Civil Engineering (CIVE)

Civil Engineering (CIVE) Courses

CIVE 5101 [0.5 credit] (CVG 7120)
Solid Mechanics
Cartesion tensor notation; stresses and strains in a continuum; transformations, invariants; equations of motion; constitutive relations; generalized Hooke's Law, bounds for elastic constant: strain energy, superposition, uniqueness; formulation of plane stress and plane strain problems; energy principles, variational methods; plasticity.

CIVE 5103 [0.5 credit] (CVG 7122)
Finite Element Analysis 1
Advanced finite element methods for linear systems. The relationship with variational and Galerkin formulations, system of linear equations, polynomial interpolation, numerical integration, and theory of elasticity is explored. Isoparametric formulations for structural and continuum elements are examined. Introduction to linear dynamics and nonlinear problems.
Precludes additional credit for CIVJ 5301.
Also offered at the undergraduate level, with different requirements, as CIVE 4201, for which additional credit is precluded.

CIVE 5104 [0.5 credit] (CVG 7123)
Earthquake Engineering and Analysis
Advanced vibration analysis techniques; Rayleigh-Ritz procedure; subspace iteration; derived Ritz coordinates; proportional and non-proportional damping; introduction to seismology; earthquake response analysis via time and frequency domain; response spectrum approach; multiple input excitations; design considerations and code requirements; other advanced topics in earthquake engineering.
Prerequisite(s): CIVE 5106 or permission of the Department.

CIVE 5105 [0.5 credit] (CVG 7124)
Finite Element Analysis 2
Variational and Galerkin formulations: assumed displacement, assumed stress and hybrid elements; plate bending: convergence, completeness and conformity, patch test, Kirchhoff and Mindlin plate theories, nonlinear elasticity and plasticity; geometric non-linearity, Eulerian and Lagrangian formulations; incremental and iterative schemes, finite elements in dynamics.
Precludes additional credit for CIVJ 5303.
Prerequisite(s): CIVE 5103 or permission of the Department.

CIVE 5106 [0.5 credit] (CVG 7137)
Dynamics of Structures
Structural dynamics, single and multi-degree-of-freedom systems, formulation of equations of motion, methods of analytical mechanics, free and forced vibrations, normal mode analysis, numerical methods for the response analyses of single and multiple-degree-of-freedom systems.

CIVE 5108 [0.5 credit] (CVG 7181)
Performance-Based Earthquake Engineering
Seismic performance assessment of new and existing buildings using modelling. Design and construction of nonlinear structural models. Accounting for mass, material behaviour, damping, and nonlinear geometry. Use of pushover and time history analysis methods to determine seismic performance. Consideration of nonstructural elements in determining performance.

CIVE 5109 [0.5 credit]
Estimation and Identification in Dynamics using Data
Dynamical systems and their computational models, probability and stochastic processes, stochastic dynamical systems, state estimation in linear dynamics using Kalman filtering, state estimation of nonlinear dynamical systems, system identification using combined state and parameter estimation, application to engineering.

CIVE 5200 [0.5 credit] (CVG 7138)
Masonry Behaviour and Design
Properties of masonry materials and assemblages. Behaviour and design of walls, columns and lintels. Treatment of specialized design and construction topics. Design of lowrise and highrise structures. Discussion of masonry problems. Emphasis on a practice-oriented approach.
Also offered at the undergraduate level, with different requirements, as CIVE 4403, for which additional credit is precluded.

CIVE 5202 [0.5 credit]
Structural Assessment of Historic Buildings
General concepts related to conservation of heritage structures; materials, construction techniques and structural components; classical structural analysis approaches; seismic behaviour, damage and collapse mechanisms of historic buildings; modern conservation criteria and practical implementation of repair or strengthening strategies.
Also listed as BLDG 5202.

CIVE 5204 [0.5 credit] (CVG 7126)
Advanced Steel Structures
Limit states design philosophy; material behaviour; tension members; plate buckling; torsion; lateral torsional buckling; beams, axially loaded columns and beam-column behaviour; brittle fracture and fatigue; frame stability and second order effects.

CIVE 5206 [0.5 credit] (CVG 7128)
Prestressed Concrete
Behaviour and analysis of prestressed concrete elements subjected to axial loads, flexure and shear: material properties; prestressing systems; linear and non-linear behaviour; deflections; compression-field approaches; disturbed regions; restraint of deformations; design requirements; applications to pressure vessels, bridges and frames.

CIVE 5208 [0.5 credit] (CVG 7130)
Advanced Mechanics of Reinforced Concrete
Review of various analytical methods, constitutive models, and failure criteria for reinforced concrete structures; performance assessment and forensic analysis; nonlinear finite element analysis of concrete structures.

CIVE 5209 [0.5 credit] (CVG 7100)
Geotechnical Case Studies
The critical study of case histories relating to current procedures of design and construction in geotechnical engineering. The importance of instrumentation and monitoring field behaviour will be stressed. In-situ testing.

CIVE 5210 [0.5 credit]
Advanced Computational Modeling Strategies of Historic Buildings
Introduction to conservation engineering; commonly used construction materials in historic buildings and their constitutive laws; Graphical and numerical methods to analyze masonry arches; Theory and application of discrete element method and its applications to assess masonry buildings.
Also listed as BLDG 5203.

CIVE 5300 [0.5 credit] (CVG 7101)
Advanced Soil Mechanics
Effective stress, pore pressure parameters, saturated and partially saturated soils; seepage; permeability tensor, solutions of the Laplace equation; elastic equilibrium; anisotropy, non-homogeneity, consolidation theories; shear strength of cohesive and cohesionless soils; failure and yield criteria.

CIVE 5303 [0.5 credit] (CVG 7103)
Pavements and Materials
An analysis of the interaction of materials, traffic, and climate in the planning, design construction, evaluation, maintenance, and rehabilitation of highway and airport pavements.

CIVE 5305 [0.5 credit] (CVG 7151)
Traffic Engineering
Introduction to principles of traffic engineering.
Traffic operation concepts. Travel modes and modal characteristics. Traffic stream characteristics and queuing theory. Capacity and level of service analysis of roads and intersections.
Also offered at the undergraduate level, with different requirements, as CIVE 4205, for which additional credit is precluded.

CIVE 5307 [0.5 credit] (CVG 7153)
Urban Transportation
Urban transportation systems, planning and management. Introduction to models of urban travel demand. Overview of modern transportation planning issues and policies. The role of transportation planning within the wider context of transportation decision-making. Transportation land use interaction.

CIVE 5308 [0.5 credit] (CVG 7154)
Highway Geometric Design
Principles of highway geometric design. Safety and human factors, and their interaction with the road elements. Multimodal considerations. Road design elements. New and evolving concepts.

CIVE 5310 [0.5 credit]
Road Safety Analysis
Fundamental analytical techniques for road safety analysis, background of traffic safety analysis, network screening, before and after analysis, and surrogate measures of safety.

CIVE 5311 [0.5 credit]
Advanced Pavement Engineering and Management
Civil infrastructure system, pavement network analysis, pavement structural designs, PMED, pavement management systems, life cycle assessment (LCA) methodologies, life cycle cost analysis (LCCA) procedures.

CIVE 5403 [0.5 credit] (CVG 7158)
Airport Planning
Framework for airport planning and design. Aircraft characteristics; demand forecasting; airport site selection; noise, airside capacity; geometric design; the passenger terminal complex; cargo area; general aviation; ground transportation; land use planning.

CIVE 5500 [0.5 credit] (CVG 7104)
Earth Retaining Structures
Approaches to the theoretical and semi-empirical analysis of earth retaining structures. Review of the earth pressure theories. Analysis and design methods for rigid and flexible retaining walls, braced excavations, and tunnels. Instrumentation and performance studies.

CIVE 5501 [0.5 credit] (CVG 7105)
Advanced Foundation Engineering
Review of methods of estimating compression and shear strength of soils. Bearing capacity of shallow and deep foundations. Foundations in slopes. Pile groups. Use of in-situ testing for design purposes.

CIVE 5503 [0.5 credit] (CVG 7107)
Numerical Methods in Geomechanics
Advanced theories of soil and rock behaviour. Plasticity models. Generalized failure criteria. Critical state and cap models. Dilatancy effects. Associative and non-associative flow rules. Hardening rules. Consolidation, visco-elasticity, creep behaviour. Finite element formulation. Iterative schemes. Time marching schemes. Solution of typical boundary value problems.
Prerequisite(s): CIVE 5101, CIVE 5103, or permission of the Department.

CIVE 5505 [0.5 credit] (CVG 7109)
Geotechnical Earthquake Engineering
Seismic hazards, earthquakes and ground motion, wave propagation, ground response analysis, soil properties for dynamic analysis: laboratory tests, in-situ tests, modulus and damping curves, liquefaction susceptibility, post liquefaction response, seismic effects on slope stability, retaining structures.
Precludes additional credit for CIVE 5801 (2001-2003).

CIVE 5506 [0.5 credit]
Fundamentals of Geomechanics
Tensor calculus, Cauchy stress, kinematics of continuum deformation (strain), elasticity for geomaterials, plasticity for geomaterials, constitutive models for soils, Cam-clay model.

CIVE 5507 [0.5 credit] (CVG 7184)
Blast Load Effects on Structures
Threats, risk analysis, vulnerability assessment; explosives: types and mechanisms; load determination; response of structural elements under blast loads, analysis and design for blast loads; blast mitigation, retrofit of structures; post-event assessment.
Also listed as IPIS 5507.
Prerequisite(s): those enrolled in the M.IPIS program must have prior knowledge of structural steel and reinforced concrete design, typically obtained through the completion of an undergraduate engineering degree.

CIVE 5603 [0.5 credit]
Advanced Building Characterization, Conservation and Rehabilitation
Supporting concepts and techniques for the identification, documentation, and conservation of heritage and existing buildings; advanced workshops by experts from key disciplines and practice areas in heritage conservation.
Also listed as BLDG 5201.

CIVE 5604 [0.5 credit]
Probability, Statistics, Stochastic Processes and Statistical Inference in Engineering
Fundamental of probability and statistics, (robust and ridge) regression, generalised linear models, sparse models, mixture models, stochastic processes, statistical inference and applications.

CIVE 5609 [0.5 credit] (CVG 7170)
Fundamentals of Fire Safety Engineering
The fire safety system, including social, economic and environmental issues; description of the fire safety regulatory system and the governing building codes and standards. This includes the global fire safety system in a facility and active fire protection systems; detection, suppression, smoke management.
Precludes additional credit for CIVE 5707 (2001-2002).

CIVE 5610 [0.5 credit] (CVG 7171)
Fire Dynamics I
Fundamentals of combustion including material and energy balances, chemical thermodynamics, kinetics, premixed and diffusive burning. Advanced topics in the theory of combustion, flame propagation, efficiency of combustion, and the physico-chemical properties of combustible material.
Precludes additional credit for CIVE 5705 (2001-2003).

CIVE 5611 [0.5 credit] (CVG 7173)
People in Fires
Review of the work presented by the founders in the field of human behaviour in fire. Introduction to the basic notions of perception, cognition, information processing, decision-making and problem solving. Behavioural concepts such as panic, commitment, affiliation, familiarity and role are discussed.

CIVE 5612 [0.5 credit] (CVG 7174)
Fire Modeling
Fire modeling and its role in fire safety engineering. Review of the main modeling techniques used in Fire Safety Engineering: network, zone and Computational Fluid Dynamics (CFD).
Precludes additional credit for CIVE 5802 (2002-2003).

CIVE 5613 [0.5 credit] (CVG 7172)
Fire Dynamics II
Fire dynamics from ignition through heat transfer to growth and spread of fires and their suppression. Factors such as containment and its role in the dynamics of fires and explosions are covered.
Precludes additional credit for CIVE 5803 (2002-2003).
Prerequisite(s): CIVE 5610 Fire Dynamics I.

CIVE 5614 [0.5 credit] (CVG 7175)
Design for Fire Resistance
Behaviour of materials and structures at elevated temperatures; fire-resistance tests; fire-resistance ratings; building code requirements; real-world fires; assessing the fire resistance of steel, concrete and wood building assemblies.
Precludes additional credit for CIVE 5709 (2001-2003).

CIVE 5615 [0.5 credit] (CVG 5320)
Fire Behaviour of Materials
Fundamentals and scientific aspects of materials behaviour during fires, material specifications, thermal and mechanical properties, fire hazards of materials, structural fire response, residual strength, failure criteria, mechanisms of flame retardancy, and standards and testing protocols.

CIVE 5616 [0.5 credit]
Wood Structures and Fire
Introduction to fire-safe design of wood buildings, brief review of wood products and wood design, prescriptive code requirements, determination of fire-resistance of wood structures through different methods.

CIVE 5617 [0.5 credit]
Practical Applications of Fire Protection
Introduction to the practical application of fire protection engineering from a consulting and a regulatory perspective. Main highlights include performance-based design, fire forensics, emergency preparedness and firefighting.

CIVE 5705 [0.5 credit] (CVG 7300)
Topics in Structures
Courses in special topics related to building design and construction, not covered by other graduate courses.

CIVE 5706 [0.5 credit] (CVG 7301)
Topics in Structures
Courses in special topics related to building design and construction, not covered by other graduate courses.

CIVE 5707 [0.5 credit] (CVG 7302)
Topics in Structures
Courses in special topics related to building design and construction, not covered by other graduate courses.

CIVE 5708 [0.5 credit] (CVG 7303)
Topics in Structures
Courses in special topics related to building design and construction, not covered by other graduate courses.

CIVE 5709 [0.5 credit] (CVG 7304)
Topics in Structures
Courses in special topics related to building design and construction, not covered by other graduate courses.

CIVE 5800 [0.5 credit] (CVG 7305)
Topics in Geotechnique
Courses in special topics in geotechnical engineering, not covered by other graduate courses.

CIVE 5801 [0.5 credit] (CVG 7306)
Topics in Geotechnique
Courses in special topics in geotechnical engineering, not covered by other graduate courses.

CIVE 5802 [0.5 credit] (CVG 7307)
Topics in Geotechnique
Courses in special topics in geotechnical engineering, not covered by other graduate courses.

CIVE 5803 [0.5 credit] (CVG 7308)
Topics in Geotechnique
Courses in special topics in geotechnical engineering, not covered by other graduate courses.

CIVE 5804 [0.5 credit] (CVG 7309)
Topics in Geotechnique
Courses in special topics in geotechnical engineering, not covered by other graduate courses.

CIVE 5805 [0.5 credit] (CVG 7310)
Topics in Transportation
Courses in special topics in transportation engineering, not covered by other graduate courses.

CIVE 5806 [0.5 credit] (CVG 7311)
Topics in Transportation
Courses in special topics in transportation engineering, not covered by other graduate courses.

CIVE 5807 [0.5 credit] (CVG 7312)
Topics in Transportation
Courses in special topics in transportation engineering, not covered by other graduate courses.

CIVE 5808 [0.5 credit] (CVG 7313)
Topics in Transportation
Courses in special topics in transportation engineering, not covered by other graduate courses.

CIVE 5809 [0.5 credit] (CVG 7314)
Topics in Transportation
Courses in special topics in transportation engineering, not covered by other graduate courses.

CIVE 5810 [0.5 credit] (CVG 7185)
Topics in Fire Safety
Courses in special topics related to fire safety, not covered by other graduate courses.

CIVE 5811 [0.5 credit]
Topics in Fire Safety
Courses in special topics related to fire safety, not covered by other graduate courses.

CIVE 5812 [0.5 credit]
Topics in Fire Safety
Courses in special topics related to fire safety, not covered by other graduate courses.

CIVE 5813 [0.5 credit]
Topics in Fire Safety
Courses in special topics related to fire safety, not covered by other graduate courses.

CIVE 5814 [0.5 credit]
Topics in Fire Safety
Courses in special topics related to fire safety, not covered by other graduate courses.

CIVE 5900 [1.0 credit] (CVG 6000)
Civil Engineering Project
Students enrolled in the program M.Eng. by project will conduct an engineering study, analysis, or design project under the general supervision of a member of the Department.

CIVE 5901 [0.0 credit] (CVG 7314)
Master's Seminar
The series consists of presentations by graduate students or external speakers. Graduate students in the Civil Engineering program are required to participate in these seminar series by attending all seminars and making at least one presentation during their graduate studies.

CIVE 5906 [0.5 credit] (CVG 6108)
Directed Studies 1
Prerequisite(s): open only to students in a Civil Engineering Master's program.

CIVE 5909 [2.5 credits] (CVG 5909)
M.A.Sc. Thesis

CIVE 6901 [0.0 credit]
Ph.D. Seminar
The series consists of presentations by graduate students or external speakers. Graduate students in the Civil Engineering program are required to participate in these seminar series by attending all seminars and making at least one presentation during their graduate studies.

CIVE 6902 [0.0 credit] (CVG 9998)
Ph.D. Comprehensive Examination
Graduate students at the Doctoral level in the Civil Engineering program are required to successfully complete written and oral comprehensive examinations in subject areas determined by the student's advisory committee.

CIVE 6903 [0.0 credit]
Ph.D. Proposal
Graduate students at the Doctoral level in the Civil Engineering program are required to successfully complete a PhD Thesis Proposal which consists of a written proposal and a successful defence of the proposal. Students should register in term they will defend their proposal.
Prerequisite(s): CIVE 6909 (taken concurrently).

CIVE 6906 [0.5 credit] (CVG 6109)
Directed Studies 2
Prerequisite(s): open only to students in the Civil Engineering Ph.D. program.

CIVE 6909 [0.0 credit] (CVG 9999)
Ph.D. Thesis