

# Civil Engineering (CIVE)

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## Civil Engineering (CIVE) Courses

### Civil & Environmental Eng.

### Faculty of Engineering & Design

#### **CIVE 2004 [0.5 credit]**

##### **GIS, Surveying, and Graphics**

Engineering geometry and spatial graphics. Structural engineering drawings and computer aided drafting. Fundamentals of surveying, measuring horizontal and vertical distances and angles. Topographic and construction surveys. GPS and electronic surveying. Geographic information systems, data, data structure and processing, spatial referencing, cartographic modeling, application software.

Precludes additional credit for CIVE 1004.

Lectures three hours a week, problem analysis and laboratories three hours a week.

#### **CIVE 2005 [0.5 credit]**

##### **Architectural Technology 2**

Technical issues involved in architectural design of buildings from ancient times to the present. Technological innovation and materials related to structural developments, and the organization and design of structures. Basic concepts of calculus, equilibrium, and mechanics of materials.

Precludes additional credit for CIVE 1005.

Prerequisite(s): ARCC 2202.

Lectures three hours a week, laboratory three hours a week.

#### **CIVE 2101 [0.5 credit]**

##### **Mechanics II**

Plane trusses. Virtual work. Friction. Relative motion of particles. Kinematics of a rigid body: translation, rotation; general plane motion; absolute and relative motion. Kinetics of a rigid body: equations of motion; work-energy; impulse-momentum; conservation of momentum and energy. Conservative forces and potential energy.

Precludes additional credit for MAAE 2101 and ECOR 2101.

Prerequisite(s): ECOR 1101 and MATH 1004 and MATH 1104.

Lectures three hours a week, problem analysis three hours a week.

#### **CIVE 2200 [0.5 credit]**

##### **Mechanics of Solids I**

Stress and strain. Stress-strain relationship: Hooke's law. Torsion of circular shafts. Bending moment and shear force distribution. Flexural stresses. Deflection. Shear stress in beams. Stresses in thin-walled cylinders. Transformation of 2D stress and strain: Mohr's circle. Buckling of columns.

Precludes additional credit for MAAE 2202.

Prerequisite(s): ECOR 1101 for B.Eng. students or CIVE 2005 for B.A.S. with Concentration in Conservation and Sustainability.

Lectures three hours a week, problem analysis and laboratory three hours a week.

#### **CIVE 2700 [0.5 credit]**

##### **Civil Engineering Materials**

Introduction to material science. Structure of atoms. Crystallography. Crystal Imperfections. Characteristics, behaviour and use of Civil Engineering materials: steel, concrete, asphalt, wood, polymers, composites. Specifications. Physical, chemical and mechanical properties. Quality control and material tests. Fatigue. Corrosion. Applications in construction and rehabilitation of structures.

Prerequisite(s): CHEM 1002 or CHEM 1101 or equivalent, MATH 1004. Recommended prerequisite: PHYS 1004.

Lectures three hours a week, problem analysis and laboratory three hours a week.

#### **CIVE 3202 [0.5 credit]**

##### **Mechanics of Solids II**

Shear flow. Definition of shear centre, Saint Venant and warping torsional constants. Behaviour, governing differential equations and solutions for torsion, beam-columns, lateral torsional buckling of doubly symmetric beams, axially loaded doubly symmetric, singly symmetric and asymmetric columns. Failure criterion, fatigue and fracture.

Precludes additional credit for MAAE 3202.

Prerequisite(s): CIVE 2200.

Lectures three hours a week, laboratory/problem analysis three hours alternate weeks.

#### **CIVE 3203 [0.5 credit]**

##### **Introduction to Structural Analysis**

Concepts and assumptions for structural analysis: framed structures; joints; supports; compatibility and equilibrium; stability and determinacy; generalized forces and displacements. Principle of Virtual Work: unknown force calculations; influence lines. Complementary Virtual Work: displacement calculations, indeterminate analysis. Introduction to the Stiffness Method of Analysis.

Prerequisite(s): CIVE 2200 and MATH 1004.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 3204 [0.5 credit]****Introduction to Structural Design**

Building systems and structural form. Design Philosophy and design process. Limit states design. National Building Code of Canada. Determination of dead, live, snow, wind, and earthquake loads.

Prerequisite(s): CIVE 2200 (concurrent).

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 3205 [0.5 credit]****Design of Structural Steel Components**

Introduction to CAN/CSA - S16, design and behaviour concepts; shear lag, block shear, local plate buckling, lateral torsional buckling, instantaneous centre, inelastic strength and stability. Design of tension members, axially loaded columns, beams, beam-columns, simple bolted and welded connections.

Prerequisite(s): CIVE 2200. Recommended prerequisite: CIVE 3204.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 3206 [0.5 credit]****Design of Reinforced Concrete Components**

Introduction to CAN/CSA - A23.3; design and behaviour concepts; flexural analysis at service loads; shear, bond, Whitney stress block, under and over reinforced behaviour, ultimate strength. Flexural design of singly reinforced, doubly reinforced T-beams, and one-way slabs. Shear design for beams. One-way and two-way slab building systems, columns.

Prerequisite(s): CIVE 2200. Recommended prerequisite: CIVE 3204.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 3207 [0.5 credit]****Historic Site Recording and Assessment**

Methods of heritage documentation including hand recording, photography, rectified photography, total station, gps, photogrammetry, and laser scanning. Non-destructive testing techniques; environmental assessment tools for determining air quality and energy efficiency. Multidisciplinary teams for all project work. Also listed as ARCN 4100.

Prerequisite(s): third-year status in B.Eng. in Architectural Conservation and Sustainability Engineering or third-year standing in B.A.S. Concentration in Conservation and Sustainability.

Lectures three hours a week, lab or field work two hours a week.

**CIVE 3208 [0.5 credit]****Geotechnical Mechanics**

Soil composition and soil classification. Soil properties, compaction, seepage and permeability. Concepts of pore water pressure, capillary pressure and hydraulic head. Principle of effective stress, stress-deformation and strength characteristics of soils, consolidation, stress distribution with soils, and settlement. Laboratory testing. Also listed as EARTH 4107.

Prerequisite(s): EARTH 2404 or equivalent and third-year status in Engineering, or permission of the Department. Lectures three hours a week, laboratory three hours alternate weeks.

**CIVE 3304 [0.5 credit]****Transportation Engineering and Planning**

Transportation and the socio-economic environment; modal and intermodal systems and components; vehicle motion, human factors, system and facility design; traffic flow; capacity analysis; planning methodology; environmental impacts; evaluation methods. Also listed as GEOG 4304.

Prerequisite(s): third-year status in Engineering, or permission of the Department.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 3999 [0.0 credit]****Co-operative Work Term****CIVE 4200 [0.5 credit]****Matrix Analysis of Framed Structures**

Review of basic structural concepts. Betti's law and applications. Matrix flexibility method, flexibility influence coefficients. Development of stiffness influence coefficients. Stiffness method of analysis: beams; plane trusses and frames; space trusses and frames. Introduction to the finite element method.

Prerequisite(s): CIVE 3203.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4201 [0.5 credit]****Finite Element Methods in Structural Analysis**

Introduction to theory of elasticity. Simple finite elements. Virtual Work formulation of equilibrium of structure and element. Lagrange interpolation and basis for displacement shape functions. Considerations in finite element modeling. Plate bending theories and analysis. Shell theories and analysis.

Prerequisite(s): CIVE 4200.

Also offered at the graduate level, with different requirements, as CIVE 5103, for which additional credit is precluded.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4202 [0.5 credit]****Wood Engineering**

Structural design in timber. Properties, anatomy of wood, wood products, factors affecting strength and behaviour, strength evaluation and testing. Design of columns, beams and beam-columns. Design of trusses, frames, glulam structures, plywood components, formwork, foundations, connections and connectors. Inspection, maintenance and repair.

Also listed as ARCC 4202.

Prerequisite(s): fourth-year status in Engineering or permission of the Department.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4208 [0.5 credit]****Geotechnical Engineering**

Strength of soils, steady state seepage, flownets and piping. Stress distribution in soils. Earth pressures: at rest, active and passive. Design of flexible and rigid retaining structures. Stability of excavations, slopes and embankments. Settlement of foundations. Bearing capacity of footings.

Prerequisite(s): CIVE 3208.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4209 [0.5 credit]****Highway Engineering**

Highway planning; highway location and geometric design; traffic engineering; highway capacity; soil classifications; subgrade and base materials; highway drainage; frost action; structural design of rigid and flexible pavements; highway economics and finance; maintenance and rehabilitation.

Prerequisite(s): Fourth year status in engineering.

Recommended prerequisites: CIVE 2004, CIVE 3304 and CIVE 3208.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4301 [0.5 credit]****Foundation Engineering**

A critical study of the theories in soil mechanics and their application to the solution of geotechnical engineering problems. Field investigations, laboratory and field testing, shallow foundations, special footings, mat foundations, pile foundations and excavations. Discussion of new methods and current research.

Prerequisite(s): CIVE 4208.

Lectures three hours a week, laboratory three hours alternate weeks.

**CIVE 4302 [0.5 credit]****Reinforced and Prestressed Concrete Design**

Reinforced concrete shear and torsion design. Two-way slab design by Direct Design and Equivalent Frame Method. Behaviour and design of slender reinforced concrete columns. Prestressed concrete concepts; flexural analysis and design; shear design; anchorage zone design; deflection and prestress loss determination.

Prerequisite(s): CIVE 3202, CIVE 3203 and CIVE 3206.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4303 [0.5 credit]****Urban Planning**

A systematic approach to urban planning; urban sprawl; data collection; forecasting; standards; space requirements; land use; zoning; transportation; land development; site selection; land capability; layout; evaluation; housing; urban renewal and new towns.

Also listed as GEOG 4303.

Prerequisite(s): third-year status in Engineering, or permission of the Department.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4307 [0.5 credit]****Municipal Hydraulics**

Fluid flow fundamentals. Hydraulics of pipe systems. Open channel flow. Prediction of sanitary and storm sewage, flow rates. Design of water distribution systems, culverts, sanitary and storm sewers. Pumps and measuring devices. Hydraulic and flow control structures.

Prerequisite(s): MAAE 2300.

Lectures three hours a week, problem analysis 1.5 hours each week.

**CIVE 4308 [0.5 credit]****Behaviour and Design of Steel Structures**

Behaviour and design of open web steel joists, steel and composite decks, composite beams and columns, stud girders, and plate girders. Design of moment connections, base plates and anchor bolts, and bracing connections. Stability of rigid and braced frames. Design for lateral load effects.

Prerequisite(s): CIVE 3205 and fourth-year status in Engineering.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4400 [0.5 credit]****Construction/Project Management**

Systems approach to project planning and control. Analysis of alternative network planning methods: CPM, precedence and PERT; planning procedure; computer techniques and estimating; physical, economic and financial feasibility; implementation feedback and control; case studies.

Also listed as BUSI 4308.

Prerequisite(s): fourth-year status in Engineering.

Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4403 [0.5 credit]****Masonry Design**

Introduction to structural design in masonry. Properties of masonry materials and assemblages. Behaviour and design of beams, walls and columns. Selected topics including veneer wall systems, differential movement, workmanship, specifications, inspection, maintenance and repair. Lowrise and highrise building design. Also offered, at the graduate level with additional or different requirements, as CIVE 5200, for which additional credit is precluded. Prerequisite: fourth-year status in Engineering or permission of the Department. Prerequisite(s): CIVE 3204, CIVE 3206 and fourth-year status in Engineering or permission of the Department. Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4407 [0.5 credit]****Municipal Engineering**

Introduction to fundamentals of municipal engineering. Water quality: physical, chemical and biological parameters. Water treatment: softening mixing, flocculation, sedimentation, filtration, disinfection, fluoridation. Biological processes. Wastewater treatment: primary, secondary and tertiary treatment. Sludge disposal and wastewater reuse. Solid waste management. Prerequisite(s): fourth-year status in Engineering. Lectures three hours a week, problem analysis 1.5 hours each week.

**CIVE 4500 [0.5 credit]****Computer Methods in Civil Engineering**

Advanced software development for Civil Engineering applications. Examples may be chosen from surveying, transportation, geotechnical and/or structural engineering. Software technologies include object-oriented programming, data base management, Internet-based applications and graphical user interfaces. Also offered, at the graduate level with additional or different requirements, as CIVE 5602 for which additional credit is precluded. Prerequisite(s): ECOR 2606 and fourth-year status in Engineering. Lectures three hours a week, problem analysis three hours alternate weeks.

**CIVE 4601 [0.5 credit]****Building Pathology and Rehabilitation**

Deterioration mechanisms for concrete, timber, steel and masonry structures. Identification of design deficiencies; criteria for selection and design of rehabilitation systems. Design techniques to reduce deterioration in new construction and historical structures. fourth-year standing in B.A.S. concentration in Conservation and Sustainability. Also listed as ARCN 4200. Prerequisite(s): fourth-year status in B.Eng. in Architectural Conservation and Sustainability Engineering or fourth-year standing in B.A.S. concentration in Conservation and Sustainability. Lectures three hours a week, lab/field work two hours a week.

**CIVE 4614 [0.5 credit]****Building Fire Safety**

Understanding fire-structure interaction and the concepts of fire severity and resistance; behaviour of steel, concrete, and timber buildings exposed to fires; compartment fire dynamics; correlations and computer models to predict fire dynamics; fire retardants; laboratory-scale fire experiments; performance-based approach for building fire safety design. Prerequisite(s): fourth-year status in Engineering, or permission of the Department. Lectures three hours a week, problem analysis and laboratories three hours alternate weeks.

**CIVE 4907 [1.0 credit]****Engineering Project**

A major project in engineering analysis, design, development or research carried out by individual students or small teams. The objective is to provide an opportunity to develop initiative, self-reliance, creative ability and engineering judgment. A project proposal, an interim report, an oral presentation, and a comprehensive final report are required. Prerequisite(s): fourth-year status in Engineering, or permission of the department.

**CIVE 4918 [1.0 credit]****Design Project**

Teams of students develop professional level experience through a design project that incorporates fundamentals acquired in previous mathematics, science, engineering, and complementary studies courses. A final report and oral presentations are required. Prerequisite(s): fourth-year status in Engineering. Lectures one hour a week, problem analysis three hours a week.

**Summer session:** some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at [central.carleton.ca](http://central.carleton.ca)