CIVIL ENGINEERING (CIVL)

CIVL 2770 Civil Engineering Materials 5 cr
(Lab required) Principles of testing; testing standards; instrumentation; data acquisition systems; mechanical properties of steel, iron, cement, concrete, asphalt, wood and composites; classification and particle size analysis of soils and aggregates.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ENG 1440. Co-requisite: CIVL 2800.

CIVL 2780 Civil Engineering Systems 4 cr
(Lab required) Introduction to applied systems analysis approach. Use of applied systems analysis in Civil Engineering. Optimization techniques: linear programming; dynamic programming; other techniques. Evaluation: decision analysis.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (MATH 1710 or MATH 1700).

CIVL 2790 Fluid Mechanics 4 cr
(Lab required) Definition of fluid; fluid properties; variation of pressure in a fluid; hydrostatic forces; buoyancy; kinematics of flow; control volumes; continuity; Bernoulli's equation; momentum equation; energy equation; flow in closed conduits; open channel flow.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: ENG 1440, MATH 1710 or MATH 1700.
Mutually Exclusive: BIOE 2790

CIVL 2800 Solid Mechanics 1 4 cr
(Lab required) Analysis of deformable bodies; stress and strain in three dimensions; equilibrium equations and strain-displacement relations; constitutive relations and mechanical behaviour of materials; radially symmetric and plane problems in elasticity; relevant experimental demonstrations.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: ENG 1440, MATH 1710 or MATH 1700.
Mutually Exclusive: BIOE 2800

CIVL 2830 Graphics for Civil Engineers 2 cr
(Lab required) Orthographic Drawing: Object Orientation and Views, Space Dimensions, Surfaces, Lines, and Hidden Features. Computer-based Drawings. Applications: Steel and Reinforced Concrete Structures, Digital Terrain Models. Ethical, Legal and Professional Issues.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Co-requisite: CIVL 2840.
Mutually Exclusive: ENG 1400, MECH 2112

CIVL 2840 Civil Engineering Geomatics 3 cr
(Lab required) Geomatics in civil engineering, map-making, map-reading, computerized maps; leveling; distance measurement angles, directions, traverses; coordinate geometry; electronic survey instruments; global positioning system; geographic information systems; digital photogrammetric methods and data; aspects of route surveying. Not to be held with CIVL 2820.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Pre or Co-requisite: MATH 1210, Co-requisite: CIVL 2830.
Mutually Exclusive: CIVL 2820

CIVL 3590 Numerical Methods in Engineering Analysis 4 cr
(Lab required) Variety of numerical techniques applicable to solutions of problems in civil engineering. Students may not hold credit for CIVL 3590 and MATH 2120.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: COMP 1010 or COMP 1012. Pre or Co-requisite: MATH 2132 or prerequisite MATH 2100.
Equiv To: MATH 2120, MECH 2150

CIVL 3690 Environmental Engineering Analysis 4 cr
(Lab required) Introduction to environmental engineering analysis concepts, basic water and wastewater quality testing. Water pollution and water quality in rivers and lakes. Design principles used for design of unit operations and processes applied in water and/or wastewater treatment.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: [(CHEM 1110 and CHEM 1126) or CHEM 1311 or the former CHEM 1310], [ENG 2030 or ENG 2040 (or the former ENG 2010)], [STAT 2220 or (STAT 1000 and STAT 2000)].

CIVL 3700 Environmental Engineering Design 4 cr
(Lab required) Design principles are developed for water, solid/soil and air pollution control. Application of the principles in design projects which may include surface and groundwater remediation, solid waste management, landfilling, soil remediation and site assessment; municipal and industrial wastewater treatment; odour and air pollution abatement facilities.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3690.

CIVL 3710 Finite Element Analysis 4 cr
(Lab required) One-dimensional analysis of fluid flow, seepage and heat transfer; truss, beam and frame elements; two-dimensional problems; isoparametric elements and Gauss quadrature; time-dependent problems, diffusion, consolidation, and time integration methods; introduction to commercial packages; solution of problems in civil engineering (seepage, dams, pavements).
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: [CIVL 2790, CIVL 2800], [CIVL 3590 or MATH 2120.].

CIVL 3730 Geotechnical Materials and Analysis 4 cr
(Lab required) Soil and rock properties: laboratory and field techniques; in situ states of stress and consolidations; constitutive models; stress beneath loaded areas and around tunnels; analysis of simple retaining structures and slopes; stability and settlement of shallow and deep foundations in soil and rock.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (GEOL 1340 or the former GEOL 2250), CIVL 2770, CIVL 2800.

CIVL 3740 Hydraulics 4 cr
(Lab required) Hydraulics of uniform and gradually varied flow; backwater computation and classification of surface water profiles; hydraulic jumps, spillways, and stilling basins; flow over weirs; hydraulic models; theory of turbo-machinery.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 2790.

CIVL 3750 Hydrology 4 cr
(lab required) Basic hydrological processes; precipitation; evapotranspiration; infiltration and runoff; analytical methods; hydrograph theory and application; application to reservoir design; project floods and flow forecasting; statistical analysis.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite or corequisite: STAT 2220 or (STAT 1000 and STAT 2000).

CIVL 3760 Structural Analysis 4 cr
(Lab required) Different structural forms and load distribution, analysis of cables; statically determinate curved, beams and frames; influence lines; energy methods and deflections of structures; flexibility and stiffness methods; computer-aided structural analysis; introduction to structural dynamics.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 2800.

CIVL 3770 Design of Steel Structures 4 cr
(Lab required) Introduction to design of steel structures; loading calculations based on building codes; structural configurations; design of beams, columns, beam-columns and connections based on limit state design.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2770, CIVL 3760.

CIVL 3790 Transportation Engineering 1 4 cr
(lab required) Introduction to transportation. Overview of Canada and U.S. transport systems. Fundamentals of transport systems analysis. Introduction to sequential demand modeling. Analysis and evaluation of uninterrupted flow on highways. Basics of geometric design of highways. Basics of design of at-grade intersections. Introduction to computer applications in transportation engineering. Basics of pavement engineering and design.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2840, CIVL 2770, CIVL 2780, (STAT 2220 or (STAT 1000 and STAT 2000)).

CIVL 4000 Uncertainty Analysis in Civil Engineering Systems 4 cr
(Lab required) Fundamentals of uncertainty, risk, reliability and decision making in Civil Engineering applications. Mathematical basis for analyzing the effects of uncertainty on Civil Engineering design. Data driven modelling and analysis of multi-variable Civil Engineering systems. Computer-based numerical and simulation methods to evaluate uncertainty in Civil Engineering applications. Risk analysis using Bayesian Decision Theory.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 3590, MATH 2130, and STAT 2220.

CIVL 4020 Masonry Design and Construction 4 cr
(Lab required) Introduction to the building codes that govern masonry design. Advanced design procedures for masonry members and structures. Single-story and multi-story building design.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3760.

CIVL 4022 Properties and Design of Concrete Mixtures 4 cr
(Lab required) Constituent materials (cement, admixtures, etc.) of concrete; performance-based design and control of concrete mixtures; fresh, hardened and durability properties of concrete.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 2770.

CIVL 4024 Sustainable Building Design: Principles of Best Practice 4 cr
(Lab required) Best practices in sustainable design; current standards that govern building envelope components, cladding systems, membranes, interface details and indoor air quality. Industry challenges; presents fundamental principles of building science and demonstrates their application to the design, repair and maintenance of buildings; building systems; how environments affect material performance. May not be held with BIOE 4412 or BIOE 4700.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3760, Pre or Corequisite: CIVL 3770.
Mutually Exclusive: BIOE 4412, BIOE 4700

CIVL 4030 Advanced Structural Design 4 cr
(Lab required) Special topics in structural engineering including analysis and design of prestressed concrete structures, fibre-reinforced polymer (FRP)- reinformced concrete structures, and wood structures.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Pre- or corequisite: CIVL 3770.

CIVL 4032 Bridge Engineering 4 cr
(Lab required) Fundamentals of highway bridge engineering, base knowledge of bridge construction technology and tools for structural analysis and evaluation for most common bridge types built in North America according to current standards.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3760.

CIVL 4040 Structural Dynamics 4 cr
(Lab required) Dynamic loads in civil engineering; overview of structural dynamics; single-degree-of-freedom systems; free-vibration, harmonic, periodic and impulsive loads; multi-degree-of-freedom systems; distributed systems; beam vibrations; steady-state vibrations of foundations; introduction to earthquake engineering; elastic waves in soils, response and design spectrums; wind vibrations.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3760.

CIVL 4050 Engineering Economics 3 cr
Introduction to engineering economics. Time value of money and discounted cash flow calculations. Comparing alternatives. Replacement analysis and life-cycle costing. Public sector engineering economy studies. Private sector engineering economy studies. Before and after-tax analysis. Applications in cost-estimating. Applications in asset management systems. Basic accounting. Accommodating capital limitations. Dealing with inflation. Dealing with risk and uncertainty.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: STAT 2220 or (STAT 1000 and STAT 2000).
Equiv To: ENG 3000

CIVL 4100 Engineering Management and the Environment 4 cr
(Lab required) Teams of students apply environmental management techniques, such as: impact assessment, site assessment, and auditing to selected engineering construction projects and operations; several oral and written reports are required. Co- or
PR/CR: A minimum grade of C is required unless otherwise indicated.
prerequisite: CIVL 3700.

CIVL 4120 Water Treatment Plant Design 4 cr
(Lab required) Design of unit processes used in potable water treatment plants: solid/liquid separation, oxidation, coagulation, filtration, adsorption and disinfection. Determination of design parameters through laboratory studies. Water treatment plants design standards and guidelines.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3690.

CIVL 4130 Solid Waste Management 4 cr
(Lab required) Engineering principles and the practice of integrated management of solid wastes, including characteristics, sorting, utilization and final disposal in landfill. Principles of leachate and hazardous waste management and disposal.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Pre or Co-requisite: CIVL 3700.

CIVL 4180 Environmental Systems 4 cr
(Lab required) Development of a river water quality model; waste allocation modelling; modelling of the sites selection process; analysis of environmental impact using technical and non-technical (i.e. sociological, ethical, aesthetic) parameters.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2780, CIVL 3690, CIVL 3750.

CIVL 4200 Groundwater Contamination 4 cr
(Lab required) Introduction to the principles of groundwater chemistry; chemical evolution of natural groundwater flow systems; sources of contamination; mass transport processes; hydrochemical behaviour of contaminants; nuclear waste disposal; non-aqueous phase organics; aquifer remediation.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2790 and (GEOL 1340 or GEOL 2250). Pre or Co-requisite: CIVL 3690.

CIVL 4220 Geotechnical Design 4 cr
(Lab required) Site characterization; design and construction of surface footings, deep foundations, tunnels, earth and rock support systems; design and remediation of slopes; frozen soils and foundation design; geosynthetics and geofabrics in geotechnical construction; reinforced earth; geoenvironmental issues; tailing dams, clean-up, and remediation.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3730.

CIVL 4230 Geotechnical Engineering 4 cr
(Lab required) Case-history approach to geotechnical engineering practice from civil and mining engineering; relationship between predicted and observed behaviour; surface and shallow footings; propped walls and bulkheads; rock and soft ground tunneling; deep foundations; rock and soil slopes; culverts; geoenvironmental problems.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3730.

CIVL 4232 Geotechnical Earthquake Engineering 4 cr
(Lab required) Introduction to soil dynamics and geotechnical earthquake engineering. Behavior of soil subjected to various types of dynamic or cyclic loadings; liquefaction and lateral spreading of soil; design of shallow and deep foundations. retaining structures, slopes and pavements subject to seismic loading; design code provisions.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3730.

CIVL 4250 Groundwater Hydrology 4 cr
(Lab required) Introduction to the theory of groundwater flow, flow nets, regional groundwater flow, well hydraulics, role of groundwater in geologic and engineering processes, multiphase flow.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2790, GEOL 1340 (or the former GEOL 2250), MATH 2130 (or MATH 2110), MATH 2132 (or MATH 2100).
Mutually Exclusive: GEOL 3450

CIVL 4300 Design of Urban Water Systems 4 cr
(Lab required) Water supply and the design of water distribution systems. Urban hydrology and design of wastewater and stormwater collection systems. Manitoba specific applications will be discussed.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2790. Pre-or Corequisites: CIVL 3750.

CIVL 4330 Graduation Project 4 cr
The student will undertake an original study involving engineering design, procedure, or experimental investigation that emphasizes the student's initiative and judgement. The student must demonstrate an ability to plan, conduct and formally report on the study by written thesis and oral presentation.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: Completion of 120 credit hours, ENG 2010.

CIVL 4332 Civil Engineering Thesis Project 4 cr
The student will undertake an original study involving engineering design, procedure, or experimental investigation that emphasizes the student's initiative and judgement. The student must demonstrate an ability to plan, conduct and formally report on the study by written thesis and oral presentation. May not be held with CIVL 4330.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: Completion of 120 credit hours, and [ENG 2030 or ENG 2040 (or the former ENG 2010).].
Equiv To: CIVL 4330

CIVL 4350 Hazardous Waste Treatment 4 cr
(Lab required) Sources and classification of hazardous and industrial wastes. Overview of the waste management problem. Theory and applications of various physical, chemical, and thermal, waste treatment processes. Waste elimination options and strategies.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3690.

CIVL 4360 Water Resources Planning and Management 4 cr
(Lab required) Introduction to the theory and application of water resources planning and management as a constrained optimization problem with multiple conflicting objectives. Water laws including international, inter-provincial and local regulations will be discussed. The process for planning a water resource project, including identifying the problems and opportunities, resource and demand forecasting, plan formulation and evaluation, and optimization will be discussed.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2780, CIVL 3590. Pre-or co-requisite: CIVL 3750.

CIVL 4380 Infrastructure Engineering and Construction Management 4 cr
(Lab required) Infrastructure engineering; drainage systems, maintenance engineering and management. Construction and project management; workplace health and safety, construction site field trips, construction equipment, temporary facilities, project management. Elements of law for civil engineers.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ENG 3000 or CIVL 4050.

CIVL 4390 Reinforced Concrete Structures 4 cr
(Lab required) Limit state design of reinforced concrete; analysis and design of beams and one-way slabs subjected to bending and shear; bond, cracking and deflection considerations; column design; isolated footings.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: CIVL 2770, CIVL 3760.

CIVL 4400 Transportation Engineering 2 4 cr
(Lab required) Fundamentals of traffic control for highways. Capacity and level of service analysis on urban streets. Urban supplement to geometric design guide for Canadian roads. Modelling vehicle performance. Elements of railway engineering. Design for trucks. Transportation systems management. Application of intelligent transportation systems. Basic pavement design methods. Introduction to pavement management systems. Highway accidents and design for safety. Legislative and policy framework for transportation engineering.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3790.

CIVL 4410 Transportation Systems 4 cr
(Lab required) Contemporary approaches to transportation planning. Data for transportation planning. Advanced demand analysis and modelling. Illustrative transport planning studies. Planning and design for public passenger transportation. Planning and design for barrier-free transportation and transport of disabled persons. Goods movement and trucking studies. Planning and design for motor carrier operations. Planning and design for grain handling and transportation. Transport planning in developing countries. Evaluating transport plans and projects. Transport and the environment. Transport and energy. Vehicle operating costs and engineering unit cost models.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3790.

CIVL 4420 Highway Pavement Design 4 cr
(Lab required) Soil classification and properties; soil-moisture-density-strength relationships; earthwork operations and specifications; soil stabilization; granular bases; surface drainage; structural design of flexible and rigid pavements.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Pre- or co-requisites: CIVL 3790.

CIVL 4460 Technology, Society, and the Future 3 cr
Impact of technology and technological change on society - past, present, future; specific technologies, e.g. construction, machine power, computers, communications, medical, military: the process of technological change; invisible effects of technology; technology and resource use; sustainable development, limits to growth and the role of technology.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: one of the courses from the list of Written English for Engineering Students, or the former ENGL 1310, or the former ENGL 1320.

CIVL 4470 Watershed Processes 4 cr
(Lab required) Rainfall-runoff processes, flood routing; characteristics and mechanics of flow in (natural) channels; computer modelling of watershed hydrology and hydraulics; influence of man-made structures; river morphology, sediment transport prediction, design of a stable channel; river ice processes.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: CIVL 3750. Pre or co-requisite: CIVL 3740.

CIVL 4500 Contemporary Topics in Civil Engineering 4 cr
This course will cover contemporary topics in Civil Engineering. The specific topics and a detailed outline will be available at the time of registration prior to the start of the registration period for the session in which the course will be offered.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: Permission of the department head.

CIVL 4590 Design Project 6 cr
An interdisciplinary project-based course involving engineering design, teamwork and delivered in studio format. Students are expected to work in pre-assigned teams under the guidance of professional engineers on a pre-determined project. Lecture material will cover project management, construction, environmental and economic issues. Each team will be required to give an oral presentation of their design project.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: [ENG 2030 or ENG 2040 (or the former ENG 2010)], CIVL 2840, CIVL 3690, CIVL 3730, CIVL 3740, CIVL 3750, CIVL 3770, and CIVL 3790.