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

- Graduates will be able to demonstrate expertise in a core subject area of civil and environmental engineering.
- Graduates will be able to demonstrate a working knowledge of various areas of CEE and related fields.
- Students will be able to describe and discuss sound research approaches and knowledge of advances in Civil and Environmental Engineering.
- Students will be able to demonstrate the ability to apply knowledge of mathematics, science and engineering.
- Graduates will be able to identify pertinent research problems, to formulate and execute a research plan.
- Graduates will be able to describe and discuss advances of knowledge in civil and environmental engineering.
- 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.
- 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 having an earned M.S. or M.E. 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. Prescribed core courses are required for each area of study (see “Core Courses” below).

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 study has a minimum core requirement for the M.S., M.E., and Ph.D. degrees. The core requirements in the different areas of study are as follows:

Environmental Engineering

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ECIV 750</td>
<td>Principles of Environmental Engineering Process</td>
<td>3</td>
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</table>

Select two of the following:

- ECIV 555 Principles of Municipal Solid Waste Engineering
- ECIV 556 Air Pollution Control Engineering
- ECIV 558 Environmental Engineering Process Modeling
- 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

Total Credit Hours 9

Geotechnical Engineering

<table>
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<tr>
<th>Course</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>ECIV 730</td>
<td>Advanced Soil Mechanics</td>
<td>3</td>
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Select three of the following:

- 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 Dynamics of Soils and Foundations
- ECIV 736 Ground Improvement Techniques
- ECIV 737 Advanced Foundation Design

Total Credit Hours 12

Structural Engineering

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ECIV 720</td>
<td>Advanced Structural Mechanics and Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

Select three of the following:

- 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

### Total Credit Hours

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<th>Course</th>
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<tbody>
<tr>
<td></td>
<td><strong>Transportation Engineering</strong></td>
<td>12</td>
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</table>

#### Select one from each group:

**Group One**
- ECIV 535  Geotechnical Engineering in Transportation
- ECIV 540  Transportation Systems Planning
- ECIV 541  Highway Design

**Group Two**
- ECIV 542  Traffic Engineering
- ECIV 748  Traffic Flow Theory

**Group Three**
- ECIV 705  Deterministic Civil and Environmental Systems Engineering
- ECIV 706  Probabilistic Civil and Environmental Systems Engineering

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<tr>
<td></td>
<td><strong>Water Resources Engineering</strong></td>
<td>9</td>
</tr>
</tbody>
</table>

#### Select one of the following options:

**Option One**

**Select two of the following:**
- 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

**Select one of the following:**
- ECIV 560  Open Channel Hydraulics
- ECIV 562  Engineering Hydrology
- ECIV 563  Subsurface Hydrology

**Option Two**

**Select three of the following:**
- 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

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