

CIVIL ENGINEERING, PH.D.

All programs of study must be approved by the student's academic advisor and the Department of Civil and Environmental Engineering graduate director.

Learning Outcomes

1. Graduates will be able to demonstrate expertise in a core subject area of civil and environmental engineering.
2. Graduates will be able to demonstrate a working knowledge of various areas of CEE and related fields.
3. Students will be able to describe and discuss sound research approaches and knowledge of advances in Civil and Environmental Engineering.
4. Students will be able to demonstrate the ability to apply knowledge of mathematics, science and engineering.
5. Graduates will be able to identify pertinent research problems, to formulate and execute a research plan.
6. Graduates will be able to describe and discuss advances of knowledge in civil and environmental engineering.
7. Graduates will be able to generate and analyze original research results, and to communicate these results through oral presentations and written publications submitted to refereed archival journals.
8. Graduates will demonstrate the basic skills needed for life-long learning and professional development.

Admissions

Students should have the equivalent of an M.E. or M.S. degree in civil engineering or closely related engineering field. Exceptional students may be eligible to enter directly the Ph.D. degree program with a B.S. degree in civil engineering or closely related engineering field. Applicants must generally exceed the minimum grade point average and test score requirements listed for the M.S. degree program. Outstanding students with non-engineering baccalaureate degrees may qualify for admission to the Ph.D. degree program, with the understanding that they must complete specified deficiency/prerequisite courses.

Degree Requirements (60 Post-Baccalaureate Hours)

Completion of the doctoral degree requires a minimum of 60 credits beyond the baccalaureate degree, of which 12 must be ECIV 899. Students holding an M.E. or M.S. degree must complete a minimum of 30 credit hours beyond the master's degree. At least half of the course work must be completed at the 700 level or higher. At least 12 hours of core course work are required for each area of specialization (see "Core Courses" below).

For students pursuing a Ph.D. degree in the same area of specialization as their M.E. or M.S. degree, a minimum of 18 credit hours of course work is required. Core courses may be satisfied during the M.E. or M.S. degree. For students pursuing a Ph.D. degree in a different area of specialization from their M.E. or M.S. degree, a minimum of 24 credit hours of course work in the new area is required. "Area of specialization" refers to environmental, geotechnical, railway, structural, transportation or water resources engineering.

Credits earned in ECIV 798 do not count toward a student's program of study.

The residency requirement for the Ph.D. degree ensures that students benefit from and contribute to the complete spectrum of educational and professional opportunities provided by the graduate faculty of a comprehensive university. The granting of a doctoral degree presupposes a minimum of three full years of graduate study following admission to the doctoral program. As such, the residency requirement may be fulfilled by enrollment in at least 18 graduate credit hours within a span of three consecutive semesters (excluding summers). Enrollment in a summer term is not required to maintain continuity, but credits earned during summer terms may be used to count toward residency. Enrollment through the APOGEE program does not satisfy the residency requirement for the Ph.D. degree.

Core Courses

Each area of specialization has specific graduate core course requirements that are presented in the tables below. These requirements are designed to provide opportunities for cross-disciplinary programs of study that require breadth and flexibility beyond classical courses offered for a given area of specialization, and that may better reflect the student's personal research and career interests. This can be achieved by allowing to substitute one additional core course with any USC graduate (500-level or higher) course, subject to the approval of the student's advisor and ECIV graduate director through the program of study (DPOS) form.

Environmental Engineering (12 hours)

| Course | Title | Credits |
|--|---|-----------|
| ECIV 750 | Principles of Environmental Engineering Process | 3 |
| Select three of the following: | | 9 |
| ECIV 502 | Life Cycle Assessment of Engineered Systems | |
| ECIV 555 | Principles of Municipal Solid Waste Engineering | |
| ECIV 556 | Air Pollution Control Engineering | |
| ECIV 558 | Environmental Engineering Process Modeling | |
| ECIV 590 | Intermediate Special Topics * | |
| ECIV 751 | Water and Wastewater Treatment Theory I | |
| ECIV 752 | Water and Wastewater Treatment Theory II | |
| ECIV 753 | Unit Operations Laboratory for Water and Wastewater Treatment | |
| ECIV 755 | Industrial Wastewater Treatment | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select one USC graduate (500-level or higher) course * | | |
| Total Credit Hours | | 12 |

* To be approved by student's advisor and ECIV graduate director through program of study (DPOS) form.

Geotechnical Engineering (12 hours)

| Course | Title | Credits |
|--------------------------------|---|---------|
| ECIV 730 | Advanced Soil Mechanics | 3 |
| Select three of the following: | | 9 |
| ECIV 590 | Intermediate Special Topics * | |
| ECIV 731 | Slope Stability, Retaining Systems and Lateral Earth Pressure | |
| ECIV 732 | Theoretical and Numerical Methods in Geomechanics | |
| ECIV 733 | Physico-chemical Properties of Soils | |

| | | |
|--|---|-----------|
| ECIV 734 | Soil Dynamics and Geotechnical Earthquake Engineering | |
| ECIV 736 | Ground Improvement Techniques | |
| ECIV 737 | Advanced Foundation Design | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select one USC graduate (500-level or higher) course * | | |
| Total Credit Hours | | 12 |

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Railway Engineering (12 hours)

| Course | Title | Credits |
|--|---|-----------|
| Select two of the following "Fundamental" core courses: | | 6 |
| ECIV 580 | Railway Engineering I | |
| ECIV 582 | Operation and Logistics of Railway Systems | |
| ECIV 588 | Design of Railway Bridges and Structures | |
| ECIV 590 | Intermediate Special Topics * | |
| Select one "Advanced" core course ** | | |
| Select one "Advanced or "Cross-Disciplinary" core course ** | | |
| Select one of the following "Advanced" core courses: | | 3 |
| ECIV 707 | Management of Engineering Projects | |
| ECIV 724 | Dynamics of Structures | |
| ECIV 734 | Soil Dynamics and Geotechnical Earthquake Engineering | |
| ECIV 784 | Dynamic Analysis of Railway Systems | |
| ECIV 789 | Design Project in Railway Engineering | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select one of the following "Cross-Disciplinary" core courses: | | 3 |
| Select one Environmental Engineering core course | | |
| Select one Geotechnical Engineering core course | | |
| Select one Structural Engineering core course | | |
| Select one Transportation Engineering core course | | |
| Select one Water Resources Engineering core course | | |
| Select one USC graduate (500-level or higher) courses * | | |
| Total Credit Hours | | 12 |

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** Applies to PhD students with MS/ME degree only. May be taken for either "Fundamental" core course credit, or "Advanced" or "Cross-Disciplinary" core course credit, not both.

Structural Engineering (12 hours)

| Course | Title | Credits |
|--------------------------------|---|---------|
| ECIV 720 | Advanced Structural Mechanics and Analysis | 3 |
| Select three of the following: | | 9 |
| ECIV 590 | Intermediate Special Topics * | |
| ECIV 722 | Theory and Design of Plates and Shells | |
| ECIV 724 | Dynamics of Structures | |
| ECIV 725 | Advanced Analysis and Design in Structural Metals | |
| ECIV 726 | Repair and Retrofit of Structures | |
| ECIV 727 | Advanced Analysis and Design of Reinforced Concrete | |

| | | |
|--|--|-----------|
| ECIV 728 | Prestressed Concrete Analysis and Design | |
| ECIV 737 | Advanced Foundation Design | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select one USC graduate (500-level or higher) course * | | |
| Total Credit Hours | | 12 |

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Transportation Engineering (12 hours)

| Course | Title | Credits |
|--|---|-----------|
| Select one of the following: | | 3 |
| ECIV 535 | Geotechnical Engineering in Transportation | |
| ECIV 540 | Transportation Systems Planning | |
| ECIV 541 | Highway Design | |
| Select one of the following: | | 3 |
| ECIV 542 | Traffic Engineering | |
| ECIV 748 | Traffic Flow Theory | |
| Select one of the following: | | 3 |
| ECIV 705 | Deterministic Civil and Environmental Systems Engineering | |
| ECIV 706 | Probabilistic Civil and Environmental Systems Engineering | |
| Select one of the following: | | 3 |
| ECIV 590 | Intermediate Special Topics * | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select one USC graduate (500-level or higher) course * | | |
| Total Credit Hours | | 12 |

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Water Resources Engineering (12 hours)

| Course | Title | Credits |
|---|---|-----------|
| Select up to one of the following: | | 0-3 |
| ECIV 560 | Open Channel Hydraulics | |
| ECIV 562 | Engineering Hydrology | |
| ECIV 563 | Subsurface Hydrology | |
| ECIV 590 | Intermediate Special Topics * | |
| Select at least two of the following: | | 6-12 |
| ECIV 760 | Computational Hydraulics | |
| ECIV 761 | Numerical Methods in Subsurface Hydrology | |
| ECIV 762 | Advanced Hydrology | |
| ECIV 763 | Unsaturated Flow Theory | |
| ECIV 764 | Contaminant Transport | |
| ECIV 765 | Erosion and Sediment Control | |
| ECIV 766 | Fluid Transients | |
| ECIV 767 | Sediment Transport and River Mechanics | |
| ECIV 790 | Selected Topics in Civil Engineering * | |
| Select up to one of the following: | | 0-3 |
| Select ne USC graduate (500-level or higher) course * | | |
| Total Credit Hours | | 12 |

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