A Methodology for Converting an Engineering Program from Quarters to Semesters

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Abstract

California Polytechnic State University in San Luis Obispo has offered classes on the quarter system since its inception in 1946. In the Fall of 2021, the university was mandated to move to the semester system by Fall 2026. After researching the literature and interviewing universities that had made the same conversion in the past, it became apparent that no suggested methodology for making this conversion was available. This paper chronicles the conversion to semester effort to date and suggests a formalized methodology that other institutions can use if found in the same situation.

Some challenges are that initial information from university leadership can be sparse or overly restrictive; programs are dependent on each other for general education and support courses; the desired outcomes at various levels are different; and the curriculum conversion schedule seems like a long time to make a transition, but it is not. In reality, any creative thinking must be done very early in the process as the final years are filled with approval processes, new course descriptions, revised catalog and new articulation agreements with the community colleges. Many express concerns about the three-year transition period where students experience portions of their academic experience under both systems. Using the architectural engineering (ARCE) program as an example, this paper addresses all of these and suggests some helpful hints for navigating the process.

Introduction

Most colleges and universities are on the semester calendar system. Since 1987, 132 colleges have converted from quarters to semesters, leaving only around 5 percent of the Nation's colleges on a quarter system [1]. The California State University (CSU) system, the largest university system in the nation, consists of 23 universities. In 2012, six CSU campuses started their conversion to the semester system. Currently, 22 of the 23 CSU campuses are on the semester system. In October 2021, the CSU Chancellor mandated that California Polytechnic State University in San Luis Obispo (Cal Poly SLO) would convert to the semester system starting in the Fall semester of 2025. The reasons cited for the conversion were articulation and equity, student success, and administrative efficiency. In March 2022, the deadline was extended to Fall 2026 to accommodate Assembly Bill 928: Student Transfer Achievement Reform Act [2] a revision to general education in the CSU system that will include course unit requirements and will not be finalized until Spring 2024. Full General Education (GE) course proposals cannot be submitted until the Chancellor's Office releases AB 928 requirements and new GE template.

The university timeline for completion is specified in Table 1 and was taken from Academic Senate Resolution 946-22 [3]. While five years seems like ample time to make this transition, it is not. The timeline shows that the time between the announcement of the decision to the submission of every academic department's plan was only sixteen months. This paper chronicles the conversion to semester effort during this time period for the architectural engineering (ARCE) program and suggests a formalized methodology that other programs and institutions

can use if found in the same situation. The paper attempts to focus on the process and the challenges of this conversion more than the specific details of the ARCE curriculum.

January 27, 2023	Each academic department submits its Academic Program Plan to the appropriate college curriculum committee.
March 17, 2023	Deadline for Academic Program Plan Approval by College Curriculum Committees
Summer 2023	Program proposals due to the University
Fall 2023	Catalog & Curriculum Team review Proposals in preparation for review
Winter 2024 to Winter 2025	Academic Senate Curriculum Committee (ASCC) reviews 2026-27 Catalog proposals
Spring and Summer 2025	Build and publish 2026-27 Catalog

Table 1: Timeline for Academic Program Proposal Review, including Faculty and Staff Support for Summer 2023 [3]

Review of the Literature

After reviewing the literature, it became apparent that no suggested methodology for making this conversion was available, which became a key motivation for writing this paper. A number of works chronicled the relative advantages and disadvantages of the quarter and semester systems. Bostwick et.al. [4] contended that conversion to the semester system negatively impacts on-time graduation rates and specifically lowers first-year grades, decreases the probability of enrolling in a full course load, and delays the timing of major choice. Johnson and Kestler [5] conducted a mixed methods study, involving a sample of Midwestern university students' favoritism toward quarters and semesters, the students' predicted and perceived changes to their motivated behaviors, and their self-reported motivation/learning strategies during the conversion to a semester calendar. The paper also compared the various advantages of both systems and concluded that students prefer the quarter system and faculty prefer the semester system.

Eastman and Walker [6] provided general insights into calendar conversion processes from an institutional perspective, and more insights specific to the Engineering Technology community at Rochester Institute of Technology. The paper included a fairly detailed institutional methodology and also listed some other universities that have undergone Quarter-to-Semester (Q2S) conversions in the last 25 years. It also examined the process and results from the department of Electrical, Computer, and Telecommunications engineering technology.

Sitaram and Sala [7] documented the transition of the Mechanical Engineering program at Baker State College in Flint, Michigan to semesters in 2018. The authors also lamented the dearth of material in the literature on this topic. The paper described the discrete changes made in the program but covered little about the approach or methodology that was used.

Other papers examined the effects on a single course during a transition to semesters. Mondragon-Torres and Christman [8] described how a sequence of three embedded systems design courses for computer engineering technology students were enhanced in a semester format by updating the skill sets, course content, and platforms used. Similarly, Abrams et.al. [9] detailed the enhancement of an introductory mechanical engineering course at The Ohio State University's Summer 2012 conversion from quarters to semesters.

Consulting Other University Programs

The authors also contacted universities with similar programs with recent experience in a Q2S conversion, specifically the Cal Poly Pomona Civil Engineering program and the Milwaukee School of Engineering (MSOE) Architectural Engineering program. Cal Poly Pomona converted to semesters in 2018, along with the other five CSUs, leaving Cal Poly SLO as the lone holdout. Having completed the conversion, Pomona was able to provide perspective, but the memory was still fresh. MSOE was still in the process of converting to semesters and was two years ahead of this program so the memory was even fresher but the perspective was less.

The interview with the Cal Poly Pomona civil engineering department head highlighted the following points:

- Simply convert your existing curriculum; don't make big changes.
- The program is dependent on the university office of transition to declare the overall rules regarding time modules, number of units, and other constraining information.
- Communicate and integrate with the other departments. Build coalitions with the other departments
- The university will attempt to use this process to enact budget cuts.
- The four-year transition period when students are parts of both systems requires some additional thought and flexibility.
- Expect the GE courses to push for more units.
- Expect the Department Conversion Committee to do most of the work but bring it to the overall faculty for a vote. Engage the entire faculty.
- The program needs a strong presence on the Academic Senate.
- Look to those semester-based programs with similar curricula for guidance and ideas.
- The semester conversion lost some of the pace of the quarter system, but allows more time for foundational material.
- Advocate for 9 Weighted Teaching Units (WTU) of teaching per semester rather than the 12 WTU's teaching workload now in effect. This is a unique issue for the CSU.

- While the program did significant work in this conversion process, there was no specific methodology developed in advance.

The interview with MSOE ARCE department head resulted in the following advice:

- The GE courses were given an entire relook; beware of a growth in percentage of GE courses
- It was easy to meet the ABET accreditation requirements in the conversion.
- Estimate the amount of work this will take and triple it. Fight for additional compensation for the faculty members involved.
- Proceed on a serial rather than parallel approach to the conversion.
- Expect your initial plans to be denied in the higher-level review process and adjust accordingly.
- The most contentious issues were senior project, digital tools versus physical models, and the mode of instruction for the freshman seminar course.
- The program was given a strict budget of 128 semester units but a lot of flexibility in the number of units and modes of instruction for individual courses.
- There are many university level committees making decisions (common courses committee, university conversion committee, undeclared majors committee, calendar committee) that effect the program. Get faculty to serve on those committees.
- There was no formal methodology used. The program did prepare a reflection report looking at five other programs before starting.

Our a priori expectation was that this is a parallel process and a once-in-a-generation opportunity to take a fresh holistic look at the curriculum. It was surprising that both programs interviewed told us not to do that. There was not time in the conversion schedule to do that and attempting to do so would only bog us down.

The advice and perspectives offered by the Pomona and MSOE programs were insightful and valuable. In retrospect, we would have interviewed some of those schools listed in [6] had we seen it earlier.

Development of a Methodology

Without a defined methodology from the literature, the ARCE faculty team developed the following procedure which guided our efforts within the time allotted. The serial set of steps were the following:

1. **Consultation:** Consult the literature and interview those similar programs which recently converted from quarters to semesters
2. **Guiding Principles:** Have the faculty review the mission, vision, core values, program objectives and student outcomes to produce guiding principles for the semester conversion. Seek guiding principles from the students, college, university, and advisory board.

3. **Independent Solutions:** Develop independent and diverse solutions for a semester-based curriculum. Critically evaluate the various solutions.
4. **Consensus Solution:** Combine the best of these independent solutions into a single straw man draft curriculum. Revise the draft curriculum until the faculty reaches majority consensus.
5. **Formal Submittal:** Prepare and submit the new curriculum in the university format specified.

Those steps that operate in parallel to the serial steps are:

6. **Inter-Department Coordination:** Coordinate with, consult with, and advise those departments that share common courses.
7. **University Planning:** As needed, modify the program plan to integrate university level decisions and guidance as it arrives.
8. **Committee Participation:** Serve on critical committees and bodies (Academic Senate, GE Committee, College Curriculum Committee, etc.) to help influence policy and decisions.

Implementing the Plan

The university decision to convert to semesters was announced in October 2021 (Fall quarter 2021) and the draft curricular plan was due late January 2023 (Winter quarter 2023). With 16 months to complete the plan, a timeline was developed with elements of the plan due to be completed in Fall 2021, Winter 2022, Spring 2022, Summer 2022, Fall 2022 and Winter 2023. That initial timeline is shown in Appendix A and despite some obstacles along the way, the program followed it.

Fall 2021

The review of the literature and interviews with other similar programs were the first early steps and have already been discussed. Several faculty meetings were devoted to reviewing the vision, mission, core values, program objectives and student outcomes to ensure they were still all relevant. Divided into smaller groups, the faculty used these documents to develop some guiding principles for the revised curriculum. The group efforts were consolidated and the following faculty guiding principles were created and approved:

Faculty Guiding Principles

- Maintain our brand
- Maintain the same pace and variety of courses
- Create some electives (the current program has none)
- Meet the structural engineering needs of the Architecture (ARCH) and Construction Management (CM) students
- Teach structure as systems
- Prepare students for graduate school

- Maintain hands-on portion of curriculum (design, computer, experimental labs)
- Use latest commercial software and design codes
- Communicate visually
- Meet past practice of class sizes (35 for lecture, 24 for activity, 16 for lab)
- More flexibility in pre-requisites
- Maintain current mix of theory versus practice and analysis versus design
- Meet ABET accreditation requirements
- Master the basics: mechanics and load flow
- Increase/improve interdisciplinary collaboration
- Do no harm
- Target interventions to improve weak areas of the curriculum
- No increase in faculty teaching workload

These guiding principles then provide a gauge to measure the effectiveness of whatever competing solutions emerge. At the same time, the students and industry advisory board were asked for their recommended guiding principles as we embark on this adventure. The ARCE advisory board is comprised of practicing structural engineers, architects and project managers. About half of the members at any given time are graduates of the Cal Poly ARCE program. At the Fall 2021 Advisory Board meeting (back on campus following the pandemic), the board was divided into three smaller groups to do this. Their separate lists were consolidated and synthesized to create their consensus guiding principles.

Industry Advisory Board Guiding Principles

- Focus curriculum on subject matter most practical for graduates to use on the job in first few years.
- Maintain "learn by doing" philosophy.
- Enhance interdisciplinary focus with ARCH and CM.
- Maintain focus on the undergraduate degree
- Industry trend towards sustainability and resiliency should be integrated into the curriculum.
- Preserve and enhance the "crown jewels" -- the four upper division design labs (Structural Systems, Steel, Timber/Masonry, and Concrete design labs)
- Infuse more complexity and detail into the courses and teach problem solving
- Bring back electives that were lost to unit reduction.
- Enhance interdisciplinary nature of curriculum; the awareness of other roles and disciplines in real world projects.
- Preserve pace of work that the quarter system required.
- Include using digital tools as part of the project requirements.
- Take some of the extra time in the design labs to address adaptive reuse, forensic analysis, sustainability of preservation of structures, etc.
- Hands on learning.
- Maintain smaller class sizes, particularly in the upper division courses.

- Blend of theory and practice.
- Maintain the focus on structural engineering of buildings.
- Preparation for FE/EIT.
- Address how program can accommodate 2-year transfer students from other schools.
- Ability to communicate graphically.
- Grow the program and produce more graduates.
- Increase diversity of student population.

Because the size of the student body is so much larger than the faculty or the advisory board, the students offered four pages of guiding principles. The information was solicited at a lunch meeting of the Structural Engineering Organization of California (SEAOC) student chapter and each student attendee was asked to submit one or two guiding principles on a sheet of paper as they left the meeting. The extensive student list was scoured for duplication, common themes and items we had not heard from other groups. A reduced sampling of student guiding principles is shown below.

Student Guiding Principles

- CAD/Revit-based studio class or just 1 semester of architecture studio using Rhino
- Spread out classes across all 4 years instead of cramming it into junior year
- Make a 4-year graduation more feasible
- More ARCE classes in 1st and 2nd year to build a stronger connection to peers
- Changing course units to better align with the amount of work (i.e. ARCE 257)
- Along with creating new course numbers that make sense (clearly communicate), organize them such that it is obvious how one course applies to another (future/upper-level) course.
- Give students academic credit for internship opportunities or study abroad
- Maintain “Learn by Doing”
- Add more flexibility for exploration of other engineering courses or elective courses.
- Focus more on industry applicability and interdisciplinary study
- More room for flexibility to do courses outside of ARCE (i.e. free electives, professional electives, class options)
- Ensure class time isn’t wasted in courses so the students can have ample opportunity to understand material and get sleep (please, more sleep)
- Ensure collaboration, hands-on, and real-world curriculum
- Prepare students for work as a structural engineer with practical applications of ARCE courses: wholistic classes (buildings + HVAC), continue design labs, room for professional electives in other disciplines (civil, ME, etc.)
- Having an education and courses that are attractive to industry hiring managers
- Prepare students for the FE
- Consider how changes will this effect student workloads -- ease the workload

The Architectural Engineering program is part of the College of Architectural and Environmental Design (CAED). The CAED also developed some guiding principles for the development of new semester curricula. Not surprisingly, the emphasis from above was sometimes different from those who were developing, teaching and learning from the new curriculum.

College Guiding Principles

- Promote Inter-disciplinary (or cross-, multi-, intra-, co-, etc.) educational opportunities
- Improve the ease of Change of Major within and into the college
- Improve ease of transfer into CAED programs from community colleges or 4-year institutions
- Expand graduate programs and integrate them into educational pathways within the CAED, between colleges and in communities.
- Incorporate the Curricular Goals of the CAED Diversity Plan: Broaden Disciplinary Perspectives, Advance the DEI Teacher-Scholar, and Embrace Inclusive Teaching
- Sustain the curricular variety and intensity that is a hallmark of our existing quarter system
- Leverage CAED resources more effectively, managing implications of curricular change and calendar change; take advantage of resource sharing
- Increase the CAED's contributions to general education at Cal Poly

Similarly, the university had some guiding principles that also influenced the development of individual program curricula. Most of those were built into the CAED guiding principles.

While developing guiding principles was an important early step, it quickly became apparent that no real progress would be made and the real issues will not be uncovered until a program started looking at the details of the curriculum. To identify issues for discussion and remain open to all alternatives, those tenured and tenure-track faculty willing to participate divided into five teams to independently develop a proposed semester curriculum for the ARCE program. A sixth team was added when a group of students asked if they could participate.

There was some initial resistance because we had so little information. The university transition team had barely formed. We did not know whether our semesters would be 14, 15 or 16 weeks in length, how many semester units would be allowed for ABET programs, the status of the new GE courses, what other departments would be offering or whether courses were restricted to being 3 units, 4 units or some other prescribed formula. A credible plan could not be developed unless we have more information.

The solution was to make a reasonable assumption and create an initial plan. If the assumption turned out to be wrong, we could adjust but we will have uncovered and discussed some valuable issues. We assumed a 15-week semester, ABET programs being allowed 128 units, GE courses in the current proportion and no constraints on the number of units for courses and what other departments were offering. The hope was that this process would help clarify what we wanted

other departments to do and we were in a better position ask them. As it turned out, most of the assumptions were true and we got an earlier start this conversion than many others.

Fall quarter ended with the six independent teams identified. Quarters often end with a wine and cheese mini-retreat for faculty to discuss issues that will not fit into a 50-minute weekly faculty meeting. In this case, we yielded the time to the six teams and charged them to present their proposals during winter quarter faculty meetings.

Winter 2022

During the winter quarter, five of the ten weekly faculty meetings were devoted to the independent teams presenting their respective solutions, stating their rationale, and fielding questions from the floor. The sixth team was off winter quarter and delayed reporting until Spring quarter. Four of the proposals were mostly a straight conversion of the current quarter curriculum to a semester curriculum with only minor changes in content but very different approaches to the logistics. The student plan almost identically mirrored one of the faculty team plans. One faculty team proposed a major restructuring of the curriculum with a greater focus on computer simulations, form finding, and spatial reasoning. It featured coverage of simple structures using algebraic statics, graphical statics and equilibrium without statics and then reinforced those methods on more complex and indeterminate structures later on. The proposal suggested a large overhaul of the program with two main threads, Drawing/Analysis and Design/Testing.

Many did not embrace the more radical change either because they did not understand it, were not comfortable teaching it or disagreed with the approach. It was clear that the majority of the faculty favored an evolutionary revision of a curriculum that has served us well rather than a revolutionary approach that risks losing the program's strengths. It also became important not to marginalize or ignore the revolutionary opinion. There were some incredibly valuable thoughts and ideas in the outlier suggested plan that could and should be incorporated into the more conventional plan that got adopted.

While the faculty meetings worked well for a presentation of the plans, the 50-minute sessions were not suitable for synthesizing and comparing the various options. The faculty conducted a mini-retreat during finals week of winter quarter to examine the differences in some of the plans and the issues they revealed. Each faculty team gave a three-minute presentation reminding everyone of the details of their specific plan. During the presentations, each faculty member was asked to list two things about each plan that they liked and two things they did not like. Finally, each faculty member was asked to assess which of the guiding principles were reflected in these plans and on which ones were we falling short. The meeting minutes recorded these responses to provide continuity for the spring quarter discussion.

Some key suggestions and issues that resulted from the six independent plans were:

- Most of the ARCE courses in the current quarter-based curriculum are 3 units offered over a ten-week quarter. If the same course and content is offered in the fifteen-week semester system, it would need to be 2 units to be equivalent. Using this conversion, faculty members will have an incredible number of preparations and the work load would certainly be increased -- potentially six preparations with a 12-unit semester workload. Some combining of courses is needed.
- One of the plans made every course four units which meant a maximum of three preparations for faculty in a semester. Many of the combination of classes did not work well.
    - The current freshman experience course stands alone as a 2-unit quarter course. Under this plan, it becomes a 4-unit semester course which requires a lot more content that the first-year students are not ready for.
    - The ARCE program currently requires a lecture course in timber, steel, concrete, and masonry followed by a design lab experience in steel, concrete and timber/masonry. A 4 unit course requires that lecture course and design lab to be combined which was unappealing to many of the faculty.
    - For two disparate courses where the content is not compatible, a suggested solution was two 7-1/2 week experiences that preserve some of the pace of the quarter system. The plan proposed a 4-unit Timber/Steel course with two instructors. Offer two sections of the course. Section 1 takes Timber first and Steel second while Section 2 takes Steel first and Timber second with each instructor switching sections at 7-1/2 weeks. Each instructor essentially teaches half the course twice, which reduces preparation time.
- Some courses combine more easily than others.
    - A year-long architecture sequence for example simply draws the course dividing line at the halfway point instead of the one-third points and does not have to change a thing.
    - The introductory statics/mechanics course and the analysis courses are not exact fits but can be fairly easily combined.
    - The soil mechanics (2 lecture plus lab) was combined with the foundations lecture (3 units) resulting in a minor increase in teaching units as the lab extends over an entire semester.
    - It is most difficult to combine courses like electrical circuits, thermodynamics and fluid mechanics that have nothing in common and are taught by different departments into a year-long experience. This exposes a key advantage of the quarter system where students can be exposed to smaller doses of more courses.
- All of the plans kept the same relative percentages of content in the introductory, analysis and design courses. There was no serious effort to poach units from another area.

Spring 2022

During Spring quarter, the sixth independent plan was presented to the faculty. Working with six different plans became cumbersome. The goal for the quarter was to combine the best of the six plans into a single plan. A comparison chart was created that compared all six plan proposals in the areas of first year experience, introductory classes, analysis sequence, design sequence, structural systems, CAD Drawing, and creativity (adding something new to the curriculum).

Those creativity items from various plans included:

- A placeholder class for an interdisciplinary experience yet to be determined
- Separate building systems classes on electrical systems and mechanical systems. These courses would contain enough theoretical content to eliminate electrical circuits and thermodynamics from the curriculum
- Alter the structural systems course sufficiently to make it an interdisciplinary experience with ARCH and CM students.
- Bring one of the design labs into the earlier schematic phase of design and include ARCH students.
- Make the second ARCH studio an interdisciplinary experience in conceptual design.
- Incorporate graphical statics and use Grasshopper and Python for form finding.
- Make the first-year experience interdisciplinary throughout the college for the first half of the course and discipline-specific for the second half.

The comparison chart was helpful, but did not provide the impetus to gain consensus on a single plan.

The bigger accomplishment during this quarter was communication with other departments. The discussion in creating an ARCE curriculum raised a number of discussion topics for other departments. These helped create agenda items for meetings with these departments during spring quarter.

- The ARCE students currently take the year-long sequence of freshman Architecture studios side-by-side with ARCH students taught by ARCH faculty. These highly creative and artistic studios are great but a full year is too much. Students are not exposed to other important architecture topics that are not part of first year studio. Also, the ARCE students don't see architecture again until an upper division interdisciplinary experience senior year. Several plans suggested one semester of ARCH studios freshman year in the current format and a second ARCH studio in the third year taught only to ARCE students.
- The primary construction management (CM) studio that the ARCE students take is a six-unit sophomore studio that is not articulated at any community college. There are topics in the Fundamentals of Engineering (FE) that are not covered in this course. While CM is

an important part of the program, there are probably a better selection of courses for ARCE students to take.

- Civil Engineering (CE) and ARCE both teach a Building Systems course. Teaching one course for both departments should be explored
- Computer Science teaches a two-unit introductory programming course using MATLAB. The ARCE program has switched to Python and would like a low-unit introductory course using Python.
- The introductory Physics course requires Calculus 1 as a pre-requisite resulting in Physics 1 for most students not be taken until Winter quarter of freshman year. Statics which requires both can start Spring quarter. We asked Physics to teach the initial Physics and Calculus courses concurrently to allow Statics to still be taken in the first year.
- Math and Statistics are two different departments. ARCE students currently take six 4-unit courses for 24 quarter units. The combined offering under the semester system should be 16 semester units.
- The general Chemistry course taken by engineers is currently 4 quarter units. We proposed Chemistry make the same course 3 semester units
- ARCE program relies on Agriculture Engineering (surveying), Construction Management (engineering economics), Mechanical Engineering (thermodynamics, fluid mechanics, rigid body dynamics), Geology (geology), Electrical Engineering (circuits), and Architecture (ARCH history). Most of these courses are four quarter units which equates to 2.75 semester units. When those courses are all rounded up to 3 semester units, programs will not be able to take them all.
- The inclusion of true interdisciplinary experiences requires coordination with all those participating. The CAED leadership met several times to discuss these opportunities during spring quarter
- ARCE is one of two ABET-accredited engineering located outside the College of Engineering (CENG). It was very beneficial to provide a representative to the CENG semester transition committees to understand what they were planning and develop common positions…..such as the number of units needed for ABET engineering programs.

At the same time, Academic Senate (AS) resolutions came forth providing information that clarified the assumptions we had been making. AS-942-22 [10] established semester length as 15-weeks with an additional week for final exams. AS-944-22 [11] allowed each academic program the freedom to assign any course with units of credit that best meet its program needs and course learning outcomes. It also stated that the GE courses would be 3 units and that both first-time students and transfer students will comply with the requirements of AB 928 curriculum. Finally, no undergraduate degree will exceed 120 semester units unless otherwise

approved. AS-946-22 [3] established the curricular transition timeline shown in the Introduction section of this paper.

In addition, the Semester Conversion committee is advocating for changes in the expected faculty workload in semesters and options for improved implementation of Teacher-Scholar Model in semesters [12]. The specific proposal is to revised the current workload model of 12 units teaching and 3 units service to a workload model of 9 units teaching, 3 units research and 3 units service.

All developments were discussed at a faculty retreat during finals week and the analysis of the six plans was shared. Looking at six plans was unworkable and no overall consensus emerged. It was decided that the Curriculum Committee chair would attempt to consolidate the six plans into a single strawman plan that would be presented at the annual Fall retreat in September.

Summer 2022

Over the summer months, the Curriculum Committee chair met with all faculty members individually, assessed the six proposed curricular plans and drafted a single plan that attempted to capture the best from each plan and incorporated the input received from previous discussions. He and the department head continued to communicate with other departments.

Fall 2022

The Fall 2022 quarter began in early September with the annual faculty retreat, an all-day event conducted in the week prior to classes starting. Read-ahead documents and an agenda were sent out in advance. The plan for the retreat was:

- Provided an orientation on the process and reasoning in the development of the single strawman solution and explain the process by which we would revise the strawman solution.
- The faculty member who proposed the revolutionary independent plan gave a presentation on innovative content and exercises that he has introduced into his courses over the years and made suggestions as to where this content might be included within the strawman solution.
- The faculty formed into three smaller groups of three faculty members each. Each group developed proposals that would improve the strawman. The suggestion had to be created in the form of a motion that could be voted up or down. For anything added to the proposed curriculum, the motion had to include what would be taken away.
- Each team presented their motions to the group. In the cases where the motions were similar, we attempted to consolidate the proposals into a single motion.

- The motions were taken in order, discussed and voted on. If the motion passed, the strawman was revised to include the content of the motion. If the motion did not pass, then no revision was made.
- Once the group motions were all considered and voted on, a revised strawman would be circulated to the faculty. During the quarter, a second round would occur where individuals could offer motions from the floor for revision.
- Once that round of motions was complete, the faculty would vote to accept the revised strawman as the approved curricular plan to be submitted in January.

The plan was sound but there were some mistakes in the execution. First of all, there was not enough time allotted to this task during the retreat. The retreat agenda include other items such as the annual program assessment, a presentation on a student trip to Ecuador, and an extended lunch where part-time faculty were included. The entire day should have been devoted to this process. As a result, the faculty teams did not have enough time to fully develop their motions and of the 14 motions developed, only five were fully discussed and voted on. Also, the faculty teams phrased their thoughts in bullet points rather than clear motions which caused the discussion to ramble and a lot of effort was spent trying to decipher the actual proposal. This also led to aside discussions that got into the minute content of a specific course that were not productive. The retreat ended with motions left unconsidered that would have to be discussed in faculty meetings. The process would have been more successful with more time allotted and a more rigid and disciplined approach to the discussion and voting.

The 50-minute weekly faculty meetings were not a good venue for continuing this process. By the time introductory business was conducted, there was 30 minutes remaining for addressing the previously proposed motions. The faculty became increasingly frustrated as nothing was getting decided. Some declared that we were heading down a path that nobody supported and others suggested we should start over. This was the low point in the process.

Several groups of self-selected faculty members met on their own to suggest the best way to move forward. They tried to define what was most important to them and how the strawman could be revised. The curriculum committee chair listened carefully and revised the plan to accommodate the suggestions. The content of the revised plan was presented and discussed at a couple of faculty meetings and the most pressing issues were identified.

A half-day faculty retreat was scheduled in December during final exam week with the implicit understanding that nobody leaves the room until we have achieved consensus. Since we had two strawmen plans, we voted that the most recent was the one that we would work from. We used the same process outlined for the retreat but enforced that any action had to be in the complete form of a comprehensible motion and the discussion discipline was enforced. The retreat was

successful as motions were voted up or down and the faculty voted to approve a semester curriculum to be submitted in January.

In addition, the CAED requested an advance copy of all department semester flow charts in the college to assess efficiency and determine if any additional resources are being requested. The number of units and the modes of instruction were the biggest factors for budget considerations. Those determine the personnel budget which is 93-97% of the total department budget. The goal was to create a semester program that does not require additional personnel costs.

Winter 2023

Most of the motions were voted up or down by a substantial majority. There were a couple of motions that were voted down by a single vote or did not pass because of a tie. These issues were very important to the faculty teaching specific courses. In an attempt to address these issues, the Curriculum Committee (CC) chair met individually with each faculty member to better understand key issues important to them. Based on the one-on-one meetings, a compromise solution was prepared. The CC chair got support from other faculty members and proposed a change to the curriculum that already had faculty approval. The CC chair incorporated that change into an alternate curriculum during the holiday break. The faculty was presented with this alternate curriculum and asked to approve it or stay with the version previously approved. The faculty voted to approve the new version in the first faculty meeting of the winter 2023 quarter.

The faculty-approved ARCE semester curriculum was documented in the format prescribed by the university and submitted to the CAED college curriculum committee by the January 27th deadline. The curriculum flowchart for the existing quarter-based curriculum is in Appendix B and the new semester-based curriculum is in Appendix C.

Many of the changes and ideas for the semester curriculum have already been discussed. Major changes include the third-year architecture studio and the creation of some electives. A number of support courses could not be fully replicated in the semester curriculum. Courses such as dynamics, engineering economics, surveying, thermodynamics, fluid dynamics, electrical circuits, were listed in the three Fundamental Engineering (FE) elective courses where students can choose which they wish to take from a prescribed list. The is also an ARCE Technical Elective which has a much larger list of courses from which a student can choose.

The ARCE quarter program had four culminating experiences to include the three design labs and a separate senior project. The concrete/masonry lab becomes the senior capstone project and the independent senior project is now an elective. The first-year experience class is 2 units. The attempt to make it half interdisciplinary and half discipline-specific was pedagogically sound but

administratively impossible to execute. Most of those items classified as creative in the comparison chart, did not make it in to the approved version of the curriculum, but still have a chance to be integrated into the detailed topics of a specific course.

The ARCE faculty assessed the new curriculum with respect to the guiding principles as shown in Appendix D. Some of the guiding principles were fully met in the quarter-based curriculum and others were not. As such, each faculty member rated the attainment of the guiding principles for both the quarter and semester curricula using a Likert scale rubric and the analysis focused on the difference (or delta) between the quarter and semester curricula.

The largest delta on the Appendix D faculty survey reveal those areas where the semester curriculum reflects the greatest improvement over the quarter system. Those areas with the highest delta values are:

- Create some electives and give students more choice and flexibility (+1.79), (+1.61), (+1.41), (+1.70)
- Spread ARCE classes out more evenly over the four years (+1.10), (+0.71)
- Create course numbering system that makes sense (+0.80)
- Accommodate transfer students (+0.55)

Those items with multiple scores represent guiding principles from different constituencies that essentially repeated the same point. Similarly, those guiding principles with the lowest deltas indicate the greatest degradation of the semester-based program over the quarter system.

- Maintain the pace/variety/intensity of courses (-1.06), (-1.20), (-1.23), (-0.71)
- Do no harm (-1.08)
- Enhance the interdisciplinary focus (-0.86)
- Maintain our brand (-0.80)

The survey numbers are also helpful to distinguish between those areas where the program is excelling under the quarter system and will continue to excel under semesters and those areas where the program is doing poorly under quarters and will continue to do poorly with semesters. Those areas where excellence is maintained are:

- Small class sizes (4.78)
- Meet ABET accreditation requirements (4.70)
- Practical curriculum that prepares students and appeals to industry (4.50), (4.00)
- Maintain Learn By Doing (4.3), (4.33)
- Focus on the undergraduate (4.5)
- Heavy focus on structural engineering of buildings (4.67), (4.28)

Conversely, those areas where the program performs poorly and will continue to do so under semesters are:

- Address adaptive reuse, forensic analysis, sustainability of preservation of structures in the design labs (1.71)
- Grow program and produce more graduates (1.71)
- Expand graduate programs and integrate with CAED disciplines (2.00)
- Take advantage of resource sharing (2.14)

The results showed that the new curriculum did a great job of preserving the best of the old curriculum. Students will still be getting a top-notch structural engineer education that will be attractive to the hiring industry. Access for transfer students improved marginally and students will be well prepared for graduate school. ARCE students in the future will have a few more elective choices in the curriculum. On the flip side, the new curriculum is less interdisciplinary and students will be less prepared to take the FE exam because they will take fewer courses that comprise the exam.

The new proposal is 131 semester units which is right in line with the current 196 quarter unit curriculum. We may be asked to reduce units during the review process, but for the first iteration, the strategy was to ask for everything we needed. We can always reduce later, but anything we give up, we will never get back.

The faculty also revised the support course programs for ARCH and CM students in collaboration with those departments, revised the ARCE minor, and converted the master's program to semesters. Those are beyond the scope of this paper.

The Path Ahead

With the submission of the draft curriculum plan, one might suggest that the real work is just beginning. The approval process will be extensive as both the college curriculum committee and the Academic Senate through the Academic Senate Curriculum Committee, General Education Governance Board, and United States Cultural Pluralism Review Committee will approve or request revisions to each program. An entirely new catalog needs to be created where every course (4,320 courses currently exist) has to be proposed, documented and approved. Finally, articulation agreements for the new course need to be negotiated with the 116 community colleges in California for transfer students.

While this cumbersome, iterative process is overwhelming, most of the big picture creative thinking for individual programs was completed with the draft submission of the program curriculum. The overall structure, the cost, the modes of instruction and the relationships with other departments will be fixed and very hard to change. The detailed thinking will take place when the course objectives and specific content is decided for each of these courses. Individual faculty members will be assigned and compensated for developing individual courses, but

significant faculty coordination and collaboration will be needed to ensure continuity and coverage.

When the semester system starts in Fall 2026, the first-year students will complete their degrees entirely on the semester system. Those classes which entered in the Fall of 2023, 2024 and 2025 will experience part of their academic careers under a mixture of quarters and semesters. There will need to be a transition program for each of these classes. With a commitment to not delay any student's path to graduation and the implementation of well-crafted course substitutions that always favor the student, this can be achieved with minimum rancor. The good news is that the problem only lasts for three years and simply needs to be endured.

Conclusions and Recommendations

This paper presents a general methodology for an engineering program to switch from quarters to semesters where no previous methodology has been documented. The Cal Poly Architectural Engineering program was used as an example. The details of specific course changes were minimized except to illustrate the various challenges and pitfalls that can occur. Overall, the methodology worked and will hopefully be helpful to any engineering program that has to make the same transition……especially if the time between initial announcement and submission of a new program is only 16 months.

The following lessons learned and recommendations are summarized:

- Making assumptions for unknown information can facilitate an early start to a process where little time is allotted to develop a new curriculum. Using past practice tends to provide realistic assumptions. Even if the assumptions are all wrong, the program is still better off than if it had stood idle.
- It is important that every voice get heard and minority opinions not be marginalized. It can result in some inefficiencies but results in more buy-in from faculty and enhanced team effort.
- Conversely, for retreats and meetings where decisions are expected to be made, the rules need to be expressed in advance, rigidly enforced during the meeting, and used to keep the discussion on track in a disciplined manner. Everyone will appreciate it once a decision is actually reached.
- The Q2S conversion is a parallel process where initial department planning, consultation with other departments, and updating information from the university all proceed simultaneously.
- Early review of the literature, consultation with others that have completed the same process, and the development of guiding principles is very beneficial…..but don't spend too much time doing it. Consolidate and prioritize the guiding principles to create fewer. We had too many and it was difficult to identify what was really important.

- This paper did not distinguish between work done by a department Curriculum Committee (or Semester Conversion Committee) and that done by the faculty at large. In our specific case, the department was terribly short-handed. Such a committee would have had around six members and we only had eight faculty available to do the work. We decided early to make the entire faculty the Curriculum Committee. In a larger or more healthily-staffed department, much of the preparation effort should done by a sub-committee with frequent updates and consultation with the entire faculty.
- While the example program illustrated herein only made evolutionary changes to an existing curriculum that most of the faculty supported, a program should not shy away from making revolutionary changes and totally revising a curriculum if it is needed. A conversion from quarters to semesters really is a once-in-a-generation opportunity to make big wholistic changes to a curriculum, even though most don't.

References

[1] Fleisher, Chris. Quarters vs. semesters: How does switching to a different academic calendar impact students? American Economic Association, February 21, 2022. https://www.aeaweb.org/research/college-semesters-quarters-graduation (accessed 3 February 2023).

[2] State of California Assembly Bill, AB-928 Student Transfer Achievement Reform Act of 2021: Associate Degree for Transfer Intersegmental Implementation Committee. California Legislative Information. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB928 (accessed 10 February 2023).

[3] Academic Senate Resolution AS-946-22: Academic Senate Ad Hoc Quarter to Semester Committee Procedures for Curricular and Program Proposal Review, 2022-26. Adopted: May 31, 2022. California Polytechnic State University https://content-calpoly-edu.s3.amazonaws.com/academicsenate/1/images/AS-946-22_0.pdf (accessed 4 February 2023).

[4] Bostwick, V., Fischer, S. and Lang, M. Semesters or Quarters? The Effect of the Academic Calendar on Postsecondary Student Outcomes. American Economic Journal: Economic Policy 14(1):40-80, February 2022.

[5] Johnson, M.L. and Kestler,J.L. Transitioning from Quarters to Semesters: Changes in College Students' Predicted and Perceived Motivation. December 2014, College and University Journal.

[6] Eastman, M., & Walker, F. (2011, June), Ensuring Curriculum Integrity for Engineering Technology 2011 ASEE Annual Conference & Exposition, Vancouver, BC.

[7] Sitaram, P. and Sala, A.L. On the Restructuring of the Undergraduate Mechanical Engineering Curriculum for Quarter to Semester Conversion. 2018 ASEE Annual Conference & Exposition, Salt Lake City, Paper #22327.

[8] Mondragon-Torres, A.F. and Christman, J.W., Embedded Systems Design Curriculum Conversion from Quarters to Semesters, 2013 IEEE Frontiers in Education Conference (FIE), Oklahoma City, OK, USA, 2013, pp. 311-313.

[9] Abrams, L., Altschuld, J., Lilly, B. Lilly, and Mendelsohn, D.A., Introduction to Mechanical Engineering: A Course in Progress, 2012 ASEE Annual Conference & Exposition, June 2012.

[10] Academic Senate Resolution AS-942-22 Resolution to Establish Semester Terms Adopted: May 17, 2022. California Polytechnic State University https://content-calpoly-edu.s3.amazonaws.com/academicsenate/1/images/AS-942-22_0.pdf (accessed 4 February 2023).

[11] Academic Senate Resolution AS-944-22 Resolution on Units of Credit and Time Patterns on Semester Terms. Adopted: May 24, 2022. California Polytechnic State University https://content-calpoly-edu.s3.amazonaws.com/academicsenate/1/images/AS-944-22_0.pdf (accessed 4 February 2023).
[12] Academic Senate ad hoc Quarter to Semester Conversion Committee. Memorandum: Recommendations for Strengthening the Teacher-Scholar Model at Cal Poly. May 31, 2022. California Polytechnic State University. https://content-calpoly-edu.s3.amazonaws.com/academicsenate/1/images/Teacher-Scholar%20Memo.pdf (accessed 9 February 2023).

Appendix A: ARCE Transition to Semesters Short Term Plan

Fall 2021

- Decision to switch is announced
- Review mission, vision, core values, program objectives, student outcomes
- Develop guiding principles with input from students, faculty, advisory board, college
- Contact those programs who recently converted to semester (Cal Poly Pomona CE, MSOE ARCE)
- Create six independent teams to develop strawman curriculums

Winter 2022

- Teams report progress during faculty meetings
- Wine and cheese during finals week to consolidate team reports, identify good ideas, define what we want to do

Spring 2022

- Using input from faculty and teams, develop a trial curriculum
- Coordinate with MA, PHY, CE, ME, CSC, ARCH and CM to communicate our needs and learn what they are planning
- End of year mini-retreat – revise draft curriculum based on input and identify remaining issues

Summer 2022

- Meet with other departments
- Develop a trial curriculum based on input

Fall 2022

- Approve a draft semester curriculum at Fall retreat
- Brief CAED and get preliminary approval
- Negotiate with other departments
- Make changes as necessary.

Winter 2023

- Seek university approval on proposed curriculum
- Assign course responsibilities and assigned time
- Begin course documentation

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B.S. in Architectural Engineering

Suggested 4-Year Academic Flowchart

2022-2026 Catalog

Updated 3/13/2022

FRESHMAN			SOPHOMORE			JUNIOR			SENIOR		
Fall	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**	**Fall**	**Winter**	**Spring**
Introduction to Building Systems **ARCE 106 (2)**			*Structures I* **ARCE 211 (3)** PHYS 141; MATH 142	*Structures II* **ARCE 212 (3)** (ARCE 211 w/min C-)	*Structures III* **ARCE 227 (2)** (ARCE 212 w/min C-)	*Structural Analysis* **ARCE 302 (3)** (ARCE 223; 227 w/min C-. Concur: ARCE 352)	*Matrix Analysis of Structures* **ARCE 306 (3)** (ARCE 302 w/min C-. Concur: ARCE 353)	*Dynamics of Framed Structures* **ARCE 412 (3)** (ME 212; MATH 244; ARCE 306 w/min C-. Concur: ARCE 354)	*Seismic Analysis and Design* **ARCE 483 (3)** (ARCE 372; 412 w/min C-)	*Concrete Structures Design...* **ARCE 452 (3)** (ARCE 257; 444; 372 or 451 w/min C-)	
Design & Visual Communication 1.1 **ARCH 131 (4)**	*Design & Visual Communication 1.2* **ARCH 132 (4)** (ARCH 131)	*Design & Visual Communication 1.3* **ARCH 133 (4)** (ARCH 132)	*Fundamentals of Construction Management* **CM 115 (6)** (ARCE 106 or CM 113; MATH 141; PHYS 141)	*Engineering Dynamics* **ME 212 (3)** (MATH 241; ME 211 or ARCE 211)	*Mechanics of Structural Members* **ARCE 223 (3)** (ARCE 212 w/min C-. Concur: ARCE 224)	*Structural Computing Analysis* **ARCE 352 (1)** (CSC 231 or 234. Concur: ARCE 302)	*Matrix Structural Computing Analysis* **ARCE 353 (1)** (ARCE 352 w/min C-. Concur: ARCE 306)	*Numerical Analysis Laboratory* **ARCE 354 (1)** (MATH 244; ARCE 353 w/min C-. Concur: ARCE 412)	*Reinforced Concrete Design* **ARCE 444 (4)** (ARCE 371; ARCE 302 w/min C-)	*Interdisciplinary Capstone Project* **ARCE 415 (4)** (Senior Standing; Instructor Consent)	*Introduction to Engineering Surveying* **BRAE 237 (2)** (MATH 119)
Calculus I **MATH 141 (4)[1]** * [B4]	*Calculus II* **MATH 142 (4)[1]** (MATH 141 w/min C- or Instr. Consent) [B4]	*Calculus III* **MATH 143 (4)[1]** (MATH 142 w/min C- or Instr. Consent) [Area B Elective]	*Calculus IV* **MATH 241 (4)** (MATH 143)	*Structural CAD for Building Design* **ARCE 257 (2)** (CM 115)	*Mechanics of Structural Members Lab* **ARCE 224 (1)** (Concur: ARCE 223)	*Structural Systems Lab* **ARCE 371 (3)** (ARCE 223; ARCE 227 w/min C-; 3rd year standing)	*Steel Design I* **ARCE 303 (3)** (ARCE 223 w/min C-. Coreq: ARCE 371)	*Steel Structures Design Laboratory* **ARCE 372 (3)** (ARCE 257; 302; 303; 352; 371 w/min C-)	*ARCE Building Systems* **ARCE 476 (3)** (Sr Standing)	**Statistics STAT 312 (4)[1]** * OR **STAT 321 (4)[1]** * [Upper-Division B]	
	General Physics I **PHYS 141 (4)[1]** (MATH 141 w/min C-. Coreq: MATH 142 or 182) [Area B Elective]	*General Physics II* **PHYS 142 (4)** (PHYS 141; MATH 142 or 182)		*Programming for Engineering Students* **CSC 231 (2)** (MATH 142; PHYS 121, 131, or 141)	*Gen Chem for Phys Sci & Engineering I* **CHEM 124 (4)[1]** * [B1 & B3]	*Soil Mechanics* **ARCE 421 (3)** (ARCE 212 w/min C-; Recom: GEOL 201)	*Foundation Design* **ARCE 422 (3)** (ARCE 421 w/min C-)	*Timber Design* **ARCE 304 (3)** (ARCE 371 w/min C-)	*Timber & Masonry Structures...* **ARCE 451 (3)** (ARCE 257; 304; 305; 371 w/min C-)	*Fluid Mechanics I* **ME 341 (3)** (MATH 242 or 244; ME 212)	
				Linear Analysis I **MATH 244 (4)** (MATH 143)	*Physical Geology* **GEOL 201 (3)** (MATH 119)	*General Physics III* **PHYS 143 (4)** (PHYS 141; MATH 142. Recom: MATH 241)	*Electric Circuit Theory* **EE 201 (3)** (MATH 244; PHYS 143)	*Masonry Design* **ARCE 305 (2)** (ARCE 371 w/min C-)	*Eval of Cost Alt* **CM 232 (3)** (MATH 142 or 182) OR *Engineering Econ* **IME 314 (3)** (MATH 241)		
Oral Communication **COMS 101/102 (4)**** [A1] Can be taken anytime during Freshman Year											
Expository Writing **ENGL 133/134 (4)**** [A2] Can be taken anytime during Freshman Year			**History of World Architecture or Structures ARCH 217 or 218 or 219 or ARCE 260 (4)[1]** [C1]					*Thermodynamics I* **ME 302 (3)** (ME 212 and PHYS 142)			**GE (4) ******
	Reasoning, Argumentation, & Writing [A3] **COMS 126, 145, ENGL 145, 147, ES 145, PHIL 126, or WGQS 145 (4)**** (Completion of GE A2 with a C- or better) Can be taken anytime between Winter of Freshman and Winter of Sophomore Years.					**GE (4) ******	**GE (4) ******			**GE (4) ******	**GE (4) ******
			GE (4) ****			**Graduation Writing Requirement GWR*** (Students can attempt to fulfill the requirement after 80 earned units; students should complete the requirement before senior year)					
			GE (4) ****								
14	16	16	17	18	17	18	17	15	16	18	14
										TOTAL:	196

Notes:

MOST GENERAL EDUCATION COURSES CAN BE TAKEN IN ANY ORDER AS LONG AS PREREQUISITES ARE MET

* Refer to current catalog for prerequisites.

**One course from each of the following GE areas must be completed: A1, A2, A3, B2, C2, Lower-Division C Elective, Upper-Division C, D1, Area D Elective, Lower-Division E, and F. Upper-Division C should be taken only after Junior standing is reached (90 units).

Refer to online catalog for GE course selection, USCP and Graduation Writing Requirement (GWR).

USCP requirement can be satisfied by some (but not all) courses within GE categories: Upper-Division C, D1, D2, or E.

Quarterly advisor meetings are required prior to registration.

A corequisite course can be taken previously or concurrently. Concurrent courses must be taken together.

All ARCE Majors must receive a C- or better in ARCE Courses that are prerequisites for other ARCE courses.

[1] Required in Major or Support; also satisfies General Education (GE) requirement.

Legend:

Course Title
Course # (Units)
(Prerequisite)
[GE Area]

Major (71)
Support (81)
General Ed. (44)

Appendix B: Existing ARCE Quarter Curriculum Flow Chart

Architectural Engineering

1st Year		2nd Year		3rd Year		4th Year	
ARCE 1106 - Intro to Bldg Systems **1 lecture, 1 activity** **Prereq: None** Replaces ARCE 106 *+0.67 Units*	**ARCE 2211- Structural Principles I** **3 lecture** **Prereq: Physics, No Calculus** Replaces ARCE 211 & 212 ARCE, ARCH & CM Students *-1.00 Units*	**ARCE 2223-Structural Principles II** **3 lecture** **Prereq: ARCE 2211** Replaces ARCE 223 & 227 *-0.33 Units*	**ARCE 3371 - Structural Systems** **2 lab** **Prereq: ARCE 2223** Replaces ARCE 371 +0.00 Units	**ARCE 3302 - Structural Analysis I** **3 lecture** **Prereq: ARCE 2223, CSC** Replaces ARCE 302, 306 part +0.00 Units	**ARCE 4412-Structural Analysis II** **3 lecture** **Prereq: ARCE 3302** Replaces ARCE 306 part and 412 +0.00 Units	**ARCE 4483 - Seismic Design** **2 lecture, 1 lab** **Prereq: ARCE 4412, 4372?** Replaces ARCE 483 *+1.00 Unit*	**ARCE 4476 - Arch Engr Bldg Sys** **2 lecture** **Prereq: PHYS II?** Replaces ARCE 476 Cross List with CE 475? +0.00 Units
PHYS I **3 lecture, 1 lab** **Prereq: ??** **Coreq: Calc I** Replaces PHYS 141 & part 132 +0.00 Units	**PHYS II** **3 lecture, 1 lab** **Prereq: PHYS 1?** Replaces PHYS 133 and part 132 +0.00 Units	**ARCE 2224-Struc Principles II Lab** **1 lab** **Coreq: ARCE 2223** Replaces ARCE 224 *+ 0.33 Units*	**ARCE 2257 - Structural Drawings** **1 lecture, 1 lab** **Prereq: ARCE 1106** Replaces ARCE 257 *+ 0.67 Units*	**ARCE 3352- Structural Analysis I Lab** **1 lab** **Coreq: ARCE 3302** Replaces ARCE 352 and 353 part +0.00 Units	**ARCE 3353 - Structural Analysis II Lab** **1 lab** **Coreq: ARCE 3412** Replaces ARCE 353 part and 354 +0.00 Units	**ARCE 4444 - Concrete & Masonry** **3 lecture, 1 lab** **Prereq: ARCE 2223 & 3371** Replaces ARCE 305 & 444 +0.00 Units	**ARCE 4452 Concrete & Masonry Capstone Lab** **2 lab** **Prereq: ARCE 1257 & 3444** Replaces ARCE 452 +0.00 Units
MATH - CALC I **4 lecture** **Prereq: ??** **GE Mathematical Concepts** Replaces Math 141 & part 142 +0.00 Units GE1	**MATH - CALC II** **4 lecture** **Prereq: Calc I** Replaces Math 143 & part 142 +0.00 Units	**MATH - CALC III** **3 lecture** **Prereq: Calc II** Replaces Math 241 *+0.33 Units*	**MATH - LINEAR ANALYSIS** **4 lecture** **Prereq: Calc II** Replaces Math 244 *+0.33 Units*	**ARCE 3304-Timber** **2 lecture** **Prereq: ARCE 2223 & 3371** Replaces ARCE 304 +0.00 Units	**ARCE 4451 - Timber Lab** **2 lab** **Prereq: ARCE 1257 & 3304** Replaces ARCE 451 +0.00 Units	**ARCE 4372 - Steel Lab** **2 lab** **Prereq: ARCE 1257 & 3303** Replaces ARCE 372 +0.00 Units	**ARCE Technical Elective** **3 Units** Replaces ARCE 415/453 Course list to be developed by ARCE faculty to include ARCE 415/453.
Architectural Design **4 units TBD** **Prereq: None** ARCE & ARCH Students +0.00 Units	**GE - Oral Communication** **3 lecture** GE2	**CSC** **2 units TBD** Replaces CSC 231 *+0.67 Units*	**ARCH 2217/8/9 or ARCE 2260 - Arch History** **3 lecture** **Prereq: ??** **GE - Arts and Humanities** Replaces ARCH 217/8/9 or ARCE 260 *+0.33 Units* GE7	**ARCE 3421 - Soils & Foundations** **3 lecture, 1 lab** **Prereq: ARCE 2211** Replaces ARCE 421 & 422 +0.00 units	**ARCE 3303 - Steel** **2 lecture** **Prereq: ARCE 2223 & 3371** Replaces ARCE 303 +0.00 Units	**FE Engineering Course** **3 Units** Replaces EE 201, ME 302, ME 341, CM 232, BRAE 237. Course list to be developed by ARCE faculty to include ME, EE, CM, IME, BRAE, etc. +0.00 units	**FE Engineering Course** **3 Units** Replaces EE 201, ME 302, ME 341, CM 232, BRAE 237. Course list to be developed by ARCE faculty to include ME, EE, CM, IME, BRAE, etc. +0.00 units
GE - English Composition **3 lecture** GE3	**GE - Critical Thinking** **3 lecture** GE4	**CM 1115 - Construction Management Fundamentals?** **1 activity, 2 lab** **Prereq: ARCE 1106** Replaces CM 115 ARCE & CM Students +0.00 Units	**GE - Social & Behavior Science** **3 lecture** GE8	**Architectural Design for ARCE** **4 units TBD** ARCE Students Only +0.00 Units	**CHEM ?? - Chemistry** **2 Lecture, 1 Lab?** **Prereq: ??** **GE - Physical Science** Replaces CHEM 124 *+0.33 Units* GE11	**STAT ?? - Statistics & Probability** **3 lecture** **Prereq: ??** **GE Upper Division B** Replaces STAT 312 or 321 *+0.33 Units* UD-GE1	**GE Area Upper Division C** **3 lecture** UD-GE3
		GE - Biological Science **3 lecture** GE5	**GE - Ethnic Studies** **3 lecture** GE9	**GE - Arts & Humanities** **3 lecture** GE10	**FE Engineering Course** **3 Units** Replaces EE 201, ME 302, ME 341, CM 232, BRAE 237. Course list to be developed by ARCE faculty to include ME, EE, CM, IME, BRAE, etc. *-0.33 units*		
		GE - Social & Behavior Science **3 lecture** GE6			**GE Area Upper Division D** **3 lecture** **Prereq: ??** UD-GE2		
17 UNITS	**17 UNITS**	**18 UNITS**	**17 UNITS**	**17 UNITS**	**17 UNITS**	**15 UNITS**	**13 UNITS**

1/26/23

131 TOTAL UNITS

Appendix C: Proposed ARCE Semester Curriculum Flow Chart

Appendix D: Assessment of Curriculum based on Guiding Principles

Rubric

5 = Fully meets guiding principle

4 = Most meets guiding principle

3 = Partially meets guiding principle

2 = Minimally meets guiding principle

1 = Does not meet guiding principle

Faculty Guiding Principles	Quarter	Semester	Delta
• Maintain our brand	4.50	3.70	-0.80
• Maintain the same pace and variety of courses	4.11	3.05	-1.06
• Create some electives (the current program has none)	1.43	3.22	1.79
• Meet the structural engineering needs of the Architecture and CM students	3.33	2.88	-0.46
• Teach structure as systems	4.22	4.17	-0.06
• Prepare students for graduate school	4.00	3.67	-0.33
• Maintain hands-on portion of curriculum (design, computer, experimental labs)	4.22	4.05	-0.17
• Use latest Commercial Software and design codes	4.40	4.40	0.00
• Communicate visually	3.67	3.50	-0.17
• Meets past practice of class sizes (35 for lecture, 24 for activity, 16 for lab)	4.78	4.67	-0.11
• More flexibility in pre-requisites	2.25	2.78	0.53
• Maintain current mix of theory versus practice and analysis versus design	4.22	4.10	-0.12
• Meet ABET accreditation requirements	4.70	4.70	0.00
• Master the basics: mechanics and load flow	3.80	3.60	-0.20
• Increase/improve interdisciplinary collaboration	3.00	2.39	-0.61
• Do no harm	3.83	2.75	-1.08
• Targeted interventions to improve weak areas of the curriculum	3.17	2.63	-0.54
• No increase in faculty teaching workload	3.33	2.75	-0.58
CAED Guiding Principles	**Quarter**	**Semester**	**Delta**
• Promote Inter-disciplinary (or cross-, multi-, intra-, co-, etc.) educational opportunities	2.80	2.30	-0.50
• Improve the ease of Change of Major within and into the college	2.75	2.78	0.03
• Improve ease of transfer into CAED programs from community colleges or 4-year institutions	2.14	2.63	0.48
• Expand graduate programs and integrate them into educational pathways within the CAED, between colleges and in communities.	2.00	1.88	-0.13

• Incorporate the Curricular Goals of the CAED Diversity Plan: Broaden Disciplinary Perspectives, Advance the DEI Teacher-Scholar, and Embrace Inclusive Teaching	**2.38**	**2.50**	**0.13**
• Sustain the curricular variety and intensity that is a hallmark of our existing quarter system	**4.20**	**3.00**	**-1.20**
• Leverage CAED resources more effectively, managing implications of curricular change and calendar change; take advantage of resource sharing	**2.14**	**2.00**	**-0.14**
• Increase the CAED's contributions to general education at Cal Poly	**2.67**	**2.43**	**-0.24**
ARCE Advisory Board Guiding Principles	**Quarter**	**Semester**	**Delta**
• Focus curriculum on subject matter most practical for graduates to use on the job in first few years.	**4.50**	**4.20**	**-0.30**
• Maintain "learn by doing" philosophy.	**4.30**	**4.10**	**-0.20**
• Enhance interdisciplinary focus with Architecture and CM.	**3.11**	**2.25**	**-0.86**
• Maintain focus on the undergraduate degree	**4.50**	**4.56**	**0.06**
• Industry trend towards sustainability and Resiliency should be integrated into the curriculum.	**2.14**	**2.13**	**-0.02**
• Preserve and enhance the "crown jewels" -- the upper division design labs	**4.67**	**4.25**	**-0.42**
• Infuse more complexity and detail into the courses and teach problem solving	**2.50**	**2.67**	**0.17**
• Bring back electives that were lost to unit reduction.	**1.50**	**3.11**	**1.61**
• Enhance Interdisciplinary nature of curriculum; the awareness of other roles and disciplines in real world projects.	**2.75**	**2.33**	**-0.42**
• Preserve pace of work that the quarter system mandated.	**4.11**	**3.40**	**-0.71**
• Include using digital tools as part of the project requirements.	**3.50**	**3.67**	**0.17**
• Take some of the extra time in the design labs to address adaptive reuse, forensic analysis, sustainability of preservation of structures	**1.71**	**1.75**	**0.04**
• Hands on learning.	**4.00**	**3.80**	**-0.20**
• Keep smaller class sizes, particularly in the upper division courses.	**4.88**	**4.89**	**0.01**
• Blend of theory and practice.	**4.13**	**4.22**	**0.10**
• Maintain the focus on structural engineering of buildings.	**4.67**	**4.56**	**-0.11**
• Preparation for FE/EIT.	**4.25**	**3.89**	**-0.36**
• Address how program can accommodate 2-year transfer students from other schools.	**2.06**	**2.61**	**0.55**
• Ability to communicate graphically.	**3.50**	**3.56**	**0.06**
• Grow the program and produce more graduates.	**1.71**	**1.78**	**0.06**

• Increase diversity of student population.	**2.57**	**2.38**	**-0.20**
• Maintain the pace of a quarter system curriculum.	**4.33**	**3.10**	**-1.23**
ARCE Student Guiding Principles	**Quarter**	**Semester**	**Delta**
• CAD/Revit-based studio class or just 1 semester of architecture studio using Rhino	**3.00**	**3.40**	**0.40**
• Spread out classes across all 4 years instead of cramming it into junior year	**3.00**	**3.71**	**0.71**
• Make a 4-year graduation more feasible	**3.25**	**3.11**	**-0.14**
• More ARCE classes in 1st and 2nd year to build a stronger connection to peers	**2.33**	**3.43**	**1.10**
• Changing course units to better align with the amount of work (i.e. ARCE 257)	**2.29**	**2.63**	**0.34**
• Along with creating new course numbers that make sense (clearly communicate), organize them such that it is obvious how one course applies to another (future/upper-level) course.	**2.20**	**3.00**	**0.80**
• Give students academic credit for internship opportunities or study abroad	**2.00**	**1.86**	**-0.14**
• Maintain "Learn by Doing"	**4.33**	**4.00**	**-0.33**
• There is little flexibility in the ARCE flowchart for exploration of other engineering courses or elective courses. Add more flexibility	**1.71**	**3.13**	**1.41**
• Focus more on industry applicability and interdisciplinary study	**3.33**	**2.70**	**-0.63**
• More room for flexibility to do courses outside of ARCE (i.e. free electives, professional electives, class options)	**1.43**	**3.13**	**1.70**
• Ensuring class time isn't wasted in courses so the students can have ample opportunity to understand material and get sleep (please, more sleep)	**2.33**	**2.29**	**-0.05**
• Ensuring collaboration, hands-on, and real-world curriculum	**4.00**	**3.70**	**-0.30**
• Prepare students for work as a structural engineer with practical applications of ARCE courses	**4.28**	**4.25**	**-0.03**
• Having an education and courses that are attractive to industry hiring managers	**4.22**	**3.90**	**-0.32**
• Prepare students for the FE	**4.13**	**4.00**	**-0.13**
• Consider how changes will this effect student workloads -- ease the workload	**2.33**	**2.29**	**-0.05**