289K. Special Topics in Chemical Engineering: Advanced Transport Phenomena (1-5)
Lecture and/or laboratory. Prerequisite: consent of instructor. Special topics in Advanced Transport Phenomena. May be repeated for credit when topic differs. Offered irregularly. — F, W, S (F, W, S.)

289L. Special Topics in Chemical Engineering: Biomolecular Engineering (1-5)
Lecture and/or laboratory. Prerequisite: consent of instructor. Special topics in Biomolecular Engineering. May be repeated for credit when topic differs. Offered irregularly. — F, W, S (F, W, S.)

290. Seminar (1)

290C. Graduate Research Group Conference (1)
Discussion — 1 hour. Prerequisite: consent of instructor. Research problems, progress and techniques in chemical engineering. May be repeated for credit. ([S/U grading only] Offered irregularly. — F, W, S (F, W, S.)

294. Current Progress in Biotechnology (1)
Seminar — 1 hour. Prerequisite: graduate standing. Seminars presented by guest lecturers on subjects of their own research. May be repeated for credit. (Same course as Molecular and Cellular Biology 294.) ([S/U grading only] Offered irregularly. — F, W, S (F, W, S.)

298. Group Study (1-5)
Prerequisite: consent of instructor. Group study. ([S/U grading only] Offered irregularly. — F, W, S (F, W, S.)

299. Research (1-12)
Research. ([S/U grading only] Offered irregularly. — F, W, S (F, W, S.)

Professional

100. Teaching of Chemical Engineering (1)
Discussion — 1 hour. Prerequisite: qualifications and acceptance as teaching assistant and/or associate in chemical engineering. Participation as a teaching assistant or associate-in in a designated engineering course. Methods of leading discussion groups or laboratory sections, writing and grading quizzes, use of laboratory equipment, and grading laboratory reports. May be repeated two times for credit. ([S/U grading only] Offered irregularly. — F, W, S (F, W, S.)

Engineering: Civil and Environmental

[College of Engineering]
Amit M. Kanvinde, Ph.D., Chairperson of the Department 530-752-0586

Faculty
John E. Bolander, Ph.D., Professor Fabian A. Toledo, Associate Professor Ross W. Boulanger, Ph.D., Professor Colleen E. Bronner, Ph.D., Lecturer Christopher D. Cappa, Ph.D., Professor Y. H. (Rob) Chai, Ph.D., Professor Lijuan Cheng, Ph.D., Associate Professor Yannis F. Dokulas, Ph.D., Professor Jeannie L. Darby, Ph.D., Professor

Academic Senate Distinguished Teaching Award
Jason T. Delong, Ph.D., Professor

Youngue Fan, Ph.D., Professor

Alexander L. Forrest, Ph.D., Assistant Professor

John T. Harvey, Ph.D., Professor

Jonathan D. Herman, Ph.D., Assistant Professor

Miguel A. Jaller, Ph.D., Assistant Professor

Boris Jeremic, Ph.D., Professor

Amit M. Kanvinde, Ph.D., Professor

M. Levent Kavvas, Ph.D., Professor

Alissa Kendall, Ph.D., Associate Professor Michael J. Kleeman, Ph.D., Professor Sashi K. Kulkarni, Ph.D., Professor Bruce L. Kutter, Ph.D., Professor Frank J. Loge, Ph.D., Professor Jay R. Lund, Ph.D., Professor

Sabbie A. Milneal, Ph.D., Professor

Mark P. Moadra, Ph.D., Professor (Civil and Environmental Engineering: Mechanical and Aerospace Engineering)

Debbie A. Niemeier, Ph.D., Professor

Mark M. Rashid, Ph.D., Professor

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N. Sukumar, Ph.D., Professor

Anthony S. Wexler, Ph.D., Professor (Civil and Environmental Engineering: Mechanical and Aerospace Engineering: Land, Air and Water Resources)

Thomas M. Young, Ph.D., Professor

Bassam A. Younis, Ph.D., Professor

H. Michael Zhang, Ph.D., Professor

Emeriti Faculty
Takashi Asano, Ph.D., Professor Emeritus

Don O. Brush, Ph.D., Professor Emeritus

Daniel P. Y. Chang, Ph.D., Professor Emeritus

James A. Cheney, Ph.D., Professor Emeritus

Leonard R. Herrmann, Ph.D., Professor Emeritus

Academic Senate Distinguished Teaching Award

UC Davis Prize for Teaching and Scholarly Achievement

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Timothy R. Ginn, Ph.D., Professor Emeritus

Ian P. King, Ph.D., Professor Emeritus

Bruce E. Larson, Ph.D., Professor Emeritus

Miguel A. Marinho, Ph.D., Professor Emeritus

(Civil and Environmental Engineering: Land, Air and Water Resources)

Patricia L. Metcalfe, Ph.D., Professor Emeritus

Gerald T. Orlob, Ph.D., Professor Emeritus

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Melvin R. Ramey, Ph.D., Professor Emeritus

Karl M. Romstad, Ph.D., Professor Emeritus

Academic Senate Distinguished Teaching Award

Edward D. Schroeder, Ph.D., Professor Emeritus

Academic Senate Distinguished Teaching Award

Verne H. Scott, Ph.D., Professor Emeritus

Michael A. Taylor, Ph.D., Professor Emeritus

George Tchobanoglous, Ph.D., Professor Emeritus

Stefan Wurzer, Ph.D., Professor Emeritus

Affiliated Faculty
Norman A. Abrahamson, Ph.D., Adjunct Professor

Kenneth J. Loh, Ph.D., Adjunct Associate Professor

Patrick C. Lucia, Ph.D., Adjunct Professor

Brian H. Maroney, D. Engr., Adjunct Assistant Professor

The Civil and Environmental Engineering Programs

Mission. The Department of Civil and Environmental Engineering integrates research, education, and professional service in areas related to civil infrastructure and the environment. We provide the profession and academia with outstanding graduates who advance both engineering practice and fundamental knowledge.

Program Educational Objectives. The objectives of the Civil Engineering undergraduate program at the University of California, Davis are to produce civil and environmental engineers who (1) are proficient in the fundamentals of engineering science, analytical and computer reasoning, and design in the context of civil and environmental engineering, (2) are able to apply these skills in developing safe, sustainable, economical and environmentally sound solutions to civil engineering problems either within the profession or through post-graduate research, (3) grow professionally in their careers through continued development of technical and management skills, (4) achieve professional licensure, and assume the responsibilities of professional service, and (4) understand the needs and represent the diversity of the program’s constituencies*, thereby serving the needs of society and the profession.

*The constituency of the CEE program includes our students and those organizations or employers that might join during career paths spanning professional practice, education, and research. Specifically, these constituencies may include consulting firms and organizations, and state and federal agencies or laboratories, universities, community colleges, contractors, civil-product manufacturers and suppliers, and environmental organizations.

Study Abroad and Civil Engineering. The department offers courses in locations such as Ireland, Italy, and Japan through the Summer Abroad Program. Students may also complete a portion of the civil engineering program at an international institution, such as the University of Edinburgh, by participating in an Educational Abroad Program. The department encourages interested students to participate in both Summer Abroad and Education Abroad Programs. Please consult with the undergraduate staff advisor in 126-D for more information. Often students are in their junior or senior year of study when they participate in this option.

Civil Engineering Undergraduate Program

The Civil Engineering program is accredited by the Engineering Accreditation Commission of ABET; see http://www.abet.org.

Students are encouraged to adhere carefully to all prerequisite requirements. The instructor is authorized to drop students from a course for which stated prerequisites have not been completed. Exclusive of General Education units, the minimum number of units required for the Civil Engineering major is 52 (77 units in lower division and 75 units in upper division).

Lower Division Required Courses

UNITS
Mathematics 21A-21B 21C 21D 16
Mathematics 22A-22B 8
Physics 9A-9B 9C and choice of Physics 9D Chemistry 2C, Biological Science 2A or Geology 50-50L 19
Chemistry 2A 10
Civil and Environmental Engineering 3, 16
(Civil and Environmental Engineering 3 is designed for lower division students and is not open to upper-division students. Students who do not take this course will substitute four units of additional upper-division Civil and Environmental Engineering coursework.)

One course from: Civil and Environmental Engineering 19, Engineering 6, or Computer Science Engineering 30
Engineering 35, 45 or 45Y 8
English 3 or University Writing Program 1, 1V, or 1Y, or Comparative Literature 1, 2, 3, or 4, or Native American Studies 5 (grade of C- or better) 4
Communication 1 or 3

Upper Division Requirements:

Environmental Engineering. This area focuses on understanding and managing aspects of physical, chemical, and biological processes in natural and engineered systems. Areas of emphasis include improvement of air, land, and water quality in the face of increasing population, expanding industrialization, and global climate change. Examples of environmental engineering include innovative analytical and process design of air, water, wastewater, and solid waste treatment systems; mathematical modeling of natural and engineered systems; life cycle analysis; sampling, analysis, transport and transformation of natural and anthropogenic pollutants; and modeling of air pollutant emissions.
Civil Engineering

Upper Division Required Courses

Engineering 103, 104, 104L, 106*........... 12
Engineering 102 or 105........................ 4
Civil and Environmental Engineering 114, 190.............................. 6
One course from Civil and Environmental Engineering 115, 153; Mathematics 118A; or Statistics 108......................... 4
Civil & Environmental Engineering
Select one course from the following group options: ........................................... 14-17
Environment: Civil and Environmental Engineering 140 or 148A or 149
Geotechnical: Both Civil and Environmental Engineering 171 and 171 Lab
Structures: Civil and Environmental Engineering 130
Transportation: Civil and Environmental Engineering 161 or 163 or 165
Water Resources: Both Civil and Environmental Engineering 141 and 141 Lab

Civil & Environmental Engineering Depth
Select two courses from the following group options: ........................................... 15-16
Environment: Civil and Environmental Engineering 140, 148B, 150
Geotechnical: Civil and Environmental Engineering 173, 175, 179
Structures: Civil and Environmental Engineering 131, 132, 133, 136
Transportation: Civil and Environmental Engineering 161, 162, 179
Water Resources: Civil and Environmental Engineering 142, 144, 145, 146

Senior Design Requirement:
Must complete at least two of the following courses as part of the Civil & Environmental Engineering depth and elective:
Civil & Environmental Engineering 127, 136, 145, 148B, 150, 162, or 173
Civil & Environmental Engineering
electives.............................................. 20

Depth and elective:
Civil & Environmental Engineering electives may include any upper division, letter-graded Civil & Environmental Engineering course not already used towards another degree requirement, Engineering 102 or 105, and may include, but not exceed, a combination of six units from Civil & Environmental Engineering 198 and 199**

Upper Division Composition Requirement ......................................................... 0.4
One course from the following (grade of C- or better is required): Undergraduate Writing Program 101, 102E, 102G, 104A, 104E, 104T or passing the Upper Division Composition Exam.

*: No unit of coursework may be used to satisfy two different degree requirements, i.e., although a course may be listed in more than one category, that course may only satisfy one requirement.

**: A maximum of 4 units of upper-division courses outside of Civil & Environmental Engineering may be considered on a petition basis. Please consult with the undergraduate staff adviser.

Construction Engineering and Management Minor

To declare this minor program offered by the Department of Civil and Environmental Engineering, students must complete ENG 104 with a C- or better and submit a short personal statement focusing on academic and career goals. Additional advisees will be selected based on the availability of student seats in the major.

Construction Engineering and Management Minor

Construction Engineering and Management Minor

Civil and Environmental Engineering 137, 143, 153................................. 12
Twelve units from:
Civil and Environmental Engineering 179,
Agricultural and Resource Economics 112, 155, 157, 171A, 171B, Economics 134, 162, Environmental Science and Policy 161; may include one course from Agricultural and Resource Economics 18, Management 11A................................. 12

Minor advisers:
J.L. Darby, J.T. Harvey, J.R. Lund

Sustainability in the Built Environment Minor

All courses must be taken for a letter grade. A grade of C- or better is required for all courses used to satisfy minor requirements with an overall GPA in minor requirement courses of 2.00 or better.

Civil and Environmental Engineering 123, 143................................. 8
Twelve units from:
Civil and Environmental Engineering 125, 126, 127, 128, 148A, 149, 155, 162,
165, Engineering 188, Anthropology 101 (same as Environmental Science & Policy 101), 104N, Agricultural and Resource Economics 175, 176, Atmospheric Science 116, Community and Regional Development 142, 154, 157,
Environmental Science and Policy 161, 162, 171, Environmental Toxicology 101, 102A, Geology 130, 134, Landscape Architecture 3, 180*, Plant Sciences 101,
141, 150, 162, or 173

*: Due to variability in series course offering, consent of minor adviser is required.

Minor advisers:
F.J. Loge, A. Kendall

The Graduate Program in Civil and Environmental Engineering

M.S. and Ph.D.: Designated Ph.D. emphasis available in Biotechnology

http://cee engr uc davis edu/ 530 752 1441

With over thirty faculty members, over $20 million in annual research expenditures and over 200 graduate students, the Department of Civil and Environmental Engineering integrates research, education and professional services in areas related to civil infrastructure and the environment. Graduate students benefit from close working relationships with professors who are the leading international experts in their field. They are supported in their study and research by robust funding, and they have access to state-of-the-art research centers. For example, the Center for Geotechnical Modeling, http:// cgm engr uc davis edu/, has the largest centrifuge of its kind in the nation and gives researchers access to their peers at other unique centers via high-speed networks. Since 1960, researchers at the J. Amorcho Hydraulics Laboratory (JHLL) have served the state of California by solving ecological, biological, environmental and hydraulic engineering problems. Students may also have the opportunity to work in one of the many modern environmental engineering programs.
labs or the structural testing facilities in the department. Our graduates go on to serve the profession and academia by advancing the leading edge of fundamental knowledge, as well as engineering practice.

Generous financial support is available in the form of research assistancies, teaching assistancies, fellowships and financial aid. About 75% of the graduate students in our program are either fully or partially supported.

Research Highlights:
- Alternative fuel transportation infrastructure
- Earthquake engineering
- Environmental engineering
- Environmental planning and management
- Geotechnical engineering
- Hydraulics and fluid mechanics
- Hydrology
- Structural engineering
- Structural health monitoring
- Structural mechanics
- Systems planning and design
- Transportation engineering
- Transportation planning and design
- Water resources engineering

Research Facilities and Partnerships:
- Advanced Transportation Infrastructure Research Center
- Center for Geotechnical Modeling
- Center for Watershed Sciences
- Center for Water-Energy Efficiency
- Institute of Transportation Studies
- J. Amoroco Hydraulics Laboratory (JAHL)
- John Muir Institute of the Environment
- J. Amoroco Hydraulics Laboratory (JAHL)
- Tahoe Environmental Research Center
- Institute of Transportation Studies
- Center for Water-Energy Efficiency Center

Complete information on our website.

Courses in Engineering:
Civil and Environmental (ECI)

Lower Division

3. Civil Infrastructure and Society (4)
Lecture—4 hours; laboratory—3 hours. Prerequisite: Mathematics 21A (may be taken concurrently). Pass One restricted to lower division students; Civil Engineering majors. Introduction to civil infrastructure and its relationship with society and the natural environment. Exposure to innovative research on civil engineering and environmental systems. Participation in laboratory experiments illustrates the solution of representative but simplified engineering problems. Not open for credit to upper division students. GE credit: SciEng or SocSci [OL, SE or SS].—F. (F.) Darby

16. Spatial Data Analysis (2)
Lecture—2 hours. Prerequisite: Physics 9A (may be taken concurrently). Restricted to Civil Engineering and Biological Systems Engineering majors; non-majors accommodated on a space-available basis. Computer-aided design and geographic information systems in civil engineering practice. GE credit: SciEng [QIL, SE].—S. (S.) Fa, Bronner

17. Surveying (2)
Lecture—2 hours. Prerequisite: Physics 9A (may be taken concurrently). Restricted to Civil Engineering and Biological Systems Engineering majors; non-majors accommodated on a space-available basis. Theory behind and description of modern methods of land surveying in Civil Engineering. Offered irregularly. GE credit: SciEng [SE].

19. C Programming for Civil and Environmental Engineers (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: Mathematics 21A (may be taken concurrently). Pass One open to Civil Engineering majors and Optical Science and Engineering majors. Computational problem solving for Civil and Environmental Engineering applications using structured C programming. Algorithm design applied to realistic problems. Offered irregularly. GE credit: SciEng [SE].—Jeronimo

90X. Lower Division Seminar (1-4)
Seminar—1-4 hours. Prerequisite: consent of instructor. Examination of a special topic in a small group setting. May be repeated for credit. GE credit: SciEng [SE].

92. Internship in Engineering (1-5)
Internship. Prerequisite: Lower division standing; approval of project prior to period of internship. Supervised work experience in civil engineering. May be repeated for credit. (P/NP grading only.) GE credit: SE.

98. Directed Group Study (1-5)
Prerequisite: consent of instructor and lower division standing. (P/NP grading only.) GE credit: SE.

99. Special Study for Undergraduates (1-5)
Prerequisite: consent of instructor; lower division standing. (P/NP grading only.) GE credit: SE.

Upper Division

114. Probabilistic Systems Analysis for Civil Engineers (4)
Lecture—4 hours. Prerequisite: C or better in Mathematics 21C. Probabilistic concepts and models in engineering. Statistical analysis of engineering experimental and field data. Introduction to stochastic processes and models of engineering systems. Not open for credit to students who have completed Statistics 120. GE credit: SciEng [QIL, SE].—W, S. (W, S.)

115. Computer Methods in Civil & Environmental Engineering (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: Engineering 9 or Computer Science Engineering 30, and Mathematics 22B. Open to Civil Engineering majors only. Presentation, implementation and application of numerical algorithms and computer models for the solution of practical problems in Civil and Environmental Engineering. GE credit: SciEng [SE].—S. (S.) Sukumar, Younis

119. Parallel Processing for Engineering Applications (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: C programming or consent of instructor. Fundamentals of parallel computing for engineering applications; emphasis on structured parallel programming for distributed memory parallel clusters. Not open for credit to students who have completed course 119B. Offered irregularly. GE credit: SciEng [SE].—Kleeman, Jeremic

123. Urban Systems and Sustainability (4)
Lecture—4 hours. Prerequisite: upper division standing. Systems-level approach of how to evaluate and modify sustainability of urban systems based on interaction with natural environments. Topics include: definition/metrics of urban sustainability; system analyses of urban systems; understanding, policy, legislation; measures and modification of ecofootprints. GE credit: SciEng or SocSci, Div. Wrt1 ACHG, DD, SE, SL, SS, VE. —S. J. Kendall

125. Building Energy Performance (4)
Lecture—4 hours. Prerequisite: upper division standing in Engineering. Open to students in the College of Engineering. Mechanisms of energy consumption in buildings including and uses, thermal loads, ventilation, air infiltration, thermal energy distribution, HVAC systems; energy performance simulation; methods and strategies of energy efficiency. Offered in alternate years. GE credit: SciEng [SE].—(S.) Modera

126. Integrated Planning for Green Civil Systems (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: Physics 9C or Landscape Architecture 60 or Design 145 or Environmental Science and Policy 100 or Nature and Culture 120 or Anthropology 100 or Statistics 32 or Plant Sciences 101; consent of instructor. Working within multidisciplinary teams, a heuristic learning environment, and multiple realistic constraints, an integrated design process will be applied to the planning of a project-based green and sustainable civil system. Offered irregularly. GE credit: SciEng [SE].

127. Integrated Design for Green Civil Systems: Senior Design Experience (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 126; consent of instructor. Restricted to senior level standing. Working within multidisciplinary teams and a heuristic, project-based learning environment, a green and sustainable civil system will be designed. Evaluate various design options under architectural, structural, cost and environmental constraints, and present designs through oral and written presentations. Offered irregularly. GE credit: SciEng [SE].

128. Integrated Construction for Green Civil Systems (4)
Lecture—2 hours; laboratory—6 hours. Prerequisite: course 127. Working within multidisciplinary teams, a heuristic learning environment, and multiple realistic constraints, an integrated design process will be applied to the construction of a project-based green and sustainable civil system. Offered irregularly. GE credit: SciEng [SE].

130. Structural Analysis (4)
Lecture—4 hours. Prerequisite: C or better in Engineering 104; Mathematics 22A. Open to Civil Engineering majors. Elastic structural analysis of determinate and indeterminate trusses, beams and frames. Plastic bending and limit analysis. GE credit: SciEng [QIL, SS].—W, S. (F. S.)

131. Matrix Structural Analysis (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: C or better in Engineering 104; Engineering 6. Open to Engineering majors only. Matrix formulation and computer analysis of statically indeterminate structures. Stiffness and flexibility formulations for elastic structures. Finite element methods for elasticity and bending problems. Offered irregularly. GE credit: SciEng [SE].—S.

132. Structural Design: Metallic Elements (4)
Lecture—4 hours. Prerequisite: course 130. Design of metallic beams, columns, and other members for various types of loading and boundary conditions; design of connections between members; member performance within structural systems. GE credit: SciEng [QIL, SS].—VL, —F. (W.) Bolander, Kanivendi

135. Structural Design: Concrete Elements (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 130. Restricted to Civil Engineering, Civil Engineering/Materials Science and Engineering, and Materials Science and Engineering majors only. Strength design procedures for columns, rectangular beams, T-beams and I-beams; cross section design. Building code requirements for bending, shear, axial load, combined stresses and bond. Introduction to prestressed concrete. GE credit: SciEng [QIL, SE].—W, (W.) Chai

136. Building Design: Senior Design Experience (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 130 or 131; course 135 or 132. Restricted to senior level standing. Design of a building structure for a specific need under the multiple constraints of safety, serviceability, cost and aesthetics. Offered irregularly. GE credit: SciEng [SE].—S.

137. Construction Principles and Project Management (4)
Lecture—3 hours; laboratory—3 hours. Restricted to upper division standing in Engineering. Project management, with civil engineering construction and
design applications, including project scope, sched- 
ule, resources, cost, quality, risk, and control. Con- 
struction industry overview. Interactions between 
planning, design, construction, operations. Construc-
tion operations analysis. Contract issues. Project 
management software, field trips, guest lectures. Of-

138. Earthquake Loads on Structures (4) 
Lecture—3 hours; discussion—1 hour. Prerequisite: 
course 130 and determination of loads on struc-
tures due to earthquakes. Methods of estimating 
equivalent static lateral forces; response spectrum 
and time history analysis. Concepts of mass, damping 
and stiffness in structural designs. Design for 
inelastic behavior. Numerical solutions and Code 
requirements. GE credit: SciEng | SE. — W. (S.) Kuna-

139. Advanced Structural Mechanics (4) 
Lecture—3 hours. Prerequisite: Civil Engineering 104. 
Review of stress, strain, equilibrium, compatibility, 
and elastic material behavior. Plane stress and plane 
strain problems in elasticity; energy 
methods. Theories for unsymmetric bending, straight 
and curved beams. Beams on elastic foundations; 
stresses in plates and shells; elastic stability. Offered 
irregularly. GE credit: SciEng | SE. — Rashid, Su-

140. Environmental Analysis of Aqueous 
Systems (3) 
Lecture—3 hours. Prerequisite: Chemistry 2B. Intro-
duction to chemical principles underlying current 
practices in sampling and analysis of water and 
water, and waste water. GE credit: SciEng | SE. — F. (F.) Darby, Young

140L. Environmental Analysis of Aqueous 
Laboratory (1) 
Laboratory—3 hours. Prerequisite: Chemistry 2B or 
the equivalent; course 140 (may be taken concur-
rently). Restricted to Civil Engineering undergraduate 
and graduate students. Introduction to "wet chemi-
cal" and instrumental techniques commonly used 
in the examination of water and wastewater and 
associated data analysis. Offered irregularly. GE credit: 
SciEng | SE. — F. Darby

141. Engineering Hydraulics (3) 
Lecture—3 hours. Prerequisite: C or better in Engi-
neering 103. Nature of flow of a real fluid; flow 
in pipes; open channel flow; turbomachinery; fluid 
forces on objects: boundary layers, lift and drag. GE credit: 
SciEng | SE. — F. (F. W.) Bombardelli, Schladow, Young

141L. Engineering Hydraulics Laboratory (1) 
Laboratory—3 hours. Prerequisite: course 141 (may 
be taken concurrently). Open to Engineering stu-
dents only. Laboratory experiments and demonstra-
tions on flow measurement, sluice gates, hydraulic 
jump, flow characteristics, and centrifugal pumps. 
GE credit: SciEng | SE. — F. (F. W.) Bombardelli, Schladow, Young

142. Engineering Hydrology (4) 
Lecture—4 hours. Prerequisite: course 141 (may 
be taken concurrently). Restricted to students in the 
College of Engineering; open to Engineering stu-
dents only. Applications and problems in hydrology 
and water resource operations. GE credit: SciEng | QL, SE. — F. (F.) Kavvas

143. Green Engineering Design and 
Sustainability (4) 
Lecture—3 hours; discussion—1 hour. Prerequisite: 
Civil Engineering 106; course 148A. Restricted to upper 
division standing; Pass One Restricted to Civil Engi-
neering majors. Application of concepts, goals and 
metrics of sustainability, green engineering and 
industrial ecology to engineering design. Other 
course topics include life-cycle assessments, analysis 
of environmental management systems, and econom-
ics of pollution prevention and sustainability. GE credit: SciEng | QL, SE. — W. (W.) Bronner

144. Groundwater Systems Design (4) 
Lecture—4 hours. Prerequisite: course 141. Ground-
water occurrence, distribution, and movement; 
groundwater flow systems; radial flow to wells and 
aquifer testing; contamination; transport of 
groundwater; fate and transport of subsurface 
contaminants. Soil transport by groundwater; fate 
and transport of subsurface contaminants. Ground-
water supply and transport modeling. GE credit: 
SciEng | SE. — W. (W.) Bronner

144L. Groundwater Systems Design 
Laboratory (1) 
Laboratory—3 hours. Prerequisite: course 144. 
taken concurrently. Computer modeling of ground-
water flow under regional gradients. Introduction/ 
withdrawal, and natural and engineered boundary 
conditions. Use of Groundwater Vistas computer pro-
gram. Offered irregularly. — Ginn

145. Hydraulic Structure Design: Senior 
Design Experience (4) 
Lecture—2 hours; discussion—1 hour; laboratory—3 
hours. Prerequisite: C or better in course 141. 
Restricted to senior level standing. Project-based 
course covering the design of an integrated urban 
drainage system, including consideration of design 
alternatives, multiple realistic constraints (public 
safety, economic, environmental, sustainability and 
health), quantities for hydraulic modeling, modelinig 
codes and standards, design drawings and specifi-
cations and cost analysis. Offered irregularly. GE 
credit: SciEng | SE. — S. (S.) Young

146. Water Resources Simulation (4) 
Lecture—4 hours. Prerequisite: Engineering 103. Computer simulation techniques in the 
analysis, design and operation of surface water 
systems; modeling concepts and practices with 
application to surface runoff; water quality in rivers 
and streams and dispersion of contaminants in water 
bodies. GE credit: SciEng, Wrt | SE. — W. (W.) Bom-
bardelli, Young

148A. Water Quality Management (4) 
Lecture—4 hours. Prerequisite: C or better in Chem-
istry 2B. Basic concepts of water quality measure-
ments and regulations. Introduction to physical, 
biological and chemical processes in natural waters. 
Fundamentals of mass balances in water and waste-
treatment. GE credit: SciEng | SE. — W. (W.) 
Bronner, Young

148B. Water and Wastewater Treatment 
System Design: Senior Design Experience (4) 
Lecture—3 hours; laboratory—3 hours. Prerequisite: 
C or better in Engineering 103 and course 148A. 
Restricted to senior level standing. Design and evalua-
tion of wastewater treatment systems. GE credit: 
SciEng | QL, QL, VL, WE. — S. (S.) Darby

149. Air Pollution (4) 
Lecture—3 hours; discussion—1 hour. Prerequisite: 
Mathematics 21D, 22B; C or better in Chemistry 2B. 
Atmospheric Science 121A or C or better in Engineering 
103. Physical and technical aspects of air pollution. 
GE credit: SciEng | QL, SE, VL, WE. — S. (S.) Darby

150. Air Pollution Control System Design: 
Senior Design Experience (4) 
Lecture—3 hours; discussion—1 hour. Prerequisite: 
C or better in Atmospheric Science 149 or course 
149. Restricted to senior standing. Design and evalua-
tion of air pollution control devices and sys-

153. Deterministic Optimization and 
Design (4) 
Lecture—3 hours; laboratory—3 hours. Prerequisite: 
Mathematics 21C and 22A; computer programming 
course. Operations research. Optimization tech-
niques such as linear, integer, dynamic 
grandming, and non-linear programming.

Applications in civil engineering disciplines, includ-
ing multiple realistic constraints, through computer-
based design projects. GE credit: SciEng | QL, SE. — F. (F.) Fan

155. Water Resources Engineering 
Planning (4) 
Lecture—4 hours. Prerequisite: Engineering 106 or 
Economics 1A. An introduction to water resources 
planning concepts, role of engineering, economic, envi-
ronmental and social information and analysis; 
institutional, political and legal aspects. Case studies 
and computer models illustrating the planning of water 
resource systems. GE credit: SciEng or SocSci, 
Wrt | QL, SE or SS, VL. — S. (W.) Herman, Lunn

161. Transportation System Operations (4) 
Lecture—3 hours; discussion—1 hour. Prerequisite: 
C or better in both Mathematics 21C and Physics 
9A. Principles of transportation system operations; 
traffic characteristics and methods of measurement; 
models of transportation operations and congestion 
applied to urban streets and freeways. GE credit: 
SciEng | QL, SE. — F. (F.) Zhang

162. Transportation Land Use Sustainable 
Design: Senior Design Experience (4) 
Lecture—3 hours; laboratory—3 hours. Prerequisite: 
C or better in course 141. Restricted to senior level standing. 
Interactions between land use and transportation systems design. 
Generalized design paradigm; project-based solu-
tions for transportation land use. Students will select 
from various strategies to satisfy multiple constraints 
including cost, effectiveness and environmental sus-
tainability. Oral, poster and written presentations 
required. GE credit: SciEng | SE, SL. — S. (S.) Nie-
meier

163. Energy and Environmental Aspects 
of Transportation (4) 
Lecture—3 hours; extensive writing. Prerequisite: 
Economics 1A or Engineering 106. Engineering, 
economic, and systems planning concepts. Analysis 
and evaluation of energy, air quality and selected 
environmental attributes of transportation technolo-
gies. Strategies for reducing pollution and petroleum 
consumption in light of institutional and political con-
straints. Evaluation of vehicle emission models, 
(Same course as Environmental Science and Policy 
163.) Offered in alternate years. GE credit: SciEng or 

165. Transportation Policy (3) 
Lecture—3 hours. Transportation and associated 
environmental problems confronting urban areas, 
and prospective technological and institutional solu-
tions. Draws upon concepts and methods from eco-
nomics, engineering, political science and 
environmental studies. Offered in alternate years. 
GE credit: SciEng or SocSci, Wrt | QL, SE or SS. — 
(F.) Spering

171. Soil Mechanics (4) 
Lecture—4 hours. Prerequisite: C or better in Engi-
neering 104; Engineering 103 (may be concurrent); 
course 171L requiring students to 1. Engine-
ing and Civil Engineering/Materials Science 
and Engineering majors only. Soil formations, mass-
volume relationships, soil classification, effective 
stress, soil-water-void relations, or saturation, 
seepage, capillarity, compressibility, consolidation, 
strength, states of stress and failure, lateral ear-
thy pressures, and slope stability. GE credit: 
SciEng | SE. — F. (F. S.) Kuver

171L. Soil Mechanics Laboratory (1) 
Laboratory—3 hours. Prerequisite: course 171 must 
be taken concurrently. Laboratory studies utilizing 
standard testing methods to determine physical, 
mechanical and hydraulic properties of soils; valida-
tion and demonstration of basic principles of soil behavior. 
GE credit: SciEng | SE. — F. (F. S.) Kutter

173. Foundation Design: Senior Design 
Experience (4) 
Lecture—4 hours. Prerequisite: course 171. 
Restricted to senior level standing. Soil exploration 
and determination of properties for design; design of 
shallow and deep foundations for bearing capac-
ities and settlements; design of retaining structures;
187. Selected Topics in Civil Engineering: Geotechnical Earthquake Engineering (4)
Lecture—4 hours. Prerequisite: consent of instructor. Directed group study in Geotechnical Earthquake Engineering. May be repeated for credit when the topic is different. GE credit: SciEng | SE.—F, W, S. (F, W, S.)

189. Selected Topics in Civil Engineering: Transportation Planning (1-5)
Lecture—4 hours. Prerequisite: course 122A. Application to linear and non-linear structural mechanics problems; linear elasticity, weak form, and finite element approximation. Incompressible media problems. Non-linear problems with material nonlinearity.—S. (S.) Sukumar

213. Analysis of Structures Subjected to Dynamic Loads (4)
Lecture—4 hours. Prerequisite: course 211 (may be taken concurrently). Analysis of structures subjected to earthquake, wind and blast loading; distributed, consistent and lumped mass techniques; computer implementation; non-linear response spectrum; frequency and time domain analysis; seismic protection of structures; numerical methods in linear and nonlinear structural dynamics.—F. (F.) Abrahamson

214. Probabilistic Seismic Hazard Analysis and Design Ground Motions (4)
Lecture—4 hours. Probabilistic seismic hazard analysis for use in developing design spectra and for seismic risk analyses, including the development of earthquake ground motion time histories for use in dynamic analyses of structures. Offered in alternate years.—F. (F.) Abrahamson

215. Theory of Plates and Introduction to Shells (3)
Lecture—3 hours. Prerequisite: course 201 (may be taken concurrently). Development of classical and refined plate theories. Application to isotropic, orthotropic and composite plates. Solutions for rectangular and circular plates. Membrane theory for axisymmetric shells and bending of circular shells.

223. Advanced Dynamics, Signal Processing, and Smart Structures Technology (4)
Lecture—4 hours. Prerequisite: course 213 or equivalent. Signal processing and system identification of structures under dynamic excitations; Fourier and Laplace transforms; data acquisition and sensor design fundamentals; sensor technologies/techniques for nondestructive evaluation; structural control; actuators and dampers for smart structures; piezoelectrics and acoustic emissions; micro- and nano-fabrication.

232. Advanced Topics in Concrete Structures (4)
Lecture—4 hours. Prerequisite: courses 130 or 131, 138 and graduate standing. Durability of reinforced concrete; strength of two-way slabs; modified compression field theory.—S. (S.) Chai

233. Advanced Design of Steel Structures (4)
Lecture—4 hours. Prerequisite: courses 130 or 131, 132. Review of Load and Resistance Factor Design (LRFD); steel-plate girder design; plastic design of indeterminate systems; moment frames and bracing systems; connection design; seismic design of steel structures; vibration of flooring systems; steel-concrete composite design.—S. (S.) Bolander
234. Prestressed Concrete (4)
Lecture—4 hours. Prerequisite: courses 130 or 135, 139, or the equivalent. Survey of materials and section design; analysis of prestress effects; and design for shear and torsion; deflection control; posttensioning systems; prestress losses; flexural design; elastic design; and analysis of concrete behavior. Offered in alternate years. —Bolander

235. Cement Composites (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: Engineering 104. Applications of cement composites; mixing; mixing technology and proportioning; component and composite properties; hydration reactions and microstructure development; mechanisms of failure; nondestructive test methods; fiber reinforced cement; concrete durability; novel reinforcing materials; ferrocement; repair and retrofit technologies; applications to structural design. Offered in alternate years. —W. Bolander

236. Design of Fiber Reinforced Polymer Composite Structures (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 135. Basics of mechanics and design of polymer matrix composites; composite classification, manufacturing process, micromechanical property determination, classical lamination theory, strength determinations, classical lamination theory, strengthening and retrofitting of existing reinforced concrete structures. —S. Cheng

237. Bridge Design (4)
Lecture—4 hours. Prerequisite: courses 130, 135; course 234 recommended. Open to graduate students only. Bridge types, behavior and construction characteristics; design philosophy, details; methods according to Caltrans and American Association of State Highway and Transportation Officials codes, principles of seismic design and assessment of concrete bridges; modern bridges using advanced fiber reinforced polymer composites; fieldtrip required. —S. Cheng

238. Performance-Based Seismic Engineering (4)
Lecture—4 hours. Prerequisite: Courses 138 and 213. Modern seismic design; performance-based seismic design; seismic hazard; seismic demands: linear and nonlinear procedures; performance-based assessment; deterministic and probabilistic procedures; review of FEMA-350, FEMA-356, ATC-40 and other performance-based guidelines. —W. Kunnath

240. Water Quality (4)

241. Environmental Reactive Chemical Transport Modeling (4)
Lecture—4 hours. Prerequisite: Chemistry 2A, or Chemistry 2B, or course 149, or equivalent. Model reactive chemical transport in air and water including kinetic reactions, equilibrium reactions, and processes biasing transport. Emphasis on numerical solution schemes and programming techniques to provide deeper insight into model performance and limitations. Offered in alternate years. —S. S Kleeman

242. Pilot Plant Laboratory (4)
Lecture—4 hours. Prerequisite: Engineering 105, course 141, 149 or the equivalent. Factors determining air quality. Effects of air pollutants. Physical and chemical fundamentals of atmospheric transport and reaction processes. Introduction to dispersion modeling. Offered in alternate years. —F. (J) Kleeman

243A. Water and Waste Treatment (4)
Lecture—4 hours. Prerequisite: course 148A or the equivalent. Characteristics of water and airborne waste treatment processes and process kinetics; design system treatment. —F. (F).

243B. Water and Waste Treatment (4)
Lecture—4 hours. Prerequisite: course 243A. Continuous operation of course 243A. Aerobic, anaerobic, biological processes and biological treatment systems. —W. (W) Loge

243L. Pilot Plant Laboratory (4)
Lecture—1 hour; discussion—1 hour; laboratory—6 hours. Prerequisite: course 243A and 243B (may be taken concurrently). Laboratory investigation of physical, chemical, and biological processes for water and waste-water treatment. —W. (W) Darby

244. Life Cycle Assessment for Sustainable Engineering (4)
Lecture—4 hours. Prerequisite: graduate standing. Life cycle assessment methodology is taught emphasizing applications to infrastructure and energy systems. Life cycle design, life cycle cost methods, other tools from industrial ecology, and links to policy are covered as well. —(F) Kendall

245A. Applied Environmental Chemistry: Inorganic (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Engineering 105, Chemistry 2B or the equivalent, course 140, Chemistry 2C or 107A recommended. Chemistry of natural and polluted waters. Topics include chemical thermodynamics, principles, redox reactions, gas solution and solid-solution equilibria, thermodynamics, carbonate systems, coordination chemistry, interfacial phenomena. Offered in alternate years. —S. Young

245B. Applied Environmental Chemistry: Organic (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Chemistry 128A, 128B, 128C, or the equivalent; Chemistry 2C or 107A recommended. Transport and transformation of organic chemicals in the environment. Topics include application of thermodynamics to predict solubility and activity coefficients, distribution of organic chemicals between the aqueous phase and air, solid, or solid phases; chemical, photobiological and chemical transformation reactions. Offered in alternate years. —S. Young

246. Pilot Plant Laboratory (4)
Lecture—1 hour; discussion—1 hour; laboratory—6 hours. Prerequisite: course 243A, 243B (may be taken concurrently) or consent of instructor, graduate standing. Laboratory investigation of physical, chemical, and biological processes for water and waste-water treatment. —W. (W) Darby

246N. Understanding Climate Change: Causes and Consequences (4)
Lecture—4 hours. Open to graduate students. Diverse processes that control climate and drive climate change. Observational, experimental and modeling techniques and methods used in the development of our scientific understanding of the Earth system. —S. (J) Coopa

247. Aerosols (4)
Lecture—4 hours. Prerequisite: Engineering 103, 105, course 141, 149. Behavior of airborne particles including particle formation, modification, and removal processes. Offered in alternate years. —F. Kleeman

247L. Aerosols Laboratory (4)
Lecture—2 hours; laboratory—6 hours. Prerequisite: course 247. Methods of generation and characterization of aerosols. Techniques include flow rate measurement, aerosol generation, aerosol collection, ions measurement, metals measurement, and carbon measurement. May be repeated one time for credit. —Kleeman

248. Biofilm Processes (4)
Lecture—4 hours. Prerequisite: Soil Science 111 or 211 or course 243B or consent of instructor; calculus and basic cell molecular biology recommended. Natural and engineered biofilms, including biofilm occurrence and development, spatial structure, microbial processes, fundamental and applied research tools, biofilm reactors, beneficial uses, and detrimental effects.

249. Probabilistic Design and Optimization (4)
Lecture—4 hours. Prerequisite: courses 114 and 153 and Engineering 106, or equivalents. Design by optimization for probabilistic systems, decision theory, the value of information, probabilistic linear programming, probabilistic nonlinear optimization, and probabilistic nonlinear optimization. Applications in civil engineering design, project evaluation, and risk management. Offered in alternate years. —W. Lund

250. Civil Infrastructure System Optimization and Idemtification (4)
Lecture—4 hours. Prerequisite: Mathematics 21C, 22A, programming course; Applied Science Engineering 115 and mathematical modeling course recommended. Applied mathematics with a focus on modeling, identifying and controlling dynamic, stochastic, and underdetermined systems. Applications in transportation networks, water resource planning, and other civil infrastructure systems. Offered in alternate years. —(S) Fan

251. Transportation Demand Analysis (4)
Lecture—4 hours. Prerequisite: course 114 or the equivalent. Procedures used in urban travel demand forecasting. Principles and assumptions of modeltrip generation, trip distribution, model split. New methods of estimating travel demand. Computer exercises using empirical data to calibrate models and forecast travel demand. —(F) (J) Nie-meyer

252. Sustainable Transportation Technology and Policy (3)
Lecture—2 hours; discussion—1 hour. Prerequisite: course 165. Role of technical fixes and demand management in creating sustainable transportation system. Emphasis on technology options, including alternative fuels, electric propulsion, and IVHS. Analysis of the transportation demand market and market demand impacts, environment impacts, economics and politics. (Same course as Environmental Science and Policy 252.) Offered in alternate years—S. Sperling

253. Dynamic Programming and Multistage Decision Processes (4)
Lecture—4 hours. Prerequisite: Mathematics 21C, 22A, programming course; Applied Science Engineering 115 recommended. Operations research. Optimization techniques with a focus on dynamic programming in treating deterministic, stochastic, and adaptive multistage decision processes. Brief review of linear programming and nonlinear programming. Applications in transportation networks and other civil infrastructure systems. —(S) Fan

254. Discrete Choice Analysis of Travel Demand (4)
Lecture—4 hours. Prerequisite: course 114. Behavioral and statistical principles underlying the formulation and estimation of discrete choice models. Practical application of discrete choice models to characterization of choice behavior, hypothesis test- ing, and forecasting. Emphasis on computer exer- cises using real-world data sets. (Same course as Geography 279.)

256. Urban Traffic Management and Control (4)
Lecture—4 hours. Prerequisite: course 114. Basic concepts, models, and methods related to the branch of traffic science that deals with the move- ment of vehicles on a road network, including travel speed, travel time, congestion concepts, car-following and hydrodynamic traffic models. —(F) (J) Zhang

257. Flow in Transportation Networks (4)
Lecture—4 hours. Prerequisite: course 153; 161 or 256 recommended. Elements of graph theory, a sur- vey of pertinent optimization techniques, extremal principles in network flow problems, deterministic equilibrium assignment, stochastic equilibrium assignment, extensions of equilibrium assignments and dynamic transportation network assignment. —W. (W) Zhang
258. Transportation Planning in Developing Countries (3)
Lecture—3 hours. Prerequisite: course 160 or consent of instructor. Investigation of the role that transportation investments and policies play in the development of regions and countries. Emphasis is on identification of appropriate planning and decision-making methods for developing regions. Offered in alternate years. —F. (S.) Harvey

259. Asphalt and Asphalt Mixes (4)
Lecture—4 hours. Prerequisite: course 179 or consent of instructor. Asphalts and asphalt mix types and their use in civil engineering structures, with primary emphasis on pavements. Asphalt, aggregate properties, and effects on mix properties. Design, construction, recycling. Recent developments and research. Offered in alternate years. —W. (W.) Harvey

260. Sediment Transport (4)
Lecture—4 hours. Prerequisite: course 141 or equivalent. Sediment transport in hydrologic systems—process-oriented course which will emphasize how sediment moves and the physical processes that affect sediment transport. Field trip. Offered in alternate years. —F. (S.) Schlawod

264A. Transport, Mixing and Water Quality in Rivers and Lakes (4)
Lecture—4 hours. Prerequisite: courses 141 and 240. Principal causes of mixing and transport in rivers, lakes, and reservoirs and their impacts on water quality. Case studies of specific lakes and rivers. Offered in alternate years. —F. (S.) Schlawod

264B. Transport, Mixing and Water Quality in Estuaries and Wetlands (4)
Lecture—4 hours. Prerequisite: courses 141 and 240. Principal causes of mixing and transport in estuaries and wetlands, and their impacts on water quality. Topics include advection/diffusion; tides; transversal, longitudinal, and vertical dispersion; sediment transport; nutrient cycling; computer modeling of estuaries. Case studies of specific systems. Offered in alternate years. —Schlawod

265. Stochastic Hydrology and Hydraulics (4)
Lecture—4 hours. Prerequisite: course 266 or consent of instructor. Physics-based stochastic methods in modeling hydrologic and hydraulic processes; theory for modeling hydrologically/governing equations as stochastic partial differential equations applied to various hydrologic/hydraulic processes under uncertainty, including transport, open channel flow, overland flow, and groundwater. Offered in alternate years. —F. (S.) Kavvas

266. Applied Stochastic Methods in Engineering (4)
Lecture—4 hours. Prerequisite: course 114 or Mathematics 111 or 112. Mathematics 118A may be taken concurrently. Stochastic processes classification; Gaussian random fields; stochastic calculus in mean square; Ito and Stratonovich differential equations; Fokker-Planck equation; stochastic differential equations with random coefficients. Offered in alternate years. —F. (S.) Kavvas

267. Water Resource Management (3)
Lecture—3 hours. Prerequisite: course 114, 141, and 142; course 153 recommended. Engineering, institutional, environmental, economic, and social basis for managing local and regional water resources. Examples in the context of water development and management. Uses of computer modeling to improve water management. [Same course as Geography 212.] —F. (S.) Lund

268. Infrastructure Economics (3)
Lecture—3 hours. Prerequisite: Economics 1A, Engineering 106 or the equivalent. Economics applied to infrastructure engineering planning, operations, maintenance, and management problems; microeconomic and macroeconomic principles; beneficial/cost analysis; effect of uncertainty; optimization economics; non-classical economics; public finance. Offered in alternate years. —W. (W.) Lund

269. Transportation-Air Quality: Theory and Practice (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 149 or the equivalent. Health and regulatory aspects of airborne pollutants. Principles of modeling vehicle emissions. Conformity issues and the regulatory framework for air quality modeling. Offered in alternate years. —S. Niemier

270. Advanced Water Resources Management (3)
Lecture—3 hours. Prerequisite: courses 153 and 267 or the equivalent. Discussion of technical papers related to aspects of system maintenance, regionalization, multi-objective methods, risk analysis, institutional issues, pricing model application, economic development, forecasting, operations, and other topics. Offered in alternate years. —Lund

271. Inverse Problems (4)
Lecture—3 hours. Prerequisite: courses 114 and 144 or equivalents. Inverse calibration of distributed parameter models, using data representing design outputs. Forward and inverse mappings, stability, uniqueness, identifiability. Optimization formulation of inverse problems, maximum likelihood and other objective function direct and indirect approaches, solution by UCODE in hands-on project format. —Younis

272A. Advanced Hydrogeology (4)

272B. Advanced Hydrogeology (4)

272C. Multiphase Reactive Transport (4)
Lecture—4 hours. Prerequisite: courses 142, 144, 148A. Multi-component reactive transport including multiple phases. Advection/dispersive transport, chemical equilibria, and mass transformation kinetics. Natural chemical/microbiological processes including sorption, complexation, biodegradation, and diffusive mass transfer. Eulerian and Lagrangian averaging methods. Applications to contaminant remediation problems in river and subsurface hydrology. Offered in alternate years. —Younis

273. Water Resource Systems Engineering (3)
Lecture—3 hours. Prerequisite: courses 114 and 153 or the equivalent. Planning, design, and management of water resource systems. Application of deterministic and stochastic optimization techniques. Water allocation, resource development, and design and operation of reservoir systems. Surface water and groundwater management. Offered in alternate years. —Younis

275. Hydrologic Time-Series Analysis (4)
Lecture—4 hours. Prerequisite: course 114 and 142. Application of statistical methods for analysis and modeling of hydrologic series. Statistical simulation and prediction of hydrologic sequences using time series models. Offered in alternate years. —Kavvas

276. Watershed Hydrology (4)
Lecture—4 hours. Prerequisite: course 142 or the equivalent. Analysis and mathematical modeling of hydrologic processes in a watershed. Precipitation analysis and modeling. Theory of overland flow and its kinematic wave approximation. Analysis and modeling of saturated and unsaturated subsurface flow processes taking place on a hill slope. —Kavvas

277A. Computational River Mechanics I (4)
Lecture—4 hours. Prerequisite: Applied Science Engineering 115, course 141 (both may be taken concurrently). Unsteady open-channel flows, computation of two-dimensional flow, contoured water surfaces, shallow water equations, St. Venant equations, method of characteristics, finite difference models. Stability and accuracy of explicit and implicit schemes, flood routing in simple and compound channels, advective plumes. Not open for credit to students who have completed course 277B. —Younis

277B. Computational River Mechanics II (4)
Lecture—4 hours. Prerequisite: course 277A. Open channel flows, physical aspects of river mechanics, formulation of depth-averaged equations, boundary conditions, coordinates transformation and grid generation, finite-difference solution techniques, applications to two-dimensional momentum and pollutant transport in rivers. Offered irregularly. —Younis

277C. Turbulence and Mixing Processes (4)
Lecture—4 hours. Prerequisite: graduate standing. Nature of turbulent flows, conservation equations, momentum, heat and mass transport in free and well-bounded flows, body forces and mixing, roughness effects, turbulence modeling and simulation. Offered irregularly. —Younis

278. Hydrodynamics (3)

280A. Nonlinear Finite Elements for Elastic-Plastic Problems (4)
Lecture—4 hours. Prerequisite: consent of instructor. State of the art finite element methods and tools for elastoplastic problems, including computational techniques based on the finite element method and the theory of elastoplasticity. Offered in alternate years. —W. (W.) Jeremic

280B. Nonlinear Dynamic Finite Elements (4)
Lecture—4 hours. Prerequisite: consent of instructor. State of the art computational methods and tools for analyzing linear and nonlinear dynamics problems. Offered in alternate years. —J. (S.) Jeremic

281A. Advanced Soil Mechanics (4)
Lecture—4 hours. Prerequisite: course 281A. Site investigation and soil characterization within the context of slope stability analysis. —W. (W.) Delong

282. Pavement Design and Rehabilitation (4)
Lecture—4 hours. Prerequisite: course 179 or consent of instructor. Advanced pavement design and structural/functional condition evaluation for concrete and asphalt pavements. Highways, airfields, port facilities, new facilities, rehabilitation, reconstruction. Mechanistic-empirical procedures, material, climate and traffic characterization. Use of current design methods; recent developments and research. Offered in alternate years. —S. (F.) Harvey

283. Physico-Chemical Aspects of Soil Behavior (4)
Lecture—3 hours. Prerequisite: laboratory—3 hours. Prerequisite: course 171. Study of the geotechnical behavior of soils considering formation, transport, mineralogy,
soil-fluid-electrolyte systems, surface tension, particle mechanics, shape, fabric, and structure. Laborato-
ries focus on the interactions and properties of fundamental interparticle forces (contact, Van Der Waals, capillarity and chemical). Offered in alternate years. — F. Kutter

284. Theoretical Geomechanics (4)
Lecture—4 hours. Prerequisite: course 171. Elastici-

ty, plasticity, micromechanics, coupled behavior and large deformations for geomaterials. Prediction of stress-strain-volume change behavior of geomate-

rials. Monotonic and cyclic loading, anisotropy, bifurcation of deformations. — W. (W) Jeremi-

286. Advanced Foundation Design (4)
Lecture—4 hours. Prerequisite: course 173. Design and analysis of pile and pier foundations, including seismic effects; deep excavation systems; tie-back,

287. Geotechnical Earthquake Engineering (4)
Lecture—4 hours. Prerequisite: courses 138 and 281 A. Characteristics and estimation of earthquake ground motions; wave propagation and local site response; liquefaction potential and remediation; residual strength and stability considerations; ground deformations; dynamic soil-structure interac-
tion. — S. (S) Dejong

288. Earth and Rockfill Dams (4)
Lecture—4 hours. Prerequisite: courses 281A and 281 B. May be taken concurrently. Site selection; design considerations; layout; seismic effects includ-
ing considerations of fault movements; construction; environmental considerations, instrumentation; main-
tenance remediation and retrofit of existing dams. Offered in alternate years. — W. (W) Boulang-

289A. Selected Topics in Civil Engineering: Environmental Engineering (1-5)
Prerequisite: consent of instructor. Directed group study in Environmental Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

289B. Selected Topics in Civil Engineering: Hydraulics and Hydrologic Engineering (1-
5)
Prerequisite: consent of instructor. Directed group study in Hydraulics and Hydrologic Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

289C. Selected Topics in Civil Engineering: Engineering Planning (1-5)
Prerequisite: consent of instructor. Directed group study in Engineering Planning. May be repeated for credit. — F, W, S. (F, W, S.)

289D. Selected Topics in Civil Engineering: Geotechnical Engineering (1-5)
Prerequisite: consent of instructor. Directed group study in Geotechnical Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

289E. Selected Topics in Civil Engineering: Structural Engineering (1-5)
Prerequisite: consent of instructor. Directed group study in Structural Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

289F. Selected Topics in Civil Engineering: Structural Mechanics (1-5)
Prerequisite: consent of instructor. Directed group study in Structural Mechanics. May be repeated for credit. — F, W, S. (F, W, S.)

289G. Selected Topics in Civil Engineering: Transportation Engineering (1-5)
Prerequisite: consent of instructor. Directed group study in Transportation Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

289H. Selected Topics in Civil Engineering: Transportation Planning (1-5)
Prerequisite: consent of instructor. Directed group study in Transportation Planning. May be repeated for credit. — F, W, S. (F, W, S.)

289I. Selected Topics in Civil Engineering: Water Resources Engineering (1-5)
Lecture, laboratory; lecture/laboratory. Prerequisite: consent of instructor. Directed group study in Water Resources Engineering. May be repeated for credit. — F, W, S. (F, W, S.)

290. Seminar (1)
Seminar—1 hour. Discussion of current graduate research, and guest lectures on recent advances. Oral presentation of individual study. Course required of graduate degree candidates. (S/U grad-
ing only) — F, W, S. (F, W, S.)

290C. Graduate Research Group Conference (1)
Discussion—1 hour. Research problems, progress, and techniques in civil engineering. May be repeated for credit. (S/U grading only) — F, W, S. (F, W, S.)

296. Topics in Water and Environmental Engineering (1)
Seminar—2 hours. Seminars presented by visiting lecturers, UC Davis faculty and, graduate students. May be repeated for credit. (S/U grading only) — F, W, S. (F, W, S.)

298. Group Study (1-5)
Prerequisite: consent of instructor. (S/U grading only)

299. Research (1-12)
(S/U grading only)

Professional

390. The Teaching of Civil Engineering (1)
Discussion —1 hour. Prerequisite: meet qualifications for teaching assistant and/or associate instructor in Civil Engineering. Participation as teaching assistant or associate-in in a designated engineering course. Methods of leading discussion groups or laboratory sections, writing and grading quizzes, use of labora-
tory equipment, and grading laboratory reports. May be repeated for total of 9 units. (S/U grading only) — F, W, S. (F, W, S.)

Engineering: Computer Science

(Nina Amenta, Ph.D., Chairperson of the Department)

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Faculty
Nina Amenta, Ph.D., Professor
Zhaojun Bai, Ph.D., Professor
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Zhaojun Bai, Ph.D., Professor
Matthew Bishop, Ph.D., Professor
Hao Chen, Ph.D., Associate Professor
Ian Davidson, Ph.D., Professor
Premkumar T. Devanbu, Ph.D., Professor
David Doty, Ph.D., Professor
Raissa D'Souza, Ph.D., Professor
Kurt Eiselt, Ph.D., LSOE
Matthew K. Ferren, Ph.D., Professor
Vladimir Filkov, Ph.D., Professor
Matthew Franklin, Ph.D., Professor
Dipak Ghosal, Ph.D., Professor
Daniel Gusfield, Ph.D., Professor
Francesco Giannetti, Ph.D., Professor
Bernd Hammann, Ph.D., Professor
Chou-Jui Hsieh, Ph.D., Assistant Professor
Patrice Koehl, Ph.D., Professor
Yong Jun Lee, Ph.D., Assistant Professor
Karl Levitt, Ph.D., Professor
Xin Liu, Ph.D., Associate Professor
Kwan-Liu Ma, Ph.D., Professor
Norman Matloff, Ph.D., Professor
Nelson Max, Ph.D., Distinguished Professor
Prasanna Mohapatra, Ph.D., Professor
Biswaath Mukherjee, Ph.D., Distinguished Professor
Distinguished Teaching Mentor Award
Michael Neff, Ph.D., Associate Professor
Ronald A. Olson, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Phillip Rogaway, Ph.D., Professor
Cindy Rubio Gonzalez, Ph.D., Assistant Professor
Zhendong Su, Ph.D., Associate Professor
Ilia Tagkopoulos, Ph.D., Associate Professor
S. Felix Wu, Ph.D., Professor
Emeriti Faculty
John Bruin, Ph.D., Professor Emeritus
Kenneth I. Joy, Ph.D., Professor
Academic Senate Distinguished Teaching Award
Peter Linz, Ph.D., Professor Emeritus
Charles U. Martel, Ph.D., Professor
Raju Pandey, Ph.D., Associate Professor
Richard F. Walters, Ph.D., Professor Emeritus
Academic Senate Distinguished Teaching Award
Affiliated Faculty
Peer-Timo Bremer, Ph.D., Adjunct Associate Professor
Matt Butter, M.S., Lecturer
Sean Davis, M.S., Lecturer
Todd J. Green, Ph.D., Assistant Professor
Hans Hagen, Ph.D., Adjunct Professor
Rob Gysel, Ph.D., Lecturer
Bertram Ludaescher, Ph.D., Professor
Christopher Nitta, Ph.D., Assistant Adjunct Professor
Sean Peisert, Ph.D., Assistant Adjunct Professor
Massimo Tornatore, Ph.D., Adjunct Associate Professor
Gunther Weber, Ph.D., Assistant Adjunct Professor

The Computer Science and Engineering Program
The Department of Computer Science administers two curricula: Computer Science and Engineering in the College of Engineering, and Computer Science in the College of Letters and Science. The Computer Science Engineering major develops a solid understanding of the entire machine, including hands-on experience with its hardware components. The Computer Science major has some course work on hard-

ware, at the digital-design level, on simulators. The Computer Science Engineering major has fewer free electives. The CS major’s more generous electives make it easier to complete a minor or double major. A key theme of the Computer Science Engineering curriculum is the hardware/software interaction, a theme reflected in the courses required and the ori-

entation of the courses themselves. The Computer Science and Engineering major provides students with a solid background in mathemat-
ics, physics, chemistry, and electronic circuits and systems, all supporting the computer hardware and computer software courses that constitute the focus of the curriculum.

Mission. The University of California, Davis, is, first and foremost, an institution dedicated to learning and teach-

ing, committed to serving the needs of society. The Department of Computer Science contributes to the mission in three ways. First, it's undergraduate and graduate education programs seek to educate stu-
dents in the fundamental principles of computer sci-
ence and the skills needed to solve the complex technological problems of modern society. The breadth of courses offered provides a framework for life-
long learning and an appreciation for multidisci-
pinary activities. Second, through its research pro-
grams, the department contributes to the development and progress of computer science, and software and information technology, to provide innovative, creative solutions for societal needs. Finally, the department disseminates its research-to