## CIVIL AND ENVIRONMENTAL ENGINEERING

### Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECIV 502</td>
<td>Life Cycle Assessment of Civil and Environmental Engineering Systems</td>
<td>3</td>
<td>D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.</td>
</tr>
<tr>
<td>ECIV 503</td>
<td>Structural Modeling and Experimental Methods</td>
<td>3</td>
<td>ECIV 327.</td>
</tr>
<tr>
<td>ECIV 520</td>
<td>Structural Analysis II</td>
<td>3</td>
<td>ECIV 320.</td>
</tr>
<tr>
<td>ECIV 521</td>
<td>Numerical Methods in Mechanics</td>
<td>3</td>
<td>D or better in ECIV 201 or ENCP 201.</td>
</tr>
<tr>
<td>ECIV 524</td>
<td>Structural Vibrations</td>
<td>3</td>
<td>ECIV 320.</td>
</tr>
<tr>
<td>ECIV 526</td>
<td>Timber and Masonry Design</td>
<td>3</td>
<td>ECIV 320.</td>
</tr>
<tr>
<td>ECIV 530</td>
<td>Foundation Analysis and Design</td>
<td>3</td>
<td>C or better in ECIV 320.</td>
</tr>
<tr>
<td>ECIV 531</td>
<td>Design of Earth Structures</td>
<td>3</td>
<td>ECIV 330.</td>
</tr>
<tr>
<td>ECIV 533</td>
<td>Geosynthetics and Geotechnical Design of Landfills</td>
<td>3</td>
<td>ECIV 330.</td>
</tr>
<tr>
<td>ECIV 535</td>
<td>Geotechnical Engineering in Transportation</td>
<td>3</td>
<td>ECIV 330.</td>
</tr>
<tr>
<td>ECIV 539</td>
<td>Experimental Methods in Geotechnical Engineering</td>
<td>3</td>
<td>ECIV 330, ECIV 330L.</td>
</tr>
<tr>
<td>ECIV 540</td>
<td>Transportation Systems Planning</td>
<td>3</td>
<td>ECIV 340.</td>
</tr>
<tr>
<td>ECIV 541</td>
<td>Highway Design</td>
<td>3</td>
<td>ECIV 340.</td>
</tr>
<tr>
<td>ECIV 542</td>
<td>Traffic Engineering</td>
<td>3</td>
<td>ECIV 340.</td>
</tr>
<tr>
<td>ECIV 551</td>
<td>Elements of Water and Wastewater Treatment</td>
<td>3</td>
<td>ECIV 350.</td>
</tr>
<tr>
<td>ECIV 555</td>
<td>Principles of Municipal Solid Waste Engineering</td>
<td>3</td>
<td>ECIV 350.</td>
</tr>
</tbody>
</table>

- **Prerequisites:** D or better in ECIV 320 or ENCP 201.
- **Topics:** The steps of conducting and interpreting an environmental life cycle assessment on civil and environmental engineering systems. Fundamentals associated with conducting a life cycle assessment, including goal and scope, inventory analysis, impact assessment, and interpretation.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 327.

- **Prerequisites:** ECIV 320.

- **Prerequisites:** D or better in ECIV 201 or ENCP 201.

- **Prerequisites:** C or better in ECIV 320.

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- **Prerequisites:** ECIV 330.

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- **Prerequisites:** D or better in ECIV 303, ECIV 325, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 327.

- **Prerequisites:** ECIV 330, ECIV 340.

- **Prerequisites:** D or better in ECIV 111 or ENCP 102 and D or better in ECIV 340.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 330.

- **Prerequisites:** ECIV 330, ECIV 330L.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 330, ECIV 330L.

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- **Prerequisites:** ECIV 330.

- **Prerequisites:** ECIV 330, ECIV 330L.

- **Prerequisites:** D or better in ECIV 111 or ENCP 102 and D or better in ECIV 340.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 330.

- **Prerequisites:** ECIV 330, ECIV 330L.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.

- **Prerequisites:** ECIV 330.

- **Prerequisites:** D or better in ECIV 350 and D or better in either ECIV 303, ECIV 325, ECIV 327, ECIV 330, ECIV 340 or ECIV 362.
ECIV 556 - Air Pollution Control Engineering (3 Credits)
Introduction to the sources of air pollution and the engineering principles used for control and prevention.
Prerequisites: ECIV 350.

ECIV 557 - Sustainable Construction for Engineers (3 Credits)
Instruction to sustainable engineering design alternatives and principles for construction and site development from preconstruction through design and the construction phase.
Prerequisites: ECIV 350 and ECIV 570.

ECIV 558 - Environmental Engineering Process Modeling (3 Credits)
Modeling fate and transport phenomena in environmental processes with applications in engineered unit operators and natural systems.
Prerequisites: ECIV 350 and MATH 242.

ECIV 560 - Open Channel Hydraulics (3 Credits)
Steady and unsteady flows in single or multiple-channel systems.
Prerequisites: ECIV 360.

ECIV 562 - Engineering Hydrology (3 Credits)
Applications of hydrologic techniques to design problems; stormwater simulation models; urban stormwater.
Prerequisite or Corequisite: D or better in ECIV 362.

ECIV 563 - Subsurface Hydrology (3 Credits)
Hydrologic cycle, subsurface physical properties, equations of groundwater flow, well flow, well design, groundwater resource development, design of dewatering systems, groundwater contamination.
Prerequisites: D or better in ECIV 201 or ENCP 201; D or better in ECIV 362.

ECIV 570 - Land Development for Engineers (3 Credits)
Fundamentals of designing and permitting the conversion of land to new or altered states, including environmental issues, traffic and parking, utility resources, site engineering, ADA, safety, planning, and zoning requirements.
Prerequisites: Three from ECIV 320, ECIV 330, ECIV 340, ECIV 350, and ECIV 362.

ECIV 580 - Railway Engineering I (3 Credits)
Introduction to the analysis and design of the railway infrastructure for freight and passenger systems to include track and track support systems, grade crossings, special trackwork, construction, inspection, assessment and compliance.
Prerequisites: ECIV 303, ECIV 320, ECIV 330, ECIV 340.
Corequisite: ECIV 303.

ECIV 582 - Operation and Logistics of Railway Systems (3 Credits)
Principles of rail operations; Network management; Best practices for train planning, performance management and delivery of service; technical elements of a railway from an operations perspective (train controls, signaling, communications, yards, tractive power etc).
Prerequisites: ECIV 340.

ECIV 586 - Design of Railway Structures (3 Credits)
Introduction to railway infrastructure; Structural design considerations and criteria of railway structures; Bridge types and components; Planning and preliminary design of modern railway bridges; Loads and forces; Structural analysis and design of steel railway bridges and components.
Prerequisite or Corequisite: ECIV 330, ECIV 325 or ECIV 327.

ECIV 589 - Intermediate Special Topics (3 Credits)
The content of this course varies, and the topics are selected by the faculty. The aim of this course is to expose upper-level undergraduate students and graduate students to a contemporary issue, not covered in any Civil and Environmental Engineering course. Possible topics include intelligent infrastructure, sustainable construction, and monitoring and improvement of poor and degrading infrastructure.

ECIV 705 - Deterministic Civil and Environmental Systems Engineering (3 Credits)
Planning, design, and operation of large-scale, integrated civil and environmental engineering systems, with applications of mathematical programming and other search models.
Prerequisites: ECIV 405.

ECIV 706 - Probabilistic Civil and Environmental Systems Engineering (3 Credits)
Civil and environmental systems engineering under uncertainty, including decision rules, decision theory, uncertainty propagation, stochastic programming, and conservative design.
Prerequisites: STAT 509.

ECIV 707 - Management of Engineering Projects (3 Credits)
This course focuses in studying the life-cycle of a project using a systems engineering approach. Industry standards for engineering companies as well as practical considerations are studies through the semester.

ECIV 708 - Engineering Risk and Reliability (3 Credits)
Risk analysis is presented in the context of reliability in design including applications to mechanical and electrical systems with discussion of failure modes and life cycle costs.

ECIV 712 - Boundary Element Methods in Engineering (3 Credits)
Introduction to boundary element methods and their computer implementation. Steady-state and transient solutions of two- and three-dimensional problems of elasticity and potential flow.
Prerequisites: ENCP 260, MATH 242.

ECIV 720 - Advanced Structural Mechanics and Analysis (3 Credits)
Development of concepts and practical applications of the finite element method of structural analysis with emphasis on the displacement method approach. Initial strains, specified displacements, numerical integration, and isoparametric elements are included.
Prerequisites: ECIV 520.

ECIV 722 - Theory and Design of Plates and Shells (3 Credits)
Prerequisites: MATH 242.

ECIV 724 - Dynamics of Structures (3 Credits)
Lumped and continuous multidegree of freedom mechanical systems and structural assemblies. Steady-state, shock, and random excitation. Modal analysis, numerical methods. Introduction to wave propagation, earthquake engineering, and nonlinear vibrations.
Prerequisites: ENCP 260, MATH 242.
ECIV 725 - Advanced Analysis and Design in Structural Metals (3 Credits)
Analysis and behavior of metal structural components under general loading combinations. Buckling phenomena of thin-walled open sections in the elastic and inelastic regions, and correlation with design code criteria. Behavior and design of plate girders.
Prerequisites: ECIV 325.

ECIV 726 - Repair and Retrofit of Structures (3 Credits)
Analysis and modeling existing and repaired structures. Selection, modeling, and design of repair and/or retrofit measures.
Prerequisites: ECIV 520.

ECIV 727 - Advanced Analysis and Design of Reinforced Concrete (3 Credits)
Design of multistory structures, two-way slabs, joints in buildings, pavement design, and miscellaneous topics.
Prerequisites: ECIV 327.

ECIV 728 - Prestressed Concrete Analysis and Design (3 Credits)
Pre-stressing methods and materials; flexural analysis, shear and torsion, design of simple, composite and continuous beams. Deflections, slab design, and study of axially loaded members.
Prerequisites: ECIV 327.

ECIV 730 - Advanced Soil Mechanics (3 Credits)
Course covers the mechanical properties of soil; analysis of the field and laboratory tests to determine soil properties required for foundation analysis and design; consolidation theory; and settlement analysis.
Prerequisites: ECIV 530.

ECIV 731 - Slope Stability, Retaining Systems and Lateral Earth Pressure (3 Credits)
Prerequisites: ECIV 530.

ECIV 732 - Theoretical and Numerical Methods in Geomechanics (3 Credits)
Constitutive models and their numerical implementation. Elastic and plastic approaches to analysis. Finite element applications to geomechanics problems. Layer analysis, arching, and stability case studies.
Prerequisites: ECIV 530.

ECIV 733 - Physico-chemical Properties of Soils (3 Credits)
Prerequisites: ECIV 530.

ECIV 734 - Dynamics of Soils and Foundations (3 Credits)
Prerequisites: ECIV 330.

ECIV 736 - Ground Improvement Techniques (3 Credits)
Application of soil mechanics principles to improving the engineering characteristics of soil and rock. Topics include mechanisms of soil densification, preconsolidation, grouting, ground freezing, reinforced earth, and soil nailing.
Prerequisites: ECIV 530.

ECIV 737 - Advanced Foundation Design (3 Credits)
Prerequisites: ECIV 530.

ECIV 742 - Intermodal Freight Transport (3 Credits)
Marine container terminal design and operations, rail-yard design and operations, cross-dock terminal design and operations, drayage routing and scheduling, and network design. Application of operations research techniques to intermodal transportation.
Prerequisites: D or better in ECIV 705.

ECIV 744 - Discrete Choice Analysis of Travel Demand (3 Credits)
Individual choice theory; binary choice models; unordered multinomial and multi-dimensional choice models; sampling theory and sample design; ordered multinomial models, aggregate prediction with choice models; joint stated preference and revealed preference modeling, and longitudinal choice analysis; review of state-of-the-art and future directions.
Prerequisites: D or better in STAT 509.

ECIV 746 - Flows in Transportation Networks (3 Credits)
Design, operation, and management of traffic flows over complex transportation networks. Covers two major topics: traffic flow modeling and traffic flow operations. Includes deterministic and probabilistic models, elements of queueing theory, and traffic assignment. Concepts and methods are illustrated through various applications and examples.
Prerequisites: D or better in ECIV 706.

ECIV 748 - Traffic Flow Theory (3 Credits)
Prerequisites: ECIV 541, STAT 509.

ECIV 750 - Principles of Environmental Engineering Process (3 Credits)
Basic physical, chemical, and biological processes applied to aqueous systems.
Prerequisites: CHEM 112 and MATH 142.

ECIV 751 - Water and Wastewater Treatment Theory I (3 Credits)
Physical and chemical water and wastewater treatment processes. Topics include mixing, coagulation, sedimentation, filtration, oxidation, absorption, and ion exchange.
Prerequisites: ECIV 750.

ECIV 752 - Water and Wastewater Treatment Theory II (3 Credits)
Biological water and wastewater treatment process. Topics include activated sludge, biofilms, nutrient removal, lagoons, and sludge treatment and disposal.
Prerequisites: ECIV 750.
ECIV 753 - Unit Operations Laboratory for Water and Wastewater Treatment (3 Credits)
Laboratory experiments in selected processes for water and wastewater treatment.
Prerequisites: ECIV 350L.

ECIV 755 - Industrial Wastewater Treatment (3 Credits)
Industrial sources, characteristics, and treatment plant design.
Prerequisites: ECIV 751 or ECIV 752.

ECIV 760 - Computational Hydraulics (3 Credits)
Unsteady flow in open channels and pipes: theory, governing equations, and methods for their solution.
Prerequisites: ECIV 560.

ECIV 761 - Numerical Methods in Subsurface Hydrology (3 Credits)
Formation of groundwater flow and solute transport problems: theory and practice, numerical methods, solution techniques.
Cross-listed course: GEOL 775

ECIV 762 - Advanced Hydrology (3 Credits)
Advanced theories and techniques used in stormwater modeling; kinematic hydrology; soil physics infiltration; deterministic and parametric stormwater models; stochastic methods.
Prerequisites: ECIV 562.

ECIV 763 - Unsaturated Flow Theory (3 Credits)
Moisture content-matric suction relationships, theory of flow in unsaturated soils, governing equations, measurement techniques, computer modeling of flow and transport.
Prerequisites: ECIV 563.

ECIV 764 - Contaminant Transport (3 Credits)
Quantitative study of conservative and non-conservative pollutant transport in groundwater. Special topics include: transport processes, field techniques to determine aquifer transport parameters, and computer modeling of flow and transport.
Prerequisites: ECIV 563.

ECIV 765 - Erosion and Sediment Control (3 Credits)
Erosion, sediment transport, methods for control, pond hydraulics and performance, nonpoint source pollution, stream water quality.
Prerequisites: ECIV 562.

ECIV 766 - Fluid Transients (3 Credits)
Definitions; derivation of governing equations; methods of solution; method of characteristics; transients caused by turbomachinery, and methods for controlling transients.
Prerequisites: ENCP 360.

ECIV 767 - Sediment Transport and River Mechanics (3 Credits)
Sediment properties, review of fluid mechanics of sediment transport as bedload and suspended load, stability analysis of bedforms, alternate bars, growth and migration of meander bends.
Prerequisites: ECIV 560.

ECIV 784 - Dynamic Analysis of Railway Systems (3 Credits)
Dynamic characteristics of railway systems and their components; Modeling and simulations of railway systems including trains, track and ballast; Dynamic interaction of components including wheel-rail and train-bridge interaction; Study of environmental vibrations; Advanced topics on infrastructure assessment, infrastructure upgrade and vibration mitigation.
Prerequisites: ECIV 524.

Prerequisite or Corequisite: ECIV 520.

ECIV 789 - Design Project in Railway Engineering (4 Credits)
Application of engineering design principles in railway projects; project management; project scheduling; cost estimation; ethics; environmental and social impact; design drawings; report documents.
Prerequisites: ECIV 580 or ECIV 582.

ECIV 790 - Selected Topics in Civil Engineering (3-9 Credits)
Individual studies and/or investigations of special topics in the field of civil engineering.

ECIV 797 - Research in Civil Engineering (1-12 Credits)
Credits to be designated upon registration.

ECIV 798 - Seminar in Civil and Environmental Engineering (0 Credits)
Seminar on current topics in civil and environmental engineering. Includes oral presentations by students on their research projects. Recommended by the department that all graduate students participate each semester the seminar series is offered.

ECIV 799 - Thesis Preparation in Civil Engineering (1-12 Credits)
To be arranged by candidates for the master’s degree with the instructor under whose direction the master’s thesis is being written.

ECIV 899 - Dissertation Preparation in Civil Engineering (1-12 Credits)