

Civil and Environmental Engineering

The George R. Brown School of Engineering

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Degrees Offered: B.A., M.C.E., M.E.E., M.E.S., M.S., Ph.D.

Civil and environmental engineering (C&EE) is a broad and diverse field of study that offers students an education with several degree options. The most flexible degree options are at the bachelor's level, where students can major in civil engineering or complete a double major with any other Rice University major. The double major has two tracks, one in environmental engineering sciences (EES), and the other in environmental sciences (ES). Three nonthesis graduate degrees (M.C.E., M.E.E., and M.E.S) are available to students who desire additional education and specialization in civil engineering, environmental engineering, or environmental sciences. Joint M.B.A./Master of Engineering degrees are also available in conjunction with the Jesse H. Jones Graduate School of Management.

Students admitted for graduate study leading to M.S. or Ph.D. degrees must complete a rigorous course of study that combines advanced course work with scholarly research culminating in the public defense of a written thesis. Graduate research is carried out in a range of areas reflecting the interests of the department's faculty. Examples include structural engineering and mechanics, earthquake engineering, geotechnical engineering, computer-aided design, hydrology, water resources and water quality engineering, air pollution and its control, and hazardous waste treatment.

Degree Requirements for B.A. in Civil Engineering

For general university requirements, see Graduation Requirements (pages 20–23). For the B.A. degree, students majoring in civil engineering must have a total of at least 120 semester hours at graduation. The B.A. is not accredited as a professional degree.

Specific requirements include:MATH 101 and 102 *Single Variable Calculus I and II*MATH 211 *Ordinary Differential Equations and Linear Algebra*MATH 212 *Multivariable Calculus*PHYS 101 *Mechanics (with Lab)*PHYS 102 *Electricity and Magnetism (with Lab)*CEVE 211 *Engineering Mechanics*CEVE 300 *Mechanics of Solids I*CEVE 302 *Strength of Materials Lab*CEVE 363 *Applied Fluid Mechanics*BIOS 122 *Fundamental Concepts in Biology*PHYS 201 *Waves and Optics*PHYS 202 *Modern Physics***Any two of the following:**MECH 200 *Classical Thermodynamics*
ELEC 242 *Fundamentals of Electrical Engineering II*CAAM 211 *Introduction to Engineering Computation*MSCI 301 *Materials Science*ESCI 451 *Analysis of Environmental Data***Any two of the following:**CHEM 211 *General Chemistry with Lab I* or CHEM 122 *General Chemistry with Lab 2*ESCI 101 *The Earth* or ESCI 102 *Evolution of the Earth***Any five additional CEVE courses,** selected in consultation with an advisor**Degree Requirements for B.A. in Environmental Science and Engineering**

The Department of Civil and Environmental Engineering offers the B.A. as a double major with any other major at Rice University. The double major has two tracks: one in environmental engineering sciences (EES), and one in environmental sciences (ES). Faculty from the Wiess School of Natural Sciences work with C&EE faculty in offering courses, advising, and administering the ES track of this double major. The double major is designed to accommodate:

- Students wishing to obtain a solid preparation for later graduate study in environmental engineering, environmental science, or other careers as environmental professionals (e.g., environmental economics or environmental law), and
- Students pursuing nonenvironmental careers (e.g., historians, lawyers, mechanical engineers, chemists) who will nonetheless benefit from a knowledge of the environmental dimensions of problems and issues they will confront.

The 68-semester-hour (minimum) double major in environmental science and engineering may be taken in conjunction with *any* stand-alone major offered in any school of the university. The EES track is highly recommended for students wishing to pursue graduate study in environmental engineering. Students choosing the ES track are encouraged to select one of the following participating faculty members from the Wiess School of Natural Sciences as their adviser:

John Anderson (*Earth Science*)Andre Droxler (*Earth Science*)Arthur Few (*Physics and Astronomy and Environmental Science*)F. M. Fisher (*Ecology and Evolutionary Biology*)P. A. Harcombe (*Ecology and Evolutionary Biology*)William Leeman (*Earth Science*)D. Queller (*Ecology and Evolutionary Biology*)R. L. Sass (*Ecology and Evolutionary Biology*)Dale Sawyer (*Earth Science*)J. E. Strassmann (*Ecology and Evolutionary Biology*)A. Thornhill (*Ecology and Evolutionary Biology*)

The key components of the double major include:

- Foundation course work in mathematics, physics, chemistry, and biology, required in both tracks.
- A set of 5 undergraduate core courses, required of all double majors, that acquaint undergraduates with a range of environmental problems encountered by scientists, engineers, managers, and policy makers. Core courses in the EES track cover the breadth of water, soil, and air media within the context of engineering technologies and approaches to problem solving, and stress quantitative analytical tools used to address environmental problems. Core courses in the ES track stress the components of the global environment and their interactions.
- 24 semester hours of environmental electives, in both tracks, from four categories: (1) social sciences and business, (2) humanities and architecture, (3) natural sciences, and (4) engineering. Students may petition to have electives, in addition to those currently listed, apply toward the double major.

Specific Course Requirements for a Double Major (B.A.) in Environmental Science and Engineering

General Prerequisites

CHEM 121 or 151 *General Chemistry with Laboratory*

CHEM 122 or 152 *General Chemistry with Laboratory*

MATH 101 *Single Variable Calculus I*

MATH 102 *Single Variable Calculus II*

PHYS 101 or 125 or 111 *Mechanics*

PHYS 102 or 126 or 112 *Electricity and Magnetism*

BIOS 201 *Introductory Biology*

BIOS 202 *Introductory Biology*
(Environmental sciences track only)

1 of the following 2 courses:

NSCI 230 *Computation in Natural Science* (Environmental sciences track only)

MATH 211 *Ordinary Differential Equations and Linear Algebra*
(Environmental engineering sciences track only)

Core Courses: Environmental Sciences Track

BIOS 325 *Ecology*

GEOL 326 *Environmental Geology*

PHYS 443 *Atmospheric Science*

or CEVE 411 *Air Resource Management*

2 of the following 3 courses:

CEVE 401 *Introduction to Environmental Chemistry*

CEVE 412 *Hydrology and Watershed Analysis*

GEOL 451 *Analysis of Environmental Data*

Core Courses: Environmental Engineering Sciences Track

CEVE 401 *Introduction to Environmental Chemistry*

CEVE 403 *Principles of Environmental Engineering*

CEVE 411 *Air Resource Management*

CEVE 412 *Hydrology and Watershed Analysis*

CEVE 434 *Chemical Transport and Fate in the Environment*

Sample Curriculum in the Environmental Engineering Sciences Track**Freshman Year****Fall**MATH 101 *Single Variable Calculus I*PHYS 101 *Mechanics*CHEM 121 *General Chemistry with
Laboratory*

Electives

HPER 101

SpringMATH 102 *Single Variable Calculus II*PHYS 102 *Electricity and Magnetism*CHEM 122 *General Chemistry with
Laboratory*

Electives

HPER 102

Sophomore Year**Fall**MATH 211 *Ordinary Differential
Equations*BIOS 201 *Introductory Biology*

Environmental Elective*

Environmental Elective

Spring

Environmental Elective

Environmental Elective

*CEVE 201 *Introduction to Environ-
mental Systems* recommended as
environmental elective**Junior Year****Fall**CEVE 401 *Introduction to
Environmental Chemistry*

Environmental Elective

Environmental Elective

SpringCEVE 411 *Air Resource Management***Senior Year****Fall**CEVE 403 *Principles of Environmental
Engineering*CEVE 434 *Chemical Transport and Fate
in the Environment*

Environmental Elective

SpringCEVE 412 *Hydrology and Watershed
Analysis*

Environmental Elective

24 semester hours of environmental electives are required, with at least 6 semester hours of course work from each of four categories. Consult the faculty adviser or Department of Environmental Science and Engineering for a list of approved electives.

Sample Curriculum in Environmental Sciences Track**Freshman Year****Fall**MATH 101 *Single Variable Calculus I*PHYS 101 *Mechanics*CHEM 121 *General Chemistry with
Laboratory*

Electives

HPER 101

SpringMATH 102 *Single Variable Calculus II*PHYS 102 *Electricity and Magnetism*CHEM 122 *General Chemistry with
Laboratory*

Electives

HPER 102

Sophomore Year**Fall**NSCI 230 *Computation in the Natural
Sciences*BIOS 201 *Introductory Biology*

Environmental Elective

Environmental Elective

SpringBIOS 202 *Introductory Biology*

Environmental Elective

Environmental Elective

Junior Year**Fall**

BIOS 325 *Ecology*
 GEOL 326 *Environmental Geology*
 Environmental Elective

Spring

PHYS 443 *Atmospheric Science*
 or ENVI 411 *Air Resource Management*
 Environmental Elective

Senior Year**Fall**

GEOL 451 *Analysis of Environmental Data* or ENVI 401 *Introduction to Environmental Chemistry*
 Environmental Elective
 Environmental Elective

Spring

CEVE 412 *Hydrology and Watershed Analysis*

24 semester hours of environmental electives are required, with at least 6 semester hours of course work from each of four categories. Consult the faculty adviser or Department of Civil and Environmental Engineering for a list of approved electives.

Degree Requirements for M.C.E., M.E.E., M.E.S., M.S., and Ph.D.

Admission. Applicants pursuing graduate education in structural engineering, structural mechanics, and geotechnical engineering should have a B.S.C.E. with a significant emphasis on structural engineering, but students with other undergraduate degrees may apply if they have adequate preparation in mathematics, mechanics, and structural analysis and design. Courses such as engineering technology or construction technology, however, do not represent adequate preparation. Applicants for the M.E.E. and the M.E.S. must have a B.S. or B.A. in related areas of science and engineering. Successful applicants typically have at least a 3.00 (B) grade point average in undergraduate work and high Graduate Record Examination (GRE) scores. For general university requirements, see Graduate Degrees (pages 65–70) and Admission to Graduate Study (pages 64–65).

M.C.E. Program. The Master of Civil Engineering (M.C.E.) is a professional nonthesis degree requiring 30 hours of study. Students with a B.S. in Civil Engineering are eligible to apply. Areas of study include structural dynamics, offshore technology, reinforced concrete and prestressed concrete, reliability of systems, random vibrations, soil dynamics, soil-structure interaction, and structural control. For general university requirements, see Graduate Degrees (pages 65–70). To earn an M.C.E. degree, students must: complete 30 semester hours of approved courses

M.B.A./M.C.E. Program. For general university requirements, see Graduate Degrees (pages 65–70). See also Management and Accounting (pages 197–207). To earn a M.B.A./M.C.E. degree, students must:

- Complete 24 semester hours of civil engineering courses
- Complete 52 semester hours of business administration courses

M.E.E. Program. The Master of Environmental Engineering (M.E.E.) is a professional nonthesis degree requiring 30 hours of study. Students who have a B.S. degree in any field of engineering may apply. Areas of study include hydrology and water resources engineering, water treatment, water chemistry, air pollution and its control, and hazardous waste treatment. Although the program is open to all qualified applicants, candidates usually are completing undergraduate programs in environmental engineering and wish to extend their education into a fifth year of specialized study.

M.E.S. Program. The Master of Environmental Science (M.E.S.) is a professional nonthesis degree requiring 30 hours of study. To enter the M.E.S. program, applicants must have a B.A. or B.S. degree in any of the natural or physical sciences. Areas of study include hydrology and water resources engineering, water treatment, water chemistry, air pollution and its control, and hazardous waste treatment. Although the program is open to all qualified applicants, candidates typically are completing undergraduate programs in environmental science and wish to extend their education into a fifth year of specialized study.

M.S. Program. The Master of Science degree is offered in both civil engineering and environmental engineering. For general university requirements, see Graduate Degrees (pages 65–70). To earn a M.S. degree, students must:

- Complete at least 24 semester hours of approved courses. For students studying Environmental Engineering this must include one course each in environmental chemistry, water treatment, hydrology, and air quality (comparable course work completed previously may be substituted for the core courses)
- Select a thesis committee according to department requirements and conduct original research in consultation with the committee.
- Present and defend in oral examination an approved research thesis.

Students take the oral exam only after the committee determines the thesis to be in a written format acceptable for public defense. Normally, students take two academic years and the intervening summer to complete the degree.

Students intending to extend their studies into the Ph.D. degree program should note that the department does not grant an automatic M.S. degree to candidates who have not written a satisfactory master's thesis.

Ph.D. Program in Civil Engineering. For general university requirements, see Graduate Degrees (pages 65–70). To earn a Ph.D. degree in civil engineering, students must:

- Complete at least 48 semester hours of approved courses with high standing.
- Pass a comprehensive preliminary examination testing the candidate's knowledge of the field and ability to think in a creative manner.
- Pass an oral qualifying examination on the proposed thesis research and related topics.
- Complete a thesis that constitutes an original contribution to knowledge.
- Pass a final public oral examination on the thesis and related topics.

Ph.D. Program in Environmental Engineering. To earn a Ph.D. degree in environmental engineering sciences, candidates must successfully accomplish the following (spending at least four semesters in full-time study at Rice):

- Complete 90 semester hours of approved course work with high standing.
- Pass a preliminary written examination on the field of environmental engineering sciences.
- Pass a qualifying examination on course work, proposed research, and related topics.
- Complete a dissertation indicating an ability to do original and scholarly research.
- Pass a formal public oral examination on the thesis and related topics.

Ph.D. candidates in environmental engineering sciences take the preliminary exam, administered by department faculty, after two semesters of course work. Candidates who pass this exam then form a doctoral committee according to department requirements. The qualifying examination administered by the doctoral committee after candidates develop a research proposal evaluates their preparation for the proposed research and identifies any areas requiring additional course work or study.

See CEVE in the Courses of Instruction section.