

Executive Summary:

The Samueli School of Engineering has developed a series of 2-unit freshman hands-on design courses under the number Engineering 96. These courses have been popular and well-liked by Freshmen students. They provide an introduction to engineering while the rest of the freshman classes are not in engineering (except for CS 31 and department introductory seminars). Such freshman hands-on design courses have become a common part of engineering curricula nationwide.

The School has also introduced a new 2-unit course, Engineering 2, in Winter 2020 to introduce freshmen to interplay of technology and society. This initial offering was very successful based on the student evaluations and the content covered. The idea of this course is to introduce students to the importance of understanding societal context at the beginning of their engineering training as part of integrating societal context and societal impact into our program more broadly. Think of this class as providing a new frame or a new lens through which to understand engineering. Providing this at the beginning of their experience catalyzes a deeper understanding of these issues throughout their four years.

Taken together, these two courses provide a natural introduction for freshmen to the how and the why of engineering. However, these courses currently do not meet any degree requirement, and are completely voluntary. This proposal is to incorporate these two two-unit classes into the curriculum of each major.

One possibility is to simply add these courses as an additional requirement for each major. This would increase the total units above 180 units, which may not be desired. However, one could make the case that since these two two-unit courses are typically taken during freshman year in separate quarters, in addition to three “regular” courses, it may be that they do not affect time-to-degree much or at all.

Another approach, which was piloted by four majors (Chemical Engineering, Computer Engineering, Electrical Engineering, and Materials Science) for the winter 2020 offering of Engineering 2, is to allow the combination of Engineering 96 and Engineering 2 optionally to replace an existing GE requirement. The pilot allowed the combination of Engineering 96 and Engineering 2 to replace the Foundations of Society and Culture, Social Analysis requirement because Engineering 2 is entirely focused on social analysis and Engineering 96 provides a technology context to Engineering 2.

Another appropriate replacement might be the “Foundations of Scientific Inquiry” requirement, since the combination of Engineering 2 and Engineering 96 is an introduction to the Foundations of Scientific Inquiry in Science *and Technology*. However, this GE requirement is currently satisfied by a life sciences class, so it is currently a “life sciences” requirement.

Yet another alternative would be to allow students to take these two classes instead of some other departmental requirement.

Request for discussion:

Can you discuss these alternatives in your department to see if any of these options seems acceptable to your department:

1. Have the combination of Engineering 96 and 2 as an additional schoolwide requirement
2. Have the combination of Engineering 96 and 2 satisfy the social analysis GE requirement (as an option)
3. Have the combination of Engineering 96 and 2 satisfy the Foundation of Scientific Inquiry requirement (as an option)
4. Have the combination of Engineering 96 and 2 satisfy some other requirement in your major, such as an elective, (as an option)

Detailed discussion of Engineering 96

A wide variety of hands-on engineering courses targeted to freshmen have been introduced under the Engineering 96 course number and have been well-attended by Samueli undergraduate students.

In the spring of 2015 UCLA, Professor Oscar Stafsudd pioneered the first Engineering 96 course, which enabled freshman hands-on design through the implementation of digital imaging systems and algorithms. Professor Kaiser introduced a second innovative and ambitious Engineering 96 course in Fall 2015, which allowed freshmen to design and implement Internet of Things robots and sensors. Starting in Fall of 2016, we added letter suffixes to denote the topic area of the Engineering 96 course. Engineering 96A was created as an omnibus identifier for any new topic. Engineering 96B was used for Professor Stafsudd’s digital imaging course and Engineering 96C was used for Professor Kaiser’s Internet of Things course. The first use of Engineering 96A was by Professor Peter Reiher in spring 2017 to offer a computer science Engineering 96 experience.

In Fall of 2018, Professor Jake Schmidt, the newly appointed director of our Maker Space, launched a series of new freshman hands-on design projects under the Engineering 96A number initially including Go-Karts and Rockets. In the Winter of 2019, Professor Schmidt added Engineering 96A courses on 3D Pharmaceuticals, Electrocardiograms, Soap Synthesis, and Virtual Reality while continuing to offer the projects on Go-Karts and Rockets. In Fall 2019 the courses on Electrocardiogram, Go-Karts, and Rockets were renumbered as Engineering 96E, 96G, and 96R, respectively, and new topics were added as 96A courses including an Artificial Intelligence (AI) City, an Autonomous Rover, the design of a CubeSat Small Satellite, and the Design of Coffee.

Table 1 lists topics addressed in the various Engineering 96 course offerings from 2015-2019.

Table 1. E96 Courses Offered (2015-2019)

Course	Title, Instructor	Course Description
96	Introduction to Engineering Design	Introduction to engineering design while building teamwork and communication skills and examination of engineering majors offered at UCLA and of engineering careers. Completion of hands-on engineering design projects, preparation of short report describing projects, and presentation of results. Specific project details and relevant majors explored vary with instructor. May be repeated once for credit with topic or instructor change. (Initial general course number freshman design course)
96A	Introduction to Engineering Design	Introduction to engineering design while building teamwork and communication skills and examination of engineering majors offered at UCLA and of engineering careers. Completion of hands-on engineering design projects, preparation of short report describing projects, and presentation of results. Specific project details and relevant majors explored vary with instructor. May be repeated once for credit with topic or instructor change. (Omnibus course number for new topics)
Topics Offered Under the Omnibus 96A Number:		
96A	Computer Science (Reiher)	

96A	Go Karts (later became 96G, Schmidt)	
96A	Rockets (later became 96R, Schmidt)	
96A	3D Pharmaceuticals (Schmidt)	
96A	AI City (Schmidt)	
96A	Autonomous Rover (Schmidt)	
96A	CubeSat Small Satellite (Schmidt)	
96A	Design of Coffee (Schmidt)	
96A	Electrocardiogram (later became 96E, Schmidt)	
96A	Soap Synthesis (Schmidt)	
96B	Introduction to Engineering Design: Digital Imaging, Prof. Stafsudd	Recommended for undergraduate Aerospace Engineering, Bioengineering, Computer Science, Electrical Engineering, and Mechanical Engineering majors. Introduction to engineering design while building teamwork and communication skills and examination of engineering majors offered at UCLA and of engineering careers. Hands-on experience with state-of-art solid-state imaging devices. How to focus, expose, record, and manipulate telescopic images. Development of photographic technology from early chemical experiments to widespread use of cell phone camera. Completion of hands-on engineering design projects, preparation of short report describing projects, and presentation of results
96C	Introduction to Engineering Design: Internet of Things, Professor Kaiser	Introduction to engineering design while building teamwork and communication skills and examination of engineering majors offered at UCLA and of engineering careers. Hands-on experience with state-of-art Internet of things (IoT) technology to offer students opportunity to rapidly develop innovative and inspiring systems that provide ideal introduction to computing systems and IoT applications specific to their major field. IoT technology has become one of most important advances in technology history with applications ranging from wearable
96E	Introduction to Engineering Design: Electrocardiogram, Professor Schmidt	Students learn and use concepts and techniques in electrical circuit design and analysis, cardiac electrophysiology, biophysics, microcontrollers, and computer programming. Students work in teams to design, construct, and test circuit boards capable of measuring human electrocardiograms by capturing data with microcontroller, with computer analysis and display. Students present their designs orally and in writing. Letter grading.
96G	Introduction to Engineering Design: Go-Karts	Students learn and use concepts and techniques in electrical circuit design and analysis, cardiac electrophysiology, biophysics, microcontrollers, and computer programming. Students work in teams to design, construct, and test circuit boards capable of measuring human electrocardiograms by capturing data with microcontroller, with computer analysis and display. Students present their designs orally and in writing
96R	Introduction to Engineering Design: Rockets	Introduction to basic concepts in aerospace engineering, computer-aided design, finite element analysis, 3D printing, carbon fiber layup, telemetry, general mechanical design and assembly, and machine shop fabrication. Concepts applied to team-based design, construction, and testing of small 3D-printed rockets and larger, high-power rockets. Students present their designs orally and in writing and evaluate their performance against other student teams. Rockets fired from Mojave Desert launch site in class field trip. No prior experience or coursework needed. Study led by experienced undergraduate members of Bruin Rocket Project. Meetings, and design and fabrication homework, make use of Makerspace facilities and tools.

Table 2. Target Number of Sections and Total Number Offered by Academic Year

We would have offered even more sections during the 2019-2020 academic year, but many of the spring 2020 sections had to be cancelled due to the UCLA campus closure of in-person instruction in response to the COVID-19 pandemic. Indeed, it is likely that we will not meet our year-two goal of offering 30 sections because of the COVID-19 pandemic.

However, Professor Kaiser achieved a notable success in providing meaningful hands-on design experiences remotely to students enrolled in his spring 2020 Eng. 96C sections. Attached to this report is the exciting narrative of how he was able to support students remotely implementing projects related to the Internet of Things. We are therefore confident in the feasibility of offering the five sections of 96C this upcoming fall quarter even with instruction remaining remote because

of the pandemic. We are hoping to offer a wider variety of design projects in winter and/or spring of 2021 assuming that the pandemic abates.

The figures that follow describe our success increasing the number of course sections offered by term within each academic year to date across all Eng. 96 offerings (Figure 1), and the total number of students enrolled by term for each academic year (Figure 2). In addition, Figure 3 shows the course enrollment history across all Engineering 96 offerings—96, 96A, 96B, 96C, 96E, 96G, and 96R—beginning in fall 2015 to our projected offerings in fall 2020 of 96C.

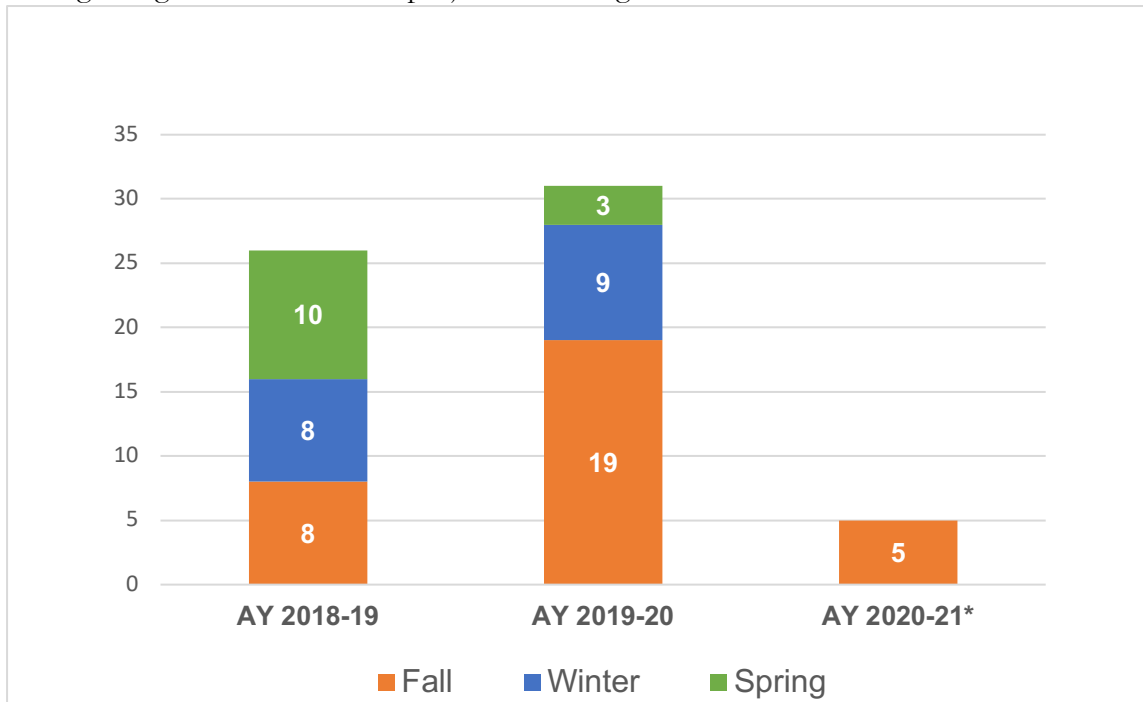
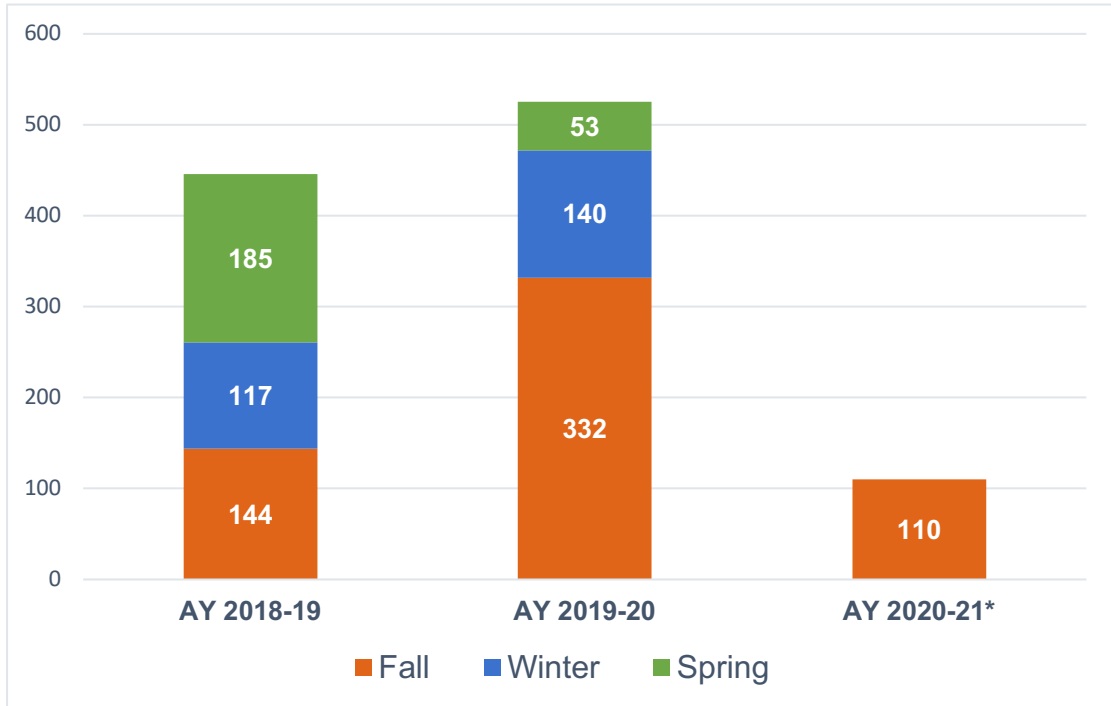


Figure 1: Engineering 96 course sections offered by term for academic years of interest.

*For AY 2020-21 only estimates for fall 2020 are shown.

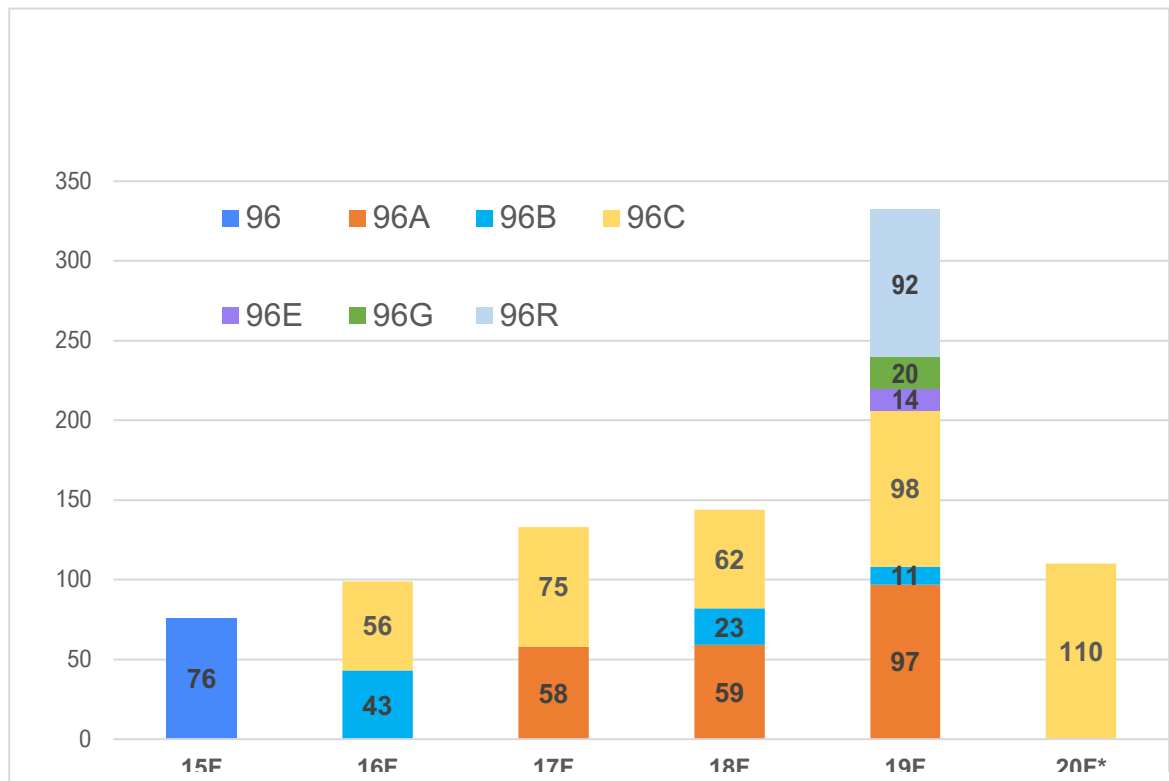
As previously noted, the decrease in the number of sections to be offered this fall 2020 (shown in figure 1 above) is a result of the campus closure caused by COVID-19. The only section of the series to be offered is 96C given its demonstrated adaptability to remote delivery as experienced in spring 2020 and fully described in a separate narrative.

Figure 3 shows the exponential growth of the overall Engineering 96 fall course enrollment following the increase in section offerings from 2015 through 2019. The noted drop in fall 2020 projected enrollment to 120 students compared to 332 enrolled in fall 2019 results from the decrease to only five sections of 96C offered due to pandemic conditions.



*For AY 2020-21 only estimates for fall 2020 are shown.

Figure 2: Engineering 96 course enrollments by term for academic years of interest.



*For AY 2020-21 only estimates for fall 2020 are shown.

Figure 3: Engineering 96 course enrollments for fall terms 2015-2019.

Pointer to Detailed discussion of Engineering 2

Engineering 2: Technology and Society is a two-unit course that provides an introduction to the broader societal opportunities, impacts, and challenges associated with technology. The course draws from both historical and contemporary examples, and considers some of the key ethical, policy, and legal questions spurred by rapid technological change. The course aims to help students develop a broad, contextualized view of the role of technology in society.

Attached to this email are the syllabus and course evaluations from the initial offering.