Graduate Courses by Areas Offered in Civil Engineering Department

Graduate students can take graduate courses from different specialty areas in Civil Engineering, from other departments in the College of Engineering, and from departments in other colleges at Auburn University based on the approval of major advisor. All course numbers ending 6, e.g., CIVL 6216 Chemical Principles of Environmental Engineering, are possibly offered as video outreach option.

General CE Graduate Courses

CIVL 7950 GRADUATE SEMINAR (1) SEM. 1. SU. Course may be repeated for a maximum of 6 credit hours.

CIVL 7970/7976 SPECIAL TOPICS IN CIVIL ENGINEERING (1-3) LEC. Individual student or group endeavor under direct faculty supervision involving special topics of an advanced nature in civil engineering. Course may be repeated for a maximum of 9 credit hours.

CIVL 7980/7986 ENGINEERING PROJECT (1-10) LEC. Departmental approval. Course may be repeated with change in topics.

CIVL 7990 RESEARCH AND THESIS (1-10) MST. Departmental approval. Credit to be arranged.

Hydraulics/Hydrology

CIVL 6110/6116 OPEN CHANNEL HYDRAULICS (3) LEC. 3. Pr. CIVL 3110. Application of continuity, energy, and momentum analyses to problems of open channel flow. Topics include rapidly and gradually varied flow, unsteady flow, flood routing, computational methods, design concepts and applications. Credit will not be given for both CIVL 5110 and CIVL 6110/CIVL 6116.

CIVL 6120 HYDROLOGIC ANALYSIS AND MODELING (3) LEC. 3. Pr. CIVL 3110 and STAT 3110. Departmental approval Hydrologic cycle, hydrologic frequency analysis, precipitation, infiltration, runoff hydrograph, flood routing, urban hydrology, watershed hydrologic modeling, and computer modeling applications.

CIVL 6130 HYDRAULIC DESIGN (3) LEC. 3. Pr. CIVL 3110. Pressurized flow applications; pump-pipeline design optimization; multiple reservoir operation; flow measurement/control systems; distribution manifolds; fundamentals of unsteady flows. Departmental approval. May count either CIVL 5130 or CIVL 6130.

CIVL 6150/6156 GROUNDWATER HYDRAULICS (3) LEC. 3. Pr. CIVL 3110. Mechanics of groundwater flow, definitions, conservation of mass, Darcy's law, confined and unconfined flow,
steady and transient flow, groundwater transport. May count either CIVL 5150 or CIVL 6150/CIVL 6156.


CIVL 7170/7176 NUMERICAL METHODS IN HYDRAULICS AND HYDROLOGY (3) LEC. 3. Pr. CIVL 3230. Numerical approximations of ordinary and partial differential equations representing problems common to civil engineering including groundwater flow, soil consolidation, and mass transport. The formulation and computational solution of diffusion and equilibrium problems are emphasized. Computer programming is required.

**Environmental Engineering**

CIVL 6210/6216 CHEMICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING (3) LEC. 3. Pr. CIVL 3230. Fundamentals of aquatic chemistry as applied to environmental engineering: chemical thermodynamics, acid/base equilibrium, solution/dissolution chemistry, redox equilibrium, and chemical kinetics. Departmental approval. Credit will not be given for both CIVL 5210 and CIVL 6210/CIVL 6216.

CIVL 6220 ENVIRONMENTAL ENGINEERING PROCESSES LABORATORY (1) LAB. 3. Pr. CIVL 3230. Laboratory exploration of the fundamentals and applications of aquatic chemistry, physical-chemical processes and biological processes, as employed in water and wastewater treatment. Departmental approval. May count either CIVL 5220 or CIVL 6220.

CIVL 6230/6236 ENVIRONMENTAL HEALTH ENGINEERING (3) LEC. 3. Application of engineering methodology in environmental health; communicable disease control, insect and rodent control, solid and hazardous wastes, noise, radiological health, legal and administrative considerations, etc. Departmental approval. Credit will not be given for both CIVL 5230 and CIVL 6230/CIVL 6236.

CIVL 6240/6246 AIR POLLUTION (3) LEC. 3. Nature, sources and effects of air pollutants; effects of atmospheric conditions on dispersion; dispersion modeling theory and design of control devices; legal/administrative control. Departmental approval. Credit will not be given for both CIVL 5240 and CIVL 6240/CIVL 6246.

CIVL 6250/6256 BIOLOGICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING (3) LEC. 3. Pr. CIVL 3230. Fundamentals of aquatic biology and microbiology as applied to environmental engineering: microbial growth, microbial metabolism, microbial population dynamics, wastewater treatment microbiology, environmental impacts, toxicity testing, and biomonitoring. Departmental approval. Credit will not be given for both CIVL 5250 and CIVL 6250/CIVL 6256.

CIVL 7210/7216 METHODS OF POLLUTANT ANALYSIS IN ENVIRONMENTAL ENGINEERING (3) LEC. 2. LAB. 3. Pr. CIVL 6210 or CIVL 6216. Fundamentals of identifying and quantifying environmental pollutants: review of pollutant chemistry, quality and quantity of pollutants, statistical basis of sampling, environmental sampling techniques, analytical techniques, and data analysis.

CIVL 7220/7226 WATER AND WASTEWATER OPERATIONS AND PROCESSES I (3) LEC. 3. Pr. CIVL 3230. Departmental approval Coreq. CIVL 6210. Physical and chemical principles applied to water and wastewater treatment. Advanced mathematical and modeling concepts.
CIVL 7230/7236 WATER AND WASTEWATER OPERATIONS AND PROCESSES II (3) LEC. 3. Pr. CIVL 7220 or CIVL 7226. Departmental approval. Rigorous analysis of unit operations and processes used in modern water and wastewater treatment systems. Mixing, coagulation, sedimentation, filtration, and chemical precipitation.

CIVL 7240/7246 WATER AND WASTEWATER OPERATIONS AND PROCESSES III (3) LEC. 3. Pr. CIVL 7220 or CIVL 7226. Departmental approval. Design and analysis of unit operations and processes used in modern water and wastewater treatment systems are rigorously examined: adsorption, ion exchange, membrane filtration, reverse osmosis, gas transfer, corrosion, and treatment residuals processing.


CIVL 7260/7266 ENVIRONMENTAL NUTRIENT CONTROL PROCESSES (3) LEC. 3. Pr. CIVL 7250 or CIVL 7256. The nature, sources, and impacts of aquatic nutrients in the environment: microbial nutrient cycles, biological nutrient removal processes, chemical nutrient control processes, natural systems for nutrient removal.


CIVL 7280/7286 SURFACE WATER QUALITY MODELING (3) LEC. 3. Pr. CIVL 3230. Departmental approval. Physical, chemical, biological and hydrological considerations relating to the degradation and self purification of streams, lakes, and estuaries. Water uses and water quality goals, objectives and criteria. Principles of water quality modeling and waste load allocation.

Geotechnical Engineering

CIVL 6330/6336 LANDFILLS (3) LEC. 3. Pr. CIVL 3310. Landfill siting design, construction and operational practices; regulations, terminology, closure regulations and procedures. Credit will not be given for both CIVL 5330 and CIVL 6330/CIVL 6336.

CIVL 6340/6346 GEOSYNTHETICS AND SOIL IMPROVEMENT (3) LEC. 3. Pr. CIVL 3310. Use of geosynthetics in civil engineering design: reinforcement, retaining walls, filtration, slopes, roads and erosion control. Evaluation and testing of geosynthetics. Improvement of soil properties for civil engineering design: principles and practice of densification, grouting, reinforcement, stone columns, soil nailing. Credit will not be given for both CIVL 5340 and CIVL 6340/CIVL 6346.

CIVL 6350/6356 EARTH RETAINING STRUCTURES (3) LEC. 3. Pr. CIVL 3310. Analysis and design of earth retaining strutures. Shear strength; earth pressure theory; gravity, mechanically stabilized, flexible sheet, and anchored structures. May count either CIVL 5350 or CIVL 6350/CIVL 6356.

CIVL 7310/7316 FOUNDATION ENGINEERING (3) LEC. 3. Pr. CIVL 3310 and CIVL 4600. Analysis, design and construction of shallow and deep foundation systems.

CIVL 7330/7336 SOIL PROPERTIES (3) LEC. 3. Pr. CIVL 3310. Soil behavior, shear strength, compressibility, hydraulic conductivity, and measurement of soil properties.
CIVL 7340/7346 SOIL DYNAMICS (3) LEC. 3. Pr. CIVL 3310. Soil behavior during dynamic loads, wave propagation, dynamically loaded foundations, geotechnical earthquake engineering.


CIVL 7390/7396 IN SITU TESTING OF SOILS (3) LEC. 3. Pr. CIVL 4310. In situ tests used in geotechnical engineering: test procedures, interpretation of results, and designing from in situ geotechnical data.

Construction Engineering and Management

CIVL 6410 GEOGRAPHIC INFORMATION SYSTEMS IN CIVIL ENGINEERING (3) LEC. 3. Pr. CIVL 2010. Departmental approval Basic principles and the development of geographic information systems and practical experiences in the field of civil engineering. Credit will not be given for both CIVL 5410 and CIVL 6410.


CIVL 6430/6436 CONSTRUCTION SAFETY (3) LEC. 3. Pr. CIVL 3410. Departmental approval Various causes of construction accidents and adopted strategies preventing worksite injuries and illnesses are investigated. Emphasis on OSHA standards, insurance, and health and safety hazards. Credit will not be given for both CIVL 5430 and CIVL 6430/CIVL 6436.

CIVL 6440/6446 CONSTRUCTION EQUIPMENT AND METHODS (3) LEC. 3. Pr. CIVL 3410 and CIVL 3310 and CIVL 3510. Selection of equipment for heavy construction operations, production rates, owning and operating costs, fleet management. May count either CIVL 5440 or CIVL 6440/CIVL 6446.

CIVL 6450 EROSION AND SEDIMENT CONTROL TECHNOLOGIES IN CONSTRUCTION (3) LEC. 3. Pr. CIVL 3310 and CIVL 3410. Process of erosion, sediment transport, and sedimentation along with strategies adopted to prevent and manage erosion on construction sites. May count either CIVL 5450 or CIVL 6450.

CIVL 6460 PROJECT ESTIMATING (3) LEC. 3. Pr. CIVL 3410. Conceptual and definitive estimates, overhead and profit determination; claim change order pricing. May count either CIVL 5460 or CIVL 6460.

CIVL 6480/6486 LEGAL ASPECTS OF CIVIL ENGINEERING PRACTICE (3) LEC. 3. Pr. CIVL 3410. Covered is the law of contracts, agency, association, property, and labor law, studied generally and in the context that the practicing civil engineer encounters them. Departmental approval. May count either CIVL 5480 or CIVL 6480/CIVL 6486.

CIVL 7410/7416 TEMPORARY STRUCTURES AND FACILITIES (3) LEC. 3. Pr. STAT 3010 and CIVL 3310 and CIVL 3610. Construction loads, applicable codes and standards, and design principles for temporary structures; planning and implementation of construction facilities; economic analysis of alternatives.
Transportation Engineering

CIVL 6500/6506 TRAFFIC ENGINEERING ANALYSIS (3) LEC. 3. Pr. CIVL 3510. Capacity analysis of rural and suburban highways, 2-lane highways, freeways, weaving sections, ramps and intersections. May count either CIVL 5500 or CIVL 6500/CIVL 6506.

CIVL 6510/6516 TRAFFIC CONTROL SYSTEMS DESIGN (3) LEC. 3. Pr. CIVL 3510 and STAT 3010. Fundamental design concepts for highway traffic control systems. Control requirements and warrants: hardware operation and equipment selection; development and implementation of timing plans for isolated intersections and intersection networks. May count either CIVL 5510 or CIVL 6510/CIVL 6516.

CIVL 6560/6566 TRANSPORTATION PLANNING (3) LEC. 3. Pr. CIVL 3510 and STAT 3010. The planning process for urban and regional transportation development. Topics include planning objectives and data requirements; planning inventories; modeling of trip-making behavior, development and evaluation of alternate plans; multimodal applications, including railway operations. Departmental approval. May count either CIVL 5560 or CIVL 6560/CIVL 6566.

CIVL 6580/6586 INTELLIGENT TRANSPORTATION SYSTEMS (3) LEC. 3. Pr. CIVL 3510. Introduction to intelligent transportation systems, covering applications of information and communications technologies to transportation, with emphasis on operations of traffic management and traveler information systems. Departmental approval. May count either CIVL 5580 or CIVL 6580/CIVL 6586.

CIVL 7500/7506 TRAFFIC FLOW THEORY (3) LEC. 3. Pr. CIVL 6500 or CIVL 6506. Departmental approval Basic phenomena underlying traffic stream movement and individual vehicle behavior. Topics include flow parameters and relationships; microscopic and macroscopic flow models; equations of motion and state; single and multi-regime flow models.

CIVL 7520/7526 PUBLIC TRANSPORTATION (3) LEC. 3. Pr. CIVL 3510. Departmental approval Technology and characteristics of public transportation; transportation demand analysis; transit users; innovative technologies.

CIVL 7540/7546 TRANSPORTATION SAFETY (3) LEC. 3. Pr. CIVL 6500 or CIVL 6506. Departmental approval Transportation safety problems and the engineer's role in developing and administering safety programs. Topics include hazardous location identification; analysis of accident data; development and evaluation of accident countermeasures and safety programs.

CIVL 7550/7556 ROADSIDE DESIGN (3) LEC. 3. Pr. CIVL 6500 or CIVL 6506. Departmental Approval Concepts of roadside design that can prevent or reduce crash severity. Topics include design, selection, placement and construction of longitudinal barriers, crash cushions, bridge rails, transitions, end terminals, sign posts, and other roadside features.

Structure Engineering

CIVL 6600/6606 ADVANCED REINFORCED CONCRETE DESIGN (3) LEC. 3. Pr. CIVL 4600. Analysis and design of continuous beams and one-way slabs, bond and development length, torsion,
slenderness effects in columns, two-way slabs, footings, and retaining walls. May count either CIVL 5600 or CIVL 6600/CIVL 6606.

CIVL 6620/6626 PRE-STRESSED CONCRETE DESIGN (3) LEC. 3. Pr. CIVL 4600. Properties and behavior of pre-stressed concrete, pre-stressing systems and end anchorages, analysis and design of beams for flexure and shear, camber and deflection, cable layout, pre-stressed concrete slabs. May count either CIVL 5620 or CIVL 6620/CIVL 6626.

CIVL 6630/6636 ADVANCED CONCRETE MATERIALS (3) LEC. 3. Pr. CIVL 3820. Comprehensive coverage of concrete materials. Topics include cement and aggregate properties; concrete microstructure; mechanical properties; supplementary cementing materials, chemical admixtures; durability issues; special concretes. May count either CIVL 5630 or CIVL 6630/CIVL 6636.

CIVL 6640/6646 STRUCTURAL MASONRY DESIGN (3) LEC. 3. Pr. CIVL 4600. Properties of masonry component materials; behavior and design of unreinforced and reinforced masonry assemblages and structures. May count either CIVL 5640 or CIVL 6640/CIVL 6646.

CIVL 6650/6656 ADVANCED STEEL DESIGN (3) LEC. 3. Pr. CIVL 4650. Composite construction, open web joists, torsion, plate girders, plastic analysis and design, highway bridges, computer applications. May count either CIVL 5650 or CIVL 6650/CIVL 6656.


CIVL 6690/6696 TIMBER DESIGN (3) LEC. 3. Pr. CIVL 3610. Properties and behavior of timber and plywood; design of timber beams, columns, floor and wall assemblies and wood formwork; timber trusses and laminated arches. May count either CIVL 5690 or CIVL 6690/CIVL 6696.

CIVL 6700/6706 DESIGN FOR LATERAL LOADS (3) LEC. 3. Pr. CIVL 3610 and (CIVL 4600 or CIVL 4650). Wind meteorology and loadings, effects of wind loadings, building code wind pressures and load provisions, fundamentals of structural vibrations, earthquake characteristics and loadings, building code earthquake provisions, building lateral load resisting systems. May count either CIVL 5700 or CIVL 6700/CIVL 6706.

CIVL 6710/6716 STRUCTURAL REPAIR (3) LEC. 3. Pr. CIVL 4600. Evaluation of causes of distress; condition; repair materials; methods of repair; protection methods; and structural strengthening in structural concrete applications. May count either CIVL 5710 or CIVL 6710/CIVL 6716.


CIVL 7620/7626 STRUCTURAL DYNAMICS II (3) LEC. 3. Pr. CIVL 7610 or CIVL 7616. Analysis of MDOF systems by direct numerical integration, continuous systems, nonlinear dynamics response, earthquake response of structures.

CIVL 7630/7636 ADVANCED STRESS ANALYSIS (3) LEC. 3. Pr. CIVL 3610. Hooke's 1-D, 2-D, 3-D stress strain relations and applications, stress and strain transformations and Mohr's circle, material properties and failure theories, biaxial bending, unsymmetrical bending, composite material members, shear center, torsional stress, stress concentrations, beams on elastic foundations.

CIVL 7640/7646 STABILITY OF STRUCTURES (3) LEC. 3. Coreq. CIVL 6670. Introduction to stability and failure of compression members, rigid bar buckling, elastic and inelastic buckling of
columns, approximate methods of buckling analysis, beam-columns, buckling of frames, torsional buckling, lateral torsional buckling of beams.

CIVL 7650/7656 ADVANCED ANALYSIS OF FRAMED STRUCTURES (3) LEC. 3. Pr. CIVL 6670 or CIVL 6676. Matrix analysis of framed structures, elastic supports, specified displacements, member end releases, principle of minimum potential energy, geometric non-linearity, frame stability, substructures.

CIVL 7660/7666 FINITE ELEMENT METHODS IN STRUCTURAL MECHANICS (3) LEC. 3. Pr. CIVL 6670 or CIVL 6676. Departmental approval Introduction to finite element analysis; variational principles. 1D, 2D and 3D element formulation; nonlinear (geometric and constitutive) formulations and solutions; eigenvalue problems.

CIVL 7670/7676 NUMERICAL TECHNIQUES IN STRUCTURAL ANALYSIS (3) LEC. 3. Basic concepts of non-linear analyses, formulation of the continuum mechanics incremental equations, total and updated Lagrangian formulations, finite elements for non-linear analyses, non-linear solution strategies.

CIVL 7680/7686 FATIGUE AND FRACTURE MECHANICS (3) LEC. 3. Pr. CIVL 4650. Departmental approval Linear-elastic and elastic-plastic fracture mechanics, fatigue, yield criteria, applications to highway structures.

CIVL 7690/7696 ANALYSIS OF PLATE AND SHELL SYSTEMS (3) LEC. 3. Pr. CIVL 6670 or CIVL 6676. Departmental approval. Analysis of isotropic and anisotropic plates with various shapes and boundary conditions due to lateral and in-plane loads; large deflection considerations; numerical techniques; bending and membrane behavior of isotropic shells.

CIVL 7710/7716 APPLIED ELASTICITY (3) LEC. 3. Pr. CIVL 6670 or CIVL 6676. Departmental approval. Analysis of stress-strain; generalized stress-strain relationships; solution of elasticity problem by potentials; thick cylinders, disks and spheres; energy principles and introduction of variational methods.

CIVL 7770/7776 VARIATIONAL METHODS IN STRUCTURAL MECHANICS (3) LEC. 3. Pr. CIVL 6670 or CIVL 6676. Departmental approval. Calculus of variations; derivation of Euler's equations and boundary conditions; applications of energy principles to structures; variational approaches to finite element methods.

**Pavements and Materials**

CIVL 6810/6816 PAVEMENT DESIGN AND CONSTRUCTION (3) LEC. 3. Pr. CIVL 3820 and CIVL 3310 and CIVL 3510. General concepts, traffic factors, material characterization, layer thickness selection, earthwork, base and sub-base construction, surface course construction quality control/assurance. May count either CIVL 5810 or CIVL 6810/CIVL 6816.

CIVL 6820 DESIGN AND PRODUCTION OF ASPHALT PAVING MIXTURES (3) LEC. 2. LAB. 3. Pr. CIVL 3820. Selection and optimization of component materials based on physical properties, specification criteria, performance expectations, and costs. Production and quality assurance. May count either CIVL 5820 or CIVL 6820.

CIVL 7810/7816 ADVANCED CONSTRUCTION MATERIALS (4) LEC. 3. LAB. 3. Pr. CIVL 6810 or CIVL 6816. Departmental approval Evaluate soils, unbound and stabilized materials, hot mix
asphalt, and cement concrete products; stress-strain relationships; thermal expansion; design and testing of non-traditional construction products.

CIVL 7820/7826 ADVANCED PAVEMENT DESIGN AND REHABILITATION (3) LEC. 3. Pr. CIVL 7810 or CIVL 7816. Pavement management concepts, life cycle costs analysis, design and rehabilitation alternatives, serviceability concepts, empirical thickness selection models, reliability.

CIVL 7830 ASPHALT CONCRETE MIX DESIGN (3) LEC. 2. LAB. 3. Marshall and Superpave mix design methods and QC/QA for asphalt concrete are covered. Topics include aggregate, asphalt and mix properties, laboratory testing and proportion optimization.

CIVL 7840/7846 PAVEMENT MANAGEMENT AND REHABILITATION (3) LEC. 3. Pr. CIVL 3820. Departmental approval Topics include: network and project level management, pavement distress surveys, non-destructive testing for condition measurements, flexible and rigid pavement maintenance and rehabilitation practices.

CIVL 7860 PAVEMENT CONSTRUCTION (3) LEC. 3. Pr. CIVL 3820. Operation, quality control and specifications of component construction processes for asphalt and concrete paving; and overview of major rehabilitation strategies.

CIVL 7870 ADVANCED CHARACTERIZATION OF PAVEMENT MATERIALS (3) LEC. 2. LAB. 3. Pr. CIVL 3820. This course introduces theories and procedures for determining fundamental properties of asphalt materials for advanced material evaluation and pavement design.