

# ECIV (ECIV)

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## **ECIV 160. Surveying and Computer Graphics. 3 Units.**

Principles and practice of surveying; error analysis, topographic mapping, introduction to photogrammetry and GIS; principles of graphics; computer-aided-drafting. Laboratory.

## **ECIV 300. Undergraduate Research. 3 Units.**

Research conducted under the supervision of a sponsoring Civil Engineering faculty member. Research can be done on an independent topic or as part of an established on-going research activity. The student will prepare a written report on the results of the research. Course may fulfill one technical elective requirement.

## **ECIV 310. Strength of Materials. 3 Units.**

Mechanical properties of materials, deformations, stresses, strains and their transformation. Torsion of structural and machine elements, pressure vessels and beams under combined loading. Deflection and statically indeterminate beams. Energy methods and column stability. Prereq: ENGR 200.

## **ECIV 311. Civil Engineering Materials. 3 Units.**

Steel, concrete, wood, masonry, and fiber-reinforced plastic. Experiments, advanced reading, and field trips. Strength, stiffness, ductility, and other properties of materials. Experiments on the flexural, compressive, and shear behavior of structural elements. Prereq: ECIV 310.

## **ECIV 320. Structural Analysis I. 3 Units.**

Static, linear, structural analysis of trusses and frames for member forces and displacements. Analysis of cables and arches. Behavior of statically determinate and indeterminate systems using stiffness and flexibility formulations. Introduction to structural analysis software. Structural load calculations and load path. Recommended preparation: ECIV 310. Prereq: ENGR 200.

## **ECIV 321. Matrix Analysis of Structures. 3 Units.**

Matrix formulation and computer analysis (MATLAB recommended) for statically indeterminate linear structural systems; Stiffness method (direct/displacement method); Potential Energy Method; Development of element equations for 1D axial and flexural members and 2D triangle element; Transformation between local to global coordinates; Development of displacement fields (linear function for axial members and cubic function for flexural members); Shape function concept in approximation; Introduction to elasticity, finite element analysis and nonlinear structural analysis. Additional term project on programming for six degrees of freedom beam structure analysis will be assigned to students enrolled in ECIV428. Recommended for all students: Linear Algebra, Structural Analysis, and MATLAB Programming. Offered as ECIV 321 and ECIV 428. Prereq: ECIV 320 and EMAE 250.

## **ECIV 330. Soil Mechanics. 4 Units.**

The physical, chemical, and mechanical properties of soils. Soil classification, capillarity, permeability, and flow nets. One dimensional consolidation, stress and settlement analysis. Shear strength, stability of cuts, and design of embankments, retaining walls and footings. Standard laboratory tests performed for the determination of the physical and mechanical properties of soils. Laboratory. Recommended preparation: ECIV 310.

## **ECIV 340. Construction Management. 3 Units.**

Selected topics in construction management including specifications writing, contract documents, estimating, materials and labor, bidding procedures and scheduling techniques. The course is augmented by guest lecturers from local industries.

## **ECIV 341. Construction Scheduling and Estimating. 3 Units.**

The focus is on scheduling, and estimating and bidding for public and private projects. This includes highways as well as industrial and building construction. The use of computers with the latest software in estimating materials, labor, equipment, overhead and profit is emphasized. Recommended preparation: ECIV 340 and consent of instructor.

## **ECIV 342. BIM and Computer Graphics. 3 Units.**

This course is intended to apply Building Information Modeling tools in a meaningful manner within the AEC field. The course will progress through the core concepts of widely used VDC tools: AutoCAD, Sketchup, Revit, Navisworks. The key areas of focus will be conceptualizing projects, quantity takeoff, scheduling, and constructability review. Class time will involve hands-on training and exercises that will simulate real-world situations and deadlines. Complexity levels in the models will be minimized to ensure focus on concepts. Students will have multiple opportunities to hone their presentation skills with their projects through the course progression. Prereq: ECIV 160 and ECIV 340.

## **ECIV 343. BIM Data Management & Remote Sensing. 3 Units.**

The course is intended to create awareness and advocacy for advanced design and planning technologies in the AEC industry, and integration into standard BIM platforms. The course will enhance competency in utilization of core BIM platforms for students with basic experience in Sketchup, Revit and Navisworks. Class time will involve hands-on exercises to simulate professional applications of technologies that improve accuracy and communication on projects. Technical equipment processes will be demonstrated in person, and situational challenges will be presented and assigned for course projects. Technology focus will include drones, LIDAR, and virtual reality simulations. Recommended Preparation: ECIV 341. Prereq: ECIV 342.

## **ECIV 351. Engineering Hydraulics and Hydrology. 3 Units.**

Application of fluid statics and dynamics to Civil Engineering Design. Hydraulic machinery, pipe network analysis, thrust, hammer, open channel flow, sewer system design, culverts, flow gauging, retention/detention basin design. Applied hydrology, hydrograph analysis and hydraulic routing will also be introduced. Recommended preparation: Concurrent enrollment in ENGR 225.

## **ECIV 360. Civil Engineering Systems. 3 Units.**

Introduction to probability and statistics. Discrete and continuous random variables, probability distributions, bivariate data, probabilistic analysis of systems, and reliability analysis. Introduction to engineering economics. Interest rates and equivalence, present worth, rate of return analysis, depreciation, and inflation.

## **ECIV 361. Water Resources Engineering. 3 Units.**

Water doctrine, probabilistic analysis of hydrologic data, common and rare event analysis, flood forecasting and control, reservoir design, hydrologic routing, synthetic streamflow generation, hydroelectric power, water resource quality, water resources planning. Recommended preparation: ECIV 351.

## **ECIV 362. Solid and Hazardous Waste Management. 3 Units.**

Origin and characterization of solid and hazardous waste. Solid and hazardous waste regulations. Methods of solid and hazardous waste disposal. Waste management planning. Landfill siting and design considerations. Site Conceptual Models for remediation of contaminated sites. Technologies used for soil and groundwater remediation at solid and hazardous waste sites. Offered as ECIV 362 and ECIV 462.

## **ECIV 368. Environmental Engineering. 3 Units.**

Principle and practice of environmental engineering. Water and waste water engineering unit operations and processes including related topics from industrial waste disposal, air pollution and environmental health.

**ECIV 370. Structural Design I. 3 Units.**

Professional role of a structural engineer. Professional and legal responsibilities. Design of structures, beams, columns, beam-columns, and connections. Structures of steel and reinforced concrete. Recommended preparation: ECIV 320. Prereq: ECIV 310.

**ECIV 371. Structural Design II. 3 Units.**

Continuation of ECIV 370. Torsion design of concrete members, design of continuous beams and slabs, reinforcement development, concrete serviceability deflection criteria, design of two-way slabs, stability design of steel members, lateral-torsional buckling and local buckling of steel members, steel connection design, software aided design of a steel building structure. Recommended preparation: ECIV 310 and ECIV 315. Offered as ECIV 371 and ECIV 471. Prereq: ECIV 370.

**ECIV 372. Timber and Masonry Design. 3 Units.**

Introduction to wood material. Design for timber beams and columns to resist vertical and lateral loads. Design of nailed and bolted connections. Introduction to masonry materials and design of wall. Offered as ECIV 372 and ECIV 472. Prereq: ECIV 322.

**ECIV 396. Civil Engineering Special Topics I. 1 - 3 Units.**

Special topics in civil engineering in which a regular course is not available. Conferences and report.

**ECIV 397. Civil Engineering Topics II. 3 Units.**

Special topics in civil engineering in which a regular course is not available. Conferences and report.

**ECIV 398. Civil Engineering Senior Project. 3 Units.**

Capstone course for civil engineering students. Material from previous and concurrent courses used to complete a multidisciplinary engineering design project. Professional engineering topics such as project management, engineering design, communications, and professional ethics. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Counts as SAGES Senior Capstone. Counts as SAGES Senior Capstone.

**ECIV 400T. Graduate Teaching I. 0 Unit.**

This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with the student's dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student's area of study. Prereq: Ph.D. students in Civil Engineering.

**ECIV 411. Elasticity, Theory and Applications. 3 Units.**

General analysis of deformation, strain, and stress. Elastic stress-strain relations and formulation of elasticity problems. Solution of elasticity problems by potentials. Simple beams. The torsion problem. Thick cylinders, disks, and spheres. Energy principle and introduction to variational methods. Elastic stability. Matrix and tensor notations gradually introduced, then used throughout the course. Recommended preparation: ECIV 310 or equivalent.

**ECIV 415. Fracture Mechanics and Size Effect. 3 Units.**

Linear Elastic Fracture Mechanics: crack tip fields, stress intensity factors, energy release rate, J-integral, fracture criteria. Nonlinear Theories: R-curve, plastic fracture mechanics. Quasibrittle Materials: cohesive crack models, fracture process zone. Fatigue cracks. Size Effect: linear elastic fracture mechanics prediction, size effect in quasibrittle materials. Experimental determination of fracture properties. Recommended preparation: ECIV 411. Prereq: ECIV 310.

**ECIV 420. Finite Element Analysis. 3 Units.**

Theory and application of the finite element method. Approximation theory as the basis for finite element methods. The formulations for a variety of finite elements in one, two, and three dimensions. The modeling and analysis of structural components and systems using planar, solid, and plate elements. Implementations of element formulations using Matlab. An advanced finite element analysis program will be used for analysis of structural problems. Recommended preparation: ECIV 321 is a prerequisite for structural engineering students. Background in advanced mechanics and numerical analysis of structures is required for this course. If you have not completed these courses, please discuss with the instructor. Prereq: Graduate Standing or ECIV 321.

**ECIV 421. Advanced Topics in Reinforced Concrete Structures. 3 Units.**

Group project-based course to evaluate nonlinear dynamic behavior of multistory reinforced concrete structures designed to the US building design codes (ACI318, ASCE7, ASCE41); Main Topics including Review of RC Design Principles, Procedure Requirements and Assumptions; Inelastic Behavior of Plain Concrete, Reinforced Concrete, and Reinforcing Steel; Code-Based Design vs. Performance-Based Design; Strength vs. Displacement Demand Parameters at the Member, Story, and Structure Levels; Pushover Analysis Using an Open Source Code (OpenSees). Prereq: Graduate Standing or ECIV 321, ECIV 322 and ECIV 323.

**ECIV 422. Advanced Structural Steel Design. 3 Units.**

Advanced topics for the design of steel structures including member and frame stability, design of members for torsion, plate girders, base plate and anchorage connections, and basics of composite systems. Plastic analysis and design concepts for structural engineering limit state load applications. Seismic design of steel lateral force resisting systems. Recommended Preparation: ECIV 321. Prereq: ECIV 323 or instructor consent.

**ECIV 424. Structural Dynamics. 3 Units.**

Modeling of structures as single and multidegree of freedom dynamic systems. The eigenvalue problem, damping, and the behavior of dynamic systems. Deterministic models of dynamic loads such as wind and earthquakes. Analytical methods, including modal, response spectrum, time history, and frequency domain analyses. Recommended preparation: ECIV 321 and consent of instructor.

**ECIV 425. Structural Design for Dynamic Loads. 3 Units.**

Structural design problems in which dynamic excitations are of importance. Earthquake, wind, blast, traffic, and machinery excitations. Human sensitivity to vibration, mechanical behavior of structural elements under dynamic excitation, earthquake response and earthquake-resistant design, wind loading, damping in structures, hysteretic energy dissipation, and ductility requirements. Recommended preparation: ECIV 424.

**ECIV 426. Probabilistic Analysis. 3 Units.**

Introduction to probability and statistics. Uncertainty and decision analysis. Probability models for structural loads and strength. Probabilistic analysis of engineering systems. Estimation of the reliability of structures and infrastructure systems. Monte Carlo simulation. Recommended preparation: ECIV 360, introduction of probability and statistics, or equivalent.

**ECIV 427. Environmental Organic Chemistry. 3 Units.**

This is an advanced course focusing on examination of processes that effect the behavior and fate of anthropogenic organic contaminants in aquatic environments. The lectures will focus on intermolecular interactions and thermodynamic principles governing the kinetics of some of the important chemical and physicochemical transformation reactions of organic contaminants. Recommended Preparation: One semester of Organic chemistry or prior approval of the instructor.

**ECIV 428. Matrix Analysis of Structures. 3 Units.**

Matrix formulation and computer analysis (MATLAB recommended) for statically indeterminate linear structural systems; Stiffness method (direct/displacement method); Potential Energy Method; Development of element equations for 1D axial and flexural members and 2D triangle element; Transformation between local to global coordinates; Development of displacement fields (linear function for axial members and cubic function for flexural members); Shape function concept in approximation; Introduction to elasticity, finite element analysis and nonlinear structural analysis. Additional term project on programming for six degrees of freedom beam structure analysis will be assigned to students enrolled in ECIV428. Recommended for all students: Linear Algebra, Structural Analysis, and MATLAB Programming. Offered as ECIV 321 and ECIV 428. Prereq: Graduate Student standing.

**ECIV 430. Foundation Engineering. 3 Units.**

Subsoil exploration. Various types of foundations for structures, their design and settlement performance, including spread and combined footings, mats, piers, and piles. Design of sand-drain installations and earth-retaining structures including retaining walls, sheet piles, and cofferdams. Case studies. Recommended preparation: ECIV 330.

**ECIV 432. Mechanical Behavior of Soils. 3 Units.**

Soil statics and stresses in a half space-tridimensional consolidation and sand drain theory; stress-strain relations and representations with rheological models. Critical state and various failure theories and their experimental justification for cohesive and noncohesive soils. Laboratory measurement of rheological properties, pore water pressures, and strength under combined stresses. Laboratory. Recommended preparation: ECIV 330.

**ECIV 433. Soil Dynamics. 3 Units.**

I-DOF and M-DOF dynamics; wave propagation theory; dynamic soil properties. Foundation vibrations, design of machine foundations. Seismology; elastic and elastoplastic response spectra, philosophy of earthquake-resistant design. One and two-dimensional soil amplification, liquefaction, dynamic settlement. Soil-structure interaction during earthquakes. Recommended preparation: ECIV 330 and consent of instructor.

**ECIV 434. Field Instrumentation and Insitu Testing. 3 Units.**

In situ test methods. Standard Penetration Test (SPT), Cone Penetration Test (CPT), pressuremeter, vane shear test, dilatometer, seismic methods, electromagnetic methods, and electrical methods. Geotechnical field instrumentation. Measurement of load, stress, pore pressure, and deformation in the field. Stress wave theory, pile driving analysis, pavement condition survey. Recommended preparation: ECIV 330.

**ECIV 437. Pavement Analysis and Design. 3 Units.**

Analysis and design of rigid and flexible airfield and highway pavements. Pavement evaluation and rehabilitations, overlay design. Recommended preparation: ECIV 330.

**ECIV 450. Environmental Engineering Chemistry. 3 Units.**

Fundamentals of inorganic, organic, and physical chemistry with emphasis on the types of problems encountered in the environmental engineering field. Equilibria among liquid, gaseous, and solid phases; kinetics to the extent that time permits. A strong mathematical approach is taken in solving the equilibrium and kinetic problems presented. Equilibrium speciation software for solution of more complex problems. Topics that will be covered in the course include chemical equilibrium, acid/base reactions, mathematical problem solving approach, graphical approaches, titration curves, solubility of gases and solids, buffering systems, numerical solution of equilibrium problems, thermodynamics, oxidation-reduction reactions, principles of quantitative chemistry and analytical techniques, introduction to the use of analytical instrumentation, and chemical kinetics. Prereq: ECIV 368 or requisites not met permission.

**ECIV 456. Intelligent Infrastructure Systems. 3 Units.**

Topics on smart infrastructure systems; smart materials fabrication, embedded sensing technology for infrastructure condition monitoring, the system models for infrastructural condition diagnosing and adaptive controlling, and spatial-temporal integrated infrastructure management system.

**ECIV 461. Environmental Engineering Biotechnology. 3 Units.**

Process design fundamentals for biological reactors applied to environmental engineering processes, including wastewater treatment, bioremediation, and bioenergy production. Topics include mass balances, methane fermentation, fixed-growth reactors, molecular biology tools, and reactor models. Recommended preparation: ECIV 368 Environmental Engineering.

**ECIV 462. Solid and Hazardous Waste Management. 3 Units.**

Origin and characterization of solid and hazardous waste. Solid and hazardous waste regulations. Methods of solid and hazardous waste disposal. Waste management planning. Landfill siting and design considerations. Site Conceptual Models for remediation of contaminated sites. Technologies used for soil and groundwater remediation at solid and hazardous waste sites. Offered as ECIV 362 and ECIV 462.

**ECIV 471. Structural Design II. 3 Units.**

Continuation of ECIV 370. Torsion design of concrete members, design of continuous beams and slabs, reinforcement development, concrete serviceability deflection criteria, design of two-way slabs, stability design of steel members, lateral-torsional buckling and local buckling of steel members, steel connection design, software aided design of a steel building structure. Recommended preparation: ECIV 310 and ECIV 315. Offered as ECIV 371 and ECIV 471.

**ECIV 472. Timber and Masonry Design. 3 Units.**

Introduction to wood material. Design for timber beams and columns to resist vertical and lateral loads. Design of nailed and bolted connections. Introduction to masonry materials and design of wall. Offered as ECIV 372 and ECIV 472.

**ECIV 500T. Graduate Teaching II. 0 Unit.**

This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with the student's dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student's area of study. Prereq: Ph.D. student in Civil Engineering.

**ECIV 600T. Graduate Teaching III. 0 Unit.**

This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with student's dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student's area of study. Prereq: Ph.D. students in Civil Engineering.

**ECIV 601. Independent Study. 1 - 18 Units.**

Plan B.

**ECIV 651. Thesis M.S.. 1 - 18 Units.**

Plan A.

**ECIV 660. Special Topics. 1 - 18 Units.**

Topics of special interest to students and faculty. Topics can be those covered in a regular course when the student cannot wait for the course to be offered.

**ECIV 695. Project M.S.. 1 - 9 Units.**

Research course taken by Plan B M.S. students. Prereq: Enrolled in the ECIV Plan B MS Program.

**ECIV 701. Dissertation Ph.D.. 1 - 9 Units.**

(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.