

The Civil Engineering Program at Santa Clara University

Mission

The Mission of the Department of Civil Engineering is to educate our students to prepare for careers in which they can contribute positively to the design, construction, maintenance and advancement of civil engineering-based systems critical to the quality of life in a changing world. We do this by providing students with the skills and tools necessary to understand the physical world, to apply this understanding to current and future needs of a sustainable society and to responsibly and ethically address the impacts that engineered systems can have on a community and its environment. As part of this process, the Department's faculty and students will advance the state of knowledge of the discipline through research, industrial collaboration, publication and relevant service to their profession and community.

Program Educational Objectives

The educational objectives developed by the Department for its undergraduate program reflect our commitment to providing a program that produces graduates who, within five years of graduation, will:

- **capably design, build, maintain, or improve civil engineering-based systems in the context of environmental, economic, and societal requirements,**
- **serve the community as ethical and responsible professionals, and**
- **engage in life-long learning for professional growth.**

These Program Educational Objectives have been approved by the Department's Industry Advisory Board.

Program (Learning) Outcomes

Learning outcomes describe the abilities, knowledge base, and characteristics that are expected of students at the completion of their undergraduate education. Satisfying these outcomes helps ensure that the aforementioned Program Educational Objectives will be met. Individual outcomes are detailed below.

1. Students will demonstrate:
 - a. an ability to apply knowledge of mathematics, science, and engineering
 - b. an ability to design and conduct experiments, as well as to analyze and interpret data
 - c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
 - d. an ability to function on multidisciplinary teams
 - e. an ability to identify, formulate, and solve engineering problems
 - f. an understanding of professional and ethical responsibility
 - g. an ability to communicate effectively
 - h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
 - i. a recognition of the need for, and an ability to engage in life-long learning
 - j. a knowledge of contemporary issues
 - k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
2. Students will be able to explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.
3. Students will be able to apply their knowledge of four technical areas within the general discipline of civil engineering. The technical areas can include structural, water resources, environmental, transportation, geotechnical, and construction engineering.
4. Students will develop an understanding of the mission of the University to produce graduates with competence, conscience, and compassion and its relation to professional engineering practice.



Department of Civil Engineering

Typical Program of Studies for Civil Engineering Students Entering the University as Freshmen During the 2016/2017 Academic Year

(FIRST TIME OFFERED)	FALL	WINTER	SPRING
FROSH	MATH 11 - CALC I CHEM 11 - CHEM I L&L (5) CRIT THINK WRITING I CENG 7 - GRAPH COMM L&L ENGR 1 - INTRO ENGR (2)	MATH 12 - CALC II PHYS 31 - PHYSICS I L&L (5) CRIT THINK WRITING II CULTURES & IDEAS I	MATH 13 - CALC III PHYS 32 - PHYSICS II L&L (5) CENG 10 - SURVEYING L&L CULTURES & IDEAS II
SOPH	MATH 14 - CALC IV PHYS 33 - PHYSICS III L&L (5) CENG 15 - COMP APL CE L&L (3) CENG 41 - STATICS	AMTH 106 - DIFF EQNS CENG 20 - GEOLOGY L&L (4) CENG 44A - STR MATLS L&L (4) ENGL 181 - TECH WRITING (4)	CENG 44B - STR MATLS (2) CENG 115 - MATERIALS L&L (5) CENG 132 - STR ANALYSIS ELEN 49 - POWER SYS or RTC 1
JUNIOR	CENG 121A - GEOTECH I L&L (4) CENG 145 - TRANS ENG DES CENG 148 - STRUCT SYS L&L (5) ELEN 49 - POWER SYS or RTC 1	AMTH 112 - RISK IN CIV ENGR CENG 121B - GEOTECH II (2) CENG 125 - MUNI ENG L&L CENG 141 - FLUIDS/HYDR L&L (5) CENG TECH ELECTIVE	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES L&L (5) CENG 143 - ENV ENG L&L (4) CENG 192A - CE PROJ DEV (1) CENG TECH ELECTIVE
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEV (1) CENG TECH ELECTIVE UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 193 - CE PROJ DESIGN (4) FLEX COURSE FLEX COURSE UNIV CORE REQUIREMENT	CENG 194 - CE DES COMM (1) FLEX COURSE UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT

Each course is 4 units unless a different number is shown in parentheses, above. One-unit labs are also indicated; where available, they must be taken together with the associated lecture course.

University CORE requirements for engineering students are detailed in the University Bulletin and the CORE Curriculum Handbook. This sample program, shown above, assumes that all CORE Curriculum requirements will be satisfied by ten required humanities courses in combination with other required program/major course work. Engineering students are expected to use a limited number of selectively chosen courses to satisfy multiple CORE Curriculum requirements to complete all degree program requirements in four years.

The 3 FLEX COURSES include a CENG technical elective, a computer applications course (CENG 160 – GIS (3) or CENG 182 – BIM (3)), and a free elective. A second computer applications course can be taken as an analysis elective. The 4 CENG TECHNICAL ELECTIVES must include at least two design-focused technical electives and one analysis-focused technical elective. Students should work with their academic advisor to select the electives that address their professional goals and help prepare them for their senior capstone design project.

CATEGORY I: CENG DESIGN-FOCUSED ELECTIVES:

CENG 119 - DES SUSTAIN CONSTRUCT	CENG 136 - ADV CONCRETE DES	CENG 144 - ENVIRON SYSTEMS DES
CENG 133 - TIMBER DES	CENG 137 - EARTHQUAKE ENGR DES	CENG 146 - COLD FORMED STEEL DES
CENG 134 - STEEL DES	CENG 138 - GEOTECH ENGR DES (4/1)	CENG 150 - TRAFFIC ENGR DES
CENG 135 - CONCRETE DES	CENG 142 - WATER RES DES	

CATEGORY II: CENG ANALYSIS-FOCUSED ELECTIVES:

CENG 118 - CONSTRUCTION ENGR (3)	CENG 151 - SPEC TOPICS TRANS ENGR	CENG 186 - CONST PLANNING
CENG 123 - ENVIRON REACTION ENG	CENG 160 - GIS WATER RESOURCES (3)	CENG 187 - CONST OPERATIONS
CENG 124 - WATER LAW & POLICY	CENG 161 - SUSTAINABLE WATER RES (3)	CENG 182 - INTRO TO BIM (3)
CENG 139 - GROUNDWATER HYDRO (3)	CENG 162 - COMP WATER RES (3)	
CENG 149 - CIVIL SYSTEMS ENGR	CENG 184 - CONST ADMIND (3)	

Sample Programs of Study for a Civil Engineering Sub-discipline Focus

Typical coursework for the first two years of study is provided in the General Program of Studies. Sample programs for an optional focus in a Civil Engineering sub-discipline are provided below. Students should work with a faculty advisor to finalize their selection of technical electives. A design technical elective must be substituted for one of the courses marked with a + and an analysis technical elective must be substituted for one of the courses marked with a *.

CONSTRUCTION ENGINEERING AND MANAGEMENT FOCUS			
JUNIOR	CENG 121A - GEOTECH (3/1) CENG 145 - TRANS ENGR DES CENG 148 - STR SYSTEMS (4/1) CENG 118 - CONST ENGR (3)	AMTH 112 - RISK IN CIVIL ENG CENG 121B - GEOTECH (2) CENG 125 - MUNICIPAL ENG (3/1) CENG 141 - FLUIDS/HYD (4/1) CENG 184 - CONST ADMIN (3) +	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES (4/1) CENG 143 - ENVIRON ENG (3/1) CENG 192A - CE PROJ DEVL (1) CENG 119 - DES SUST CONST
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEVL (1) CENG 186 - CONST PLANNING + ELEN 49 - POWER SYS or RTC 1 UNIV CORE REQUIREMENT	CENG 193 - PROJECT DESIGN (4) FLEX COURSE UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 194 - CE PROJ COMM CENG 187 - CONST OPERATIONS + UNIV CORE REQUIREMENT FLEX COURSE
THE 2 FLEX COURSES MUST BE A COMPUTER APPLICATIONS COURSE (CENG 169 OR 182) AND A UNIVERSITY CORE REQ.			
GEOTECHNICAL ENGINEERING FOCUS			
JUNIOR	CENG 121A - GEOTECH (3/1) CENG 145 - TRANS ENG CENG 148 - STR SYSTEMS (4/1) ELEN 49 - POWER SYS or RTC 1	AMTH 112 - RISK IN CIVIL ENG CENG 121B - GEOTECH (2) CENG 125 - MUNICIPAL ENG (3/1) CENG 141 - FLUIDS/HYD (4/1) CENG 135 - CONC DES (4/1)	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES (4/1) CENG 143 - ENVIRON ENG (3/1) CENG 192A - CE PROJ DEVL (1) CENG 138 - GEOT DES (4/1)
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEVL (1) UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT CENG TECH ELECTIVE	CENG 160 - GIS (3) CENG 193 - PROJECT DESIGN (4) CENG 137 - EQ ENG UNIV CORE REQUIREMENT	CENG 182 - BIM (3) CENG 194 - CE PROJ COMM (1) UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT
STRUCTURAL ENGINEERING FOCUS			
JUNIOR	CENG 121A - GEOTECH LL (3/1) CENG 145 - TRANS ENG CENG 148 - STR SYSTEMS (4/1) ELEN 49 - POWER SYS or RTC 1	AMTH 112 - RISK IN CIVIL ENG CENG 121B - GEOTECH (2) CENG 125 - MUNICIPAL ENG (3/1) CENG 141 - FLUIDS/HYD (4/1) CENG 135 - CONC DES (4/1) *	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES (4/1) CENG 143 - ENVIRON ENG (3/1) CENG 192A - CE PROJ DEVL (1) CENG 133 - TIMBER DES *
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEVL (1) CENG 134 - STEEL DES * UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 193 - PROJECT DESIGN (4) CENG 137 - EQ ENG DES * UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 182 - BIM (3) CENG 194 - CE PROJ COMM (1) CENG 138 - GEOT DES * (4/1) UNIV CORE REQUIREMENT
TRANSPORTATION ENGINEERING FOCUS			
JUNIOR	CENG 121A - GEOTECH LL (3/1) CENG 145 - TRANS ENG CENG 148 - STR SYSTEMS (4/1) ELEN 49 - POWER SYS or RTC 1	AMTH 112 - RISK IN CIVIL ENG CENG 121B - GEOTECH (2) CENG 125 - MUNICIPAL ENG (3/1) CENG 141 - FLUIDS/HYD (4/1) CENG 150 - TRAFFIC DES	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES (4/1) CENG 143 - ENVIRON ENG (3/1) CENG 192A - CE PROJ DEVL (1) CENG 151 - SPEC TOPICS TRAN +
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEVL (1) CENG 149 - CIVIL SYS ENG + UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 160 - GIS (3) CENG 193 - CE PROJ DESIGN (4) CENG TECH ELECTIVE UNIV CORE REQUIREMENT	CENG 194 - CE PROJ COMM (1) CENG 197 or 199 + UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT
WATER RESOURCES / ENVIRONMENTAL ENGINEERING FOCUS			
JUNIOR	CENG 121A - GEOTECH (3/1) CENG 145 - TRANS ENG CENG 148 - STR SYSTEMS (4/1) ELEN 49 - POWER SYS or RTC 1	AMTH 112 - RISK IN CIVIL ENG CENG 121B - GEOTECH (2) CENG 125 - MUNICIPAL ENG (3/1) CENG 141 - FLUIDS/HYD (4/1) CENG 123L or CENG 144	CENG 128 - ENGR ECON (3) CENG 140 - WATER RES (4/1) CENG 143 - ENVIRON ENG (3/1) CENG 192A - CE PROJ DEVL (1) CENG 142 or CENG 162
SENIOR	CENG 192B - CE PRACTICE (2) CENG 192C - CE PROF DEVL (1) CENG 139 or CENG 161 UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT	CENG 160 - GIS (3) CENG 193 - CE PROJ DESIGN (4) CENG 123 or CENG 144 UNIV CORE REQUIREMENT	CENG 194 - CE PROJ COMM (1) CENG 142, 162 or 124 UNIV CORE REQUIREMENT UNIV CORE REQUIREMENT
AT LEAST TWO DESIGN TECHNICAL ELECTIVES AND ONE ANALYSIS TECHNICAL ELECTIVE MUST BE SELECTED.			

Table 5-3. CORE Curriculum Requirements for Civil Engineering Majors

All SCU students must complete the University's CORE Curriculum. This thematic set of courses aims to instill the knowledge, habits of thought and action, and an orientation to society that the University believes will best prepare its graduates for personal and professional life after Santa Clara. Key components include the capacity for critical judgment, clear expression, ethical decision-making, and the concern for others; all of these being characteristic traits of a Jesuit education. The CORE Curriculum requirements listed below must be followed by all students entering the University as first-year students beginning with the fall term of the 2009-2010 academic year.

There are normally ten required humanities courses in the CORE Curriculum that all SCU students must complete. These courses satisfy the categorical requirements shown below. The CORE Curriculum web site and the CORE Curriculum Guide identify classes that fulfill each categorical requirement. Engineering students can complete one course that satisfies two of these requirements as long as the course has been approved for both CORE categories.

Critical Thinking and Writing I (CTW-I)	Religion, Theology and Culture I (RTC-I)
Critical Thinking and Writing II (CTW-II)	Religion, Theology and Culture II (RTC-II)
Cultures and Ideas I (C&I-I)	Religion, Theology and Culture III (RTC-III)
Cultures and Ideas II (C&I-II)	Ethics
Cultures and Ideas III (C&I-III)	Diversity

CORE Curriculum requirements for Mathematics, Natural Science (with lab), and Advanced Writing for all engineering students are satisfied by completing required civil engineering major coursework. In addition to the base requirements, students also must complete coursework that satisfies five additional learning outcomes. To finish the civil engineering major in a four-year period, these learning outcomes should be satisfied using either strategically selected base CORE courses (from the list above), pre-approved required or elective major courses, or a pre-approved combination of courses. The following table indicates the additional learning outcome topics and provides a listing of the pre-approved courses that can be used to satisfy each outcome.

Course Options for Specific, Supplemental Required CORE Curriculum Learning Outcomes				
Science, Technology And Society	Civic Engagement	Social Science	Arts	Experiential Learning
ENGL 181 & Capstone	ENGR 1 & Capstone	Various	ENGL 181 & Capstone	Various

The SCU CORE Curriculum also requires that engineering students complete an approved three-course (12-unit) Pathway or cluster of thematically linked courses. Students will take these courses from a pre-approved Pathway that is administered by an associated group of faculty members. The pre-approved Pathways will offer many more than three course offerings; it is up to each individual student and his/her faculty advisor to select the most appropriate courses for a particular major. The table provided below lists Pathway options and recommendations for civil engineering students. All courses must be taken within the same Pathway; no mixing and matching is allowed. Students must declare the Pathway that they intend to complete by the end of their sophomore year. Engineering students must take at least one Pathway course (minimum of four units) from outside their major department and any non-major Pathway course(s) should, where possible, satisfy other (base) CORE Curriculum requirements.

	Pre-approved Pathway Course Options/Recommendations for Civil Engineering Students			
	Digital Age	Sustainability	Values in Science & Technology	Design Thinking
Course #1	CENG 7	Two from CENG 20, 115, 119, 140, 143, 144, or 161	Two from CENG 115, 119, 140, 143, 144, or 161	8 units from CENG 119, 128, 148, 192A, or 193
Course #2	CENG 15			
Course #3	PHIL 3A or ENGR 19	PHIL 9 or RSOC 64	PHIL 9 or CHEM 11	PHIL 3A or ENGR 19

As part of the documentation (portfolio) requirements for the CORE Curriculum, students must submit a composite reflection paper during their senior year and three Pathway course-based papers that detail course projects. Formatting requirements and submission information will be made available to students at the appropriate time.