alignment with accreditation standards, or others, as identified in the MOU)? Does the transformation align the program to similar programs at other institutions?* |
| As stated in our curriculum transformation proposal, the following was our motivation going into the Q2S process (edited for brevity and clarity):  The Computer Engineering curriculum transformation seeks to restructure and re-sequence the major courses to maintain alignment with the ACM/IEEE Body of Knowledge, while also remaining within unit limitations for CSU semester campuses. A simple conversion cannot accomplish this goal, as a one-to-one mapping of quarter courses to semester courses would not preserve the sequencing inherent in certain Body of Knowledge topic areas or would unnaturally delay graduation as a multi-course quarter sequence gets mapped to a longer multi-course semester sequence. Both of these negative consequences of a conversion would be detrimental to students in the major, so a transformation will enhance the student learning experience. An important constraint will be to maintain topic area overlaps with the Computer Science and Electrical Engineering curriculum so that the total number of courses required for all three degrees in each academic year will remain within the workload limits of the department. This will allow timely offering of courses so that student graduation will not be delayed due to course unavailability.  …  We are also taking a long-term approach to the quarter to semester process. We wish to create a semester curriculum that embodies exemplary academic and curricular practices, so that the curriculum will be suited to the degree program for years to come. A curriculum transformation will enable this vision, while a curricular conversion is a short-sighted process that seeks to minimize disruptions at the point of converting to semesters, but sacrifices a long-term commitment to excellence in our program. We feel that the issue of converting students from the current quarter curriculum to the proposed semester curriculum should be handled as a unique, one-time occurrence and that it should not drive our Q2S process. Additionally, there is no requirement from ABET for the curriculum to be identical, just that it be equivalent. Since the driving force behind both the quarter curriculum and the semester curriculum is the ACM/IEEE Body of Knowledge, we believe that if each individual student is evaluated for their current Body of Knowledge coverage under the quarter system and is assigned semester courses that cover the gaps, that should be satisfactory for ABET purposes.  We also sought to incorporate stand-alone high impact practice courses as a required component of the curriculum, but unit constraints quickly killed that enthusiasm, so our stand-alone courses that were specifically for high impact practices (research, leadership, service learning, teaching experiences) are now elective options. High impact practices were incorporated into other portions of the curriculum as unit constraints and ACM/IEEE Body of Knowledge requirements allowed.  The 120 unit constraint is a severe problem for engineering programs, even with the promise in the Academic Senate documents that engineering will receive 6-9 units of General Education modifications. As seen from the attached comparison to other CSU campuses, only CSU Long Beach has an ABET accredited Computer Engineering program which is nominally 120 semester units at the Chancellor’s Office’s degree tracker (although upon looking at the catalog, one cannot help but notice it all adds up to 121). When surveying the core units, cognate units, and general education units for the three smallest unit totals (Chico, Long Beach, and Northridge), one sees that the core ranges from 61 to 72 semester units (69 average), the cognate ranges from 22 to 35 semester units (30 average), the core+cognate ranges from 94 to 103 (99 average), and the non-double-counted GE ranges from 24 to 27 semester units (26 average). Our proposal has 62 semester units of core and 33 semester units of cognate. The core is significantly below most of the other CSU campuses, but there are no more units to spare. Receiving 6-9 units of GE modifications will put us in the 24-27 non-double-counted GE unit range, which still makes it very difficult to achieve a program that is 120 units overall.  Additionally, the proposed model curriculum on C-ID.net (part of the SB1440 process) has a high level of lower division core and cognate courses. It has 39 semester units of programming, discrete structures, circuits, calculus, and physics for the Computer Engineering track, plus an additional 32 lower division general education units for CSU transfers (or 28 semester units for those using the IGETC program). This model curriculum comes from a state-wide consortium of academics from all involved constituents, and it shows how difficult it is to have an engineering program within an overall 120 unit constraint. Even with this difficulty, the proposed curriculum has 58 units of upper division course work required for transfer students, assuming that we receive 3 units of upper division general education modifications.  Our other primary consideration is creating a program that will be suitable for ABET accreditation. ABET program requirements for Computer and Electrical Engineering (see below for the URL) requires one and one-half year of engineering topics (where “one year” is one-fourth of the total units for graduation) and one year of mathematics and science cognates. This would be 48 core units and 32 math/science cognates. Assuming that the full freshman sequence and senior project sequence counts as engineering (which ABET may not do since GE outcomes are embedded in that course), the proposed curriculum has 54 engineering units and 38 math/science units.  We were also mindful of the campus desire to maintain quarter-to-semester equivalent units (QSE units) during the conversion and transformation process. For Computer Engineering, there are 54 QSE core units, 39 QSE cognate units, and 93 QSE overall units. The initial cognate proposals from other NSME departments put our cognate units at 41 actual semester units. We removed one cognate course (PHYS 2230) as it was not part of the C-ID.net proposed model curriculum and we shifted ENGR/ECE 2070 from the cognate to the core (4 QSE). We chose a 3 lecture + 1 lab unit model for our courses, as this is the standard for engineering courses. We streamlined several course sequences to recover units from the 3+1 model. This results in our proposed 58 core units (54 QSE + 4 for shifting ENGR/ECE 2070 into the core), 37 cognate units, and 95 core+cognate units. The net gain of 2 QSE is from cognate growth and could not be recovered in streamlining degree requirements.  Summary of External Standards and Resources for Computer Engineering Programs   * C-ID.net transfer model curriculum between CA community colleges and CSUs/UCs for Engineering (Computer Engineering track): <http://www.c-id.net/docs/Engineering%20MC_3-3-2014.pdf> * ACM/IEEE CE 2004 Body of Knowledge (160 pages) is the primary standard for Computer Engineering programs: <http://www.acm.org/education/education/curric_vols/CE-Final-Report.pdf> * ABET curriculum guidelines for Computer and Electrical Engineering (Select General Criterion 5. Curriculum and III. Program Criteria - Program Criteria for Electrical, Computer, Communications, and Similarly Named Engineering Programs): <http://abet.org/eac-criteria-2014-2015/> * Fundamentals of Engineering (FE) exam for Electrical and Computer Engineering (has more of an electrical engineering focus): <http://cdn3.ncees.co/wp-content/uploads/2013/10/FE-Ele-CBT-specs_with-ranges.pdf> * Comparison to other CSU campuses: see below attachment |
| **Supporting documentation (optional) and unit exception proposals** should be attached below by placing your curser after this paragraph, then locating the **Insert Tab** in the top ribbon and find **Insert > Object > Attach as File**. Need Help? [See Tip Sheet](#_Tip_Sheet)  **Optional Attachment(s):**  > |

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| **Evidence-Based Modifications**  *Please indicate how assessment results and evidence-based practices have informed the curriculum revision.* |
| The primary focus of our curriculum transformation is to create a Computer Engineering program that is capable of being accredited by ABET, and aligns with the curriculum models at both the state level (C-ID.net) and national/international level (ACM/IEEE CC 2004). Our primary change based on these sources was to streamline the computer architecture sequence, so that computer engineering students take a different sequence than computer science students. The CS 2013 redesign removed need for detailed digital circuits course for computer science students, while CC 2004 has a strong focus on digital circuits for computer engineering students. This allowed the department to design two computer architecture and organization sequences: CMPS 2240+3240 for Computer Science students with a stronger focus on assembly language in the first course and ECE 3200+CMPS 3240 for Computer Engineering students with a stronger focus on digital circuits in the first course. This saves a course for both majors. |
| *Check all the types of assessment results that informed the curricular revision:*  X Course Learning Outcomes  X Program Learning Outcomes X University Learning Outcomes X Externally-Normed Standards |

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| **Impact on Students**  *Please indicate how students will be affected (e.g., time to degree, graduation rates, improved learning, student financial implications, etc.). Specifically address the impact on all audiences, including those outside of the major.* |
| Alignment with the SB1440 and C-ID.net requirements for the Engineering (Computer Engineering track) model curriculum should streamline the process for transfer students from CA community colleges, along with transfer to and from other CSUs and UCs. If both campuses are mapped to the same C-ID course identifiers for their lower division courses, articulation becomes a much simpler process. This allows students to save money by completing the lower division requirements at a community college. |

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| **Resource Implications**  *Please describe the resource implications (faculty resources, facility usage, library holdings, etc.).* |
| The department currently has sufficient library holdings to support the program. Room utilization may become an issue as more courses will be taught each term. Time conflicts with cognate courses may become inevitable, as most daytime time blocks will be needed to teach courses in order to have sufficient room space.  The department currently has 8 T/TT faculty, 1 full-time lecturer, and several part-time lectures (listed by name in the attached courses listings). The department has been authorized to search for one more ECE faculty in 2014/15 for a hire date beginning in Fall 2015 (listed as “New ECE” in the attached course listings). This will be sufficient to teach courses, provided that the total enrollment per course does not exceed the current 3-5 year average enrollments in the courses.  Since the program is in the process of growing, this may be an invalid assumption. See attached enrollment file for historic enrollments by course and projected number of sections needed given current rooms. The CEE/CS rooms have a capacity of 35 students. For the freshman sequence shared with Engineering Sciences, larger class sizes will have to be accommodated in other room space.  X The attached 2016-17 course schedule demonstrates that the curriculum will be offered with existing faculty and existing resources.  Additional resources are required, as described and fully justified here.  > Attach 2016-17 Course Schedule Here  Place your cursor above then locate the Insert Tab in the top ribbon and find **Insert > Object > Attach as File**. Need Help ? [See Tip Sheet](file:///C:/Users/jlussier/AppData/Local/Microsoft/Windows/Temporary%20Internet%20Files/Content.Outlook/NUA2V6MX/AH%20Department%20Summary--Curriculum%20Transformation_revised.docx#_Tip_Sheet) |

Courses that are not identified explicitly in this table will be archived with the potential to be returned to the catalog when needed.

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| Conversion Type | List of courses in each category |
| **New Courses** | * See attached list |
| **Unchanged Courses** | * See attached list |
| **Changed Courses** | * See attached list |
| **Inactivation of Elective Courses** | * See attached list |
| **Inactivation of Required Courses** | * See attached list |
| **ATTACHED LIST** |  |

# Catalog Copy Changes

The curriculum transformation should be reflected in the program description. Paste the current catalog copy from [*here*](http://www.csub.edu/q2s/facstaff/program_info/index.html), turn on Track Changes (instructions below), and then make any necessary modifications.

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| **Catalog Copy: Program Description and Requirements for the Degree** |
| **Department of Computer and Electrical Engineering and Computer Science**  **School of Natural Sciences, Mathematics, and Engineering**  **Department Chair:** Melissa Danforth  **Program Office:** Science Building III, 317  **Telephone:** (661) 654-3082  **email:** ceecs@cs.csubak.edu  **Website:** www.cs.csubak.edu  **Faculty:** M. Danforth, S. Garcia, S. Jafarzadeh, S. Kukreja, W. Li, H. Mehrpoyan, T. Meyer, D. Meyers, M. Thomas, H. Wang, A. Wani  **Program Description**  Computer Engineering is a field, which in some sense, resides between the long-established fields of Computer Science and Electrical Engineering. It is concerned with topics such as analog and digital circuit design, embedded controllers, computer hardware, system software, computer system design, data communication, signal processing, computer networks, robotics, computer vision, graphics and image processing, and other topics in computing where hardware plays an important role. Computer engineers often work with other engineers, physical scientists, and software engineers.  The Computer and Electrical Engineering and Computer Science Department moved into a new building in Fall 2008. The department administers its own local area network which includes multiple Unix/Linux servers, two software programming labs, a walkin lab/tutoring center, one advanced workstation lab, an isolated network lab, an AI/visualization lab, a DSP/communications lab, one digital electronics hardware lab, a power systems/electronics lab, and a robotics/control systems lab. There is also a study room/library with computers available to students.  An important goal of the department is to enable students to work much more closely with faculty than they would be able to at larger universities. A detailed description of student learning goals and objectives can be found at <http://www.cs.csub.edu/all_abet.pdf>.  **Requirements for the Bachelor of Science Degree in Computer Engineering**  **Total Units Required to Graduate 120 units**  **Major Requirements 95 units**  ECE/CMPS Courses 62  Cognate Courses 33  **Minor Requirement 0 units**  **General Education Requirements 24 units \*\*\***  First-year Seminar 0\*  Foundational Skills 6\*  LD Area B 3\*  LD Area C 6  LD Area D 6  AI-Hist/Gov6  JYDR3  UD Thematic Areas (C&D) 3\*  Capstone 0\*  SELF 0\*\*  GWAR 0\*\*  **Additional Units 1 unit**  \* The following required major courses also meet general education requirements: ECE/ENGR 1618 meets First-year Seminar, MATH 2310 or 2510 meets Foundational Skill B4, PHYS 2210 meets LD Area B1/B3, PHIL 3318 meets UD Thematic Area C, and CMPS 4908 meets Capstone. Additionally, ENGR/ECE/PHYS 2070 currently satisfies the requirements of Foundational Skill A3 for engineering majors. Total reduction: 15 units (required)  \*\* The SELF requirement may be met by selecting another General Education course with a SELF overlay or by taking a stand-alone course. The GWAR requirement can be met by taking an exam, taking another General Education course with a GWAR overlay, or by taking a stand-alone course.  \*\*\* Computer Engineering is guaranteed 6-9 units of General Education modifications outside of LD Area B by the Academic Senate documentation. The department does not, as of this submission, know exactly what those modifications are. The total unit count has been reduced by 9 units until such time as the modifications are approved by GECCo.  **SB1440 Units Required 58 units\***  \* Units required for graduation after completion of the Engineering (Computer Engineering focus) model curriculum and lower-division general education at a California community college. Total assumes 3 units of upper division general education modifications.  **Requirements for the Major in Computer Engineering**  1. **Lower division required courses** (18 units):  ECE 1618, ECE/ENGR/PHYS 2070, CMPS 2010, 2020, 2120  2. **Upper division required courses** (32 units):  CMPS 3240, 3600, ECE 3040, 3070, 3200, 3220, 3250, 4902, 4908  3. **Upper division elective courses** (12 units):  Select 12 units of electives from the following:  **Digital Communications and Signal Processing:**  ECE 3230, 4220, 4250, 4260  **Control Systems, Robotics, and Digital Design:**  ECE 4240, 4320, 4570  **Image Processing and Computer Vision:**  ECE 4460, 4470  **Special Topics and Independent Study**  ECE 3770, 3771, 4770, 4771, 4800, 4860, 4870, 4890  *Only a combined total of 4 units of ECE 377x, 477x, 48xx may be used for elective credit.*  4. **Required cognate courses** (33 units):  MATH 2510 or 2310, MATH 2520 or 2320, MATH 2530, 2610, PHYS 2210, 2220, PHIL 3318  5. **General Education Courses and Notes:**   ECE 4908 satisfies the Capstone requirement.   PHIL 3318 satisfies UD Thematic Area C and the Computer Engineering Ethics requirement.   PHYS 2210 satisfies LD Areas B1 and B3.   MATH 2510 or 2310 satisfies Foundational Skill B4.   ENGR/ECE/PHYS 2070 satisfies Foundational Skill A3.   Remaining modifications will be documented after decision from GECCo.  **Requirements for the Bachelor of Science Degree in Computer Engineering with a Concentration in Electrical Engineering (This concentration has been elevated to a Degree Program. Please see Electrical Engineering).**  **Note:** Several of the courses required for Computer Engineering are listed under the Computer Science Degree Program (CMPS prefix). Additionally, all Computer Engineering and Electrical Engineering courses descriptions are listed under the Computer Engineering Degree Program and carry the ECE prefix.  ***Lower Division***  **ECE/ENGR 1618 Introduction to Engineering I (2)**  This course will provide an introduction to the practice of engineering and the various areas within the engineering disciplines. Students will be informed of engineering curricula and career opportunities within the various engineering disciplines. This course will also introduce students to important topics for academic success, both at the major level and at the university level. Each week lecture meets for 100 minutes. (GE FYS)  **ECE/ENGR 1620 Introduction to Engineering II (2)**  This course builds on the foundational skills in engineering design and practices developed in ECE/ENGR 1618. Students will design, build, test, and present engineering projects designed to solve specified problems within given constraints. Additionally, the impact of engineering from a global, social, economic, and environmental perspective is presented through case studies. Each week lecture/discussion meets for 100 minutes. Prerequisite: ECE/ENGR 1618  **ENGR/ECE/PHYS 2070 Electric Circuits (4)**  An introduction to the analysis of electrical circuits. Use of analytical techniques based on the application of circuit laws and network theorems. Analysis of DC and AC circuits containing resistors, capacitors, inductors, dependent sources and/or switches. Natural and forced responses of first and second order RLC circuits; the use of phasors; AC power calculations; power transfer; and energy concepts. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: PHYS 2220 with a grade of C- or better, or permission of the instructor  **ECE 2770 Special Topics (1-3)**  This course will be used to supplement regularly scheduled courses with additional material at the beginning level.  **ECE 2771 Special Topics Laboratory (1)**  Optional laboratory for the study of topics at the beginning level. Co-requisite: ECE 2770  ***Upper Division***  **ECE 3040 Signals and Systems (4)**  Time and frequency domain techniques for signal and system analysis. Fourier series and transforms, and Laplace transforms. Topics in differential equations and probability. Use of a numerical computing environment such as MATLAB. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070  **ECE 3070 Analog Circuits (4)**  Design, construction, and debugging of analog electronic circuits. Diodes, filters, oscillators, transistors, JFETs, op-amps, and basic analog circuit design. Broadband applications in networking and communications. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070  **ECE 3200 Digital Circuits (4)**  Introduce combinational logic and sequential logic designs, and microprocessors. Cover digital concepts, number systems, operations, and codes, logic gates, Boolean algebra and logic simplification, combinational logic and its functions, flip-flops and related devices, counters, shift registers, memory and storage, concepts of microprocessors, assembly language, computers, and buses. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3070  **ECE 3220 VHDL (4)**  Introduces logic system design using a hardware description language (VHDL). Covers the VHDL language in depth and explains how to use it to describe complex combinational and sequential logic circuits. Include a weekly lab where students will get hands-on experience implementing digital systems on Field Programmable Gate Arrays. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3200.  **ECE 3230 Digital Communications (4)**  This course focuses on the representation of signals and noise, Gaussian processes, correlation functions and power spectra, linear systems and random processes, performance analysis and design of coherent and noncoherent communication systems, phase-shift-keying, frequency-shift-keying, and M-ary communication systems, optimum receivers and signal space concepts, information and its measure, source encoding, channel capacity, and error correcting coding. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040  **ECE 3250 Embedded Systems (4)**  Introduce embedded systems. Cover embedded concepts, NI sbRIO embedded system devices, LabVIEW RT and FPGA modules, combinational and sequential logic circuits design, finite state machines, memory and storage, sensor and motor interface. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ECE 3070 and ECE 3200  **ECE 3320 Fields and Waves (4)**  This course focuses on the fundamentals of electromagnetics. Students are expected to acquire expertise in vector analysis, electrostatic and magnetic fields, Maxwell’s equations, plane waves, reflection, attenuation, and impedance. Knowledge of circuit theory, Matlab, differential equations, and calculus are required to successfully complete the course. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520 and ENGR/ECE/PHYS 2070.  **ECE 3340 Control Systems (4)**  Introduce control system analysis and design. Cover control system modeling, time response, reduction of multiple systems, stability analysis, steady-state errors, root locus technique, PID controller, and fuzzy controller. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3040.  **ECE 3370 Power Systems Fundamentals (4)**  This course is an introductory subject in the field of electric power systems. Electric power systems have become increasingly important as a way of transmitting and transforming energy in industrial, military and transportation uses. The course covers basic elements of power system, three-phase circuit analysis, transformers, transmission line configuration, the per unit system and power flow. Each week lecture meets for 200 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3040  **ECE 3380 Power Electronics and Electric Drives (4)**  The course is an introduction to switched-mode power converters, electromechanical energy conversion systems, and electric drives. It provides a basic knowledge of circuitry for the control and conversion of electrical power with high efficiency. These converters can change and regulate the voltage, current, or power; dc-dc converters, ac-dc rectifiers, dc-ac inverters, and ac-ac cycloconverters are in common use. Applications include electronic power supplies, aerospace and vehicular hybrid power systems, and renewable energy systems. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3070, ECE 3320, ECE 3370.  **ECE 3770 Special Topics (1-3)**  This course will be used to supplement regularly scheduled courses with additional material at the intermediate level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements.  **ECE 3771 Special Topics Laboratory (1)**  Optional laboratory for the study of topics at the intermediate level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Co-requisite: ECE 3770  **ECE 4220 Digital Signal Processing (4)**  This course provides an introduction to principles of Digital Signal Processing (DSP) including sampling theory, aliasing effects, frequency response, Finite Impulse Response filters, Infinite Impulse Response filters, spectrum analysis, Z transforms, Discrete Fourier Transform and Fast Fourier Transform. Overviews of modern DSP applications such as modems, speech processing, audio and video compression and expansion, and cellular protocols. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040  **ECE 4240 Microprocessor System Design (4)**  Introduce microprocessor architecture and organization. Cover bus architectures, types and buffering techniques, Memory and I/O subsystems, organization, timing and interfacing, Peripheral controllers and programming. Design a microprocessor system. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ENGR/ECE/PHYS 2070 and ECE 3200  **ECE 4250 Wireless Communications (4)**  In this course analytical characterizations of mobile communications channels are developed. The main techniques for mitigating the mobile communication channel effects such as Equalization, Diversity, etc. are examined. Multiple access techniques used in wireless communications, such as FDMA as well as digital TDMA and CDMA techniques are presented. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: MATH 2320 or 2520, ENGR/ECE/PHYS 2070, ECE 3040  **ECE 4260 Wireless Networks (4)**  This course focuses on wireless data communications including wireless internet. The students acquire knowledge into the current and future state-of-the-art of technology in the field of wireless communications. Another goal of the course is to ensure student(s) can explain the impact of commercial, political, and regulatory factors on the design of wireless systems. The course will treat current relevant technologies, and the exact content may change from year to year. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: MATH 2320 or 2520  **ECE 4320 Instrumentation, Control, Data Acquisition (4)**  Introduce basic concepts in Instrumentation, Control and Data Acquisition. Cover analog and digital signal inputs, outputs, and generation. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3070  **ECE 4330 Mechatronics (4)**  Intelligent electro-mechanical systems. Topics include electronics (A/D, D/A converters, op-amps, filters, power devices), software program design (event-driven programming, state machine-based design), DC and stepper motors, basic sensing and basic mechanical design. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: CMPS 2020 with a grade of C- or better, ECE 3070, and ECE 3200  **ECE 4370 Power Systems Analysis (4)**  This course follows the discussions from the first course in power systems. This course focuses on power flow, symmetrical components, faulted system analysis, and protection schemes. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: ECE 3370  **ECE/CMPS 4460 Image Processing (4**)  Digital image acquisition, image enhancement and restoration, image compression, computer implementation and testing of image processing techniques. Students gain hands-on experience of complete image processing systems, including image acquisition, processing, and display through laboratory experiments. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: CMPS 2020 with a grade of C- or better  **ECE/CMPS 4470 Computer Vision (4)**  Imaging formation, early vision processing, boundary detection, region growing, two-dimensional and three-dimensional object representation and recognition techniques. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisite: CMPS 2020 with a grade of C- or better  **ECE 4570 Robotics (4)**  Introduce robotic systems. Cover Mindstorms NXT, motion control, target steering and trajectory planning, obstacle avoidance, line tracking, and multiple sensor fusion. Each week lecture meets for 150 minutes and lab meets for 150 minutes. Prerequisites: ENGR/ECE/PHYS 2070 and ECE 3040  **ECE 4770 Special Topics (1-3)**  This course will often be used to supplement other courses with additional work at a more advanced level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor  **ECE 4771 Special Topics Laboratory (1)**  Optional laboratory for the study of topics at a more advanced level. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Co-requisite: ECE 4770. Prerequisite: Permission of the instructor  **ECE 4800 Undergraduate Research (1-4)**  Independent study into a research topic under the supervision of a faculty member. Students will establish the research goals and objectives with their faculty supervisor. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor  **ECE 4860 Internship (1-4)**  Internships may be arranged by the department with various agencies, businesses, or industries. The assignments and coordination of work projects with conferences and reading, as well as course credits, evaluation, and grading are the responsibility of the faculty liaison (or course instructor), working with the field supervisor. Offered on a credit, no-credit basis only. The department will determine the number of credit units offered. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor  **ECE 4870 Cooperative Education (1-4)**  The Cooperative Education program offers a sponsored learning experience in a work setting, integrated with a field analysis seminar. The field experience is contracted by the Cooperative Education office on an individual basis, subject to approval by the department. The field experience, including the seminar and reading assignments, is supervised by the cooperative education coordinator and the faculty liaison (or course instructor), working with the field supervisor. Students are expected to enroll in the course for at least two semesters. Offered on a credit, no-credit basis only. The department will determine the number of credit units offered. Course is repeatable, but only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: Permission of the instructor  **ECE 4890 Experiential Prior Learning (1-4)**  Majors in Computer and Electrical Engineering with significant prior experience in computers and/or electronics may have some of their experience count for academic credit toward their degree. In order to be considered for experiential learning credit the student must have completed CMPS 2010 and have the approval of the department. Only a combined total of 4 units of ECE 377x, 477x, and 48xx may be used for elective credit towards the major requirements. Prerequisite: CMPS 2010 with a grade of C- or better and permission of the instructor  **ECE 4902 Senior Project I (2)**  After consultation with the faculty supervisor and investigation of relevant literature, the student(s) shall prepare a substantial project with significance in the designated area. The timeline, teamwork responsibilities, milestones, and presentation(s) will be scheduled. Prerequisite: Upper-division standing.  **ECE 4908 Senior Project II (2)**  This is the completion phase of the project. The student(s) will present a project report to the entire class, explaining the nature of the work, the finished product, and its relationship to the field. Prerequisite: Upper-division standing and ECE 4902  **ECE 4960 Leadership in Engineering (1-2)**  Leadership in computer and electrical engineering related activities that meet campus and/or community needs. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor  **ECE 4970 Service Learning in Engineering (1-2)**  Service learning in computer and electrical engineering related activities that meet campus and/or community needs. Students will design and/or implement a service learning project in consultation with their faculty supervisor and, if applicable, community partners. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor  **ECE 4980 Teaching in Engineering (1-2)**  Experience supporting teaching activities in department courses, providing tutoring in the department tutoring center, leading problem solving sessions, and/or supporting other instructional activities in the department. Offered on a credit, no-credit basis only. Course is repeatable. Course credits cannot be used as elective credit towards the major requirements, but can be used as additional university units. Prerequisite: Permission of the instructor |

# Curriculum Map

No modification of the existing curriculum map (matrix of courses vs program learning outcomes) is required by these proposed changes. Please attach.

X The existing and revised curriculum maps are attached. The revised curriculum map has been updated to reflect the proposed changes and loaded into TaskStream.

Attach Curriculum Map

Attach the curriculum map to this template by placing your cursor after this paragraph, then locating the Insert Tab in the top ribbon and find **Insert > Object > Attach as File**. Need Help ? [See Tip Sheet](#_Tip_Sheet)

Existing curriculum maps can be found in TaskStream or by [*clicking this link*](http://www.csub.edu/q2s/facstaff/program_info/index.html).

> Attach Curriculum Map Here 

# Program Units

Does simple course conversion keep the unit requirements for the major (or any concentration/emphasis) within the allowable range? (24-54 semester units for a BA, 36-66 semester units for a BS, and ≥30 semester units for master’s degrees)

Yes

X No; We have submitted a proposal to correct the discrepancy; We seek an exception.

X We are within 120 semester units, which no longer requires an exception proposal.

# Review and Approval

Choose Review and Approval Cycle: Curriculum Committee Review

The curricular proposal has been reviewed and approved by the member(s) listed below.

| Review Cycle | Name | Date Approved | Comments / Revision Requests |
| --- | --- | --- | --- |
| Department | Melissa Danforth | 8/22/2014 |  |
| Curriculum Committee | Melissa Danforth | [CC Review Date] |  |
| Q2S Exceptions Committee | [Q2S CCC Chair] | [Q2S CCC Review Date] | This Review Level only applies to exceptions and interschool programs. |
| Dean  *(Final Approval)* | [Dean Approver] | [Dean Approval Date] |  |

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