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** | Electrical 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 Electrical Engineering curriculum transformation seeks to restructure and re-sequence the major courses to maintain alignment with the Body of Knowledge for electrical engineering majors, while also remaining within unit limitations for CSU semester campuses. While there is not an ACM/IEEE recommendation for core topic hours as there is with the Computer Science and Computer Engineering curriculum, the NCEES Fundamentals of Engineering exam for Electrical Engineering (FE-EE) provides a nationally-normed representation of important topic areas in Electrical Engineering, which can be used to derive a Body of Knowledge for the major. The FE-EE exam is the first of two exams that electrical engineers must pass during the professional engineering (PE) licensing process in the USA.  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 Computer 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 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 Electrical Engineering program which is 120 semester units at the Chancellor’s Office’s degree tracker. 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 64 to 68 semester units (66 average), the cognate ranges from 26 to 35 semester units (33 average), the core+cognate ranges from 93 to 103 (99 average), and the non-double-counted GE is 27 semester units at all of those campuses. Our proposed program has 56 core units and 36 cognate units. The core units are significantly below the state-wide range and average for electrical engineering programs. 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 38 semester units of programming, chemistry, circuits, calculus, and physics for the Electrical 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 52 engineering units and 37 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 Electrical Engineering, there are 47 QSE core units, 42 QSE cognate units, and 89 QSE overall units. The initial cognate proposals from other NSME departments put our cognate units at 46 actual semester units. We removed one cognate course (PHYS 2230) as it was not part of the C-ID.net proposed model curriculum, we removed the chemistry lab, 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. To incorporate high impact practices, the freshman course was extended to a two quarter sequence. We streamlined several course sequences to recover units from the 3+1 model and the additional freshman course, which was able to recover all but 1 QSE. The engineering faculty also felt that the curriculum was lacking fundamental coverge in control systems, as this is one of the fundamental areas of electrical engineering , so a core course in control systems was added to the curriculum. This results in our proposed 56 core units (47 QSE + 4 for shifting ENGR/ECE 2070 into the core + 4 for control systems + 1 unrecovered from streamlining), 36 cognate units, and 92 core+cognate units.  Summary of External Standards and Resources for Electrical Engineering Programs   * C-ID.net transfer model curriculum between CA community colleges and CSUs/UCs for Engineering (Electrical Engineering track): <http://www.c-id.net/docs/Engineering%20MC_3-3-2014.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 Electrical 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 (FE exam). We streamlined the signals and systems sequence into a single semester course (previously two quarter courses). We also streamlined the cognate requirements to reflect the model curriculum. |
| *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 (Electrical 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. Mehrpouyan, T. Meyer, D. Meyers, M.Thomas, H. Wang, A. Wani  **Program Description**  Electrical Engineering is a large and expanding field which is concerned with the following fundamental areas: digital signal processing, semiconductor electronics, microprocessors and embedded systems, VSLI design, cyber-physical systems, data communications, energy systems and power electronics, transmission and distribution, RF and microwave, robotics and control system design, electromechanics and mechatronics, computer networks, digital design, image processing and computer vision. If computer science can be regarded to be on the information processing side of computer engineering, then electrical engineering can be regarded to be on the side which builds upon the fundamental physical properties of electricity and magnetism. Electrical engineers often work with other engineers, physical scientists, and computer scientists.  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 Electrical Engineering**  **Total Units Required to Graduate 120 units**  **Major Requirements 92 units**  CMPS/ECE Courses 56  Cognate Courses 36  **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** **4 units**  \* 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 (Electrical 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 Electrical Engineering**  1. **Lower division required courses** (12 units):  ECE 1618, 1620, ENGR/ECE/PHYS 207, CMPS 2010  2. **Upper division required courses** (32 units):  ECE 3040, 3070, 3200, 3230, 3320, 3370, 3340, 4902, 4908  3. **Upper division elective courses** (12 units):  Select 12 units of elective courses from the following. At least one course must be at the 4000-level:  **Digital Design and Embedded Systems**  ECE 3220, 3250, 4240  **Digital Communication and Digital Signal Processing**  ECE 4220, 4250, 4260  **Control Systems and Robotics**  ECE 4320, 4570  **Power Systems and Power Electronics**  ECE 3380, 4330, 4370  **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** (36 units):  MATH 2510 or 2310, MATH 2520 or 2320, MATH 2530, 2610, 3220, CHEM 1000, 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.  **COURSE DESCRIPTIONS**  **Note:** All Computer Engineering and Electrical Engineering courses descriptions are listed under the Computer Engineering Degree Program and carry the ECE prefix. |

# 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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