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SCHOOL OF ENGINEERING
MARK MATSUMOTO, DEAN

University of California, Merced
5200 N. Lake Road | Merced, CA 95343
PHONE: 209-228-4411
FAX: 209-228-4047

TO: Jay Sharping, Chair
Undergraduate Council

FROM: Mark Matsumoto
Dean of Engineering

SUBJECT: Civil Engineering (CE) Bachelor of Science (B.S.) Degree Program Proposal

DATE: April 17, 2019

CC: Professor Tom Harmon

I am pleased to offer my endorsement for the proposed undergraduate program in Civil Engineering (CE), which is to be administered by the Department of Civil and Environmental Engineering (CEE) within the School of Engineering (SoE). The CEE faculty consists of 13.5 faculty members (one member has a split appointment with Physics).

The proposed CE major will complement Environmental Engineering (ENVE) major but seek broader coverage than the ENVE major. The proposed CE major will encompass hydrology and water resources; water and air quality; geomatics (remote sensing and geospatial analysis); and sustainable buildings, infrastructure and energy. In addition, a new sustainable systems area will be integrated across the four areas to reinforce the sustainability theme of the major.

The Executive Committee of the School of Engineering reviewed the Civil Engineering B.S. degree and met to discuss and vote on the proposal on February 25, 2019. This degree program would a new major for students at UC Merced to pursue, a major that many prospective students seek, but one that we do not offer. We also hope that by offering this major that there will be a better distribution of enrollment of the SoE majors. Discussion within the Executive Committee was highly supportive, particularly since the proposed CE program focus on sustainability resonates with the School and campus identitify

The vote by the SoE Executive Committee to approve was unanimous with one recusal by the CEE representative.

The School is committed to providing the CE program with support at the same level of support currently offered to the other SoE undergraduate majors.

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SCHOOL OF ENGINEERING

University of California, Merced
5200 N. Lake Road
Merced, CA 95343

TO: Undergraduate Council

FROM: Catherine Keske, Executive Committee Chair, School of Engineering

SUBJECT: Civil Engineering Bachelor of Science Degree Program Proposal

DATE: July 8, 2019

The School of Engineering Executive Committee reviewed the Civil Engineering Bachelor of Science program proposal at their February 25, 2019 meeting.

The Committee expressed excitement for the new major, and noted that it would be good for other Departments to write letters of support to include with the proposal. It was also noted that it would be beneficial to articulate how heavy flow majors such as CSE can have a transfer pathway into the CEE major. With the noted suggestions, the vote by the School of Engineering Executive Committee to approve was unanimous with one recusal by the CEE representative.

In summary, the School of Engineering Executive Committee endorses the proposal of the Civil Engineering Bachelor of Science Degree Program.

CC: Fatima Paul, Associate Director, Academic Senate Office
SOE Personnel Services

B.S. Civil Engineering major proposal

Thomas Harmon <tharmon@ucmerced.edu>
to Jian-Qiao, Christopher, Stefano, Ariel, Paul

Wed, Feb 27, 4:26 PM

Dear Colleagues,

I am asking for your enthusiastic support of the new civil engineering proposal (attached). As you know, it may grow quickly and there are likely to be some growing pains associated with fundamental engineering courses, adequate sections of math and physics, and maybe some other issues. It is hard to know exactly.

We look forward to working with you on offerings that can help all of our programs.

Please let me know if you have any questions, and whether you support our proposal.

Many thanks,
Tom

PDF UCM BS Civil Engin...

16

Paul Maglio
to Thomas

Mar 13, 2019, 6:18 AM

Tom,

The MCS faculty unanimously endorse the Civil Engineering BS proposal.

Nevertheless, the faculty suggest you demonstrate a pathway for students to fulfill MAD Minor requirements, as the MAD Minor is the only minor program offered in the School of Engineering. The MAD Minor combines social science and engineering to create hands-on, practical experiences with data-driven analytics, professional communication, and entrepreneurship to help students acquire knowledge for managing complex systems. Minor requirements may be fulfilled through General Education and technical elective courses. Specifically, the MAD Minor requires one lower division General Education course, MIST 50 "Introduction to Entrepreneurship", three core MIST courses that fulfill GE or technical elective requirements, and one elective course (which may be fulfilled by ENVE 155 or ENGR 180). We believe small changes to the framing of GE and technical elective requirements in the proposed major will allow students to complete this minor program in a four-year program of study.

Stefano Carpin
to Thomas

Wed, Mar 6, 5:37 PM

Tom:

during today's department meting the CSE faculty discussed the proposal to establish a BS in civil engineering and expressed unanimous support for it.

Best regards,

•••

Jian-Qiao Sun Mon, Mar 11, 8:30 AM

to Thomas

Tom, 8 out of 11 ME faculty voted to support your proposed CE program. 3 others did not vote.
Hence, you have ME's support. All the best, Jian

==========

Jian-Qiao Sun
Professor and Chair, Ph.D., P.E., ASME Fellow
Editor-in-Chief, IJDC
School of Engineering
University of California, Merced
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Web: http://faculty.ucmerced.edu/jqsun https://ucmeri.ucmerced.edu/ http://agtech.ucmerced.edu
Journal: http://www.springer.com/materials/mechanics/journal/40435

•••

Ariel Escobar Wed, Mar 13, 12:04 PM

to Thomas

Dear Tom, I highly support the civil engineering program.
Good luck!!
Ariel

ARIEL L ESCOBAR, PhD
Professor and Chair
Dept. of Bioengineering
School of Engineering
UNIVERSITY OF CALIFORNIA, MERCED
off 209-228-4618
Bldg. S&E1. Rm. 340.
5200 North Lake Road, Merced, CA 95343

Christopher Viney Tue, Apr 2, 12:33 PM (2 days ago)

to Thomas

Dear Tom

I am pleased to confirm that, on 1 March 2019, a quorum of MSE faculty voted to warmly support your proposal for establishing a Civil Engineering degree program at UC Merced. The topic was also discussed at our 15 March meeting, at which the support of faculty who had been absent on 1 March was also noted.

Best wishes for a successful launch!

--Christopher

CHRISTOPHER VINEY
MA, PhD, FASM, CPhys, FInstP, CSci, CChem, FRSC

PROFESSOR OF ENGINEERING; FOUNDING FACULTY;
CHAIR, MATERIALS SCIENCE & ENGINEERING

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BUILDING THE FUTURE IN THE HEART OF CALIFORNIA

B.S. Civil Engineering degree program

Inbox ×

Thomas Harmon <tharmon@ucmerced.edu>
to Ajay, François, Anne

Tue, Apr 2, 4:17 PM (2 days ago)

Dear Ajay, Francois and Anne:

I am writing to ask for you department's support of our proposal for a new engineering degree. We are hoping to accept new students for Fall 2020 (basically a year from now). According to the UGC Chair (Jay Sharping), an email letter of support is fine.

Our market research has led us to believe that this program will attract perhaps 3x more students than the environmental engineering degree. But we really don't know. We're estimating about 300 majors in civil, to go with the 100 in environmental.

This will amount to the need for an additional 3 sections in all the usual math, physics, and chemistry courses that civil majors need, as I'm sure you know.

I've attached the latest proposal, and am happy to answer any questions you may have about this.

thanks for taking a look, and best regards,
Tom

PDF UCM BS Civil Engin...

Anne Kelley
to Thomas

Tue, Apr 2, 8:11 PM (2 days ago)

Tom,

I am happy to support this proposal for a B.S. in Civil Engineering. I think that offering this degree makes a great deal of sense and it should be fairly popular among our undergraduates. 300 new majors (75 per year) will, as you note, require up to three additional lab/discussion sections of CHEM 2 (fewer to the extent that these new CE majors come from other majors that would also have taken CHEM 2). We should be able to accommodate that within already planned growth.

I wish you the best in getting this program off the ground and I hope that it will help us attract highly qualified students to UC Merced.

Anne

Francois Blanchette
to Ajay, Thomas, Anne

Apr 3, 2019, 9:40 AM (1 day ago)

Hi Tom,

That looks fine to me, though I do have one question. When you say you anticipate about 300 students in the fully formed major, do you have a sense of where those students would be drawn from? Do you think these students would be students who would otherwise not have been admitted at UCM and will add to our total number of students, of would they replace students who would otherwise have gone into other majors?

Adding 300 students is a big deal, and will require additional resources. Moving 300 students from one major to another is not nearly as onerous.

Thanks,
Francois

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SCHOOL OF ENGINEERING

University of California, Merced
5200 N. Lake Road | Merced, CA 95343
PHONE: 209-228-4411
FAX: 209-228-4047

To: Undergraduate Council

From: Erin Hestir, Curriculum Committee, Department of Civil & Environmental Engineering

SUBJECT: Civil Engineering Bachelor of Science Degree Program Proposal

DATE: October 8, 2019

Attached is a revised proposal for the Civil Engineering Bachelor of Science Degree Program. The original proposal has been revised to address the UGC comments received by Thomas Harmon in July and August 2019. Please note the revised proposal continue to follow the ABET format to enable alignment with program assessment, accreditation, and external review.

In order to ensure UGC that all necessary proposal content is covered, and that all of the comments have been addressed, the following two documents are also enclosed:

- **Appendix 1** – Follows the UGC Format for Proposals for New or Substantive Change to Undergraduate Degree Programs. This document maps the content in the ABET-formatted Civil Engineering proposal document to the UGC-format to enable ease of reference for reviewing committees.
- **Appendix 2** – Contains a point-by-point response to UG's comments, including a brief summary of revisions made to address UGC concerns.

cc:

Abbas Ghassemi
Thomas Peterson
Thomas Harmon
Mark Matsumoto
SoE Personnel Services

Attachment:

Civil Engineering BS Degree Program Proposal

PROPOSAL FOR AN UNDERGRADUATE PROGRAM LEADING TO A

Bachelor of Science (B.S.) Degree in

Civil Engineering

Submitted by
Thomas C. Harmon, Professor & Chair
Department of Civil & Environmental Engineering

UGC Version: April 4, 2019
Revised: October 8, 2019

PROPOSED MAJOR IN CIVIL ENGINEERING

1. OVERVIEW

The School of Engineering (SoE) proposes to establish a new Bachelor of Science (B.S.) degree program in *Civil Engineering*. Assuming degree approval by July 1, 2019, the major will accept first-year students for enrollment in Fall 2019 and transfer students for Fall 2021.

1.1 Curriculum Overview

The proposed B.S. Civil Engineering (CE) major curriculum will include new courses with the CE subject prefix and preexisting courses with other prefixes (mainly ENVE for Environmental Engineering, ENGR for general engineering). The major will follow the same pattern as other engineering majors, with the first year covering fundamental sciences and math along with general education requirements. A new feature will be CE 001 Overview of Civil Engineering, which will introduce freshmen to the sub-discipline of Civil Engineering (and to the department faculty) and will help them understand how to start their professional development pathway. The second year will include a transition from basic math and sciences to fundamental engineering courses. This year will also include a cohort-building course CE 010 Civil Engineering Surveying and Computational Analysis, which will build skills in modern surveying techniques as well as graphical and computational analysis. During the third year the students will take a suite of civil engineering core courses that satisfy ABET accreditation criteria. The fourth year will encompass technical electives and a two-semester culminating design courses (Engineering Capstone). The catalog copy for the proposed Civil Engineering degree is summarized in section 3.

1.2 Curriculum Oversight and Administration

This degree program and the curriculum in this proposal was developed by an *ad hoc* Civil Engineering (CE) Program Committee.

Member	**Affiliation**
Thomas Harmon, Chair	Civil & Environmental Engineering
Marc Beutel	Civil & Environmental Engineering
Wolfgang Rogge	Civil & Environmental Engineering
Robert Rice	Civil & Environmental Engineering
Alejandro Gutierrez	Mechanical Engineering

While drafting the curriculum, we obtained external feedback on the proposal at several steps of the process from the academic colleagues and practitioners in civil engineering, listed below:

Extramural Reviewer	**Position**
Keith Stolzenbach, Ph.D., PE	Professor emeritus, Civil & Environmental Engineering, UCLA
Michael Deas, Ph.D., P.E.	Watercourse Engineering, Inc. Davis, CA
General R. Mark Toy, P.E.	Regional Commander, US Army Corps of Engineers
Dena Traina, P.E.	Principal Engineer, Provost & Pritchard Consulting Group

Once the program has been established, an interim CE Curriculum Committee (CC), consisting solely of UCM Academic Senate members, will approve and manage the Civil Engineering courses

(coordinating with the SoE and UCM Undergraduate Council). The inaugural CE CC is shown below.

Member	**Primary oversight**
Abbas Ghassemi, Chair	Service learning, capstone, sustainability
Marc Beutel	Environmental engineering elements
Josue Medellin-Azuara	Hydrology, resources and project management
Erin Hestir	Geomatics and computational analysis
Marie-Odile Fortier	Sustainability and systems engineering
Colleen Naughton	Sustainability, structures, systems engineering

The term of service for the inaugural CC will be two years and is renewable. Following the completion of the inaugural two years, CC members will be self- or peer-nominated and elected by simple majority vote of the CEE faculty. Nominations should balance needs for membership continuity and familiarizing all faculty with the curriculum.

2. JUSTIFICATION

Civil Engineering is considered the oldest of the engineering disciplines and is commonly associated with both the natural and manmade environment. Air and water quality improvements, urban renewal, planning and building whole new communities, providing water, power, and ground transportation systems are the responsibility of the civil engineering profession. Civil engineering involves the planning, design, construction, maintenance, and operation of the infrastructure that supports modern civilization; it is a keystone of our society.

Civil engineers are frequently listed among the top ten highest paying college majors,[1] with a median salary of $86,640 annually,[2] making this an attractive major choice for undergraduate students. In California, the median wage is even higher at $107,896.[3] The job outlook is also favorable: US civil engineering jobs are predicted by the Bureau of Labor Statistics to increase by 6% from 2018 to 2028, which is 1% faster than the average.[4] This projected growth rate is even higher in California, where jobs for civil engineers are expected to grow by 10.4% between 2016 and 2026.[5] As current US infrastructure, which has been rated as D+ by the American Society of Civil Engineers[6], continues to age and new public works are needed, civil engineers will continue to be in demand. The field shows a current unemployment rate of only 1.8%,[7] which is about half of the national unemployment rate.[8] Civil engineering has been holistically rated #2 among Best Engineering Jobs by the US News & World Report rankings, above mechanical engineering and environmental engineering which are also ranked among the top ten engineering jobs.[9]

[1] https://www.glassdoor.com/blog/50-highest-paying-college-majors/
[2] https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm
[3] https://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172051&Geography=0604000101
[4] https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm#tab-6
[5] https://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172051&Geography=0604000101
[6] https://www.infrastructurereportcard.org/
[7] https://money.usnews.com/careers/best-jobs/civil-engineer
[8] https://www.bls.gov/news.release/pdf/empsit.pdf
[9] https://money.usnews.com/careers/best-jobs/rankings/best-engineering-jobs

Global climate change, population growth, and resource limitations will have a significant impact on how societal needs are met. The emphasis on sustainability in the proposed CE program at UCM is ideally suited to address the future requirements of the civil engineering profession, particularly in a region of California that is slated for rapid urban development over the next 50 years. This proposed program also will complement the excellent, existing UCM programs related to sustainability issues in California and globally. Further, the CE program will increase the comprehensiveness of the School of Engineering academic and research offerings and will be synergistic with the School and campus programs related to environmental quality, hydrology and climate, materials and energy, intelligent systems, embedded and remote sensing, green buildings, and sustainable systems and infrastructure.

With the approval of the CE major, the Department of Civil & Environmental Engineering (CEE) will offer two degrees, the B.S. Environmental Engineering (EnvE) and B.S. Civil Engineering (CE). Based on enrollments at other UCs, we expect the CE major to attract 200 or more undergraduates to CEE by 2022. At other institutions that offer both Civil Engineering and Environmental Engineering Bachelor's degrees, the enrollment in Civil Engineering tends to notably surpass that of Environmental Engineering. California Polytechnic State University has 650 undergraduate students enrolled in Civil Engineering and 200 undergraduate students in Environmental Engineering.[10] The University of Pittsburgh had an enrollment of 260 Civil Engineering majors and 32 Environmental Engineering majors in 2017.[11] The University of Nevada, Reno has a current enrollment of 328 Civil Engineering majors and 86 Environmental Engineering majors.[12] The University at Buffalo has 480 undergraduate students enrolled in Civil Engineering and 117 students enrolled in Environmental Engineering.[13] Our projected number of enrolled Civil Engineering students of 200, relative to our current enrollment of 113 Environmental Engineering students, is a sound, if not conservative, estimate relative to these ratios.

With a combined enrollment surpassing 300, EnvE and CE will increase the teaching efficiency of the CEE faculty and could reduce pressure on the large engineering majors. Given the connections between civil and environmental engineering, society and infrastructure, we anticipate that the CEE majors will serve as a cornerstone of campus sustainability initiatives in 2020 and beyond.

The current EnvE degree emphasizes faculty strengths in hydrology and water resources, water and air quality, and geomatics (remote sensing and geospatial analysis). The degree's greatest strength is its close connection to cutting-edge environmental research. Students receive foundational knowledge in the classroom and hands-on training in signature field courses like snow hydrology. Our alumni work for water quality engineering firms, regulating agencies, and natural resource managers, and pursue advanced degrees. The proposed CE major will achieve broader coverage than the EnvE major, encompassing four main areas, the three noted above plus a new one, sustainable structures. In addition, a new sustainable systems area will be integrated across the four areas to reinforce the sustainability theme of the major and position the UCM program competitively amongst modern CEE programs.

[10] https://ceenve.calpoly.edu/about
[11] https://www.engineering.pitt.edu/Enrollment-Data/
[12] https://www.unr.edu/ia/census-date
[13] http://engineering.buffalo.edu/home/academics/undergrad/data.html

3. THE MAJOR

3.1 Program Learning Outcomes

The B.S. degree in Civil Engineering (CE) will be offered by the School of Engineering through the CEE Department faculty. The program will be consistent with UC Merced degree hallmarks, producing program graduates who will:

1. Demonstrate a strong disciplinary foundation, engage in interdisciplinary thinking, think critically, problem-solve, apply varied aspects of information literary, monitor and guide their own learning, describe the origins of knowledge, and demonstrate an inquiry-based approach to the world;
2. Respect and value diversity, seek and recognize new cultures;
3. Understand and contribute to their local and global communities, possess a sense of place, act ethically, and be responsive to the needs of society;
4. Be proficient in collaboration and teamwork, possess strong communication skills, serve as leaders in their professional and civil communities;
5. Demonstrate initiative, respond to challenges with resiliency and learn from failure, and assume responsibility for their education and in life-long learning.

3.1.1. ABET Program Educational Objectives

For civil engineering, it is important that program PLOs are consistent with the national engineering accreditation (ABET) Program Educational Objectives (PEOs) while remaining consistent with our institutional outcomes. From this perspective, our CE graduates are expected to achieve a set of student outcomes outlined by ABET (www.abet.org) by demonstrating:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
2. An ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors;
3. An ability to communicate effectively with a range of audiences;
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal context;
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

In addition to the seven general PLOs above, ABET prescribes the following specific content[14]:

> *The curriculum must prepare graduates to apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of basic science; apply probability and statistics to address uncertainty; analyze and solve problems in at least four technical areas appropriate to civil engineering; conduct*

[14] https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2018-2019/#GC5

experiments in at least two technical areas of civil engineering and analyze and interpret the resulting data; design a system, component, or process in at least two civil engineering contexts; include principles of sustainability in design; explain basic concepts in project management, business, public policy, and leadership; analyze issues in professional ethics; and explain the importance of professional licensure.

3.1.2. Assessment

A rolling assessment plan will be used for the CE program, which will be aligned with the ABET assessment schedule. Each year within a six-year cycle, one to two of the seven national engineering accreditation (ABET) Program Educational Objectives (PEOs) will be assessed through assignments in required courses. With the assistance of a School of Engineering Assessment Coordinator, rubrics will be developed to determine the extent to which the individual learning outcomes are met. Instructors will collect examples of high, average, and low-performing student assignments that were designed to explicitly address a specific learning outcome. The instructors will rate class performance using the rubrics and also holistically address areas that need improvement. The instructors will formulate plans to improve student learning outcomes in the next class iteration and implement them. Coordination of rolling assessments, communication of results, and modifications to course content and teaching strategies will be the responsibility of the curriculum committee, with assistance from a School of Engineering Assessment Coordinator, and in consultation with the Department Chair, and CEE faculty and instructors. Furthermore, external assessment will be provided every six years through ABET accreditation reviews on-site.

3.2 Curriculum Description

The proposed CE degree program was designed to achieve ABET's general student outcomes and civil-specific criteria. A sample 4-year plan is provided in Figure 1. These are discussed in detail below.

Foundational Math and Sciences. A civil engineer must have a solid foundation, and breadth of basic knowledge from the sciences and engineering to utilize materials and resources, both natural and manufactured, towards the creation of facilities, systems, or devices to meet society's infrastructure needs. ABET requires no fewer than 32 semester units in this area, including math through differential equations, calculus-based physics, chemistry, and one additional basic science, which we included as a menu of lower division science courses in biology and earth systems science. Our curriculum unit count in this area is 36.

Civil Engineering Core. The program will provide some flexibility allowing students to choose 3 core courses from 4 areas but will also have a required core aimed at integrating knowledge from the different civil areas. The required lower division core will include an introductory seminar (CE 001) followed a course in modern surveying and computational approaches (CE 010) and a survey course exercising problem-solving skills and introducing design concepts in all program areas of civil engineering (CE 020). At the upper division, the core will include required classes in civil engineering systems (CE 100) and sustainable energy (EnvE 160), and a selection of core courses in 4 areas (students choose at least 3): (i) hydrology and water resources, (ii) environmental engineering, (iii) geomatics, and (iv) sustainable structures.

Experimentation: The ability to conduct experiments and analyze and interpret results for civil engineering components and systems is another important skill to develop. ABET requires demonstrated experiences in at least two technical areas of civil engineering. We will ensure that

our students achieve competency in this area by including laboratory sections (both traditional labs and field labs) in three of our four core courses.

Design: Design skills are an important skill for engineers and ABET requires that design exercises be interspersed throughout the curriculum for better retention, and that there be major design experiences in at least two different civil engineering. We will introduce CE students to the elements of design in CE 1 and then to design exercises in each of the core classes. Then two electives emphasizing design will follow the core courses, chosen from a menu of offerings in a manner that two areas are selected. A two-semester culminating design course (capstone design) will complete the degree, exposing students to a project spanning the entire design cycle and exercising project management skills in the contest of a real-world project.

Writing, Verbal, and Graphical Presentation Skills. Civil engineers work in teams with other engineers as well as many people from a variety of fields – economists, social scientists, geologists, biologists, chemists, political and civic leaders, etc. Civil engineers work with the general public to a much greater degree than any other type of engineer. Many projects are publicly funded and require public input, such as meetings and hearings. This means that civil engineers must learn to communicate technical information effectively to clients and the general public. The proposed civil engineering will emphasize development of effective communication skills with major discipline-based writing and presentation experiences placed in the lower division (WRI 010, CE 020), design electives, and capstone design courses.

General Education. The proposed CE program was developed in accord with the UC Merced General Education (GE) principles. The program includes a Spark seminar class in the first year to help the students engage with their education, the campus, and the surrounding community. In addition to significant social sciences, humanities and arts (SSHA) components are required, including one lower division SSHA course and three upper division SSHA courses.

In terms of the *GE Approaches to Knowledge* requirement, students will be advised to plan these electives so as to achieve adequate coverage of social science, arts and humanities courses. Intellectual experience "badges" will be acquired as follows:

- Scientific Method CHEM 2
- Literary and Textual Analysis ENGR 155 Engineering Economics[15]
- Media and Visual Analysis CE 010 CE Surveying, Computations & Analysis; ENGR 180 Spatial Analysis
- Quantitative and Numerical Analysis MATH 021
- Societies and Cultures of the Past Advised to choose from certified menu
- Diversity and Identity Advised to choose from certified menu
- Global Awareness ENGR 180; ENGR 193 and 194 Capstone Design
- Sustainability CE 100[16]; ENGR 180; ENVE 140
- Practical and Applied Knowledge ENGR 151; ENGR 193 and 194 Capstone Design
- Ethics ENGR 193 and 194 Capstone Design
- Leadership, Community, and Engaging the World ENGR 193 and 194 Capstone Design

The lower division *GE Written Communication* and *Quantitative Reasoning* requirements are included as WRI 010 and MATH 021, respectively. The *GE language* requirement will be satisfied

[15] Under review for badge certification
[16] Proposed for badge certification

by the new course CE 010, which will include significant computational programming in multiple programming languages. The *GE Crossroads* requirement will be satisfied by one or more interdisciplinary courses in the engineering curriculum. Currently, ENGR 180 is certified as a Crossroads course and is part of our CE geomatics area. The *GE Writing in the Discipline* requirement will be satisfied by multiple major writing experiences in design courses, including the capstone design course sequence (ENGR 193 and 194), which is already certified for this purpose. The *GE Culminating Experience* will be satisfied by the capstone design course sequence.

3.3 Course Requirements

Major requirements for the Bachelor of Science in Civil Engineering are as follows:
Lower-division requirements (61 units minimum + 12 units lower/upper SSHA elective):

a) MATH 021 (4), MATH 022 (4), MATH 023 (4), MATH 024 (4), MATH 032 (4)
b) CHEM 002 (4)
c) PHYS 008 (4), PHYS 009 (4)
d) Basic science elective (choose 1): BIO 3 (4), BIO 5 (4), BIO 43 (4), BIO 60 (4), ESS 01 (4), ESS 05 (4), ESS 010 (4), ESS 020 (4)
e) WRI 010 (4)
f) CE 001 (1), CE 010 (4), CE 020 (4)
g) Spark Seminar (4)
h) ENGR 045 (4), ENGR 057 (4)
i) Social Science, Humanities or Arts electives (at least one course each) (12) [upper or lower division]

Upper-division requirements (47 units minimum):

A) ENGR 120 (4), ENGR 151 (4), ENGR 155 (3), ENGR 091/191 (1)
B) CE 100 (4), ENVE 160 (4), CE 193 (2), CE 194 (3)
C) CE required core (choose 3): ENVE 110 (3 lec, 1 L), CE 120 (3 lec, 1 L), ENVE 176 (3 lec, 1 L), ENGR 180 (3 lec, 1 L)
D) CE design electives (at least 2): Environmental [(ENVE 132 (3), ENVE 170 (3)], Hydrology [ENVE 114, ENVE 140], Geomatics [ENVE 152 (4)], Sustainable Structures/Energy [ENVE 162 (3)], Applied Design [ENGR 96/196 (2) + ENGR 97/197 (1) *must be taken concurrently*]
E) GE Crossroads elective (4) [ENGR 180 or another certified course]

3.3.1 Transfer Students

Many paths lead to engineering and degrees at UC Merced. The UC Merced Civil and Environmental Engineering program welcomes transfer students as a valued part of our community and classrooms. UC Merced Civil Engineering transfer degree requirements follow the UC Merced School of Engineering transfer requirements: https://admissions.ucmerced.edu/transfer/major-preparation-schools (minimum 2.4 GPA or 2.8 for non-residents, English, Math, Writing, and transferable unit (60) requirements). Transfer students are required to complete courses equivalent to CHEM 2, MATH 21, 22, 23, 24, and 32 (desired), PHYS 8 and PHYS 9. Equivalent courses at various California Community colleges with UC

Merced are listed at ASSIST.org. Any questions can be directed to the office of admissions, regional transfer initiative advisor, and/or school of engineering (https://admissions.ucmerced.edu/transfer/contact-us).

The UC Merced STEM center (https://admissions.ucmerced.edu/transfer/contact-us), engineering walk-ins advising, bobcat advising center, and Peer Assisted Learning support (PALs) tutoring (http://learning.ucmerced.edu/programs/tutoring) can aid transfer students in their transition to UC Merced and Civil Engineering courses.

4. COURSE DESCRIPTIONS

The following courses are new or substantially revised courses that are needed for the proposed CE degree program. All other courses in the program are existing UC Merced courses.

CE 001: Overview of Civil & Environmental Engineering, 1 unit

An introductory seminar focusing on introducing students to the civil and environmental engineering professions and preparing them to successfully navigate the majors. Discussion and guest speakers typifying career pathways, projects, the design process, current events in the field, and illustrating the need to engage in life-long learning. Hands-on experiences, field trips, and career development workshops. *Requisites and Restrictions: Civil, Environmental and Undeclared Engineering majors*

CE 010: Civil Engineering Surveying, Computing, & Analysis, 4 units (3 lecture, 1 lab)

CE 10 is a computer-oriented introduction to probability, data analysis and describing uncertainty. Spatial measurement topics are also introduced, including GPS, leveling, distance and angular measurement, mapping and topographic surveys, automated data collection, terrain models, construction surveying, geodesy, and geographical information systems (GIS). Virtual experiments will be conducted, and real-world data sets will be analyzed using computer software, including Microsoft Excel and an object-oriented programming language (e.g., Matlab, Python, R). *Requisites and Restrictions: MATH 21 (or equivalent score on the Competency Exam, or transfer institution equivalent)*

CE 020 (formerly ENVE 020): Introduction to Civil and Environmental Engineering, 4 units

Introduction to historical, current, and future issues in civil and environmental engineering. Principles of mass and energy balance; water resources; water and air quality control; remote sensing; and sustainable buildings and infrastructure. Introduction to systems approaches and associated analytical approaches. *Requisites and Restrictions: CHEM 2, MATH 21(or equivalent score on the Competency Exam, or transfer institution equivalent)*

CE 100: Civil Engineering for Sustainable Systems, 4 units (3 lecture, 1 lab)

Civil engineering systems planning, design, monitoring, and preservation with environmental and social sustainability. Tools for decision analysis. Material flow analysis and life cycle assessment. Related design exercises and lab exercises, experiments and data interpretation.
Requisites and Restrictions: CE 020, MATH 24 and MATH 32 (or transfer institution equivalent)

ENGR 180: Spatial Analysis and Modeling, 4 units (3 lecture, 1 lab)

Principles of geographic information systems [GIS]; applications of GIS to environmental, water, and resource management issues; problem solving with GIS. Other topics include spatial analysis interpolation techniques and model integration. Related lab exercises, experiments and data interpretation. *Requisites and Restrictions: MATH 21, and CE 10*

ENVE 110: Hydrology and Climate, 4 units (3 lecture, 1 lab)

Basics of the hydrological cycle and the global climate system. Fundamentals of surface and subsurface hydrology, hydrometeorology, precipitation, evapotranspiration, statistical and probabilistic methods, unit hydrograph and flood routing. Related hydrologic lab exercises and experiments and data interpretation. *Requisites and Restrictions: CE 20, and MATH 21 and MATH 22 (or transfer institution equivalent)*

ENVE 176: Water and Wastewater Treatment, 4 units (3 lecture, 1 lab)

Water treatment, use, reclamation, and reuse. Biological treatment processes. Introduction to modeling and designing treatment systems; both conventional and advanced technology. Use of mass balances for system evaluation and design. *Requisites and Restrictions: CE 20, ENGR 120 and (ENVE 100 or CE 100)*

CE 120: Civil and Sustainable Structures, 4 units (3 lecture, 1 lab)

Fundamentals of structural mechanics and introduces their application to the design of sustainable structures. The topics covered will be continuum mechanics, theory of beams, column stability, statically indeterminate structures, fundamentals of sustainable structures, structural efficiency, and sustainable materials. Related design exercises and lab exercises, experiments and data interpretation. *Requisites and Restrictions: ENGR 57 and CE 20*

5. SAMPLE 4-YEAR ACADEMIC PLAN

Semester 1	**Units**		**Semester 2**	**Units**	
MATH 21 Calc1	4		MATH 22 Calc 2	4	
PHYS 8 Intro physics 1	4		PHYS 9 Intro Physics 2	4	
CHEM 2 Intro Chem 1	4		Spark Seminar	4	**W**
CE 1 CE Seminar	1		WRI 10	4	**W**
Total	*13*		*Total*	*16*	
Semester 3	**Units**		**Semester 4**	**Units**	
MATH 23 Calc 3	4		MATH 24 LinAlg & DiffEqs	4	
ENGR 45 Into Materials	4		ENGR 57 Statics Dynamics[S]	4	
CE 10 Survey/Computing/Analysis	4	**L**	**CE 20 Intro CE (core)**	4	**d, W**
Science GE	4		Social Science GE	4	
ENGR 91 Professional Seminar	1				
Total	*17*		*Total*	*16*	
Semester 5	**Units**		**Semester 6**	**Units**	
ENGR 120 (Fluids)	4	**L**	ENGR 155 Engr Econ/Management[S]	3	**d**
ENGR 151 Strength of Materials	4		ENVE 160 (core) Sustainable Energy	4	**L**
ENGR 96/196 & 97/197[E] Service Learn.	3	**D**	**CE 100 (core) CEE Systems**	4	
MATH 32	4		Arts & Humanities GE	4	
Total	*15*		*Total*	*15*	
Semester 7	**Units**		**Semester 8**	**Units**	
CE 120 (core) Sustainable Structures	4		ENGR 194 Capstone 2	3	**D, W**
SSHA GE	4		ENVE 140 Water Res Planning[E]	3	**D**
ENGR 193 Capstone 1	2	**D, W**	ENVE 175 (core) Wastewater Treat	4	
ENGR 180 – Spatial Analysis	4	**L, XR**	ENVE 162 Energy Systems	3	**d**
Total	*14*		*Total*	*16*	

Notes:

(1) **Total units shown: 122**
(2) **Bold** courses are new
(3) **S =** course typically offered in summer terms
(4) W = significant writing component; **L** = lab component; **d** = design component; **D** = major design project; E = Engineering design elective (typical course shown)

6. SAMPLE 2-YEAR ACADEMIC PLAN (TRANSFER STUDENTS)

Semester 5	**Units**		**Semester 5**	**Units**	
ENGR 57 Statics Dynamics[S]	4	**L**	ENGR 45 Intro Materials	4	
CE 10 Survey/Computing/Analysis	4	**L**	ENVE 160 Sustainable Energy	4	**L**
CE 20 (core) Intro to CE	4	**d, W**	ENGR 120 Fluid Mechanics[S]	4	**D, W**
MATH 32	4		**CE 100 (core) CEE Systems**	4	
			ENGR 91 Prof. Seminar	1	
Total	*16*		*Total*	*17*	
Semester 7	**Units**		**Semester 8**	**Units**	
CE 120 (core) Sustainable Structures	4		ENGR 194 Capstone 2	3	**D, W**
ENGR 151 Strength Materials	4		ENVE 140 Water Res Planning[E]	3	**L**
ENGR 193 Capstone 1	2	**D, W**	ENGR 180 (core) Spatial Analysis	4	**L, XR**
ENGR 155 Engr Econ/Management[S]	3	**d**	ENVE 170 Cont. Fate Transport	3	**L**
Science GE	4	**L**	ENVE 110 Hydrology Climate	4	
Total	*17*		*Total*	*17*	

Notes:

(1) **Total units shown: 67**
(2) **Bold** courses are new
(3) **S =** course typically offered in summer terms
(4) **W** = significant writing component; **L** = lab component; **d** = design component; **D** = major design project; E = Engineering design elective (typical course shown)

7. B.S. CIVIL ENGINEERING INSTRUCTIONAL ROSTER

B.S. Civil Engineering core courses with instructor-in-charge (first faculty member) and secondary instructors.

Course Number	Course Title	Instructor-in-Charge	Second Faculty
CE 1	Civil Engineering Seminar	Dept. Chair	Matsumoto
CE 10	Surveying & Computations	New LPSoE	Hestir, Viers
CE 20	Intro to Civil Engineering	Naughton	Rogge, Harmon, Ghassemi
CE 100	Civil Engineering Systems	Fortier	Naughton, Medellin-Azuara
ENVE 110	Hydrology & Climate	Medellin-Azuara	Safeeq, Bales
CE 120	Sustainable Structures	New Faculty	Gutierrez, Rice
ENVE 160	Sustainable Energy	Fortier	Naughton, Ghassemi
ENVE 176	Wastewater Treatment	Beutel	Conklin, Harmon
ENGR 180	Spatial Analysis	Viers	Hestir, Naughton, New LPSoE
ENGR 193	Capstone 1	Gutierrez Ghassemi	Rice, New LPSoE
ENGR 194	Capstone 2	Gutierrez Ghassemi	Rice, New LPSoE

8. DRAFT TEXT FOR THE CATALOG DESCRIPTION

Civil Engineering Major

Air and water quality improvements, urban renewal, planning and building whole new communities, providing water, power, and ground transportation systems are the responsibility of the civil engineering profession. Civil engineering involves the planning, design, construction, maintenance, and operation of the infrastructure that supports modern civilization; it is a keystone of our society.

The undergraduate major in Civil Engineering prepares students for careers in both industry and government agencies concerned with managing air quality, water quality and supply, infrastructure, energy, public health and the welfare of the total environment. The program is also a good foundation for further study in earth science, engineering, business, management, law and public health. The curriculum provides students with a quantitative understanding of the physical, chemical and biological principles that control the quality of our natural and engineered environment and focuses on the design, development, implementation and assessment of sustainable engineering solutions to society's waste and resource management challenges.

In the coming decades, civil engineers will increasingly be called upon to address broader issues of environmental sustainability by minimizing the release of residuals through altered production processes and choice of materials; by capturing the resource value of wastes through recovery, recycling and reuse; and by managing natural resources to meet competing societal objectives.

UC Merced emphasizes sustainability across the Civil Engineering Curriculum, taking a highly interdisciplinary approach that combines strong theoretical foundation with field studies, laboratory experiments and computational simulations. Core courses within the major provide students with a firm foundation in the physical and life sciences and the ways that they apply to air and water quality, energy, hydrology and water management, remote sensing of the environment, and sustainable infrastructure. Emphasis areas allow students the flexibility to study in more depth by following tracks developed in consultation with their academic adviser(s). The four areas of emphasis for Civil Engineering at UC Merced are: (1) Hydrology and water resources, (2) Environmental engineering, (3) Geomatics, and (4) Sustainable structures.

Environmental Engineering focuses on engineering solutions to water, air and waste issues, including measurement technology, air- and water-quality assessments, treatment systems and remediation of contaminated air and waters. Physical, chemical and biological aspects are included. Sustainable energy systems engineering focuses on engineering solutions to energy problems, both regionally and globally. The sources, fate, effects of air and water pollutants, as well as the planning and design of solar and other renewable energy systems are evaluated.

Hydrology and Water Resources focuses on the sources, balance and use of water in both natural and managed environments, including precipitation, mountain snowpack, river runoff, vegetation, water use and groundwater. Both the physical and chemical aspects of the water cycle are included, as are sustainable water resources management, human and agricultural water requirements, and sustainable water delivery and water policy. The program covers the use of mathematical,

computational and experimental approaches to understanding the dynamics of the hydrologic cycle and transport within hydrologic systems.

Geomatics focuses on the management of global infrastructure by collecting, measuring and archiving geospatial data. Geomatics engineers use advanced mapping techniques to ensure the welfare and safety of the public. This includes digital and 3-D mapping, Geographic Information Systems (GIS), Global Positioning Systems (GPS), remote sensing, photogrammetric mapping, applications programming and project management. Geomatics technologies provide the tools needed to tackle environment challenges, sustainable management and sustainable development.

Sustainable Structures focuses on the design and engineering of the built environment. This encompasses analysis and modeling of structural loads on infrastructure and its resilience in the natural environment. Planning, design, construction, monitoring, and preservation of infrastructure are key aspects of the program, with considerations of safety, environmental sustainability, and public welfare. Structural engineering utilizes decision analysis, mechanics, materials, and project management skills.

Civil engineers need to understand not only the technical but also the social and political contexts of their work. They must be able to communicate and plan, finance and market their products and ideas. Social sciences, business, humanities and arts courses are an important part of the curriculum. The result is a major that is hands-on and creative, engaging and adaptable.

The Civil Engineering program at UC Merced is accredited by the Engineering Accreditation Commission of ABET, abet.org.

Note: Curriculum Description, course requirements, and course descriptions are contained above.

Appendix 1:

Proposal for an Undergraduate Program Leading to a Bachelor of Science Degree in Civil Engineering

(Following the Undergraduate Council Format for Proposals for New or Substantive Change to Undergraduate Degree Programs)

1. Program Description and Rationale

The full program description and rationale can be found on page 2, section 1.1., and pages 3-5, section 2. Note page and section references refer to ABET-formatted proposal.

Below is a brief summary of the contents contained in those sections. We refer the committee to the sections listed above for the full text.

Program focus: Civil engineering. Air and water quality improvements, urban renewal, planning and building whole new communities, providing water, power, and ground transportation systems are the responsibility of the civil engineering profession. Civil engineering involves the planning, design, construction, maintenance, and operation of the infrastructure that supports modern civilization.

Program rationale: Global climate change, population growth, and resource limitations will have a significant impact on how societal needs are met. The emphasis on sustainability in the proposed CE program at UCM is ideally suited to address the future requirements of the civil engineering profession, particularly in a region of California that is slated for rapid urban development over the next 50 years.

Contribution to undergraduate education at UCM: The proposed program will complement the excellent, existing UCM programs related to sustainability issues in California and globally. Given the connections between civil and environmental engineering, society and infrastructure, we anticipate that the CE majors will serve as a cornerstone of campus sustainability initiatives in 2020 and beyond.

Job Market & Student Demand: Civil engineers are frequently listed among the top ten highest paying college majors,[1] with a median salary of $86,640 annually,[2] making this an attractive major choice for undergraduate students. In California, the median wage is even higher at $107,896.[3] The job outlook is highly favorable for both the nation (6% growth) and the state (10% growth), with unemployment at nearly half the national unemployment rate. We anticipate that many of our graduates will become a part of the engineering work force in the Central Valley, thus the program fills an important niche in the regional economy. Based on enrollments at other UCs and other US institutions that offer both environmental and civil engineering degree programs, we expect the CE major to attract 200 or more undergraduates by 2022.

Overlaps and complements to existing undergraduate programs: With a combined enrollment surpassing 300, EnvE and CE will increase the teaching efficiency of the CEE faculty and could reduce pressure on the large engineering majors. The CE program will increase the comprehensiveness of the School of Engineering academic and research offerings and will be synergistic with the School and campus programs related to environmental quality, hydrology and climate, materials and energy, intelligent

[1] https://www.glassdoor.com/blog/50-highest-paying-college-majors/
[2] https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm
[3] https://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172051&Geography=0604000101

systems, embedded and remote sensing, green buildings, and sustainable systems and infrastructure. The proposed CE major will achieve broader coverage than the current EnvE major, encompassing four main areas, the three noted above plus a new one, sustainable structures with a focus on buildings, infrastructure and energy. In addition, a new emphasis on sustainable systems will be integrated across the four areas to reinforce the sustainability theme of the major and position the UCM program competitively amongst modern CEE programs. Further, the CE program will increase the comprehensiveness of the School of Engineering academic and research offerings and will be synergistic with the School and campus programs related to environmental quality, hydrology and climate, materials and energy, intelligent systems, embedded and remote sensing, green buildings, and sustainable systems and infrastructure. There are no overlaps with existing programs, yet courses such as CE *010: Civil Engineering Surveying, Computing, & Analysis* might share some elements of CSE 005, however *CE 010* addresses ABET-required Civil-engineering specific survey methods, data collection and analysis methods and applications not covered in CSE 005; and CE 120: *Civil and Sustainable Structures* expands over ENGR 151 *Strengths of Materials*, but again, addresses Civil-engineering specific topics on structures required for ABET accreditaion.

2. Program requirements

Lower and upper division course requirements: Described on page 8, section 3.3.

Learning goals and outcomes: Described on page 5, section 3.1.

How course requirements address intended learning outcomes: Described on pages 6-8, section 3.2.

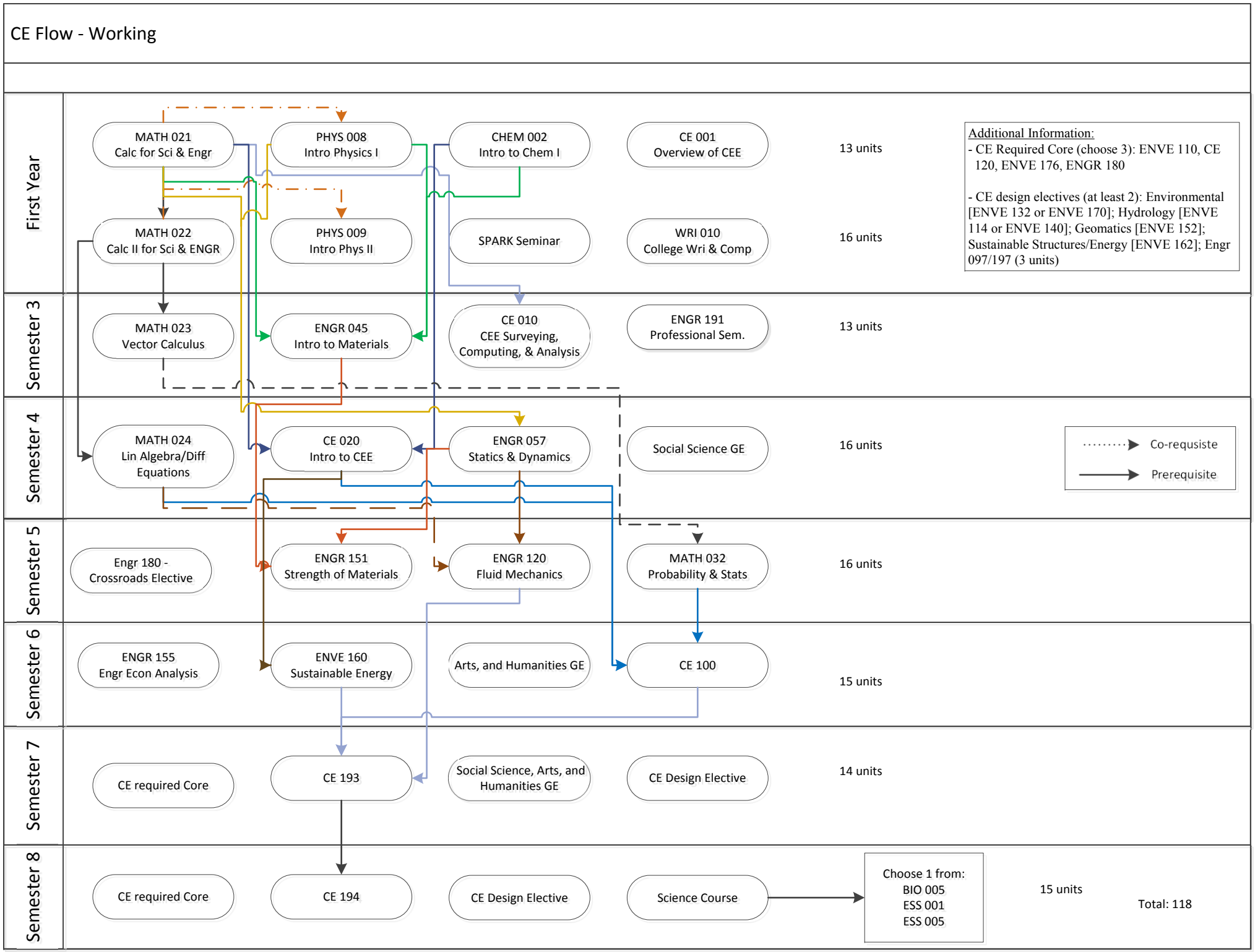
Outcomes assessments: The CE program is intended to be accredited by the Accreditation Board for Engineering and Technology (ABET), a non-governmental organization that accredits university engineering programs. A rolling assessment plan will be used for the CE program, which will be aligned with the ABET assessment schedule. A full description of the assessment plan can be found on page 6, section 3.1.2.

Minimum and maximum credits: Described on pages 8-9, section 3.3.

Sample program for a major: Described on pages 10-11, section 5.

See also, Figure 1, which shows a sample Civil Engineering Requirements working flow for students

CE Flow - Working



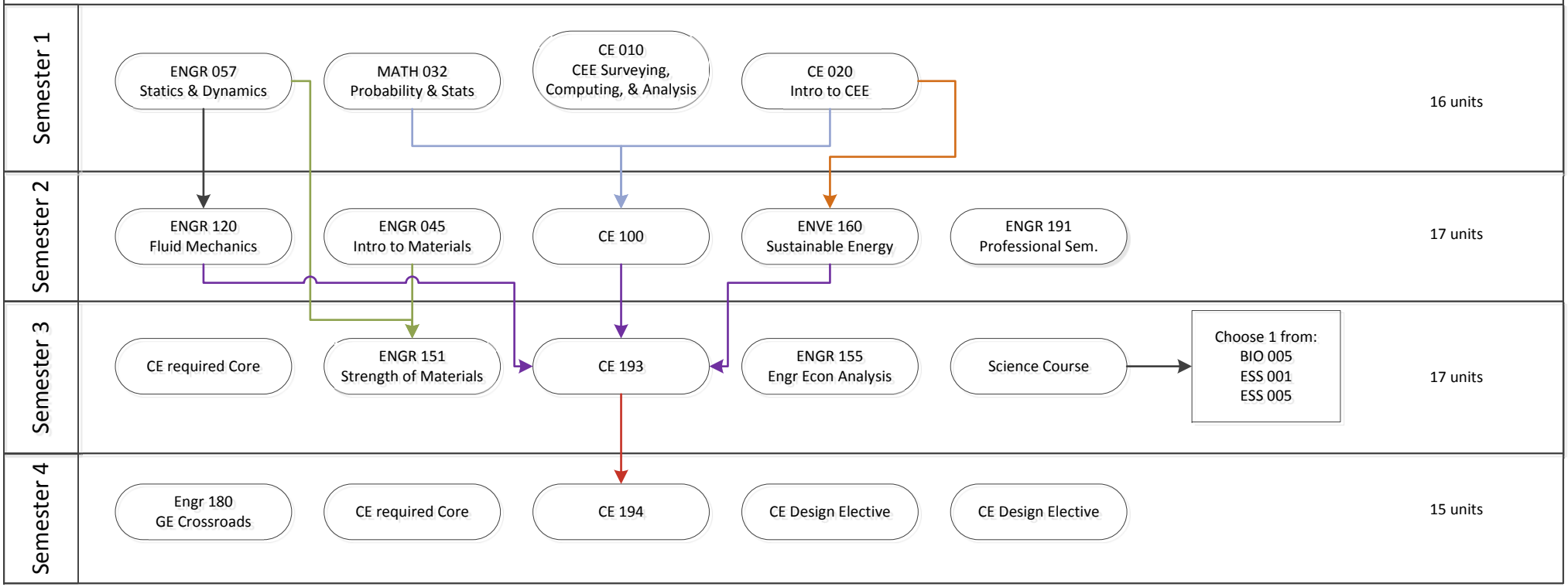
Availability of preparatory courses at community colleges: Described on page 8-9, section 3.3.1.

UC Merced Civil Engineering transfer degree requirements follow the UC Merced School of Engineering transfer requirements: https://admissions.ucmerced.edu/transfer/major-preparation-schools (minimum 2.4 GPA or 2.8 for non-residents, English, Math, Writing, and transferable unit (60) requirements). Transfer students are required to complete courses equivalent to CHEM 2, MATH 21, 22, 23, 24, and 32, PHYS 8 and PHYS 9. Equivalent courses at various California Community colleges with UC Merced are listed at ASSIST.org. For example, there is an agreement between Modesto Junior College and UC Merced for Environmental Engineering that applies to the Civil Engineering degree. Any questions can be directed to the office of admissions, regional transfer initiative advisor, and/or school of engineering (https://admissions.ucmerced.edu/transfer/contact-us).

After meeting the UC Merced engineering transfer requirements, transfer students are able to complete a B.S. in Civil Engineering in two years as indicated in section 6. Three of the required courses in semesters 5 and 6 (first year of transfer) are also available during the summer (ENGR 57, ENGR 155, and ENG 120) which can allow transfer students to reduce unit loads in the Fall and Spring semesters.

See also, Figure 2, which shows a sample Civil Engineering Requirements working flow for transfer students

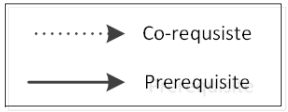
CE Flow – Working - Transfer



Additional Information:

- CE Required Core (choose 3): ENVE 110, CE 120, ENVE 176, ENGR 180

- CE design electives (at least 2): Environmental [ENVE 132 or ENVE 170]; Hydrology [ENVE 114 or ENVE 140]; Geomatics [ENVE 152]; Sustainable Structures/Energy [ENVE 162]; Engr 097/197 (3 units)



Unique courses required prior to junior year: The major will follow the same pattern as other engineering majors, with the first year covering fundamental sciences and math along with general education requirements. A new feature will be CE 001 Overview of Civil Engineering, which will introduce freshmen to the sub-disciplines?? of Civil Engineering (and to the department faculty) and will help them understand how to start their professional development pathway. The second year will include a transition from basic math and sciences to fundamental engineering courses. This year will also include a cohort-building course CE 010 Civil Engineering Surveying and Computational Analysis, which will build skills in modern surveying techniques as well as graphical and computational analysis.

Additional information and descriptions are available on page 8, section 3.3; page 9, section 4, and illustrated on page 11, section 5.

Draft catalog description of courses: Described on pages 9-10, section 4.

3. Accreditation

The CE program is intended to be accredited by the Accreditation Board for Engineering and Technology (ABET), a non-governmental organization that accredits university engineering programs. A rolling assessment plan will be used for the CE program, which will be aligned with the ABET assessment schedule. A full description of the assessment plan can be found on page 6, section 3.1.2. A brief description of the School of Engineering ABET accreditation status, timeline, and other details can be found at https://engineering.ucmerced.edu/academics/accreditation

4. Resource needs and plan for providing them

Faculty to support the program, current under recruitment, course schedule: With respect to the CE program, our current faculty and pending hires will be necessary and minimally sufficient for the start of the program delivery.

In terms of numbers of faculty, we currently have 8 Professors, 1 Teaching Professor, 4 Associate Professors, 1 Teaching Associate Professor, 2 Assistant Professors, and 1 Assistant Adjunct Professor. In the near term, through AY 2021 no new faculty resources will be required to deliver the CE program, beyond the 2 new hires already given to the department and expected to join in 2020; one as Assistant Professor and one as Assistant Teaching Professor. Assuming successful final appointments of both faculty by the AY 2020, we will be able to cover the first 2 years of the CE program.

We will require approval for an additional faculty line for AY 2022 in CE with a likely focus area on Structures and Geomatics, a line which is absolutely essential for delivery of the program. Further, as the number of students grow, we anticipate allocations of roughly 3 new faculty line over the next 5 years. Addition of these resources will accommodate program growth at the undergraduate level.

Table 1: Current and near-term faculty to support the CE program

Faculty Member	Rank	Primary Focus Area	Secondary Focus Area
Roland Winston	Distinguished Professor	Sustainable Structures	
Tom Peterson	Full Professor	Environmental Engineering	

Mark Matsumoto	Full Professor	Environmental Engineering	
Roger Bales	Full Professor	Hydrology and Water Resources	Sustainable Structures
Martha Conklin	Full Professor	Hydrology and Water Resources	
Tom Harmon	Full Professor	Environmental Engineering	Hydrology and Water Resources
Samuel Traina	Full Professor	Environmental Engineering	
Josh Viers	Full Professor	Geomatics	Hydrology and Water Resources
Abbas Ghassemi	Teaching Professor	Sustainable Structures	
Wolfgang Rogge	Associate Professor	Environmental Engineering	
Marc Beutel	Associate Professor	Environmental Engineering	
Erin Hestir	Associate Professor	Geomatics	Hydrology and Water Resources
Josue Medellin-Azuara	Acting Associate Professor	Hydrology and Water Resources	
Robert Rice	Associate Teaching Professor	Hydrology and Water Resources	
Colleen Naughton	Assistant Professor	Environmental Engineering	Sustainable Structures
Marie-Odile Fortier	Assistant Professor	Sustainable Structures	Environmental Engineering
Safeeq Khan	Assistant Adjunct Professor	Hydrology and Water Resources	
New Hire 2020	Assistant Professor	Sustainable Structures	
New Hire 2020	Assistant Teaching Professor	Sustainable Structures	

Specialized staff/needed FTE: None. For courses that require TAs, we anticipate relying on graduate students from related programs, especially the Environmental Systems program which currently provides TAs for the ENVE program, until a graduate program in CE is approved. Program administration will be handled by the School of Engineering, including academic advising and class scheduling; it is not expected that this will have a substantial impact on administrative resources.

Specialized space needs: The program will require lab space for the Structural Engineering course and classrooms to deliver each of the new courses listed for the CE program at least one time per year.

Library resources needed: It is anticipated that participants in the new major will avail themselves of existing library resources, including access to library databases and search tools, borrowing privileges, and ongoing library programs such as library tutorials, citing sources, and technology access (e.g., IT Express, print/cop/scan). No additional library or other resources are needed to deliver this program.

Instructional computing resources: Two courses will require use of a computer lab for sections; it is expected that all required software will be either open-source or already available through a campus site license. Campus-wide enterprise software solutions (e.g., Microsoft Office Excel, Matlab, ArcGIS) or Open-Source software will be used where possible.

Resource needs for field studies or off-campus activities: None

Specialized facilities: None

5. Potential for non-majors to participate

The CE major offers the possibility of non-major students to enroll in various CE core courses (subject to seat availability) including CE 001, Overview of Civil Engineering and CE 010, Civil Engineering, Surveying, Computing and Analysis. Most other classes have overlaps with programs such as ENVE. (ENVE 110, ENVE 140, ENVE 160, ENVE 176, ENVE 152) and other engineering programs through ENGR 97, ENGR 91, ENGR 151, ENGR 155, ENGR 180, ENGR 197, and the Capstone classes. Indeed, students from other Engineering majors (Mechanical, CSE) often enroll in ENVE courses. We anticipate non-majors will also find CE courses attractive. Students from the minor in Management Analytics and Decision Making for example, will benefit from taking ENVE 155 or ENGR 180, which is a designated Cross-Roads course.

6. Timetable for implementation

Initiating and Building Program:
CRF submission - Spring 2020 and Fall 2020
Outreach and advertisement - AY 2020 - 2021
Admissions - Fall 2020 (no transfers)

Phasing:
First cohort - Fall 2021 – Freshman only.
Transfer admissions offered Fall 2022. This timeline may be hastened with additional faculty line (requested for AY 2022).

Appendix 2:

Response to UGC Comments from July and August 2019

Note: UGC Comments are reproduced in italics. The response to the comments are provided below.

UGC Identified the following items as missing from the proposal:

- *Draft catalog text (the proposal notes it is provided in section III)*
- *Discussion of programmatic accreditation requirements and plans for achieving accreditation*
- *Assessment plan*
- *Resource needs (CAPRA will address this aspect of the proposal)*
- *Timetable for implementation*

We have revised the proposal to ensure all missing items are included. Additionally, please see Appendix 1. In this document, we have created an easy-to-reference document that maps the ABET-formatted proposal contents previously submitted to UGC to the standard UGC proposal format.

-We would like to see more rationale (see Item #1 in the UGC policy): for example, although the proposal does motivate the program, it does not give any quantitative information about expected employment demand for CE graduates and does not cite any reports on the topic. An expected enrollment of 200 students is given, but it is difficult be clear how that figure was obtained. A discussion of overlaps with other programs is needed (perhaps also in response to Paul Maglio's e-mail as well).

See Appendix 1. Further justification and rationale is provided below:

Civil engineers are frequently listed among the top ten highest paying college majors,[1] with a median salary of $86,640 annually,[2] making this an attractive major choice for undergraduate students. In California, the median wage is even higher at $107,896.[3] The job outlook is also favorable as US civil engineering jobs are predicted by the Bureau of Labor Statistics to increase by 6% from 2018 to 2028, which is 1% faster than the average.[4] This projected growth rate is even higher in California, where jobs for civil engineers are expected to grow by 10.4% between 2016 and 2026.[5] As current US infrastructure which has been rated as D+ by the American Society of Civil Engineers[6] continues to age and new public works are needed, civil engineers will continue to be in demand. The field shows a current

[1] https://www.glassdoor.com/blog/50-highest-paying-college-majors/
[2] https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm
[3] https://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172051&Geography=0604000101
[4] https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm#tab-6
[5] https://www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172051&Geography=0604000101
[6] https://www.infrastructurereportcard.org/

unemployment rate of only 1.8%,[7] which is about half of the national unemployment rate.[8] Civil engineering has been holistically rated #2 among Best Engineering Jobs by the US News & World Report rankings, above mechanical engineering and environmental engineering which are also ranked among the top ten engineering jobs.[9]
The addition of a Civil Engineering Bachelor's degree program is projected to increase enrollment in the School of Engineering at UC Merced. At other institutions that offer both Civil Engineering and Environmental Engineering Bachelor's degrees, the enrollment in Civil Engineering tends to notably surpass that of Environmental Engineering. California Polytechnic State University has 650 undergraduate students enrolled in Civil Engineering and 200 undergraduate students in Environmental Engineering.[10] The University of Pittsburgh had an enrollment of 260 Civil Engineering majors and 32 Environmental Engineering majors in 2017.[11] The University of Nevada, Reno has a current enrollment of 328 Civil Engineering majors and 86 Environmental Engineering majors.[12] The University at Buffalo has 480 undergraduate students enrolled in Civil Engineering and 117 students enrolled in Environmental Engineering.[13] Our projected number of enrolled Civil Engineering students of 200, relative to our current enrollment of 113 Environmental Engineering students, is a sound, if not conservative, estimate relative to these ratios.

-We need more information regarding transfer preparation (see Item #2 in the UGC policy): for example, what does a transfer student need to do to be prepared to transfer into the major. Also … it may be tough to get 71 units in 2 years. The proposal should include a statement on the availability of courses … when will the required courses be offered according to the available teaching plans? We also need a clear draft of the catalog description.

See Appendix 1.

Many paths lead to engineering and degrees at UC Merced. The UC Merced Civil and Environmental Engineering program welcomes transfer students as a valued part of our community and classrooms. UC Merced Civil Engineering transfer degree requirements follow the UC Merced School of Engineering transfer requirements: https://admissions.ucmerced.edu/transfer/major-preparation-schools (minimum 2.4 GPA or 2.8 for non-residents, English, Math, Writing, and transferable unit (60) requirements). Transfer students are required to complete courses equivalent to CHEM 2, MATH 21, 22, 23, 24, and 32 (not required, but preferred); see https://admissions.ucmerced.edu/transfer/major-preparation-schools#soe), PHYS 8 and PHYS 9. Equivalent courses at various California Community colleges with UC Merced are listed at ASSIST.org. For example, there is an agreement between Modesto Junior College and UC Merced for Environmental Engineering that applies to the Civil Engineering

[7] https://money.usnews.com/careers/best-jobs/civil-engineer
[8] https://www.bls.gov/news.release/pdf/empsit.pdf
[9] https://money.usnews.com/careers/best-jobs/rankings/best-engineering-jobs
[10] https://ceenve.calpoly.edu/about
[11] https://www.engineering.pitt.edu/Enrollment-Data/
[12] https://www.unr.edu/ia/census-date
[13] http://engineering.buffalo.edu/home/academics/undergrad/data.html

degree. Any questions can be directed to the office of admissions, regional transfer initiative advisor, and/or school of engineering (https://admissions.ucmerced.edu/transfer/contact-us).

After meeting the UC Merced engineering transfer requirements, transfer students are able to complete a B.S. in Civil Engineering in two years as indicated in section 6. Three of the required courses in semesters 5 and 6 (first year of transfer) are also available during the summer (ENGR 57, ENGR 155, and ENG 120) which can allow transfer students to reduce unit loads in the Fall and Spring semesters. The UC Merced STEM center (https://admissions.ucmerced.edu/transfer/contact-us), engineering walk-ins advising, bobcat advising center, and Peer Assisted Learning support (PALs) tutoring (http://learning.ucmerced.edu/programs/tutoring) can aid transfer students in their transition to UC Merced and Civil Engineering courses.

- We (and CAPRA) will need more information about resource implications (see Item #4 in the UGC policy): for example, we will need a list of current faculty delivering the ENVE degree, expected faculty needed to deliver the Civil Engineering Degree, plans to address any gap in faculty needs, undergraduate laboratory space and support…

See Appendix 1.

Regarding faculty needed to deliver the CE degree, these faculty are included in the table below. Our current faculty and anticipated faculty hires (as described next) will be necessary and minimally sufficient for the start of the program delivery. In terms of numbers of faculty, we currently have 8 Professors, 1 Teaching Professor, 4 Associate Professor, 1 Teaching Associate Professor, 2 Assistant Professor, and 1 Assistant Adjunct Professor.

Not included in the table is Dr. Alejandro Gutierrez, an Assistant Teaching Professor in Mechanical Engineering who will be helping the CE program deliver its Cap Stone design courses.

Note we are conducting two searches this academic year, one for an assistant professor and another for an LPSOE, focused on building departmental capacity in our sustainable structures focus area. With these two additions, we have all the faculty needed to deliver this program. The courses covered by these faculty are detailed in the table in Section 7 of the original program proposal. We will need approval for an additional faculty line likely with a structures and geomatics focus for the 2022 AY in CE, a line which is absolutely essential for delivery of the program. Further, as the number of students grow, we anticipate allocations of roughly 3 new faculty line over the next 5 years. Addition of these resources will accommodate program growth at the undergraduate level.

Table 1: Current and near-term faculty to support the CE program

Faculty Member	Rank	Primary Focus Area	Secondary Focus Area

Roland Winston	Distinguished Professor	Sustainable Structures GOOD SIMPLE TITLE! And has nice ring to it.	
Tom Peterson	Full Professor	Environmental Engineering	
Mark Matsumoto	Full Professor	Environmental Engineering	
Roger Bales	Full Professor	Hydrology and Water Resources	Sustainable Structures
Martha Conklin	Full Professor	Hydrology and Water Resources	
Tom Harmon	Full Professor	Environmental Engineering	Hydrology and Water Resources
Samuel Traina	Full Professor	Environmental Engineering	
Josh Viers	Full Professor	Geomatics	Hydrology and Water Resources
Abbas Ghassemi	Teaching Professor	Sustainable Structures	
Wolfgang Rogge	Associate Professor	Environmental Engineering	
Marc Beutel	Associate Professor	Environmental Engineering	
Erin Hestir	Associate Professor	Geomatics	Hydrology and Water Resources
Josue Medellin-Azuara	Acting Associate Professor	Hydrology and Water Resources	
Robert Rice	Associate Teaching Professor	Hydrology and Water Resources	
Colleen Naughton	Assistant Professor	Environmental Engineering	Sustainable Structures
Marie-Odile Fortier	Assistant Professor	Sustainable Structures	Environmental Engineering
Safeeq Khan	Assistant Adjunct Professor	Hydrology and Water Resources	
New Hire 2020	Assistant Professor	Sustainable Structures	
New Hire 2020	Assistant Teaching Professor	Sustainable Structures	

- Potential for non-majors to participate (Item #5 in the UGC policy) has to be included. Some of this may be part of the "overlaps with other programs" stuff (from Item #2 in the UGC policy).

See Appendix 1.